UNITED STATES
SECURITIES AND EXCHANGE COMMISSION
Washington, D.C. 20549

FORM 10-K

☒ **ANNUAL REPORT PURSUANT TO SECTION 13 OR 15(d) OF THE SECURITIES EXCHANGE ACT OF 1934**

For the fiscal year ended December 31, 2021

or

☐ **TRANSITION REPORT PURSUANT TO SECTION 13 OR 15(d) OF THE SECURITIES EXCHANGE ACT OF 1934**

For the transition period from to

Commission file number: 001-33638

INTERNATIONAL TOWER HILL MINES LTD.

(Exact name of registrant as specified in its charter)

British Columbia, Canada (State or other jurisdiction of incorporation or organization)	**98-0668474** (I.R.S. Employer Identification No.)
2710-200 Granville Street, Vancouver, British Columbia, Canada (Address of principal executive offices)	**V6C 1S4** (Zip code)

Registrant's telephone number, including area code: (604) 683-6332

Securities registered pursuant to Section 12(b) of the Act:

Title of each class:	Trading Symbol	Name of each exchange on which registered:
Common Shares, no par value	**THM**	**NYSE American**

Securities registered pursuant to Section 12(g) of the Act: **None**

Indicate by check mark if the registrant is a well-known seasoned issuer, as defined in Rule 405 of the Securities Act.

Yes ☐ No ☒

Indicate by check mark if the registrant is not required to file reports pursuant to Section 13 or Section 15(d) of the Act.

Yes ☐ No ☒

Indicate by check mark whether the registrant (1) has filed all reports required to be filed by Section 13 or 15(d) of the Securities Exchange Act of 1934 during the preceding 12 months (or for such shorter period that the registrant was required to file such reports), and (2) has been subject to such filing requirements for the past 90 days.

Yes ☒ No ☐

Indicate by check mark whether the registrant has submitted electronically every Interactive Data File required to be submitted pursuant to Rule 405 of Regulation S-T (§ 232.405 of this chapter) during the preceding 12 months (or for such shorter period that the registrant was required to submit such files).

Yes ☒ No ☐

Indicate by check mark whether the registrant is a large accelerated filer, an accelerated filer, a non-accelerated filer, a smaller reporting company, or an emerging growth company. See the definitions of "large accelerated filer," "accelerated filer," "smaller reporting company," and "emerging growth company" in Rule 12b-2 of the Exchange Act.

Large accelerated filer	☐	Accelerated filer	☐
Non-accelerated filer	☒	Smaller reporting company	☒
		Emerging Growth Company	☐

If an emerging growth company, indicate by check mark if the registrant has elected not to use the extended transition period for complying with any new or revised financial accounting standards provided pursuant to Section 13(a) of the Exchange Act. ☐

Indicate by check mark whether the registrant has filed a report on and attestation to its management's assessment of the effectiveness of its internal control over financial reporting under Section 404(b) of the Sarbanes-Oxley Act (15 U.S.C. 7262(b)) by the registered public accounting firm that prepared or issued its audit report. ☐

Indicate by check mark whether the registrant is a shell company (as defined in Rule 12b-2 of the Act). Yes ☐ No ☒

Based on the last sale price on the NYSE American of the registrant's Common Shares on June 30, 2021 (the last business day of the registrant's most recently completed second fiscal quarter) of $1.05 per share, the aggregate market value of the voting stock held by non-affiliates of the registrant was approximately $139.1 million.

As of March 1, 2022, the registrant had 194,908,184 Common Shares outstanding.

DOCUMENTS INCORPORATED BY REFERENCE

To the extent specifically referenced in Part III, portions of the registrant's definitive Proxy Statement on Schedule 14A to be filed with the Securities and Exchange Commission in connection with the registrant's 2022 Annual Meeting of Shareholders are incorporated by reference into this report.

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FORWARD LOOKING STATEMENTS

This Annual Report on Form 10-K contains forward-looking statements or information within the meaning of the United States Private Securities Litigation Reform Act of 1995 concerning anticipated results and developments in the operations of the Company in future periods, planned exploration activities, the adequacy of the Company's financial resources and other events or conditions that may occur in the future. Forward-looking statements are frequently, but not always, identified by words such as "expects," "anticipates," "believes," "intends," "estimates," "potential," "possible" and similar expressions, or statements that events, conditions or results "will," "may," "could" or "should" (or the negative and grammatical variations of any of these terms) occur or be achieved. These forward-looking statements may include, but are not limited to, statements concerning:

- the Company's future cash requirements, the Company's ability to meet its financial obligations as they come due, and the Company's ability to raise the necessary funds to continue operations on acceptable terms, if at all;
- the Company's ability to carry forward and incorporate into future engineering studies of the Livengood Gold Project updated mine design, production schedule and recovery concepts identified during the optimization process;
- the Company's potential to carry out an engineering phase that will evaluate and optimize the Livengood Gold Project configuration and capital and operating expenses, including determining the optimum scale for the Livengood Gold Project;
- the Company's strategies and objectives, both generally and specifically in respect of the Livengood Gold Project;
- the Company's belief that there are no known environmental issues that are anticipated to materially impact the Company's ability to conduct mining operations at the Livengood Gold Project;
- the potential for the expansion of the estimated mineral resources at the Livengood Gold Project;
- the potential for a production decision concerning, and any production at, the Livengood Gold Project;
- the sequence of decisions regarding the timing and costs of development programs with respect to, and the issuance of the necessary permits and authorizations required for, the Livengood Gold Project;
- the Company's estimates of the quality and quantity of the mineral resources at the Livengood Gold Project;
- the timing and cost of any future exploration programs at the Livengood Gold Project, and the timing of the receipt of results therefrom;
- the expected levels of overhead expenses at the Livengood Gold Project; and
- future general business and economic conditions, including changes in the price of gold and the overall sentiment of the markets for public equity.

Such forward-looking statements reflect the Company's current views with respect to future events and are subject to certain known and unknown risks, uncertainties and assumptions. Many factors could cause actual results, performance or achievements to be materially different from any future results, performance or achievements that may be expressed or implied by such forward-looking statements, including, among others:

- the demand for, and level and volatility of the price of, gold;
- conditions in the financial markets generally, the overall sentiment of the markets for public equity, interest rates, currency rates, and the rate of inflation;
- general business and economic conditions, including the effect of the COVID-19 pandemic on such conditions;
- government regulation and proposed legislation (and changes thereto or interpretations thereof);

- defects in title to claims, or the ability to obtain surface rights, either of which could affect the Company's property rights and claims;
- the Company's ability to secure the necessary services and supplies on favorable terms in connection with its programs at the Livengood Gold Project and other activities;
- the Company's ability to attract and retain key staff, particularly in connection with the permitting and development of any mine at the Livengood Gold Project;
- the accuracy of the Company's resource estimates (including with respect to size and grade) and the geological, operational and price assumptions on which these are based;
- the timing of the Company's ability to commence and complete planned work programs at the Livengood Gold Project;
- the timing of the receipt of and the terms of the consents, permits and authorizations necessary to carry out exploration and development programs at the Livengood Gold Project and the Company's ability to comply with such terms on a safe and cost-effective basis;
- the ongoing relations of the Company with the lessors of its property interests and applicable regulatory agencies;
- the metallurgy and recovery characteristics of samples from certain of the Company's mineral properties and whether such characteristics are reflective of the deposit as a whole; and
- the continued development of and potential construction of any mine at the Livengood Gold Project property not requiring consents, approvals, authorizations or permits that are materially different from those identified by the Company.

Should one or more of these risks or uncertainties materialize, or should underlying assumptions prove incorrect, actual results may vary materially from those described herein. This list is not exhaustive of the factors that may affect any of the Company's forward-looking statements. Forward-looking statements are statements about the future and are inherently uncertain, and actual achievements of the Company or other future events or conditions may differ materially from those reflected in the forward-looking statements due to a variety of risks, uncertainties and other factors, including without limitation those discussed in Part I, Item 1A, Risk Factors, of this Annual Report on Form 10-K, which are incorporated herein by reference, as well as other factors described elsewhere in this report and the Company's other reports filed with the SEC.

The Company's forward-looking statements contained in this Annual Report on Form 10-K are based on the beliefs, expectations and opinions of management as of the date of this report. The Company does not assume any obligation to update forward-looking statements if circumstances or management's beliefs, expectations or opinions should change, except as required by law. For the reasons set forth above, investors should not attribute undue certainty to or place undue reliance on forward-looking statements.

CAUTIONARY NOTE REGARDING SIMILAR OR ADJACENT MINERAL PROPERTIES

This Annual Report on Form 10-K contains information with respect to adjacent or similar mineral properties in respect of which the Company has no interest or rights to explore or mine. Readers are cautioned that the Company has no interest in or right to acquire any interest in any such properties, and that mineral deposits on adjacent or similar properties, and any results of the mining or exploitation thereof, are not indicative of mineral deposits on the Company's properties, or any potential results of the mining or exploitation thereof.

GLOSSARY OF TERMS

The following is a glossary of certain terms that may be used in this report.

"alteration"	Changes in the chemical or mineralogical composition of a rock, generally produced by weathering or hydrothermal solutions
"anomalous"	Departing from the expected or normal
"April 2017 Report"	The technical report entitled "Canadian National Instrument 43-101 Technical Report Pre-feasibility Study on the Livengood Gold Project, Livengood, Alaska, USA" dated April 10, 2017 and prepared by certain Qualified Persons under NI 43-101, as filed under the Company's profile on SEDAR at www.sedar.com
"As"	Arsenic
"basalt"	A dark coloured igneous rock, commonly extrusive – the fine-grained equivalent of gabbro
"biotite"	A common rock forming mineral of the mica group
"Board"	The Board of Directors of ITH
"chert"	A microcrystalline or cryptocrystalline sedimentary rock, consisting chiefly of interlocking crystals of quartz less than about 30 microns in diameter
"clastic"	Pertaining to a rock or sediment composed principally of fragments derived from pre-existing rocks or minerals and transported some distance from their places of origin; also said of the texture of such a rock
"cm"	Centimeters
"common shares"	The common shares without par value in the capital of ITH as the same are constituted on the date hereof
"conglomerate"	A coarse grained clastic sedimentary rock, composed of rounded to sub-angular fragments larger than 2mm in diameter set in a fine-grained matrix of sand or silt, and commonly cemented by calcium carbonate, iron oxide, silica or hardened clay
"December 2021 Report"	The technical report entitled "NI 43-101 Technical Report Pre-feasibility Study of the Livengood Gold Project, Livengood, Alaska, USA" dated December 17, 2021 and prepared by certain Qualified Persons under NI 43-101, as filed on December 17, 2021 under the Company's profile on SEDAR at www.sedar.com
"deformation"	A general term for the processes of folding, faulting, shearing, compression, or extension of rocks as a result of various earth forces
"deposit"	A mineralized body which has been physically delineated by sufficient drilling, trenching, and/or underground work, and found to contain a sufficient average grade of metal or metals to warrant further exploration and/or development expenditures. Such a deposit does not qualify as a commercially mineable ore body or as containing reserves or ore, unless final legal, technical and economic factors are resolved
"diamond drill"	A type of rotary drill in which the cutting is done by abrasion rather than percussion. The cutting bit is set with diamonds and is attached to the end of the long hollow rods through which water is pumped to the cutting face. The drill cuts a core of rock which is recovered in long cylindrical sections, an inch or more in diameter
"dip"	The angle that a stratum or any planar feature makes with the horizontal, measured perpendicular to the strike and in the vertical plane
"dike"	A tabular body of igneous rock that cuts across the structure of adjacent rocks or cuts massive rocks
"director"	A member of the Board of Directors of ITH
"disseminated"	Fine particles of mineral dispersed throughout the enclosing rock
"epigenetic"	Of or relating to a mineral deposit of origin later than that of the enclosing rocks
"g/t"	Grams per metric tonne
"gabbro"	A group of dark coloured, basic intrusive igneous rocks – the approximate intrusive equivalent of basalt

"grade"	To contain a particular quantity of ore or mineral, relative to other constituents, in a specified quantity of rock
"host"	A rock or mineral that is older than rocks or minerals introduced into it or formed within it
"host rock"	A body of rock serving as a host for other rocks or for mineral deposits, or any rock in which ore deposits occur
"hydrothermal"	A term pertaining to hot aqueous solutions of magmatic origin which may transport metals and minerals in solution
"intrusion"	The process of the emplacement of magma in pre-existing rock, magmatic activity. Also, the igneous rock mass so formed
"intrusive"	Of or pertaining to intrusion, both the process and the rock so formed
"kg"	Kilograms
"km"	Kilometers
"lode"	A vein of metal ore in the earth
"m"	Meters
"mm"	Millimeters
"mafic"	Said of an igneous rock composed chiefly of dark, ferromagnesian minerals, also, said of those minerals
"magma"	Naturally occurring molten rock material, generated within the earth and capable of intrusion and extrusion, from which igneous rocks have been derived through solidification and related processes
"magmatic"	Of, or pertaining to, or derived from, magma
"massive"	Said of a mineral deposit, especially of sulphides, characterized by a great concentration of ore in one place, as opposed to a disseminated or veinlike deposit
"mineral reserve"	The economically mineable part of a measured and/or indicated mineral resource. It includes diluting materials and allowances for losses, which may occur when the material is mined or extracted and is defined by studies at pre-feasibility or feasibility level as appropriate that include application of "modifying factors" (which are defined in NI 43-101 as considerations used to convert mineral resources to mineral reserves, including but not, mining processing, metallurgical, infrastructure, economic, marketing, legal, environmental, social and governmental factors). Such studies demonstrate that, at the time of reporting, extraction could reasonably be justified. The reference point at which mineral reserves are defined, usually the point where the ore is delivered to the processing plant, must be stated. It is important that, in all situations where the reference point is different, such as for a saleable product, a clarifying statement is included to ensure that the reader is fully informed as to what is being reported. The public disclosure of a mineral reserve must be demonstrated by a pre-feasibility study or feasibility study.
"mineral resource"	A concentration or occurrence of solid material of economic interest in or on the Earth's crust in such form, grade or quality and quantity that there are reasonable prospects for eventual economic extraction. The location, quantity, grade or quality, continuity and other geological characteristics of a mineral resource are known, estimated or interpreted from specific geological evidence and knowledge, including sampling.
"mineralization"	The concentration of metals and their chemical compounds within a body of rock
"NI 43-101"	National Instrument 43-101 of the Canadian Securities Administrators entitled "Standards of Disclosure for Mineral Projects"
"NSR"	Net smelter return
"NYSE American"	NYSE American (formerly, NYSE MKT and the American Stock Exchange)
"ophiolite"	An assemblage of mafic and ultramafic igneous rocks ranging from spilite and basalt to gabbro and peridotite, and always derived from them by later metamorphism, whose origin is associated with an early phase of the development of a geosyncline
"RC"	A method of drilling whereby rock cuttings generated by the drill bit are flushed up from the bit face to the surface through the drill rods by air or drilling fluids for collection and analysis
"Sb"	Antimony
"sedimentary"	Pertaining to or containing sediment (typically, solid fragmental material transported and deposited by wind, water or ice that forms in layers in loose unconsolidated form), or formed by its deposition
"sill"	A tabular igneous intrusion that parallels the planar structure of the surrounding rock
"strike"	The direction taken by a structural surface

“tabular”	Said of a feature having two dimensions that are much larger or longer than the third, or of a geomorphic feature having a flat surface, such as a plateau
“Canadian Tax Act”	*Income Tax Act* (Canada)
“TRS”	The Technical Report Summary for the Livengood Gold Project filed as Exhibit 96.1 to this Annual Report on Form 10-K.
“tectonic”	Pertaining to the forces involved in, or the resulting structures of, tectonics
“tectonics”	A branch of geology dealing with the broad architecture of the outer part of the earth, that is, the major structural or deformational features and their relations, origin and historical evolution
“TSX”	Toronto Stock Exchange
“ultramafic”	Said of an igneous rock composed chiefly of mafic minerals
“vein”	An epigenetic mineral filling of a fault or other fracture, in tabular or sheet-like form, often with the associated replacement of the host rock; also, a mineral deposit of this form and origin
“volcaniclastic”	Pertaining to a clastic rock containing volcanic material in whatever proportion, and without regard to its origin or environment

USE OF NAMES

In this Annual Report on Form 10-K, unless the context otherwise requires, the terms "we", "us", "our", "ITH", "International Tower Hill", or the "Company" refer to International Tower Hill Mines Ltd. and its subsidiaries.

CURRENCY

All dollar amounts in this Annual Report on Form 10-K are presented in United States dollars unless otherwise stated. References to C$ refer to Canadian currency.

PART I

ITEM 1. BUSINESS

Overview

ITH is a company engaged in the acquisition and development of mineral properties. The Company currently holds or has the right to acquire interests in a development stage project in Alaska referred to as the "Livengood Gold Project" or the "Project". The Company has not yet begun extraction of mineralization from the deposit or reached commercial production. The Company has a 100% interest in its Livengood Gold Project, which as of December 31, 2021 , has a measured and indicated mineral resource of 704.5 million tonnes at an average grade of 0.60 g/tonne (13.62 million ounces). As reported in the Technical Report Summary attached as Exhibit 96.1 to this Annual Report on Form 10-K, a portion of the mineral resources at the Project have been converted into proven and probable reserves of 430.1 million tonnes at an average grade of 0.65 g/tonne (9.0 million ounces) based on a gold price of $1,680 per ounce. A more complete description of the Livengood Gold Project, including detailed presentation of resources and reserves, and the current activities is set forth in Part I, Item 2 and Part II, Item 7, Management's Discussion and Analysis of Financial Condition and Results of Operations of this Annual Report on Form 10-K.

From 2006 to 2008, the Company focused primarily on the acquisition and exploration of mineral properties in Alaska and Nevada by acquiring through staking, purchase, lease or option (primarily from AngloGold Ashanti (U.S.A.) Exploration Inc. ("AngloGold") in a transaction which closed on August 4, 2006) interests in a number of mineral properties in Alaska (Livengood Gold Project, Terra, LMS, BMP, Chisna, Coffee Dome, West Tanana, Gilles, West Pogo, Caribou, Blackshell and South Estelle) and Nevada (North Bullfrog and Painted Hills) that it believed had the potential to host large precious or base metal deposits. Since early 2008, the Company's primary focus has been the exploration and advancement of the Livengood Gold Project and the majority of its resources have been directed to that end. In August 2010, ITH undertook a corporate spin-out arrangement transaction whereby all of its mineral property interests other than the Project were spun out as an independent and separate company. Since the completion of that transaction, the sole mineral property held by the Company has been the Livengood Gold Project and the Company has focused exclusively on the ongoing exploration and potential development of the Livengood Gold Project.

The head office and principal executive address of ITH is located at 200 Granville Street, Suite 2710, Vancouver, British Columbia, Canada V6C 1S4, and its registered and records office is located at 745 Thurlow Street, Suite 2400, Vancouver, British Columbia, Canada V6E 0C5.

2021

Livengood Gold Project Developments

On January 12, 2021, the Company announced that the Board had approved a 2021 budget of $5.6 million and endorsed the associated 2021 work program to advance the Livengood Gold Project. The key element of the 2021 work program was the completion of the Pre-Feasibility Study (the "PFS") for the Livengood Gold Project. The work program also advanced the baseline environmental data collection in critical areas of hydrology and waste rock geochemical characterization needed to support future permitting, as well as community engagement.

Livengood Gold Project Pre-Feasibility Study

On November 4, 2021, the Company announced the results of the PFS for the Livengood Gold Project which are summarized in the Technical Report Summary. The TRS details a project that would process 65,000 tons per day and produce 6.4 million ounces of gold over 21 years from a gold resource estimated at 13.6 million ounces at 0.60 g/tonne. The study utilized a third-party review by Whittle Consulting and BBA Inc. to integrate new interpretations based on an expanded geological database, improved geological modelling, new resource estimation methodology, an optimized mine plan and production schedule, additional detailed metallurgical work at various gold grades and grind sizes, changes in the target grind for the mill, new engineering estimates, and updated cost inputs, all of which significantly de-risk the Project. The TRS has estimated the capital costs of the Project at US$1.93 billion, the total cost per ton milled at US$13.12, the all-in sustaining costs at US$1,171 per ounce, and net present value (5%) at US$1,800/oz of US$400 million.

The Project configuration evaluated in the TRS is a conventional, owner-operated surface mine that would utilize large-scale mining equipment in a blast/load/haul operation. Mill feed would be processed in a 65,000 tons per day comminution circuit consisting of primary and secondary crushing, wet grinding in a single semi-autogenous (“SAG”) mill and single ball mill followed by a gravity gold circuit and a conventional carbon in leach (“CIL”) circuit.

Whittle Enterprise Optimization

Prior to beginning the PFS, the Company retained Whittle Engineering and BBA Inc. to collaborate on an enterprise optimization study (the “Whittle and BBA Study”) to review various technologies and project configurations and to recommend the optimum configuration for the PFS. The Whittle and BBA Study reviewed secondary crushing with SAG and ball mill, tertiary crushing with ball mill, gravity/CIL at p80 of 90 micron to 250 micron, stand-alone and auxiliary heap leach configurations, gravity only gold recovery, gravity/flotation with pressure oxidation and CIL of flotation concentrate. These configurations were evaluated at various combinations of project ramp up strategy, annual throughput, primary, secondary, and tertiary grind size, as well as mining fleet size and stockpile management strategies. Tailings technologies reviewed included conventional tailings and pressure filtered tailings.

The Whittle and BBA Study determined that the gravity/CIL plant at p80 250 micron with conventional tailings provided the highest net present value, which is the configuration detailed in the TRS.

The TRS was prepared by independent third-party consultants. The Company cautions that the PFS which is summarized in the TRS is preliminary in nature, and is based on technical and economic assumptions which are expected to be further refined and evaluated in a full feasibility study which may be completed in the future. The TRS is based on a mineral resource estimate effective as of August 20, 2021 using a different mineral resource model than used in the April 2017 Report. The Company has determined that the mineral resource estimate of August 20, 2021 remains current as of December 31, 2021.

COVID-19 Pandemic

In March 2020, the World Health Organization declared the novel coronavirus 2019 (“COVID-19”) a global pandemic. This contagious disease outbreak, which has continued to spread, and any related adverse public health developments, has adversely affected workforces, economies, and financial markets globally, potentially leading to an economic downturn. While it is not possible for the Company to predict the duration or magnitude of the adverse results of the outbreak, including as a result of the emergence of variant strains of the virus and ongoing vaccination efforts, and its ultimate effects on the Company’s business, results of operations or ability to raise funds at this time, as of the date of this Annual Report on Form 10-K, the COVID-19 pandemic has not had any material adverse effects on the Company.

2022

Outlook

On March 9, 2022, the Company announced that the Board had approved a 2022 budget of $3.2 million and endorsed the associated 2022 work program to advance the Livengood Gold Project. The 2022 work program will advance the baseline environmental data collection in critical areas of hydrology and waste rock geochemical characterization needed to support future permitting, as well as advance community engagement.

The Company remains open to a strategic alliance to help support the future development of the Project while considering all other appropriate financing options. The size of the gold resource, the Project’s favorable location, and the Company’s proven team are some of the reasons the Company could potentially attract a strategic partner with a long-term development horizon who understands the Project is highly leveraged to gold prices.

Regulatory, Environmental and Social Matters

All of the Company’s currently proposed exploration is in the State of Alaska. In Alaska, low impact, initial stage surface exploration such as stream sediment, soil and rock chip sampling does not require any permits. The State of Alaska requires an APMA (Alaska Placer Mining Application) exploration permit for all substantial surface disturbances such as trenching, road building and drilling. These permits are reviewed by related state and federal agencies that can comment on and require specific changes to proposed work plans to minimize impacts on the environment. The permitting process for significant disturbances generally requires 30 days for processing and all work must be bonded. The Company currently has all necessary permits with respect to its currently planned exploration activities in Alaska. Although the Company has never had an issue with the timely processing of APMA permits, there can be no assurances that delays in permit approval will not occur.

ITH has established a Technical Committee, which has adopted a formal, written charter. As set out in its charter, the overall purpose of the Technical Committee is to assist the Board in fulfilling its oversight responsibilities with respect to the Company's continuing commitment to improving the environment and ensuring that activities are carried out and facilities are operated and maintained in a safe and environmentally sound manner that reflects the Company's ideals and principles of sustainable development. The primary function of the Technical Committee is to monitor, review and provide oversight with respect to the technical aspects of the Company's projects as well as monitor policies, standards, and programs relative to health, safety, community relations and environmental-related matters. The Technical Committee also advises the Board and makes recommendations for the Board's consideration regarding health, safety, community relations and environmental-related issues.

Although not set out in a specific policy, the Company strives to be a positive influence in the local communities where its mineral projects are located, not only by contributing to the welfare of such communities through donations of money and supplies, as appropriate, but also through hiring local workers to assist in ongoing exploration programs when appropriate. The Company considers building and maintaining strong relationships with local communities to be fundamental to its ability to continue to operate in such regions and to assist in the eventual development (if any) of mining operations in such regions, and it attaches considerable importance to commencing and fostering such relationships from the beginning of its involvement in any particular area.

Corporate Structure

ITH was incorporated under the *Company Act* (British Columbia) under the name "Ashnola Mining Company Ltd." on May 26, 1978. ITH's name was changed to "Tower Hill Mines Ltd." on June 1, 1988, and subsequently changed to "International Tower Hill Mines Ltd." on March 15, 1991. ITH has been transitioned under, and is now governed by, the *Business Corporations Act* (British Columbia).

ITH has three material subsidiaries:

- Tower Hill Mines, Inc. ("TH Alaska"), a corporation incorporated in Alaska on June 27, 2006, which holds most of the Company's Alaskan mineral properties and is 100% owned by ITH;

- Tower Hill Mines (US) LLC, a limited liability company formed in Colorado on June 27, 2006, which carries on the Company's administrative and personnel functions and is wholly owned by TH Alaska; and

- Livengood Placers, Inc., a corporation incorporated in Nevada on June 11, 1998, which holds certain Alaskan properties and is 100% owned by TH Alaska.

The following corporate chart sets forth all of ITH's material subsidiaries:

Competition

ITH is a development stage company. The Company competes with other mineral resource exploration and development companies for financing, technical expertise and the acquisition of mineral properties. Many of the companies with whom the Company competes have greater financial and technical resources. Accordingly, these competitors may be able to spend greater amounts on the acquisition, exploration and development of mineral properties. This competition could adversely impact the Company's ability to finance further exploration and to achieve the financing necessary for the Company to develop its mineral properties.

Availability of Raw Materials and Skilled Employees

All aspects of the Company's business require specialized skills and knowledge. Such skills and knowledge include the areas of geology, drilling, logistical planning, preparation of feasibility studies, permitting, construction and operation of a mine, financing and accounting. Since commencing its current operations in mid-2006, the Company has found and retained appropriate employees and consultants and believes it will continue to be able to do so in the future.

All of the raw materials the Company requires to carry on its business are readily available through normal supply or business contracting channels in Canada and the United States. Since commencing exploration activities at the Livengood Gold Project in mid-2006, the Company has been able to secure the appropriate personnel, equipment and supplies required to conduct its contemplated programs. The Company does not believe that it will experience any shortages of required personnel, equipment or supplies in the foreseeable future.

Human Capital Resources

At December 31, 2021, the Company had three employees. The Company also uses consultants with specific skills to assist with various aspects of project evaluation, engineering, community engagement and investor relations, and corporate governance.

Seasonality

As the Company's mineral exploration activity takes place in Alaska, its business is seasonal. Due to the northern climate, exploration work on the Livengood Gold Project can be limited due to excessive snow cover and cold temperatures. In general, surface sampling work is limited to May through September and surface drilling from March through November, although some locations afford opportunities for year-round exploration operations and others, such as road-accessible wetland areas, may only be explored while frozen in the winter.

Available Information

ITH maintains an internet website at www.ithmines.com. The Company makes available, free of charge, through the Investors section of its website, its Annual Reports on Form 10-K, Quarterly Reports on Form 10-Q, Current Reports on Form 8-K, and all amendments to those reports filed or furnished pursuant to Section 13 or 15(d) of the Exchange Act, as soon as reasonably practicable after such material is electronically filed with, or furnished to, the SEC and its Annual Information Form, press releases and material change reports and other reports filed on the System for Electronic Document Analysis and Retrieval (SEDAR). The Company's SEC filings are available from the SEC's internet website at www.sec.gov, which contains reports, proxy and information statements and other information regarding issuers that file electronically. The Company's SEDAR filings are available from the Canadian Securities Administrators' internet website at www.sedar.com under the Company's profile. The contents of these websites are not incorporated into this report and the references to the URLs for these websites are intended to be inactive textual references only.

ITEM 1A. RISK FACTORS

You should carefully consider the following risk factors in addition to the other information included in this Annual Report on Form 10-K. Each of these risk factors could materially and adversely affect our business, operating results and financial condition, as well as materially and adversely affect the value of an investment in our common shares. The risks described below are not the only ones facing the Company. Additional risks that we are not presently aware of, or that we currently believe are immaterial, may also adversely affect our business, operating results and financial condition. We cannot assure you that we will successfully address these risks or that other unknown risks exist that may affect our business.

Risks Related to Our Business

Our success depends on the development and operation of the Livengood Gold Project, which is our only project.

Our only property at this time is our Livengood Gold Project, which is in the development stage. The TRS indicates that the Project would generate a minimal positive return at a gold price of $1,680 per ounce. The Company would need to see higher gold prices over a sustained period for the Project to be commercially viable. While management is exploring opportunities identified in the Technical Report Summary for optimization and reducing Project costs, there can be no assurance that any such efforts will be successful, that any of the optimization opportunities or cost savings will in fact be realized or that the price of gold will increase sufficiently, and be sustained for a sufficient period, to warrant a decision to develop the Project. No assurance can be given that any level of recovery of ore reserves will be realized or that any identified mineral deposit will ever qualify as a commercial mineable ore body which can be legally and economically exploited. If we are not able to identify commercially viable mineral deposits or profitably extract minerals from such deposits, if the Project is not developed, or if the Project is otherwise subject to deterioration, destruction or significant delay, we may never generate revenues and our shareholders may lose all or a substantial portion of their investment.

We have a history of losses and expect to continue to incur losses in the future.

We have incurred losses and have had no revenue from operations since inception, and we expect to continue to incur losses in the foreseeable future. We have not commenced commercial production on the Livengood Gold Project and we have no other mineral properties. We have no revenues from operations and we do not anticipate generating revenues from operations until we are able, if ever, to begin production at the Livengood Gold Project. We will continue to incur operating losses until the Livengood Gold Project begins to generate sufficient revenues to fund continuing operations, which cannot be assured. The Project is currently in the development stage and, as contemplated in the Technical Report Summary, would generate a minimal positive return at a gold price of $1,680 per ounce. Our activities may not result in profitable mining operations and we may not succeed in establishing mining operations or profitably producing metals at the Livengood Gold Project.

We face various risks related to health epidemics, pandemics and similar outbreaks, which may have material adverse effects on our business, financial position, results of operations and/or cash flows.

We face various risks related to health epidemics, pandemics and similar outbreaks, including the global outbreak of COVID-19. The continued spread of COVID-19 has led to disruption and volatility in the global capital markets, which increases the cost of capital and adversely impacts access to capital. If significant portions of the population are unable to work effectively, including because of illness, quarantines, government actions, facility closures or other restrictions in connection with the COVID-19 pandemic, our operations will likely be impacted. In addition, our costs may increase as a result of the COVID-19 outbreak. These cost increases may not be fully recoverable or adequately covered by insurance.

It is possible that the continued spread of COVID-19 could also adversely affect our business partners, delay our plans to advance the Livengood Gold Project or cause other unpredictable events. We continue to work with our stakeholders to address this global pandemic responsibly. In addition, we continue to monitor the situation, to assess further possible implications to our business, and to take actions in an effort to mitigate adverse consequences.

We cannot at this time predict the impact of the COVID-19 pandemic, but it could have material adverse effects on our business, financial position, results of operations and/or cash flows.

We are a development stage company and have no history producing metals from our properties. Any future revenues and profits are uncertain.

We have no history of mining or refining any mineral products or metals and the Livengood Gold Project is not currently producing. There can be no assurance that the Livengood Gold Project will be successfully placed into production, produce minerals in commercial quantities, or otherwise generate operating earnings. Advancing properties from the development stage into commercial production requires significant capital and time and will be subject to further feasibility studies, permitting requirements and construction of the mine, processing plants, roads and related works and infrastructure. We will continue to incur losses until such time, if ever, as our mining activities successfully reach commercial production levels and generate sufficient revenue to fund continuing operations. There is no certainty that we will produce revenue from any source, operate profitably or provide a return on investment in the future.

We will require additional financing to fund exploration and, if warranted, development and production. Failure to obtain additional financing could have a material adverse effect on our financial condition and results of operation and could cast uncertainty on our ability to continue as a going concern.

Advancing properties from exploration and development into the production stage requires significant capital and time, and successful commercial production from a property, if any, will be subject to completing feasibility studies, permitting and construction of the mine, processing plants, roads, and other related works and infrastructure. The Company does not presently have sufficient financial resources or a source of operating cash flow to complete the permitting process and, if a production decision is made, the construction of a mine at the Livengood Gold Project. The completion of the permitting process and any construction of a mine at the Livengood Gold Project will depend upon the Company's ability to obtain financing through the sale of its equity securities, enter into a joint venture or strategic alliance relationship, secure significant debt financing or find alternative means of financing. There is no assurance that the Company will be successful in obtaining the required financing on favorable terms or at all. Even if the results of exploration are encouraging, the Company may not be able to obtain sufficient financing to conduct the further exploration that may be necessary to determine whether or not a commercially mineable deposit exists.

Our ability to obtain additional financing in the future will depend upon a number of factors, including prevailing capital market conditions, the status of the national and worldwide economy, our business performance and the price of gold and other precious metals. Capital markets worldwide have been adversely affected during the past few years, including in 2021, by substantial losses by financial institutions and market volatility due to the onset of the COVID-19 pandemic, among other things. Failure to obtain such additional financing on favorable terms or at all could result in delay or indefinite postponement of further mining operations or exploration and development and the possible partial or total loss of our interests in the Livengood Gold Project.

Resource exploration is a highly speculative business, and certain inherent exploration risks could have a negative effect on our business.

Our long-term success depends on our ability to identify mineral deposits on the Livengood Gold Project and other properties we may acquire, if any, that can then be developed into commercially viable mining operations. Resource exploration is a highly speculative business and involves a high degree of risk, including, among other things, unprofitable efforts resulting both from the failure to discover mineral deposits and from finding mineral deposits which, though present, are insufficient in size and grade at the then prevailing market conditions to return a profit from production. Substantial expenditures are required to establish proven and probable mineral reserves through drilling and analysis, to develop metallurgical processes to extract metal, and to develop the mining and processing facilities and infrastructure at any site chosen for mining. Although substantial benefits may be derived from the discovery of a major mineralized deposit, no assurance can be given that minerals will be discovered in sufficient quantities to justify commercial operations or that funds required for development can be obtained on a timely basis. The marketability of minerals which may be acquired or discovered by the Company will be affected by numerous factors beyond the control of the Company and cannot be accurately predicted. These factors include market fluctuations, the proximity and capacity of milling facilities, mineral markets and processing equipment, and government regulations, including regulations relating to prices, taxes, royalties, land use, importing and exporting of minerals and environmental protection. The exact effect of these factors cannot be accurately predicted, but the combination of these factors may result in the Company not receiving an adequate return on invested capital.

Mineral resource estimates are based on interpretation and assumptions and could be inaccurate or yield less mineral production under actual conditions than is currently estimated. Any material changes in these estimates will affect the economic viability of placing a property into production.

The mineral resource estimates included in our reports are estimates only and no assurance can be given that any particular level of recovery of minerals will in fact be realized or that an identified reserve or resource will ever qualify as a commercially mineable (or viable) deposit which can be legally and economically exploited. The estimating of mineral resources and mineral reserves is a subjective process and the accuracy of mineral resource and mineral reserve estimates is a function of the quantity and quality of available data, the accuracy of statistical computations, and the assumptions used and judgments made in interpreting available engineering and geological information. There is significant uncertainty in any mineral resource or mineral reserve estimate and the actual deposits encountered and the economic viability of a deposit may differ materially from the Company's estimates. In addition, the grade of mineralization ultimately mined may differ from that indicated by drilling results and such differences could be material. Because we have not commenced actual production, mineralization estimates, including mineral resource estimates, for the Livengood Gold Project may require adjustments or downward revisions, and such adjustments or revisions may be material.

Until ore is actually mined and processed, mineral resources, mineral reserves and grades of mineralization must be considered as estimates only. The grade of ore ultimately mined, if any, may differ from that indicated by any pre-feasibility or definitive feasibility studies and drill results. There can be no assurance that minerals recovered in small scale laboratory tests will be duplicated in large scale tests under on-site conditions or in production scale operations. Extended declines in market prices for gold may render portions or all of our mineral resources uneconomic and result in reduced reported mineralization or adversely affect the commercial viability determinations reached by us. Material changes in estimates of mineralization, grades, stripping ratios, recovery rates or of our ability to extract such mineralization may affect the economic viability of projects and the value of our Livengood Gold Project. The estimated resources described in our reports should not be interpreted as assurances of mine life or of the profitability of future operations. Estimated mineral resources and mineral reserves may have to be re-estimated based on changes in applicable commodity prices, further exploration or development activity or actual production experience. This could materially and adversely affect estimates of the volume or grade of mineralization, estimated recovery rates or other important factors that influence mineral resource or mineral reserve estimates. Market price fluctuations for gold, silver or base metals, increased production costs or reduced recovery rates or other factors may render any particular reserves uneconomical or unprofitable to develop at a particular site or sites. A reduction in estimated reserves could require material write downs in investment in the affected mining property and increased amortization, reclamation and closure charges. Mineral resources are not mineral reserves and there is no assurance that any mineral resources will ultimately be reclassified as proven or probable reserves. Mineral resources which are not mineral reserves do not have demonstrated economic viability.

There may be differences in U.S. and Canadian practices for reporting reserves and resources.

We currently file resource and reserve estimates with Canadian securities regulators in accordance with NI 43-101 and with the SEC in accordance with subpart 1300 of Regulation S-K. Both sets of reporting standards have similar goals in terms of conveying an appropriate level of confidence in the disclosures being reported but embody different approaches and definitions. While the requirements for reporting mineral resources, including subcategories of measured, indicated and inferred resources, and mineral reserves are largely similar for NI 43-101 and S-K 1300 standards, disclosures of resources and reserves in Canada and the United States could vary as a result of applying the applicable requirements of each jurisdiction. Our reserve and resource estimates are currently identical in our Canadian and U.S. filings, but future disclosures of resources and reserves may not be the same across both jurisdictions, and changes in disclosure requirements in Canada or in the U.S. may cause us to report different resources and reserves in each jurisdiction.

Increased costs could affect our ability to bring our projects into production and, once in production, our financial condition and ability to be profitable.

Management anticipates that costs at the Livengood Gold Project will frequently be subject to variation from one year to the next due to a number of factors, such as changing ore grade, metallurgy and revisions to mine plans, if any, in response to the physical shape and location of the ore body. In addition, costs are affected by the price of commodities such as fuel, rubber and electricity. Such commodities are at times subject to volatile price movements, including increases that could make production less profitable or not profitable at all. A material increase in costs could also impact our ability to maintain operations and have a significant effect on the Company's profitability in the event that a production decision is made.

The volatility of the price of gold could adversely affect any future operations and, if warranted, our ability to develop our properties.

Even if commercial quantities of mineral deposits are discovered by the Company, there is no guarantee that a profitable market will exist for the sale of the metals produced, if any. The Company's long-term viability and profitability, the value of the Company's properties, the market price of its common shares and the Company's ability to raise funding to conduct continued exploration and development, if warranted, depend, in large part, upon the market price of gold. The decision to put a mine into production and to commit the funds necessary for that purpose must be made long before the first revenue from production would be received. A decrease in the price of gold may prevent the Company's property from being economically mined or result in the write-off of assets whose value is impaired as a result of lower gold prices.

The price of gold has experienced significant movement over short periods of time, and is affected by numerous factors beyond the control of the Company, including economic and political conditions, expectations of inflation, currency exchange fluctuations, interest rates, global or regional demand, sale or purchase of gold by various central banks and financial institutions, speculative activities and increased production due to improved mining and production methods. The volatility of mineral prices represents a substantial risk which no amount of planning or technical expertise can fully eliminate. There can be no assurance that the price of gold will be such that any such deposits can be mined at a profit. The volatility in gold prices is illustrated by the following table, which presents the high, low and average fixed price in U.S. dollars for an ounce of gold, based on the London Bullion Market Association P.M. fix, over the past five years:

	High	Low	Average
2017	$ 1,346	$ 1,151	$ 1,257
2018	$ 1,355	$ 1,178	$ 1,269
2019	$ 1,546	$ 1,270	$ 1,393
2020	$ 2,067	$ 1,474	$ 1,771
2021	$ 1,943	$ 1,684	$ 1,799
January 1, 2022 to March 1, 2022	$ 1,936	$ 1,788	$ 1,839

Our results of operations could be affected by currency fluctuations.

The Livengood Gold Project is located in the United States, with most costs associated with the Project paid in U.S. dollars, and the Company maintains its accounts in Canadian and U.S. dollars, making it subject to foreign currency fluctuations. There can be significant swings in the exchange rate between the U.S. and Canadian dollar. There are no plans at this time to hedge against any exchange rate fluctuations in currencies. Adverse foreign currency fluctuations may cause losses and materially affect the Company's financial position and results.

Resource exploration, development and production involve a high degree of risk and we do not maintain insurance with respect to certain of these risks, which exposes us to significant risk of loss.

Resource exploration, development and production involve a high degree of risk. Our operations are, and any future development or mining operations we may conduct will be, subject to all of the operating hazards and risks normally incident to exploring for and developing mineral properties, such as, but not limited to:

- economically insufficient mineralized material;
- fluctuation in exploration, development and production costs;
- labor disputes;
- unanticipated variations in grade and other geologic problems;
- water conditions;
- difficult surface or underground conditions;
- mechanical and equipment failure;
- failure of pit walls or dams;
- environmental hazards;
- industrial accidents;
- metallurgical and other processing problems;
- unusual or unexpected rock formations;
- personal injury, cave-ins, landslides, flooding, fire, explosions, and rock-bursts;
- metal losses;
- power outages;

- periodic interruptions due to inclement or hazardous weather conditions; and
- decrease in the value of mineralized material due to lower gold prices.

These risks could result in damage to, or destruction of, mineral properties, facilities or other property, personal injury, environmental damage, delays in operations, increased cost of operations, monetary losses and possible legal liability. Although the Company maintains or can be expected to maintain insurance within ranges of coverage consistent with industry practice, no assurance can be given that the Company will be able to obtain insurance to cover all of these risks at economically feasible premiums or at all. The Company may elect not to insure where premium costs are disproportionate to the Company's perception of the relevant risks. The payment of such insurance premiums and of such liabilities would reduce the funds available for exploration and production activities, if warranted. Should events such as these that are not covered by insurance arise, they could reduce or eliminate our assets and shareholder equity as well as result in increased costs and a decline in the value of our assets or common shares.

We may not be able to obtain all required permits and licenses to place any of our properties into production.

The current and future operations of the Company require licenses and permits from various governmental authorities. There can be no assurance that the Company will be able to obtain all necessary licenses and permits that may be required to carry out exploration, development and mining operations at its projects, on reasonable terms or at all. Costs related to applying for and obtaining permits and licenses may be prohibitive and could delay our planned exploration and development activities. Failure to comply with permitting requirements may result in enforcement actions, including orders issued by regulatory or judicial authorities causing operations to cease or be curtailed, and may include corrective measures requiring capital expenditures, installation of additional equipment, or remedial actions. Delays in obtaining, or a failure to obtain, any such licenses and permits, or a failure to comply with the terms of any such licenses and permits that the Company does obtain, could delay or prevent production of the Livengood Gold Project and have a material adverse effect on the Company.

Title to the Livengood Gold Project may be subject to defects in title or other claims, which could affect our property rights and claims.

There are risks that title to the Livengood Gold Project may be challenged or impugned. The Livengood Gold Project is located in the State of Alaska and may be subject to prior unrecorded agreements or transfers or native land claims, and title may be affected by undetected defects. There may be valid challenges to the title of the Livengood Gold Project which, if successful, could impair development or operations. This is particularly the case in respect of those portions of our properties in which we hold our interest solely through a lease with the claim holders, as such interest is substantially based on contract and has been subject to a number of assignments (as opposed to a direct interest in the property).

Some of the mining claims at the Livengood Gold Project are U.S. federal or Alaska state "unpatented" mining claims. There is a risk that a portion of such unpatented mining claims could be determined to be invalid, in which case the Company could lose the right to mine any minerals contained within those mining claims. Unpatented mining claims are created and maintained in accordance with the applicable U.S. federal and Alaska state mining laws. Unpatented mining claims are unique property interests and are generally considered to be subject to greater title risk than other real property interests due to the validity of unpatented mining claims often being uncertain. This uncertainty arises, in part, out of the complex federal and state laws and regulations under the provisions of the *U.S. General Mining Law of 1872* (the "U.S. General Mining Law"). Unpatented mining claims are always subject to possible challenges of third parties or validity contests by the United States federal government or the Alaska state government, as applicable. The validity of an unpatented mining claim, in terms of both its location and its maintenance, is dependent on strict compliance with a complex body of federal and state statutory and decisional law. Title to the unpatented mining claims may also be affected by undetected defects such as unregistered agreements or transfers and there are few public records that definitively determine the issues of validity and ownership of unpatented mining claims. The Company has not obtained full title opinions for the majority of its mineral properties. Not all the mineral properties in which the Company has an interest have been surveyed, and their actual extent and location may be in doubt. Should the federal government impose a royalty or additional tax burdens on the properties that lie within public lands, the resulting mining operations could be seriously impacted, depending upon the type and amount of the burden.

The leases and agreements pursuant to which the Company has interests, or the right to acquire interests, in a significant portion of the Livengood Gold Project provide that the Company must make a series of cash payments over certain time periods or expend certain minimum amounts on the exploration of the properties. Failure by the Company to make such payments or make such expenditures in a timely fashion may result in the Company losing its interest in such properties. There can be no assurance that the Company will have, or be able to obtain, the necessary financial resources to be able to maintain all of its property agreements in good standing, or to be able to comply with all of its obligations thereunder, which could result in the Company forfeiting its interest in one or more of its mineral properties.

The Company may not have and may not be able to obtain surface or access rights to all or a portion of the Livengood Gold Project.

Although the Company acquires the rights to some or all of the minerals in the ground subject to the mineral tenures that it acquires, or has a right to acquire, in most cases it does not thereby acquire any rights to, or ownership of, the surface to the areas covered by its mineral tenures. In such cases, applicable mining laws usually provide for rights of access to the surface for the purpose of carrying on mining activities, however, the enforcement of such rights through the courts can be costly and time-consuming. It is necessary to negotiate surface access or to purchase the surface rights if long-term access is required. There can be no guarantee that, despite having the right at law to access the surface and carry-on mining activities, the Company will be able to negotiate satisfactory agreements with any such existing landowners/occupiers for such access or purchase such surface rights, and therefore it may be unable to carry out planned exploration or mining activities. In addition, in circumstances where such access is denied, or no agreement can be reached, the Company may need to rely on the assistance of local officials or the courts in such jurisdiction, the outcomes of which cannot be predicted with any certainty. The inability of the Company to secure surface access or purchase required surface rights could materially and adversely affect the timing, cost or overall ability of the Company to develop any mineral deposits it may locate.

We are subject to significant governmental regulations which affect our operations and costs of conducting our business.

Any exploration activities carried on by the Company are, and any future development or mining operations we may conduct will be, subject to extensive laws and regulations governing various matters, including:

- mineral concession acquisition, exploration, development, mining and production;
- management of natural resources;
- exports, price controls, taxes and fees;
- labor standards on occupational health and safety, including mine safety;
- post-closure reclamation;
- environmental standards, waste disposal, toxic substances, explosives, land use and environmental protection; and
- dealings with indigenous peoples and historic and cultural preservation.

Companies engaged in exploration activities often experience increased costs and delays in production and other schedules as a result of the need to comply with applicable laws, regulations and permits. Failure to comply with applicable laws, regulations and permits may result in civil or criminal fines or penalties, enforcement actions thereunder, including the forfeiture of claims, orders issued by regulatory or judicial authorities requiring operations to cease or be curtailed, and may include corrective measures requiring capital expenditures, installation of additional equipment or costly remedial actions, any of which could result in the Company incurring significant expenditures. The Company may also be required to compensate third parties suffering loss or damage as a result of our mineral exploration activities and may have civil or criminal fines or penalties imposed for violations of such laws, regulations and permits.

It is also possible that future laws and regulations could cause additional expense, capital expenditures, restrictions on or suspension of the Company's operations and delays in the exploration and development of the Company's properties.

Legislation has been proposed that would significantly affect the mining industry and our business.

In recent years, members of the United States Congress have repeatedly introduced bills which would supplant or alter the provisions of the U.S. General Mining Law. If adopted, such legislation, among other things, could eliminate or greatly limit the right to a mineral patent, impose federal royalties on mineral production from unpatented mining claims located on U.S. federal lands (which includes certain of the mining claims at the Livengood Gold Project), result in the denial of permits to mine after the expenditure of significant funds for exploration and development, reduce estimates of mineral reserves and reduce the amount of future exploration and development activity on U.S. federal lands, all of which could have a material and adverse effect on the Company's ability to operate and its cash flow, results of operations and financial condition.

Our activities are subject to environmental laws and regulations that may increase our costs of doing business and restrict our operations.

The activities of the Company are subject to environmental regulations in the jurisdictions in which we operate. Environmental legislation generally provides for restrictions and prohibitions on spills, releases or emissions into the air, discharges into water, management of waste, management of hazardous substances, protection of natural resources, antiquities and endangered species and reclamation of lands disturbed by mining operations. Certain types of operations require the submission and approval of environmental impact assessments. Environmental legislation is evolving in a manner involving stricter standards and enforcement, increased fines and penalties for non-compliance, more stringent environmental assessments of proposed projects and a heightened degree of responsibility for companies and their officers, directors and employees. Compliance with environmental laws and regulations and future changes in these laws and regulations may require significant capital outlays, cause material changes or delays in our current and planned operations and future activities and reduce the profitability of operations. It is possible that future changes in these laws or regulations could have a significant adverse impact on the Livengood Gold Project or some portion of our business, causing us to re-evaluate those activities at that time.

Examples of current U.S. federal laws which may affect our current operations and may impact future business and operations include, but are not limited to, the following:

The Comprehensive Environmental, Response, Compensation, and Liability Act ("CERCLA"), and comparable state statutes, impose strict, joint and several liability on current and former owners and operators of sites and on persons who disposed of or arranged for the disposal of hazardous substances found at such sites. It is not uncommon for the government to file claims requiring cleanup actions, demands for reimbursement for government-incurred cleanup costs, or natural resource damages, or for neighboring landowners and other third parties to file claims for personal injury and property damage allegedly caused by hazardous substances released into the environment. The Federal Resource Conservation and Recovery Act ("RCRA"), and comparable state statutes, govern the disposal of solid waste and hazardous waste and authorize the imposition of substantial fines and penalties for noncompliance, as well as requirements for corrective actions. CERCLA, RCRA and comparable state statutes can impose liability for clean-up of sites and disposal of substances found on exploration, mining and processing sites long after activities on such sites have been completed.

The Clean Air Act ("CAA") restricts the emission of air pollutants from many sources, including mining and processing activities. Our mining operations may produce air emissions, including fugitive dust and other air pollutants from stationary equipment, storage facilities and the use of mobile sources such as trucks and heavy construction equipment, which are subject to review, monitoring or control requirements under the CAA and state air quality laws. New facilities may be required to obtain permits before work can begin, and existing facilities may be required to incur capital costs in order to remain in compliance. In addition, permitting rules may impose limitations on our production levels or result in additional capital expenditures in order to comply with the regulations.

The National Environmental Policy Act ("NEPA") requires federal agencies to integrate environmental considerations into their decision-making processes by evaluating the environmental impacts of their proposed actions, including issuance of permits to mining facilities, and assessing alternatives to those actions. If a proposed action could significantly affect the environment, the agency must prepare a detailed statement known as an Environmental Impact Statement ("EIS"). The U.S. Environmental Protection Agency ("EPA"), other federal agencies, and any interested third parties will review and comment on the scoping of the EIS and the adequacy of and findings set forth in the draft and final EIS. We are required to undertake the NEPA process for the Livengood Gold Project permitting. The NEPA process can cause delays in issuance of required permits or result in changes to a project to mitigate its potential environmental impacts, which can in turn impact the economic feasibility of a proposed project or the ability to construct or operate the Livengood Gold Project or other properties and may make them entirely uneconomic.

The Clean Water Act ("CWA"), and comparable state statutes, impose restrictions and controls on the discharge of pollutants into waters of the United States. The discharge of pollutants into regulated waters is prohibited, except in accordance with the terms of a permit issued by the EPA or an analogous state agency. The CWA regulates storm water mining facilities and requires a storm water discharge permit for certain activities. Such a permit requires the regulated facility to monitor and sample storm water run-off from its operations. The CWA and regulations implemented thereunder also prohibit discharges of dredged and fill material in wetlands and other waters of the United States unless authorized by an appropriately issued permit. The CWA and comparable state statutes provide for civil, criminal and administrative penalties for unauthorized discharges of pollutants and impose liability on parties responsible for those discharges for the costs of cleaning up any environmental damage caused by the release and for natural resource damages resulting from the release.

The Safe Drinking Water Act ("SDWA") and the Underground Injection Control ("UIC") program promulgated thereunder, regulate the drilling and operation of subsurface injection wells. The EPA directly administers the UIC program in some states and in others the responsibility for the program has been delegated to the state. The program requires that a permit be obtained before drilling a disposal or injection well. Violation of these regulations or contamination of groundwater by mining related activities may result in fines, penalties, and remediation costs, among other sanctions and liabilities under the SDWA and state laws. In addition, third party claims may be filed by landowners and other parties claiming damages for alternative water supplies, property damages, and bodily injury.

Regulations and pending legislation governing issues involving climate change could result in increased operating costs, which could have a material adverse effect on our business.

A number of governments or governmental bodies have introduced or are contemplating regulatory changes in response to various climate change interest groups and the potential impact of climate change. Legislation and increased regulation regarding climate change could impose significant costs on us, our future partners and our suppliers, including costs related to increased energy requirements, capital equipment, environmental monitoring and reporting and other costs to comply with such regulations. Any adopted future climate change regulations could also negatively impact our ability to compete with companies situated in areas not subject to such limitations. Given the emotion, political significance and uncertainty around the impact of climate change and how it should be dealt with, we cannot predict how legislation and regulation will affect our financial condition, operating performance and ability to compete. Furthermore, even without such regulation, increased awareness and any adverse publicity in the global marketplace about potential impacts on climate change by us or other companies in our industry could harm our reputation. The potential physical impacts of climate change on our operations are highly uncertain and would be particular to the geographic circumstances in areas in which we operate. These may include changes in rainfall and storm patterns and intensities, water shortages, changing sea levels and changing temperatures. These impacts may adversely impact the cost, production and financial performance of our operations.

Land reclamation requirements for our properties may be burdensome and expensive in the future.

Land reclamation requirements are generally imposed on mineral exploration companies (as well as companies with mining operations) in order to minimize long term effects of land disturbance. Reclamation may include requirements to:

- control dispersion of potentially deleterious effluents;
- treat ground and surface water to drinking water standards; and
- reasonably re-establish pre-disturbance land forms and vegetation.

In order to carry out reclamation obligations imposed on us in connection with the potential development activities at the Livengood Gold Project, we must allocate financial resources that might otherwise be spent on further exploration and development programs. We plan to set up a provision for reclamation obligations on the Livengood Gold Project, as appropriate, but this provision may not be adequate. If we are required to carry out unanticipated reclamation work, our financial position could be adversely affected.

The mining industry is intensely competitive, and we have limited financial and personnel resources with which to compete.

The Company's business of the acquisition, exploration and, if warranted, development and mining of mineral properties is intensely competitive. The Company may be at a competitive disadvantage in acquiring additional mining properties because it must compete with other individuals and companies, many of which may have greater financial resources, operational experience and technical capabilities than the Company. The Company may also encounter increasing competition from other mining companies in efforts to hire experienced mining professionals. Increased competition could adversely affect the Company's ability to attract necessary capital funding, acquire suitable producing properties or prospects for mineral exploration in the future, or attract or retain key personnel or outside technical resources.

A shortage of equipment and supplies could adversely affect our ability to operate our business.

We are dependent on various supplies and equipment to carry out our exploration and, if warranted, development and mining operations. The shortage of such supplies, equipment and parts could have a material adverse effect on our ability to carry out our operations and therefore limit or increase the cost of production.

We are dependent on key personnel and the absence of any of these individuals could adversely affect our business. We may experience difficulty attracting and retaining qualified personnel.

Our future success is largely dependent on the performance and abilities of our directors, officers, employees and management and on our ability to attract and retain additional key personnel in exploration, mine development, sales, marketing, technical support and finance. In addition, the Company has relied and may continue to rely upon consultants and others for operating expertise. There is no assurance that we will be able to maintain the services of our directors, officers, employees or other qualified personnel required to operate our business. The loss of the services of these persons could have a material adverse effect on our business and prospects. Recruiting and retaining qualified personnel is critical to our success and there can be no assurance we will be able to recruit and retain such personnel. The number of persons skilled in the acquisition, exploration and development of mineral properties is limited and competition for such persons is intense. If we are not successful in attracting and retaining qualified personnel, our ability to develop our properties could be affected, which could have a material adverse effect on our business, results of operations, cash flows and financial condition. We do not maintain "key man" life insurance policies on any of our officers or employees.

Our ability to use our net operating loss carryforwards to offset future taxable income may be subject to certain limitations.

In general, under Section 382 of the U.S. Internal Revenue Code of 1986, as amended (the "Code"), a corporation that undergoes an "ownership change" is subject to limitations on its ability to utilize its pre-change net operating loss carryforwards ("NOLs") to offset future taxable income. Similarly, where control of a corporation has been acquired by a person or group of persons, subsection 111(5) of the *Income Tax Act* (Canada) (the "Canadian Tax Act"), and equivalent provincial income tax legislation restrict the corporation's ability to carry forward non-capital losses from preceding taxation years. Our existing NOLs may be subject to limitations arising from previous ownership changes. Future changes in our stock ownership, some of which are outside of our control, could result in an ownership change under Section 382 of the Code or an acquisition of control for the purposes of subsection 111(5) of the Canadian Tax Act, and adversely affect our ability to utilize our NOLs in the future. There is also a risk that due to regulatory changes, such as suspensions on the use of NOLs, or other unforeseen reasons, our existing NOLs could expire or otherwise be unavailable to offset future income tax liabilities. For these reasons, we may not be able to utilize a material portion of the NOLs reflected on our balance sheet, even if we attain profitability.

Risks Related to Our Common Shares

Our share price may be volatile and as a result you could lose all or part of your investment.

In recent years, the securities markets in the United States and Canada have experienced a high level of price and volume volatility, and the market price of securities of many companies, particularly those considered exploration or development stage companies, have experienced wide fluctuations in price which have not necessarily been related to the operating performance, underlying asset values or prospects of such companies. Any quoted market for our common shares may be subject to market trends and conditions generally, notwithstanding any potential success we have in creating revenues, cash flows or earnings. The price of our common shares has been subject to price and volume volatility in the past. In 2021, the price of our common shares on the TSX ranged from a low of C$0.79 to a high of C$1.92, and on the NYSE American ranged from a low of $0.65 to a high of $1.52. From January 1, 2022 to March 1, 2022, the price of our common shares on the TSX ranged from a low of C$0.87 to a high of C$1.44, and on the NYSE American ranged from a low of $0.69 to a high of $1.13. There can be no assurance that significant fluctuations in the trading price of the Company's common shares will not continue to occur, or that such fluctuations will not materially adversely impact the Company's ability to raise equity funding without significant dilution to its existing shareholders, or at all. As a result, our shareholders may be unable to resell their shares at a desired price.

Future sales of our securities in the public or private markets will dilute our current shareholders and could adversely affect the trading price of our common shares and our ability to continue to raise funds in new stock offerings.

It is likely that the Company will issue common shares or securities exercisable or convertible into common shares in the future. The Company may issue securities on less than favorable terms to raise sufficient capital to fund its business plan. Any transaction involving the issuance of equity securities or securities convertible into common shares would result in dilution, possibly substantial, to present and prospective holders of common shares, could adversely affect the trading prices of our common shares and could impair our ability to raise capital through future offerings of securities.

We have never paid dividends on our common shares.

We have not paid dividends on our common shares to date, and we may not be in a position to pay dividends for the foreseeable future. Our ability to pay dividends will depend on our ability to successfully develop the Livengood Gold Project and generate earnings from operations. Further, our initial earnings, if any, will likely be retained to finance our operations. Any future dividends will depend upon our earnings, our then-existing financial requirements and other factors, and will be at the discretion of the Board.

We believe that we likely were a passive foreign investment company ("PFIC") during the fiscal year ended December 31, 2021, which may result in adverse U.S. federal income tax consequences to U.S. holders.

We believe that we likely were a PFIC for U.S. federal income tax purposes during the fiscal year ended December 31, 2021, and we expect that we will be a PFIC in the current year and that we may continue to be classified as a PFIC in future years. The determination of whether or not the Company is a PFIC is a factual determination dependent on a number of factors and cannot be made until the close of the applicable tax year. Accordingly, no assurances can be given regarding the Company's PFIC status for the current year or any future year. If the Company is a PFIC at any time during a U.S. holder's holding period, then certain potentially adverse tax consequences could apply to such U.S. holder's acquisition, ownership, and disposition of common shares. For more information, please see the discussion in "Certain U.S. Federal Income Tax Considerations for U.S. Holders" below.

ITEM 1B. UNRESOLVED STAFF COMMENTS

None.

ITEM 2. PROPERTIES

The Company is engaged in the acquisition and development of mineral properties. The Company currently holds or has the right to acquire interests in one property – a development stage property in Alaska referred to as the Livengood Gold Project (the "Livengood Gold Project" or the "Project").

Information concerning our mining properties in this Annual Report on Form 10-K has been prepared in accordance with the requirements of subpart 1300 of Regulation S-K, which first became applicable to us for the fiscal year ended December 31, 2021. These requirements differ significantly from the previously applicable disclosure requirements of SEC Industry Guide 7. Among other differences, subpart 1300 of Regulation S-K requires us to disclose our mineral resources, in addition to our mineral reserves, as of the end of our most recently completed fiscal year both in the aggregate and for each of our individually material mining properties.

As used in this Annual Report on Form 10-K, the terms "mineral resource," "measured mineral resource," "indicated mineral resource," "inferred mineral resource," "mineral reserve," "proven mineral reserve" and "probable mineral reserve" are defined and used in accordance with subpart 1300 of Regulation S-K. Under subpart 1300 of Regulation S-K, mineral resources may not be classified as "mineral reserves" unless the determination has been made by a qualified person that the mineral resources can be the basis of an economically viable project. You are specifically cautioned not to assume that any part or all of the mineral deposits (including any mineral resources) in these categories will ever be converted into mineral reserves, as defined by the SEC.

You are cautioned that, except for that portion of mineral resources classified as mineral reserves, mineral resources do not have demonstrated economic value. Inferred mineral resources are estimates based on limited geological evidence and sampling and have a too high degree of uncertainty as to their existence to apply relevant technical and economic factors likely to influence the prospects of economic extraction in a manner useful for evaluation of economic viability. Estimates of inferred mineral resources may not be converted to a mineral reserve. It cannot be assumed that all or any part of an inferred mineral resource will ever be upgraded to a higher category. A significant amount of exploration must be completed in order to determine whether an inferred mineral resource may be upgraded to a higher category. Therefore, you are cautioned not to assume that all or any part of an inferred mineral resource exists, that it can be the basis of an economically viable project, or that it will ever be upgraded to a higher category. Likewise, you are cautioned not to assume that all or any part of measured or indicated mineral resources will ever be converted to mineral reserves.

Additionally, we are subject to the reporting requirements of the applicable U.S. and Canadian securities laws, and as a result we publicly report our mineral reserves and mineral resources according to two different standards. U.S. reporting requirements are governed by subpart 1300 of Regulation S-K. Canadian reporting requirements for disclosure of mineral properties are governed by the NI 43-101. Both sets of reporting standards have similar goals in terms of conveying an appropriate level of confidence in the disclosures being reported but embody different approaches and definitions. While the requirements for reporting mineral resources, including subcategories of measured, indicated and inferred resources, and mineral reserves are largely similar for NI 43-101 and S-K 1300 standards, disclosures of resources and reserves in Canada and the United States could vary as a result of applying the applicable requirements of each jurisdiction.

The information that follows relating to the Livengood Gold Project is derived, for the most part, from, and in some instances is an extract from, the TRS relating to the property attached hereto as Exhibit 96.1 and prepared in compliance with Item 601(b)(96) and subpart 1300 of Regulation S-K. Portions of the following information are based on assumptions, qualifications and procedures that are not fully described herein. Reference should be made to the full text of the TRS, incorporated herein by reference and made a part of this Annual Report on Form 10-K.

LIVENGOOD GOLD PROJECT, ALASKA

The Company currently holds, or has rights to acquire, ownership or leasehold interests in a group of adjacent mineral properties in Alaska which are collectively referred to as the "Livengood Gold Project." The Livengood Gold Project is located approximately 113 km (70 miles) by road northwest of Fairbanks, Alaska and approximately 65 km (40 miles) north of the boundary of the Fairbanks North Star Borough as shown in Figure 1 below. The Project lies within the Tolovana Mining District in the northern part of the Tintina Gold Belt. The Company owns a 100% interest in the Livengood Gold Project and the Company's primary focus is to develop the Project with the objective of achieving commercial production. The Company's book value of its investment in the Livengood Gold Project is $55,375,124 as of December 31, 2021.

Property Description and Location

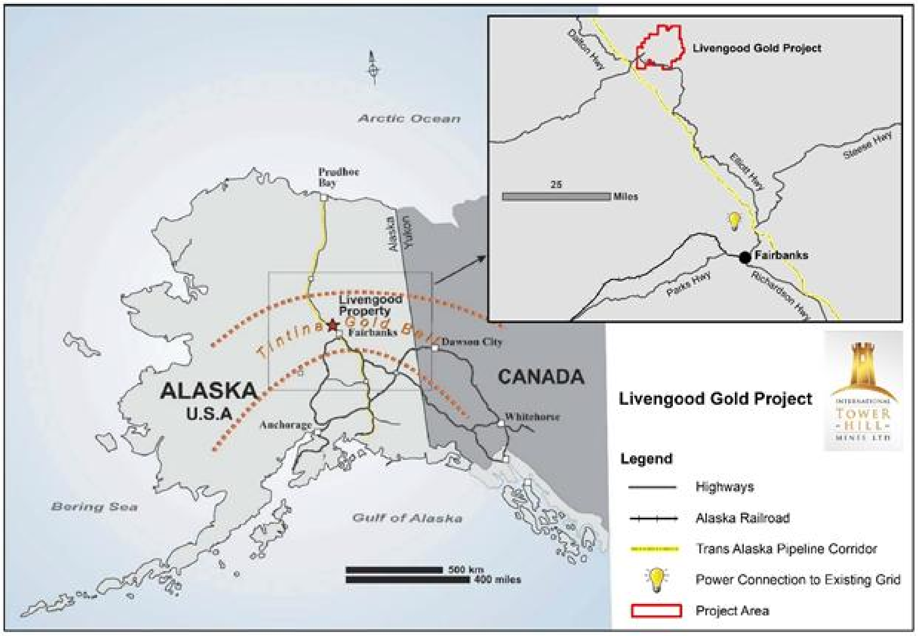

Figure 1: Location of the Livengood Gold Project

Accessibility, Climate, Local Resources, Infrastructure and Physiography

The Livengood Gold Project is located approximately 113 km (70 miles) by road northwest of Fairbanks, Alaska in the Tolovana Mining District within the Tintina Gold Belt. The Project area is centered on Money Knob, a local topographic high point located at 65˚30'16''N, 148˚31'33''W. This feature and the adjoining ridgelines are the probable lode gold source for the Livengood placer deposits which lie in the adjacent valley and which have been actively mined since 1914 and have produced more than 500,000 ounces of gold.

The Livengood Gold Project straddles and is accessed via the Elliot Highway, a paved, all-weather road linking the north slope oil fields at Prudhoe Bay to central and southern Alaska through Fairbanks. At present there are no full-time residents in the former mining town of Livengood. A number of unpaved roads have been developed in the area providing excellent access. A 427 m (1400-foot) runway is located 6 km (3.7 miles) to the southwest near the former Alyeska Pipeline Company Livengood Camp and is suitable for light aircraft. The Livengood Gold Project is also adjacent to the Alyeska Pipeline corridor, which transports crude oil from Prudhoe Bay south. This corridor contains a fiber optic communications cable utilized at the Livengood Gold Project.

Topography at the site is eroded hills and valleys with a general elevation difference of 200 m (656 feet). The valleys generally contain active streams draining into the Tolovana River system to the west.

The site is approximately 65 km (40 miles) south of the Arctic Circle, and has a subarctic climate with long, cold winters and short, warm summers. Annual precipitation is approximately 40 cm (16 inches). Average low temperatures in winter are -21° to -28° Celsius (-6° to -18° Fahrenheit), with records reaching as low as -55° Celsius (-67° Fahrenheit). Exploration work on the Livengood Gold Project can be limited due to excessive snow cover and cold temperatures. In general, surface sampling work is limited to May through September and surface drilling from March through November. Road-accessible wetland areas may only be explored while frozen in the winter. Work to date on the site has been limited to exploration and geotechnical drilling and environmental baseline activities. The Company does not have any plant or equipment at the site, relying on contractors to perform the work.
The nearest community to Livengood Gold Project is the village of Minto, a town with a population of approximately 177 located approximately 65 km (40 miles) southwest by road. The Fairbanks metropolitan area has a population of approximately 100,000 people, and comprises the regional center with hospitals, government offices, businesses and the University of Alaska, Fairbanks. The city is

linked to southern Alaska along a north-south transportation and utility corridor that includes two paved highways, a railroad to tide water, an interlinked electrical grid, and communications infrastructure. Fairbanks has an international airport serviced daily by up to three major airlines.

In preliminary, non-binding discussions, the local utility in Fairbanks (Golden Valley Electrical Association) has indicated that 80-100 Megawatts of power could be available to the Livengood Gold Project. Livengood would be connected to the local grid by building an 82 km (50 miles) 230-kVA line along the pipeline corridor. Environmental baseline studies required for the electrical line construction started in 2011.

The TRS describes the plans for the infrastructure required at the Livengood Gold Project. These include evaluating mine shops; process, water and tailing management facilities; power; access roads; administration offices; and camp facilities.

Livengood Gold Project Lands

The Livengood Gold Project covers approximately 19,546 hectares (48,300 acres), all of which is controlled by the Company through its wholly-owned subsidiary, TH Alaska. The Livengood Gold Project is comprised of multiple land parcels: 100% owned patented mining claims; 100% owned State of Alaska mining claims; 100% owned federal unpatented placer claims; land leased from the Alaska Mental Health Trust ("AMHT"); land leased from holders of state and federal patented and unpatented mining and placer claims; and undivided interests in patented mining claims. The property and claims controlled through ownership, leases or agreements are summarized below:

100% owned patented mining claims

- U.S. Mineral Survey 1960 and 2447, located on lower Livengood Creek, subject to an agreement to allow Larry Nelson, as agent for Nelson Mining Company, to operate a placer mine on MS 1960 and 2447 through February 2, 2023.
- U.S. Mineral Survey 1956, located on lower Gertrude Creek, subject to a reserved royalty of 5% of gross value held by Key Trust Company on behalf of the Luther Hess Trust.
- With respect to portions of U.S. Mineral Survey 1626, located on lower Amy Creek:
  100% of No. 2 Above Discovery Any Creek,
  100% of No. 3 Above Discovery Amy Creek, and
  100% of Up Grade Association Bench

100% owned State of Alaska mining claims

- 169 state claims acquired by purchase
- 153 state claims acquired by location

100% owned federal unpatented placer claims

- 29 federal unpatented placer claims

100% owned Livengood Placers, Inc., a private Nevada corporation that is 100% owned by TH Alaska. Livengood Placers, Inc. is the record owner of the following:

- 29 patented claims
- 108 federal unpatented placer claims
- 24 State of Alaska mining claims

Leased property

- Alaska Mental Health Trust Lease. A lease of the AMHT mineral rights having a term commencing July l, 2004 and extending 19 years until June 30, 2023, subject to further extensions beyond June 30, 2023 by either commercial production or payment of an advance minimum royalty equal to 125% of the amount paid in year 19 and diligent pursuit of development. The lease requires minimum work expenditures and advance minimum royalties (all of which minimum royalties are recoverable from production royalties) which escalate annually with inflation. A net smelter return ("NSR") production royalty of between 2.5% and 5.0% (depending upon the price of gold) is payable to the lessor with respect to the lands subject to this lease. In addition, an NSR production royalty of l% is payable to the lessor with respect to the unpatented federal mining claims subject to the lease described in the Hudson/Geraghty Lease below and an NSR production royalty of between 0.5% and 1.0% (depending upon the price of gold) is payable to the lessor with respect to the lands acquired by the Company as a result of the purchase of Livengood Placers, Inc. in December 2011. As of December 31, 2021, there were 9,970 acres included in the AMHT lease.

- Hudson/Geraghty Lease. A lease of 20 federal unpatented lode mining claims having an initial term of ten years commencing on April 21, 2003 and continuing for so long thereafter as advance minimum royalties are paid and mining related activities, including exploration, continue on the property or on adjacent properties controlled by the Company. The lease requires an advance minimum royalty of $50,000 on or before each anniversary date for the duration of the lease (all of which minimum royalties are recoverable from production royalties). An NSR production royalty of between 2% and 3% (depending on the price of gold) is payable to the lessors. The Company may purchase 1% of the royalty for $1,000,000.

- Griffin Lease. A lease of three patented lode claims having an initial term of ten years commencing January 18, 2007, and continuing for so long thereafter as advance minimum royalties are paid. The lease requires an advance minimum royalty of $20,000 on or before each anniversary date through January 18, 2017 and $25,000 on or before each subsequent anniversary (all of which minimum royalties are recoverable from production royalties). An NSR production royalty of 3% is payable to the lessors. The Company may purchase all interests of the lessors in the leased property (including the production royalty) for $1,000,000 (less all minimum and production royalties paid to the date of purchase), of which $500,000 is payable in cash over four years following the closing of the purchase and the balance of $500,000 is payable by way of the 3% NSR production royalty. The Company has acquired a 40% interest in the mining claims subject to the lease, providing the Company with a 40% interest in the lease.

- Tucker Lease. A lease of two unpatented federal lode mining claims and four federal unpatented placer claims having an initial term of ten years commencing on March 28, 2007, and continuing for so long thereafter as advance minimum royalties are paid and mining related activities, including exploration, continue on the property or on adjacent properties controlled by the Company. The lease requires an advance minimum royalty of $15,000 on or before each anniversary date for the duration of the lease (all of which minimum royalties are recoverable from production royalties). The Company is required to pay the lessor the additional sum of $250,000 upon making a positive production decision, of which $125,000 is payable within 120 days of the decision and $125,000 is payable within a year of the decision (all of which are recoverable from production royalties). An NSR production royalty of 2% is payable to the lessor. The Company may purchase all of the interest of the lessor in the leased property (including the production royalty) for $1,000,000.

Patented claims (undivided interests less than 100%)

- An undivided 203/240th interest in that certain patented placer mining claim known as the "Kinney Bench" claim, included within U.S. Mineral Survey No. 1626 on lower Amy Creek.

- An undivided 53/90th interest in that certain patented placer mining claim known as the "Union Bench Association" claim, included within U.S. Mineral Survey No. 1626 on lower Amy Creek.

- An undivided 83/120th interest in that certain patented placer mining claim known as the "Bessie Bench" claim, included within U.S. Mineral Survey No. 1626 on lower Amy Creek.

- An undivided 23/60th interest in those certain patented placer mining claims known as the “War Association” claim; the “Mutual Association” claim; and the “O.K. Fraction” claim, all included within U.S. Mineral Survey No. 2033 on lower Amy Creek.

- An undivided 2/5th interest in those certain patented lode mining claims included within U.S. Mineral Survey No. 1990.

On State of Alaska lands, the state holds both the surface and the subsurface rights. State of Alaska 40-acre mining claims require an annual rental payment by November 30th of each year of $40 per claim to be paid to the state for the first five years, $85 per year for the second five years, and $205 per year thereafter. The annual rental rates for each 160-acre claim are $165 for the first five years, $330 for the second five years, and $825 per year thereafter. As a consequence of the annual rentals due, all Alaska State Mining Claims have an expiry date of November 30th each year. In addition, there is a minimum annual work expenditure requirement of $100 per 40-acre claim (due on or before noon on September 1 in each year) or cash-in-lieu thereof, and an affidavit evidencing that such work has been performed is required to be filed on or before November 30th in each year. Excess work can be carried forward for up to four years. If the rental is paid and the work requirements are met, the claims can be held indefinitely. The work completed by the Company during the 2021 field season was filed as assessment work, and the value of that work is sufficient to meet the assessment work requirements through September 1, 2025 on all State of Alaska mining claims.

Holders of State of Alaska mining claims are also required to pay a production royalty on all revenue received from minerals produced on state land during each calendar year. The production royalty rate is 3% of net income.

Holders of federal unpatented mining claims are required to pay an annual rental of $165 per 20 acres.

All of the foregoing agreements are in good standing and are transferable. The Company has taken reasonable steps to verify title to mineral properties in which it has an interest. Except for the patented claims, none of the properties have been surveyed.

Holders of Federal and Alaska State unpatented mining claims have the right to use the land or water included within mining claims only when necessary for mineral prospecting, development, extraction, or basic processing, or for storage of mining equipment. However, the exercise of such rights is subject to the appropriate permits being obtained.

Geology and Mineralization

The rocks at the Livengood Gold Project are part of the Livengood Terrane, an east–west belt, approximately 240 km (149 miles) long, consisting of tectonically interleaved assemblages of various ages. These assemblages include the Amy Creek Assemblage, a sequence of latest Proterozoic and/or early Paleozoic basalt, mudstone, chert, dolomite, and limestone. An early Cambrian ophiolite sequence of mafic and ultramafic sea floor rocks was thrust over the Amy Creek Assemblage and was, in turn, overthrust by a sequence of Devonian shale, siltstone, conglomerate, volcanic, and volcaniclastic rocks, which are the dominant host to the mineralization currently under exploration at the Livengood Gold Project. The Devonian assemblage was overthrust by a second klippe of Cambrian ophiolite rocks. All of these rocks are intruded by Cretaceous multiphase monzonitic and syenitic dikes and sills. Gold mineralization is spatially and temporally associated with these intrusive rocks.

Gold mineralization occurs in association with disseminated arsenopyrite and pyrite in volcanic, sedimentary, and intrusive rocks, and in quartz veins cutting the more competent lithologies, primarily volcanic rocks, sandstones, and, to a lesser degree, ultramafic rocks. Three principal stages of alteration are currently recognized, an early biotite stage, followed by albite-quartz, and a late sericite-quartz assemblage. Carbonate appears to have been introduced with and subsequent to these stages. Arsenopyrite and pyrite were introduced primarily during the albite-quartz and sericite-quartz stages. Gold correlates strongly with arsenic and occurs primarily within and on the margins of arsenopyrite and pyrite.

Mineralization is interpreted as intrusion-related, consistent with other gold deposits of the Tintina Gold Belt, and has a similar As-Sb geochemical association. Mineralization is controlled partly by lithologic units, but thrust-fold architecture was key to providing pathways for intrusive and associated hydrothermal fluids.

Local fault and contact limits to mineralization have been identified, but overall, the deposit has not been closed off in any direction. The current resource and area drilled covers the most significant portion of the area with anomalous gold in surface soil samples, but still represents only about 25% of the total gold-anomalous area.

Among deposits of the Tintina Gold Belt, mineralization at the Livengood Gold Project is most similar to the dike and sill-hosted mineralization at the Donlin Creek deposit, where gold occurs in narrow quartz veins associated with dikes and sills of similar composition. The age of the intrusions and the genetic link between the mineralization and intrusive rocks are typical of those of other nearby gold deposits of the Tintina Gold Belt, which have been characterized as intrusion-related gold systems and for these reasons the Livengood Gold Project is best classified with them.

History and Exploration

Gold was first discovered in the gravels of Livengood Creek in 1914. Subsequently, over 500,000 ounces of placer gold were produced and the small town of Livengood was established. From 1914 through the 1970's, the primary focus of prospecting activity was placer deposits. Historically, prospectors considered Money Knob and the associated ridgeline the source of the placer gold. Prospecting, in the form of dozer trenches, was carried out for lode type mineralization in the vicinity of Money Knob primarily in the 1950's. However, to date no significant production has been derived from lode gold sources in the Livengood Gold Project area.

The geology and mineral potential of the Livengood District have been investigated by state and federal agencies and explored by several companies over the past 50-plus years. Modern mapping and sampling investigations were initially carried out by the U.S. Geological Survey in 1967 as part of a heavy metal assessment program. Mapping completed in the course of this program recognized the essential rock relations, thrust faulting, and mineralization associated with Devonian clastic rocks, the thrust system and intrusive rocks. Since then, the Livengood placer deposits and the surrounding geology have featured in numerous investigations and mapping programs at various scales by the U.S. Geological Survey and the Alaska State Division of Geological and Geophysical Surveys.

In addition to individuals prospecting the area, since the 1970's several mining companies, including Homestake, AMAX, Placer Dome, Cambior and AngloGold, have investigated the potential for lode gold mineralization beneath the Livengood placers and on the adjacent hillsides, including at Money Knob. Placer Dome's work appears to have been the most extensive, but it was focused largely on the northern flank of Money Knob and the valley of Livengood Creek.

The most recent round of exploration of the Money Knob area began when AngloGold acquired the property in 2003 and undertook an 8-hole RC program on the Hudson-Geraghty lease. The results from this program were encouraging and were followed up with an expanded soil geochemical survey which identified gold-anomalous zones over Money Knob and to the east. Based on the results of this and prior (Cambior) soil surveys, 4 diamond core holes were drilled in late 2004. Results from these two AngloGold drill programs were deemed favorable but no further work was executed due to financial constraints and a shift in corporate strategy.

The Company acquired the Livengood Gold Project in 2006 from AngloGold and has advanced the soil sampling coverage, drilled surface geochemical anomalies and conducted drilling campaigns on the Livengood Gold Project since that time.

In 2006, the Company conducted a 1,227 m, seven hole program and continued to demonstrate the presence of mineralization over a broader area. The 2007 campaign consisted of 15 diamond drill holes for a total of 4,411 m. These holes focused on extending and defining the volcanic-hosted mineralization first recognized by AngloGold in 2003. However, as drilling progressed, it became clear that although mineralization is strongest in the volcanic rocks, it occurs in all rock types at Money Knob.

Based on favorable results in 2007, the 2008 program consisted of 29,150 m of RC and 2,187 m core drilling in 109 and 9 holes, respectively. The drill program was designed to improve definition and expand the resource calculated early in 2008 based on 2007 drill data. The 2008 drill program did not identify limits to mineralization in any direction. Instead, a thicker mineralized zone (up to 200 m) was identified. In addition, this campaign highlighted the fact that mineralization occurs in all rock types, not just in Devonian volcanic rocks, indicating potential more widespread mineralization than envisioned prior to the 2008 drill program.

In 2009, the Company completed 12 diamond drill holes totaling 4,572 m and 195 RC holes totaling 59,757 m. Six of the diamond drill holes were drilled across the NNW-trending Core Zone in order to better understand the structural controls and to test the depth continuity of the mineralization. This drilling confirmed that the Core Zone is the locus of a swarm of 0.2 - 1.0 m thick southerly dipping dikes. In addition, a number of larger (+10 m thick) steeply dipping NNW-trending dikes were observed, suggesting that ENE extension may have occurred at about the time of dike magmatism. The RC holes were primarily targeted at grid infill drilling to improve resource estimation of the Core Zone and a step-out program that led to discovery and delineation of the Sunshine and Tower Zones.

In 2010, the Company completed 40 diamond drill holes totaling 13,631 m and 198 RC holes totaling 56,550 m. These holes, filled in between the Core and Sunshine Zones, expanded the SW Zone and infilled to 50 m spacing in the Core and Sunshine Zones.

Nearly all drill holes at Money Knob have been drilled in a northerly direction at an inclination of -50 degrees (RC) and -60 degrees (core) in order to best intercept the south dipping structures and mineralized zones as close to perpendicular as possible. A few holes have been drilled in other directions to test other features and aspects of mineralization. Most exploration holes have been spaced at 75 m apart along lines 75 m apart, subsequent infill drilling in the center of 75 m squares brings the nominal drill spacing to 50 m for a significant portion of the deposit. Core is recovered using triple tube techniques to ensure good recovery (>95%) and confidence in core orientation. RC holes are bored and cased for the upper 0-30 m to prevent down hole contamination and to help keep the hole open for ease of drilling at greater depths.

In 2011, the Company continued with resource definition drilling, completing 26,163 m of RC drilling and 11,468 m of diamond drilling. Two areas of the deposit, the Core and Sunshine crosses, were selected for 15 m-spaced RC in-fill drilling on crosses with north-south and east-west legs 150 m in length. A third area, Area 50 in the Sunshine Zone, measuring 195 m by 240 m, was drilled on a 37.5 m grid with alternating core and RC drilling. Two resources were generated for each volume using ordinary kriging on samples composited to 10 m lengths: the first including those portions of the 50 m grid drilling within the volume; and a second using both the grid and close-spaced drilling within the same volume. On average, the effect of the increased drilling density on tonnage, grade, and contained ounces of gold was less than 1% and confirmed the integrity of the previously reported resource estimate. In 2011, the Company broadened the scope of the field program to include 2,240 m of exploration drilling outside the resource area, as well as 8,932 m of geotechnical drilling and 1,192 m of large diameter groundwater test wells.

In May 2012, the Company commenced an 18-hole program of condemnation drilling to either sterilize or establish the presence of significant mineralization in the area surrounding the Money Knob deposit. The purpose of the condemnation drilling program was to determine appropriate areas for infrastructure development. Additionally, four of these holes are also being used for hydrological studies. The program was completed in July 2012 with 3,065 m in 19 holes.

Also in May 2012, the Company commenced multi-faceted drill programs consisting of hydraulic gradient, infrastructure, borrow source identification, and large-diameter wells for pump tests. The hydraulic gradient and infrastructure drilling consisted of 5,826 m in 49 holes utilizing core drilling. The geotechnical and borrow source information was obtained from 2,695 m drilled in 73 holes, utilizing core, sonic, and auger drilling methods. Seven large diameter wells have been drilled for a total of 1,031 m.

The drill program from February through October 2012 totaled 15,731 m in 199 holes.

The Company has not completed any material exploration at the Project since 2012, but has focused on engineering, metallurgical studies, and environmental baseline activities.

The Company relies upon consultants and contractors to carry on many of its activities and, in particular, to carry out drilling programs at the Livengood Gold Project and in connection with metallurgical test work, engineering and the preparation of technical reports on the Project (including the TRS). If ITH expands its activities in the future, it may choose to hire additional employees rather than relying on consultants.

Sample Preparation, Analyses and Security

The Company samples all holes from surface to total depth, using defined procedures. For RC samples, pulverized material is passed through a cyclone to separate solids from drilling fluids, then over a spinning conical splitter. The splitter is set to collect two identical splits of sample weighing 2-5 kg (4.4-11.0 pounds) each. Representative coarse material is collected and saved in chip trays for geological description. Samples are put in pre-numbered, bar-coded bags by the drill site crew. One sample is submitted for analysis, and one sample is kept for reference. Samples are secured on site and transported to a sample preparation facility operated by ALS Chemex in Fairbanks.

Core materials are collected at the drill site and placed in core boxes. Run blocks, orientation blocks and depths are placed in the boxes at site. The core is transported to a sample management facility at the Project, where it is described, then sawn in half. Half of the core is collected for assaying and half remains for reference. Core samples are weighed before shipping.

Internal Controls

The Company's geologic work program at Livengood was designed and was supervised by Chris Puchner, formerly Chief Geologist of the Company and a "qualified person" as defined in subpart 1300 of Regulation S-K. Mr. Puchner was responsible for all aspects of the work, including the quality control/quality assurance program. The quality assurance/quality control program implemented by the Company meets or exceeds industry standards. A quality assurance/quality control program includes insertion of blanks and standards (1/10 samples) and duplicates (1/20 samples). Blanks help assess the presence of any contamination introduced during sample preparation and help calibrate the low end of the assay detection limits. Commercial standards are used to assess the accuracy of the analyses. Duplicates help assess the homogeneity of the sample material and the overall sample variance. The Company has undertaken rigorous protocols to assure accurate and precise results. Among other methods, weights are tracked throughout the various steps performed in the laboratory to minimize and track errors. A group of 2,096 metallic screen fire assays performed in 2011 did not indicate any bias in the matching fire assays.

On-site Project personnel photograph the core from each individual borehole prior to preparing the split core. Duplicate RC drill samples are collected with one split sent for analysis. Representative chips are retained for geological logging. On-site personnel at the Project log and track all samples prior to sealing and shipping. All sample shipments are sealed and shipped to ALS Chemex in Fairbanks, Alaska, for preparation and then on to ALS Chemex in Reno, Nevada, or Vancouver, B.C., for assay. ALS Chemex's quality system complies with the requirements for the International Standards ISO 9001:2000 and ISO 17025:1999. Analytical accuracy and precision are monitored by the analysis of reagent blanks, reference material and replicate samples. Quality control is further assured by the use of international and in-house standards. Finally, representative blind duplicate samples are forwarded to ALS Chemex and an ISO compliant third-party laboratory for additional quality control.

Data entry and database validation procedures have been checked and found to conform to industry practices. Procedures are in place to minimize data entry errors. These include pre-numbered, pre-tagged, bar-coded bags, and bar-coded data entry methods which relate all information to sample and drill interval information. Likewise, data validation checks are run on all information used in the geologic modeling and resource estimation process. Database entries for a random sample (10%) of drill holes used for the resource estimate were checked against the original assay certificates by one of the independent authors of the April 2017 Report and the error rate was found to be within acceptable limits.

Analysis of assay data from core and RC sampling has been performed to check for down hole contamination of RC and to compare the data distributions produced by the two methods. Analysis of RC data has not indicated cyclic down hole contamination. Decay analysis conducted on both core drilling and RC drilling indicates similar patterns of monotonic grade increase or decrease. Comparison of the grade distributions between core and RC data were conducted using Quantile-Quantile plots, and simulation of population means for different numbers of samples. The comparison indicated that the mean of all core data was 4% lower than RC data. Comparison of core and RC data below the water table showed similar population means, suggesting that down hole contamination was not occurring.

Core and RC check samples have been collected during each drilling campaign by independent third parties. Results from these samples, as well as blanks and standards included, are consistent with the Company's initial results. This includes a similar increase in variance for samples at higher grades, a pattern consistent with nugget effect. No systematic high or low bias has been observed.

Environmental Studies, Permitting and Social and Community Impacts

The Livengood Gold Project is currently operating in compliance with all environmental regulations that apply during the development stage of major mineral projects. The Company has received all necessary exploration permits for activities such as trenching, drill road building and drilling. These permits are also reviewed by related state and federal agencies that can comment and require specific changes to the proposed work plans to minimize impacts on the environment. The permitting process for major exploration projects generally requires 30-60 days for processing. The Company currently has all necessary permits with respect to its exploration activities in Alaska. Although the Company has never had an issue with the timely processing of exploration permits there can be no assurances that delays in permit approval will not occur. Reclamation of surface disturbance associated with exploration activities is conducted concurrently where required.

The Company has been conducting extensive, multi-disciplinary environmental baseline studies in and around the Project area since 2008 in order to understand the current environmental conditions and to allow Project design to be optimized to minimize potential environmental effects. The environmental baseline programs conducted or currently underway at the Project include:

- surface water and hydrology;

- groundwater hydrogeology;
- geohydrology;
- wetlands and vegetation;
- meteorology and air quality;
- aquatic life and resources;
- wildlife and habitat;
- cultural resources;
- rock characterization; and
- geochemical characteristics.

Based on review of the studies completed to date, the Company believes that there are no known environmental issues that are anticipated to materially impact the Company's ability to conduct mining operations at the Project.

Looking forward to potential project development, a site-specific monitoring plan and water management plan for both operations and post mine closure will be developed in conjunction with detailed engineering and project permit planning. Development of the Livengood Gold Project will require a number of state and federal permits. Federal permits will be issued pursuant to the National Environmental Policy Act (NEPA) and Council of Environmental Quality (CEQ). In fulfillment of the NEPA requirements, the Livengood Gold Project will be required to prepare an Environmental Impact Statement. Although at this time it is unknown which department will become the lead federal agency, the State of Alaska is expected to take a cooperating role to coordinate the NEPA review with the State permit process. Actual permitting timelines are controlled by the NEPA review and U.S. Federal and State agency decisions. There are no municipal or community agreements required for the Livengood Gold Project.

2021 Pre-Feasibility Study

On January 12, 2021, the Company announced that the Board had approved a 2021 budget of $5.6 million, with the key element of the 2021 work program being the completion of an updated PFS on the Livengood Gold Project. The work program also advanced the baseline environmental data collection in critical areas of hydrology and waste rock geochemical characterization as needed to support future permitting, as well as advanced community engagement.

On November 4, 2021, the Company announced the results of the PFS for its Livengood Gold Project, which are summarized in the TRS. The TRS detailed a project that would process 65,000 tons per day and produce 6.4 million ounces of gold over 21 years from a gold resource estimated at 13.6 million ounces at 0.60 g/tonne. The PFS utilized a third-party review by Whittle Consulting and BBA Inc. to integrate new interpretations based on an expanded geological database, improved geological modelling, new resource estimation methodology, an optimized mine plan and production schedule, additional detailed metallurgical work at various gold grades and grind sizes, changes in the target grind for the mill, new engineering estimates, and updated cost inputs, all of which significantly de-risked the Project. The TRS estimated the capital costs of the Project at US$1.93 billion, the total cost per ton milled at US$13.12, the all-in sustaining costs at US$1,171 per ounce, and the net present value (5%) at US$1,800/oz of US$400 million.

The Project configuration evaluated in the TRS is a conventional, owner-operated surface mine that would utilize large-scale mining equipment in a blast/load/haul operation. Mill feed would be processed in a 65,000 tons per day comminution circuit consisting of primary and secondary crushing, wet grinding in a single semi-autogenous ("SAG") mill and single ball mill followed by a gravity gold circuit and a conventional carbon in leach ("CIL") circuit.

December 2021 Report

In December 2021, the Company filed the December 2021 Report with respect to the Livengood Gold Project. Readers are cautioned that the NI 43-101 reports filed on SEDAR by the Company in September of 2013, October of 2016, and April 2017 are no longer considered current and should therefore no longer be relied upon by investors.

Technical Report Summary

The TRS, current as of December 31, 2021, indicates that the Project generates a minimal positive return at a gold price of $1,680 per ounce. Readers are encouraged to review the entire TRS Report on EDGAR, with particular emphasis on the sensitivity analyses contained therein. The TRS for the Livengood Gold Project is filed as Exhibit 96.1 to this Annual Report on Form 10-K.

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Mineral Resource and Reserve Estimates

Table 1: Livengood Gold Project mineral resources estimate (exclusive of reserves)

Classification	Metric tons (Mmt)	Au (g/mt)	Contained Au (Koz)
Measured	234.50	0.53	3,990.49
Indicated	40.01	0.49	629.61
Total Measured and Indicated	274.51	0.52	4,620.10
Inferred	15.98	0.40	206.98

1. The Qualified Person for the mineral resource estimate is Resource Development Associates.
2. The effective date of the estimate is August 20, 2021 and the estimate is current as of December 31, 2021.
3. Mineral resources for the Project are enumerated as per §229.1302(d)(1)(iii)(A) (Item 1302(d)(1)(iii)(A) of Regulation S-K).
4. Mineral resources are not mineral reserves and do not meet the threshold for reserve modifying factors, such as estimated economic viability, that would allow for conversion to mineral reserves. There is no certainty that any part of the mineral resources estimated will be converted into mineral reserves.
5. Open pit resources stated as contained within a potentially economically minable open pit; pit optimization was based on gold price of US$1,650 per ounce, which was 5% over the three year rolling average as of August, 2021, variable mining and recoveries as described in Table 1C, and general and administrative cost of US$1.55 per tonne, and a pit slope of 45 degrees.
6. Numbers in the table have been rounded to reflect the accuracy of the estimate and may not sum due to rounding.
7. Mineral resources are reported exclusive of mineral reserves (for a presentation of resource inclusive of mineral resources, please refer to [Section 10] of the TRS). The reserves reported in Table 2 represent measured mineral resources and indicated mineral resources that were evaluated with modifying factors related to open pit mining.

Table 1C: Pit constraining parameters used for resource estimates

Parameter	Unit	Rock Type 4	Rock Type 5	Rock Type 6	Rock Type 7	Rock Type 8	Rock Type 9
Mining Cost	$/total mt	1.76	1.74	1.74	1.68	1.76	1.76
Au Cut-off	g/mt	0.21	0.20	0.25	0.25	0.33	0.33
Processing Cost	$/process mt	9.27	9.15	9.17	9.50	9.71	9.71
Au Recovery	%	84	80	71	67	55	56
Administrative Cost	$/process mt	1.55	1.55	1.55	1.55	1.55	1.55
Royalty	%	3	3	3	3	3	3
Au Selling Price	$/oz	1,650	1,650	1,650	1,650	1,650	1,650
Overall Slope Angle	Degrees	45	45	45	45	45	45

Table 2: Livengood Project mineral reserves

Classification	Ore Metric tons (Mmt)	Au Grade (g/mt)	Contained Au Koz
Proven Reserves			
Rock Type 4	75.4	0.54	1,314
Rock Type 5	110.5	0.55	1,972
Rock Type 6	91.7	0.65	1,922
Rock Type 7	61.0	0.70	1,367
Rock Type 8	2.4	0.73	56
Rock Type 9	70.5	0.82	1,861
Total Proven Reserves	**411.5**	**0.64**	**8,492**
Probable Reserves			
Rock Type 4	2.5	0.48	39
Rock Type 5	4.0	0.47	62
Rock Type 6	3.0	0.99	94
Rock Type 7	4.8	0.98	152
Rock Type 8	0.3	0.76	6
Rock Type 9	3.9	1.26	159
Total Probable Reserves	**18.5**	**0.86**	**512**
Total Proven and Probable Reserves	**430.1**	**0.65**	**9,004**

1. The Qualified Person for the Mineral Reserve Estimate is Jeffrey Cassoff, P. Eng., of BBA USA Inc.
2. The effective date of the estimate is October 22, 2021 and the estimate is current as of December 31, 2021.
3. Mineral reserves for the Project are enumerated as per added §229.1302(e)(2) (Item 1302(e)(2) of Regulation S-K).
4. Mineral reserves are estimated using a gold price of US$1,680 per ounce, which approximated the 2 year rolling average gold price during October 2021, and consider a 3% royalty, US$1.80 per ounce for smelting, refining, and transportation costs, and a gold payable of 99.9%.
5. Metallurgical recovery curves were developed for each rock type (“RT”), with the Mineral Reserves having the following tonnage weighted averages: 83.3% for RT4, 79.8% for RT5, 73.5% for RT6, 66.4% for RT7, 58.7% for RT8 and 57.1% for RT9, including 22% for massive stibnite mineralization.
6. As a result of the complex metallurgical recovery equations, it is difficult to determine specific cut-off grades. The following presents the lowest gold grades for each rock type that are processed in the life of mine plan: 0.26 g/t for RT4, 0.28 g/t for RT5, 0.31 g/t for RT6, 0.31 g/t for RT7, 0.42 g/t for RT8 and 0.42 g/t for RT9.
7. The strip ratio for the open pit is 1.15 to 1.
8. The mineral reserves are inclusive of mining dilution and ore loss.
9. The reference point for the mineral reserves is the primary crusher.
10. Totals may not add due to rounding.

Changes in Mineral Resource and Reserve Estimates from 2020 to 2021

This is the first reporting of resources and reserves under subpart 1300 of Regulation S-K. The changes to the resource and reserve estimates shown below were the result of complete integration of all material technical information generated by the Company since the April 2017 Report, including new geologic interpretations based on an expanded geological database, improved geological modelling, new resource estimation methodology, new optimized mine plan and production schedule, additional detailed metallurgical work at various gold grades and grind sizes, changes in the target grind for the mill, new engineering estimates, and updated cost and revenue inputs. Details are provided in the TRS.

Classification	Contained Au (Koz) 2020	Contained Au (Koz) 2021	% Change
Resources (exclusive of reserves)			
Measured	Not reported	3,990	N/A
Indicated	Not reported	630	N/A
Total Measured and Indicated Resources	Not reported	4,620	N/A
Inferred	Not reported	207	N/A
Resources (inclusive of reserves)			
Measured	10,841	12,842	+18 %
Indicated	620	1,142	+84 %
Total Measured and Indicated Resources	11,461	13,984	+22 %
Inferred	1,127	207	-82%
Reserves			
Proven	8,620	8,492	-1%
Probable	353	512	+45 %
Total Proven and Probable Reserves	8,973	9,004	+0 %

ITEM 3. LEGAL PROCEEDINGS

We are periodically a party to or otherwise involved in legal proceedings arising in the normal course of business. Management does not believe that there is any pending or threatened proceeding against us which, if determined adversely, would have a material adverse effect on our financial position, liquidity or results of operations.

ITEM 4. MINE SAFETY DISCLOSURES

Pursuant to Section 1503(a) of the Dodd-Frank Act, issuers that are operators, or that have a subsidiary that is an operator, of a coal or other mine in the United States are required to disclose specified information about mine health and safety in their periodic reports. These reporting requirements are based on the safety and health requirements applicable to mines under the Federal Mine Safety and Health Act of 1977 (the “Mine Act”) which is administered by the U.S. Department of Labor’s Mine Safety and Health Administration

(“MSHA”). During the fiscal year ended December 31, 2021, the Company and its subsidiaries were not subject to regulation by MSHA under the Mine Act and thus no disclosure is required under Section 1503(a) of the Dodd-Frank Act.

PART II

ITEM 5. MARKET FOR REGISTRANT’S COMMON EQUITY, RELATED STOCKHOLDER MATTERS AND ISSUER PURCHASES OF EQUITY SECURITIES

Market Information

The common shares of the Company are listed and posted for trading on the TSX under the symbol “ITH”, on the NYSE American under the symbol “THM”, and on the Frankfurt Stock Exchange under the symbol “-1I1-”. As at March 1, 2022, there were 194,908,184 common shares issued and outstanding, and the Company had approximately 100 shareholders of record.

Dividends

Since its inception, ITH has not paid any dividends. ITH has no present intention of paying any dividends, as it anticipates that all available funds will be invested to finance the growth of its business. The Board will determine if and when dividends should be declared and paid in the future after taking into account many factors, including ITH’s financial condition, operating results and anticipated cash needs at the relevant time. There are no restrictions which prevent ITH from paying dividends.

Recent Sales of Unregistered Equity Securities

None.

Purchases of Equity Securities by the Issuer and Affiliated Purchasers

None.

Exchange Controls

Canada has no system of exchange controls. There are no Canadian restrictions on the repatriation of capital or earnings of a Canadian public company to non-resident investors. There are no laws in Canada or exchange restrictions affecting the remittance of dividends, profits, interest, royalties and other payments to non-resident holders of the Company’s securities, except as discussed in “Certain Canadian Federal Income Tax Considerations for U.S. Resident Holders” below.

There are no limitations under the laws of Canada or in the organizing documents of the Company on the right of foreigners to hold or vote securities of the Company, except that the *Investment Canada Act* (Canada) may require review and approval by the Minister of Industry (Canada) of certain acquisitions of “control” of the Company by a “non-Canadian.” The threshold for acquisitions of control is generally defined as being one-third or more of the voting shares of the Company. “Non-Canadian” generally means an individual who is not a Canadian citizen, or a corporation, partnership, trust or joint venture that is ultimately controlled by non-Canadians.

Certain Canadian Federal Income Tax Considerations for U.S. Resident Holders

This summary is applicable to a holder of common shares of the Company who, for the purposes of the Canadian Tax Act and any applicable treaty and at all relevant times, is not (and is not deemed to be) resident in Canada, deals at arm’s length and is not affiliated with the Company, does not (and is not deemed to) use or hold the common shares in, or in the course of, carrying on a business in Canada, is not a “specified shareholder” (as defined in subsection 18(5) of the Canadian Tax Act) of the Company, is not an insurer that carries on an insurance business in Canada and elsewhere, and holds the common shares as capital property (a “Non-Resident Holder”).

This summary is based on the current provisions of the *Canada-U.S. Income Tax Convention (1980)*, as amended (the “Canada-U.S. Treaty”), the Canadian Tax Act, the regulations thereunder, all specific proposals to amend the Canadian Tax Act and regulations publicly announced by or on behalf of the Minister of Finance (Canada) prior to the date hereof and the Company’s understanding of the administrative policies and assessing practices published in writing by the Canada Revenue Agency prior to the date hereof. This summary assumes that all specific proposals to amend the Canadian Tax Act and regulations will be enacted as currently proposed, does not otherwise take into account any change in law or administrative policy or assessing practice, whether by judicial, governmental, legislative or administrative decision or action, and does not take into account other federal or provincial, territorial or foreign tax consequences, which may vary from the Canadian federal income tax considerations described herein.

This summary is of a general nature only, is not exhaustive of all Canadian federal income tax considerations, and it is not intended to be, nor should it be construed to be, legal or tax advice to any Non-Resident Holder of common shares and no representation with respect to Canadian federal income tax consequences to any Non-Resident Holder of common shares is made herein. Accordingly, Non-Resident Holders of common shares should consult their own tax advisers with respect to their individual circumstances.

Dividends on Common Shares

Canadian withholding tax at a rate of 25% (subject to reduction under the provisions of any applicable tax treaty) will be payable on dividends (or amounts paid or credited on account or in lieu of payment of, or in satisfaction of, dividends) paid or credited or deemed to have been paid or credited to a Non-Resident Holder of common shares. Under the Canada–U.S. Treaty, the withholding tax rate is generally reduced to 15% for a Non-Resident Holder entitled to the benefits of the Canada–U.S. Treaty who is the beneficial owner of the dividends (or 5% if the holder is a company that owns at least 10% of the common shares of the Company at such time).

Certain U.S.-resident entities that are fiscally transparent for United States federal income tax purposes (including limited liability companies) may not in all circumstances be entitled to the benefits of the Canada–U.S. Treaty. Non-Resident Holders are urged to consult with their own tax advisors to determine their entitlement to benefits under the Canada-U.S. Treaty based on their particular circumstances.

This summary does not deal with special situations such as the particular circumstances of traders or dealers or Non-Resident Holders who have entered into a “derivative forward agreement” (as defined in the Canadian Tax Act) in respect of the common shares. Such Non-Resident Holder should consult their own tax advisors.

Capital Gains and Losses

Subject to the provisions of any relevant tax treaty, capital gains realized by a Non-Resident Holder on the disposition or deemed disposition of common shares held as capital property will not be subject to Canadian tax unless the common shares are “taxable Canadian property” (as defined in the Canadian Tax Act), in which case the capital gains will be subject to Canadian tax at rates which will approximate those payable by a Canadian resident.

Common shares of the Company generally will not be “taxable Canadian property” to a Non-Resident Holder provided that, at the time of the disposition or deemed disposition, the common shares are listed on a designated stock exchange (which currently includes the TSX and NYSE American), unless at any time during the 60-month period that ends at that time: (a) one or any combination of (i) such Non-Resident Holder, (ii) persons not dealing at arm’s length with such Non-Resident Holder and (iii) partnerships in which such Non-Resident Holder or a person described in (ii) holds a membership interest directly or indirectly through one or more partnerships, owned 25% or more of the issued shares of any class or series of the capital stock of the Company; and (b) more than 50% of the fair market value of the common shares disposed of was derived directly or indirectly from one or any combination of real or immovable property situated in Canada, “Canadian resource properties” (as defined in the Canadian Tax Act), “timber resource properties” (as defined in the Canadian Tax Act), and options in respect of, or interests in, or civil law rights in, any such properties (whether or not such property exists). In certain circumstances set out in the Canadian Tax Act, the common shares may be deemed to be “taxable Canadian property”.

Under the Canada–U.S. Treaty, a Non-Resident Holder entitled to the benefits of the Canada–U.S. Treaty and to whom the common shares are “taxable Canadian property” will not be subject to Canadian tax on the disposition or deemed disposition of the common shares unless at the time of disposition or deemed disposition, the value of the common shares is derived principally from real property situated in Canada. Non-Resident Holders are urged to consult with their own tax advisors to determine their entitlement to benefits under the Canada-U.S. Treaty based on their particular circumstances.

Currency Conversion

Generally, for purposes of the Canadian Tax Act, all amounts relating to the acquisition, holding or disposition of common shares, including dividends, adjusted cost base and proceeds of dispositions must be determined in Canadian dollars using the daily exchange rate of the Bank of Canada on the particular date the particular amount arose or in certain situations, such other rate of exchange as acceptable to the Canada Revenue Agency.

Certain U.S. Federal Income Tax Considerations for U.S. Holders

The following is a discussion of certain material U.S. federal income tax consequences to U.S. Holders (as defined below) of acquiring, owning, and disposing of our common shares. This discussion does not purport to be a comprehensive description of all of the U.S. tax considerations that may be relevant to a particular investor's decision to acquire the common shares, including any state, local or non-U.S. tax consequences of acquiring, owning, and disposing of common shares. This discussion applies only to those U.S. Holders that hold common shares as capital assets for U.S. tax purposes (generally, for investment and not in connection with the carrying on of a trade or business) and does not address all aspects of U.S. federal income tax law that may be relevant to investors that are subject to special or different treatment under U.S. federal income tax law (including, for example, a holder liable for the alternative minimum tax or a holder that actually or constructively owns 10% or more by voting power or value of our common shares). This discussion is based on the U.S. Internal Revenue Code of 1986, as amended (the "Code"), its legislative history, existing and proposed U.S. Treasury regulations, published rulings and other administrative guidance of the U.S. Internal Revenue Service (the "IRS") and court decisions, all as in effect on the date hereof. These laws are subject to change or differing interpretation by the IRS or a court, possibly on a retroactive basis. This discussion also assumes that the Company is not, and will not become, a controlled foreign corporation ("CFC") as defined for U.S. federal income tax purposes.

As used herein, the term "U.S. Holder" means a beneficial owner of our common shares that is:

- an individual citizen or resident of the United States;
- a corporation (or other entity treated as a corporation for U.S. federal income tax purposes) created or organized in the United States or under the laws of the United States, any state or political subdivision thereof, or the District of Columbia;
- an estate, the income of which is subject to U.S. federal income tax regardless of its source; or
- a trust (i) if a U.S. court is able to exercise primary supervision over the trust's administration and one or more U.S. persons are authorized to control all substantial decisions of the trust or (ii) that has a valid election in effect to be treated as a U.S. person under applicable U.S. Treasury regulations.

If a partnership (including any entity treated as a partnership for U.S. federal income tax purposes) is a beneficial owner of the common shares, the U.S. tax treatment of a partner in the partnership generally will depend on the status of the partner and the activities of the partnership. A holder of the common shares that is a partnership and partners in such a partnership should consult their own tax advisors about the U.S. federal income tax consequences of acquiring, owning, or disposing of common shares, particularly in light of recent U.S. tax reform.

Distributions

Subject to the passive foreign investment company rules discussed below, should a distribution be made, a U.S. Holder must include in gross income as dividend income the gross amount of any distribution paid on the common shares (including the amount of any non-U.S. taxes withheld from such amount), to the extent such distribution is paid out of current or accumulated earnings and profits (as determined for U.S. federal income tax purposes). Distributions in excess of our current and accumulated earnings and profits (as determined for U.S. federal income tax purposes) will first be treated as a non-taxable return of capital to the extent of the U.S. Holder's basis in the common shares and thereafter as gain from the sale or exchange of common shares. See "Sale, Exchange, or Other Disposition of Common Shares" below.

Dividends received by U.S. Holders that are individuals, estates, or trusts will be taxed at preferential rates if such dividends meet the requirements of "qualified dividend income." Dividends that fail to meet such requirements, and dividends received by corporate U.S. Holders, are taxed at ordinary income rates. In order for dividends to qualify as "qualified dividend income," an entity must be considered a "qualified foreign corporation" and certain other requirements must be met. While we believe the Company is a qualified foreign corporation, a dividend received by a U.S. Holder will not be qualified dividend income if the Company is a passive foreign investment company for the taxable year during which the dividend is paid or the immediately preceding taxable year. See the discussion below regarding our passive foreign investment company status under "Passive Foreign Investment Company Rules." In the case of a corporate U.S. Holder, dividends received generally will not be eligible for the dividends-received deduction.

Dividends paid on the common shares will generally be treated as foreign source income for U.S. foreign tax credit purposes. Foreign tax credits are generally subject to various classifications and other limitations. The rules relating to computing foreign tax credits are complex. U.S. Holders should consult their own tax advisors to determine the foreign tax credit implications of owning common shares.

Sale, Exchange, or Other Disposition of Common Shares

Subject to the passive foreign investment company rules discussed below, a U.S. Holder that sells or otherwise disposes of the common shares will recognize capital gain or loss for U.S. federal income tax purposes equal to the difference between (i) the U.S. dollar value of the amount realized on the sale or disposition and (ii) the tax basis, determined in U.S. dollars, of such common shares. Such gain or loss will be treated as long-term capital gain or loss if the U.S. Holder's holding period is greater than one year at the time of sale, exchange, or other disposition. Long-term capital gains of individuals are generally subject to preferential maximum U.S. federal income tax rates. A U.S. Holder's ability to deduct capital losses is subject to certain limitations.

Passive Foreign Investment Company Rules

If the Company is considered a "passive foreign investment company" (a "PFIC") for U.S. federal income tax purposes at any time during a U.S. Holder's holding period, then certain potentially adverse tax consequences apply to such U.S. Holder's acquisition, ownership, and disposition of common shares. In general, a non-U.S. corporation will be a PFIC in any taxable year in which, after applying certain look-through rules, either (1) at least 75% of its gross income for the taxable year is passive income; or (2) at least 50% of the average value (determined on a quarterly basis) of its assets is attributable to assets that produce or are held for the production of passive income. Passive income generally includes dividends, interest, royalties, rents (other than certain rents and royalties derived in the active conduct of a trade or business), and the excess of gains over losses from the disposition of certain assets that produce passive income. If a foreign corporation owns at least 25% by value of the stock of another corporation, the foreign corporation is treated for purposes of the PFIC tests as owning its proportionate share of the assets of the other corporation, and receiving directly its proportionate share of the other corporation's income.

We believe that we likely were a PFIC for U.S. federal income tax purposes during the fiscal year ended December 31, 2021, and we expect that we will be a PFIC in the current year and that we may be a PFIC in future years. The determination of whether or not the Company is a PFIC is a factual determination dependent on a number of factors that cannot be made until the close of the applicable tax year. Accordingly, no assurances can be given regarding the Company's PFIC status for the current year or any future year. The Company's status as a PFIC can have significant adverse tax consequences for a U.S. Holder if we are a PFIC for any year during such U.S. Holder's holding period.

A U.S. Holder that holds common shares while the Company is a PFIC may be subject to increased tax liability upon the sale, exchange, or other disposition of the common shares or upon the receipt of certain distributions, regardless of whether the Company is a PFIC in the year in which such disposition or distribution occurs. These adverse tax consequences include:

(a) "Excess distributions" by the Company are subject to the following special rules. An excess distribution generally is the excess of the amount a PFIC distributes to a shareholder during a taxable year over 125% of the average amount it distributed to the shareholder during the three preceding taxable years or, if shorter, the part of the shareholder's holding period before the taxable year. Distributions with respect to the common shares during the taxable year to a U.S. Holder that are excess distributions must be allocated rateably to each day of the U.S. Holder's holding period. The amounts allocated to the current taxable year and to taxable years prior to the first year in which the Company was classified as a PFIC are included as ordinary income in a U.S. Holder's gross income for that year. The amount allocated to each other prior taxable year is taxed as ordinary income at the highest tax rate in effect for the U.S. Holder in that prior year (without offset by any net operating loss for such year) and the tax is subject to an interest charge at the rate applicable to deficiencies in income taxes (the "special interest charge").

(b) The entire amount of any gain realized upon the sale or other disposition of the common shares will be treated as an excess distribution made in the year of sale or other disposition and as a consequence will be treated as ordinary income and, to the extent allocated to years prior to the year of sale or disposition, will be subject to the special interest charge described above.

Special rules apply for calculating the amount of the foreign tax credit with respect to excess distributions by a PFIC.

While there are certain U.S. federal income tax elections (described below) that can be made to mitigate the adverse tax consequences described above such elections are only available in limited circumstances and must be made in a timely manner. These rules are very complex and U.S. Holders are urged to consult their own tax advisers regarding the potential of making an election to mitigate the adverse consequences described above of the Company being classified as a PFIC.

Qualifying Electing Fund (“QEF”) Election. A U.S. Holder of stock in a PFIC, including the Company, may make a QEF election with respect to such PFIC to elect out of the tax treatment discussed above. Generally, a QEF election should be made with the filing of a U.S. Holder’s U.S. federal income tax return for the first taxable year for which both (i) the U.S. Holder holds common shares, and (ii) the Company was a PFIC. A U.S. Holder that timely makes a valid QEF election with respect to a PFIC will generally include in gross income for a taxable year (i) as ordinary income, such holder’s pro rata share of the Company’s ordinary earnings for the taxable year, and (ii) as long-term capital gain, such holder’s pro rata share of the Company’s net capital gain for the taxable year. However, the QEF election is available only if such PFIC provides such U.S. Holder with certain information regarding its earnings and profits as required under applicable U.S. Treasury regulations. **There can be no assurance that the Company will provide U.S. Holders with the information required for them to make a QEF election.**

Deemed Sale Election. If the Company is a PFIC for any year during which a U.S. Holder holds common shares, but the Company ceases in a subsequent year to be a PFIC, then a U.S. Holder may make a deemed sale election for such subsequent year in order to avoid the adverse PFIC tax treatment described above that would otherwise continue to apply because of the Company’s having previously been a PFIC. If such election is timely made, the U.S. Holder would be deemed to have sold the common shares held by the holder at their fair market value, and any gain from such deemed sale would be taxed as an excess distribution (as described above). The basis of the common shares would be increased by the gain recognized, and a new holding period would begin for the common shares for purposes of the PFIC rules. The U.S. Holder would not recognize any loss incurred on the deemed sale, and such a loss would not result in a reduction in basis of the common shares. After the deemed sale election, the U.S. Holder’s common shares with respect to which the deemed sale election was made would not be treated as shares in a PFIC, unless the Company subsequently becomes a PFIC.

Mark-to-Market Election. Alternatively, a U.S. Holder of “marketable stock” (as defined in the applicable Treasury regulations) in a PFIC may make a mark-to-market election for such stock to elect out of the adverse PFIC tax treatment discussed above. If a U.S. Holder makes a mark-to-market election for shares of marketable stock, the U.S. Holder will include in income each year an amount equal to the excess, if any, of the fair market value of the shares as of the close of the holder’s taxable year over the holder’s adjusted basis in such shares. A U.S. Holder is allowed a deduction for the excess, if any, of the adjusted basis of the shares over their fair market value as of the close of the taxable year. However, deductions are allowable only to the extent of any net mark-to-market gains on the shares included in the holder’s income for prior taxable years. Amounts included in a U.S. Holder’s income under a mark-to-market election, as well as gain on the actual sale or other disposition of the shares, are treated as ordinary income. Ordinary loss treatment also applies to the deductible portion of any mark-to-market loss on the shares, as well as to any loss realized on the actual sale or disposition of the shares, to the extent that the amount of such loss does not exceed the net mark-to-market gains previously included for such shares. A U.S. Holder’s basis in the shares will be adjusted to reflect any such income or loss amounts. However, the special interest charge and related adverse tax consequences described above for non-electing holders may continue to apply on a limited basis if the U.S. Holder makes the mark-to-market election after such holder’s holding period for the shares has begun.

Because our common shares are regularly traded on TSX, the NYSE American, and the Frankfurt Stock Exchange, we anticipate that our common shares will be classified as “marketable stock.” No assurances can be given, however, that our common shares are or will be marketable stock.

Form 8621 (Information Return by a Shareholder of a Passive Foreign Investment Company or Qualified Electing Fund). If we are a PFIC for any taxable year during which a U.S. Holder holds common shares, such U.S. Holder will be required to file an annual information report with such U.S. Holder’s U.S. Federal income tax return on IRS Form 8621.

The PFIC rules are complex, and U.S. Holders should consult their own tax advisors regarding the PFIC rules and how they may affect the U.S. federal income tax consequences of the acquisition, ownership, and disposition of common shares in the event the Company is a PFIC at any time during the holding period for such common shares.

Medicare Tax

A U.S. Holder that is an individual or estate, or a trust that does not fall into a special class of trusts that is exempt from such tax, will be subject to a 3.8% tax on the lesser of (1) the U.S. Holder’s “net investment income” for the relevant taxable year and (2) the excess of the U.S. Holder’s modified gross income for the taxable year over a certain threshold (which in the case of an individual will be $200,000 or $250,000, depending on the individual’s circumstances). A holder’s net investment income will generally include dividend income and net gains from the disposition of common shares, unless such dividends or net gains are derived in the ordinary course of the conduct of a trade or business (other than a trade or business that consists of certain passive or trading activities). U.S. Holders are urged to consult their own tax advisors regarding the applicability of the Medicare tax in respect of their investment in the common shares.

Disclosure Requirements for Specified Foreign Financial Assets

U.S. Holders (including certain domestic corporations, partnerships, and trusts that are considered formed or availed of for the purpose of holding, directly or indirectly, "specified foreign financial assets," referred to as "specified domestic entities" in applicable United States Treasury regulations) that, during any taxable year, hold any interest in any "specified foreign financial asset" generally will be required to file with their U.S. federal income tax returns certain information on IRS Form 8938 if the aggregate value of all such assets exceeds certain specified amounts. The term "specified foreign financial asset" generally includes any financial account maintained with a non-U.S. financial institution, which may include common shares if they are not held in an account maintained with a financial institution. Substantial penalties may be imposed, and the period of limitations on assessment and collection of U.S. federal income taxes may be extended, in the event of a failure to comply with this reporting and filing requirement. U.S. Holders should consult their own tax advisors as to the possible application to them of these requirements.

Foreign Currency Transactions

Generally, amounts received by a U.S. Holder in foreign currency (including distributions paid in foreign currency to a U.S. Holder in connection with the ownership of common shares or on the sale, exchange, or other disposition of common shares) will be equal to the U.S. dollar value of such foreign currency based on the applicable exchange rate on the date of receipt (regardless of whether such foreign currency is converted into U.S. dollars at that time). The subsequent disposition of any foreign currency received (including an exchange for U.S. currency) will generally give rise to ordinary gain or loss in an amount equal to the difference between the U.S. dollar value of the foreign currency on the date it was received and the date of the subsequent disposition. Each U.S. Holder should consult its own tax adviser regarding the U.S. federal income tax consequences of receiving, owning, and disposing of foreign currency.

Information Reporting and Backup Withholding

Payments made within the United States or by a U.S. payor or U.S. middleman, of dividends on, and/or proceeds arising from the sale or other taxable disposition of, common shares will generally be subject to information reporting and backup withholding tax (currently at a 24% rate) if a U.S. Holder (a) fails to furnish such U.S. Holder's correct U.S. taxpayer identification number (generally on Form W-9), (b) furnishes an incorrect U.S. taxpayer identification number, (c) is notified by the IRS that such U.S. Holder has previously failed to properly report items subject to backup withholding tax, or (d) fails to certify, under penalty of perjury, that such U.S. Holder has furnished its correct U.S. taxpayer identification number and that the IRS has not notified such U.S. Holder that it is subject to backup withholding tax.

Backup withholding is not an additional tax. Any amounts withheld under the U.S. backup withholding tax rules will be allowed as a credit against a U.S. Holder's U.S. federal income tax liability, if any, or will be refunded, if such U.S. Holder furnishes required information to the IRS in a timely manner. Each U.S. Holder should consult its own tax advisor regarding the information reporting and backup withholding rules.

Acquiring, owning, or disposing of our common shares may have tax consequences under the laws of the United States and Canada that are not described in this Annual Report on Form 10-K. Shareholders are solely responsible for determining the tax consequences applicable to their particular circumstances and should consult their own tax advisors concerning an investment in the Company's common shares.

ITEM 6. [RESERVED]

ITEM 7. MANAGEMENT'S DISCUSSION AND ANALYSIS OF FINANCIAL CONDITION AND RESULTS OF OPERATIONS

Current Business Activities

General

2021

Livengood Gold Project Developments

During the year ended December 31, 2021, the Company progressed on a decision to embark on a new phase for the Livengood Gold Project as a result of the strengthening macro-economic backdrop for gold.

On January 12, 2021, the Company announced that the Board had approved a 2021 budget of $5.6 million and endorsed the associated 2021 work program to advance the Livengood Gold Project (the "Project"). The key element of the 2021 work program was the completion of the Pre-Feasibility Study (the "PFS") for the Livengood Gold Project. The work program also advanced the baseline environmental data collection in critical areas of hydrology and waste rock geochemical characterization needed to support future permitting, as well as advance community engagement.

Livengood Gold Project Pre-Feasibility Study

On November 4, 2021, the Company announced the results of the PFS for the Project. The PFS detailed a project that would process 65,000 tons per day and produce 6.4 million ounces of gold over 21 years from a gold resource estimated at 13.6 million ounces at 0.60 g/tonne. The PFS utilized a third-party review by Whittle Consulting and BBA Inc. to integrate new interpretations based on an expanded geological database, improved geological modelling, new resource estimation methodology, an optimized mine plan and production schedule, additional detailed metallurgical work at various gold grades and grind sizes, changes in the target grind for the mill, new engineering estimates, and updated cost inputs, all of which significantly de-risk the Project. The PFS has estimated the capital costs of the Project at US$1.93 billion, the total cost per ton milled at US$13.12, the all-in sustaining costs at US$1,171 per ounce, and the net present value (5%) at US$1,800/oz of US$400 million.

The Project configuration evaluated in the PFS is a conventional, owner-operated surface mine that will utilize large-scale mining equipment in a blast/load/haul operation. Mill feed would be processed in a 65,000 tons per day comminution circuit consisting of primary and secondary crushing, wet grinding in a single semi-autogenous ("SAG") mill and single ball mill followed by a gravity gold circuit and a conventional carbon in leach ("CIL") circuit.

Whittle Enterprise Optimization

Prior to beginning the PFS, the Company retained Whittle Engineering and BBA Inc. to collaborate on an enterprise optimization study (the "Whittle and BBA Study") to review various technologies and project configurations and to recommend the optimum configuration for the PFS. The Whittle and BBA Study reviewed secondary crushing with SAG and ball mill, tertiary crushing with ball mill, gravity/CIL at p80 of 90 micron to 250 micron, stand-alone and auxiliary heap leach configurations, gravity only gold recovery, gravity/flotation with pressure oxidation and CIL of flotation concentrate. These configurations were evaluated at various combinations of project ramp up strategy, annual throughput, primary, secondary, and tertiary grind size, as well as mining fleet size and stockpile management strategies. Tailings technologies reviewed included conventional tailings and pressure filtered tailings.

The Whittle and BBA Study determined that the gravity/CIL plant at p80 250 micron with conventional tailings provided the highest net present value, which is the configuration detailed in the PFS.

The PFS was prepared by independent third-party consultants.

The Company cautions that the PFS is preliminary in nature, and is based on technical and economic assumptions which will be further refined and evaluated in a full feasibility study. The PFS is based on an updated Project mineral resource estimate effective as of August 20, 2021 using a different mineral resource model than used in the April 2017 Report.

COVID-19 Pandemic

In March 2020, the World Health Organization declared the novel coronavirus 2019 ("COVID-19") a global pandemic. This contagious disease outbreak, which has continued to spread, and any related adverse public health developments, has adversely affected workforces, economies, and financial markets globally, potentially leading to an economic downturn. While it is not possible for the Company to predict the duration or magnitude of the adverse results of the outbreak, including as a result of the emergence of variant strains of the virus and ongoing vaccination efforts, and its ultimate effects on the Company's business, results of operations or ability to raise funds at this time, as of the date of this Annual Report on Form 10-K, the COVID-19 pandemic has not had any material adverse effects on the Company.

2022

Outlook

On March 9, 2022, the Company announced that the Board had approved a 2022 budget of $3.2 million and endorsed the associated 2022 work program to advance the Livengood Gold Project. The 2022 work will advance the baseline environmental data collection in critical areas of hydrology and waste rock geochemical characterization needed to support future permitting, as well as advance community engagement.

The Company remains open to a strategic alliance to help support the future development of the Project while considering all other appropriate financing options. The size of the gold resource, the Project's favorable location, and the Company's proven team are some of the reasons the Company would potentially attract a strategic partner with a long-term development horizon who understands the Project is highly leveraged to gold prices.

Results of Operations

Summary of Quarterly Results

Description	December 31, 2021	September 30, 2021	June 30, 2021	March 31, 2021
Net loss	$ (1,015,489)	$ (1,648,913)	$ (2,178,014)	$ (1,137,872)
Basic and diluted net loss per common share	$ (0.01)	$ (0.01)	$ (0.01)	$ (0.01)

Description	December 31, 2020	September 30, 2020	June 30, 2020	March 31, 2020
Net income (loss)	$ (1,995,576)	$ (1,101,763)	$ (1,486,464)	$ 65,085
Basic and diluted net income (loss) per common share	$ (0.01)	$ (0.01)	$ (0.01)	$ 0.00

Significant fluctuations in the Company's quarterly net income (loss) have mainly been the result of operating cost changes.

Year ended December 31, 2021 compared to Year ended December 31, 2020

The Company had cash and cash equivalents of $7,780,671 at December 31, 2021 compared to $13,049,293 at December 31, 2020. The Company incurred a net loss of $5,980,288 for the year ended December 31, 2021, compared to a net loss of $4,518,718 for the year ended December 31, 2020. The following discussion highlights certain selected financial information and changes in operations between the year ended December 31, 2021 and the year ended December 31, 2020.

Mineral property exploration expenditures were $3,517,540 for the year ended December 31, 2021 compared to $2,364,899 for the year ended December 31, 2020. The increase of $1,152,641 is due to expenditures for metallurgical studies and engineering to complete the PFS on the Livengood Gold Project, partially offset by the Company limiting field activities to the continuation of critical environmental baseline work while moving forward with a multi-phase metallurgical test work program.

Share-based payment charges were $535,117 during the year ended December 31, 2021 compared to $385,531 during the year ended December 31, 2020. The $149,586 increase in share-based payment charges during the period was mainly the result of equity compensation issued or granted to certain officers and employees of the Company at a higher issue price during the year ended December 31, 2021 as compared to the year ended December 31, 2020. The Company granted 316,795 deferred share units ("DSUs") of C$1.31 per DSU and 240,000 incentive stock options at an issue price of C$1.31 per option during the year ended December 31, 2021 compared to 451,085 DSUs of C$0.92 per DSU and 255,000 incentive stock options at an issue price of C$0.92 per option during the year ended December 31, 2020. All DSUs granted in each of these periods were fully vested upon issuance and all options vest one-third on the grant date, one-third on the first anniversary, and one-third on the second anniversary. At December 31, 2021, there was $98,577 of unrecognized compensation expense related to non-vested options outstanding.

Share-based payment charges were allocated as follows:

Expense category:	Year ended December 31, 2021	Year ended December 31, 2020
Consulting	$ 380,878	$ 304,205
Investor relations	10,282	6,456
Wages and benefits	143,957	74,870
	$ 535,117	$ 385,531

Excluding share-based payment charges of $380,878 and $304,205, respectively, consulting fees increased to $231,509 for the year ended December 31, 2021 from $168,208 for the year ended December 31, 2020. The increase of $63,300 is primarily due to increased investor relations services.

Excluding share-based payment charges of $143,957 and $74,870, respectively, wages and benefits increased to $791,116 for the year ended December 31, 2021 from $733,967 for the year ended December 31, 2020. The increase of $57,149 is primarily due to increased healthcare expenses of $12,782 and increased payroll and payroll-related benefit accruals of $44,367 as at December 31, 2021.

Regulatory expenses were $178,264 for the year ended December 31, 2021 compared to $138,191 for the year ended December 31, 2020. The increase of $40,073 is primarily due to costs for TSX listing fees and increased filing fees due to the Company's increased market valuation.

Insurance costs were $179,659 for the year ended December 31, 2021 compared to $144,837 for the year ended December 31, 2020. The increase of $34,822 is primarily due to premium increases to maintain coverage.

Excluding share-based payment charges of $10,282 and $6,456, respectively, investor relations costs were $66,974 for the year ended December 31, 2021 compared to $50,750 for the year ended December 31, 2020. The increase of $16,224 was primarily due to contracted investor relations services of $10,072 and conference expenses of $6,152.

Excluding share-based payments, all other operating expense categories reflected only moderate changes period over period.

Other items amounted to an expense of $64,839 during the year ended December 31, 2021 compared to an expense of $103,889 in the year ended December 31, 2020. The Company had a foreign exchange loss of $101,818 during the year ended December 31, 2021 compared to a foreign exchange loss of $191,071 during the year ended December 31, 2020 as a result of the impact of exchange rates on certain of the Company's U.S. dollar cash balances. The average exchange rate during the year ended December 31, 2021 was C$1 to US$0.7994 compared to C$1 to US$0.7461 for the year ended December 31, 2020.

Liquidity and Capital Resources

The Company has no revenue generating operations from which it can internally generate funds. To date, the Company's ongoing operations have been predominantly financed through sale of its equity securities by way of public offerings, private placements and the subsequent exercise of share purchase and broker warrants issued in connection with such private placements. There are currently no warrants outstanding.

As at December 31, 2021, the Company reported cash and cash equivalents of $7,780,671 compared to $13,049,293 at December 31, 2020. The decrease of approximately $5.3 million resulted mainly from operating expenditures on the Livengood Gold Project of approximately $5.3 million.

Our anticipated expenditures for year 2022 are approximately $3.2 million, including $426,972 for mineral property leases and $205,720 for mining claim government fees. Total commitments for years 2022 through 2027 for mineral property leases and mining claim government fees are $3,050,441 and $1,234,320, respectively.

As at March 8, 2022, management believes that the Company has sufficient financial resources to maintain its operations for the next twelve months.

The Company had no cash flows from financing activities during the year ended December 31, 2021.

Financing activities during the year ended December 31, 2020 included an "at-the-market" offering pursuant to which the Company issued a total of 7,334,513 common shares at an average price of $1.40 for gross proceeds of $10.3 million. Share issuance costs included $0.5 million related to the Offering.

The Company had no cash flows from investing activities during the years ended December 31, 2021 and December 31, 2020.

As at December 31, 2021, the Company had working capital of $7,342,470 compared to working capital of $12,718,381 at December 31, 2020. The Company expects that it will operate at a loss for the foreseeable future, but believes the current cash and cash equivalents will be sufficient for it to complete its anticipated 2022 work plan at the Livengood Gold Project and satisfy its currently anticipated general and administrative costs through the 2023 fiscal year.

The Company will require significant additional financing to continue its operations (including general and administrative expenses) in connection with advancing activities at the Livengood Gold Project and the development of any mine that may be determined to be built at the Livengood Gold Project, and there is no assurance that the Company will be able to obtain the additional financing required on acceptable terms, if at all. In addition, any significant delays in the issuance of required permits for the ongoing work at the Livengood Gold Project, or unexpected results in connection with the ongoing work, could result in the Company being required to raise additional funds to advance permitting efforts. The Company's review of its financing options includes pursuing a future strategic alliance to assist in further development, permitting and future construction costs, although there can be no assurance that any such strategic alliance will, in fact, be realized.

Despite the Company's success to date in raising significant equity financing to fund its operations, there is significant uncertainty that the Company will be able to secure any additional financing in the current or future equity markets. See "Risk Factors – *We will require additional financing to fund exploration and, if warranted, development and production. Failure to obtain additional financing could have a material adverse effect on our financial condition and results of operation and could cast uncertainty on our ability to continue as a going concern.*" The quantity of funds to be raised and the terms of any proposed equity financing that may be undertaken will be negotiated by management as opportunities to raise funds arise. Specific plans related to the use of proceeds will be devised once financing has been completed and management knows what funds will be available for these purposes. Due to this uncertainty, if the Company is unable to secure additional financing, it may be required to reduce all discretionary activities at the Project to preserve its working capital to fund anticipated non-discretionary expenditures beyond the 2023 fiscal year.

Other than cash held by its subsidiaries for their immediate operating needs in the United States, all of the Company's cash reserves are on deposit with a major Canadian chartered bank. The Company does not believe that the credit, liquidity or market risks with respect thereto have increased as a result of the current market conditions.

Critical Accounting Estimates

Mineral properties and exploration and evaluation expenditures

The Company's mineral project is currently in the exploration and evaluation phase. Mineral property acquisition costs are capitalized when incurred. Mineral property exploration costs are expensed as incurred. At such time that the Company determines that a mineral property can be economically developed, subsequent mineral property expenses will be capitalized during the development of such property.

The Company assesses interests in exploration properties for impairment when facts and circumstances suggest that the carrying amount of an asset may exceed its recoverable amount. Impairment analysis includes assessment of the following circumstances: a significant decrease in the market price of a long-lived asset or asset group; a significant adverse change in the extent or manner in which a long-lived asset or asset group is being used or in its physical condition; a significant adverse change in legal factors or in the business climate that could affect the value of a long-lived asset or asset group, including an adverse action or assessment by a regulator; an accumulation of costs significantly in excess of the amount originally expected for the acquisition or construction of a long-lived asset or asset group; a current-period operating or cash flow loss combined with a history of operating or cash flow losses or a projection or forecast that demonstrates continuing losses associated with the use of a long-lived asset or asset group; or a current expectation that, more likely than not, a long-lived asset or asset group will be sold or otherwise disposed of significantly before the end of its previously estimated useful life. The term more likely than not refers to a level of likelihood that is more than 50%.

Stock-based compensation

The Company follows the provisions of Financial Accounting Standards Board ("FASB") Accounting Standards Codification Section 718 "Compensation - Stock Compensation", which establishes accounting for equity-based compensation awards to be accounted for using the fair value method. The Company uses the Black-Scholes option pricing model to determine the grant date fair value of the awards. Compensation expense is measured at the grant date and recognized over the requisite service period, which is generally the vesting period.

Recently Adopted Accounting Policies

For a description of recently adopted accounting policies, please see Note 2 – *Summary of Significant Accounting Policies* within our Notes to Consolidated Financial Statements in Item 8 of this Annual Report on Form 10-K.

ITEM 7A. QUANTITATIVE AND QUALITATIVE DISCLOSURES ABOUT MARKET RISK

Not applicable.

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ITEM 8. FINANCIAL STATEMENTS AND SUPPLEMENTARY DATA.

REPORT OF INDEPENDENT REGISTERED PUBLIC ACCOUNTING FIRM

To the Shareholders and Directors of
International Tower Hill Mines Ltd.

Opinion on the Consolidated Financial Statements

We have audited the accompanying consolidated balance sheets of International Tower Hill Mines Ltd. (the "Company") as of December 31, 2021 and 2020, and the related consolidated statements of operations and comprehensive loss, changes in shareholders' equity, and cash flows for each of the years ended December 31, 2021 and 2020, and the related notes (collectively referred to as the "financial statements"). In our opinion, the financial statements present fairly, in all material respects, the financial position of the Company as of December 31, 2021 and 2020, and the results of its operations and its cash flows for each of the years ended December 31, 2021 and 2020, in conformity with accounting principles generally accepted in the United States of America.

Basis for Opinion

These financial statements are the responsibility of the Company's management. Our responsibility is to express an opinion on these financial statements based on our audits. We are a public accounting firm registered with the Public Company Accounting Oversight Board (United States) ("PCAOB") and are required to be independent with respect to the Company in accordance with the U.S. federal securities laws and the applicable rules and regulations of the Securities and Exchange Commission and the PCAOB.

We conducted our audits in accordance with the standards of the PCAOB. Those standards require that we plan and perform the audit to obtain reasonable assurance about whether the financial statements are free of material misstatement, whether due to error or fraud. The Company is not required to have, nor were we engaged to perform, an audit of its internal control over financial reporting. As part of our audits we are required to obtain an understanding of internal control over financial reporting but not for the purpose of expressing an opinion on the effectiveness of the entity's internal control over financial reporting. Accordingly, we express no such opinion.

Our audits included performing procedures to assess the risks of material misstatement of the financial statements, whether due to error or fraud, and performing procedures that respond to those risks. Such procedures included examining, on a test basis, evidence regarding the amounts and disclosures in the financial statements. Our audits also included evaluating the accounting principles used and significant estimates made by management, as well as evaluating the overall presentation of the financial statements. We believe that our audits provide a reasonable basis for our opinion.

Critical Audit Matters

The critical audit matters communicated below are matters arising from the current period audit of the financial statements that were communicated or required to be communicated to the audit committee and that: (1) relate to accounts or disclosures that are material to the financial statements and (2) involved our especially challenging, subjective, or complex judgments. The communication of critical audit matters does not alter in any way our opinion on the financial statements, taken as a whole, and we are not, by communicating the critical audit matters below, providing separate opinions on the critical audit matters or on the accounts or disclosures to which they relate.

Assessment of impairment indicators of mineral property

As described in Note 4 to the consolidated financial statements, the carrying amount of the Company's mineral property was $55,375,124 as at December 31, 2021. Management applies judgment to assess the mineral property for impairment indicators that could give rise to the requirement to conduct a formal impairment test. Internal and external factors such as (i) significant decrease in the market price of the asset, (ii) current period cash flow or operating losses combined with a history of losses or a forecast of continuing losses associated with the use of the asset, (iii) significant changes in expected capital and operating costs, and reclamation costs, (iv) significant adverse changes in the business climate or legal factors including changes in gold prices, and (v) current expectation that the asset will more likely than not be sold or disposed of significantly before the end of its estimated useful life, are evaluated by management in determining whether there are any indicators of impairment.

The principal considerations for our determination that the assessment of impairment indicators of the mineral property is a critical audit matter are that there was judgment by management when assessing whether there were indicators of impairment for the mineral property. This in turn led to a high degree of auditor judgment, subjectivity and effort in performing procedures to evaluate audit evidence relating to the judgments made by management in their assessment of indicators of impairment that could give rise to the requirement to conduct a formal impairment test.

Addressing the matter involved performing procedures and evaluating audit evidence in connection with forming our overall opinion on the consolidated financial statements. These procedures include, among others, evaluating management's assessment of indicators of impairment; and assessing whether there has been a significant decrease in the market price of the asset, significant changes in the expected capital costs, operating costs, reclamation costs, and current period cash flow or operating losses combined with a history of losses or forecasted continued losses associated with the use of the asset, by considering the current and past performance of the mineral property including other third-party information and evidence obtained in other areas of the audit, as applicable. The procedures performed also included (i) evaluating whether there were significant adverse changes in the business climate or legal factors including changes in gold prices by considering external market data and industry data; and (ii) assessing the completeness of external and internal factors that could be considered as indicators of impairment of the Company's mineral property, including consideration of evidence obtained in other areas of the audit.

We have served as the Company's auditor since 2017.

/s/ DAVIDSON & COMPANY LLP

Vancouver, Canada

Chartered Professional Accountants

March 8, 2022

INTERNATIONAL TOWER HILL MINES LTD.
CONSOLIDATED BALANCE SHEETS
As at December 31, 2021 and 2020
(Expressed in U.S. Dollars)

	Note	December 31, 2021	December 31, 2020
ASSETS			
Current assets			
Cash and cash equivalents		$ 7,780,671	$ 13,049,293
Prepaid expenses and other		141,680	162,079
Total current assets		7,922,351	13,211,372
Property and equipment		7,465	7,832
Mineral property	4	55,375,124	55,375,124
Total assets		$ 63,304,940	$ 68,594,328
LIABILITIES AND SHAREHOLDERS' EQUITY			
Current liabilities			
Accounts payable		$ 259,648	$ 199,026
Accrued liabilities	5	320,233	293,965
Total liabilities		579,881	492,991
Shareholders' equity			
Share capital, no par value; unlimited number of authorized shares; 194,908,184 shares issued and outstanding at December 31, 2021 and 2020	7	288,032,132	288,032,132
Contributed surplus		35,989,922	35,454,805
Accumulated other comprehensive income		1,828,121	1,759,228
Deficit		(263,125,116)	(257,144,828)
Total shareholders' equity		62,725,059	68,101,337
Total liabilities and shareholders' equity		$ 63,304,940	$ 68,594,328

Nature of operations (Note 1)
Commitments (Note 9)

The accompanying notes are an integral part of these consolidated financial statements.

INTERNATIONAL TOWER HILL MINES LTD.
CONSOLIDATED STATEMENTS OF OPERATIONS AND COMPREHENSIVE LOSS
For the Years Ended December 31, 2021 and 2020
(Expressed in U.S. Dollars)

	Note	December 31, 2021	December 31, 2020
Operating Expenses			
Consulting fees	7	$ 612,387	$ 472,413
Depreciation		367	7,602
Insurance		179,659	144,837
Investor relations	7	77,256	57,206
Mineral property exploration	4	3,517,540	2,364,899
Office		33,292	27,590
Other		17,181	17,774
Professional fees		210,594	219,268
Regulatory		178,264	138,191
Rent	11	135,372	135,762
Travel		18,464	20,450
Wages and benefits	7	935,073	808,837
Total operating expenses		(5,915,449)	(4,414,829)
Other income (expense)			
Loss on foreign exchange		(101,818)	(191,071)
Interest income		20,260	76,361
Other income		16,719	10,821
Total other income (expense)		(64,839)	(103,889)
Net loss for the year		(5,980,288)	(4,518,718)
Other comprehensive income			
Exchange difference on translating foreign operations		68,893	185,217
Total other comprehensive income for the year		68,893	185,217
Comprehensive loss for the year		$ (5,911,395)	$ (4,333,501)
Basic and diluted net loss per share		$ (0.03)	$ (0.02)
Weighted average number of shares outstanding - basic and diluted		194,908,184	189,870,444

The accompanying notes are an integral part of these consolidated financial statements.

INTERNATIONAL TOWER HILL MINES LTD.
CONSOLIDATED STATEMENTS OF CHANGES IN SHAREHOLDERS' EQUITY
For the Years Ended December 31, 2021 and 2020
(Expressed in U.S. Dollars)

	Number of shares	Share capital	Contributed surplus	Accumulated other comprehensive income	Deficit	Total
Balance, December 31, 2019	187,573,671	$ 278,213,801	$ 35,069,274	$ 1,574,011	$ (252,626,110)	$ 62,230,976
Stock based compensation-option	—	—	90,914	—	—	90,914
Stock based compensation-DSU	—	—	294,617	—	—	294,617
Exchange difference on translating foreign operations	—	—	—	185,217	—	185,217
At-The-Market offering	7,334,513	10,299,277	—	—	—	10,299,277
Share issuance costs	—	(480,946)	—	—	—	(480,946)
Net loss	—	—	—	—	(4,518,718)	(4,518,718)
Balance, December 31, 2020	194,908,184	288,032,132	35,454,805	1,759,228	(257,144,828)	68,101,337
Stock based compensation-option	—	—	167,267	—	—	167,267
Stock based compensation-DSU	—	—	367,850	—	—	367,850
Exchange difference on translating foreign operations	—	—	—	68,893	—	68,893
Net loss	—	—	—	—	(5,980,288)	(5,980,288)
Balance, December 31, 2021	194,908,184	$ 288,032,132	$ 35,989,922	$ 1,828,121	$ (263,125,116)	$ 62,725,059

The accompanying notes are an integral part of these consolidated financial statements.

INTERNATIONAL TOWER HILL MINES LTD.
CONSOLIDATED STATEMENTS OF CASH FLOWS
For the Years Ended December 31, 2021 and 2020
(Expressed in U.S. Dollars)

	December 31, 2021	December 31, 2020
Operating Activities		
Loss for the year	$ (5,980,288)	$ (4,518,718)
Add items not affecting cash:		
Depreciation	367	7,602
Stock-based compensation-option	167,267	90,914
Stock-based compensation-DSU	367,850	294,617
Changes in non-cash working capital items:		
Accounts receivable	18,770	94,795
Prepaid expenses	1,555	(14,447)
Accounts payable and accrued liabilities	86,964	156,302
Cash used in operating activities	(5,337,515)	(3,888,935)
Financing Activities		
Issuance of common shares	—	10,299,277
Share issuance costs	—	(480,946)
Cash provided by financing activities	—	9,818,331
Effect of foreign exchange on cash and cash equivalents	68,893	182,276
Increase/(decrease) in cash and cash equivalents	(5,268,622)	6,111,672
Cash and cash equivalents, beginning of year	13,049,293	6,937,621
Cash and cash equivalents, end of year	$ 7,780,671	$ 13,049,293

The accompanying notes are an integral part of these consolidated financial statements.

INTERNATIONAL TOWER HILL MINES LTD.
NOTES TO CONSOLIDATED FINANCIAL STATEMENTS
(Expressed in U.S. Dollars)

1. GENERAL INFORMATION, NATURE OF OPERATIONS

International Tower Hill Mines Ltd. ("ITH" or the "Company") is incorporated under the laws of British Columbia, Canada. The Company's head office address is 2710-200 Granville Street, Vancouver, British Columbia, Canada.

International Tower Hill Mines Ltd. consists of ITH and its wholly owned subsidiaries Tower Hill Mines, Inc. ("TH Alaska") (an Alaska corporation), Tower Hill Mines (US) LLC ("TH US") (a Colorado limited liability company), and Livengood Placers, Inc. ("LPI") (a Nevada corporation). The Company is in the business of acquiring, exploring and evaluating mineral properties, and either joint venturing or developing these properties further or disposing of them when the evaluation is completed. At December 31, 2021, the Company was in the exploration stage and controls a 100% interest in its Livengood Gold Project in Alaska, U.S.A.

These consolidated financial statements have been prepared on a going-concern basis, which presumes the realization of assets and discharge of liabilities in the normal course of business for the foreseeable future.

The Company will require significant additional financing to continue its operations in connection with advancing activities at the Livengood Gold Project and for the development of any mine that may be determined to be built at the Livengood Gold Project. There is no assurance that the Company will be able to obtain the additional financing required on acceptable terms, if at all.

In addition, any significant delays in the issuance of required permits for the ongoing work at the Livengood Gold Project, or unexpected results in connection with the ongoing work, could result in the Company being required to raise additional funds to advance permitting efforts. The Company's review of its financing options includes pursuing a future strategic alliance to assist in further development, permitting and future construction costs.

Despite the Company's success to date in raising significant equity financing to fund its operations, there is significant uncertainty that the Company will be able to secure any additional financing in the current or future equity markets. The amount of funds to be raised and the terms of any proposed equity financing that may be undertaken will be negotiated by management as opportunities to raise funds arise. Specific plans related to the use of proceeds will be devised once financing has been completed and management knows what funds will be available for these purposes. Due to this uncertainty, if the Company is unable to secure additional financing, it may be required to reduce all discretionary activities at the Project to preserve its working capital to fund anticipated non-discretionary expenditures beyond the 2022 fiscal year. As at March 8, 2022, management believes that the Company has sufficient financial resources to maintain its operations for the next twelve months.

In March 2020, the World Health Organization declared the novel coronavirus 2019 ("COVID-19") a global pandemic. This contagious disease outbreak, which has continued to spread, and any related adverse public health developments, has adversely affected workforces, economies, and financial markets globally, potentially leading to an economic downturn. While it is not possible for the Company to predict the duration or magnitude of the adverse results of the outbreak and its ultimate effects on the Company's business, results of operations or ability to raise funds at this time, the COVID-19 pandemic has not had any material adverse effects on the Company.

2. SUMMARY OF SIGNIFICANT ACCOUNTING POLICIES

Basis of presentation

These consolidated financial statements are presented in United States dollars and have been prepared in accordance with U.S. generally accepted accounting principles ("U.S. GAAP"). On March 8, 2022, the Board approved the consolidated financial statements dated December 31, 2021.

Basis of consolidation

These consolidated financial statements include the accounts of ITH and its wholly owned subsidiaries TH Alaska, TH US, and LPI. All intercompany transactions and balances have been eliminated.

Significant judgments, estimates and assumptions

The preparation of financial statements in accordance with U.S. GAAP requires management to make judgments, estimates and assumptions that affect the reported amounts of assets and liabilities and disclosure of contingent assets and liabilities at the date of the financial statements, and the reported amounts of revenues and expenses during the period. These judgments, estimates and assumptions are regularly evaluated and are based on management's experience and knowledge of the relevant facts and circumstances. While management believes the estimates to be reasonable, actual results could differ from those estimates and could impact future results of operations and cash flows.

The areas which require significant judgment and estimates that management has made at the financial reporting date, that could result in a material change to the carrying amounts of assets and liabilities, in the event actual results differ from the assumptions made, relate to, but are not limited to the following:

Significant judgments

- the determination of functional currencies;
- quantitative and qualitative factors used in the assessment of impairment of the Company's mineral property; and
- the analysis of resource calculations, drill results, labwork, etc. which can impact the Company's assessment of impairment, and provisions, if any, for environmental rehabilitation and restoration.

Cash and cash equivalents

Cash equivalents include highly liquid investments with original maturities of twelve months or less, and which are subject to an insignificant risk of change in value. Cash equivalents are held for the purpose of meeting short-term cash commitments rather than for investment or other purposes.

Property and equipment

On initial recognition, property and equipment are valued at cost. Property and equipment is subsequently measured at cost less accumulated depreciation, less any accumulated impairment losses, with the exception of land which is not depreciated. Depreciation is recorded over the estimated useful life of the assets at the following annual rates:

Computer equipment - 30% declining balance;
Computer software - 3 years straight line;
Furniture and equipment -20% declining balance; and
Leasehold improvements - straight-line over the lease term.

Additions during the year are depreciated at one-half the annual rates. Depreciation methods, useful lives and residual values are reviewed at each financial year-end and adjusted if appropriate.

Mineral properties and exploration and evaluation expenditures

The Company's mineral project is currently in the exploration and evaluation phase. Mineral property acquisition costs are capitalized when incurred. Mineral property exploration costs are expensed as incurred. At such time that the Company determines that a mineral property can be economically developed, subsequent mineral property expenses will be capitalized during the development of such property.

The Company assesses interests in exploration properties for impairment when facts and circumstances suggest that the carrying amount of an asset may exceed its recoverable amount. Impairment analysis includes assessment of the following circumstances: a significant decrease in the market price of a long-lived asset or asset group; a significant adverse change in the extent or manner in which a long-lived asset or asset group is being used or in its physical condition; a significant adverse change in legal factors or in the business climate that could affect the value of a long-lived asset or asset group, including an adverse action or assessment by a regulator; an accumulation of costs significantly in excess of the amount originally expected for the acquisition or construction of a long-lived asset or asset group; a current-period operating or cash flow loss combined with a history of operating or cash flow losses or a projection or forecast that demonstrates continuing losses associated with the use of a long-lived asset or asset group; a current expectation that, more likely than not, a long-lived asset or asset group will be sold or otherwise disposed of significantly before the end of its previously estimated useful life. The term more likely than not refers to a level of likelihood that is more than 50%.

Asset retirement obligations

The Company records a liability based on the best estimate of costs for site closure and reclamation activities that the Company is legally or contractually required to remediate. The provision for closure and reclamation liabilities is estimated using expected cash flows based on engineering and environmental reports and accreted to full value over time through periodic charges to income. The Company does not have any material provisions for environmental rehabilitation as of December 31, 2021.

Impairment of long-lived assets and long-lived assets to be disposed of

Long-lived assets are reviewed for impairment whenever events or changes in circumstances indicate that the carrying amount of an asset may not be recoverable. Recoverability of assets to be held and used is measured by a comparison of the carrying amount of an asset to future net cash flows expected to be generated by the asset. If such assets are considered to be impaired, the impairment to be recognized is measured by the amount by which the carrying amount of the assets exceeds the fair value of the assets. Assets to be disposed of are reported at the lower of the carrying amount and the fair value less costs to sell.

Income taxes

The Company accounts for income taxes under the asset and liability method. Current income taxes are the expected taxes payable or receivable on the taxable income or loss for the year, using tax rates enacted or substantively enacted at the reporting date, and any adjustment to taxes payable in respect of previous years. Deferred tax assets and liabilities are recognized for the future tax consequences attributable to differences between the financial statement carrying amounts of existing assets and liabilities and their respective tax bases. Deferred tax assets and liabilities are measured using enacted tax rates expected to apply to taxable income in the years in which those temporary differences are expected to be recovered or settled. Under the asset and liability method, the effect on deferred tax assets and liabilities of a change in tax rates is recognized in income in the period that includes the enactment date. A valuation allowance is recognized if it is more likely than not that some portion or the entire deferred tax asset will not be recognized.

Net loss per share

Basic loss per share is calculated using the weighted average number of common shares outstanding during the period. Diluted loss per share reflects the potential dilution that could occur if securities or contracts that may require the issuance of common shares in the future were converted, unless the impact is anti-dilutive. For the year ended December 31, 2021, this calculation proved to be anti-dilutive, and therefore the Company’s 2,947,049 stock options and 2,151,276 deferred share units (“DSUs”) outstanding at year-end have been excluded from the calculation.

Stock-based compensation

The Company follows the provisions of Financial Accounting Standards Board (“FASB”) Accounting Standards Codification Section 718 “Compensation - Stock Compensation”, which establishes accounting for equity-based compensation awards to be accounted for using the fair value method. Equity-settled share-based payment arrangements are initially measured at fair value at the date of grant and recorded within shareholders’ equity. Arrangements considered to be cash-settled are initially recorded at fair value and classified as accrued liabilities, and subsequently re-measured at fair value at each reporting date. The Company’s stock option plan is an equity-settled arrangement and the Company’s deferred share unit plan can be an equity or cash settled arrangement depending on the grant date term.

The fair value at grant date of all share-based payments is recognized as compensation expense over the period for which benefits of services are expected to be derived, with a corresponding credit to shareholders' equity or accrued liabilities depending on whether they are equity-settled or cash-settled. The Company estimates the fair value of stock options granted using the Black-Scholes option pricing model and estimate the expected forfeiture rate at the date of grant. The value of DSUs is estimated based on the quoted market price of the Company's common shares. When awards are forfeited because non-market based vesting conditions are not satisfied, the expense previously recognized is proportionately reversed.

Functional currency

The Company's consolidated financial statements are presented in U.S. dollars, which is the Company's reporting currency. The functional currency of ITH is the Canadian ("CAD" or "C") dollar and the functional currency of ITH Alaska, TH US and LPI is the U.S. dollar.

In accordance with ASC 830, Foreign Currency Matters, the Company translates the assets and liabilities into U.S. dollars using the rate of exchange prevailing at the balance sheet date and the statements of operations and comprehensive loss and cash flows are translated at an average rate during the reporting period. Adjustments resulting from the translation from CAD into U.S. dollars are recorded in shareholders' equity as part of accumulated other comprehensive income.

Foreign currency transactions are translated into the functional currency of the respective currency of the entity or division, using the exchange rates prevailing at the dates of the transactions (spot exchange rate). Foreign exchange gains and losses resulting from the settlement of such transactions and from the re-measurement of monetary items denominated in foreign currency at period-end exchange rates are recognized in profit or loss. Non-monetary items that are not re-translated at period end are measured at historical cost (translated using the exchange rates at the transaction date), except for non-monetary items measured at fair value, which are translated using the exchange rates as at the date when fair value was determined. Gains and losses are recorded in the statement of operations and comprehensive loss.

Recently adopted accounting pronouncements

Accounting Standards Update No. 2019-12—Income Taxes (Topic 740). In December 2019, the FASB issued guidance intended to simplify various aspects related to accounting for income taxes and removes certain exceptions to the general principles and also clarifies and amends existing guidance to improve consistent application. The Company adopted the standard on January 1, 2021 and adoption had no impact on the Company's financial statements.

Recently issued accounting pronouncements

Accounting Standards Update No. 2016-13—Measurement of Credit Losses on Financial Instruments. In June 2016, the FASB issued guidance intended to change how companies account for credit losses for most financial assets and certain other instruments. For trade receivables, loans and held-to-maturity debt securities, companies will be required to estimate lifetime expected credit losses and recognize an allowance against the related instruments. For available for sale debt securities, companies will be required to recognize an allowance for credit losses rather than reducing the carrying value of the asset. The adoption of this update, if applicable, will result in earlier recognition of losses and impairments.

Accounting Standards Update No. 2018-19—Codification Improvements to ASC 326, Financial Instruments—Credit Losses. In November 2018, the FASB introduced guidance on an expected credit loss methodology for the impairment of financial assets measured at amortized cost basis. That methodology replaces the probable, incurred loss model for those assets. ASU 2018-19 is the final version of Proposed Accounting Standards Update 2018-270, which has been deleted. Additionally, the amendments clarify that receivables arising from operating leases are not within the scope of Subtopic 326-20. Instead, impairment of receivables arising from operating leases should be accounted for in accordance with ASC 842, Leases.

These updates are effective beginning January 1, 2023, and the Company is currently evaluating ASU 2016-13 and ASU 2018-19 and the potential impact of adopting this guidance on its financial reporting.

3. FAIR VALUE OF FINANCIAL INSTRUMENTS

The carrying values of cash and cash equivalents, accounts payable and accrued liabilities approximate their fair values due to the short-term maturity of these financial instruments.

Financial instruments measured at fair value are classified into one of three levels in the fair value hierarchy according to the significance of the inputs used in making the measurement. The three levels of the fair value hierarchy are as follows:

- Level 1 – Unadjusted quoted prices in active markets for identical assets or liabilities;
- Level 2 – Inputs other than quoted prices that are observable for the asset or liability either directly or indirectly; and,
- Level 3 – Inputs that are not based on observable market data.

There were no financial instruments measured at fair value.

4. MINERAL PROPERTY

The Company had the following activity related to the mineral property:

Capitalized acquisition costs		Amount
Balance, December 31, 2019	$	55,375,124
Additions		—
Balance, December 31, 2020	$	55,375,124
Additions		—
Balance, December 31, 2021	$	55,375,124

The following table presents costs incurred for exploration and evaluation activities for the years ended December 31, 2021 and 2020:

		Year ended December 31, 2021		Year ended December 31, 2020
Exploration costs:				
Aircraft services	$	8,400	$	—
Environmental		185,330		169,704
Equipment and facilities rental		61,409		54,945
Field costs		327,075		70,254
Geological/geophysical		2,121,323		1,437,530
Land maintenance & tenure		709,922		563,243
Legal		90,542		54,982
Transportation and travel		13,539		14,241
Total expenditures for the year	$	3,517,540	$	2,364,899

Properties acquired from AngloGold, Alaska

Pursuant to an Asset Purchase and Sale and Indemnity Agreement dated June 30, 2006, as amended on July 26, 2007 (the “AngloGold Agreement”), among the Company, AngloGold Ashanti (U.S.A.) Exploration Inc. (“AngloGold”) and TH Alaska, the Company acquired all of AngloGold’s interest in a portfolio of seven mineral exploration projects in Alaska and referred to as the Livengood, Chisna, Gilles, Coffee Dome, West Pogo, Blackshell, and Caribou properties (the “Sale Properties”) in exchange for a cash payment of $50,000 on August 4, 2006, and the issuance of 5,997,295 common shares, representing approximately 19.99% of the Company’s issued shares following the closing of the acquisition and two private placement financings raising an aggregate of C$11,479,348.

As further consideration for the transfer of the Sale Properties, the Company granted to AngloGold a 90-day right of first offer with respect to the Sale Properties and any additional mineral properties in Alaska in which the Company acquires an interest and which interest the Company proposes to farm out or otherwise dispose of. Upon AngloGold’s equity interest in the Company being reduced to less than 10%, this right of first offer would then terminate.

On December 11, 2014, the Company closed a private placement financing in which AngloGold elected not to participate. As a result of the shares issued in this private placement, AngloGold’s ownership in the Company was reduced to less than 10% and thus both AngloGold’s right to maintain its ownership percentage interest and its right of first offer on the Company’s Alaskan properties terminated upon the closing of the December 2014 private placement.

Details of the Livengood Property (being the only Sale Property still held by the Company) are as follows:

Livengood Property:

The Livengood property is located in the Tintina gold belt approximately 113 kilometers (70 miles) north of Fairbanks, Alaska. The property consists of land leased from the Alaska Mental Health Trust, a number of smaller private mineral leases, Alaska state mining claims purchased or located by the Company and patented ground held by the Company.

Details of the leases are as follows:

a) a lease of the Alaska Mental Health Trust mineral rights having a term commencing July 1, 2004 and extending 19 years until June 30, 2023, subject to further extensions beyond June 30, 2023 by either commercial production or payment of an advance minimum royalty equal to 125% of the amount paid in year 19 and diligent pursuit of development. The lease requires minimum work expenditures and advance minimum royalties (all of which minimum royalties are recoverable from production royalties) which escalate annually with inflation. A net smelter return ("NSR") production royalty of between 2.5% and 5.0% (depending upon the price of gold) is payable to the lessor with respect to the lands subject to this lease. In addition, an NSR production royalty of l% is payable to the lessor with respect to the unpatented federal mining claims subject to the lease described in b) below and an NSR production royalty of between 0.5% and 1.0% (depending upon the price of gold) is payable to the lessor with respect to the lands acquired by the Company as a result of the purchase of Livengood Placers, Inc. in December 2011. As of December 31, 2021, the Company has paid $3,993,856 from the inception of this lease.

b) a lease of federal unpatented lode mining claims having an initial term of ten years commencing on April 21, 2003 and continuing for so long thereafter as advance minimum royalties are paid and mining related activities, including exploration, continue on the property or on adjacent properties controlled by the Company. The lease requires an advance minimum royalty of $50,000 on or before each anniversary date for the duration of the lease (all of which minimum royalties are recoverable from production royalties). An NSR production royalty of between 2% and 3% (depending on the price of gold) is payable to the lessors. The Company may purchase 1% of the royalty for $1,000,000. As of December 31, 2021, the Company has paid $880,000 from the inception of this lease.

c) a lease of patented lode claims having an initial term of ten years commencing January 18, 2007, and continuing for so long thereafter as advance minimum royalties are paid. The lease requires an advance minimum royalty of $20,000 on or before each anniversary date through January 18, 2017 and $25,000 on or before each subsequent anniversary (all of which minimum royalties are recoverable from production royalties). An NSR production royalty of 3% is payable to the lessors. The Company may purchase all interests of the lessors in the leased property (including the production royalty) for $1,000,000 (less all minimum and production royalties paid to the date of purchase), of which $500,000 is payable in cash over four years following the closing of the purchase and the balance of $500,000 is payable by way of the 3% NSR production royalty. The Company has acquired a 40% interest in the mining claims subject to the lease, providing the Company with a 40% interest in the lease. As of December 31, 2021, the Company has paid $265,000 from the inception of this lease.

d) a lease of unpatented federal lode mining and federal unpatented placer claims having an initial term of ten years commencing on March 28, 2007, and continuing for so long thereafter as advance minimum royalties are paid and mining related activities, including exploration, continue on the property or on adjacent properties controlled by the Company. The lease requires an advance minimum royalty of $15,000 on or before each anniversary date for the duration of the lease (all of which minimum royalties are recoverable from production royalties). The Company is required to pay the lessor the additional sum of $250,000 upon making a positive production decision, of which $125,000 is payable within 120 days of the decision and $125,000 is payable within a year of the decision (all of which are recoverable from production royalties). An NSR production royalty of 2% is payable to the lessor. The Company may purchase all of the interest of the lessor in the leased property (including the production royalty) for $1,000,000. As of December 31, 2021, the Company has paid $188,000 from the inception of this lease.

Title to mineral properties

The acquisition of title to mineral properties is a detailed and time-consuming process. The Company has taken steps to verify title to mineral properties in which it has an interest. Although the Company has taken every reasonable precaution to ensure that legal title to its properties is properly recorded in the name of the Company, there can be no assurance that such title will ultimately be secured.

5. ACCRUED LIABILITIES

The following table presents the accrued liabilities balances at December 31, 2021 and 2020.

	December 31, 2021	December 31, 2020
Accrued liabilities	$ 202,982	$ 227,459
Accrued salaries and benefits	117,251	66,506
Total accrued liabilities	$ 320,233	$ 293,965

Accrued liabilities at December 31, 2021 include accruals for general corporate costs and project costs of $34,912 and $168,070, respectively. Accrued liabilities at December 31, 2020 include accruals for general corporate costs and project costs of $51,151 and $176,308, respectively.

6. INCOME TAXES

A reconciliation of income taxes at statutory rates with the reported taxes is as follows for the years ended December 31, 2021 and 2020:

	December 31, 2021	December 31, 2020
Loss before income taxes	$ (5,980,288)	$ (4,518,718)
Statutory Canadian corporate tax rate	27.00 %	27.00 %
Expected income tax (recovery)	$ (1,614,678)	$ (1,220,054)
Effect of change in tax rate	3,455,247	—
Share-based payments	123,866	104,093
Unrecognized items for tax purposes	(340,304)	(129,854)
Difference in tax rates in other jurisdictions	(85,531)	(115,057)
Adjustment to prior years provision versus statutory tax returns	(7,996)	(7,789)
Change in valuation allowance	(1,530,604)	1,368,661
Total income tax expense (recovery)	$ —	$ —

The significant components of the Company's deferred tax assets are as follows:

	December 31, 2021	December 31, 2020
Deferred income tax assets (liabilities):		
Mineral properties	$ 16,711,128	$ 18,750,505
Property and equipment	10,464	10,365
Share issue costs	83,928	118,756
Net operating losses available for future periods	55,506,072	55,302,874
	72,311,592	74,182,500
Valuation allowance	(72,311,592)	(74,182,500)
Net deferred tax asset	$ —	$ —

At December 31, 2021, the Company has available net operating losses for Canadian income tax purposes of approximately $23,013,000 and net operating losses for US income tax purposes of approximately $161,982,000 available for carry-forward to reduce future years' taxable income, if not utilized, expiring as follows:

	Canada	United States
2040	$ 1,033,000	$ 8,449,000
2039	938,000	7,743,000
2038	388,000	8,638,000
2037	1,394,000	8,800,000
2036	1,383,000	8,798,000
2035	406,000	10,703,000
2034	1,694,000	12,587,000
2033	1,827,000	14,208,000
2032	2,629,000	16,797,000
2031	4,180,000	40,825,000
2030	2,829,000	18,765,000
2029	2,074,000	2,973,000
2028	1,253,000	1,412,000
2027	907,000	1,284,000
2026	78,000	—
	$ 23,013,000	$ 161,982,000

The Company also has available mineral resource expenses that are related to the Company's exploration activities in the United States of approximately $117,054,000 which may be deductible for U.S. tax purposes. Future tax benefits, which may arise as a result of applying these deductions to taxable income, have not been recognized in these accounts due to the uncertainty of future taxable income.

7. SHARE CAPITAL

Authorized

The Company's share capital consists of an unlimited number of authorized common shares without par value. At December 31, 2020 and 2021, there were 194,908,184 shares issued and outstanding.

Share issuances

There were no share issuances during the year ended December 31, 2021.

On August 31, 2020, the Company entered into an At Market Issuance ("ATM") Sales Agreement with B. Riley Securities, Inc. ("B. Riley"), pursuant to which the Company was entitled, at its discretion and from time-to-time during the term of the sales agreement, to sell through B. Riley such number of common shares of the Company as would result in aggregate gross proceeds to the Company of up to $10,300,000 (the "Offering"). The Company would pay B. Riley a commission of up to 3% of the gross proceeds from the sale of common shares pursuant to the ATM Sales Agreement.

During the year ended December 31, 2020, the Company issued 7,334,513 common shares pursuant to the Offering for gross proceeds of $10,299,277. Share issuance costs were $480,946 resulting in net proceeds of $9,818,331 from the Offering.

Stock options

The Company adopted an incentive stock option plan in 2006, as amended September 19, 2012 and re-approved by the Company's shareholders on May 28, 2015, May 30, 2018, and May 25, 2021 (the "Stock Option Plan"). The essential elements of the Stock Option Plan provide that the aggregate number of common shares of the Company that may be issued pursuant to options granted under the Stock Option Plan and any other share-based compensation arrangements may not exceed 10% of the number of issued shares of the Company at the time of the granting of options. Options granted under the Stock Option Plan will have a maximum term of ten years. The exercise price of options granted under the Stock Option Plan shall be fixed in compliance with the applicable provisions of the Toronto Stock Exchange ("TSX") Company Manual in force at the time of grant and, in any event, shall not be less than the closing price of the Company's common shares on the TSX on the trading day immediately preceding the day on which the option is granted, or such other price as may be agreed to by the Company and accepted by the TSX. Options granted under the Stock Option Plan vest immediately, unless otherwise determined by the directors at the date of grant.

During the year ended December 31, 2021, the Company granted a total of 240,000 incentive stock options to certain officers and employees of the Company to purchase common shares in the capital stock of the Company at an issue price of C$1.31 per share. Of the total 240,000 stock options granted, 150,000 were granted to Mr. Karl Hanneman, Chief Executive Officer. All of the options vest one-third on the grant date, one-third on May 25, 2022, one-third on May 25, 2023 and expire on May 25, 2027.

During the year ended December 31, 2020, the Company granted a total of 255,000 incentive stock options to employees of the Company to purchase common shares in the capital stock of the Company at an issue price of C$0.92 per share. Of the total 255,000 stock options granted, 150,000 were granted to Mr. Karl Hanneman, Chief Executive Officer. All of the options vest one-third on the grant date, one-third on May 27, 2021, one-third on May 27, 2022 and expire on May 27, 2026.

A summary of the status of the stock option plan as of December 31, 2021 and 2020 and changes during the fiscal years is presented below:

	Year Ended December 31, 2021			Year Ended December 31, 2020		
	Number of Options	Weighted Average Exercise Price (C$)	Aggregate Intrinsic Value (C$)	Number of Options	Weighted Average Exercise Price (C$)	Aggregate Intrinsic Value (C$)
Balance, beginning of the year	2,707,049	$ 0.94		2,452,049	$ 0.94	
Granted	240,000	$ 1.31		255,000	$ 0.92	
Exercised	—	—		—	—	
Cancelled	—	—		—	—	
Balance, end of the year	2,947,049	$ 0.97	$ 235,200	2,707,049	$ 0.94	$ 2,287,262

The weighted average remaining life of options outstanding at December 31, 2021 was 1.9 years.

Stock options outstanding are as follows:

	December 31, 2021			December 31, 2020		
Expiry Date	Exercise Price (C$)	Number of Options	Exercisable	Exercise Price (C$)	Number of Options	Exercisable
March 25, 2022*	$ 1.11	510,000	510,000	$ 1.11	510,000	510,000
March 25, 2022*	$ 0.73	270,000	270,000	$ 0.73	270,000	270,000
March 10, 2022	$ 1.11	120,000	120,000	$ 1.11	120,000	120,000
March 16, 2023	$ 1.00	580,000	580,000	$ 1.00	580,000	580,000
March 16, 2023	$ 0.50	130,000	130,000	$ 0.50	130,000	130,000
June 9, 2023	$ 1.00	30,000	30,000	$ 1.00	30,000	30,000
March 21, 2024	$ 0.61	374,817	374,817	$ 0.61	374,817	374,817
February 1, 2025	$ 1.35	250,000	250,000	$ 1.35	250,000	250,000
August 8, 2025	$ 0.85	187,232	187,232	$ 0.85	187,232	187,232
May 27, 2026	$ 0.92	255,000	170,000	$ 0.92	255,000	85,000
May 25, 2027	$ 1.31	240,000	80,000	—	—	—
		2,947,049	2,702,049		2,707,049	2,537,049

- Expiry dates revised to March 25, 2022

A summary of the non-vested options as of December 31, 2021 and 2020 and changes during the fiscal years ended December 31, 2021 and 2020 is as follows:

Non-vested options:	Number of options	Weighted average grant-date fair value (C$)
Outstanding at December 31, 2019	—	—
Granted	255,000	$ 0.76
Vested	(85,000)	$ 0.76
Outstanding at December 31, 2020	170,000	$ 0.76
Granted	240,000	$ 0.98
Vested	(165,000)	$ 0.87
Outstanding at December 31, 2021	245,000	$ 0.91

At December 31, 2021, there was C$98,577 of unrecognized compensation expense related to non-vested options outstanding.

Deferred Share Unit Incentive Plan

On April 4, 2017, the Company adopted a Deferred Share Unit Plan (the "DSU Plan"). The DSU Plan was approved by the Company's shareholders on May 24, 2017 and re-approved by the Company's shareholders on May 27, 2020 and May 25, 2021. As at December 31, 2021, the maximum aggregate number of common shares that could be issued under the DSU Plan and the Stock Option Plan was 19,490,818, representing 10% of the number of issued and outstanding common shares on that date (on a non-diluted basis). As at December 31, 2021, the Company had stock options to potentially acquire 2,947,049 common shares outstanding under the Stock Option Plan (representing approximately 1.51% of the outstanding common shares), leaving up to 16,543,769 common shares available for future grants under the DSU Plan and under the Stock Option Plan (combined) based on the number of outstanding common shares as at that date on a non-diluted basis (representing an aggregate of approximately 8.49% of the outstanding common shares).

During the year ended December 31, 2021, in accordance with the DSU Plan, the Company granted each of the members of the Company's Board of Directors (other than those directors nominated for election by Paulson & Co., Inc.) 63,359 DSUs for a total of 316,795 DSUs with a grant date fair value (defined as the weighted average of the prices at which the common shares traded on the exchange with the most volume for the five trading days immediately preceding the grant) of C$1.31 per DSU, representing C$83,000 per director or C$415,000 in the aggregate.

During the year ended December 31, 2020, in accordance with the DSU Plan, the Company granted each of the members of the Company's Board of Directors (other than those directors nominated for election by Paulson & Co., Inc.) 90,217 DSUs for a total of 451,085 DSUs with a grant date fair value (defined as the weighted average of the prices at which the common shares traded on the exchange with the most volume for the five trading days immediately preceding the grant) of C$0.92 per DSU, representing C$83,000 per director or C$415,000 in the aggregate.

The DSUs entitle the holders to receive common shares of the Company's stock without the payment of any consideration. The DSUs vested immediately upon being granted, but the common shares of stock underlying the DSUs are not deliverable to the grantee until the grantee is no longer serving on the Company's Board of Directors.

DSUs outstanding are as follows:

	Year Ended December 31, 2021		Year Ended December 31, 2020	
	Number of DSUs	Weighted average grant-date fair value (C$)	Number of DSUs	Weighted average grant-date fair value (C$)
Balance, beginning of the year	1,834,481	$ 0.81	1,383,396	$ 0.77
Issued	316,795	$ 1.31	451,085	$ 0.92
Delivered	—	—	—	—
Balance, end of the year	2,151,276	$ 0.88	1,834,481	$ 0.81

Share-based payments

During the year ended December 31, 2021, the Company granted 240,000 stock options and 316,795 DSUs. Share-based payment compensation for the year ended December 31, 2021 total $535,117 ($167,267 related to stock options and $367,850 related to DSUs). Of the total expense for the year ended December 31, 2021, $380,878 was included in consulting fees, $143,957 was included in wages and benefits, and $10,282 was included in investor relations in the statement of operations and comprehensive loss.

During the year ended December 31, 2020, the Company granted 255,000 stock options and 451,085 DSUs. Share-based payment compensation for the year ended December 31, 2020 totaled $385,531 ($90,914 related to stock options and $294,617 related to DSUs). Of the total expense for the year ended December 31, 2020, $304,205 was included in consulting fees, $74,870 was included in wages and benefits, and $6,456 was included in investor relations in the statement of operations and comprehensive loss.

The following weighted average assumptions were used for the Black-Scholes option pricing model of the stock options:

	Year ended December 31, 2021	Year ended December 31, 2020
Expected life of options	6 years	6 years
Risk-free interest rate	0.99 %	0.40 %
Expected volatility	81.22 %	80.92 %
Dividend rate	0.00 %	0.00 %
Exercise price (C$)	$ 1.31	$ 0.92

The expected volatility used in the Black-Scholes option pricing model is based on the historical volatility of the Company's shares.

8. SEGMENT AND GEOGRAPHIC INFORMATION

The Company operates in a single reportable operating segment, being the exploration and development of mineral properties. The following tables present selected financial information by geographic location:

	Canada	United States	Total
December 31, 2021			
Mineral property	$ —	$ 55,375,124	$ 55,375,124
Property and equipment	7,465	—	7,465
Current assets	7,439,101	483,250	7,922,351
Total assets	$ 7,446,566	$ 55,858,374	$ 63,304,940
December 31, 2020			
Mineral property	$ —	$ 55,375,124	$ 55,375,124
Property and equipment	7,832	—	7,832
Current assets	12,862,068	349,304	13,211,372
Total assets	$ 12,869,900	$ 55,724,428	$ 68,594,328

	Year ended December 31, 2021	Year ended December 31, 2020
Net loss for the year - Canada	$ (1,363,483)	$ (1,134,685)
Net loss for the year - United States	(4,616,805)	(3,384,033)
Net loss for the year	$ (5,980,288)	$ (4,518,718)

9. COMMITMENTS

The following table discloses, as of December 31, 2021, the Company's contractual obligations including anticipated mineral property payments and work commitments. Under the terms of the Company's mineral property purchase agreements, mineral leases and the terms of the unpatented mineral claims held by it, the Company is required to make certain scheduled acquisition payments, incur certain levels of expenditures, make lease or advance royalty payments, make payments to government authorities and incur assessment work expenditures as summarized in the table below in order to maintain and preserve the Company's interests in the related mineral properties. If the Company is unable or unwilling to make any such payments or incur any such expenditures, it is likely that the Company would lose or forfeit its rights to acquire or hold the related mineral properties. The following table assumes that the Company retains the rights to all of its current mineral properties, but does not exercise any lease purchase or royalty buyout options:

	Payments Due by Year						
	2022	2023	2024	2025	2026	2027 and beyond	Total
Mineral Property Leases(1)	$ 426,972	$ 513,715	$ 519,136	$ 524,625	$ 530,183	$ 535,810	$ 3,050,441
Mining Claim Government Fees	205,720	205,720	205,720	205,720	205,720	205,720	1,234,320
Total	$ 632,692	$ 719,435	$ 724,856	$ 730,345	$ 735,903	$ 741,530	$ 4,284,761

1. Does not include required work expenditures, as it is assumed that the required expenditure level is significantly below the work for which will actually be carried out by the Company. Does not include potential royalties that may be payable (other than annual minimum royalty payments). See Note 4.

10. RELATED PARTY TRANSACTIONS

On August 31, 2020, the Company entered into an At Market Issuance ("ATM") Sales Agreement with B. Riley Securities, Inc. ("B. Riley"), pursuant to which the Company was entitled, at its discretion and from time-to-time during the term of the sales agreement, to sell through B. Riley such number of common shares of the Company as would result in aggregate gross proceeds to the Company of up to $10,300,000 (the “Offering”). No offers or sales of common shares were made in Canada through the facilities of the TSX or other trading markets. On September 2, 2020, the Company announced that its existing three largest shareholders had each taken their pro-rata share of the Offering, resulting in the issuance of 4,490,997 common shares (representing 2% of the 187,573,671 shares previously issued and outstanding) at the September 1, 2020 closing market price of $1.40 per share for aggregate gross proceeds of $6,287,396.

11. LEASES

On December 12, 2019, the Company entered into a one-year operating lease agreement (for the lease period of January 1, 2020 through December 31, 2020) of the Fairbanks office. After the initial one-year lease period, the agreement has continued on a month-to-month basis. Therefore, the Company has elected the short-term lease recognition exemption for the office lease. Accordingly, office lease costs will continue to be reported as rent expense on the Consolidated Statements of Operations and Comprehensive Loss and the Company will not recognize a right-of-use (ROU) asset and lease liability on the Consolidated Balance Sheets.

ITEM 9. CHANGES IN AND DISAGREEMENTS WITH ACCOUNTANTS ON ACCOUNTING AND FINANCIAL DISCLOSURE.

None.

ITEM 9A. CONTROLS AND PROCEDURES

Disclosure Controls and Procedures

As of December 31, 2021, an evaluation was carried out under the supervision of and with the participation of the Company's management, including the Chief Executive Officer and Chief Financial Officer, of the effectiveness of the design and operation of the Company's disclosure controls and procedures (as defined in Rules 13a-15(e) and 15d-15(e) of the Exchange Act). Based on the evaluation, the Chief Executive Officer and the Chief Financial Officer have concluded that, as of December 31, 2021, the Company's disclosure controls and procedures were effective in ensuring that information required to be disclosed in reports filed or submitted to the SEC under the Exchange Act is (i) recorded, processed, summarized and reported within the time periods specified in applicable rules and forms and (ii) accumulated and communicated to management, including the Chief Executive Officer and Chief Financial Officer, in a manner that allows for timely decisions regarding required disclosures.

The effectiveness of our or any system of disclosure controls and procedures, however well designed and operated, can provide only reasonable assurance that the objectives of the system will be met and is subject to certain limitations, including the exercise of judgment in designing, implementing and evaluating controls and procedures and the assumptions used in identifying the likelihood of future events.

Management's Annual Report on Internal Control over Financial Reporting

Management is responsible for establishing and maintaining adequate internal control over financial reporting, as defined in Exchange Act Rule 13a-15(f). Management evaluated, with the participation of our Chief Executive Officer and Chief Financial Officer, the effectiveness of internal control over financial reporting as of December 31, 2021. In conducting this evaluation, management used the framework established by the Committee of Sponsoring Organizations of the Treadway Commission as set forth in Internal Control – Integrated Framework (2013). Based on this evaluation under the framework in Internal Control – Integrated Framework (2013), management concluded that internal control over financial reporting was effective as of December 31, 2021.

Because of its inherent limitations, a system of internal control over financial reporting may not prevent or detect misstatements. A control system, no matter how well designed and operated, can provide only reasonable, not absolute, assurance that the control system's objectives will be met. Further, the design of a control system must reflect the fact that there are resource constraints, and the benefits of controls must be considered relative to their costs. Because of the inherent limitations in all control systems, no evaluation of controls can provide absolute assurance that all control issues and instances of fraud, if any, have been detected. The design of any system of controls is based in part upon certain assumptions about the likelihood of future events, and there can be no assurance that any design will achieve its stated objectives under all future conditions.

This Annual Report on Form 10-K does not include an attestation report of the Company's independent public accounting firm regarding internal control over financial reporting. Management's report was not subject to attestation by the Company's independent public accounting firm pursuant to rules of the Securities and Exchange Commission that permit the Company to provide only management's report in this Annual Report on Form 10-K.

Changes in Internal Control over Financial Reporting

There were no changes in internal controls over financial reporting during the fourth quarter ended December 31, 2021 that have materially, or are reasonably likely to materially affect, the Company's internal control over financial reporting.

ITEM 9B. OTHER INFORMATION

None.

ITEM 9C. DISCLOSURE REGARDING FOREIGN JURISDICTIONS THAT PREVENT INSPECTIONS

Not applicable.

PART III

ITEM 10. DIRECTORS, EXECUTIVE OFFICERS, AND CORPORATE GOVERNANCE

The information required by Items 401, 405, 406, 407(c)(3), (d)(4) and (d)(5) of Regulation S-K will be included in the Company's Proxy Statement for its 2022 Annual Meeting of Shareholders to be filed with the SEC within 120 days after December 31, 2021 (the "2022 Proxy Statement"), and is incorporated by reference in this Annual Report on Form 10-K.

The Company's Code of Business Conduct and Ethics is available on the Company's website at www.ithmines.com. We intend to post on our website any amendments to, or waivers from our Code of Business Conduct and Ethics applicable to senior financial executives.

ITEM 11. EXECUTIVE COMPENSATION

The information required by Item 402 and paragraph (e)(4) and (e)(5) of Item 407 of Regulation S-K will be contained in the Company's 2022 Proxy Statement, and is incorporated by reference in this Annual Report on Form 10-K.

ITEM 12. SECURITY OWNERSHIP OF CERTAIN BENEFICIAL OWNERS AND MANAGEMENT AND RELATED STOCKHOLDER MATTERS

The information required by Item 201(d) and Item 403 of Regulation S-K will be contained in the Company's 2022 Proxy Statement, and is incorporated by reference in this Annual Report on Form 10-K.

ITEM 13. CERTAIN RELATIONSHIPS AND RELATED TRANSACTIONS, AND DIRECTOR INDEPENDENCE

The information required by Item 404 and Item 407(a) of Regulation S-K will be contained in the Company's 2022 Proxy Statement, and is incorporated by reference in this Annual Report on Form 10-K.

ITEM 14. PRINCIPAL ACCOUNTING FEES AND SERVICES

The information required by Item 9(e) of Schedule 14A will be filed in the Company's 2022 Proxy Statement, and is incorporated by reference in this Annual Report on Form 10-K.

PART IV

ITEM 15. EXHIBITS AND FINANCIAL STATEMENT SCHEDULES

(a) Documents filed as part of this report

(1) All financial statements

The report of independent registered public accounting firm (Davidson & Company LLP, Vancouver, British Columbia, Canada, PCAOB ID 731)

The consolidated statements of operations and comprehensive loss, cash flows, and changes in shareholders' equity, and the consolidated balance sheets are included as part of Part II, Item 8, Financial Statements and Supplementary Data.

(2) Financial statement schedules

All financial statement schedules have been omitted, since the information is either not applicable or required, or because the information required is included in the consolidated financial statements and notes thereto included in this Form 10-K.

(3) Exhibits required by Item 601 of Regulation S-K

Exhibit Number	Description
3.1	Amended and Restated Articles of the Company, as amended on June 21, 2021 (filed as Exhibit 3.1 to the Company's Quarterly Report on Form 10-Q on August 6, 2021 and incorporated herein by reference)
4.1	Form of Common Share Certificate (filed as Exhibit 1 to the Company's Form 8-A on August 2, 2007 and incorporated herein by reference)
4.2	Investor Rights Agreement, dated December 28, 2016, between International Tower Hill Mines Ltd. and Paulson & Co. Inc. (filed as Exhibit 4.1 to the Company's Form 8-K filed on January 5, 2017 and incorporated herein by reference)
4.3+	Description of Securities
10.1	Mining Lease with Option to Purchase, dated January 18, 2007, between Talon Gold Alaska Inc. and Bernard E. Griffin, Donna Griffin, Larry Kilgore, Sherry Gerbi, Jerry Griffin, Tim Miller, Lynne Miller, Robert and Marcia Miller (filed as Exhibit 11 to the Company's Form 20-F on December 3, 2007 and incorporated herein by reference)
10.2**	Upland Mining Lease, effective July 1, 2004, between the Alaska Mental Health Trust Authority and Tower Hill Mines, Inc. (as successor to AngloGold (U.S.A.)) (filed as Exhibit 10.1 to the Company's Quarterly Report on Form 10-Q/A on December 10, 2013 and incorporated herein by reference)
10.3	Addendum No. 2 to Upland Mining Lease, effective July 1, 2007, between the State of Alaska, Department of Natural Resources, Mental Health Trust Land Office and Tower Hill Mines, Inc. (formerly Talon Gold Alaska, Inc.) (filed as Exhibit 10.2 to the Company's Quarterly Report on Form 10-Q on November 6, 2013 and incorporated herein by reference)
10.4	Addendum No. 3 to Upland Mining Lease, effective January 1, 2010, between the State of Alaska, Department of Natural Resources, Mental Health Trust Land Office and Tower Hill Mines, Inc. (formerly Talon Gold Alaska, Inc.) (filed as Exhibit 10.3 to the Company's Quarterly Report on Form 10-Q on November 6, 2013 and incorporated herein by reference)

10.5	Addendum No. 4 to Upland Mining Lease, effective June 27, 2013, between the State of Alaska, Department of Natural Resources, Mental Health Trust Land Office and Tower Hill Mines, Inc. (filed as Exhibit 10.4 to the Company's Quarterly Report on Form 10-Q on November 6, 2013 and incorporated herein by reference)
10.6**	Addendum No. 5 to Upland Mining Lease, effective June 30, 2013, between the State of Alaska, Department of Natural Resources, Mental Health Trust Land Office and Tower Hill Mines, Inc. (filed as Exhibit 10.5 to the Company's Quarterly Report on Form 10-Q on November 6, 2013 and incorporated herein by reference)
10.7*	2006 Stock Option Plan, as amended September 19, 2012 (filed as Exhibit 10.9 to the Company's Form 10-K on March 13, 2013 and incorporated herein by reference)
10.8*	Form of Stock Option Agreement for use under the 2006 Stock Option Plan (filed as Exhibit 10.10 to the Company's Form 10-K on March 13, 2013 and incorporated herein by reference)
10.9*	2017 Deferred Share Unit Incentive Plan (filed as Exhibit 10.2 to the Company's Quarterly Report on Form 10-Q on August 11, 2017 and incorporated herein by reference)
10.10*	Consulting Agreement, dated May 11, 2015, between David A. Cross and International Tower Hill Mines Ltd. (filed as Exhibit 10.1 to the Company's Form 8-K filed on May 12, 2015 and incorporated herein by reference)
10.11*	Financial and Accounting Consulting Agreement, dated May 11, 2015, between Cross Davis & Company LLP, Certified General Accountants and International Tower Hill Mines Ltd. (filed as Exhibit 10.2 to the Company's Form 8-K filed on May 12, 2015 and incorporated herein by reference)
10.12*	Amended and Restated Employment Agreement, dated March 12, 2018, between Karl Hanneman and Tower Hill Mines (US) LLC (filed as Exhibit 10.16 to the Company's Form 10-K on March 16, 2018 and is incorporated herein by reference)
10.13	Amended and Restated Mining Lease, dated November 22, 2017, between Kasey Leigh Tucker and Tower Hill Mines, Inc. to amend and restate Mining Lease effective as of March 28, 2017, between Ronald Tucker and Talon Gold Alaska, Inc. (filed as Exhibit 10.16 to the Company's Form 10-K on March 15, w18 and incorporated herein by reference)
10.14	Subscription Agreement, dated March 13, 2018, between the Company and Electrum Strategic Opportunities Fund II, L.P. (filed as Exhibit 10.1 to the Company's Form 8-K filed on March 16, 2018 and incorporated herein by reference)
10.15	Subscription Agreement, dated March 13, 2018, between the Company and Paulson & Co. Inc. (filed as Exhibit 10.2 to the Company's Form 8-K filed on March 16, 2018 and incorporated herein by reference)
21.1	Subsidiaries of the Company (filed as Exhibit 21.1 to the Company's Annual Report on Form 10-K on March 10, 2021 and incorporated herein by reference)
23.1+	Consent of Davidson & Company LLC
23.2+	Consent of BBA USA Inc.
23.3+	Consent of NewFields Mining Design & Technical Services, LLC
23.4+	Consent of JDS Energy & Mining Inc.
23.5+	Consent of Resource Development Associates Inc.
24+	Power of Attorney (see signature page)
31.1+	Certification of Principal Executive Officer pursuant to Exchange Act Rules 13a-14(a) and 15d-14(a), as adopted pursuant to Section 302 of the Sarbanes-Oxley Act of 2002

31.2+	Certification of Principal Financial and Accounting Officer pursuant to Exchange Act Rules 13a-14(a) and 15d-14(a), as adopted pursuant to Section 302 of the Sarbanes-Oxley Act of 2002
32.1+	Certification of the Principal Executive Officer pursuant to 18 U.S.C. Section 1350, as adopted pursuant to Section 906 of the Sarbanes-Oxley Act of 2002
32.2+	Certification of the Principal Financial and Accounting Officer pursuant to 18 U.S.C. Section 1350, as adopted pursuant to Section 906 of the Sarbanes-Oxley Act of 2002
96.1+	Technical Report Summary for the Livengood Gold Project
101	Interactive data files pursuant to Rule 405 of Regulation S-T: (i) the Consolidated Balance Sheets at December 31, 2021 and 2020, (ii) the Consolidated Statements of Operations and Comprehensive Loss for the Years Ended December 31, 2021 and 2020, (iii) the Consolidated Statements of Changes in Shareholders' Equity for the Years Ended December 31, 2021 and 2020, (iv) the Consolidated Statements of Cash Flows for the Years Ended December 31, 2021 and 2020, and (v) the Notes to the Consolidated Financial Statements
104+	Cover Page Interactive Data File (formatted as Inline XBRL and contained in Exhibit 101)

* Management contract or compensatory plan or arrangement

** Certain portions of this exhibit have been omitted by redacting a portion of the text (indicated by asterisks in the text). This exhibit has been filed separately with the Securities and Exchange Commission pursuant to a request for confidential treatment.

\+ Filed or furnished herewith

The information required by Section (a)(3) of Item 15 is set forth on the Exhibit Index that follows the signatures page of this Form 10-K.

ITEM 16. FORM 10-K SUMMARY

Not applicable.

SIGNATURES

Pursuant to the requirements of Section 13 or 15(d) of the Securities Exchange Act of 1934, the registrant has duly caused this report to be signed on its behalf by the undersigned, thereunto duly authorized.

International Tower Hill Mines Ltd.

By: /s/ Karl L. Hanneman
Karl L. Hanneman
Chief Executive Officer

Date: March 9, 2022

Power of Attorney

KNOW ALL PERSONS BY THESE PRESENTS, that each person whose signature appears below constitutes and appoints Karl. L. Hanneman as his attorney-in-fact, with the power of substitution, for him in any and all capacities, to sign any amendments to this Annual Report on Form 10-K, and to file the same, with exhibits thereto and other documents in connection therewith, with the Securities and Exchange Commission, hereby ratifying and confirming all that said attorney-in-fact, or his substitute or substitutes, may do or cause to be done by virtue hereof.

Pursuant to the requirements of the Securities Exchange Act of 1934, this report has been signed below by the following persons on behalf of the registrant and in the capacities and on the dates indicated.

By: /s/ Karl L. Hanneman
Karl L. Hanneman
Chief Executive Officer and Director
(Principal Executive Officer)

Date: March 9, 2022

By: /s/ David Cross
David Cross
Chief Financial Officer
(Principal Financial and Accounting Officer)

Date: March 9, 2022

By: /s/ Anton J. Drescher
Anton J. Drescher
Director

Date: March 9, 2022

By: /s/ Stuart A. Harshaw
Stuart A. Harshaw
Director

Date: March 9, 2022

By: /s/ Marcelo Kim
Marcelo Kim
Director

Date: March 9, 2022

By: /s/ Stephen A. Lang
Stephen A. Lang
Director

Date: March 9, 2022

By: /s/ Christopher Papagianis
Christopher Papagianis
Director

Date: March 9, 2022

By: /s/ Thomas S. Weng
Thomas S. Weng
Director

Date: March 9, 2022

EXHIBIT 4.3

DESCRIPTION OF INTERNATIONAL TOWER HILL MINES COMMON SHARES

The common shares, no par value (the "**common shares**"), of International Tower Hill Mines Ltd. (the "**Company**") are the Company's only class of securities registered under Section 12 of the Securities Exchange Act of 1934, as amended (the "**Exchange Act**").

The following description of our common shares is a summary and does not purport to be complete. It is subject to and qualified in its entirety by reference to our Articles of the Company, as amended and restated (the "**Articles**"), which are filed as Exhibit 3.1 to the Company's Quarterly Report on Form 10-Q on August 6, 2021 and incorporated herein by reference. We are incorporated in the Province of British Columbia, Canada and are subject to the *Business Corporations Act* (British Columbia).

Authorized Capital Shares

The Company's share capital consists of an unlimited number of authorized common shares of which 194,908,184 are issued and outstanding as of March 1, 2022. The outstanding common shares are fully paid and nonassessable. No other classes of shares are currently authorized.

Voting Rights

Holders of common shares are entitled to receive notice of and to attend any meetings of shareholders of the Company and at any meetings of shareholders to cast one vote for each common share held. Holders of common shares do not have cumulative voting rights. A simple majority of votes cast on a resolution is required to pass an ordinary resolution; however, if the resolution is a special resolution two-thirds of the votes cast on the special resolution are required to pass it.

Dividend Rights and Liquidation Rights

Holders of common shares are entitled to receive dividends as and when declared by the board of directors of the Company at its discretion from funds legally available therefor and to receive a pro rata share of the assets of the Company available for distribution to the shareholders in the event of the liquidation, dissolution or winding-up of the Company after payment of debts and other liabilities, in each case subject to the rights, privileges, restrictions and conditions attached to any other series or class of shares ranking senior in priority to or on a pro-rata basis with the holders of common shares with respect to dividends or liquidation.

Other Rights and Preferences

There are no pre-emptive, subscription, conversion or redemption rights attached to the common shares nor do they contain any sinking or purchase fund provisions.

Considerations for Non-Resident Holders

There are no limitations under the laws of Canada or in the organizing documents of the Company on the right of foreigners to hold or vote securities of the Company or affecting the remittance of dividends, interest and other payments to non-residents, except that the *Investment Canada Act* (Canada) may require review and approval by the Minister of Industry (Canada) of certain acquisitions of "control" of the Company by a "non-Canadian." See "Certain Canadian Federal Income Tax Considerations for U.S. Holders" and "Certain U.S. Federal Income Tax Considerations" in the Form 10-K under Part II. Item 5. Market For Registrant's Common Equity, Related Stockholder Matters And Issuer Purchases Of Equity Securities for additional information.

EXHIBIT 23.1

DAVIDSON & COMPANY LLP Chartered Professional Accountants

CONSENT OF INDEPENDENT REGISTERED PUBLIC ACCOUNTING FIRM

We hereby consent to the incorporation by reference in the Registration Statements on Form S-3 (No. 333-240276) and Forms S-8 (No. 333-174617, 333-158533 and 333-141353) of International Tower Hill Mines Ltd. of our report dated March 8, 2022, relating to the consolidated financial statements of International Tower Hill Mines Ltd., which appears in Form 10-K of International Tower Hill Mines Ltd. dated March 8, 2022.

(Signed) DAVIDSON & COMPANY LLP

Vancouver, British Columbia

Chartered Professional Accountants

March 8, 2022

A member of Nexia International

1200 - 609 Granville Street, P.O. Box 10372, Pacific Centre, Vancouver, B.C., Canada V7Y 1G6
Telephone (604) 687-0947 Davidson-co.com

EXHIBIT 23.2

CONSENT – BBA USA INC.

In connection with the International Tower Hill Mines Ltd. Annual Report on Form 10-K for the year ended December 31, 2021 and any amendments or supplements and/or exhibits thereto (collectively, the "Form 10-K"), the undersigned consents to:

(i) the filing and use of Chapters 2, 3, 10 (except Section 10.5.16.7), 12 (except Section 12.3.3.1), 13, 14, 15 (except Sections 15.14, and 15.19), 16, 17, 18, 19, 21, and the relevant portions of Chapters 1, 22, 23, 24 and 25 of the technical report summary titled "Pre-feasibility Study of the Livengood Gold Project, Alaska, USA" (the "TRS"), with an effective date of October 29, 2021, as an exhibit to and referenced in the Form 10-K;

(ii) the incorporation by reference of Chapters 2, 3, 10 (except Section 10.5.16.7), 12 (except Section 12.3.3.1), 13, 14, 15 (except Sections 15.14, and 15.19), 16, 17, 18, 19, 21, and the relevant portions of Chapters 1, 22, 23, 24 and 25 of the TRS in the Registration Statements of International Tower Hill Mines Ltd. on Form S-3 (No. 333-240276) and Form S-8 (Nos. 333-174617, 333-158533, and 333-141353) (the "Registration Statements");

(iii) the use of and references to our name, including our status as an expert or "qualified person" (as defined in Subpart 1300 of Regulation S-K promulgated by the Securities and Exchange Commission), in connection with Chapters 2, 3, 10 (except Section 10.5.16.7), 12 (except Section 12.3.3.1), 13, 14, 15 (except Sections 15.14, and 15.19), 16, 17, 18, 19, 21, and the relevant portions of Chapters 1, 22, 23, 24 and 25 of the TRS, Form 10-K and the Registration Statements; and

(iv) any extracts or summaries of Chapters 2, 3, 10 (except Section 10.5.16.7), 12 (except Section 12.3.3.1), 13, 14, 15 (except Sections 15.14, and 15.19), 16, 17, 18, 19, 21, and the relevant portions of Chapters 1, 22, 23, 24 and 25 of the TRS included or incorporated by reference in the Form 10-K and the Registration Statements, and the use of any information derived, summarized, quoted or referenced from the Chapters 2, 3, 10 (except Section 10.5.16.7), 12 (except Section 12.3.3.1), 13, 14, 15 (except Sections 15.14, and 15.19), 16, 17, 18, 19, 21, and the relevant portions of Chapters 1, 22, 23, 24 and 25 of the TRS, or portions thereof, that were prepared by us, that we supervised the preparation of, and/or that were reviewed and approved by us, that is included or incorporated by reference in the Form 10-K and the Registration Statements.

Dated: February 23, 2022
By: /s/ Signed "BBA USA Inc."
Name: BBA USA Inc.

EXHIBIT 23.3

CONSENT – NEWFIELDS MINING DESIGN & TECHNICAL SERVICES, LLC

In connection with the International Tower Hill Mines Ltd. Annual Report on Form 10-K for the year ended December 31, 2021 and any amendments or supplements and/or exhibits thereto (collectively, the “Form 10-K”), the undersigned consents to:

(i) the filing and use of Sections 10.5.16.7, 15.14, 15.19, and the relevant portions of Chapters 1, 18, 22, 23, 24 and 25 of the technical report summary titled “Pre-feasibility Study of the Livengood Gold Project, Alaska, USA” (the “TRS”), with an effective date of October 29, 2021, as an exhibit to and referenced in the Form 10-K;

(ii) the incorporation by reference of Sections 10.5.16.7, 15.14, 15.19, and the relevant portions of Chapters 1, 18, 22, 23, 24 and 25 of the TRS in the Registration Statements of International Tower Hill Mines Ltd. on Form S-3 (No. 333-240276) and Form S-8 (Nos. 333-174617, 333-158533, and 333-141353) (the “Registration Statements”);

(iii) the use of and references to our name, including our status as an expert or “qualified person” (as defined in Subpart 1300 of Regulation S-K promulgated by the Securities and Exchange Commission), in connection with Sections 10.5.16.7, 15.14, 15.19, and the relevant portions of Chapters 1, 18, 22, 23, 24 and 25 of the TRS, Form 10-K and the Registration Statements; and

(iv) any extracts or summaries of Sections 10.5.16.7, 15.14, 15.19, and the relevant portions of Chapters 1, 18, 22, 23, 24 and 25 of the TRS included or incorporated by reference in the Form 10-K and the Registration Statements, and the use of any information derived, summarized, quoted or referenced from the Sections 10.5.16.7, 15.14, 15.19, and the relevant portions of Chapters 1, 18, 22, 23, 24 and 25 of the TRS, or portions thereof, that were prepared by us, that we supervised the preparation of, and/or that were reviewed and approved by us, that is included or incorporated by reference in the Form 10-K and the Registration Statements.

Dated: February 23, 2022
By: /s/ Signed “NewFields Mining Design & Technical Services, LLC”
Name: NewFields Mining Design & Technical Services, LLC

EXHIBIT 23.4

CONSENT – JDS ENERGY & MINING INC.

In connection with the International Tower Hill Mines Ltd. Annual Report on Form 10-K for the year ended December 31, 2021 and any amendments or supplements and/or exhibits thereto (collectively, the "Form 10-K"), the undersigned consents to:

(i) the filing and use of Section 12.3.3.1, and the relevant portions of Chapters 1, 22, 23, 24 and 25 of the technical report summary titled "Pre-feasibility Study of the Livengood Gold Project, Alaska, USA" (the "TRS"), with an effective date of October 29, 2021, as an exhibit to and referenced in the Form 10-K;

(ii) the incorporation by reference of Section 12.3.3.1, and the relevant portions of Chapters 1, 22, 23, 24 and 25 of the TRS in the Registration Statements of International Tower Hill Mines Ltd. on Form S-3 (No. 333-240276) and Form S-8 (Nos. 333-174617, 333-158533, and 333-141353) (the "Registration Statements");

(iii) the use of and references to our name, including our status as an expert or "qualified person" (as defined in Subpart 1300 of Regulation S-K promulgated by the Securities and Exchange Commission), in connection with Section 12.3.3.1, and the relevant portions of Chapters 1, 22, 23, 24 and 25 of the TRS, Form 10-K and the Registration Statements; and

(iv) any extracts or summaries of Section 12.3.3.1, and the relevant portions of Chapters 1, 22, 23, 24 and 25 of the TRS included or incorporated by reference in the Form 10-K and the Registration Statements, and the use of any information derived, summarized, quoted or referenced from the Section 12.3.3.1, and the relevant portions of Chapters 1, 22, 23, 24 and 25 of the TRS, or portions thereof, that were prepared by us, that we supervised the preparation of, and/or that were reviewed and approved by us, that is included or incorporated by reference in the Form 10-K and the Registration Statements.

Dated: February 23, 2022
By: /s/ Signed "JDS Energy & Mining Inc."
Name: JDS Energy & Mining Inc.

EXHIBIT 23.5

CONSENT – RESOURCE DEVELOPMENT ASSOCIATES INC.

In connection with the International Tower Hill Mines Ltd. Annual Report on Form 10-K for the year ended December 31, 2021 and any amendments or supplements and/or exhibits thereto (collectively, the “Form 10-K”), the undersigned consents to:

(i) the filing and use of Chapters 4, 5, 6 ,7 ,8, 9, 11 and 20, and the relevant portions of Chapters 1, 22, 23, 24 and 25 of the technical report summary titled “Pre-feasibility Study of the Livengood Gold Project, Alaska, USA” (the “TRS”), with an effective date of October 29, 2021, as an exhibit to and referenced in the Form 10-K;

(ii) the incorporation by reference of Chapters 4, 5, 6 ,7 ,8, 9, 11 and 20, and the relevant portions of Chapters 1, 22, 23, 24 and 25 of the TRS in the Registration Statements of International Tower Hill Mines Ltd. on Form S-3 (No. 333-240276) and Form S-8 (Nos. 333-174617, 333-158533, and 333-141353) (the “Registration Statements”);

(iii) the use of and references to our name, including our status as an expert or “qualified person” (as defined in Subpart 1300 of Regulation S-K promulgated by the Securities and Exchange Commission), in connection with Chapters 4, 5, 6 ,7 ,8, 9, 11 and 20, and the relevant portions of Chapters 1, 22, 23, 24 and 25 of the TRS, Form 10-K and the Registration Statements; and

(iv) any extracts or summaries of Chapters 4, 5, 6 ,7 ,8, 9, 11 and 20, and the relevant portions of Chapters 1, 22, 23, 24 and 25 of the TRS included or incorporated by reference in the Form 10-K and the Registration Statements, and the use of any information derived, summarized, quoted or referenced from the Chapters 4, 5, 6 ,7 ,8, 9, 11 and 20, and the relevant portions of Chapters 1, 22, 23, 24 and 25 of the TRS, or portions thereof, that were prepared by us, that we supervised the preparation of, and/or that were reviewed and approved by us, that is included or incorporated by reference in the Form 10-K and the Registration Statements.

Dated: February 23, 2022
By: /s/ Signed “Resource Development Associates Inc.”
Name: Resource Development Associates Inc.

EXHIBIT 31.1

CERTIFICATION

I, Karl L. Hanneman, certify that:

1. I have reviewed this Annual Report on Form 10-K of International Tower Hill Mines Ltd.;

2. Based on my knowledge, this report does not contain any untrue statement of a material fact or omit to state a material fact necessary to make the statements made, in light of the circumstances under which such statements were made, not misleading with respect to the period covered by this report;

3. Based on my knowledge, the financial statements, and other financial information included in this report, fairly present in all material respects the financial condition, results of operations and cash flows of the registrant as of, and for, the periods presented in this report;

4. The registrant's other certifying officer(s) and I are responsible for establishing and maintaining disclosure controls and procedures (as defined in Exchange Act Rules 13a-15(e) and 15d-15(e)) and internal control over financial reporting (as defined in Exchange Act Rules 13a-15(f) and 15d-15(f)) for the registrant and have:

(a) Designed such disclosure controls and procedures, or caused such disclosure controls and procedures to be designed under our supervision, to ensure that material information relating to the registrant, including its consolidated subsidiaries, is made known to us by others within those entities, particularly during the period in which this report is being prepared;

(b) Designed such internal control over financial reporting, or caused such internal control over financial reporting to be designed under our supervision, to provide reasonable assurance regarding the reliability of financial reporting and the preparation of financial statements for external purposes in accordance with generally accepted accounting principles;

(c) Evaluated the effectiveness of the registrant's disclosure controls and procedures and presented in this report our conclusions about the effectiveness of the disclosure controls and procedures, as of the end of the period covered by this report based on such evaluation; and

(d) Disclosed in this report any change in the registrant's internal control over financial reporting that occurred during the registrant's most recent fiscal quarter (the registrant's fourth fiscal quarter in the case of an annual report) that has materially affected, or is reasonably likely to materially affect, the registrant's internal control over financial reporting; and

5. The registrant's other certifying officer(s) and I have disclosed, based on our most recent evaluation of internal control over financial reporting, to the registrant's auditors and the audit committee of the registrant's board of directors (or persons performing the equivalent functions):

(a) All significant deficiencies and material weaknesses in the design or operation of internal control over financial reporting which are reasonably likely to adversely affect the registrant's ability to record, process, summarize and report financial information; and

(b) Any fraud, whether or not material, that involves management or other employees who have a significant role in the registrant's internal control over financial reporting.

Date: March 9, 2022

By: /s/ Karl L. Hanneman
Karl L. Hanneman
Chief Executive Officer
(Principal Executive Officer)

XHIBIT 31.2

CERTIFICATIONS

I, David Cross, certify that:

1. I have reviewed this Annual Report on Form 10-K of International Tower Hill Mines Ltd.;

2. Based on my knowledge, this report does not contain any untrue statement of a material fact or omit to state a material fact necessary to make the statements made, in light of the circumstances under which such statements were made, not misleading with respect to the period covered by this report;

3. Based on my knowledge, the financial statements, and other financial information included in this report, fairly present in all material respects the financial condition, results of operations and cash flows of the registrant as of, and for, the periods presented in this report;

4. The registrant's other certifying officer(s) and I are responsible for establishing and maintaining disclosure controls and procedures (as defined in Exchange Act Rules 13a-15(e) and 15d-15(e)) and internal control over financial reporting (as defined in Exchange Act Rules 13a-15(f) and 15d-15(f)) for the registrant and have:

(a) Designed such disclosure controls and procedures, or caused such disclosure controls and procedures to be designed under our supervision, to ensure that material information relating to the registrant, including its consolidated subsidiaries, is made known to us by others within those entities, particularly during the period in which this report is being prepared;

(b) Designed such internal control over financial reporting, or caused such internal control over financial reporting to be designed under our supervision, to provide reasonable assurance regarding the reliability of financial reporting and the preparation of financial statements for external purposes in accordance with generally accepted accounting principles;

(c) Evaluated the effectiveness of the registrant's disclosure controls and procedures and presented in this report our conclusions about the effectiveness of the disclosure controls and procedures, as of the end of the period covered by this report based on such evaluation; and

(d) Disclosed in this report any change in the registrant's internal control over financial reporting that occurred during the registrant's most recent fiscal quarter (the registrant's fourth fiscal quarter in the case of an annual report) that has materially affected, or is reasonably likely to materially affect, the registrant's internal control over financial reporting; and

5. The registrant's other certifying officer(s) and I have disclosed, based on our most recent evaluation of internal control over financial reporting, to the registrant's auditors and the audit committee of the registrant's board of directors (or persons performing the equivalent functions):

(a) All significant deficiencies and material weaknesses in the design or operation of internal control over financial reporting which are reasonably likely to adversely affect the registrant's ability to record, process, summarize and report financial information; and

(b) Any fraud, whether or not material, that involves management or other employees who have a significant role in the registrant's internal control over financial reporting.

Date: March 9, 2022

By: /s/ David Cross
David Cross
Chief Financial Officer
(Principal Financial and Accounting Officer)

EXHIBIT 32.1

CERTIFICATION PURSUANT TO 18 U.S.C. SECTION 1350
AS ADOPTED PURSUANT TO
SECTION 906 OF THE SARBANES-OXLEY ACT OF 2002

In connection with the Annual Report on Form 10-K of International Tower Hill Mines Ltd. (the "Company"), for the period ended December 31, 2021, as filed with the Securities and Exchange Commission on the date hereof (the "Report"), I, Karl L. Hanneman, Chief Executive Officer of the Company, hereby certify pursuant to 18 U.S.C. Section 1350, as adopted pursuant to Section 906 of the Sarbanes-Oxley Act of 2002, that, to my knowledge:

1. The Report fully complies with the requirements of Section 13(a) or 15(d) of the Securities Exchange Act of 1934; and

2. The information contained in the Report fairly presents, in all material respects, the financial condition and results of operation of the Company.

Date: March 9, 2022	By: /s/ Karl L. Hanneman
	Karl L. Hanneman Chief Executive Officer (Principal Executive Officer)

EXHIBIT 32.2

**CERTIFICATION PURSUANT TO 18 U.S.C. SECTION 1350
AS ADOPTED PURSUANT TO
SECTION 906 OF THE SARBANES-OXLEY ACT OF 2002**

In connection with the Annual Report on Form 10-K of International Tower Hill Mines Ltd. (the "Company"), for the period ended December 31, 2021, as filed with the Securities and Exchange Commission on the date hereof (the "Report"), I, David Cross, Chief Financial Officer for the Company, hereby certify pursuant to 18 U.S.C. Section 1350, as adopted pursuant to Section 906 of the Sarbanes-Oxley Act of 2002, that, to my knowledge:

1. The Report fully complies with the requirements of Section 13(a) or 15(d) of the Securities Exchange Act of 1934; and

2. The information contained in the Report fairly presents, in all material respects, the financial condition and results of operation of the Company.

Date: March 9, 2022

By: /s/ David Cross
David Cross
Chief Financial Officer
(Principal Financial and Accounting Officer)

Exhibit 96.1

S-K 1300 Technical Report Summary

Pre-feasibility Study of the **Livengood Gold Project**

Livengood, Alaska, USA

Effective Date: **October 29, 2021**
Signature Date: **February 23, 2022**

Prepared for:

International Tower Hill Mines Ltd.

By:
BBA USA Inc.
NewFields Mining & Design & Technical Services, LLC
JDS Energy & Mining Inc.
Resource Development Associates Inc.

NewFields

JDS Energy & Mining Inc.

Resource
Development
Associates Inc.

DATE AND SIGNATURE PAGE

This report is effective as of the 29th day of October 2021 and is current as of December 31, 2021 for S-K 1300 purposes:

"Original signed on file"	February 23, 2022
BBA USA Inc.	Date
"Original signed on file"	February 23, 2022
NewFields Mining & Design & Technical Services, LLC	Date
"Original signed on file"	February 23, 2022
JDS Energy & Mining Inc.	Date
"Original signed on file"	February 23, 2022
Resource Development Associates Inc.	Date

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TABLE OF ABBREVIATIONS	
Abbreviation	**Description**
AARL	Anglo American Research Laboratories
ADR	Adsorption, desorption and reactivation
Ag	Silver
AGA	AngloGold Ashanti
Ai	Abrasion index
AISC	all-in sustaining costs
AMHT	Alaska Mental Health Trust
amsl	above mean sea level
ANFO	Ammonium Nitrate Fuel Oil
APDES	Alaska Pollution Discharge Elimination System
APR	Annual Percentage Rate
ARD	Acid Rock Drainage
Au	Gold
B	Billion
BBA	BBA Inc.
BWi	Bond Work index
C	Carbon
CaO	Calcium oxide (quicklime)
CCTV	closed-circuit television
CEQ	Council of Environmental Quality
CIL	Carbon in leach
CIM	Canadian Institute of Mining
CIP	Carbon in pulp
CN	Cyanide
CND	Cyanide detoxification
CNT	Cyanide (total)
CN_{WAD}	Cyanide (weak acid dissociable)
CSS	Contact Support Services
Cu	Copper
$CuSO_4$	Copper sulphate
CWi	Crusher Work index
DEF	Diesel exhaust fluid
DOT	Department of Transportation
DTH	down-the-hole
DWT	JK Drop Weight Test
EC	Engineer’s compliance
EIS	Environmental Impact Study

TABLE OF ABBREVIATIONS	
Abbreviation	**Description**
EO	Enterprise Optimization
EPA	United States Environmental Protection Agency
EPCM	Engineering, Procurement, Construction Management
EPS	Electric Power Systems, Inc.
et al.	and others
FNSB	Fairbanks North Star Borough
FOB	Freight on board
FS	Feasibility Study
G&A	General and Administration
GCL	Geosynthetic clay liner
GOH	Gross operating hours
GRG	Gravity recoverable gold
GVEA	Golden Valley Electrical Association
HCl	Hydrochloric acid
Hg	mercury
ICP	Inductively coupled plasma
ID2	Inverse Distance square
ID3	Inverse Distance cube
IDW	Inverse Distance Weighting
ILR	Intensive Leach Reactor
IROC	Integrated remote operating center
IRR	Internal Rate of Return
IT	Information Technology
ITH	International Tower Hill Mines, Ltd.
JDS	JDS Energy and Mining Inc.
K	Thousand
KPI(s)	Key performance indictors
LLC	Limited Liability Company
LLDPE	Linear low density polyethylene
LNG	Liquefied natural gas
LOM	Life of mine
LPI	Livengood Placers, Inc.
M	Million
MACRS	Modified Accelerated Cost Recovery System
ML	Metal leaching
MMBTU	Metric Million British thermal units
MPSO	MinePlan Schedule Optimizer

TABLE OF ABBREVIATIONS	
Abbreviation	**Description**
MS	Mineral survey
MSV	massive stibnite veins
MWMP	Meteoric Water Mobility Potential
$Na_2S_2O_5$	Sodium Metabisulfite
NaCN	Sodium cyanide
NAD	North American Datum (Topographical Surveying)
NaOH	Sodium hydroxide
NEPA	National Environmental Policy Act
NewFields	NewFields Mining Design & Technical Services, LLC
NHPA	National Historic Preservation Act
NN	Nearest neighbor
no.	Number
NOH	Net operating hours
NPI	Net Profits Interest
NPV	Net Present Value
NSR	Net Smelter Return
O_2	Oxygen
OCS	O'Connor Creek Substation
OK	Ordinary Kriging
PAG	Potentially Acid Generating
$PbNO_3$	Lead nitrate
PEP	Project execution plan
PFS	Pre-feasibility Study
PLT(s)	Point load test(s)
POF	Probability of failure
QA/QC	Quality Assurance/Quality Control
QP(s)	Qualified Person(s)
QSV	Quartz-stibnite-vein
RC	Reverse Circulation
RCM	Reliability-Centred Maintenance
RCRA	Resource Conservation and Recovery Act
RDA	Resource Development Associates Inc.
RMR	Rock Mass Rating
ROM	Run of mine
ROW	Right of way
RT	Rock type
RWi	Rod Work index

TABLE OF ABBREVIATIONS	
Abbreviation	**Description**
S	Sulfur
SABC	Comminution circuit consisting of a SAG mill, ball mill and pebble crusher
SAG	Semi-Autogenous Grinding
Sb	Antimony
sg	Specific gravity
SHPO	State Historic Preservation Office
SMC	SAG Mill Comminution
SO_2	Sulfur dioxide
SPCC	Spill Prevention, Control and Countermeasure Plan
SPI	SAG Power Index
SRIL	SR International Logistics
SRK	SRK Consulting (Canada and US) Inc.
SVC	Static VAR Compensator
SWPPP	Storm Water Pollution Protection Plan
TAPS	Trans-Alaska Pipeline
TBC	To be confirmed
THM	Tower Hill Mines, Inc.
TMF	Tailings management facility
TRS	Technical Report Summary
TSF	Tailing storage facility
UCS	Uniaxial Compressive Strength
US	United States
USD	United States dollars
USGS	United States Geological Survey
UTM	Universal Transverse Mercator Coordinate System
VPSA	Vacuum pressure swing adsorption
WOL	Whole ore leach
WRSF	Waste rock storage facility
XRF	X-ray Fluorescence
YT	Yukon-Tanana

TABLE OF ABBREVIATIONS – UNITS OF MEASUREMENT	
Unit	**Description**
$ or USD	United States dollar
$/mt	Dollars per metric ton
$/t	Dollars per ton
%	Percent
a	Annum (year)
A	Ampere
˚C	Degrees Celsius
˚F	Degrees Fahrenheit
µm	micron
cm	centimeter
cm^3	cubic centimeter
d	day (24 hours)
deg or o	angular degree
F_{80}	80% passing - Feed
ft	feet (12 inches)
ft2	square feet
g	gram
g/g	grams per gram
g/L	gram per Liter
g/mt	grams per metric ton
gal	gallon
gpm	(US) gallons per minute
h	hour (60 minutes)
ha	hectare
hp	horsepower
Hz	Hertz
in	inch
k	kips (1,000 pounds)
kg	kilogram
kg/m^2	kilograms per square meter
kg/mt	kilograms per metric ton
km	kilometer
km/h	kilometers per hour
kW	kilowatt
kWh/mt	kilowatt hour per metric ton
kWh/t	kilowatt hour per ton

TABLE OF ABBREVIATIONS – UNITS OF MEASUREMENT	
Unit	**Description**
L	liter
L/m	liters per minute
lb	pound
lb/ft	pounds per foot
lb/t	pounds per ton
m	meter
m^2	square meter
m^3	cubic meter
m^3	cubic meter
m^3/h	cubic meters per hour
mesh	US Mesh
mi	mile
mil	one thousandth of an inch
min	minute (60 seconds)
mm	millimeter
mm	millimeter
Mmt	Million metric ton
mph	miles per hour
mt	metric ton (1,000 kg)
Mt	Million ton
mt/d	metric ton per day
mt/h	metric ton per hour
MW	Megawatt
oz	Troy ounce
oz/y	Troy ounces per year
P_{100}	100% passing - Product
P_{80}	80% passing - Product
ppm	parts per million
t	ton (2,000 lbs)
t/d	(short) ton per day
t/h	(short) ton per hour
V	Volt
wt%	weight percent
y	year (365 days)
yd	yard (36 inches)
yd^3	cubic yard

1. EXECUTIVE SUMMARY

1.1 Introduction

The Livengood Gold Project (herein also referred to as “the Project”) is a gold exploration project located 70 mi (113 km) northwest of Fairbanks, Alaska, USA. The Project is in an active mining district that has been mined for gold since 1914.

This Technical Report Summary (the “TRS”) was prepared and compiled by BBA USA Inc. at the request of International Tower Hill Mines Ltd. (ITH) through its wholly owned subsidiary Tower Hill Mines, Inc. (THM). The purpose of the TRS is to summarize the results of the Pre-feasibility Study (PFS) for the Livengood gold deposit on the THM property. This TRS has been prepared in accordance with *§§229.1300 through 229.1305 (subpart 229.1300 of Regulation S-K*). The TRS supports the ITH November 4, 2021 news release “International Tower Hill Mines Announces Pre-Feasibility Study Results on 13.6 Million Ounce Gold Resource” announcing the results of the study. This TRS also supports the mineral resource, mineral reserve and property disclosures in ITH’s Annual Report on Form 10-K for the fiscal year ended December 31, 2021, in addition to the November 4, 2021 release.

The PFS and this TRS are based on an updated resource estimate, effective as of August 20, 2021, and has an optimized Project configuration of 65,000 t/d. The Project configuration in this TRS remains a conventional, owner-operated surface mine that will utilize large-scale mining equipment in a blast/load/haul operation. Mill feed would be processed in a 65,000 t/d (59,000 mt/d) comminution circuit consisting of primary and secondary crushing, wet grinding in a single semi-autogenous (SAG) mill and single ball mill, followed by a gravity gold circuit and a conventional carbon in leach (CIL) circuit. As a result of the changes to the Project as summarized in this TRS, including differences in the mineral resource estimation methodology and changes to the economic parameters applied to the geologic block model (gold price, recovery, CAPEX, and OPEX), all of which resulted in a change in the mineral resources, the Project as evaluated in the 2017 PFS is no longer considered current and the 2017 PFS should therefore not be relied upon by investors.

This TRS assumes that the Livengood Gold Project will be constructed using imperial units. Therefore, to the maximum extent practicable, all design work and equipment descriptions were completed and reported in imperial units, with metric units shown in parentheses. Every effort has been made to clearly display the appropriate units being used throughout this TRS. However, it is important to note that both the Livengood Gold Project drill hole database and the block model were originally created in metric units and have been consistently maintained in metric units. Therefore, some tables and figures in this TRS may be presented in metric units only to minimize the risk of data unit conversion errors.

For financial modeling, ore tonnage is reported in short tons (t), with all costs reported in $/t.

Certain other testwork, such as comminution results and unconfined compressive strength tests, are reported in metric units.

All monetary units are in United States dollars ($), unless otherwise specified. Costs are based on third quarter (Q3) 2021 dollars.

1.2 Contributors

The independent PFS was prepared through the collaboration of a number of industry-recognized consulting firms “Contributors”, including BBA USA Inc. (“BBA”, Montreal, Quebec, Canada), NewFields Mining Design & Technical Services, LLC (“NewFields”, Lone Tree, Colorado, USA), JDS Energy and Mining Inc. (“JDS”, Denver, Colorado, USA), and Resource Development Associates Inc. (“RDA”, Highlands Ranch, Colorado, USA). Qualified Persons as defined in S-K 1300 guidelines from these firms provided resource estimates, design parameters and cost estimates for mine operations, process facilities, major equipment selection, waste and tailings storage, reclamation, permitting, operating and capital expenditures. A summary of contributors to the PFS is included in Table 1-1.

Table 1-1: PFS contributors

Consulting Firm	General overview of responsibilities
BBA USA Inc.	▪ Mineral reserve estimation ▪ Mine engineering ▪ Mine CAPEX and OPEX ▪ Mineral processing and metallurgical testing ▪ Process engineering and process plant OPEX ▪ Process plant and infrastructure CAPEX ▪ G&A OPEX ▪ Environmental Studies and Permitting ▪ Financial model ▪ Overall PFS TRS integration
NewFields Mining Design & Technical Services, LLC	▪ Geotechnical engineering ▪ Waste rock and water management ▪ Tailings Management Facility (TMF) engineering and CAPEX
JDS Energy and Mining Inc.	▪ Mine pit wall slope stability
Resource Development Associates Inc.	▪ Geology ▪ Drilling ▪ Resource estimation.

1.3 Key Project Outcomes

The reader is advised that the results of the PFS summarized in this TRS are intended to provide an initial, high-level review of the proposed optimized project configuration and revised design options. The PFS mine plan, execution plan and economic model include numerous assumptions. There is no guarantee that the Project economics described herein will be achieved.

The key outcomes of this PFS are the following:

- The Livengood Gold Project Mineral Resource (exclusive of reserves) is estimated at 234.5 M Measured metric tons at an average grade of 0.53 g/mt (3.99 Moz) and 40.01 M Indicated metric tons at an average grade of 0.49 g/mt (0.63 Moz), for a total (Measured and Indicated) of 274.5 M metric tons at an average grade of 0.52 g/mt (4.62 Moz). Inferred Mineral resources total 16.0 M metric tons at an average grade of 0.40 g/mt (0.21 Moz).
- The Livengood Gold Project Mineral Resource (inclusive of reserves) is estimated at 646.0 M Measured metric tons at an average grade of 0.60 g/mt (12.48 Moz) and 58.5 M Indicated metric tons at an average grade of 0.61 g/mt (1.14 Moz), for a total (Measured and Indicated) of 704.5 M metric tons at an average grade of 0.60 g/mt. Inferred Mineral resources total 16.0 M metric tons at an average grade of 0.40 g/mt (0.21 Moz).
- Defined and estimated Proven Mineral Reserves of 411.5 M metric tons at an average grade of 0.64 g/mt (8.5 Moz contained) and Probable Mineral Reserves of 18.5 M metric tons at an average grade of 0.86 g/mt (0.5 Moz contained), for a total of 430.1 M metric tons at an average grade of 0.65 g/mt (9.0 Moz contained). To access these mineral reserves, 496.1 M metric tons of overburden and waste rock must be mined, resulting in a strip ratio of 1.15:1
- The mine plan developed for the PFS provides sufficient ore to support an annual production rate of approximately 317,000 oz/y over an estimated 20.3-year mine life, producing a total of approximately 6.4 Moz of gold.
- The material mined from the open pit peaks at 66 Mt (60 Mmt) per year and averages 57 Mt (52 Mmt). A total of 105 Mt (95 Mmt) of ore is sent to the low-grade ore stockpile over the life of the mine, with an average gold grade of 0.38 g/mt. The maximum size of the low-grade ore stockpile is 88 Mt (88 Mmt).
- The peak mine fleet requirements have been estimated at 18 x 320 t haul trucks, 2 x 40 yd^3 hydraulic shovels, 2 x 40 yd^3 wheel loaders and 5-production drills.
- Metallurgical testwork has confirmed the preferred flowsheet consisting of primary crushing, secondary crushing, and a comminution circuit (SABC configuration) producing a final grind size of 250 µm (P_{80}), with gravity recovery followed by whole ore leaching of the gravity tailings. LOM gold recovery is estimated to be 71.4% based on the rock types tested and mine plan.
- The initial capital cost (-20% / +25% accuracy) of the open pit mine, 65,000 t/d (59,000 mt/d) process plant and general site infrastructure is estimated at $1.93B, including a contingency of $220M.
- LOM project sustaining capital costs total $658M, excluding reclamation costs of $317M.
- The mining cost is estimated at $2.05/t mined, process plant operating cost is estimated at an average of $7.72/t ore processed, and general and administrative costs of $1.35/t ore processed.
- All-in sustaining cost of production of 1,171 $/oz over LOM, including sustaining capital and before reclamation expenses, royalties, mining, and income taxes.
- Base case ($1,680/oz) positive Project NPV of $45M at a 5% discount rate and an IRR of 5.3% after mining and income taxes. Payback period is 10.4 years.

1.4 Property Description, Location and Access

The Livengood property is located approximately 70 mi (113 km) by road (47 mi (75 km) by air) northwest of Fairbanks, Alaska in the Tolovana Mining District within the Tintina Gold Belt. The deposit area is centered near Money Knob, a local topographic high point. This feature and the adjoining ridge lines are the probable lode gold source for the Livengood placer deposits that lie in the adjacent valleys. These placer deposits have been actively mined since 1914 and have produced more than 500,000 oz of gold.

The property lies in numerous sections of Fairbanks Meridian Township 8N and Ranges 4W and 5W. Money Knob, the principal geographic feature within the known deposit, is located at 65̊30’16’’N, 148̊31’33’’W.

The property straddles Highway 2 (also known as the Elliott Highway), a paved, all-weather highway linking the North Slope oil fields to Fairbanks, and adjoins the Trans-Alaska Pipeline (TAPS) corridor, which transports crude oil from the North Slope south and contains the fiber optic communications cable that may be used at the Project site (see Figure 1-1). Locally, a number of unpaved roads lead from the Elliott Highway into and across the deposit. A 3,000 ft (914 m) runway is located 3.73 mi (6 km) to the southwest of the Project and is suitable for light aircraft.

The site is approximately 40 mi (64 km) south of the Arctic Circle. The climate in this part of Alaska is continental with temperate and mild conditions in summer with average lows and highs in the range of 44°F to 72°F (7°C to 22°C). Winter is cold with average lows and highs for December through March in the range of -17°F to 23°F (-27°C to -5°C). The lowest temperatures are about – 40°F (-40°C). Annual precipitation is approximately 15.7 in (400 mm) water equivalent. Winter snow pack depth is approximately 26 in (66 cm).

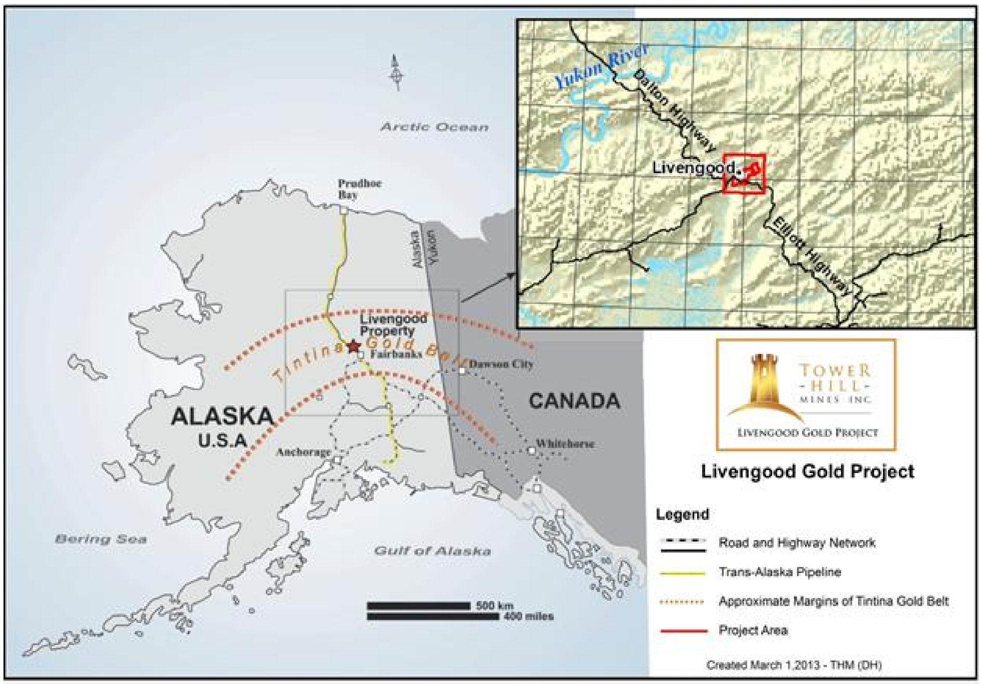

Figure 1-1: Project location map

1.5 Land Tenure

The Livengood Gold Project property covers approximately 48,300 acres (19,546 hectares), all of which is controlled by ITH through its wholly-owned subsidiaries, THM and Livengood Placers, Inc. (LPI). The Livengood Gold Project is comprised of multiple land parcels: 100% owned patented mining claims, 100% owned State of Alaska mining claims, and 100% owned federal unpatented placer claims, land leased from the Alaska Mental Health Trust (AMHT), land leased from holders of state and federal patented and unpatented lode and placer mining claims, and undivided interests in patented mining claims. The property and claims controlled through ownership, leases or agreements are shown in Figure 1-2.

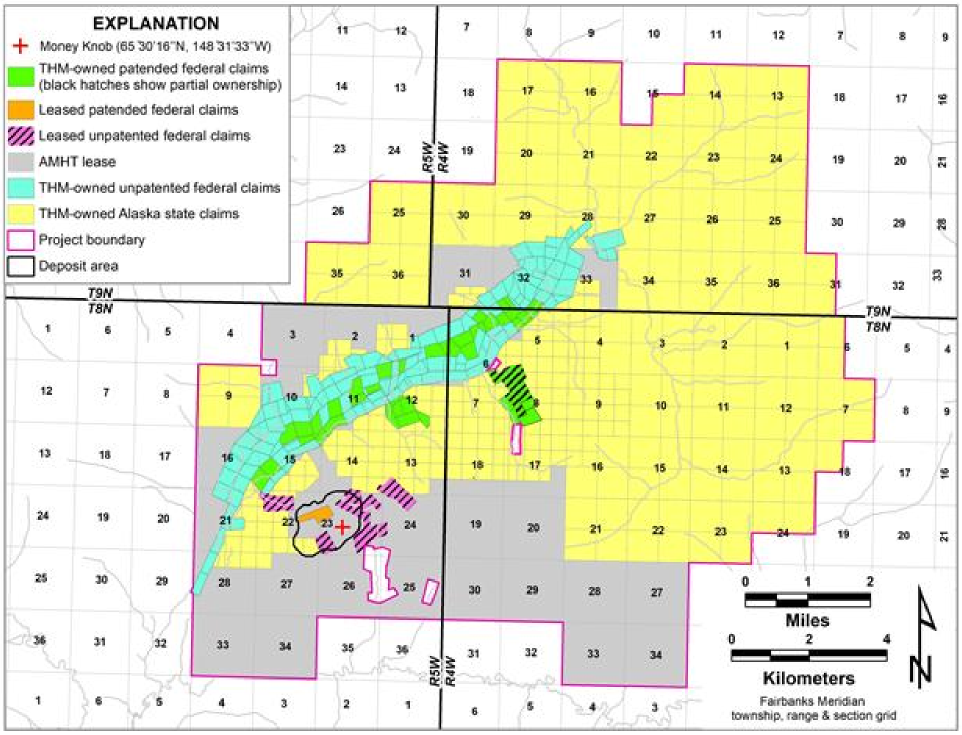

Figure 1-2: Map illustrating the company's Livengood Gold Project land holdings
(As at September 30, 2021, by tenure type, referenced to the Fairbanks Meridian Township, range and section grid.)

1.6 Property History

Gold was first discovered in the gravels of Livengood Creek in 1914 (Brooks, 1916) and led to the founding of the Town of Livengood. Subsequently, more than 500,000 oz of placer gold has been produced. From 1914 through the 1970s, the primary focus of prospecting activity was placer deposits. Historically, prospectors considered Money Knob and the associated ridgeline the source of the placer gold. Prospecting, primarily in the 1950s and in the form of dozer trenches, was carried out for lode type mineralization in the vicinity of Money Knob. However, no significant lode production has occurred to date.

Since the 1970s, the property has been prospected and explored by several companies. Geochemical surveys by Cambior Inc. in 2000 and AngloGold Ashanti (U.S.A.) Exploration Inc. (AGA) in 2003 and 2004, outlined a 1.0 × 0.5 mi^2 (1.6 × 0.8 km^2) area with anomalous gold in soil. Scattered anomalous samples continue along strike for an additional 1.2 mi (2 km) to the northeast and 1 mi (1.6 km) to the southwest. Eight reverse circulation (RC) holes were drilled by AGA in 2003 and a further four diamond core holes were drilled in 2004 to evaluate this anomaly. Favorable results from these holes revealed wide intervals of gold mineralization (BAF-7: 455 ft (138.7 m) @ 1.07 g/mt Au; MK-04-03: 181.4 ft (55.3 m) @ 0.51 g/mt Au) along with lesser intervals over a broad area. In 2006, AGA sold the Livengood Gold Project to ITH. In the same year, THM drilled a 4,026 ft (1,227 m), seven-hole core program. The success of that program led to the drilling of an additional 14,432 ft (4,400 m) in 15 diamond core holes in 2007 to test surface anomalies, expand the area of previously intersected mineralization, and advance geologic and structural understanding of the deposit. Subsequent programs have continued to expand the resource, leading to consideration of development of the deposit. Concomitant programs have included geotechnical, engineering, and metallurgical work, along with the collection of environmental baseline data. As of the end of 2014, completed exploration and delineation drilling totals 574,599 ft (175,138 m) in 621 RC holes and 140.854 ft (42,932 m) in 151 core drill holes.

Beginning in 2009, technical studies were performed to generate preliminary surface mine designs, to generate metallurgical data for process definition, and to develop pre-conceptual information on the location and capacities of potential tailings management, overburden management, water reservoir and mill process facilities. A pre-feasibility study was begun in 2011, but was not completed, as advancing technical studies indicated major changes to the flowsheet and project configuration warranted a shift to the feasibility study, which was completed in August 2013.

From 2013 through 2016, additional metallurgical testwork was performed, along with various techno-economic trade-off studies, to form the basis for the project configuration that was presented in the 2017 PFS.

The 2017 PFS work indicated that the project economics are sensitive to recovery, grind size, reagent consumption and test conditions. Further testwork was executed from 2017 through 2021, along with an Enterprise Optimization (EO) study (the “Whittle and BBA Study’’) to confirm the project configuration as well as the process conditions that are presented in this PFS.

1.7 Mineralization

Gold mineralization is associated with disseminated arsenopyrite and pyrite in volcanic, sedimentary, and intrusive rocks, and in quartz veins cutting the more competent lithologies, primarily volcanic rocks, sandstones, and to a lesser degree, ultramafic rocks. Three principal stages of alteration are currently recognized. In order from oldest to youngest, these are characterized by biotite, albite, and sericite. Carbonate was introduced with and subsequent to these stages. Arsenopyrite and pyrite were introduced primarily during the albite and sericite stages. Gold correlates strongly with arsenic and occurs primarily within and on the margins of arsenopyrite and pyrite.

Mineralization is interpreted to be intrusion-related, consistent with other gold deposits of the Tintina Gold Belt and has a similar arsenic-antimony (As-Sb) geochemical association. Mineralization is controlled partly by stratigraphic units, but thrust-fold architecture is apparently key to providing pathways for magma (dikes and sills) and hydrothermal fluid.

1.8 Mineral Processing and Metallurgical Testing

Several phases of testwork, along with an enterprise optimization study (the "Whittle and BBA Study''), have been completed since the 2017 PFS was issued.

A new round of simulations was completed at different grind sizes to determine the maximum achievable throughput using the recommended 2017 PFS configuration, which is a single line SABC circuit with pre-crushing, generating data that was used in the Whittle and BBA Study. The result of the work was a maximum throughput of 65,000 t/d (59,000 mt/d), operating to a target grind size of 250 µm (P80). The design relies upon an optimized drill & blast strategy to achieve the rated throughput with a SAG mill (D × L) 36 ft × 20 ft with 15 MW of installed power and a ball mill (26 ft × 40.5 ft) with 15 MW of installed power. The SAG mill is operated in closed circuit with a pebble crusher and the ball mill is operated in closed circuit with hydrocyclones.

The back end of the plant, all that follows comminution, was optimized as a result of this PFS work, which included a detailed analysis of previous work, completed by BBA, as well as the completion of five new rounds of testwork, completed since the issue of the 2017 PFS. The various test programs (Phases 9a, 9b, 11-13) were conducted to expand on knowledge developed through the course of the FS optimization, FS variability and 2017 PFS test programs. In the process of completing the five rounds of this PFS testwork, several key conclusions were drawn:

- Carbon in leach (CIL) methodology was retained over the carbon in pulp (CIP) of whole gravity tails (WOL). This decision was based on the 2017 PFS comparative study and on testwork results from this PFS, showing that better recoveries were obtained on RT6 and RT7 with CIL, while the other rock types appeared insensitive to CIL vs CIP.
- There are no significant adverse recovery issues introduced by mixing the chemical and physical properties of the ore types.
- Increasing the target particle size from a P_{80} of 180 to 250 µm resulted in a decrease in gold recovery of between 1% and 7%, depending upon rock type and head grades. The benefit of the coarser grind, which outweighs the recovery loss, is the higher throughput that facilitates a higher daily gold production.
- The effectiveness of gravity recovery was further confirmed because of this PFS testwork, using samples generated from both drill core and RC rig drill chips.
- Depending upon rock type, gold recovery is slightly related to location, either inside or outside the 100 ppm antimony shell.
- The overall gold recovery does not appear to be highly sensitive to either lead nitrate (0-200 ppm) or cyanide (0.4-0.8 kg/t) concentration.

After the 2017 PFS, a focused effort was made to better understand the gold recovery implications of antimony concentration in the orebody. The data collected during Phases 11, 12 and 13 were used to develop linear recovery equations for each of the five rock types, both inside and outside the 100 ppm antimony shell, and as a function of antimony concentration, grind size and gold grade. A linear equation was developed for the composites having an antimony grade above 200 ppm, regardless of whether they were in or out of the 100 ppm antimony shell. Gold recoveries (Gravity+CIL) were established for each of the Livengood ore rock types at a grind size of 250 µm (P_{80}) and are presented in Table 1-2.

Table 1-2: Average gold recovery (Gravity+CIL) estimated for each rock type

Rock Type	Au Recovery (%)
RT4	83.3
RT5	79.8
RT6	73.5
RT7	66.4
RT9	57.1

The Whittle and BBA Study reviewed various technologies and project configurations with the objective of recommending an optimum configuration for this PFS. This study determined that the gravity/CIL plant at a grind size of 250 µm (P_{80}) with conventional tailings provided the highest NPV.

1.9 Mineral Resource Estimate

The Livengood mineral resource (Effective date August 20, 2021) was estimated using Inverse Distance Weighting (IDW) interpolation techniques. A database comprising 776 drill holes containing 125,450 assays was the basis of the estimate. Assays were composited to nominal 10-meter lengths, yielding 20,806 individual samples that were used for the estimation of mineralization.

Three sources of volumetric determination were used for the resource model. One was a three-dimensional (3D) stratigraphic model used to assign rock type codes to the block model. The second was an implicit model that interpolated a 100-ppm antimony halo or “shell” for the mineral deposit, with blocks flagged as either inside or outside this halo. The third was 54 individually interpreted massive stibnite veins that were used to determine the volume percentage and grade of veins within each model block that is intersected by the veins. Gold contained within each block was estimated using Inverse Distance cubed (ID3) parameters.

Mineral resources must demonstrate reasonable prospects for eventual economic extraction. The deposit gold is amenable for open pit extraction. To determine the quantities of material meeting the “reasonable prospects” test by an open pit, the author used the Lerchs-Grossman © economic algorithm to determine economic pit limits.

Economic parameters used in the analysis are based on the average gold price ($1,650/oz) at effective date of August 20, 2021. Pit optimization parameters are shown in Table 1-3. Gold recoveries are tonnage-weighted and include the recovery from massive stibnite of 22%.

Table 1-3: Constraining parameters used for the Livengood Gold Project

Parameter	Unit	Rock type 4	Rock type 5	Rock type 6	Rock type 7	Rock Type 8	Rock Type 9
Mining Cost	$/total mt	1.76	1.74	1.74	1.68	1.76	1.76
Gold Cut-off	g/mt	0.21	0.20	0.25	0.25	0.33	0.33
Processing Cost	$/process mt	9.27	9.15	9.17	9.50	9.71	9.71
Gold Recovery	%	84	80	71	67	55	56
Administrative Cost	$/process mt	1.55	1.55	1.55	1.55	1.55	1.55
Royalty	%	3	3	3	3	3	3
Gold Selling Price	$/oz	1,650	1,650	1,650	1,650	1,650	1,650
Overall Slope Angle	Degrees	45	45	45	45	45	45

The mineral resource estimate for the Livengood Gold project is shown in Table 1-4 (Exclusive of Reserves) and Table 1-5 (Inclusive of Reserves).

Table 1-4: Livengood Gold Project mineral resource estimate (exclusive of mineral reserves) (2021 MRE), August 20, 2021 – Resource Development Associates Inc.

Classification	Ore Metric tons (Mmt)	Au Grade (g/mt)	Contained Au (Koz)
Measured	234.50	0.53	3,990.49
Indicated	40.01	0.49	629.61
Total Measured and Indicated (M & I)	**274.51**	**0.52**	**4,620.10**
Inferred	15.98	0.40	206.98

1. The effective date of the estimate is August 20, 2021.
2. Mineral resources for the Project are enumerated as per §229.1302(d)(1)(iii)(A) (Item 1302(d)(1)(iii)(A) of Regulation S-K).
3. Mineral resources are not mineral reserves and do not meet the threshold for reserve modifying factors, such as economic viability, that would allow for conversion to mineral reserves. There is no certainty that any part of the mineral resources estimated will be converted into mineral reserves.
4. Open pit resources stated as contained within a potentially economically mineable open pit; pit optimization was based on an assumed price for gold of US$1,650/oz., variable mining and recoveries, general and administrative costs of US$1.55/t and a pit slope angle of 45 degrees.
5. Numbers in the table have been rounded to reflect the accuracy of the estimate and may not sum due to rounding.
6. Mineral resources are reported exclusive of mineral reserves. The reserves disclosed in the TRS represent measured mineral resources and indicated mineral resources that were evaluated with modifying factors related to open pit mining.

Table 1-5: Livengood Gold Project mineral resource estimate (inclusive of mineral reserves) (2021 MRE), August 20, 2021 – Resource Development Associates Inc.

Classification	Ore Metric tons (Mmt)	Au Grade (g/mt)	Contained Au (Koz)
Measured	646.00	0.60	12,482.49
Indicated	58.51	0.61	1,141.61
Total Measured and Indicated (M & I)	**704.51**	**0.60**	**13,624.10**
Inferred	15.98	0.40	206.98

1. The effective date of the estimate is August 20, 2021.
2. Mineral resources for the Project are enumerated as per §229.1302(d)(1)(iii)(A) (Item 1302(d)(1)(iii)(A) of Regulation S-K).
3. Mineral resources are not mineral reserves and do not meet the threshold for reserve modifying factors, such as economic viability, that would allow for conversion to mineral reserves. There is no certainty that any part of the mineral resources estimated will be converted into mineral reserves.
4. Open pit resources stated as contained within a potentially economically mineable open pit; pit optimization was based on an assumed price for gold of US$1,650/oz., variable mining and recoveries, general and administrative costs of US$1.55/t and a pit slope angle of 45 degrees.
5. Numbers in the table have been rounded to reflect the accuracy of the estimate and may not sum due to rounding.
6. Mineral resources are reported inclusive of mineral reserves. The reserves disclosed in the TRS represent measured mineral resources and indicated mineral resources that were evaluated with modifying factors related to open pit mining.

1.10 Mineral Reserve Estimate

Mineral reserves have been estimated for the Project by BBA USA Inc., using a gold price of $1,680/oz. The mine design and mineral reserve estimate have been completed to a level appropriate for a PFS. The mineral reserve estimate stated herein is consistent with the S-K 1300 requirements and is suitable for public reporting. As such, the mineral reserves are based on Measured and Indicated Mineral Resources, and do not include any Inferred Mineral Resources.

Development of the mine production plan included pit optimization, pit and phase designs, mine scheduling and the application of modifying factors to the Measured and Indicated Mineral Resources. The Qualified Person is not aware of any legal, political, or other risks that could materially affect the development of the mineral reserve.

Table 1-6 presents the mineral reserves for the Project, which include 411.5 Mmt of Proven Mineral Reserves at an average gold grade of 0.64 g/mt, and 18.5 Mmt of Probable Mineral Reserves at an average gold grade of 0.86 g/mt for a total of 430.1 Mmt of Proven and Probable Mineral Reserves at an average gold grade of 0.65 g/mt. To access these mineral reserves, 496.1 Mmt of overburden and waste rock must be mined, resulting in a strip ratio of 1.15:1.

Table 1-6: Livengood Gold Project Mineral Reserves, October 22, 2021 – BBA USA Inc.

Classification	Ore Metric tons (Mmt)	Au Grade (g/mt)	Contained Au Koz
Proven	411.5	0.64	8,492
Probable	18.5	0.86	512
Proven and Probable Totals	**430.1**	**0.65**	**9,004**

1. The effective date of the estimate is October 22, 2021.
2. Mineral reserves are estimated using a gold price of US$1,680 per ounce, and consider a 3% royalty, 1.80/oz for smelting, refining, and transportation costs, and a gold payable of 99.9%.
3. Metallurgical recovery curves were developed for each rock type, with the Mineral Reserves having the following tonnage weighted averages: 83.3% for RT4, 79.8% for RT5, 73.5% for RT6, 66.4% for RT7, 58.7% for RT8 and 57.1% for RT9, including 22% for massive stibnite mineralization.
4. As a result of the complex metallurgical recovery equations, it is difficult to determine specific cut-off grades. The following presents the lowest gold grades for each rock type that are processed in the life of mine plan: 0.26 g/t for RT4, 0.28 g/t for RT5, 0.31 g/t for RT6, 0.31 g/t for RT7, 0.42 g/t for RT8 and 0.42 g/t for RT9.
5. The strip ratio for the open pit is 1.15 to 1.
6. The mineral reserves are inclusive of mining dilution and ore loss.
7. The reference point for the mineral reserves is the primary crusher.
8. Totals may not add due to rounding.

1.11 Mining Methods

The Livengood deposit will be mined using conventional open pit mining methods consisting of drilling, blasting, loading, and hauling with large-scale mining equipment. Vegetation, topsoil, and overburden will be stripped and stockpiled for future reclamation use. The ore and waste rock will be drilled and blasted with 32.8 ft (10 m) high benches and loaded into haul trucks with a fleet of diesel-powered hydraulic excavators and front-end wheel loaders.

The processing flowsheet consists of primary crushing, secondary crushing, and a comminution circuit (SABC configuration) producing a final grind size of 250 µm (P_{80}), with gravity recovery followed by whole ore leaching (CIL) of the gravity tailings. The mill has been designed with a nominal throughput of 65,000 t/d (59,000 mt/d). Tailings will be stored in a conventional slurry tailings facility.

Material mined from the open pit that is not directly hauled to the primary crusher will be placed in several storage facilities across the Livengood site. These facilities include growth media stockpiles, an overburden stockpile, a waste rock storage facility (WRSF), and a low-grade ore stockpile. Waste rock will also be used as construction material both during preproduction and to raise the height of the TMF dike as the mine life progresses.

To maximize the NPV of the Project, a total of six mining phases (pushbacks) have been designed and incorporated into the mining sequence to bring higher grade material forward and to defer waste rock stripping. The mining phases include a starter pit that will be mined during the three years of preproduction, during which a total of 89 Mt (81 Mmt) of waste rock has been estimated to be required for the construction of certain infrastructure such as the TMF starter dike, mine haul roads, site access roads, and platforms for the processing facilities and other buildings. Ore mined during preproduction will be stockpiled and processed after mill start-up.

A mine production plan has been prepared using the MinePlan Schedule Optimizer (MPSO) tool in the Hexagon MinePlan 3D software. Provided with economic input parameters and operational constraints such as phase sequencing, maximum bench sink rates, and mining and milling capacities, the software determines the optimal mining sequence and low-grade ore stockpiling strategy, which maximizes the NPV of the mine production plan. The mine plan has been prepared quarterly for the first two years of production and annually thereafter.

The mine production plan resulted in a 20.3-year mine life plus 3 years of preproduction development. A contractor will operate the pit during the first year of preproduction to develop the first benches in the Phase 1 starter pit and construct the network of mine haul roads. By the second year, the owner's fleet of equipment will be on-site and assembled and will take over from the contractor.

The total material mined from the open pit peaks at 66 Mt (60 Mmt) from Year 2 to Year 5 and averages 55 Mt/y (50 Mmt/y) between Year 1 and Year 17. A total of 105 Mt (95 Mmt) of ore is sent to the low-grade ore stockpile over the life of the mine, with an average gold grade of 0.38 g/mt. A total of 84% of the low-grade ore is rehandled and sent to the mill during the final five years of production, with smaller amounts rehandled in earlier years.

During the life of mine (LOM), a total of 271 Mt (246 Mmt) is hauled to the TMF for dike construction, representing 52% of the total waste rock.

The average gold grade for ore to the mill is fairly consistent on a year to year basis, ranging from 0.58 g/mt to 0.93 g/mt when the open pit is in operation, and drops to 0.36 g/mt during stockpile rehandling at the end of the mine life.

A peak gold production of 482 koz is achieved in Year 3, when higher grades will be fed to mill, which also coincides with higher mill recoveries. Gold production averages 342 koz per year between Year 1 and Year 17 and 154 koz per year during stockpile rehandling.

The mine will be operated with an owner fleet, 365 days per year, 24 hours per day, running two 12-hour shifts per day. For equipment calculations, a total of five days of lost production time has been considered for poor weather conditions.

Production drilling will be done with a fleet of autonomous diesel-powered down-the-hole (DTH) drills that will drill 9.8 inch (251 mm) diameter holes on 32.8 ft (10 m) high benches with drill patterns varying for ore and waste and by rock type. Blasting will be done using primarily Ammonium Nitrate Fuel Oil (ANFO) and with bulk emulsion during wet conditions. A total of five production drills and one secondary drill for pre-splitting and secondary blasting are required during most of the mine life.

Loading will be done using a mix of diesel-powered hydraulic shovels and frontend wheel loaders, both equipped with 40 yd^3 (31 m^3) buckets. During peak production, the fleet will include two shovels and two wheel loaders.

Hauling will be done with 320 t (291 mt) rigid frame haul trucks and the fleet requirements were estimated for each period of the mine production plan using a haulage network developed and loaded into the MS Haulage tool of MinePlan 3D. The truck fleet peaks at a total of 18 trucks.

The mine workforce has been estimated for each period of the mine plan, which includes management and supervisory personnel, mine technical services, mine operations, and mine maintenance personnel. The mine workforce peaks at 221 employees.

1.12 Recovery Methods

The recovery methods for the Project were established based on previously noted laboratory-scale testwork programs, information from equipment suppliers and on BBA's experience on similar projects. Many of the significant process plant configuration changes implemented within the 2017 PFS were retained, including the addition of secondary crushing ahead of the SAG mill for more efficient use of power, inclusion of a single line SAG/ball mill configuration, and simplification of the mill foundation and pebble re-grind circuit. Recent metallurgical testwork completed has also resulted in the grind size being further coarsened from 180 to 250 µm (P_{80}) with a design leach retention time of 24 hours. With relatively minor changes to equipment selection, this has permitted a significant increase in the nominal throughput.

The nominal Livengood process plant capacity at 93% is 65,000 t/d (59,000 mt/d) resulting in an annual capacity of 23.7 Mt/y (21.5 Mmt/y). Run of mine ore is transported to the primary gyratory (60×89) crusher, where it is crushed and stockpiled in a covered pile, then conveyed to the secondary crushing (1,250 hp) building. Crushed product (1.65 in (42 mm)) will then be conveyed and processed in a comminution circuit (SABC) consisting of wet grinding in a single semi-autogenous (SAG) mill ((D×L) 36 ft × 20 ft /20,115 hp) in closed circuit with a pebble crusher (932 hp) and a single ball mill (25.4 ft × 40 ft / 20,115 hp). The ball mill is in closed circuit with hydrocyclones. A pulp stream will be bled from a portion of the ball mill discharge and treated with a bank of eight centrifugal gravity gold separators. The gravity tails will be pre-treated with oxygen and lead nitrate, and then leached in a conventional CIL circuit (2 rows of 7 tanks). The gravity gold will be intensively leached from the gravity concentrate with two intensive leach reactor (ILR) systems.

Gold from the leach circuit will be recovered by an adsorption-desorption-recovery (ADR) circuit, where the final product will be doré. Two thickeners (213 ft / 65 m diameter) (Pre-leach and Pre-Detox) will be used to maximize water and cyanide recovery. The Inco SO_2/air cyanide detoxification method will be used to reduce the cyanide content of the process tailings to acceptable concentrations prior to being discharged to the tailings management facility (TMF). A preliminary water balance indicates that approximately 233 gpm (53 m^3/hr) of fresh water will be required during operations.

The gyratory crushing, secondary crushing and main process plant will operate 24 hours per day and 7 days per week. The operating teams will work on a schedule of two 12-hour shifts. The main process plant will be stopped periodically to perform preventive maintenance on equipment for which there is no standby unit. The process plant is designed to operate with an availability of 93%.

Process plant reagents, including cyanide, lime, elemental sulfur, hydrochloric acid, lead nitrate, carbon, and flocculants, will be delivered to site by transport truck as required and stored in the process facility.

Figure 1-3, a simplified process flow diagram, describes the conceptual process flow from the ore delivery to the crusher through to doré production and tailings management. The average gold head grade for plant feed will be 0.65 g/mt with an overall gold recovery of 71.4% based on the LOM plan.

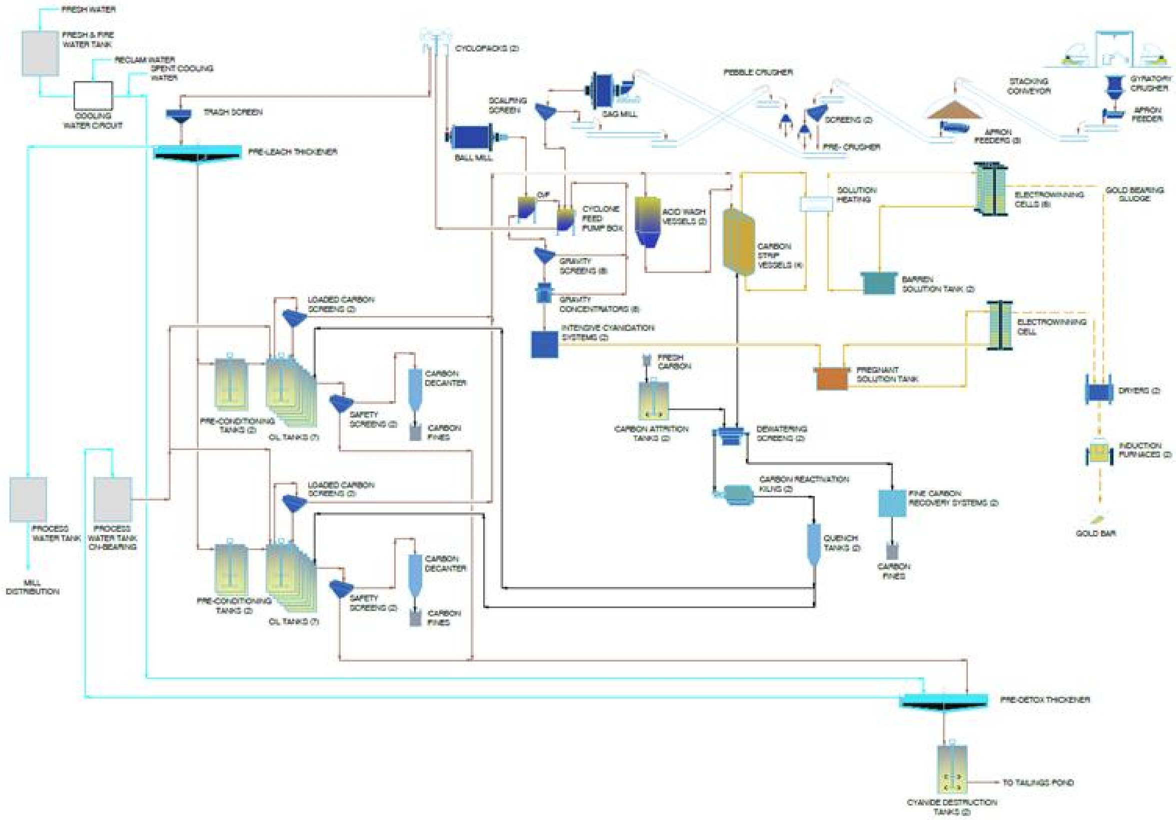

Figure 1-3: Simplified process flow diagram

The following Figure 1-4 shows the process plant feed grade and gold production per year based on the LOM mine plan. Annual gold production will average 317,000 oz/y over the LOM.

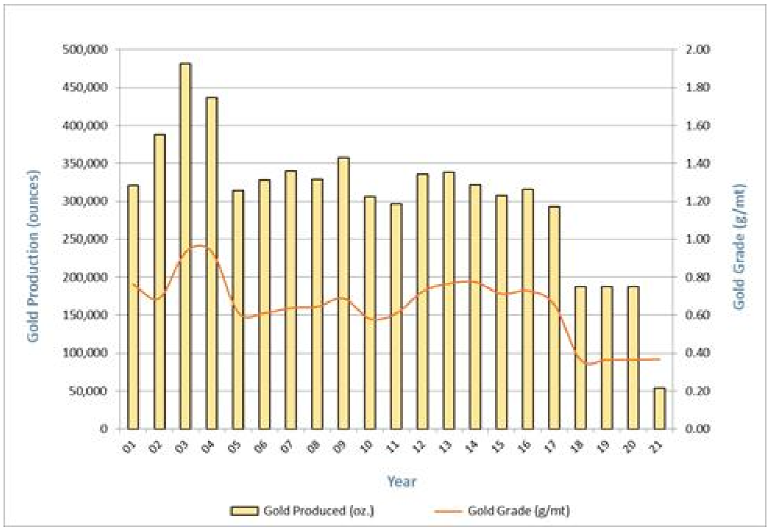

Figure 1-4: Gold production schedule (oz/year)

The process plant facilities include a wet laboratory, mill offices, a mill dry and maintenance shops. A total of 140 employees are required in the process plant, including 26 salaried staff and 114 hourly workers.

1.13 Local Resources and Project Infrastructure

1.13.1 Local Resources

The Fairbanks North Star Borough (FNSB), which has a population of approximately 100,000 people, has a hospital, government offices, businesses, military bases and the University of Alaska, Fairbanks. Fairbanks is linked to southern Alaska by a north-south transportation and utility corridor that includes two paved highways, a railroad, an interlinked electrical grid and communications infrastructure. The city has an international airport serviced by up to three major airlines and has demonstrated capacity to serve as the primary employment and service base for the Project.

The paved, all weather State Highway 2 (Elliott Highway) runs north from Fairbanks to the North Slope oilfields at Prudhoe Bay, and passes within one mile of the Money Knob deposit. Communications infrastructure (fiber optic) has been extended to the North Slope along the TAPS, which parallels the Elliott Highway and passes just west of the Livengood Project site.

1.13.2 Project Infrastructure

To the extent practicable, the infrastructure facilities for the Project have been designed for optimum construction access and operational efficiency as well as to take advantage of the existing roads and infrastructure.

Surface Infrastructure

The Project envisions construction of the following key infrastructure facilities:

- O'Connor Creek substation and 50 miles (80 km) of new 230 kV transmission line;
- Access light vehicle and mine haulage roads;
- Process plant and ancillary buildings;
- Administration, dry, maintenance, and warehouse complex;
- Mine truck wash and fueling facilities;
- Bulk fuel storage and delivery system;
- Water and sewage treatment;
- Fresh water pumping and distribution system;
- Waste rock, ore and growth media stockpiles;
- Surface water management diversion ditches;
- Tailings and Waste Rock Management Facilities;
- Temporary construction camp;
- Fairbanks Integrated Remote Operations Center (IROC);
- Fairbanks employee parking area.

Site Power

The total power demand of the Project (LOM average) is estimated to be approximately 57.8 MW, including network losses of 3% and represents the LOM average. An electrical load list was created based on a detailed mechanical equipment list that included the major power draw contributors. Minor power consumers and power for auxiliary systems were benchmarked based on BBA's past project experience. The projected annual electrical energy use is estimated to be approximately 450.9 GWh including the network losses.

A study completed by Electric Power Systems has determined that the local utility in Fairbanks (Golden Valley Electric Association) can provide the power required for the Project. The Project would be connected to the local grid by building a 50-mi (80 km) 230-kVa transmission line along the pipeline corridor. A new 138/230 kV substation at O'Connor Creek (OCS) will be required to connect the transmission line to the GVEA system.

Emergency power systems (4.16 kV and 600 V) are planned for the purpose of supplying the critical installations when the main power is lost. Critical loads will be grouped into different categories, where some will be attended to automatically and others controlled manually.

Communications and IT

A site-wide telecommunication infrastructure will be installed to provide internet access, an IP phone system, a security access system, interconnection of the fire detection system, surveillance and process video cameras, as well as a mobile radio system for personnel and site vehicles.

Tailings, Mine Waste Rock and Water Management Facility

The tailings management facility (TMF) has been designed to provide safe and secure storage of approximately 486 Mt (441 Mmt) of mill tailings along with a supernatant pond. The TMF has sufficient area to expand up to 529 Mt (480 Mmt) capacity, dependent on future modifications that would be required at the freshwater reservoir.

The TMF is situated within Livengood Valley and is formed by two cross-valley embankments, the west embankment and the east embankment. Both TMF embankments and the impoundment area in between are geomembrane-lined and designed to be constructed in phases. The TMF embankments require the removal of some native materials within the embankment footprints to improve stability characteristics of the foundation. These materials will be excavated and transported to growth media stockpiles in the general area, for use during reclamation of the Project site. The impoundment area will be covered with a layer of mine waste rock to provide a stable foundation for the installation of the geomembrane.

Solution management systems at the TMF include a groundwater drainage system and a tailings underdrain system. The groundwater drainage system will be located below the impoundment geomembrane and positioned within the main drainages. This drain system will capture near surface groundwater flow and convey it to sumps located downstream of the TMF west embankment. The collected water will be pumped into the TMF impoundment and used in the processing of ore at the mill. The tailings underdrain system is located above the impoundment geomembrane and will collect process solutions draining from the deposited tailings mass. This system will return the collected solutions to the supernatant pond for recycling back to the mill.

The TMF east embankment will also form an embankment for the fresh water reservoir. This reservoir will be used as a make-up water supply for the project. Excess water captured by the reservoir will be conveyed, via gravity through a flow-through drain, to Livengood Creek downstream of the TMF west embankment. The flow-through drain consists of multiple large diameter pipes positioned below the impoundment geomembrane and near the main groundwater drainage system.

Non-economic mine waste rock, produced by mining activities at the Livengood site, will either be incorporated into the construction of site facilities, such as the TMF, or hauled and stockpiled in Gertrude Creek valley. The current design of the waste rock storage facility is for 105 Myd^3 (80 Mm^3). An embankment constructed at the mouth of the Gertrude Creek valley will serve as a buttress for the waste rock storage facility in addition to providing containment for tailings within the TMF.

Low grade ore will also be stockpiled within the upper reaches of the Gertrude Creek valley. The current design of the stockpile is sufficient to store 45 Myd^3 (34 Mm^3) of material. The stockpile can be expanded, as needed, by modifying the design of the waste rock storage facility.

The surface water management structures required to support the project primarily include minor stormwater diversion channels and roadside ditches.

1.14 Environmental and Permitting

THM has been conducting environmental baseline studies at the Project since 2008, as part of their overall goal of providing environmentally relevant and supportable data for environmental permitting, engineering design and a basis for permit-required monitoring during construction, mining and closure of the Project. These studies include surface water, hydrology, hydrogeology, wetlands & vegetation, meteorology & air quality, aquatic resources, rock characterization, wildlife, cultural resources and noise studies.

Table 1-7: Environmental baseline studies (2008-2021)

Baseline Study	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017-2021
Surface Water										
Surface Water Quality		•	•	•	•	•	•	•	•	•
Sediment Quality						•	•	•	•	
Hydrology										
Surface Water Flow and Snow			•	•	•	•	•	•	•	•
Hydrogeology			•	•	•	•	•	•	•	•
Groundwater Quality			•	•	•	•	•	•	•	•
Hydrogeological Modeling			•	•	•	•	•	•	•	•
Permafrost Studies			•	•	•	•	•	•	•	•
Wetlands & Vegetation										
Wetlands Delineations		•	•	•	•	•	•			
Meteorology & Air Quality										
Meteorological Data			•	•	•	•	•	•	•	•
Precipitation			•	•	•	•	•	•	•	•
Ambient Air				•						
Aquatic Resources										
Bio-monitoring		•	•	•	•	•	•	•	•	•
Resident Fish Surveys		•	•	•	•	•	•			
Rock Characterization										
Static ML/ARD Testing			•	•	•	•	•	•		
Kinetic ML/ARD Testing				•	•	•	•	•	•	•
On-Site Kinetic Testing					•	•	•	•	•	•

Baseline Study	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017-2021
Wildlife Studies										
Habitat Mapping				•						
Mammal Surveys				•						
Avian Surveys				•	•					
Cultural Resources										
Cultural Site Surveys	•	•	•	•	•					
Socioeconomics (Section 17.6)				•	•	•				
Noise Studies										
Noise Surveys					•	•				

In early 2011, project engineers identified a 50 mi (80 km) power transmission corridor with a terminus at Livengood. Baseline investigations along this corridor have included: surface water quality, wetlands & vegetation, wildlife, aquatic resources, and cultural resources. The results of these programs have been used, in part, to select the transmission alignment.

Based on a review of the studies completed to date, there are no known environmental issues that are anticipated to materially impact the Project's ability to extract the gold resource.

Since development of the Project will require several federal permits, the National Environmental Policy Act (NEPA) and Council of Environmental Quality (CEQ) Regulations will govern the federal permitting portion of the Project. The NEPA process requires that all elements of a project and their direct, indirect and cumulative impacts be considered. A reasonable range of alternatives are evaluated to assess their comparative environmental impacts, including consideration of feasibility and practicality. In fulfillment of the NEPA requirements, it is anticipated that the Project will be required to prepare an Environmental Impact Statement (EIS). Upon completion of the EIS and the associated Record of Decision by the lead federal agency, the federal and state agencies will then complete their own permitting actions and decisions. The State of Alaska is expected to take a cooperating role to coordinate the NEPA review with the state permitting process. Actual permitting timelines are controlled by the federal NEPA review and federal and state agency decisions.

Actual permitting timelines are controlled by the Federal NEPA review and federal and state agency decisions. There have been no permit applications submitted for project construction.

1.15 Socioeconomic Conditions

Livengood lies within the Yukon-Koyukuk Census Area, which encompasses a nearly 150,000 square mile (mi^2) (388,000 km^2) swath of Interior Alaska from the Canadian border to the lower Yukon River. In 2020, the Census Area held a total population of 5,343 widely dispersed residents in 38 communities, of which approximately 70% were Alaska Natives. Both Minto, which is approximately 40 mi (64 km) from Livengood, and Manley Hot Springs, approximately 80 mi (129 km) away from the Project, have road access to Fairbanks.

The Fairbanks area is the service and supply hub for Interior and Northern Alaska. Construction of the Trans-Alaska Pipeline System (TAPS) resulted in an economic boom in Fairbanks from 1975 to 1977. The oil industry remains an important part of the local economy, with Fairbanks providing logistical support for the North Slope activity, operation of a local refinery and the operation and maintenance of TAPS. Today, the University of Alaska, the Fairbanks Memorial Hospital, and the Fort Knox and Pogo gold mines are some of the Fairbanks area's largest employers. The Fairbanks North Star Borough (FNSB) economy included 37,400 non-agricultural wage and salary jobs in 2019, accounting for $2.24B in annual payroll.

Most of the small communities in rural interior Alaska are largely dependent on subsistence. Seventy-five percent (75%) of the Native families in Alaska's smaller villages acquire 50% of their food through subsistence activities (Federal Subsistence Board, 1992). For families that do not participate in a cash economy, subsistence can be the primary direct means of support; for others, it contributes indirectly to income by replacing household food purchases.

The PFS estimates a total of 3.8 M man-hours during Project construction at Livengood, with a peak construction workforce of 800. The average wage of those workers is estimated at $50.00/hr. During the three years of preproduction mine development, the Owner's crew will be approximately 170 employees on average. During operations, the average number of employees is estimated at 331 peaking in year 6 at 430. Total annual wages paid during operations is estimated to be $38M based on an annual average wage of approximately $115,000/y.

The labor force in the communities nearest the mine is very small. The total population of Minto, Manley Hot Springs and Livengood combined is 312 residents in 2020. Skilled and unskilled labor to support mine development and operations will come primarily from the Fairbanks area, with a total labor force of nearly 40,000 workers. The training plan for the Project will be designed to promote safety, environmental stewardship, efficient production, and local hire.

1.16 Capital Cost and Operating Cost Estimates

1.16.1 Capital Costs

The total estimated preproduction capital cost (-20% / +25%) to design, procure, construct and commission the Livengood Gold Project facilities, including funding of reclamation activities, is estimated to be $1.93B. The estimated sustaining capital cost required by the Project is $658M. This estimate includes the addition of certain contingencies and indirect costs. The cumulative LOM capital expenditure (preproduction and sustaining capital) is estimated to be $2.852B. Table 1-8 summarizes the initial capital and sustaining capital costs by major area.

Table 1-8 summarizes the initial capital and sustaining capital costs by major area.

Table 1-8: Initial capital and sustaining capital costs by major area
($ Millions)

Cost Item/Area	Initial ($M)	Sustaining ($M)
Mine Equipment	200	139
Mine Development	230	
Process Facilities	433	
Infrastructure Facilities	459	514
Power Supply	87	
Owners Costs	296	5
Contingency	220	
Sub-total before Reclamation	**1,925**	**658**
Spare parts, consumables, and initial fills (1)	40	
Funding of Reclamation Trust Fund (2)	23	245
Total	**$1,989**M	**$903M**

Note: Rounding of some figures may lead to minor discrepancies in totals.

(1) The $40M spent on spare parts, consumables and initial fills in preproduction are recaptured in the final year of operations (Year 21).

(2) Includes initial funding, total $317M estimated costs. The difference of $49M is projected trust fund earnings.

1.16.2 Operating Costs

The operating cost estimate for the Livengood Gold Project includes all expenses incurred to operate the mine and process plant from the start of Year 1 through Year 21 at a daily average production rate of 65,000 t/d (59,000 mt/d). The expected accuracy for the operating cost estimate is that of a pre-feasibility study level (+/- 20%) and does not contain any allowances for contingency or escalation beyond Q3 2021. Any ore excavated during the preproduction period is considered as a capital expense. The average operating cost including royalties and smelting/refining fees over the life of mine is estimated to be $13.82/t ($15.23/mt). The average total number of personnel over the LOM will be approximately 331.

The total and unit operating cost estimate summaries are shown below in Table 1-9 for the three major operating cost areas: mining, processing, and general and administrative (G&A). The unit costs areas are shown in terms of total cost LOM per ore ton milled and total cost per troy ounce of gold produced.

Table 1-9: Total operating cost breakdown (LOM average)

Cost Item / Area	Total ($M)	Average ($/t mined)	Average ($/t milled)	Average ($/oz)	OPEX (%)
Mining (including stockpile reclaim)	1,910	2.05	4.03	297	29
Processing	3,659	-	7.72	569	56
General and Administration	639	-	1.35	99	10
On-site Mine Operating Costs	**6,208**	**-**	**13.09**	**965**	**95**
Royalties	323	-	0.68	50	5
Smelting, Refining and Transport	22	-	0.05	3	0.3
Sub-total before Reclamation	**6,553**	**-**	**13.82**	**1,019**	**100**
Funding of Reclamation Trust Fund	317	-	0.67	49	0
Total	**$6,893M**	**-**	**14.50/t**	**$1,068/oz**	**100%**

1.17 Project Economics

A financial analysis for the Project was carried out using a discounted cash flow approach. The internal rate of return (IRR) on total investment was calculated based on 100% equity financing even though THM may decide in the future to finance part of the Project using alternative sources of capital. The net present value (NPV) was calculated from the cash flow generated by the Project based on a discount rate of 5%. The payback period based on the undiscounted annual cash flow of the Project was also indicated as a financial measure.

No inflation or escalation exists in the economic model. THM compiled the taxation calculations for the Project with assistance from third-party taxation experts. The Livengood Gold Project is subject to three levels of taxation, including federal income tax, Alaska State income tax, and an Alaska State mining license tax. The model calculates pre-tax and after-tax returns, and is based on the current US tax system applicable to mineral resource income. The model applies 3% royalties on net smelter returns over the life of the Project, based on an average royalty calculation. The model includes provisions for doré transportation, insurance, refining and payable charges. The major inputs and assumptions used for the development of the financial model are listed in Table 1-10.

Table 1-10: Financial model inputs

Execution Plan	
Construction Period	36 months
Mine Life (after preproduction)	20.3 years
LOM Ore Tons (millions)	430.1
LOM Gold Grade (g/mt Au)	0.65
Average Annual Process Gold Production Rate (oz)	317,000
Metal Pricing	
Gold Price ($/oz)	1,680
Cost and Tax Criteria	
Estimate Basis	Q3 2021
Inflation/Currency Fluctuation	None
Leverage	100% Equity
Income Tax	AK State, Federal
Royalties	
Royalty on Net Smelter Return (NSR)	3%
Gold Transportation and Insurance, Refining, and Payable Charges	
Gold ($/oz)	3.48
Payable Terms	
Gold	99.90%

Table 1-11 below presents the results of the pre-feasibility study.

Table 1-11: Summary of pre-feasibility study results

	Value	Unit
Production Metrics		
Mill Throughput	65,000	Dry tons/day
Head Grade – LOM	0.65	g/mt
Gold Recovery	71.4	%
Mine Life	20.3	Years
Total oz Produced	6,430,178	oz
Average Annual Production – LOM	317,000	oz
Total Ore Processed	474	Million tons
Total Waste Rock (not including preproduction)	463	Million tons
Annual Mining Rate	52	Million tons
Low grade stockpile size (maximum)	88	Million tons

	Value	Unit
Capital and Operating Costs		
CAPEX – Initial	1.93	$Billion
CAPEX – Sustaining	658	$Million
Reclamation & Closure	317	$Million
OPEX – Mining - LOM	2.05	$/t mined
OPEX – Processing - LOM	7.72	$/t ore
OPEX – G&A - LOM	1.35	$/t ore
OPEX – Operating Cost – LOM	1,068	$/oz
All-In Cost Pre-Tax (CAPEX+OPEX) – LOM	1,512	$/oz
Pre-Tax Financial Metrics		
Pre-Tax NPV (@ 5%)	168	$M
Pre-Tax IRR	6.1	%
Pre-Tax Payback	9.8	Years
After-Tax Financial Metrics		
After-Tax NPV (@ 5%)	45	$M
After-Tax IRR	5.3	%
After-Tax Payback	10.4	Years

The pre-tax internal rate of return (IRR) is 6.1% and the pre-tax net present value (NPV) using a 5% discount rate over the life of mine is $168M. The after-tax IRR is 5.3% and the pre-tax NPV using a 5% discount rate over the life of mine is $45M.

The results of the after-tax sensitivity analysis performed are summarized in Figure 1-5 and Figure 1-6. This sensitivity analysis shows that both gold price and recovery variations cause the greatest and almost equivalent impact on project value. A 30% increase in the gold price to $2,184/oz would yield an IRR of 14.1% and a NPV of $1,493M. A 30% decrease in the gold price to $1,176/oz would yield a reduced IRR of -22.5% and NPV of $-1,647M. The impact of variations in operating and capital cost on both financial metrics is similar with the operating cost changes resulting in marginally larger project returns than capital cost changes, meaning reducing operating expenses would benefit the Project more than reducing capital costs by the same percentage.

Figure 1-5 After-tax sensitivity analysis for project net present value (NPV @ 5% discount rate)

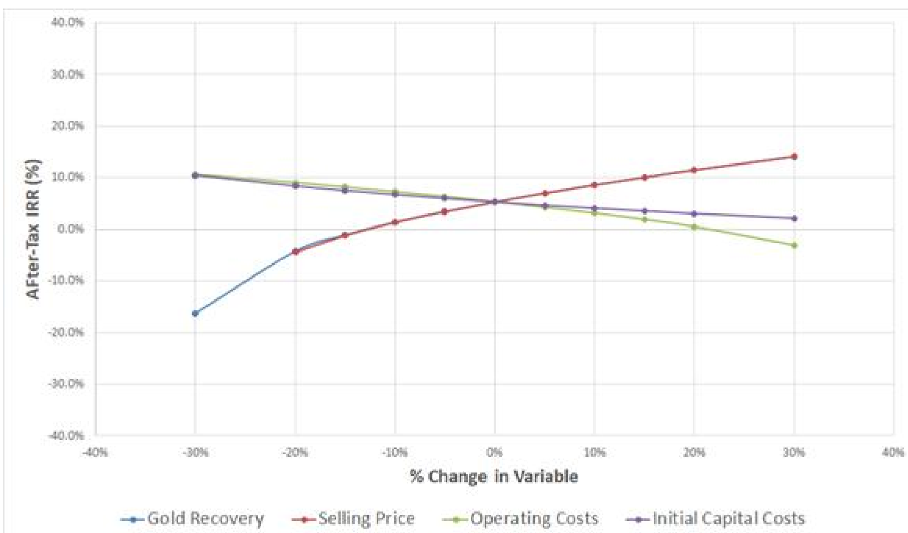

Figure 1-6 After-tax sensitivity analysis for project internal rate of return (IRR %)

1.18 Project Schedule

A hypothetical execution schedule for permitting, engineering, pre-development and construction of the Project was developed as part of the pre-feasibility study. The plan is conceptual in nature and contingent on the eventual completion of the positive feasibility study, during which it will be adjusted and refined. The major project activity milestones are presented in Table 1-12.

Table 1-12: Key project activities (preliminary)

Activity	Start date	Completion date	Duration (months)
Environmental Impact Statement and Permitting	Q1 Year -7	Q3 Year -3	48
Engineering Studies in Support of Permitting	Q1 Year -7	Q3 Year -3	48
Process Plant Detailed Engineering	Q1 Year -3	Q3 Year -2	21
Project Authorization		Q3 Year -3	
Pit Pre-Stripping / Waste Rock Supply for Construction	Q3 Year -3	Q4 Year -1	30
Tailings Management Embankment Construction	Q3 Year -3	Q4 Year -1	30
Process Plant Construction	Q4 Year -3	Q4 Year -1	27
Process Plant Dry Commissioning Completed		Q1 Year 1	
Start Process Plant Ramp-up to Commercial Production	Q1 Year 1		

1.19 Interpretations and Conclusions

This TRS was prepared to demonstrate the economic viability of an open pit mine and process plant complex based on the reserves estimated for the Livengood Gold Project. The process plant capacity is planned to be 65,000 t/d (59,000 mt/d).

This TRS provides a summary of the results and findings from each major area of investigation to a level that is equivalent and normally expected for a PFS of a resource development project. Standard industry practices, equipment and processes were used in this study. The Project contributors, on the date of publication, are not aware of any unusual or significant risks or uncertainties that could materially affect the reliability or confidence in the Project or development of the mineral reserves based on the information available.

The results of the PFS indicate that the proposed Project is technically feasible and marginally viable at the base case gold price of $1,680/oz. It is recommended to advance the Project to the feasibility study level including the completion of additional metallurgical testwork and various confirmatory studies to improve the Project's economics, study potential opportunities and reduce overall implementation risk. The decision and timeline to pursue the feasibility study is at the discretion of THM.

An analysis of the results of the investigations has identified a series of risks and opportunities associated with each of the technical aspects considered for the development of the Project.

The key risks include:

- Large earthwork quantities required to construct the Project;
- Management of waste rock could be more expensive than assumed;
- Impact of climate change on project design,
- Evolving ESG practices and governmental regulations.

The key opportunities include:

- Conducting grind/recovery metallurgical testing at coarser than 250 µm (P_{80}).

1.20 Recommendations

Based on the full list of recommendations presented in Chapter 23, it is estimated that the full feasibility study, including the recommended field activities, metallurgical testwork and environmental studies, would cost approximately $10.2M, including a 20% contingency.

2. INTRODUCTION

2.1 Overview

This Technical Report Summary (the "TRS") was prepared and compiled by BBA USA Inc. in cooperation with a number of consulting firms at the request of International Tower Hill Mines Ltd. (ITH) through its wholly owned subsidiary Tower Hill Mines, Inc. (THM). BBA USA Inc. is an independent engineering consulting firm headquartered in Montreal, Quebec, Canada.

The purpose of the TRS is to summarize the results of the Pre-feasibility Study (PFS) for the Livengood gold deposit on the THM property. This TRS has been prepared in accordance with §§229.1300 through 229.1305 (subpart 229.1300 of Regulation S-K).

The TRS supports the ITH November 4, 2021 news release "International Tower Hill Mines Announces Pre-Feasibility Study Results on 13.6 million ounce Gold Resource". This TRS also supports the mineral resource, mineral reserve and property disclosures in ITH's Annual Report on Form 10-K for the fiscal year ended December 31, 2021, in addition to the November 4, 2021 release.

This TRS was prepared based on contributions from BBA USA Inc., JDS Energy and Mining Inc., NewFields Mining Design & Technical Services, LLC, and Resource Development Associates Inc.

The Livengood property (65 ̊30'16''N, 148 ̊31'33''W) is located approximately 70 mi (113 km) northwest of Fairbanks, Alaska in the Tolovana Mining District within the Tintina Gold Belt. The property straddles Highway 2 (also known as the Elliott Highway), a paved, all-weather highway linking the North Slope oil fields to Fairbanks, and adjoins the Trans-Alaska Pipeline System (TAPS) corridor, which transports crude oil from the North Slope south.

2.2 Basis of the Technical Report Summary

This TRS is based on an updated resource estimate effective, as of August 20, 2021, and has an optimized Project configuration of 65,000 t/d (59,000 mt/d).

This TRS presents a summary of the results of the PFS for the development of the Livengood Gold Project. THM requested engineering consulting group BBA USA Inc. (BBA) to lead and perform the PFS, including contributions from a number of independent consulting firms including JDS Energy and Mining Inc. (JDS), NewFields Mining Design & Technical Services, LLC (NewFields), and Resource Development Associates Inc. (RDA).

This TRS was prepared at the request of Mr. Karl Hanneman, Chief Executive Officer of Tower Hill Mines, Inc. As of the date of this TRS, ITH is an exploration and development company trading on the Toronto

Stock Exchange (TSX) under the trading symbol (ITH) and the New York Stock Exchange (NYSE.MKT) under the trading symbol (THM).

The THM corporate office is situated at:

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Fairbanks, AK, USA 99701
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2.3 Study Contributors

A summary of the PFS contributors and their general areas of input are presented in Table 1-1.

Table 2-1: Primary PFS contributors

Consulting Firm	Scope of Services
BBA USA Inc.	▪ Mine engineering ▪ Mine capital and operating costs ▪ Mineral reserve estimation ▪ Surface infrastructure design and capital costs ▪ Metallurgical testwork analysis and process plant design ▪ Process plant capital and operating costs ▪ Environmental studies and permitting ▪ General and administration operating costs ▪ Financial analysis ▪ Overall TRS integration
JDS Energy & Mining Inc.	▪ Rock mechanics and open pit slope stability
NewFields Mining Design & Technical Services, LLC	▪ Geotechnical engineering ▪ Waste rock and water management ▪ Tailings management facility (TMF) design and capital costs ▪ Closure plan and costs
Resource Development Associates Inc.	▪ Geological modeling and mineral resource estimation ▪ Mineral resource classification

2.4 Report Responsibility

The consulting firms listed in Table 2-2, are responsible for the TRS and are independent of ITH and THM. These firms have employees which are considered to be Qualified Persons (QPs) by virtue of their employee's education, experience and memberships in good standing with professional associations.

The consulting firms have supervised the preparation of this TRS and take responsibility for the contents of the TRS as set out in Table 2-2. Each consulting firm has also contributed relevant figures, tables and portions of Chapters 1 (Summary), 22 (Interpretation and Conclusions), 23 (Recommendations), 24 (References) and 25 (Reliance on Information provided by the Registrant).

Table 2-2: Chapter/Section responsibility by Consulting Firm

Consulting Firm	Site Visit	Chapter/Section Responsibility
BBA USA Inc.	August 15, 2016	Chapters 2, 3, 10 (except Section 10.5.16.7), 12 (except Section 12.3.3.1), 13, 14, 15 (except Sections 15.14, and 15.19), 16, 17, 18, 19, 21, and the relevant portions of Chapters 1, 22, 23, 24 and 25.
NewFields Mining Design & Technical Services, LLC	March 1-2, 2012	Sections 10.5.16.7, 15.14, 15.19, and the relevant portions of Chapters 1, 18, 22, 23, 24 and 25.
JDS Energy & Mining Inc.	June 20-22, 2012	Section 12.3.3.1, and the relevant portions of Chapters 1, 22, 23, 24 and 25.
Resource Development Associates Inc.	August 2, 2011	Chapters 4, 5, 6 ,7 ,8, 9, 11 and 20, and the relevant portions of Chapters 1, 22, 23, 24 and 25.

2.5 Personal Inspection of the Livengood Property

The Consulting firm's QPs inspected the Livengood Property on the dates shown in Table 2-2 above.

2.6 Effective Dates and Declaration

This TRS supports the ITH news release "International Tower Hill Mines Announces Pre-Feasibility Study Results on 13.6 million ounce Gold Resource" dated November 4, 2021 announcing the results of the PFS. This TRS also supports the mineral resource, mineral reserve and property disclosures in ITH's Annual Report on Form 10-K for the fiscal year ended December 31, 2021, in addition to the November 4, 2021 release. The TRS has a number of effective dates as follows:

- Date of metallurgical testwork completion: April 15, 2021;
- Date of the Mineral Resource Estimate: August 20, 2021;
- Date of the Mineral Reserve Estimate: October 21, 2021;
- Date of Financial Analysis: October 29, 2021.

The overall effective date of the TRS is taken to be the date of the financial analysis and is October 29, 2021.

As of the effective date of this TRS, the Consulting firms are not aware of any known litigation potentially affecting the Livengood Gold Project. The Consulting firms did not verify the legality or terms of any underlying agreement(s) that may exist concerning the permits, royalties or other agreement(s) between third parties.

The results of this TRS are not dependent upon any prior agreements concerning the conclusions to be reached, nor are there any undisclosed understandings concerning any future business dealings between THM and the consulting firms. The consulting firms are being paid a fee for their work in accordance with the normal professional consulting practice.

The opinions contained herein are based on information collected throughout the course of the investigations by the consulting firms, which in turn reflect various technical and economic conditions at the time of writing. Given the nature of the mining business, these conditions can change significantly over relatively short periods of time. Consequently, actual results can be significantly more or less favorable.

2.7 Sources of Information

The reports and documentation listed in Chapter 24 (References) and Chapter 25 (Reliance on Information Provided by Registrant) of this TRS were used to support the preparation of this TRS. Additional information was sought from THM personnel where required. Sections from reports authored by other consultants may have been directly quoted or summarized in this TRS and are so indicated, where appropriate.

2.7.1 General

This TRS has been completed using the aforementioned sources of information, as well as available information contained in, but not limited to, the following reports, documents and discussions:

- Technical discussions with THM personnel;
- QPs' personal inspections of the Livengood gold property;
- Reports detailing mineralogical, metallurgical and grindability characteristics of the Livengood deposit, conducted by industry recognized metallurgical testing laboratories on behalf of THM;
- Geological block model received on June 4, 2021 with the file name: 210526_rda_model.bmf;
- A conceptual process flowsheet developed by BBA based on the specific Project testwork and similar operations;
- Internal and commercially available databases and cost models;
- Various reports covering site hydrology, hydrogeology, geotechnical and geochemistry;
- Internal unpublished reports received from THM; and
- Additional information from public domain sources.

2.7.2 BBA

The following individuals provided specialist input to BBA:

- Jorge Torrealba, PhD (BBA), André Allaire, PhD, P. Eng. (BBA) and Derek Blais (BBA) provided input to the comminution and metallurgical data interpretations as summarized in the TRS (Chapters 10 and 14).
- Denise Herzog, ITH Manager of Environmental Affairs provided input on recent environmental activities and current permitting status as summarized in the TRS (Chapter 17).
- Christopher Chung (BBA) provided input to the civil and geotechnical design of the general site infrastructure (Chapter 15).
- Guillaume Richer-Rochon (BBA) provided electrical designs for the site and process plant (Chapters 14 and 15).
- Bertrand Fortin (BBA) and Steven Perron (BBA) provided the designs for the process plant (Chapter 14).
- Jean-Francois Beaulieu and Laura Mottola (BBA) provided the operating philosophies, designs and costs for the Integrated Remote Operations Centre (IROC) as described in Chapter 15.
- Jocelyn Marcoux (BBA) provided input on the process plant and infrastructure capital costs (Chapter 18) as well as input on the Project construction strategies as summarized in the TRS (Chapter 21).
- Claude Catudal (BBA) provided input on the Project execution strategy and schedule as summarized in the TRS (Chapter 21).

These specialists are not considered as QPs for the purposes of this S-K 1300 TRS.

2.7.3 JDS

The following specialist reports were used by JDS:

- Knight Piesold Consulting, Technical Memorandum No. 3: Preliminary Seismic Hazard Assessment, May 5, 2011.
- SRK Consulting Inc., 2010 and 2012 Hydrogeological Investigations and Modeling Results, Livengood Project dated February 2011 and April 2013, respectively.
- Carew, T.J, Pennstrom, M.A., Bell, R.J., Klerk, Q., November 2010 Summary Report on the Livengood Project, Tolovana District, Alaska. November 1, 2010 provided geologic background information for the site.

These specialists are not considered as QPs for the purposes of this S-K 1300 TRS.

2.7.4 NewFields

The following individuals provided specialist input to NewFields:

- Joseph Compton (NewFields) provided input to the civil and geotechnical design of the TMF as well as input on the capital costs (Chapter 18).
- Joseph Hickey (NewFields) provided input on the TMF capital costs (Chapter 18).
- Troy Thompson (Ecological Resource Consultants) provided input to the water balance and water management design (Chapter 15).

These specialists are not considered as QPs for the purposes of this S-K 1300 TRS.

2.8 Currency, Units of Measure, and Calculations

This TRS assumes that the Livengood Gold Project will be constructed using imperial units. Therefore, to the maximum extent practicable, all design work and equipment descriptions were completed and reported in imperial units, with metric units shown in parentheses. Every effort has been made to clearly display the appropriate units being used throughout this TRS.

However, it is important to note that both the Livengood Gold Project drill hole database and the block model were originally created in metric units and have been consistently maintained in metric units. Therefore, some tables and figures in this TRS may be presented in metric units only to minimize the risk of data unit conversion errors.

Unless otherwise specified or noted, this TRS uses the following assumptions and units:

- Currency is in US dollars (USD or $);
- All ounce units are reported in troy ounces, unless otherwise stated: 1 oz (troy) = 31.1 g;
- All metal prices are expressed in US dollars (USD or $);
- For financial modeling, ore tonnage is reported in short tons (t), with all costs reported in $/t;
- All cost estimates have a base date of the third quarter (Q3) of 2021.

This TRS includes technical information that required subsequent calculations to derive subtotals, totals and weighted averages. Such calculations inherently involve a degree of rounding and consequently introduce a margin of error. Where these occur, the QPs consider them immaterial.

2.9 Important Notice

This TRS is intended to be used by International Tower Hill Mines Ltd. subject to the terms and conditions of its agreements with BBA USA Inc. and the relevant consulting firms. Such agreements permit International Tower Hill Mines Ltd. to file this TRS as a Technical Report Summary with the SEC's new mining rules under subpart 1300 and item 601 (96)(B)(iii) of the Regulation S-K (SK-1300). Any other use of this TRS by any third party is at that party's sole risk. The user of this document should ensure that this is the most recent TRS for the property as it is not valid if a new TRS has been issued.

2.10 Acknowledgements

The authors would like to acknowledge the general support provided by the THM management and Alaska development team personnel during this assignment. The TRS benefitted from the knowledge and specific input of the following individuals:

- Karl L. Hanneman – Chief Executive Officer
- Debbie L. Evans – Corporate Controller
- Denise A. Herzog – Environmental Affairs Manager

Their commitment, contributions and teamwork are gratefully acknowledged and appreciated.

3. PROPERTY DESCRIPTION AND LOCATION

3.1 Property Description

The Livengood Gold Project covers approximately 48,300 acres (19,546 hectares), all of which is controlled by the Company through its wholly-owned subsidiary, Tower Hill Mines, Inc. (THM) (Figure 3-1). The Livengood Gold Project is comprised of multiple land parcels: 100% owned patented mining claims, 100% owned State of Alaska mining claims, 100% owned federal unpatented placer mining claims; land leased from the Alaska Mental Health Trust (AMHT); land leased from holders of State of Alaska mining claims, patented claims, federal unpatented lode and placer mining claims, and undivided interests in patented mining claims. The property and claims controlled through ownership, leases or agreements are summarized below. All of the agreements are in good standing and are transferable. THM has taken reasonable steps to verify title to mineral properties in which it has an interest. Except for the patented mining claims and the federal unpatented mining claims of the Hudson/Geraghty lease, none of the properties have been surveyed.

3.1.1 100% Owned Patented Mining Claims

- U.S. Mineral Survey 2447, located on lower Livengood Creek, subject to an agreement to allow Larry Nelson, as agent for Nelson Mining Company, to operate a placer mine on MS 2447 through February 2, 2023.
- U.S. Mineral Survey 1956, located on lower Gertrude Creek, subject to a reserved royalty of 5% of gross value held by Key Trust Company on behalf of the Luther Hess Trust. With respect to portions of U.S. Mineral Survey 1626, located on lower Amy Creek:
  - 100% of No. 2 Above Discovery Amy Creek,
  - 100% of No. 3 Above Discovery Amy Creek, and
  - 100% of Up Grade Association Bench.

3.1.2 100% Owned State of Alaska Mining Claims

- 169 State of Alaska mining claims acquired by purchase. (Appendix A, Table A1);
- 153 State of Alaska mining claims acquired by location. (Appendix A, Table A2).

3.1.3 100% Owned Federal Unpatented Placer Mining Claims

- 29 federal unpatented placer mining claims. (Appendix A, Table A3).

3.1.4 100% Owned by Livengood Placers, Inc.

Livengood Placers, Inc. (LPI), a private Nevada corporation that is 100% owned by THM, is the record owner of the following:

- 29 patented mining claims. (Appendix A, Table A4);
- 108 federal unpatented placer mining claims. (Appendix A, Table A5);
- 24 State of Alaska mining claims. (Appendix A, Table A6).

3.1.5 Leased Property

Alaska Mental Health Trust Lease. A lease of the AMHT mineral rights having a term commencing July 1, 2004, and extending 19 years until June 30, 2023, subject to further extensions beyond June 30, 2023, by either commercial production or payment of an advance minimum royalty equal to 125% of the amount paid in Year 19 and diligent pursuit of development. The lease requires minimum work expenditures and advance minimum royalties, which escalate annually with inflation. A net smelter return (NSR) production royalty of between 2.5% and 5.0% (depending upon the price of gold) is payable to the lessor with respect to the lands subject to this lease. In addition, an NSR production royalty of 1% is payable to the lessor with respect to the unpatented federal mining claims subject to the lease described in the Hudson/Geraghty Lease below and an NSR production royalty of between 0.5% and 1.0% (depending upon the price of gold) is payable to the lessor with respect to the lands acquired by THM as a result of the purchase of LPI. in December 2011. As of December 31, 2020, there were 9,970 acres (4.035 hectares) included in the AMHT lease.

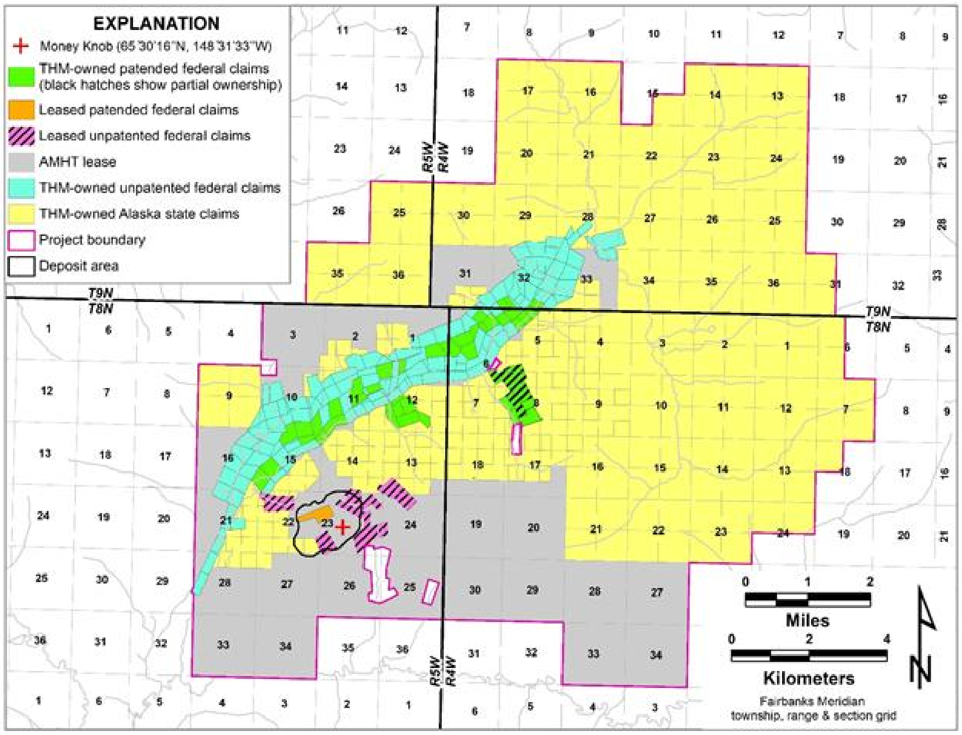


Figure 3-1: Map illustrating the company's Livengood Gold Project land holdings
(As at September 30, 2021, by tenure type, referenced to the Fairbanks Meridian Township, range and section grid.)

- Hudson/Geraghty Lease. A lease of 20 federal unpatented lode mining claims having an initial term of ten years commencing on April 21, 2003, and continuing for so long thereafter as advance minimum royalties are paid and mining-related activities, including exploration, continue on the property or on adjacent properties controlled by THM. The lease requires an advance minimum royalty of $50,000 on or before each anniversary date (all of which minimum royalties are recoverable from production royalties). An NSR production royalty of between 2% and 3% (depending on the price of gold) is payable to the lessors. THM may purchase 1% of the royalty for $1,000,000. (Appendix A, Table A7).

- Griffin Lease. A lease of U.S. Mineral Survey 1990 having an initial term of ten years commencing January 18, 2007, and continuing for so long thereafter as advance minimum royalties are paid. The lease requires an advance minimum royalty of $20,000 on or before each anniversary date through January 18, 2017, and $25,000 on or before each subsequent anniversary (all of which minimum royalties are recoverable from production royalties). An NSR production royalty of 3% is payable to the lessors. THM may purchase all interests of the lessors in the leased property (including the production royalty) for $1,000,000 (less all minimum and production royalties paid to the date of purchase), of which $500,000 is payable in cash over four years following the closing of the purchase and the balance of $500,000 is payable by way of the 3% NSR production royalty.
- Tucker Lease. A lease of two unpatented federal lode mining claims and four federal unpatented placer mining claims having an initial term of 10 years commencing on March 28, 2007, and continuing for so long thereafter as advance minimum royalties are paid and mining-related activities, including exploration, continue on the property or on adjacent properties controlled by THM. The lease requires an advance minimum royalty of $15,000 on or before each anniversary date (all of which minimum royalties are recoverable from production royalties). THM is required to pay the lessor the sum of $250,000 upon making a positive production decision, $125,000 payable within 120 days of the decision and $125,000 within a year of the decision (all of which are recoverable from production royalties). An NSR production royalty of 2% is payable to the lessor. THM may purchase all of the interest of the lessor in the leased property (including the production royalty) for $1,000,000. (Appendix A, Table A8).

3.1.6 Patented Mining Claims (Undivided Interests Less Than 100%)

- An undivided 5/6th interest in that certain patented placer mining claim known as the “Kinney Bench” claim, included within U.S. Mineral Survey No. 1626 on lower Amy Creek.
- An undivided 5/9th interest in that certain patented placer mining claim known as the “Union Bench Association” claim, included within U.S. Mineral Survey No. 1626 on lower Amy Creek.
- An undivided 1/6th interest in that certain patented placer mining claim known as the “Bessie Bench” claim, included within U.S. Mineral Survey No. 1626 on lower Amy Creek.
- An undivided 1/3rd interest in those certain patented placer mining claims known as the “War Association” claim, the “Mutual Association” claim, and the “O.K. Fraction” claim, all included within U.S. Mineral Survey No. 2033 on lower Amy Creek.
- An undivided 2/5th interest in those certain patented lode mining claims known as the “Yukon” claim, the “Mastodon” claim, and the “Piedmont” claim, all included within U.S. Mineral Survey No. 1990.

3.1.7 Other Land Obligations

State of Alaska Mining Claims

On State of Alaska lands, the state holds both the surface and the subsurface rights. State of Alaska 40-acre mining claims require an annual rental payment of $40 per claim to be paid to the state (by November 30th of each year) for the first five years, $85 per year for the second five years, and $205 per year thereafter. These rental rates are multiplied by four for each 160-acre claim. As a consequence of the annual rentals due, all State of Alaska mining claims have an expiry date of November 30th each year. In addition, there is a minimum annual work expenditure requirement of $100 per 40-acre claim and $400 per 160-acre claim (due on or before noon on September 1st each year) or cash in lieu of labor. An affidavit evidencing that such work has been performed is required to be filed on or before November 30th each year. Excess work can be carried forward for up to four years. If the rental is paid and the work requirements are met, the mining claims can be held indefinitely. The work completed by THM during the 2021 field season was filed as assessment work, and the value of that work is sufficient to meet the assessment work requirements through September 1, 2025, on all State of Alaska mining claims.

Holders of State of Alaska mining claims are also required to pay a production royalty on all revenue received from minerals produced on state land during each calendar year. The production royalty rate is 3% of net income.

Federal Unpatented Mining Claims

Holders of federal unpatented mining claims are required to pay an annual claim maintenance fee of $165 per 20 acres payable in advance on or before August 31 of each year.

Water and Land Use Considerations

Holders of State of Alaska and federal unpatented mining claims have the right to use the land and water included within mining claims only when necessary for mineral prospecting, development, extraction, or basic processing, or for storage of mining equipment. However, the exercise of such rights is subject to the appropriate permits being obtained.

3.1.8 Permits

THM has all of the necessary permits for exploration, geotechnical, and baseline data collection activities at the Project. These permits are active and include Alaska Department of Natural Resources (hard rock exploration, temporary water use), U.S. Bureau of Land Management (plan of operations), U.S. Corps of Engineers (Section 404 and nationwide wetlands), Alaska Department of Environmental Conservation (Section 401, storm water), and Alaska Department of Fish and Game (fish habitat) authorizations. Permits required to support project development are discussed in Chapter 17.

3.1.9 Environmental Liabilities

With over 100 years of placer mining activity and sporadic prospecting and exploration in the region, there is moderate to considerable historic disturbance on the property. Some of the historic placer workings are now overgrown with willow and alder. The old mining town of Livengood is now abandoned except for more modern road maintenance buildings at the town site. THM does not anticipate any significant obligations for recovery and reclamation of historic disturbance and there are no known significant existing environmental liabilities.

3.2 Location

The Livengood property is located approximately 70 mi (113 km) northwest of Fairbanks, Alaska in the Tolovana Mining District within the Tintina Gold Belt. The deposit area is centered near Money Knob, a local topographic high point. This feature and the adjoining ridge lines are the probable lode gold source for the Livengood placer deposits that lie in the adjacent valleys that have been actively mined since 1914 and produced more than 500,000 oz of gold.

The property lies in numerous sections of Fairbanks Meridian Township 8N and Ranges 4W and 5W. Money Knob, the principal geographic feature within the known deposit, is located at 65°30’16’’N, 148°31’33’’W.

The property straddles Highway 2 (also known as the Elliott Highway), a paved, all-weather highway linking the North Slope oil fields to Fairbanks, and adjoins the TAPS corridor, which transports crude oil from the North Slope south and contains the fiber-optic communications cable that may be used at the Livengood site (see Figure 3-2).

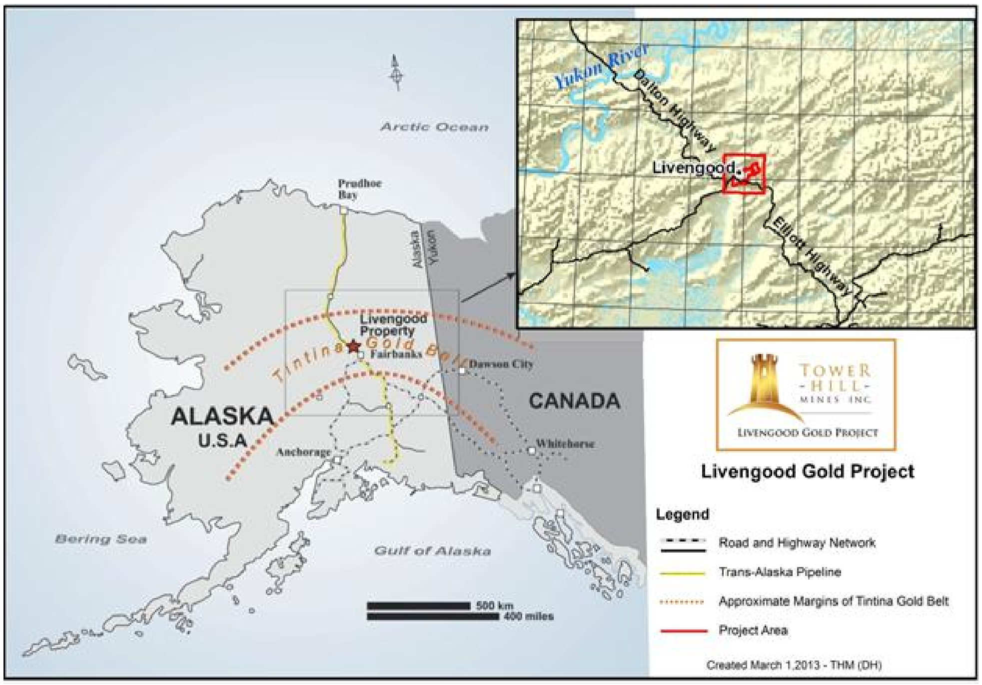


Figure 3-2: Project location map

4. ACCESSIBILITY, CLIMATE, LOCAL RESOURCES, INFRASTRUCTURE AND PHYSIOGRAPHY

4.1 Accessibility

The Livengood property is located approximately 70 mi (113 km) northwest of Fairbanks, Alaska in the Tolovana Mining District, within the Tintina Gold Belt. The property straddles Highway 2, a paved, all-weather highway linking the North Slope oil fields to Fairbanks, and adjoins the TAPS corridor. Locally, a number of unpaved roads lead from the highway into and across the deposit. A 3,000-ft (914 m) runway is located 3.7 mi (6 km) to the southwest near the former TAPS Livengood Camp and is suitable for light aircraft.

4.2 Climate

The site is approximately 40 mi (64 km) south of the Arctic Circle. The climate in this part of Alaska is continental with temperate and mild conditions in summer with average lows and highs in the range of 44°F to 72°F (7°C to 22°C). Winter is cold with average lows and highs for December through March in the range of -17°F to 23°F (-27°C to -5°C). The lowest lows are in the -40°F (-40°C) range. Annual precipitation is in the order of 15.7 in (400 mm) water equivalent. Winter snowpack depth is approximately 26 in (660 mm).

4.3 Local Resources and Infrastructure

4.3.1 Local Resources

The community of Minto (2012 population 223) is approximately 40 mi (64 km) southwest of the Project, and Manley Hot Springs (2012 population 116) is approximately 80 mi (129 km) southwest of the Project area at the western terminus of the Elliott Highway. The Fairbanks North Star Borough has a population of approximately 100,000 people, and comprises the regional center with hospitals, government offices, businesses, and the University of Alaska - Fairbanks. The city is linked to southern Alaska by a north-south transportation and utility corridor that includes two paved highways, a railroad, an interlinked electrical grid, and communications infrastructures. The city has an international airport serviced by major airlines. Fairbanks services both the Fort Knox and Pogo gold mines, which operate year round. Skilled and unskilled labor to support mine development and operations will come primarily from the Fairbanks area, with a total labor force of over 40,000 workers.

4.3.2 Infrastructure

A study completed by Electric Power Systems has determined that the local utility in Fairbanks (Golden Valley Electric Association) can provide the 55 MW of power required for the Project. The Project would be connected to the local grid by building a 50-mi (80 km) 230 kVa transmission line along the pipeline corridor.

SRK Consulting completed a regional hydrology study and determined that the average annual precipitation at the Livengood site, at project elevation of 1,400 ft (427 m) amsl, is 15.7 in (400 mm). A water balance study was completed by Ecological Resource Consultants (ERC) based on available and collected data. The study indicates that the site has an adequate water supply for the Project as designed.

Two independent fiber optic communication cables currently extend from Fairbanks to the North Slope, one along the TAPS, the other parallel to the Elliott Highway, both of which pass less than 2 mi (3.2 km) west of the Project.

4.4 Project Area

The 48,300 acres (19,500 hectares) of the Livengood Gold Project property has sufficient area to support the required Project facilities, including tailings, waste rock storage facilities and processing plant sites.

4.5 Physiography

The Project area consists of rolling terrain of the Yukon-Tanana Uplands with a maximum elevation of 2,622 ft (800 m) at Livengood Dome. Upper and mid slopes are occupied by mature black spruce (*Picea mariana*), white spruce (*P. glauca*), paper birch (*Betula neoalaskana*), and quaking aspen (*Populus tremuloides*) forests. Low-lying areas and floodplains are dominated by poorly drained shrub and black spruce woodland communities often underlain by permafrost. Few lakes or ponds occur in the Project area. Land disturbance from previous mining activity is conspicuous, particularly in Livengood Creek and lower Goldstream Creek.

5. HISTORY

5.1 General History

Gold was first discovered in the gravels of Livengood Creek in 1914 (Brooks, 1916) and led to the founding of the town of Livengood. Subsequently, over 500,000 oz of placer gold were produced. From 1914 through the 1970s, the primary focus of prospecting activity was placer deposits. Historically, prospectors considered Money Knob, a topographic high within the currently known gold deposit, and the associated ridgeline to be the source of placer gold. Prospecting, primarily in the 1950s and in the form of dozer trenches, was carried out for lode mineralization in the vicinity of Money Knob. However, no significant lode production has occurred to date.

Modern corporate exploration for lode gold mineralization in the vicinity of Money Knob and the Livengood placer deposits was initiated in 1976, continued intermittently though 1999, and included extensive soil sampling, trenching and 25 shallow drill holes. The most recent round of exploration of the Money Knob area began when AngloGold Ashanti (AGA) acquired property in 2003 and undertook an 8-hole RC program. The results from this program were encouraging and AGA followed up with an expanded soil geochemical survey, which identified gold-anomalous zones in the Money Knob area. Based on these results, prior soil surveys, and geological concepts, four diamond core holes were drilled in late 2004. The two drill programs intersected broad and extensive zones of gold mineralization, but no further work was executed due to financial constraints and a shift in corporate strategy. In 2006, AGA sold the Livengood Gold Project to ITH. In the same year, THM drilled a 4,026 ft (1,227 m), 7-hole core program. The success of that program led to the drilling of an additional 14,436 ft (4,400 m) in 15 core holes in 2007 to test surface anomalies, expand the area of previously intersected mineralization, and advance geologic and structural understanding of the deposit. Subsequent programs have continued to expand the resource, leading to consideration of development of the deposit. Concomitant programs have included geotechnical, engineering and metallurgical work, along with the collection of environmental baseline data. As of the end of 2014, AGA and THM completed exploration and delineation drilling totaling 575,078 ft (175,284 m) in 604 RC holes and 138,726 ft (42,284 m) in 149 core drill holes.

6. GEOLOGICAL SETTING AND MINERALIZATION AND DEPOSIT

6.1 Geological Setting and Mineralization

6.1.1 Regional Geology

The Livengood deposit is hosted by rocks of the Livengood Terrane (Figure 6-1), an east–west belt, approximately 150 mi (240 km) long, consisting of tectonically interleaved assemblages, which include: i) the Amy Creek assemblage, a sequence of latest Proterozoic and/or early Paleozoic basalt, mudstone, chert, dolomite, and limestone; ii) a Cambrian ophiolite sequence of mafic and ultramafic sea floor rocks thrust over the Amy Creek Assemblage, in turn overthrust by; iii) a sequence of Devonian clastic sedimentary, volcanic, and volcaniclastic rocks (Athey et al., 2004). The Devonian rocks are the dominant host to the mineralization at Livengood and have been informally subdivided into "Upper Sediments" and "Lower Sediments" stratigraphic units, separated by volcanic rocks ("Volcanics" or "Main Volcanics", Figure 6-2). The Devonian assemblage was overthrust by a second klippe of Cambrian ophiolite and structurally intercalated cherty sedimentary rocks ("Money Knob", Figure 6-2). All of these rocks are intruded by post-thrusting, Cretaceous (91.7-93.2 My; Athey, Layer, and Drake, 2004) multiphase monzonitic and syenitic dikes; gold mineralization is spatially and temporally associated with these intrusive rocks.

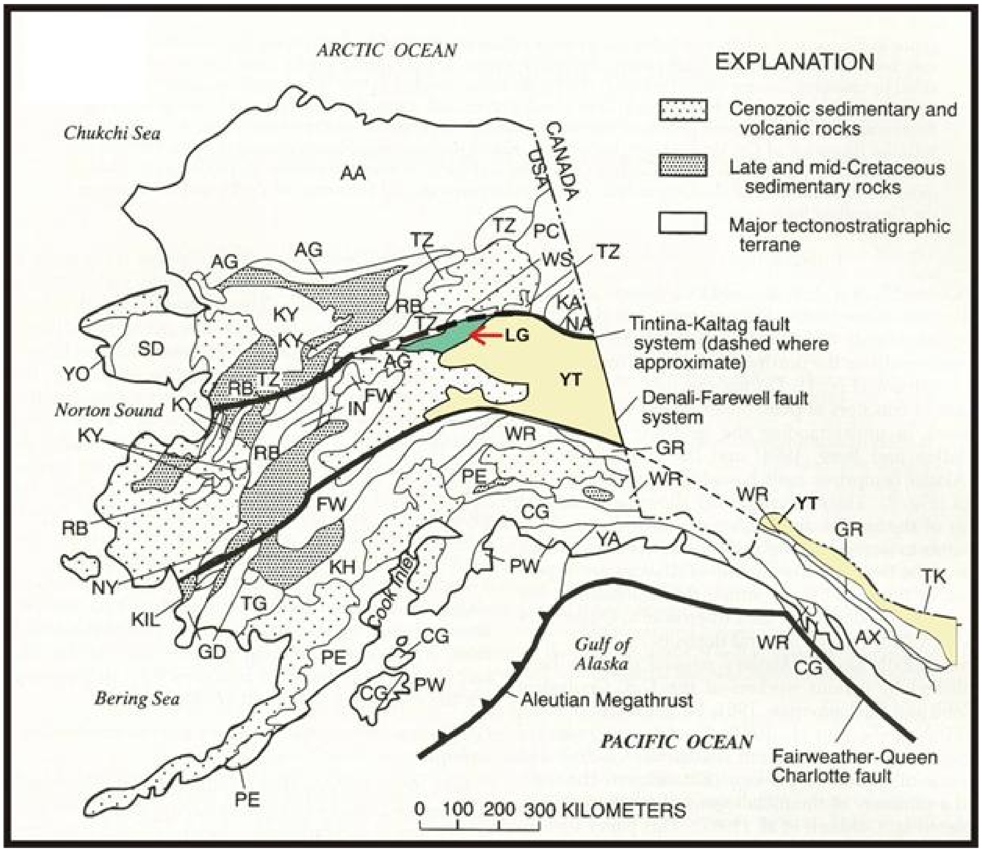


Figure 6-1: Terrane map of Alaska showing Livengood Terrane (LG: red arrow)

The heavy black line north of the Livengood Terrane is the Tintina Fault. The heavy black line to the south of the Livengood and Yukon-Tanana Terrane (YT) is the Denali Fault. The Tintina Gold Belt lies between these two faults (after Goldfarb, 1997)

6.1.2 Mineralization and Alteration

Gold mineralization is associated with disseminated arsenopyrite and pyrite in volcanic, sedimentary and intrusive rocks, and in quartz veins cutting the more competent lithologies, primarily volcanic rocks, sandstones, and to a lesser degree, ultramafic rocks. Mineralization appears to be contiguous over a map area approximately 2.5 km^2 (Figure 6-2); a 0.1 g/mt grade shell averages 920 ft (280 m) thick and drilling has not closed off the deposit at depth. The stronger zones of mineralization are associated with areas of more abundant dikes. South of the Lillian Fault (Figure 6-2 and Figure 6-3) individual mineralized envelopes are tabular and follow stratigraphic units, particularly the Devonian volcanics, or lie in envelopes that dip up to 45° to the south, mimicking the structural architecture and attitude of the diking. On the north side of the Lillian fault, mineralization is similar in style and orientation and hosted primarily in steeply dipping Upper Sediments. Three principal stages of alteration are currently recognized; in order from oldest to youngest, these are characterized by biotite, albite, and sericite. Arsenopyrite and pyrite were introduced primarily during the albite and sericite stages. Gold correlates strongly with arsenic and occurs primarily within and on the margins of arsenopyrite and pyrite grains. Carbonate was introduced with and subsequent to these stages. Dating of the sericite alteration (Athey, Layer, and Drake, 2004) indicates that mineralization and alteration were contemporaneous with the emplacement of the dikes.

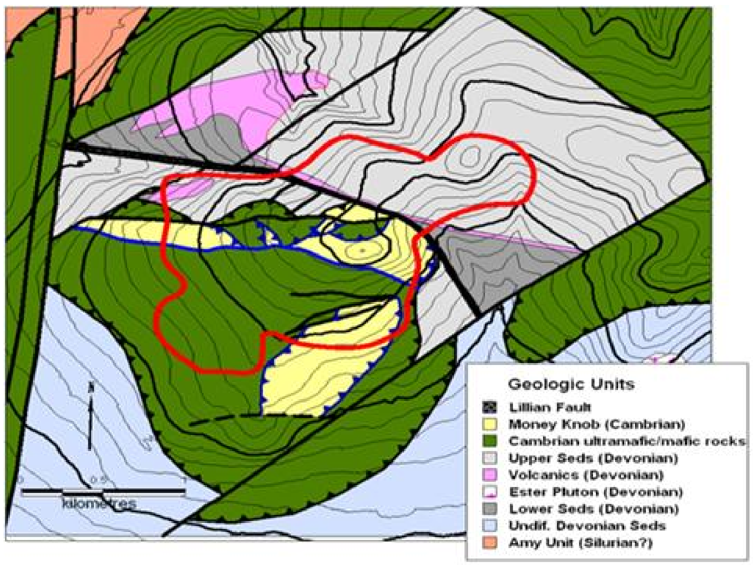


Figure 6-2: Generalized geologic map of the Money Knob area based on geologic work by THM
(Red outline is the surface projection of the gold deposit)

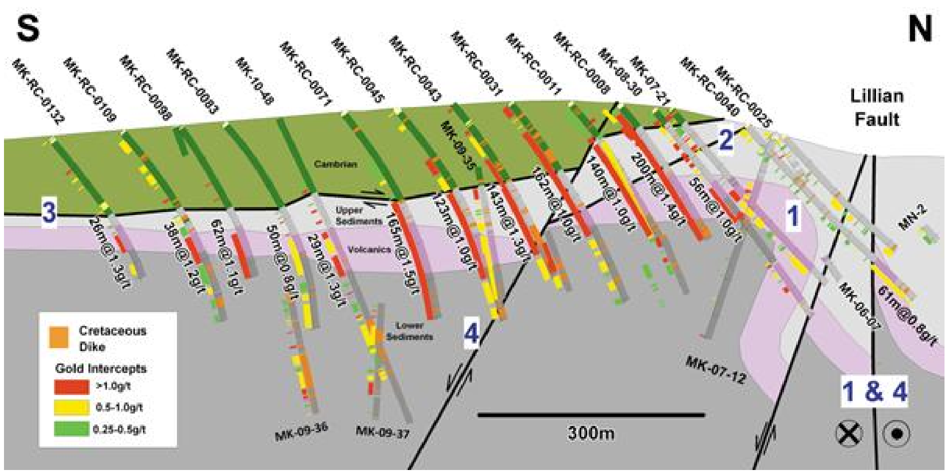


Figure 6-3: Cross section through the deposit

(Blue numbers indicate possible sequence of structural events: 1) Fold thrust development in the Permian (?); 2) NE-trending cross faults; 3) Thrust emplacement of Cambrian sheet; 4) Extensional collapse, all of which pre-date dike emplacement and coeval mineralization.)

6.1.3 Massive Stibnite Veins

Interpretations of the occurrence of massive stibnite veins (MSV) was interpreted using Leapfrog software. MSV host high concentrations of the element antimony (Sb). Sb is known to have an inverse relationship to Au metallurgical recoveries. Fifty-four individual occurrences of MSV have been identified within a corridor of Sb mineralization within the Livengood deposit. Figure 6-4 and Figure 6-5 display oblique view of the interpreted veins in relation to drill holes. Drilling shows other high grade Sb intercepts in the deposit.

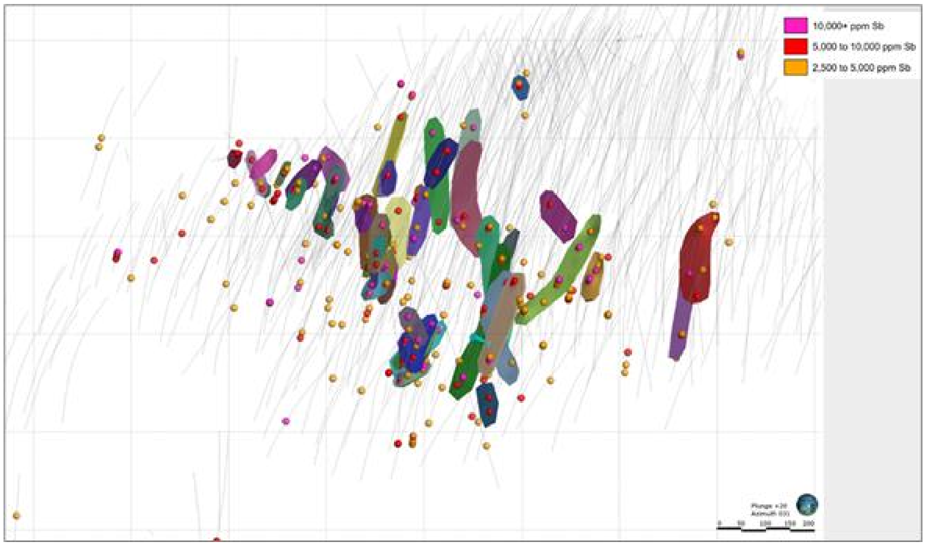


Figure 64: Caption 3D view of MSV and >2,500 ppm Sb assays-

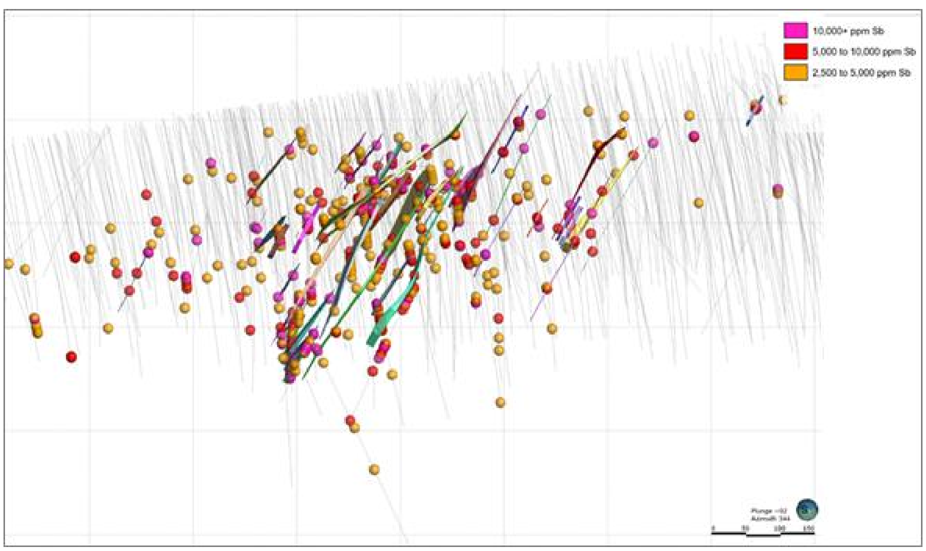


Figure 65: Caption 3D view of MSV and >2,500 ppm Sb assays-

6.1.4 Antimony Mineralization Halo

Model iterations were evaluated to estimate the Sb distribution within the Livengood deposit.

Implicit models of the Sb distribution were generated in late 2017 using the overall Sb assay data available. The implicit contouring was conditioned by "vectors", reflecting visual trends of continuity, and detected preferential alignments that guided the construction of the resulting Sb grade shells at a cut-off grade of 100 ppm.

The 100 ppm Sb shell volumetrics approximately reflect the proportion of Sb material reported to be above 100 ppm in the assay database, which suggests that about 20% of the overall mineral resources at Livengood are appreciably tainted by Sb.

It is to be noted that the modeling of the overall Sb distribution was not constrained by any of the rock units/ solids stratigraphic interpretation. Instead, the Sb distribution appears to be linked to structurally controlled domains, either some massive stibnite vein occurrences or zones of quartz-stibine veinlets reflecting, it is thought, some preferential vectors of continuity that could be related to post-mineralization structural features.

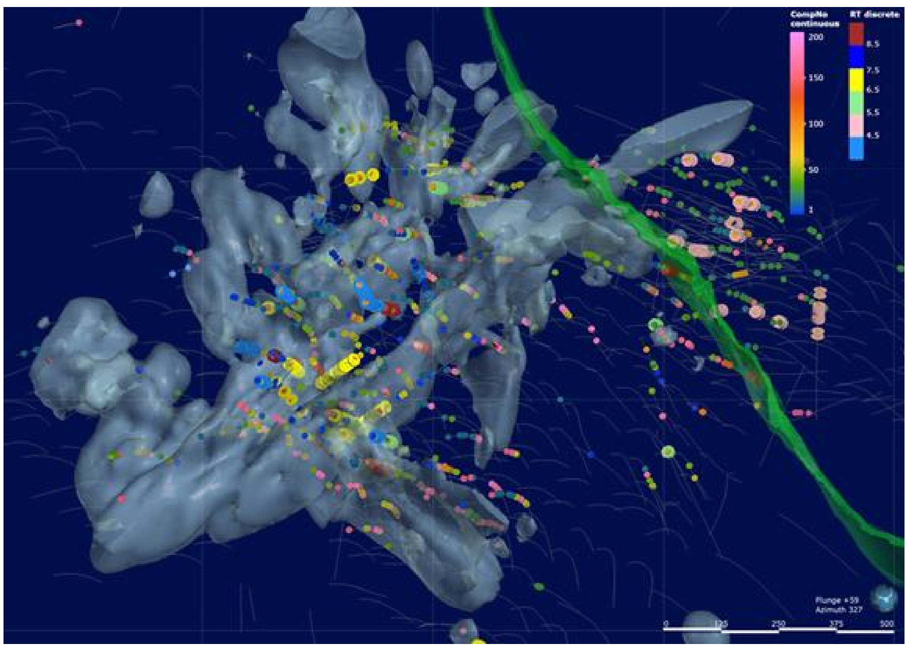


Figure 6-6: 3D view of the Sb_100ppm grade shell generated from preferential linear alignments and chosen metallurgical composite samples spatial distribution
Note the green RT8 volcanic cross-cutting unit, for reference

Detailed review of the structural data and measurements specifically related to the Quartz-Stibnite-Vein (QSV) domain, as recorded over time, suggest the prevalence of structural trends within that particular QSV domain, which were modeled as structural form interpolants using Leapfrog.

The so-called "form interpolants", shown as flowing sheets/ribbons (Figure 6-7), in return were used to guide the construction of grade shells while implicitly interpolating the Sb distribution. The resulting 100 ppm Sb shell appears as the meshed blue solid, truncated in Figure 6-8.

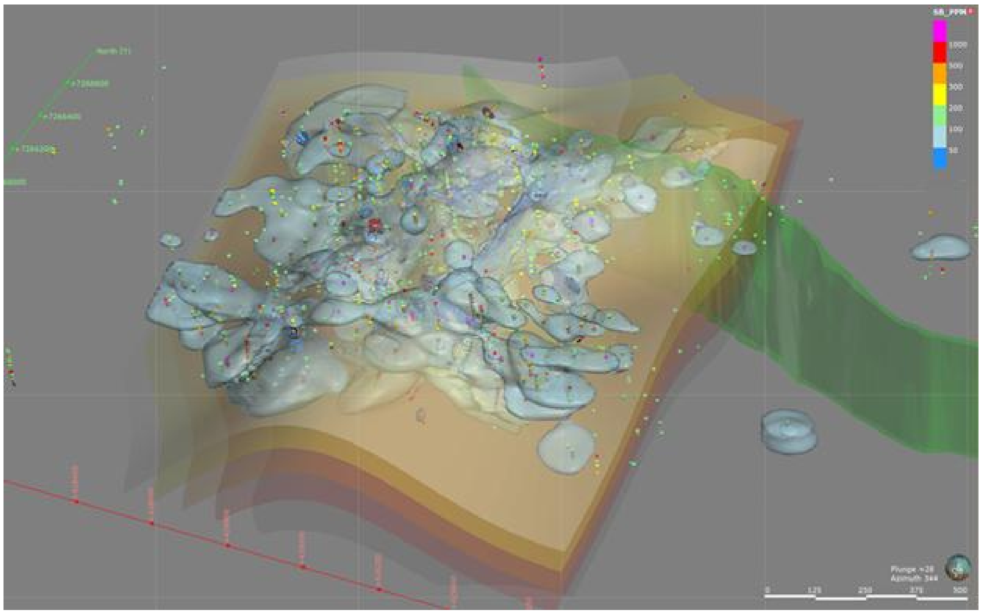


Figure 67: 3D view of the Sb_100 ppm grade shell-
derived from structurally controlled "form interpolant/sheets" guiding the implicit modeling with Leapfrog
Note the green RT8 volcanic dike unit, for reference

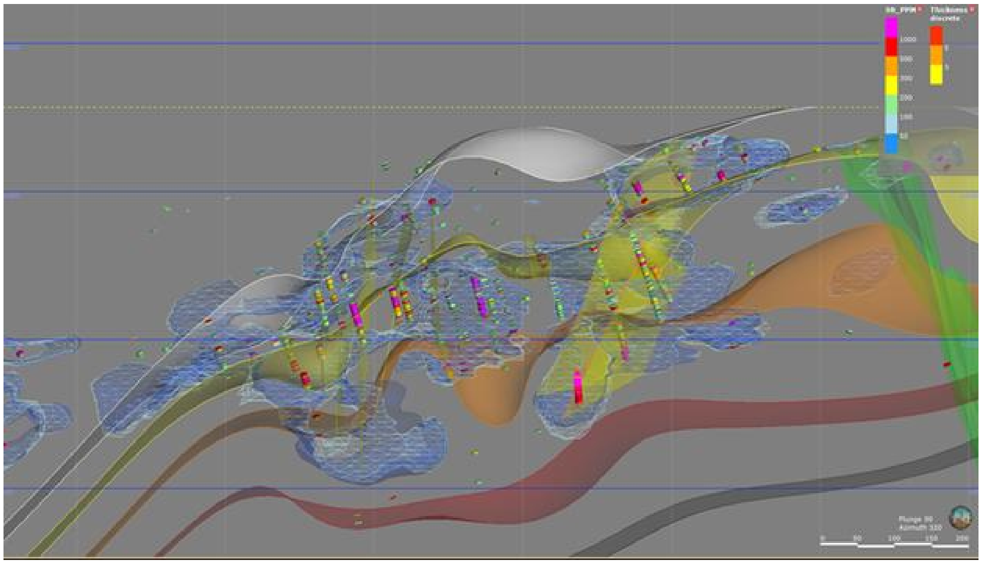


Figure 6-8: Cross section view of the Sb_100 ppm grade shell (meshed solid) derived from structurally controlled "form interpolant/sheets" shown as ribbons
To the right, note the green RT8 volcanic cross-cutting unit, for reference

6.2 Deposit

Among gold deposits of the Tintina Gold Belt, Livengood mineralization is most similar to the dike and sill-hosted mineralization of the Donlin Creek deposit, where gold occurs in narrow quartz veins associated with dikes of similar composition (Ebert, et al., 2000). The age of the intrusions and the coincidence of mineralization and intrusive rocks are typical of those of other nearby gold deposits of the Tintina Gold Belt, which have been characterized as intrusion-related gold systems (Newberry et al., 1995; McCoy et. al., 1997). For these reasons Livengood is best classified with these deposits.

7. EXPLORATION

7.1 Exploration History

Multiple companies have explored the Livengood area as outlined in Chapter 6. Among them, Cambior Inc. was chiefly responsible for outlining the sizeable area of anomalous gold in soil samples, which THM expanded between 2006 and 2010 (Figure 7-1) by collecting an additional 843 surface samples. These samples helped improve definition of anomalous gold in soil on the southwest side of Money Knob and to the northeast from Money Knob. The THM and Cambior samples were collected where C horizon material was available; the -80 mesh fraction was analyzed for gold and a multi-element package. The currently known deposit is defined by the most coherent and strongest gold anomaly, but represents detailed evaluation of only about 25% of the total gold-anomalous area.

During 2011, THM completed an IP/Resistivity survey covering the deposit and gold-anomalous soil geochemistry to the northeast, where loess and frozen ground have prevented complete geochemical coverage. The objective of the survey was to establish the geophysical signature of the deposit and identify similar signatures elsewhere in the district to prioritize exploration drilling.

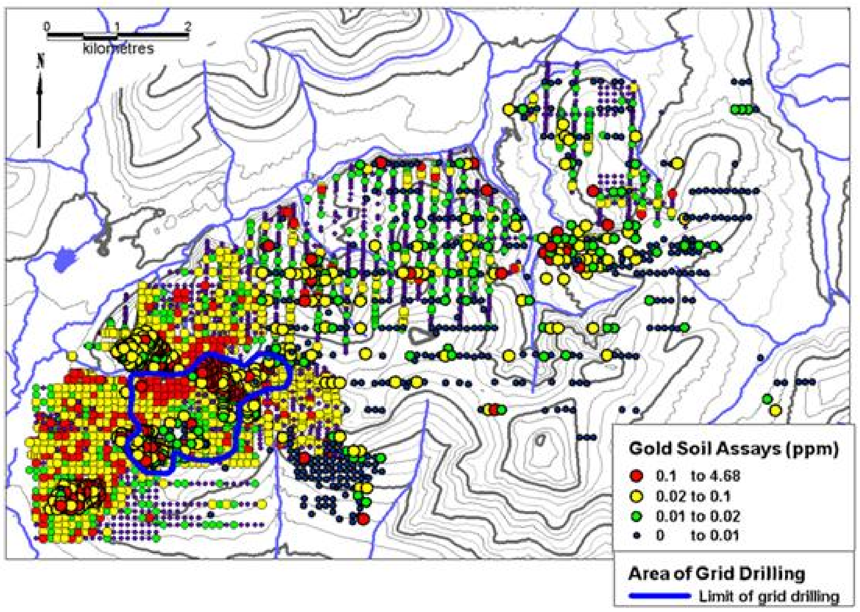


Figure 7-1: Plot of gold values in soil samples
(The surface projection of the known deposit is outlined in blue in the lower left corner of the figure)

7.2 Drilling

THM conducted drilling programs on the Livengood property from 2006 through 2012 (Figure 7-2) utilizing both core and reverse circulation (RC) drilling. These programs initially outlined mineralization in the Core Zone south of the Lillian fault in 2006 and subsequently in the Sunshine Zone area north of the fault, beginning in 2009, through step-out drilling and drill testing of areas with anomalous values in surface soil samples. Through completion of the delineation drilling at the end of the 2012 season, THM and others have completed a total of 717,435 ft (218,674 m) of exploration and delineation drilling, of which 574,599 ft (175,138 m) was RC drilling and 140,854 ft (42,932 m) was core drilling.

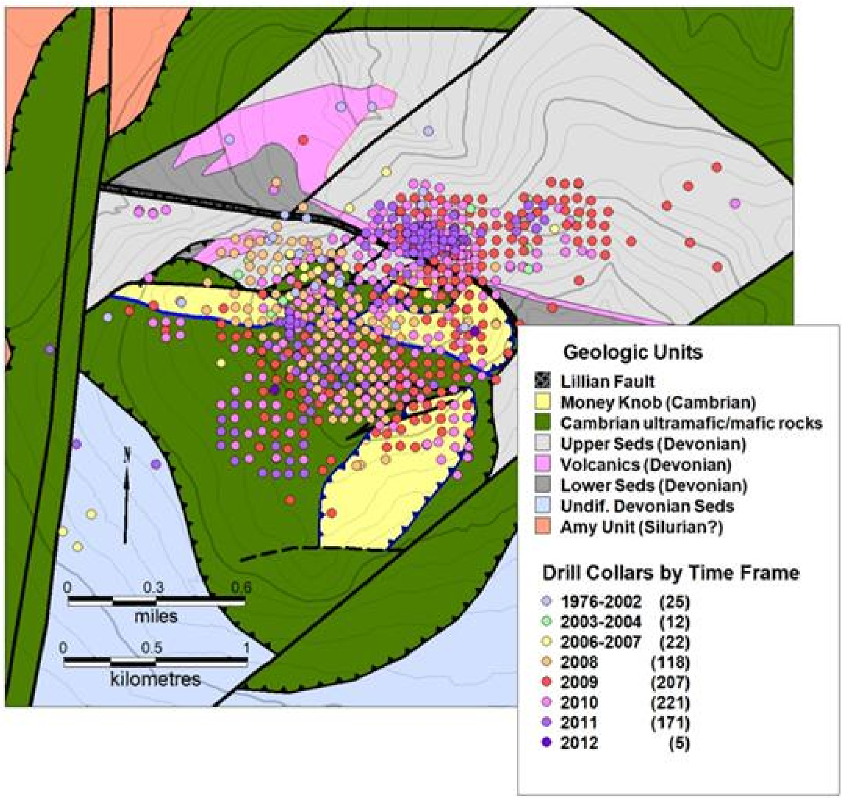


Figure 7-2: Distribution of resource / delineation drill holes in Money Knob area over time
(All holes completed after 2004 were drilled by THM. Drilling illustrated through 2011 dedicated to exploration and delineation; 2012 holes shown are geotechnical.)

Nearly all resource drill holes at Livengood have been drilled in a northerly direction at an inclination of -50° (RC) and -60° (core), to best intercept the south-dipping structures and mineralized zones as close to perpendicular as possible. A few holes have been drilled in other directions to test other features and aspects of mineralization. Initial grid drill holes were spaced at 246 ft (75 m) along lines and 246 ft (75 m) apart; subsequent infill drilling in the center of the 246 ft (75 m) square brings the nominal drill spacing to 164 ft (50 m) for a significant portion of the deposit.

Reverse circulation holes are bored and cased for the upper 0-100 ft (0-30 m) to prevent downhole contamination and to help keep the hole open for ease of drilling at greater depths. Recovery of sample material from RC holes is done via a cyclone and a dry or wet splitter, according to conditions. Drill cuttings are collected over the course of each 5 ft (1.52 m) interval and captured for a primary sample, an equivalent secondary sample ("met" sample) and a third batch of chips for logging purposes.

Diamond core holes represent 24% of the footage (meterage) drilled. Core is recovered using triple tube techniques to ensure good recovery (>92%) and confidence in core orientation. The core is oriented using either the ACTTM or the EZMarkTM tools.

Below the surface, drill hole locations are determined by sub-meter differential GPS surveys at the drill collar. The initial azimuth of drill holes is measured using a tripod mounted transit compass in conjunction with a laser alignment device mounted on the hole of the collar. Downhole surveys of RC drill holes and most core holes are completed using a gyroscopic survey instrument manufactured by Icefield Tools Corporation. Some core holes have been surveyed using the Reflex EZ ShotTM system. Results of surveys and duplicate tests show normal minor deviation in azimuth and inclination for drill holes (Brechtel, et al., 2011).

7.2.1 Reverse Circulation vs Core Drilling

On other projects, the use of reverse circulation (RC) drilling beneath the water table has resulted in inaccurate assay data, due to cyclicity and/or downhole contamination. As THM has used both RC and core drilling above and below the water table, THM has conducted a detailed evaluation of the RC data and comparison of the gold data for the two drilling techniques to check the accuracy of the RC data and evaluate any potential bias between the two drilling methods.

During RC drilling, cyclic contamination can occur if the driller fails to clean the drill hole prior to the addition of drill rods, which can be detected by grade spikes that occur with the addition of rods. Examination of the RC database indicated potential cyclic contamination in portions of six holes and one entire drill hole (Brechtel et al., 2011). The data for the affected intervals have been removed from the database used for resource calculation.

Detectable migration of mineralized material downhole, when drilling beneath the water table, can occur following penetration of a high-grade intersection and is manifested by a monotonic grade decrease for samples below the intersection. The frequency of monotonic decreases beneath high-grade intersections in both core and RC drill holes is statistically comparable; significant downhole contamination is not indicated for the RC drilling (Brechtel, et al., 2011).

Early in 2011, THM modeled the distribution and mean of gold grades for both types of drilling (Brechtel, et al., 2011). Table 7-1 compares the mean values by stratigraphic unit. The data suggests that, on average for the deposit, core gold grades (split HQ) are 4% lower than RC grades. The most notable contrast occurs in the Sunshine Zone above the water table, where the core grade is 20% lower than the RC grade.

Table 7-1: Comparison of modeled gold grades between core and RC drilling by stratigraphic unit

Unit	Core vs RC Difference
Kint (dikes)	-6%
Cambrian	-3%
Main Volcanics	-3%
Sunshine Zone Upper Sediments above water table	-20%
Sunshine Zone Upper Sediments below water table	+6%
All Data	**-4%**

Based on this work, an area in the Sunshine Zone (Area 50, Figure 7-3) and above the water table was selected for detailed drilling to further evaluate the relationship between core and RC results, where the discrepancy was the greatest. Area 50 was drilled out to nominal 123 ft (37.5 m) spacing to the water table (approximately 492 ft (150 m) below surface). The drilling included a mix of HQ core (7 drill holes sawn in half for sampling), PQ core (23 holes sampled whole), and RC drilling (28 holes), providing the opportunity to re-examine the difference between core and RC samples. All Area 50 samples were composited to 16.4 ft (5 m) lengths and grades modeled. The results are illustrated in Figure 7-4. For Area 50, the modeled mean PQ grade is 92% of that calculated for RC drilling, and the modeled HQ grade is 71% of the RC grade and 77% of the PQ grade, indicating that sawn HQ core recovers significantly less gold than either whole PQ core or RC sampling; PQ sampling is closer to RC sampling, but still lower. Ordinary kriging of the resource within the Area 50 volume by sample type bears out this relative relationship (contained gold based on PQ core is 94% of that based on RC; for HQ the contained gold is 80% of that calculated using RC) (Table 7-2).

Because the gold at Livengood is relatively coarse, the relative sample volume (e.g. RC with a 5-in (127 mm) diameter, whole PQ core with a 3.3 in (83 mm) diameter, and HQ core with a 2.4-in (61 mm) diameter that has been halved) is likely the root cause of the grade discrepancies between core and RC, due to the nugget effect. Split HQ core comprised 13% of the composites used to calculate the August 2011 resource. Based on the results above, it can be concluded that the resource is not significantly overstated and may be slightly understated.

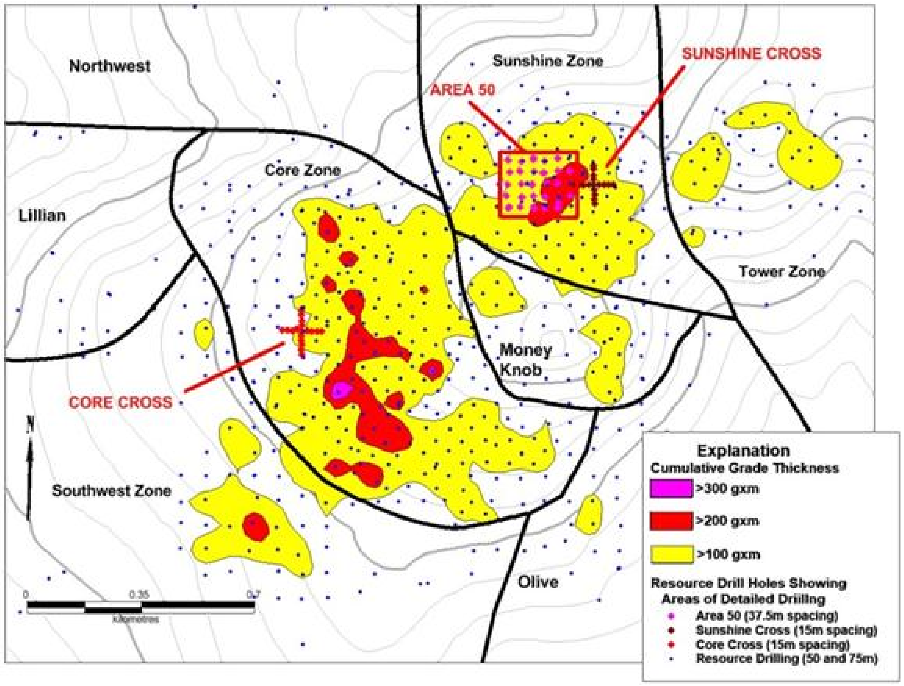


Figure 7-3: Map showing location of areas of detailed drilling
(Area 50, Sunshine Cross and Core Cross)

In addition, the mineralization in the Sunshine Zone (Area 50) is characterized by quartz-carbonate-sulfide veinlets that have a significantly higher proportion of associated coarse gold relative to the remainder of the deposit. Where the mineralized material is partially oxidized, the carbonate and sulfide are leached out, rendering the veinlets friable with the core often breaking along them. The most probable explanations for the greater discrepancies in grade in the Sunshine Zone above the water table are: i) loss of gold due to less than 100% core recovery (average 92%), and ii) progressive loss of gold with increased handling of the sample material, e.g. the HQ core was boxed, then taken from the boxes and sawn in half lengthwise then bagged (most handling), the PQ core was boxed, then transferred whole directly into sample bags (less handling), and the RC samples were bagged directly on the rig (no handling). This effect would be most pronounced in oxidized zones of the deposit, but could also occur in unoxidized rocks if they are badly broken and core recovery is less than 100%.

Table 7-2: Calculated resources for Area 50 by drill sample type
(Ordinary kriging of 32.8 ft (10 m) composites, 0.25 g/mt cut-off)

Drill Sample Type	Metric Tons (Mmt)	Tonnage Ratio	Au Grade (g/mt)	Grade Ratio	Au (oz)	Au Ratio
RC drilling	16.73		0.575		309,114	
PQ drilling, PQ/RC ratios	15.95	0.953	0.566	0.984	289,981	0.938
HQ drilling, HQ/RC ratios	15.14	0.905	0.510	0.887	248,061	0.802
HQ/PQ ratios		0.949		0.901		0.855

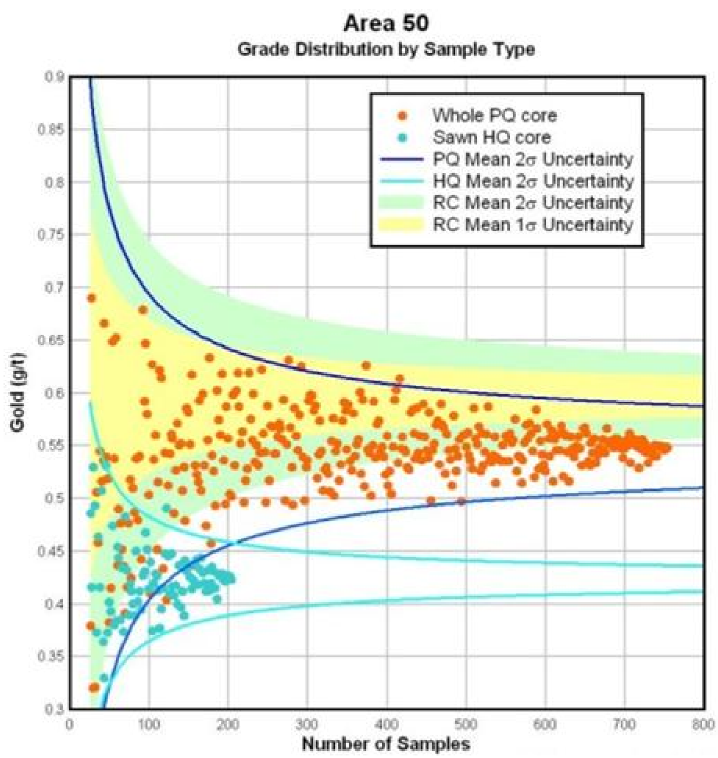


Figure 7-4: Models for RC, Whole PQ, and Sawn HQ from Area 50
(Based on 869 RC Composites, 753 PQ Core Composites, and 203 HQ Core Composites (all composited to 16.4 ft (5 m)). The modeled grade means for the RC, PQ and HQ composites in Area 50 are 0.597, 0.549 and 0.424 g/mt gold, respectively.)

7.2.2 Resource Verification Drilling

Two areas of the deposit, the Core and Sunshine crosses, were selected for 49 ft (15 m) spaced reverse circulation (RC) in-fill drilling on crosses with north-south and east-west legs 492 ft (150 m) in length (Table 7-3) to demonstrate continuity of grade and, thereby, confidence in the resource based on the wider spaced grid drilling defining the resource. A third area, Area 50, measuring 640 ft (195 m) by 787 ft (240 m) at the surface, was drilled on a 123 ft (37.5 m) grid with alternating core and RC drilling. Two resources were generated for each volume using ordinary kriging on samples composited to 33 ft (10 m) lengths: the first including those portions of the 164 ft (50 m) grid drilling (May 2011 resource) within the volume; and a second using both the grid and close-spaced drilling within the same volume. On average, the effect of the increased drilling density on tonnage, grade, and contained ounces of gold is negligible (less than 1%; see Table 123), indicating that current grid spacing adequately defines the resource.

Table 7-3: Calculated resources for the Core Cross, Sunshine Cross and Area 50
(Ordinary kriging, 0.25 g/mt cut-off)

Area, Drill Hole Spacing (1)	Metric Tons (Mmt)	Tonnage Ratio (all/grid)	Au Grade (g/mt)	Grade Ratio	Au (oz)	Au Ratio (all/grid)
Core Cross, 50 m grid & 15 m infill	15.67		0.481		242,401	
Core Cross, 50 m grid drilling only	15.37	1.020	0.477	1.008	235,715	1.028
Sunshine Cross, 50 m grid & 15 m infill	9.82		0.553		174,647	
Sunshine Cross, 50 m grid drilling only	9.81	1.001	0.566	0.977	178,556	0.978
Area 50, all drilling (37.5 m)	16.04		0.562		289,685	
Area 50, 50 m grid drilling only	16.13	0.994	0.550	1.022	285,136	1.016
All areas (averages)		**1.005**		**1.002**		**1.007**

Note: 1 m = 3.28 ft

The author is unaware of any sampling or recovery factors that could materially impact the accuracy and reliability of the drilling results for the Livengood Gold Project.

8. SAMPLE PREPARATION, ASSAYING AND SECURITY

8.1 Sample Collection, Procedures and Security

THM samples all holes from surface to total depth. Since 2009, core from the deposit is quick-logged in the split tube at the drill site, then boxed and transported by the geologist to the core logging facility in camp for detailed logging and sample markup. Samples lengths, based on geologic criteria, range from 1 ft (0.3 m) to 5 ft (1.52 m). After logging, the core is sawn in half longitudinally and sampled on the specified intervals into bags. Past procedures, largely similar, are documented in Brechtel et al. (2011).

RC samples (an “original” and a duplicate) are collected at the rig, as described in Chapter 10, directly into bar-coded bags, which are printed and coded with the hole number and sample interval. The samples are transported by project personnel from the drill site to camp, where they are logged in using a bar code reader slaved to a portable Thermo Fisher Scientific NITONTM XRF analyzer (used to collect geochemical data on all the RC samples).

When all samples for a drill hole are accounted for, a sample shipment is assembled by adding control samples for quality assurance and quality control (QA/QC). One standard (certified gold content) purchased from RockLabs or Geostats and one blank (below detection limit for gold) are added for every 18 drill samples in the shipment. Shipment paperwork is prepared for the lab and includes instructions for the preparation of prep duplicates (1 per 20 drill samples). All core samples are weighed and the weights recorded. The shipment is bagged in sealed containers and the seal numbers are recorded on the sample submittal form. The shipments are picked up at the Project site by ALS USA, Inc. (ALS) lab personnel, who acknowledge receipt and custody of the samples by signing a copy of the submittal form, which is retained in the Project files.

8.2 Lab Procedures

Drill samples were weighed upon receipt at the ALS prep lab in Fairbanks. RC samples are then dried and re-weighed. The samples are crushed (-10 mesh) and a 1 kg fraction is pulverized. Aliquots for analysis and the coarse rejects are also weighed. The tracking of weights from the field through the sample preparation process permits the detection of sample switches and/or number transcription errors. ALS forwards pulps from the Fairbanks prep lab to Vancouver or Nevada for analysis. Samples are analyzed by standard 50 g fire assay/AA finish for the gold determinations. All core samples and select RC drilling samples are also submitted for multi-element ICP-MS analyses using a 4-acid digestion technique. These are standard analyses for the exploration industry and are performed to a high standard. ALS is accredited by the Standards Council of Canada, NATA (Australia) and also has ISO 17025 and 9001 accreditations.

8.3 QA/QC Procedures and Results

ALS analytical reports are reviewed when received to: i) verify shipped vs received weights for core and dry weights against coarse rejects plus sample aliquots for all samples to check for weight loss or gain that indicates sample mixing, switches or transcription errors; and ii) blanks and standards with "out-of-range" values (±10% for standards and 3x detection limit for blanks). Errors are flagged and reported to ALS for resolution. If required, samples with questioned results and the surrounding 10 samples are re-analyzed. Upon satisfactory resolution of any discrepancies, new analytical certificates are issued by ALS.

In addition, duplicate gold pulp analyses and check assays with a second lab are requested on an annual basis. These analyses, and those for field duplicates and prep duplicates, are examined to evaluate the laboratory prep and analytical process. These data indicate no systematic bias introduced in the sample prep or gold assaying procedures, but do show scatter in the gold data, particularly at higher grades, which is interpreted as the product of nugget effect, typical for deposits with free gold. Results and detailed analysis of the data for 5,466 prep duplicates, 5,173 pulp duplicates, standard materials, and check assays are reported in Brechtel, et al., 2011.

As a further check on the integrity of gold assaying, 2,096 samples were selected for 1 kg screen fire assays for comparison to the standard 50 g fire assay/AA finish results routinely used by THM (Brechtel, et al., 2011). The mean gold grade for the samples is very similar for both data sets (within 0.1%). In detail, the data suggest that the standard fire assays are lower or equal to the screen fires at gold grades up to 9 g/mt. At grades over 9 g/mt, the 50 g assays may over-represent the gold grade, but at Livengood the number of samples at these grades is very small (<0.2% of the sample population).

8.4 Data Collection, Entry and Maintenance

Two master Project databases are maintained in Microsoft™ Access by THM: i) a drill hole database containing all the data collected in the field, including drill hole locations, downhole surveys, geologic logging, NITON™XRF geochemistry and sample interval data; and ii) an assay database that is the repository of all laboratory generated analytical data.

Data gathered electronically in the field is uploaded daily to the drill hole database utilizing custom queries. These data include RC drill logs and NITON™XRF geochemistry, collar locations and gyroscopic downhole survey data. Core logging and sampling information is collected on paper and hand entered. Once data is entered, database internal subroutines check the data for errors (i.e. gaps and overlaps in logging or sampling intervals) and data format consistency. Analytical data from ALS is received electronically, uploaded to the assay database and merged with the sample interval data read from the drill hole database. Customized queries check blank and standard analyses and flag out of range values.

The databases and all raw data are stored on a hard drive in the field office, which is copied automatically daily to the server in the Fairbanks office, where tape backup of the server is conducted nightly with rotation of tapes into offsite storage.

In the opinion of the author, the sample preparation, sample security and analytical procedures are adequate for the Livengood Gold Project.

9. DATA VERIFICATION

When the QP from RDA visited the Project, they were given unfettered access to the core logging facility and witnessed firsthand the procedures that were in place. No limitations were placed on the QP for any reason. In the opinion of the QP, the data at Livengood is adequate for the purposes of grade estimation for the Project.

The QP examined core during the site visit. Observations were that drill logs, cross sections and maps were done to a high quality. From 2006 through 2009, Dr. Paul Klipfel annually, and independently, collected a total of 80 samples from outcrops (2006), and both RC and core drill holes for gold analysis. Comparison of the results to THM's original gold assays indicates a scatter due to the nugget effect, but no systematic bias in the data (detailed discussion in Brechtel, et al., 2011). The QP reviewed the results of the 2009 verification sampling and agrees with the conclusions regarding accuracy, precision and lack of bias. Additionally, in 2010, 39 drill samples were collected for verification. The 2010 samples show a good overall correlation with the results reported by THM, with precision similar to or better than the analyses reported by the author in 2011 (Brechtel, et al., 2011). The QP has not verified all sample types or material reported, but to the best of their knowledge, THM has been diligent in their sampling procedures and efforts to maintain accurate and reliable results.

10. MINERAL PROCESSING AND METALLURGICAL TESTING

10.1 Introduction

This chapter presents the pertinent results from the testwork leading up to the 2013 feasibility study (FS), the post-FS test results that were obtained leading up to the 2017 pre-feasibility study (2017 PFS), as well as the post-2017 PFS test results that were obtained leading up to the 2021 PFS. The chapter begins with an outline of sample selection and preparation for the FS test programs (Section 10.2). This is followed by a discussion on the mineralogy and gold deportment of the Livengood gold ore rock types (Section 10.3), work that had been completed for the FS. Design work and equipment descriptions in this Chapter are reported in imperial units, with metric units shown in parentheses. Every effort has been made to clearly display the appropriate units being used throughout this TRS, certain tables show results in metric units only.

Comminution testing and the results of grinding simulations as they relate to mill circuit design and throughput estimation are covered in Section 10.4. Comminution testing was conducted in the following test programs:

- FS – Design Comminution Test Program;
- FS – Variability Comminution Test Program;
- PFS – SMC Testwork (2015-2016).

Metallurgical testing results and how these relate to back-end (post-comminution) plant design are discussed in Section 10.5. Metallurgical testing was performed in the following test programs:

- FS – Optimization Test Program;
- FS – Variability Test Program;
- 2017 PFS – Continuous Test Program;
- 2017 PFS Phase 7 – Assay procedures and water source testing;
- 2017 PFS Phase 8 – Grind, leach recovery, gravity, flotation testing;
- 2017 PFS Phase 9 – SGS and FLS / Curtin University test program, grind, leach recovery, gravity testing;
- 2017 PFS Phase 10 – Stirred tank reactor (STR) testing of rock types RT7 and RT9.
- 2021 PFS Phase 9a – Cyanide leach testing;
- 2021 PFS Phase 9b – Gravity recovery, stirred tank reactor (STR), gold deportment, diagnostic leach and flotation testing;
- 2021 PFS Phases 11 and 12 – Gold grade/recovery and grind size/recovery relationships both inside and outside the 100 ppm antimony shell.
- 2021 PFS Phase 13 – antimony concentration/gold recovery relationships.

The metallurgical testwork chapter includes discussion on gravity recovery, flotation, leach pre-conditioning, CIL, intensive leach (IL) testing, settling, cyanide detoxification and other topics as they relate to plant design. Phases 9, 9a, 9b and 11 and portions of Phase 13 represent the test programs that used RC rig duplicate rock chips in composite samples. All other test programs were based on drill core composite samples.

The chapter closes with a discussion on recovery equations (Section 10.6) and consolidates all testwork conclusions and a number of trade-offs as they relate to process flowsheet development (Section 10.7); potential opportunities for future testwork are then given (Section 10.8).

10.2 FS – Sample Selection and Preparation

As part of the work leading up to the FS, samples were selected by THM and RPA (Altman, K. 2013) and submitted to SGS for design and variability comminution composite preparation (Tajadod, J. and Lang, J., 2013).

Sample selection focused on the preparation of large bulk composite samples, which were used for flowsheet optimization testing and comminution testing. A number of variability samples were selected to test the variation in the orebody and to examine how the metallurgical response changes based on the feed grade for each of the rock types.

A mine production schedule that was developed prior to the 2013 FS was used to establish average gold grade targets to help guide the sample selection.

SGS Vancouver received two shipments in February and March 2012, originating from the Livengood property and submitted by THM. The material that was shipped was composed of approximately 3,000 individual samples, which were used for the optimization, design comminution and variability testing (Table 10-1).

Table 10-1: Livengood gold ore sample selection weights (kg) used in the FS test programs

FS Test Program	Sample weight (kg)
Optimization	4,800
Design comminution	2,700
Variability	3,000

The Livengood rock types were identified on the basis of their lithology. The six rock types identified in Table 10-2 below accounted for 100% of the reserve at that time.

Table 10-2: Definition of Livengood rock types (FS)

Rock Type	Description	% Ounces (of P&P) (1)	% Tons
RT4	Cambrian	13.1	13.9
RT5	Upper Sediments – Sunshine Zone	23.5	28.2
RT6	Upper Sediments	19.5	18.4
RT7 Bleached	Lower Sediments – South of Lillian Fault	13.5	12.1
RT8	Volcanics – North of Lillian Fault	1.9	2.0
RT9	Volcanics – South of Lillian Fault	28.5	25.4

(1) Proven & Probable

During the FS, rock type RT7 was further designated as “bleached” or “unbleached” material to account for the differences in the alteration and other factors of the samples. RT7 unbleached was not included in potential ore. The sample compositing instructions did contain some errors, so some of the RT7 samples were mixed up and in other cases bleached and unbleached material was combined.

For the design comminution test program, each sample interval was selected and added to the composite, blended, and homogenized. From each composite, 20 rocks (-3 /+2 in) were selected for the Bond low-energy impact (CWi) test. Each composite was then crushed to 100% minus 2½ in and 65 kg was split for the JK Drop Weight (DWT) test. The remaining sample was crushed to nominal 1¼ in and 5 kg was split for the Bond abrasion (Ai) test. The remaining sample was stage-crushed to ½ in and 15 kg was split for the Bond rod mill grindability (RWi) test. Finally, the remaining sample was stage-crushed to 6 mesh and 10 kg was split for the Bond ball mill grindability (BWi) test. The FS Design comminution sample preparation flowsheet is illustrated in Figure 10-1.

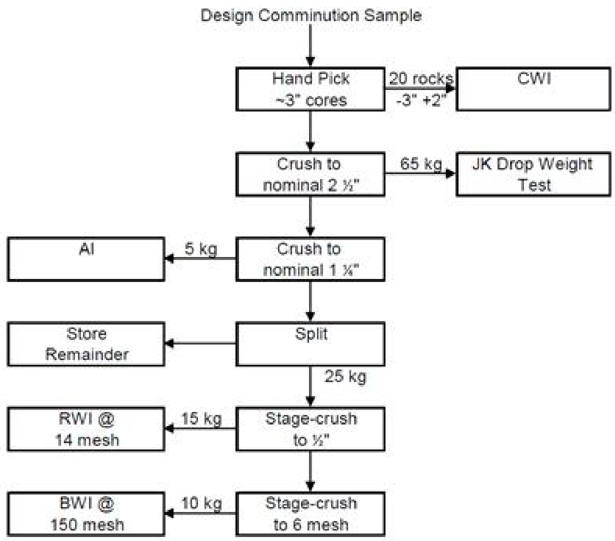


Figure 10-1: FS Design comminution sample preparation flowsheet (SGS report)

For the comminution portion of variability testing, each sample interval was selected and added to the composite, blended and homogenized. Every sample was crushed to nominal 2½ in and 10 kg was split for the SPI test. The remaining sample was stage-crushed to nominal 6 mesh, blended, and a 10 kg portion was split for the BWi test. The comminution variability sample preparation flowsheet is illustrated in Figure 10-2.

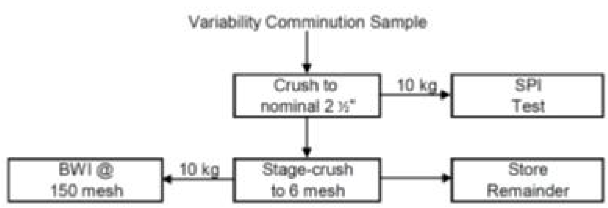


Figure 10-2: FS Variability comminution sample preparation flowsheet

Both the design comminution and variability samples were selected from the major rock types (RT4, RT5, RT6 and RT9). Rock types RT7-Bleached, RT7-Unbleached and Stibnite were also tested in the comminution variability test program. RT8 was not tested in any of the test programs. RT7-Bleached and RT7-Unbleached labels were later removed and sample results were combined and renamed RT7.

10.3 FS – Mineralogy and Gold Deportment Study

SGS (Wang, Z. and Prout, S., (2013)) undertook a high definition mineralogical examination of the Livengood samples that were used for the FS metallurgical testwork. Examination of four samples, which were identified as RT4, RT5, RT6, and RT9, was carried out using X-ray diffraction (XRD), QEMSCAN, Electron Microprobe Analysis (EMPA), optical microscopy, and chemical analysis. The purpose of this test program was to determine the overall mineral assemblage, the liberation/association of the iron sulfides and gold-bearing minerals, as well as to complete a mass balance of microscopic gold.

The RT4 sample consisted of carbonates (22.5%), talc (18.6%), quartz (16.0%), feldspars (13.1%), chlorite (11.0%), micas (6.4%), and other silicates (mainly amphibole, pyroxene, garnet and epidote) (4.7%), clays (2.5%), oxides (1.8%), along with trace (<1%) apatite and other minerals. Arsenopyrite accounted for 1.9% and pyrite for 0.9%. Gold minerals were tentatively quantified in the sample at less than 0.001%.

The RT5, RT6 and RT9 samples consisted of quartz (33.0-40.2%), micas (11.8-16.9%) feldspars (21.7%-27.7%), carbonates (3.7-7.2%), and oxides (1.5-2.1%), along with trace (<1%) talc, apatite and other minerals. Pyrite accounted for 2.9-10.5%, arsenopyrite (1.0-1.4%). Gold minerals were tentatively quantified in the samples at less than 0.001%.

In the four samples, gold occurred mainly in its native form (defined as Au 75-100%), and carried an average of 90.8-93.5 wt% Au, while all other elements were less than 1.0 wt%.

The results of the gold deportment characterization demonstrated that RT5, RT6 and RT9 all exhibited broadly similar characteristics. Rock types RT6 and RT9 demonstrated poor correlation with chemical assays, suggesting that the contribution of finer gold populations may be more significant in these ore domains. Rock type RT4 showed significant variation in both mineralogical composition and identified gold populations. It would be anticipated that RT4 may cause difficulties in recovery for a process tailored to the other ore domains.

Rock types RT5 and RT6 had pyrite as the dominant sulfide mineral over arsenopyrite. Rock type RT9 maintained this trend, but with <10% arsenopyrite (relative to pyrite) present. Generally, solid solution gold could be expected to be hosted with arsenopyrite and consequently the potential contribution of solid solution gold to the overall gold balance should not be expected to be significant in these rock types.

Rock type RT4 showed arsenopyrite to be the dominant sulfide mineral. However, the abundance of sulfide minerals was generally lower in this rock type, once again suggesting that solid solution gold should not be a major factor in process development.

Comparison of the four rock types examined for the Project demonstrated a consistent trend for the majority of gold to be present as free gold within the gravity concentration size range. The majority of gold grains that were not within the gravity recoverable range were identified as fine exposed gold grains and should be readily amenable to recovery by CIL leaching of the gravity tailings.

10.4 Comminution Testing

Comminution testwork programs were completed as part of the 2013 FS and the 2017 PFS. In both cases, the objective was to generate the information needed to size the crushing and grinding circuits for the Project.

10.4.1 FS – Comminution Testing

Comminution testing was performed on samples that comprised part of the optimization samples, as well as the variability samples. Samples were selected based on the potential mill supplier's recommendations

Design comminution samples were prepared in accordance with Figure 10-1. A total of 12 DWTs were performed on rock types RT4, RT5, RT6, RT7-Bleached, RT7-Unbleached and RT9. Priority was given to the DWT, due to limitations in the availability of PQ core.

A total of 36 samples were prepared for comminution testing, including: Bond Work index (BWi), Rod Work index (RWi), Crusher Work index (CWi) and Abrasion index (Ai). These indexes were applied in the crusher and mill sizing calculations as well as for determination of consumables, such as balls and liners.

Additional SAG power index (SPI) and BWi tests were completed using variability samples. The total number of BWi tests was 136.

The average BWi, RWi, CWi and Ai for each of the above rock types are presented in Table 10-3.

Table 10-3: Comminution data (FS)

Rock Type	Work Index Metric (kWh/mt)			
	BWi	RWi	CWi	Ai
RT4	12.3	13.1	13.3	0.14
RT5	11.9	15.7	14.1	0.15
RT6	14.4	17.3	14.4	0.12
RT7	14.1	14.5	7.7	0.17
RT9	14.3	16.3	7.4	0.35
Total Number of tests	**136**	**26**	**48**	**48**

JK Drop Weight (DWT) tests were performed on selected rock type samples. The data obtained was analyzed to determine the JKSimMet comminution parameters. These parameters were combined with equipment details and operating conditions to analyze and/or predict grinding circuit performance. While the A and b values of the DWT are not independent and cannot be used for direct comparison between ore types, their product (A×b) provides a good parameter for comparison. Lower A×b values indicate a higher resistance to abrasion breakage and also a greater resistance to impact breakage. Table 10-4 below, shows the average A and b values for each rock type. The results indicated that RT4 and RT7 would require less comminution energy than the other rock types. The numbers are indicative of a medium hard rock type.

Table 10-4: Average JK drop weight parameters by rock type (FS)

Rock Type	Number of Tests	A	b	A×b
RT4	2	62.1	0.83	51.5
RT5	2	67.6	0.50	33.8
RT6	2	50.7	0.64	32.5
RT7	4	55.4	0.89	49.3
RT9	2	60.5	0.58	35.4
Total tests	**12**			

10.4.1.1 FS – JKSimMet Simulations

Analysis of the JK Drop Weight parameters was performed by Mark Richardson of CSS using JKSimMet, a software package used to analyze the grinding circuit, which was comprised of a single (D×L) 40 ft × 25 ft SAG mill, followed by two (D×L) 28 ft × 45 ft ball mills, with a pebble crusher operated in closed circuit with the SAG mill. Following optimization, the JKSimMet results led to the conclusion that the selected circuit would process about 92,600 t/d (84,000 mt/d).

It should be noted that one vendor recommended the use of a (D) 42 ft. SAG mill to achieve the target throughput. Consideration was given to this size of mill, but it was decided that a “first of its kind” (D) 42 ft SAG was not warranted, due to a lack of reference sites with proven track record in the industry at the time of the FS.

After further consultation, the JKSimMet model was rerun using the following new parameters:

- Circuit target grind of 90 µm (P_{80});
- Daily throughput of 100,000 t/d (90,718 mt/d);
- BWi (14.3 kWh/mt) corresponding to the 75th percentile of LOM hardness.

The simulation resulted in a circulating load of 15% through the pebble crusher and a circulating load of 350% running through the ball mill circuit. The proposed circuit used a single (D × L) 40 ft × 26 ft SAG mill with 27 MW of installed power and two 28 ft × 46 ft ball mills with 29.5 MW of installed power each.

The decision was made to accept the vendor recommendation, but to also install a bypass after the pebble crusher, to allow the option to shift some of the SAG load downstream to the ball mill circuit as a way to balance the power draw in the circuits.

10.4.2 2017 PFS – Comminution Testing

BBA completed a review of the FS comminution testwork ("Comminution testing of samples from the Livengood Property". SGS report 50223-001-Phase III, com Report 3. February 26, 2013). Based on the review, BBA made the recommendation to carry out additional comminution testwork (SMC testing) to increase the level of confidence in the parameters used to design the grinding circuit and gain further insights into the variability of the Livengood gold ore's comminution properties.

10.4.2.1 2017 PFS – SMC Testwork Program (2015-2016)

SMC testwork was performed in January 2016 at SGS Vancouver to increase understanding of the ore variability by rock type in support of the grinding circuit development.

Ten composites were prepared for each rock type. Each composite was made up of several drill core intervals. The composite weights ranged from 12 to 26 kg. The samples making up a composite were all properly bagged and labeled according to the rock type (e.g. RT4) and composite number (1-10), i.e. RT4-1, RT4-2, up to RT4-10. The samples that made up the composites were bagged and labelled according to drill hole number and sample number. All samples within a composite came from a single drill hole.

BBA requested that Stephen Morrell (SMC Testing®) be engaged to assist in calibrating the SMC test results using the DWT data from the 2013 FS. This procedure is a required step in BBA's practices to ensure that the calibration of the SMC results is performed using data from DWT tests from the same deposit and ore types as opposed to using generic databases available through JKTech (owners of JKSimMet). The calibration of the SMC results for each of the rock types (RT4, RT5, RT6, RT7, and RT9) was completed using the DWT data that corresponded to each specific rock type.

Table 10-5 shows the average as well as the 50^{th} and 80^{th} percentile results of the SMC testwork. Based on BBA's experience and internal database, the RT5 and RT9 ore could be classified as hard, as the 50^{th} percentile (50^{th}) of the A×b data is in the low 30s. On this same basis, rock types RT6 and RT7 would be considered medium hard (50^{th} in the 40s), and RT4 would be considered the softest of the rock types present in the Livengood deposit (50^{th} = 73).

It is important to note that for most of the rock types there is only a small difference between the 50^{th} and 80^{th} A×b values. With the exception of RT4, the results suggest that there will not be significant grinding throughput variability from one rock type to another. In the case of RT4, ore blending with other rock types should be considered to moderate this issue.

When comparing the comminution results from the 2017 PFS to the 2013 FS, the 50th A×b results for the RT4 rock type was lower (the ore was softer) than the average of the DWT results from the FS. The 50th A×b results for rock types RT5, RT6, and RT9 were of the same order as the average of the DWT results from the FS. In the case of RT7, the 50th was slightly harder than the average of the DWT results from the FS.

Table 10-5: SMC testwork statistical analysis (2017 PFS)

RT	Number of tests	Samples ID	A×b average	A×b 50th percentile	A×b 80th percentile
4	10	RT4-1 to 10	75.0	73.1	57.1
5	10	RT5-1 to 10	36.7	33.4	29.3
6	10	RT6-1 to 10	44.4	38.5	31.3
7	10	RT7-1 to 10	47.9	40.1	33.8
9	10	RT9-1 to 10	37.9	36.7	31.8
Total	**50**				

10.4.3 Testwork Summary for Crushing and Grinding Circuit Design

A database was prepared with all available results from both the FS and 2017 PFS comminution testwork. Table 10-6 and Table 10-7 present the results of a statistical analysis by rock type using the results from the FS and 2017 PFS programs.

Table 10-6: Comminution test statistical analysis by rock type

Percentile	Rock Type	SG (g/cm^3)	JK Drop Weight Parameters (DWT and SMC test)		CWi	RWi	BWi	Ai
			A × b	ta	kWh/mt	kWh/mt	kWh/mt	g
50th	RT4	2.73	65.2	0.72	14.5	13.4	12.0	0.13
	RT5	2.68	33.4	0.36	14.2	15.7	12.0	0.15
	RT6	2.73	36.7	0.41	15.1	17.6	13.0	0.10
	RT7	2.71	42.7	0.41	7.9	14.2	12.1	0.15
	RT9	2.74	36.0	0.38	6.9	16.3	13.7	0.29
80th	ALL	2.77	32.0	0.61	15.5	17.1	13.7	0.25

Table 10-7: Comminution test statistics using all FS and 2017 PFS testwork data

Statistic	SG (g/cm^3)	JK Drop Weight Parameters		CWi	RWi	BWi	Ai
		A × b	ta	kWh/mt	kWh/mt	kWh/mt	g
Max	2.87	23.8	1.26	19.7	19.1	14.9	0.59
90%	2.79	28.9	0.79	17.0	17.9	14.3	0.33
80%	2.77	32.0	0.61	15.5	17.1	13.7	0.25
75%	2.76	33.0	0.58	14.3	16.4	13.4	0.20
50%	2.71	41.0	0.41	9.4	14.9	12.6	0.16
25%	2.66	52.9	0.32	7.2	13.1	11.7	0.10
10%	2.57	78.6	0.28	5.8	11.6	11.1	0.08
Min	2.39	121.0	0.23	4.8	11.2	10.2	0.05
Average	**2.70**	**47.1**	**0.49**	**10.8**	**14.8**	**12.6**	**0.18**

Crushing circuit simulations used the 80th percentile of the Crusher Work index (CWi) (Table 10-7)

Originally, the 80th percentiles of the DWT and BWi of the hardest ores (RT5 and RT9) were used by BBA to estimate the initial grinding circuit design parameters. This was because SMC data was not available at the time. The final grinding circuit design parameters (Table 10-8) were taken from the data point (RT6 sample ID DC5) that was closest to the 80th percentile of the A×b values of rock types RT5 and RT9. For design purposes, those results were considered the 80th percentile. Note that this same test sample's BWi value was also used for design purposes (13.1 kWh/mt).

Figure 10-3 (A×b for DWT and SMC) and Figure 10-4 (BWi) show the cumulative distributions from the comminution testwork programs. Figure 10-3 indicates the preliminary A×b design point as (Design_RT5&RT9_DWT). Similarly, Figure 10-4 indicates the preliminary BWi design point as (Design_RT5&RT9_DWT).

Table 10-6 shows the 50th percentile of the Abrasion index (Ai) for each rock type. The Ai values are classified as medium-low in abrasiveness and were used to calculate media consumption

Table 10-8: Grinding circuit design values

Percentile	Rock Type	A × b	ta	RWi	BWi
				kWh/mt	
80th	RT5+RT9	29.6	-		11.9
Design Value DWT	RT6	29.3	0.58	17.1	13.1

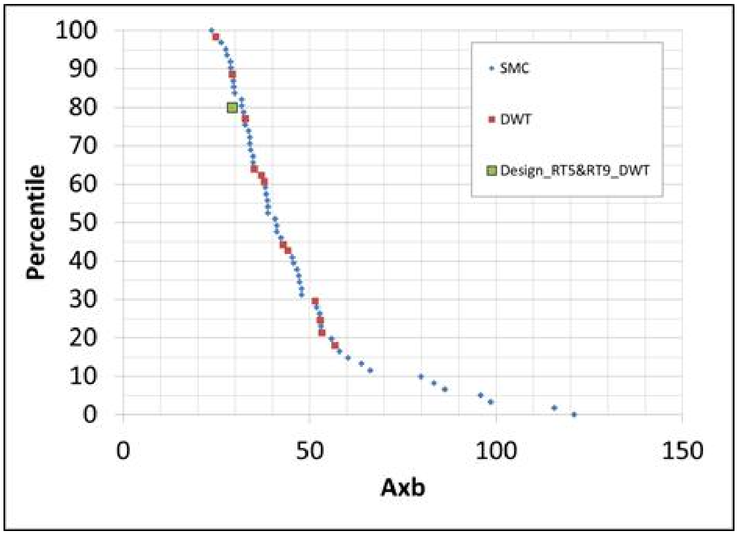


Figure 10-3: Cumulative A × b (DWT + SMC) results for the Livengood Gold Project

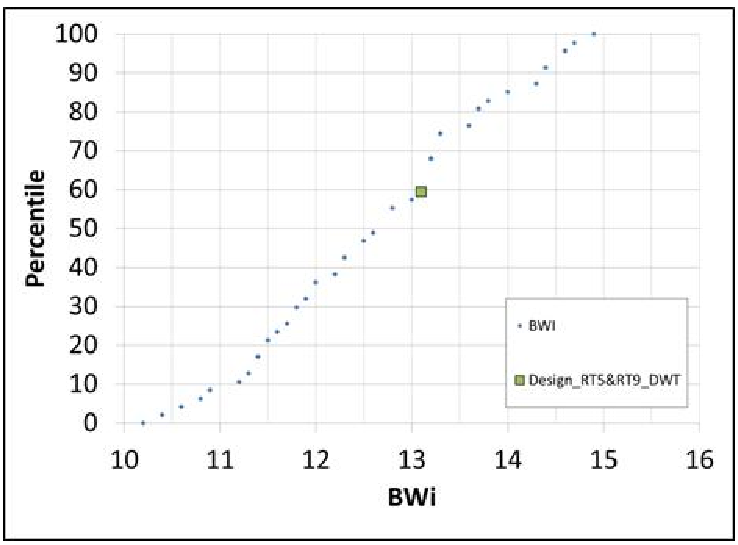


Figure 10-4: Cumulative BWi results for the Livengood Gold Project

10.4.4 Project Throughput Estimation

Three scenarios were simulated for the 2017 PFS:

1. Scenario A was a circuit based on two lines (SABC, Figure 10-5) with pre-crushing and a final product of 90 µm (P_{80}). SABC stands for a comminution circuit consisting of a semi-autogenous grinding mill (SAG), ball mill and pebble crusher.
2. Scenario B was a circuit based on one line of the same configuration as Scenario A, but with a final product of 180 µm (P_{80}).
3. Scenario C was based on the same circuit configuration as Scenario B, but with optimized blasting, resulting in a finer (F_{80}) feed.

The grind of 90 µm (P_{80}) that was used in Scenario A was based on the FS design criteria. The selection of 180 µm (P_{80}) in Scenarios B and C was the result of integrating the gold leaching results, which indicated at most a 2% difference in leaching recovery between 90 µm and 180 µm.

The grindability results from historical testwork contained in the BBA database were used to benchmark grinding circuit configurations. Crusher and mill specifications were extracted from recent projects from the BBA database.

Bruno (version 3.62) modeling software was used for the crushing simulations and JKSimMet (version 5.3) was used for the grinding simulations.

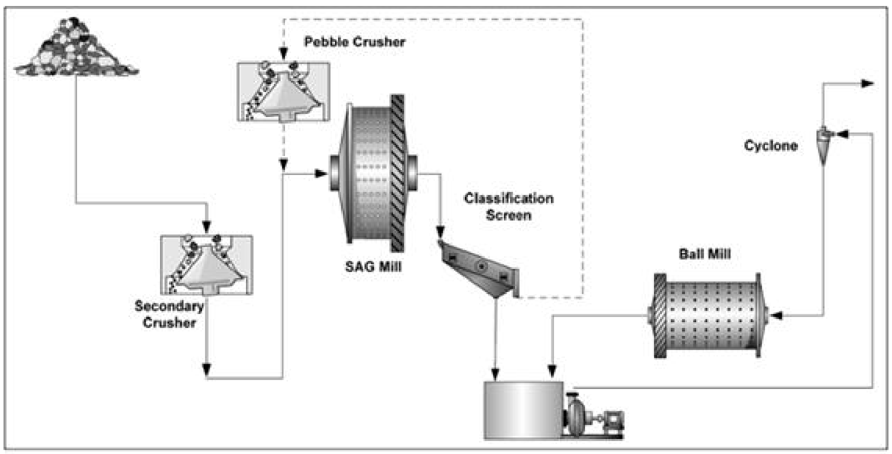


Figure 10-5: SABC with pre-crushing (secondary crusher) circuit configuration

10.4.4.1 Specific Energy and Throughput Estimations

Preliminary power calculations were completed using Moly-Cop Tools (Moly-Cop v3) and JKMRC Estimator (Power Draw Estimation Spreadsheet tools for JKSimMet V5.3). The input parameters used by the two software packages are presented in Table 10-9.

Table 10-9: SAG and ball mill design criteria for simulations

	Units	SAG Mill	Ball Mill
Nominal Dimensions (D×L)	ft × ft	36 × 20	26 × 40.5
Effective Diameter	ft	35.3	25.5
Effective Length	ft	17.5	39.5
Mill Critical Speed	%	74.5	74.8
Charge Filling	%	28	30
Balls Filling	%	15	30
Percent Solids in Mill	%	75	76.4
Ore Density	mt/m^3	2.72	2.72
Losses	%	5	5
Ball Density	mt/m^3	7.75	7.75
Feed Cone Angle	(°)	15	24.3
Discharge Cone Angle	(°)	15	24.3
Trunnion diameter	ft	8.2	6.6

The design tonnage is estimated by an iterative process using Excel's "goal and seek" function, where the installed power is the target of the function and is based on known mill specifications. The mill tonnage is varied until the estimated power consumption matches the installed power. The result is the design tonnage of the grinding circuit.

Table 10-10 presents the results of the simulations, completed using the 80th percentile of the grindability results, which are used for calculating the grinding equipment design throughput. The table also presents the 50th percentile of the grindability results for each rock type, which is used for calculating the average throughput used to design the back end (post-comminution) portion of the plant. The average plant throughput was calculated as a weighted average of the throughput for each rock type multiplied by the percentage of each rock type in the deposit, based on the latest LOM summary by rock type, reference "160614 LVG 355k Prod 45M TPA Max Unlimited Stockpile RT9 67%.xlsx".

Table 10-10: Throughput estimations for each scenario in metric tons per day (mt/d)

	50th Percentile	80th Percentile
	Throughput, mt/d	
Scenario A – SABC × 2 + Pre-crusher 90 µm (P_{80})		
RT4	78,163	-
RT5	72,952	-
RT6	69,331	-
RT7	74,189	-
RT9	66,814	-
Weighted average of each rock type	**71,801**	**-**
All rock types combined	**-**	**66,284**
Scenario B – SABC × 1 + Pre-crusher 180 µm (P_{80})		
RT4	47,914	-
RT5	46,059	-
RT6	43,498	-
RT7	46,721	-
RT9	41,510	-
Weighted average of each rock type	**44,877**	**-**
All rock types combined	**-**	**41,577**
Scenario C – SABC × 1 + Pre-crusher (Optimized Blasting)180 µm (P_{80})		
RT4	51,181	-
RT5	49,128	-
RT6	46,081	-
RT7	49,570	-
RT9	44,160	-
Weighted average of each rock type	**47,745**	**-**
All rock types combined	**-**	**44,756**

The estimated throughputs highlighted in bold were the values used for trade-off analysis and for design purposes for the 2017 PFS. The 80th percentile A×b parameter taken from the cumulative plot of all rock types (combined) was used to generate the 80th percentile throughput. This value represents the achievable throughput when the feed to the mill ranks in the 80th percentile (A×b) of all rock types. The 80th throughput value is used to design the comminution circuit.

The 50th percentile throughputs for each scenario are based on a weighted average throughput of the estimated throughputs for each rock type, which were generated through simulation using the 50th percentile A×b values that are associated with each rock type. The weighted average (50th) value is used to design the back end of the plant, which encompasses all elements of the process that follow comminution.

Table 10-11: Specific energy calculations for each scenario at design (80th percentile) A×b

Series	Parameter	Units	Scenario A (90 µm)		Scenario B (180 µm)		Scenario C (180 µm + Opt. D&B)	
			SAG Mill	Ball Mill	SAG Mill	Ball Mill	SAG Mill	Ball Mill
Number of grinding lines / Number of units per line			2/1	2/1	1/1	1/1	1/1	1/1
Mill Characteristics	Nominal dimension (D × L)	ft × ft	36.0 × 20.0	26.0 × 40.5	36.0 × 20.0	26.0 × 40.5	36.0 × 20.0	26.0 × 40.5
	Inside liner dimension (D × L)	m × m	10.77 × 5.33	7.77 × 12.04	10.77 × 5.33	7.77 × 12.04	10.77 × 5.33	7.77 × 12.04
	% of critical speed	%	74.5	74.7	75	74.6	75	74.6
	Cone angle	degree	15.0	24.3	15	24.3	15	24.3
Grinding Steel	Ball charge	% volume	15.0	30.0	14.7	30	14.7	30
Mill Power per Line	Required power	kW	13,846	14,960	13,846	14,949	13,846	14,950
		HP	18,568	20,061	18,568	20,046	18,568	20,048
	Installed power	kW	14,000	15,000	14,000	15,000	14,000	15,000
		HP	18,774	20,115	18,774	20,115	18,774	20,115
Total Circuit Power	Required power	kW	27,797	29,446	13,846	14,949	13,846	14,950
		HP	37,276	39,488	18,568	20,046	18,568	20,048
	Installed power	kW	28,000	30,000	14,000	15,000	14,000	15,000
		HP	37,549	40,231	18,774	20,115	18,774	20,115
Specific Energy	Motor output	kWh/t	8.4	9.5	6.7	7.6	6.2	7.0
		Total kWh/mt	**17.9**		**14.3**		**13.2**	

10.4.5 Comminution Circuit Simulations and Design Summary

10.4.5.1 2017 PFS Simulations

The simulations for Scenarios A, B and C were completed by BBA using the same SAG and ball mill design criteria described in Table 10-9. The SAG and ball mill specifications are based on an operation with a slightly higher ore hardness, where BBA has previously conducted design, commissioning, as well as technical support over the course of several years.

As part of BBA best practices, simulations were performed to balance the power draw in the SAG and ball mills to avoid mill throughput bottlenecks. The estimated power consumptions in Table 10-11 include adjustments for motor/drive efficiency (96%) and also ore variability factors, for which a value of 90% was assumed for the SAG mill and 95% for the ball mill.

Scenario A simulations concluded that the selected circuit (two lines SABC + pre-crusher) would process approximately 79,145 t/d (71,800 mt/d), which is based on each line having a throughput of 39,573 t/d (35,900 mt/d) (P_{80} of 90 µm).

New leaching results became available at the time that the comminution work was being conducted. The new results indicated that approximately an average 2% improvement in leaching recovery was realized at (P_{80}) 90 versus 180 µm. A new scenario was modeled (Scenario B) to explore the throughput gain by relaxing the grind size. The Scenario B simulations led BBA to conclude that the selected circuit, based on a single line, would have a weighted average throughput of 49,470 t/d (44,877 mt/d) at the coarser target grind size of 180 µm.

The final optimization simulations were run by BBA using the following parameters:

- Circuit target grind of 180 µm (P_{80});
- Finer feed (F_{80}) assumed as a result of optimized blasting.

The simulation resulted in a 27% circulating load through the pebble crusher and the ball mill circuit running at 250% circulating load, generating a 180 µm (P_{80}) product.

10.4.5.2 2017 PFS Design Recommendations

- The recommended configuration for the Project is a single line SABC circuit with pre-crushing, and considers that the crushing and grinding plant will be fed by ore that has been treated with optimized blasting techniques. The conclusion is based on analysis of simulation results as well as CAPEX and OPEX calculations. The circuit that was selected was the configuration with the lowest specific energy consumption.
- The proposed circuit uses a single (D × L) 36 ft × 20 ft SAG mill with 14 MW of installed power and one 26 ft × 40.5 ft ball mill with 15 MW of installed power.

- Based on the information analyzed, the grinding circuit is designed to process 49,334 t/d (44,756 mt/d) when the ore is at the 80th percentile of all grindability results.
- Based on the information analyzed, the grinding circuit is designed to process 52,630 t/d (47,745 mt/d) when a weighted average of the 50th percentile grindability results for each rock type are assumed as the mill feed. This is the throughput used for sizing the back-end circuit.
- Coarsening of the grind from 90 to 180 µm (P_{80}), coupled with optimized blasting, which generates a finer (F_{80}) feed material, explains the increase in per line throughput between Scenarios A and C. For a single line, Scenario C is 33% higher (52,630 t/d (47,745 mt/d) vs 39,572 t/d (35,900 mt/d)), which has a direct impact on daily gold production.
- Similarly, the coarser grind and optimized blasting are also the basis for the reduction in specific energy between Scenarios A and C. Scenario C is 26% lower (13.2 vs 17.9 kWh/t), which translates into a lower per metric ton operating cost for electricity.

10.4.5.3 2021 PFS Simulations and design recommendations

Five simulations using the 2017 PFS recommended configuration, which is a single line SABC circuit with pre-crushing, were modeled by BBA. The Bruno simulation software (crushing) and the JKSimMet (SAG and ball milling) were used applying the SAG and ball mill design criteria shown in Table 10-9 to determine the maximum achievable throughput at different grind sizes including 50, 90, 180, 215 and 250 µm (P_{80}). The simulations were performed to balance the power draw in the SAG and ball mills to avoid mill throughput bottlenecks. The results of these simulations were used to support the Whittle optimization study that is discussed in Section 10.7.2.1.

A summary of the simulations is presented in Table 10-12. The weighted averages were calculated by multiplying the throughput by the percentage of each rock type in the deposit, based on the latest mine production plan. The following are the major conclusions:

- Coarsening the grind from 180 to 250 µm (P_{80}) allowed to achieve a higher throughput (64,265 t/d (58,300 mt/d) vs 59,360 t/d (53,850 mt/d)).
- The finer grinds, 50 and 90 µm (P_{80}), required more milling capacity such as ball mills.

Table 10-12: Comminution simulations summary
(2021 PFS)

Rock Type	Grind size - P_{80} (µm)	Throughput (mt/d)	Primary crusher power demand (kW)	Secondary crusher power demand (kW)	Pebble crusher power demand (Kw)	SAG mill power demand (kW)	Ball mill power demand (kW)	Total power demand (MW)
RT4	250	64,253	432	1,160	400	12,828	14,709	29.5
RT5		57,408	378	1,023	477	14,059	13,707	29.6
RT6		57,850	405	1,071	500	14,036	14,796	30.8
RT9		57,408	209	739	447	14,038	13,823	29.3
RT7		54,979	176	664	486	14,028	14,813	30.2
Weighted average		**58,300**	**320**	**918**	**513**	**14,019**	**14,782**	**30.6**
RT4	215	57,960	390	1,069	330	13,300	14,875	30.0
RT5		54,096	357	985	437	14,037	14,238	30.1
RT6		52,109	365	987	436	13,944	14,815	30.5
RT9		55,752	203	733	426	14,024	14,818	30.2
RT7		49,901	160	616	432	13,879	14,860	29.9
Weighted average		**53,848**	**295**	**859**	**451**	**14,048**	**14,824**	**30.5**
RT4	180	52,550	354	1,104	304	12,377	14,835	29.0
RT5		50,232	331	1,041	412	13,084	14,814	29.7
RT6		47,141	330	1,016	401	12,939	14,807	29.5
RT9		50,563	184	756	387	13,200	14,867	29.4
RT7		45,816	147	643	438	12,162	14,754	28.1
Weighted average		**49,224**	**269**	**885**	**381**	**13,755**	**14,795**	**30.1**

Rock Type	Grind size - P_{80} (µm)	Throughput (mt/d)	Primary crusher power demand (kW)	Secondary crusher power demand (kW)	Pebble crusher power demand (Kw)	SAG mill power demand (kW)	Ball mill power demand (kW)	Total power demand (MW)
RT4	90	52,550	354	1,104	304	12,377	22,610	36.7
RT5		50,232	331	1,041	412	13,084	22,610	37.5
RT6		47,141	330	1,016	401	12,939	22,610	37.3
RT9		50,563	184	756	387	13,200	22,610	37.1
RT7		45,816	147	643	438	12,162	22,610	36.0
Weighted average		**49,224**	**269**	**885**	**381**	**13,755**	**22,610**	**37.9**
RT4	50	52,550	354	1,104	304	12,377	31,986	46.1
RT5		50,232	331	1,041	412	13,084	31,986	46.9
RT6		47,141	330	1,016	401	12,939	31,986	46.7
RT9		50,563	184	756	387	13,200	31,986	46.5
RT7		45,816	147	643	438	12,162	31,986	45.4
Weighted average		**49,224**	**269**	**885**	**381**	**13,755**	**31,986**	**47.3**

10.5 Metallurgical Testwork

10.5.1 FS – Metallurgical Testwork

As part of the FS, metallurgical testwork was completed to evaluate the appropriate gold recovery process. Standard recovery trade-offs, such as; whole ore leach vs flotation and CIL vs CIP were explored. The initial work was carried out to establish reagent consumption, leach residence time, and to determine the optimum leach feed particle size (P_{80}). The phases of testwork are outlined as follows:

- Optimization testing to establish preliminary ore design parameters;
- Variability testing to assess leaching response on selected gold grades and rock types;

The nature of the testwork and resulting conclusions are presented in the sections below.

10.5.2 FS – Optimization Test Program

Feasibility study optimization composites of the major rock types were prepared as indicated in Table 10-13. The assayed direct gold head grades for each of these samples are also summarized.

Table 10-13: Optimization composites used for testwork

Rock Type	Composite	Au (g/mt)
RT4	Optimization Composite 2 (RT4)	1.21
RT5	Optimization Composite 1 (RT5)	0.89
RT6	Optimization Composite 3 (RT6)	0.98
RT9	Optimization Composite 4 (RT9)	1.09
RT7	Mini optimization composite (RT7)	1.43

10.5.2.1 Gravity Recovery

Various grinds, from 100 to 225 µm (F_{80}), were tested to optimize the grind for gravity recovery from each ore type (Figure 10-6). Analysis of the results indicated that a primary grind of 180 µm (P_{80}) was suitable for all of the ore types tested. Figure 10-6 also presents the results of GRG testwork conducted for each rock type. The GRG results are greater than 60% for RT4, RT5 and RT6 and greater than 55% for RT9. Typical gold operations recover 50% to 65% of the gold associated as GRG. It is observed in Figure 10-6 that the results of the batch gravity tests are in all cases greater than 50% of the GRG.

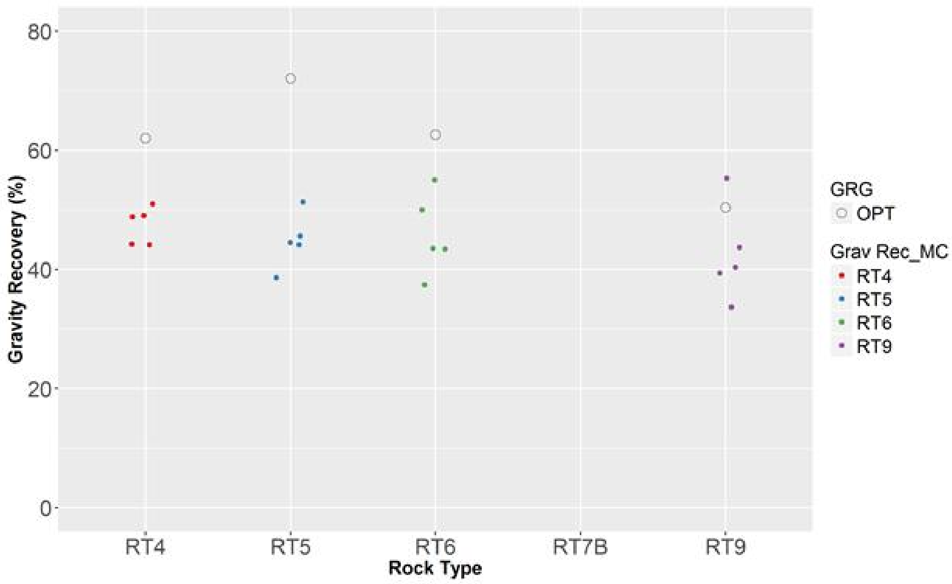


Figure 10-6: Gold gravity concentration grind-recovery relationships for RT4, RT5, RT6 and RT9 (FS)

Note from Figure 10-6, "Grav Rec_MC" is the gravity recovery to Mozley concentrate and GRG refers to the gravity recoverable gold of the optimization testwork.

Table 10-14: Comparison of gravity test results for different rock types (FS)

Test	Rock Type	Optimization Composite	Product	Mass	Grade g/mt	Rec. %	Gravity Tail K_{80}
				%	Au	Au	µm
G 1 10 kg	RT5 Sunshine Upper Sediments	Opt Comp 1	Mozley Concentrate Final Tails	0.04 99.96	860 0.48	44.1 55.9	193
			Calculated Head Direct Head	-	0.86 0.89	-	
G 4 10 kg	RT9 Volcanics	Opt Comp 4	Mozley Concentrate Final Tails	0.04 99.96	1816 0.61	55.3 44.7	190
			Calculated Head Direct Head	-	1.36 1.09	-	

Test	Rock Type	Optimization Composite	Product	Mass	Grade g/mt	Rec. %	Gravity Tail K_{80}
				%	Au	Au	µm
G 7 10 kg	RT6 Upper Sediments	Opt Comp 3	Mozley Concentrate Final Tails	0.06 99.94	710 0.52	43.5 56.5	202
			Calculated Head Direct Head	-	0.92 0.98	-	
G 10 10 kg	RT4 Cambrian	Opt Comp 2	Mozley Concentrate Final Tails	0.06 99.94	745 0.46	49.0 51.0	185
			Calculated Head Direct Head	-	0.90 1.21	-	

10.5.2.2 Flotation Option

One of the options tested was to generate a flotation concentrate from the gravity tailings and leach only the concentrate. This would be compared to a second option of direct leaching of the gravity tailings.

Flotation testing examined the effect of grind, reagent dosage, and reagent selection. Optimization of the cyanidation of the flotation concentrate and of the gravity tailings required that the effects of grind, cyanide concentration, and residence time be considered.

The RT4 rock type contained significant quantities of talc, which was difficult to separate and would increase the bulk of the potential flotation concentrate. Talc flotation cells were considered as a process option, but the decision to go to direct cyanidation leaching of the gravity tails, on the basis of the complete test results for the other three rock types, rendered this option moot.

Various grinds were tested to optimize the grind for rougher recovery from each ore type. The grind recovery data, represented below in Figure 10-7, indicated that a grind of 90 µm (P_{80}) was suitable for all of the ore types tested. The RT4 rock type did not respond well to flotation. At 12% rougher flotation mass pull, the projected rougher gold recoveries were 78%, 74%, 75% and 50% for RT5, RT9, RT6 and RT4, respectively.

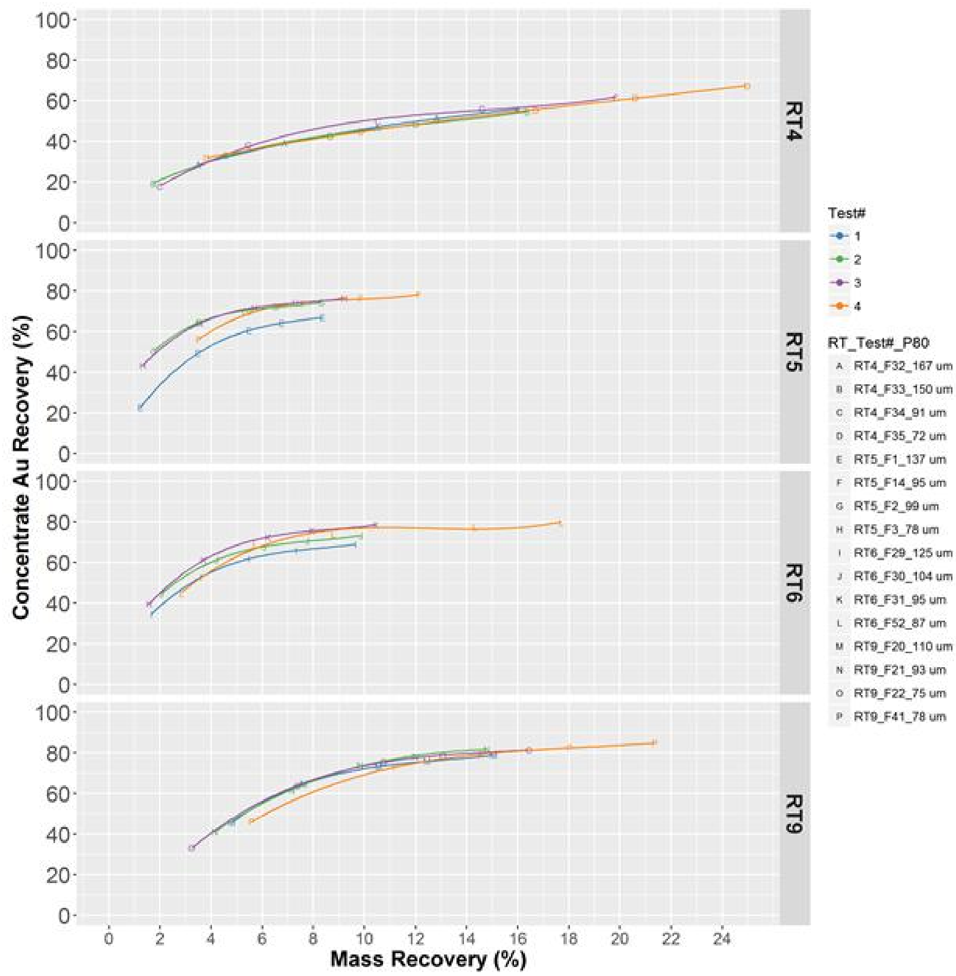


Figure 10-7: Effect of primary grind on gold rougher flotation test Kinetics for RT4, RT5, RT6 and RT9 (FS)

Flotation concentrates from RT5, RT6 and RT9 were subsequently leached (CIL) to determine recoveries. Figure 10-8 shows the gold recovery relative to time for these three rock types. Based on an analysis of the results, it became evident that the recovery of gold would be higher by applying CIL on the entirety of the gravity tails. Therefore, it was decided not to conduct any further flotation testing and CIL tests on flotation concentrate for RT4 were dropped.

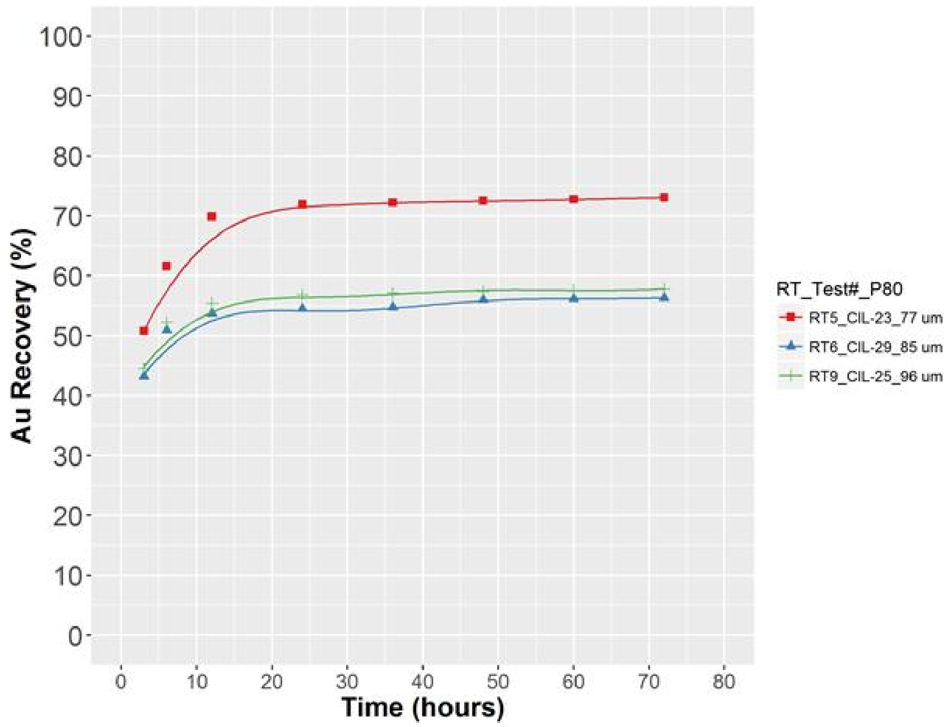


Figure 10-8: Flotation concentrates CIL test gold leach kinetics for different rock types (FS)

10.5.2.3 Flotation Option Recovery Summary

The results derived for each rock type in this test series are summarized in Table 10-15.

Table 10-15: Gold recovery resulting from the combination of gravity, flotation and CIL (FS)

	Au Recovery (%)			
Rock Type	**Gravity**	**Flotation**	**CIL**	**Total**
RT4	49.0%	50%	-	-
RT5	44.1%	78.3%	73.0%	76.1%
RT6	43.5%	75.0%	56.3%	67.4%
RT9	55.3%	74.0%	57.8%	74.4%
Arithmetic AVG	**47.7%**	**69.8%**	**62.4%**	**70.5%**

10.5.2.4 Whole Ore Leach (WOL) Option

The WOL option was also investigated, in which the Livengood process would consist of gravity and CIL leach of the gravity tails. Various grinds were tested to optimize the grind for the CIL leach recovery from each ore type. The grind recovery data, represented below in Figure 10-9, indicated that a grind of 90-100 µm (P_{80}) was suitable for CIL leaching of all of the rock types.

The observations regarding Figure 10-9 are as follows:

- The incremental gold recovery at 72 hours (vs 24 hours) for RT5 and RT6 is less than 2.5%. For RT4 and RT9, it is less than 1%;
- There were no samples collected between 5 and 24 hours;
- The gold recovery variation (for each rock type) at the particle size range from 60 to 180 µm (P_{80}) was inconclusive given the single test at each grind size.

These observations were taken into consideration in the course of developing the optimized leaching conditions during the PFS.

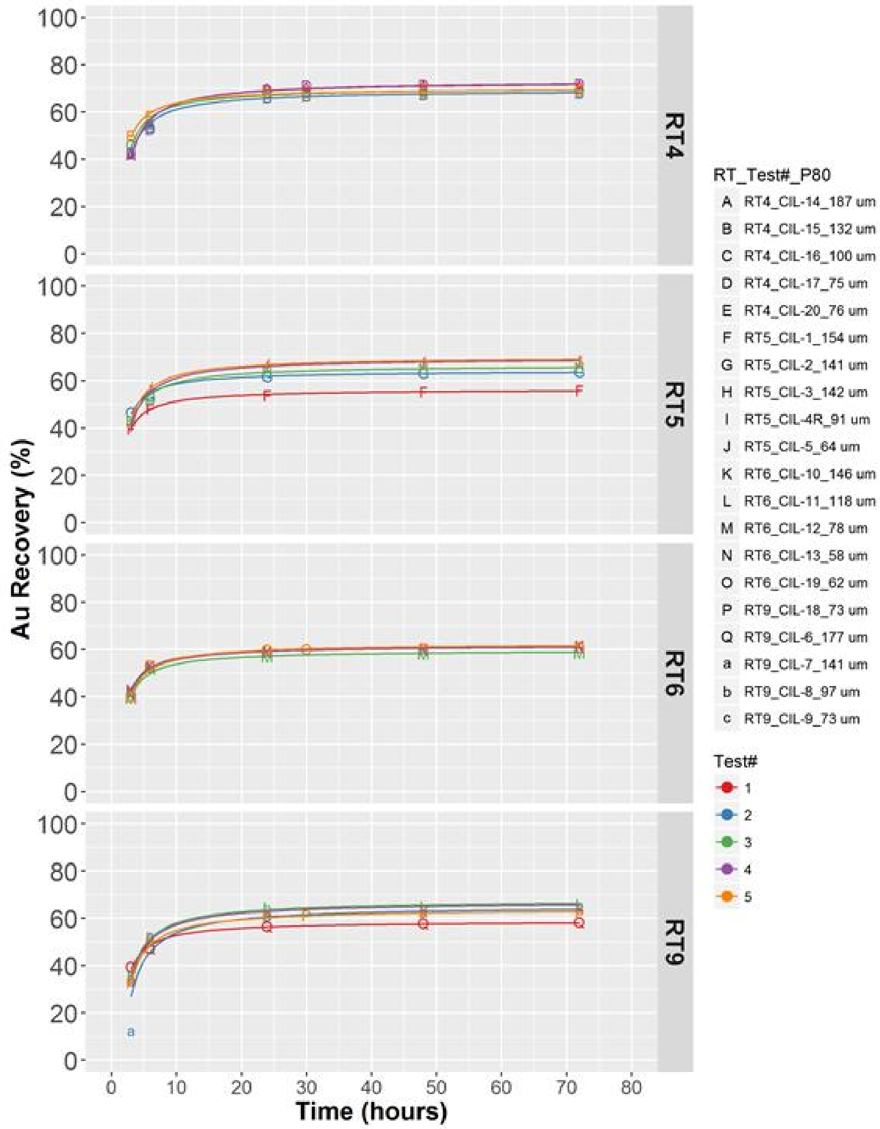


Figure 10-9: Effect of grind on gold extraction kinetics for RT4, RT5, RT6 and RT9 (FS)

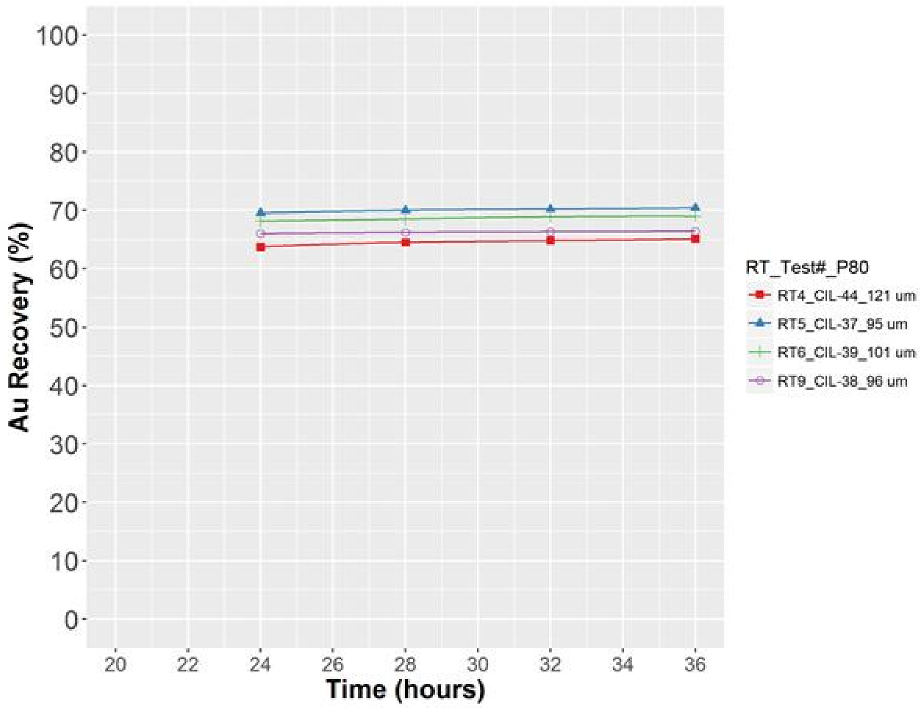


Figure 10-10: Mozley gravity tailings CIL test kinetics for different rock types (FS)

The above graph illustrates the very flat leach recovery curves for the gravity tail leach, indicating little (if any) increased extraction beyond 24 hours of leach time. Similar to the observation made for Figure 10-9, the leaching rate after 24 hours was very slow and it was decided to explore shorter leaching retention times in future testwork.

10.5.2.5 WOL Option Recovery Summary

The analysis that was completed with the optimization samples led to the conclusion that the preferred flowsheet was gravity followed by CIL of the gravity tails. The gravity plus CIL leaching of the gravity tails produced a 9-12% improved gold recovery for all rock types compared to gravity plus flotation with CIL of flotation concentrate. The overall results of whole ore leaching can be seen below in Table 10-16.

Table 10-16: Gold recovery resulting from whole ore leaching (FS)

	Au Recovery (%)		
Rock Type	**Gravity**	**CIL**	**Total**
RT4	49.0%	69.0%	84.2%
RT5	44.1%	78.0%	87.7%
RT6	43.5%	58.7%	76.7%
RT9	55.3%	66.0%	84.8%
Arth. AVG (RT4 to RT9 only)	48.0%	67.9%	83.3%
RT7 (bleached) (1)	24.3%	44.8%	58.2%

(1) RT7 (bleached) was tested in a mini-program after the other rock types.

The CIL testwork demonstrated that cyanide consumption is not overly sensitive to grind. On a weighted average basis by rock type over the life of mine, the ore required 5.75 lb/t (2.88 kg/mt) of lime and 1.74 lb/t (0.87kg/mt) of sodium cyanide in the gold leach.

10.5.2.6 WOL vs Flotation

The overall gold recoveries achieved by both process options are summarized in Table 10-17 below.

Table 10-17: Overall gold recovery of optimization samples for both process options (FS)

Rock Type	Gravity + CIL	Gravity + Flotation + CIL
RT4	84.2%	-
RT5	87.7%	76.1%
RT6	76.7%	67.4%
RT9	84.8%	74.4%
RT7	58.2%	-

The important conclusions that are drawn from the FS optimization testing include:

- All rock types responded well to gravity separation, with 44 to 55% of the gold recoverable in the gravity circuit. At a grind of approximately (P_{80}) 180 µm, these gravity recoveries were achieved at a 1% mass pull;
- Rougher flotation works reasonably well for RT5, RT6 and RT9, although the mass recovery was variable. Rougher flotation does not work well for RT4, due to the noted significant presence of talc;
- Rock type RT4 is quite different from the other rock types. It is softer, contains significantly more talc than the other samples, and contains more total carbon, Total Organic Carbon (TOC), and carbonate;
- Overall gold extraction was increased 9 to 12% by the leaching the gravity tails as compared to the leaching flotation concentrate.

A detailed analysis of the testwork results post FS by BBA indicated that there were additional opportunities to explore, such as reducing the leach retention time and targeting a coarser grind.

10.5.3 FS – Variability Test Program

Following on the optimization testing, the FS test program moved into a variability testing phase. The goal was to determine the variation that existed in the ore and to test the geological extremes of each rock type. In addition to the samples tested in the optimization phase, rock type RT7 and a rock type known as Stibnite was included in the variability testing program. The RT7 rock type, which contains varying levels of antimony (Sb) in the form of stibnite and jamesonite, was not evaluated in the initial optimization testing as it did not have a large presence in the early period of the mine life and only represented 12.1% by weight of the LOM reserve. The RT7 rock type was originally split into two sub-types, RT7-Bleached and RT7-Unbleached, as these sub-types exhibited different metallurgical responses. The Stibnite rock type represented a very small fraction of the mine's ore, but had multiple g/mt head grades.

The most favorable process conditions that were established in the optimization phase were used for variability testing. The variability test results showed an overall lower average gold recovery than what was achieved in the optimization phase, which is reflective of the extremes of the deposit, rather than the more representative optimization samples. The average overall gold recovery resulting from multiple tests for each rock type is summarized below in Table 10-18.

Table 10-18: Variability sample gold recovery (FS)

Var. Sample	Rock Type	Gravity Rec.%	CIL Rec.%	Overall Rec.,%
1	5	36.8	90.7	94.1
2	5	39.7	79.3	87.5
3	5	27.8	90.5	93.1
4	5	39.9	96.2	97.7
5	5	38.3	54.8	72.1
6	5	58.4	83.4	93.1
7	5	30.3	57.1	70.1
8	5	49.3	40.9	70.0
9	5	53.7	75.0	88.4
10	5	19.4	89.8	91.8
11	5	62.7	92.4	97.2
12	5	44.8	83.8	91.1
Average		41.8	77.8	87.2
Minimum		19.4	40.9	70.0
Maximum		62.7	96.2	97.7
76	9	17.2	40.4	50.7
77	9	20.0	53.6	62.9
78	9	11.9	50.1	56.0
79	9	24.8	37.7	53.2
81	9	56.3	32.0	70.3
82	9	36.5	73.7	83.3
83	9	21.3	74.9	80.2
84	9	26.2	39.2	55.1
85	9	8.40	17.8	24.7
86	9	34.2	50.4	67.4
87	9	41.4	70.2	82.5
88	9	53.8	42.4	73.4
89	9	40.5	58.7	75.4
Average		30.2	49.3	64.2
Minimum		8.40	17.8	24.7
Maximum		56.3	74.9	83.3
31	6	35.8	76.8	85.1
32	6	29.4	26.5	48.1
33	6	38.1	76.7	85.6
34	6	41.6	87.7	92.8
35	6	44.5	94.1	96.7
36	6	51.8	62.2	81.8
37	6	21.9	63.7	71.6
Average		37.6	69.7	80.3
Minimum		21.9	26.5	48.1
Maximum		51.8	94.1	96.7

Var. Sample	Rock Type	Gravity Rec.%	CIL Rec.%	Overall Rec.
16	4	71.0	77.1	93.4
17	4	71.3	95.4	98.7
18	4	59.1	60.5	83.8
19	4	20.5	69.4	75.7
20	4	17.1	32.4	44.0
21	4	9.90	44.9	50.4
22	4	39.6	58.3	74.8
23	4	28.7	42.3	58.9
Average		39.7	60.0	72.4
Minimum		9.90	32.4	44.0
Maximum		71.3	95.4	98.7

Var. Sample	Rock Type	Gravity Rec.%	CIL Rec.%	Overall Rec.,%
46	7 bleached	19.0	26.0	40.1
47	7 bleached	45.7	23.1	58.2
48	7 bleached	22.7	41.4	54.7
49	7 bleached	35.1	10.3	41.8
50	7 bleached	13.9	25.5	35.9
51	7 bleached	26.0	16.9	38.5
52	7 bleached	21.8	13.4	32.3
53	7 bleached	46.6	69.0	83.4
54	7 bleached	59.5	79.7	91.8
55	7 bleached	14.7	13.8	26.5
Average		30.5	31.9	50.3
Minimum		13.9	10.3	26.5
Maximum		59.5	79.7	91.8
61	7 unbleached	18.6	28.3	41.6
62	7 unbleached	26.9	39.9	56.1
63	7 unbleached	33.5	12.7	41.9
64	7 unbleached	6.60	3.90	10.2
65	7 unbleached	50.7	35.2	68.1
66	7 unbleached	19.0	12.1	28.8
67	7 unbleached	15.3	12.5	25.9
68	7 unbleached	14.7	3.80	17.9
69	7 unbleached	21.9	11.2	30.6
70	7 unbleached	63.0	60.3	85.3
Average		27.0	22.0	40.7
Minimum		6.60	3.80	10.2
Maximum		63.0	60.3	85.3
90	stibnite	2.00	7.90	9.74
91	stibnite	1.90	0.20	2.10
92	stibnite	1.90	0.60	2.49
93	stibnite	0.80	24.2	24.8
94	stibnite	3.80	70.7	71.8
95	stibnite	2.50	2.00	4.45
96	stibnite	2.00	0.30	2.29
97	stibnite	1.30	0.40	1.69
98	stibnite	1.00	2.50	3.48
Average		1.91	12.1	13.7
Minimum		0.80	0.20	1.69
Maximum		3.80	70.7	71.8

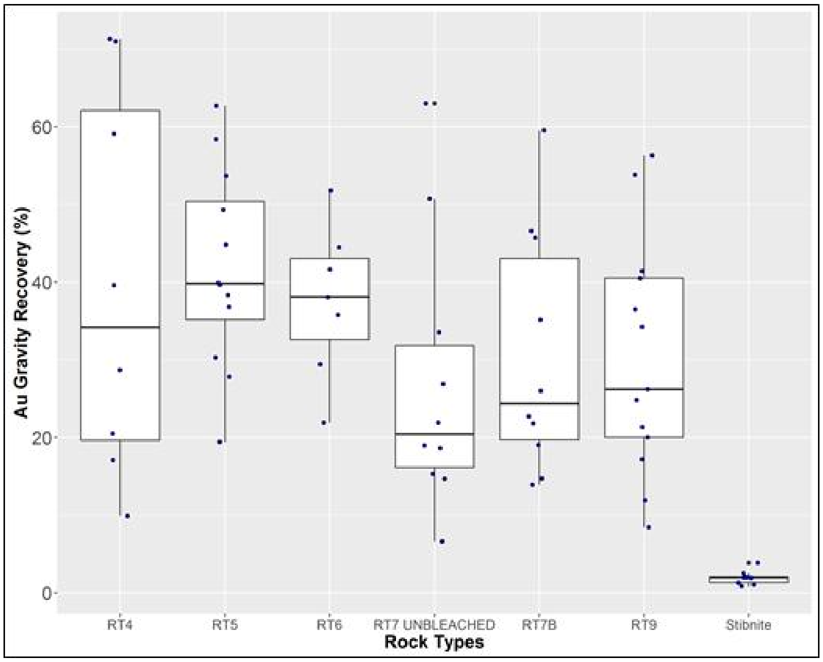


Figure 10-11: Gold gravity recovery box plots (FS)

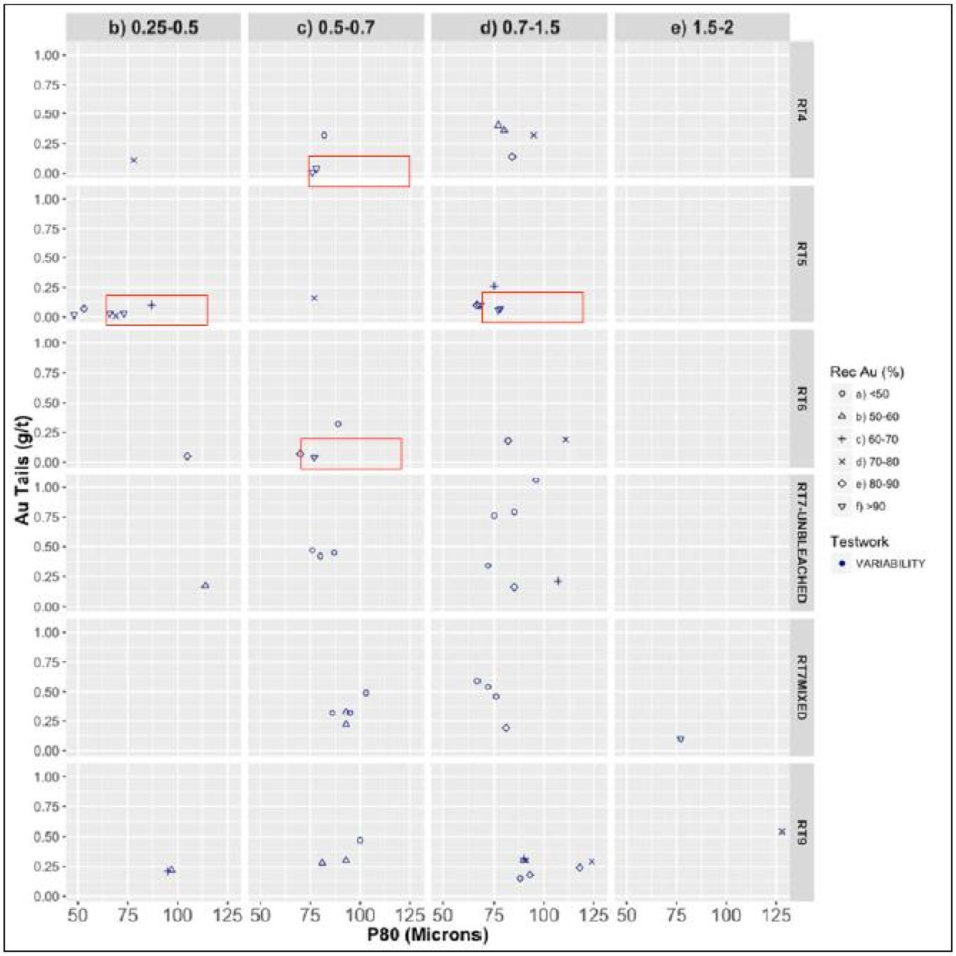


Figure 10-12: Gold in Residues from CIL testwork vs P_{80} for each rock type (FS)

The columns in Figure 10-12 represent the gold grade ranges in g/mt and the rows correspond to the different rock types.

Analysis of the results suggested that the RT4, RT5 and RT6 rock types did not show a correlation with grade, RT9 showed a weak correlation with grade, while RT7 presented a strong correlation to stibnite content and grade.

A post FS analysis led to the conclusion that the RT5 results suggested opportunities to increase gold recovery with finer grind. The red boxes associated with RT5 in Figure 10-12 highlight the lower gold in residues at the finer P_{80}(s). Similar observations have been made for RT4 and RT6. This was not observed for RT7 and RT9. BBA analyzed the information on testwork methodology that was available and a lack of consistency was observed in the residence time as well as the level of monitoring of dissolved oxygen (DO) levels during testwork preconditioning and leaching. This result was critical, because low dissolved oxygen levels during the initial hours of a leaching test will have an important and detrimental effect on the gold leaching performance. This observation was used during Phase 9 PFS testwork to standardize the O_2 preconditioning (4 hours) as well as monitoring and maintaining the DO levels (8 ppm).

Important follow-up observations from the analysis of the variability testwork include:

- The opportunity to lower the gold in residues by using finer grind (P_{80}) (RT5, Figure 10-11).
- The need to more closely monitor and control preconditioning and DO levels as these will have an impact on CN consumption

10.5.4 FS – Solid / Liquid Separation Testwork

As part of the FS, Livengood gold ore samples were submitted to Pocock Industrial, Inc. for solid liquid separation (SLS) testing. Pre-leached and leached samples from the optimized testwork were submitted to Pocock for each of the primary rock types (RT4, RT5, RT6, RT7 Bleached, and RT9). The current flowsheet contains a total of two thickeners; one pre-leach thickener, and one tailings (pre-detox) thickener.

The Project design criteria use a high rate thickening rise rate of 1.64 gpm/ft² (4.0 m_3/m²h) for both the pre-leach thickener and the tailings thickener at a design P_{80} of 90 µm. Additional savings on reagents (flocculant) are expected for the present scenario, where the P_{80} is 180 µm, but further settling testwork will be required for confirmation.

10.5.5 FS – Cyanide Detoxification Tests

10.5.5.1 FS – Cyanide Detoxification Testwork

The CIL tailings generated from the leaching testwork was used for cyanide detoxification testing. The INCO SO_2/air process was used to remove cyanide and base metal complexes from the CIL tailings generated from each rock type. The objective of this phase of testing was to optimize cyanide detoxification (CND) of the CIL tailings. The “Interim Test Program” used a 10 kg sample of each rock type (RT4, RT5, RT6, RT7 and RT9).

The feed pulp density to cyanide detoxification was between 31-39%. The results showed that it was possible to treat the CIL tailings using the INCO process to bring both weak acid dissociable cyanide (CN_{WAD}) and total cyanide (CNT) levels below 1 mg/L. The test conditions indicate that a pH of 8.5-8.6 coupled with a retention time of 94-147 minutes is ideal. The reagent consumptions from the Phase 1 testing are 8.2-14.7 g/g CN_{WAD} of equivalent SO_2, 4.9-8.9 g/g CN_{WAD} of lime, and 0.27-0.57 g/g CN_{WAD} of Cu.

The design application rates were assumed to be:

- Lime = 0.82 lb/t;
- Copper sulfate = 0.08 lb/t;
- Sodium metabisulfite = 1.65 lb/t.

10.5.5.2 Observations Made Regarding Cyanide detoxification

In the lead-up to the PFS, BBA reviewed the design of the cyanide detoxification system that was presented in the FS. The objective was to look for gaps and opportunities. The following are the major conclusions:

- The use of a sulfur burner to generate SO_2 instead of sodium metabisulfite was identified as an opportunity to lower the OPEX. Details are presented in the flowsheet development in Section 10.7.
- A model was developed to estimate the amount of cyanide that is recirculated to the leaching process via the pre-detox thickener. The result is less cyanide reporting to cyanide detoxification.

10.5.6 2017 PFS – Metallurgical Testwork

Five additional phases (Continuous, 7, 8, 9 and 10) of testwork were completed after the FS for the 2017 PFS. Testwork was conducted to explore possible opportunities established through BBA's analysis of the FS testwork and/or to clarify certain questions regarding gold leach performance and reagent consumptions. The phases of testwork are outlined as follows:

- Continuous: Processing FS Optimization composites using recycled process solutions;
- Phase 7: Assay procedures and water source testing;
- Phase 8: Exploratory testing on selected rock types;
- Phase 9: SGS / FLS Curtin University testwork: Exploratory testing on selected rock types using reverse circulation (RC) drill chip composites;
- Phase 10: Stirred tank reactor (STR) controlled leach testwork, with focus on two problematic rock types (RT7 and RT9).

The nature of the testwork and resulting conclusions are discussed below.

10.5.7 2017 PFS – Continuous Testwork

Continuous testwork was conducted using 60 kg composites taken from the optimization master composites prepared for the FS. The objective of the continuous testwork was to evaluate the impact of recirculating streams as well as generating leach residues (CIL tailings) for the cyanide detoxification testwork. The continuous testwork conditions were developed from the optimization and variability testwork.

One of the important conclusions to be drawn from the continuous testwork is that the results indicated that using lower CN additions had a minimal impact on gold leaching performance, except on RT9, where cyanide starvation conditions were observed. The continuous results were used to estimate the addition of lead nitrate and cyanide for the Phase 9 test program (see Section 10.5.10).

10.5.8 2017 PFS – Phase 7 - Assay Procedures and Water Source Testing

The Phase 7 testwork was conducted on 20 kg composites of RT4, RT5, and RT9. The objective of the Phase 7 testwork was to remove uncertainty related to the water source used for testing: SGS Vancouver water versus water that was sourced from the mine and to confirm the procedures necessary for improving assay repeatability. To improve assay repeatability, all samples had gravity recoverable gold removed prior to leaching by a combination of a centrifugal concentrator followed by gravity table, leaching was performed in triplicate, and all pulps were fire screen assayed in triplicate.

CIL testing with air sparging using both Vancouver and mine-sourced water was performed on Mozley gravity tails to compare the extractable gold using similar reagent conditions.

Gravity tail leach recoveries for duplicate samples were within 2% of each other for all three rock types using Vancouver and mine-sourced water and likely within the precision of the testwork. Cyanide consumption increased 0.3% with mine water and lime consumption decreased 8%.

Important conclusions from the Phase 7 testwork include:

- The results indicated that the gold recovery was not particularly sensitive to water source;
- Phase 7 results confirmed that performing triplicate screen metallic assays on gravity tail leach residue was the protocol required for precise work.

10.5.9 2017 PFS – Phase 8 - Grind, Recovery, Gravity, Flotation Testing

The Phase 8 testwork program was comprised of several sub-phases and all work was conducted on 75 kg core samples. The objectives of the program were to explore CIL gold recovery sensitivity to particle size.

The sub-phases are described as follows:

- Gravity testing on 180 and 250 µm (P_{80}) samples;
- CIL sensitivity testwork on 90, 180 and 250 µm (P_{80}) samples;

- At 90 µm (P_{80}), CIL of gravity tails was compared to CIL of only a flotation concentrate generated from the gravity tails.

Phase 8a

- CIL testing was extended down to 60 and 75 µm (P_{80}):
  - Knelson and Mozley tails 250 µm (P_{80}) samples from the Phase 8 testwork program were combined and reground to 60 and 75 µm (P_{80}).
- Carbon handling protocols were compared:
  - The carbon handling protocol was explored. No significant difference was found between adding new carbon and retaining the original carbon for the duration of the testwork.
- Dissolved oxygen (DO) and CN consumption were evaluated:
  - Phase 8a was the first attempt to normalize the DO levels and CN additions between different tests. There had been indications of inconsistent preconditioning in previous testwork.

Phase 8b

- Evaluated gravity and leach sensitivity at 90, 180 and 250 µm (P_{80});
- At 90 µm (P_{80}), CIL of gravity tails was compared to CIL leaching of only a flotation concentrate generated from the gravity tails.

Phase 8c

- Completed intensive leach (IL) of flotation concentrate.

Phase 8d

- Tested flotation with sulfidization at 180 µm (P_{80}).
  - Phase 8d was designed to study the response of flotation to sulfidization at a grind of 180 µm (P_{80}). Only two rock types were tested.

The important conclusions to be drawn from the Phase 8 test program include the following:

- Flotation gold recoveries did not improve with slurry sulfidization;
- Gold recovery did not improve with a grind of 60 µm (P_{80});
- CN consumption was reduced by the pre-oxidation;
- The carbon handling protocol did not affect the gold recovery performance.

10.5.10 2017 PFS – Phase 9 - SGS and FLS-Curtin University Test Program

The Phase 9 SGS / FLS-Curtin University test program was conducted on 500 kg composites made according to rock type. It was the first work conducted using reverse circulation (RC) drill chips.

The objectives of the Phase 9 test program were:

- To compare the performance of gravity recovery at 180 and 250 µm (P_{80});
- To study the impact of lead nitrate addition on intensive leach and CIL;
- To confirm and/or revise the cyanide addition to CIL;
- To study the impact of particle size on gold leaching at 75, 90, 135, 180 and 250 µm (P_{80}).

The Phase 9 program processed a large quantity of mass for each sample to confirm the process flowsheet developed in Phase 8, and to avoid having nugget effects influence the metallurgical recoveries.

The objectives of the FLS/Curtin University testwork were:

- To conduct gravity recoverable gold (GRG) testing and to perform an Integrated Liberation and Leaching Model (ILLM) characterization on the Livengood gold ore types.

Rock type splits of 100 kg each were sent to FLSmidth/AMIRA (Curtin University, Australia).

10.5.10.1 Phase 9 Metallurgical Composite Sample Selection Methodology

The Project resource has been defined by approximately 800 drill holes, about 80% of which are reverse circulation (RC) and 20% are core. Prior to the Phase 9 test program for the PFS, all of the metallurgical testwork had been completed using individual core samples or core sample composites. The Phase 9 samples were the first to be composited from RC rig duplicate rock chips. The Phase 9 samples are bulk composites prepared for each of the five major rock types to represent the average grade and approximate grade distribution of the 2013 FS Reserve.

The RC rig duplicates (rock chips), which originated from an earlier phase reported under SGS project CAVM-50223-006, were received at SGS in June 2015. The gold head assays, determined by screened metallics, are presented in Table 10-19.

.

Table 10-19: Gold head assay

Rock type composite	Au, g/mt
RT4	0.64
RT5	0.72
RT6	0.81
RT7B	0.89
RT9	0.68

Composites were prepared from samples received in super sacks that had been sorted according to their rock type. The composites were labelled as follows with the following weights (Table 10-20):

Table 10-20: Composite naming and weights for Phase 9 (2017 PFS) test program.

Composite Name	Mass (kg)
RT4 June 2015 Composite	453.6
RT5 June 2015 Composite	468.0
RT6 June 2015 Composite	472.8
RT7B June 2015 Composite	475.0
RT9 June 2015 Composite	477.5

Each composite was stage crushed to 100% minus 10 mesh, blended, and split to obtain two 100 kg splits and one bulk split as identified below:

- 100 kg forwarded to FLSmidth for GRG tests and leach tests performed at Curtin University;
- 100 kg stored in a freezer at SGS;
- Bulk split retained at SGS for use in the current testwork program.

Figure 10-13 illustrates the testwork that was conducted.

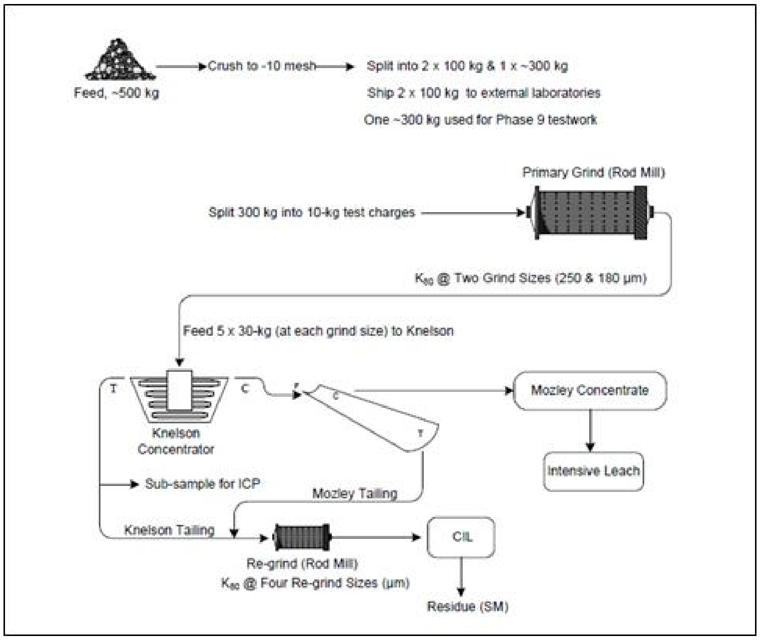


Figure 10-13: 2017 PFS (Phase 9) testwork outline

In an effort to minimize the differences found between calculated and direct head grades (possibly due to nugget effect), Phase 9 testwork was conducted following a different approach using larger samples (30 kg) versus the normal 2 kg samples used in the previous testwork.

10.5.10.2 Phase 9 – Cyanide and Lead Nitrate Addition

The ICP analysis of the leach feed composites had not been available at the time that the leaching testwork was being completed. Instead of waiting for this information, BBA recommended that the lead nitrate addition be based on the Sb content from the ICP analysis of each rock type from the continuous testwork program (Table 10-21).

Table 10-21: ICP Analysis of the CIL feed from the continuous testwork for each rock type
(2017 PFS)

Rock Type	Au	Ag	Cu	Fe	Ni	S	As	Pb	Sb	Te	Hg	Proposed Lead Nitrate addition, g/mt
RT4	0.5		45.1	5.29	1008	0.60	4748	21.6	64.0	0.18	4.3	150
RT5	0.4	0.4	51.5	4.2	121	0.97	2800	14.4	19.9	0.1	0.4	100
RT6	0.5	0.4	75.3	3.87	146	1.25	3360	29.4	62.3	0.17	1.4	150
RT7	0.6	0.5	62.8	4.12	206	1.98	3973	15.4	176.5	0.20	0.7	250
RT9	0.7	0.5	36.6	4.60	69	2.54	3995	24.1	101.8	0.13	3.1	250

Table 10-22: Comparison of cyanide addition in Phase 9 versus Continuous
(2017 PFS)

Rock Type	CN addition used during Continuous testwork kg/t	Proposed CN addition for Phase 9, kg/mt
RT4	0.52	0.71
RT5	0.71	0.71
RT6	0.51	0.8
RT7	0.67	1
RT9	0.57	1

10.5.10.3 Phase 9 – Gravity / Intensive Leach Testwork

Phase 9 gravity testwork was performed on two particle sizes, 180 and 250 µm (P_{80}), at SGS Vancouver. It was observed that similar average results were realized for RT7 and RT9. On the other hand, RT4 and RT5 show higher gravity results at 180 µm (P_{80}), and RT6 shows higher gravity recovery at the coarser grind size. In general, however, the gravity results were lower than those obtained in previous work.

Figure 10-14 summarizes the gravity testwork results of Phase 9 (180 and 250 µm); the GRG results by FLS/Curtin University, along with the results obtained from the FS optimization test program.

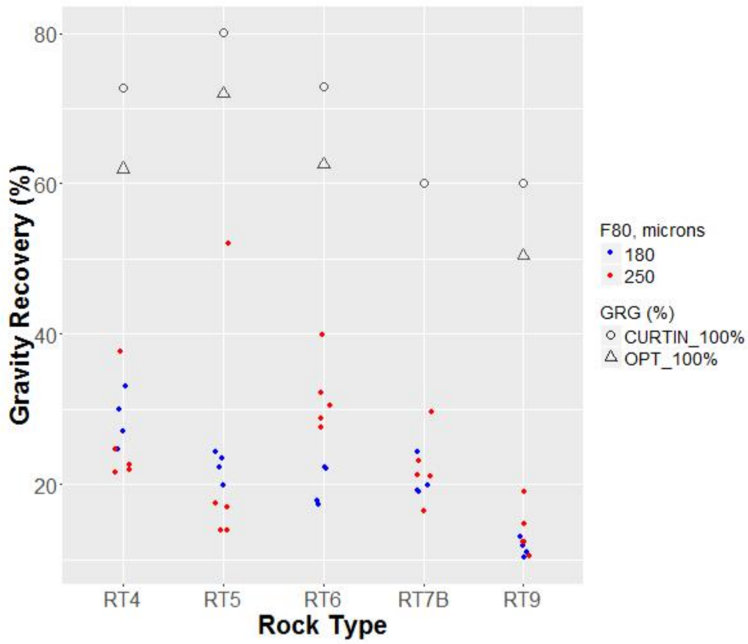


Figure 10-14: 2017 PFS (Phase 9) gravity recovery for all tock types
(GRG presented as the 3rd stage of GRG)

The GRG results from the FLS/Curtin University testwork are comparable to the results of the optimization GRG testwork, presented earlier in Figure 10-6, which is an important conclusion for a few reasons:

- The rock types tested represent 98.2% of the ore body;
- Two independent labs have produced these complementary results;
- The FS optimization testwork made use of drill core composites, whereas the FLS/Curtin testwork used RC drill chip composites, implying that two independent sample batches have been tested.

The gravity gold recovery in Phase 9, which followed the Knelson+Mozley table methodology, was lower compared to previous testwork; compare these results, for example, to those of Figure 10-11. BBA is placing less emphasis on these particular results. In future testwork, this method of testing will be applied. However, BBA recommends that a systematic review of the testing protocols be performed.

A series of benchmark graphs (Figure 10-15 to Figure 10-19) were prepared by FLS/Curtin University that compare the results of Livengood gold ores to the Curtin gravity testwork database. Figure 10-15 shows the high percentage of GRG of Livengood gold ore (60 to 80%) compared to the FLS/Curtin University database (15 to 55% for the same gold head grade).

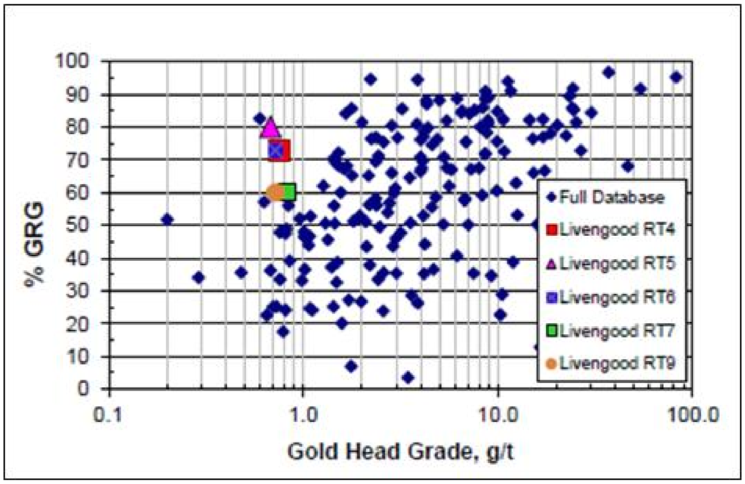


Figure 10-15: Livengood GRG results vs FLS/Curtin database (source Curtin report)
(2017 PFS)

Figure 10-16 plots the % GRG vs the gold recovered in stage 1 (of 3 stages) (P_{80} = 850 µm) of gravity testwork, showing that the results fall within the range of data contained in the full FLS/Curtin University database. This observation supports the good gravity recoverable potential of the Livengood gold ore.

A good agreement was also found between the % GRG and the gold recovery of stage 1 vs feed size (F_{80}) of the gold particles and the FLS/Curtin University database (Figure 10-17 and Figure 10-18).

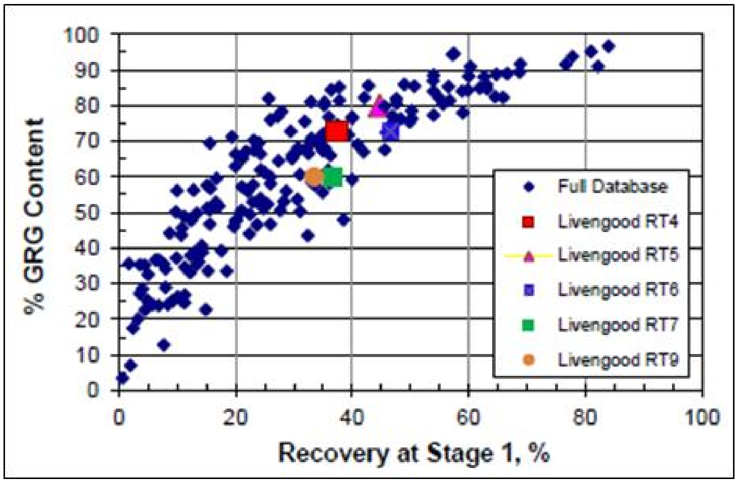


Figure 10-16: Livengood GRG results vs FLS/Curtin database (source Curtin report)
(2017 PFS)

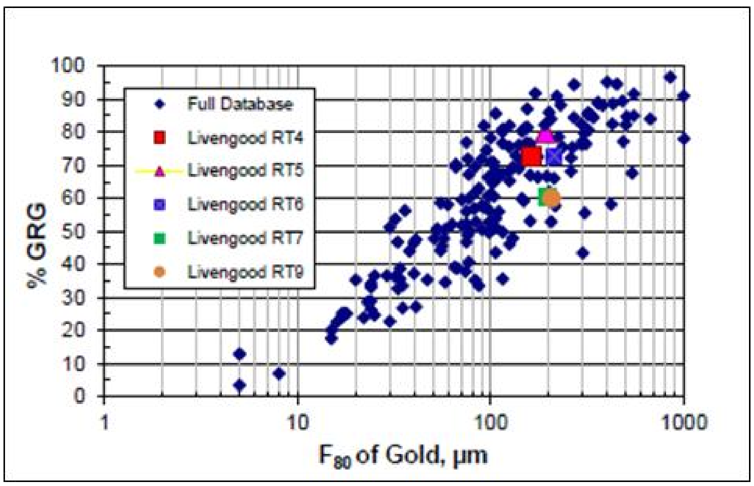


Figure 10-17: Livengood GRG results vs FLS/Curtin database (source Curtin report)
(2017 PFS)

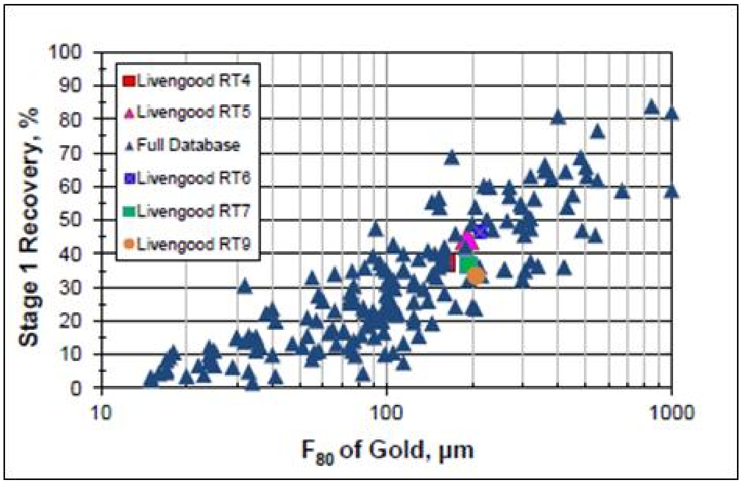


Figure 10-18: Livengood GRG results vs FLS/Curtin database (source Curtin report)
(2017 PFS)

Figure 10-19 shows the benchmarking of the results of Livengood versus two operations with similar % GRG. The operations processing ores “sample B” and “sample D” typically recover gravity gold in the order of 45 to 55%. FLS/Curtin University indicates that operations typically should achieve recoveries in the order of 50 to 66% of the plant feed GRG.

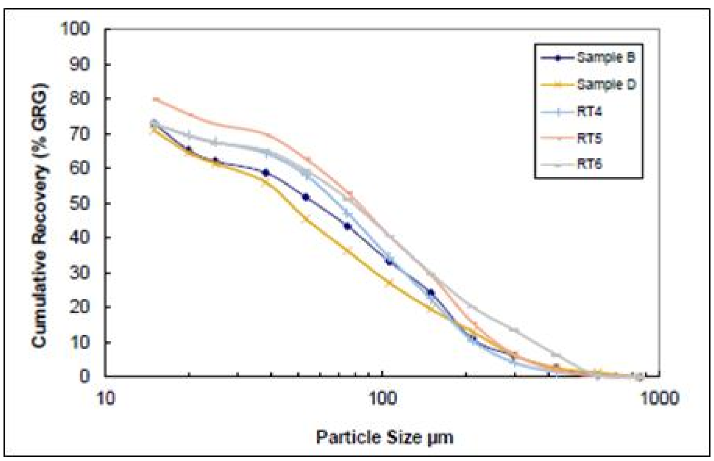


Figure 10-19: Livengood GRG results vs FLS/Curtin database (source Curtin report)
(2017 PFS)

10.5.10.4 Phase 9 – Intensive Leach Kinetic Testwork

Intensive leach testwork was conducted on Mozley concentrates. Table 10-23 presents the results of the testwork.

Table 10-23: Intensive leach results
(2017 PFS)

Test ID	Gravity K_{80}	Intensive Leach K_{80}	NaCN		CaO		Au in Residue	Calc Head	Au Recovery
	µm	µm	Add kg/mt	Cons kg/mt	kg/mt	kg/mt	g/mt	g/mt	%
IL-1	180	180	72.5	31.5	2.29	0.81	8.20	477	98.3
IL-2	250	250	61.7	25.2	1.84	<1	10.1	369	97.3
IL-3	180	180	74.0	30.5	1.84	0.65	9.64	369	97.4
IL-4	250	250	66.8	35.0	1.51	0.59	10.9	295	96.3
IL-5	180	180	73.6	30.7	0.74	<1	9.16	393	97.7
IL-6	250	250	80.2	29.9	0.88	<1	13.2	536	97.5
IL-7	180	180	72.5	30.3	1.36	0.28	8.68	389	97.8
IL-8	250	250	78.2	27.8	1.66	0.24	9.01	331	97.3
IL-9	180	180	74.7	31.6	1.18	<1	7.53	190	96.0
IL-10	250	250	74.4	35.4	0.80	0.8	7.32	215	96.6

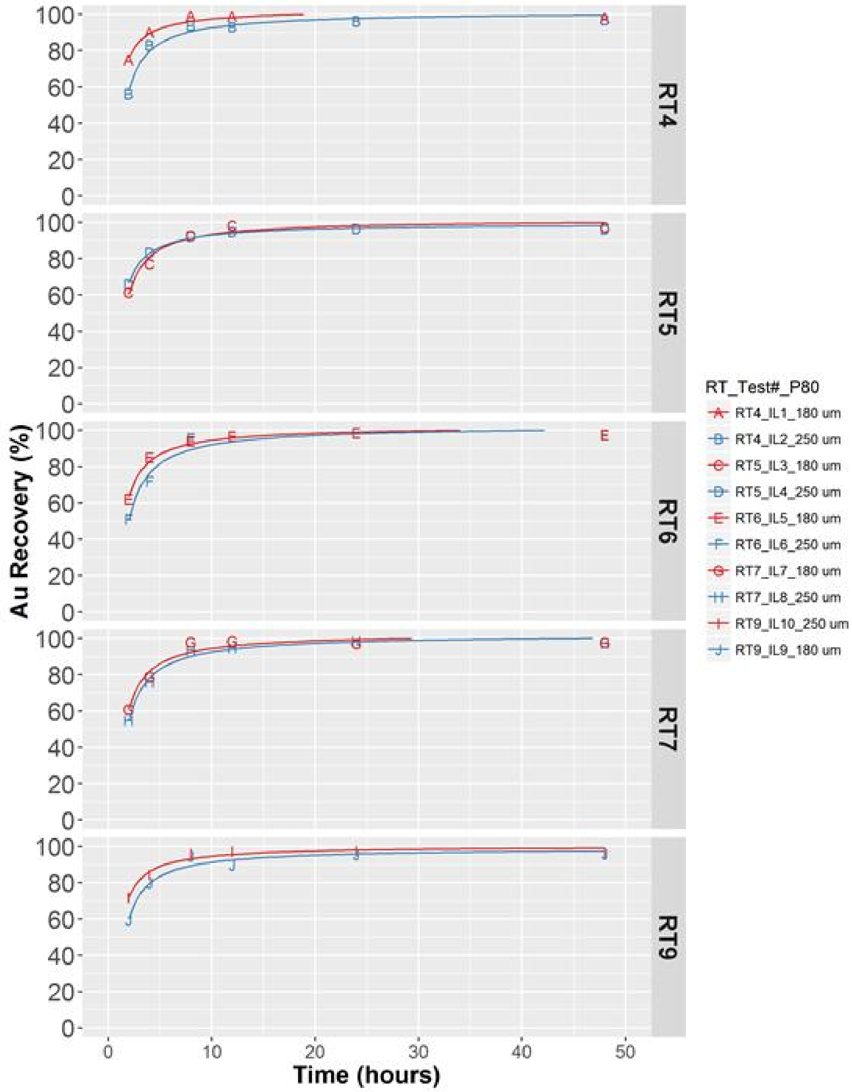


Figure 10-20: Intensive leach of Mozley concentrate

10.5.10.5 Phase 9 – Leach Kinetic Testwork

Following observations from the FS optimization test program, the decision was taken to add extra sampling times (12 and 18 hours) to the leach testwork to better characterize the gold leaching kinetics for each rock type. Figure 10-21 shows the results of kinetics tests from gravity tails at 180 µm (P_{80}). Results using 250 µm (P_{80}) gravity tails presented similar trends.

The leaching kinetics results were analyzed and it was found that for each rock type, after 18 hours of leach time, there was no extra recovery or the increment was not sufficient to justify the addition of an extra leach tank.

The latter observation was used to reduce the leaching retention time from 32 to 21 hours. The reduction in the leaching retention time translates into lower cyanide and lime consumption. An example of the analysis is presented on Table 10-24.

The important conclusions to be drawn from the Phase 9 and the FLS/Curtin testwork include:

- A high gravity recoverable gold content was confirmed;
- Improved leach results were obtained from Curtin on all samples (pH 10);
- The first intensive leach of gravity concentrates achieved excellent gold recoveries on gravity concentrates from all rock types ranging from 96 to 98%;
- Pre-conditioning and lead nitrate led to a reduction in leaching time;
- A reduction in CN consumption and required leach time were realized.

Table 10-24: Kinetic results from Phase 9
(2017 PFS)

		Phase 9					
Rock type	Item	90 µm			180 µm		
		Leaching time, hours			Leaching time, hours		
		18	24	32	18	24	32
RT4	Au head grade, g/mt	0.44			0.52		
	Au residue, g/mt	0.07	0.07	0.07	0.08	0.08	0.08
	Au Recovery, %	83.0	83.2	83.2	83.9	84.5	84.6
	CN consumption, kg/mt	0.26	0.28	0.34	0.19	0.23	0.32
	CaO consumption, kg/mt	2.29	2.56	2.51	2.14	2.35	2.30
RT5	Au head grade, g/mt	0.50			0.65		
	Au residue, g/mt	0.09	0.09	0.09	0.12	0.11	0.11
	Au Recovery, %	81.1	81.8	82.0	81.6	82.7	83.0
	CN consumption, kg/mt	0.20	0.24	0.31	0.19	0.24	0.31
	CaO consumption, kg/mt	1.75	1.77	1.75	1.77	1.78	1.74
RT6	Au head grade, g/mt	0.55			0.57		
	Au residue, g/mt	0.18	0.18	0.18	0.20	0.20	0.20
	Au Recovery, %	67.5	67.5	67.5	64.9	65.1	65.2
	CN consumption, kg/mt	0.29	0.32	0.38	0.27	0.31	0.35
	CaO consumption, kg/mt	1.59	1.68	1.62	1.46	1.55	1.52
RT7B	Au head grade, g/mt	0.53			0.75		
	Au residue, g/mt	0.28	0.28	0.28	0.35	0.34	0.33
	Au Recovery, %	47.0	47.2	47.2	53.8	55.2	55.7
	CN consumption, kg/mt	0.48	0.51	0.53	0.36	0.41	0.51
	CaO consumption, kg/mt	1.86	2.17	2.14	1.73	2.05	2.02
RT9	Au head grade, g/mt	0.62			0.55		
	Au residue, g/mt	0.29	0.29	0.29	0.31	0.30	0.30
	Au Recovery, %	53.0	53.1	53.1	43.5	44.9	45.5
	CN consumption, kg/mt	0.39	0.40	0.47	0.27	0.36	0.43
	CaO consumption, kg/mt	1.58	1.70	1.67	1.32	1.34	1.30

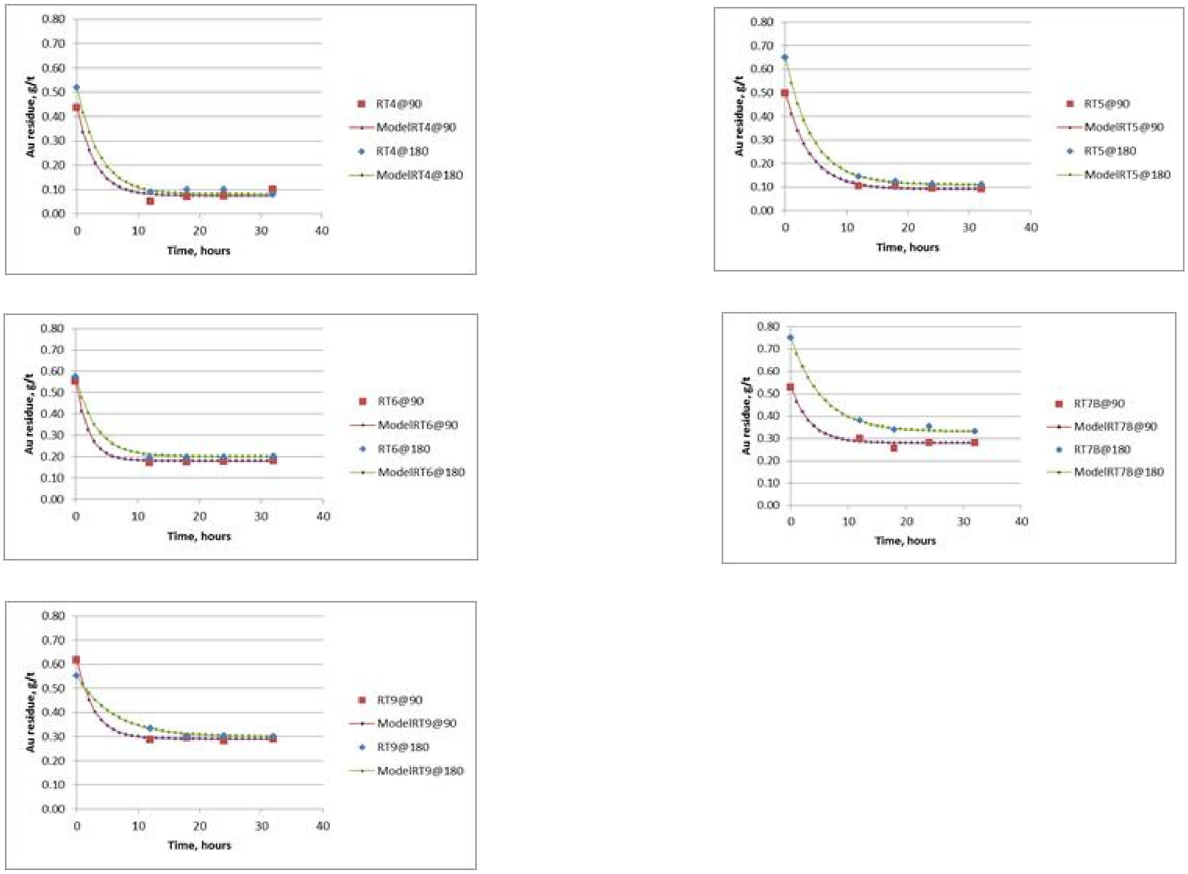


Figure 10-21: 2017 PFS (Phase 9) - Leach kinetics analyses according to rock type

10.5.11 2017 PFS – Phase 10 - Stirred Tank Reactor (STR) Leach Tests

Phase 10 was conducted under the direction of Guy Deschênes (former BBA employee), owing to his expertise on leaching gold ores containing antimony (Sb). The test program included the use of lead nitrate and control of dissolved oxygen levels under controlled leach conditions. This approach had previously been demonstrated effective at the Fort Knox Mine to control the adverse effects of antimony.

The objective of the Phase 10 test program was to determine whether antimony minerals were responsible for some low gold extractions experienced by rock types (RT7 and RT9). The antimony content of the RT7 sample tested (590 ppm) is an order of magnitude higher than that of RT9 (60 ppm or less).

Phase 10 included testing using 20 kg composites of RT7 and RT9.

The gold content in samples RT7-GR11, RT9-GR14 and RT9-V86, V89 were 0.46 g/t, 0.72 g/t and 0.50 g/t respectively. The RT7 sample contained 0.016% Cu, 4.7% Fe, 0.026% Zn and 2.0% S (S_{Tot}), whereas RT9 contained 0.014% Cu, 5.3% Fe, 0.013% Zn and 2.0% S (S_{Tot}).

Tests were conducted in stirred tank reactors (STR) under controlled conditions of the following variables; agitation, temperature, pH, free cyanide and dissolved oxygen (DO). The leaching conditions that were applied were those used for processing orebodies containing antimony minerals.

The results were compared to baseline conditions (0.5 h pre-treatment, pH 10.7, DO 4 ppm; 32 h leaching, 200 ppm NaCN, pH 10.7, DO 8 ppm). Test results for the RT7 and RT9 composite samples indicated only a modest improvement in gold extraction of 2-5%, when calculated on the basis of gold balance developed around the leach solution and residues, i.e. gold recovery based on leach testwork results. This improvement resulted from a pre-treatment of four hours, with the addition of 100 g/mt lead nitrate and oxygen. However, if the interpretation is based upon the gold content of the leach residues only, which may be valid because the assayed (direct) head grades are the same for each rock type, it suggests no improvement.

The leaching profiles of the baseline conditions and new conditions using lead nitrate are comparable, which would indicate no sign of passivation of antimony minerals. The lack of interference by antimony minerals might be explained by no or insufficient liberation during grinding, or that surface passivation had already taken place in the prior treatment of the samples. Other explanations for a lack of improvement may be that the gold is not liberated at the particle size selected, or that the gold is refractory, i.e. gold is in solid solution with the mineral. Seven tests with repeats indicated good reproducibility of the results.

Table 10-25: Phase 10 results (2017 PFS)

Sample	Feed Size P_{80}, µm	CN Test No.	Time (h)	Pre-aeration pH	Pre-aeration DO (ppm)	$Pb(NO_3)_2$ (g/mt)	Leach pH	Leach D. O. mg/L	Reagent Cons. NaCN (kg/mt)	Reagent Cons. CaO (kg/mt)	Residual NaCN g	Au Extraction (%) 2h	Au Extraction (%) 5h	Au Extraction (%) 24h	Au Extraction (%) 32h	Residue grade Au, g/mt	Head grade (g/mt Au) Calc	Head grade (g/mt Au) Direct
GR11:1-3,7-9:RT7 RT7B:repeats	90	1	0.5	10.7	4	-	10.7	8	0.67	0.9	0.11	14	20	35	21.5	0.40	0.51	0.46
		2	4	9.8	8	-	9.9	8	0.68	0.6	0.22	8	8	14	26.5	0.36	0.49	
		3	4	9.8	6	100	9.9	8	0.71	0.5	0.20	7	28	28	27.1	0.39	0.54	
		7	2	10.0	9	100	10.2	8	0.74	0.3	0.13	14	20	30	23.5	0.38	0.50	
		7R	2	10.0	6	100	10.3	8	0.65	0.4	0.15	11	20	47	28.3	0.39	0.55	
		8	4	10.1	8	100	10.2	16	0.65	0.2	0.13	15	23	25	23.9	0.39	0.52	
		8R	4	10.1	16	100	10.2	19	0.61	0.3	0.17	19	21	30	25.7	0.38	0.52	
		9	4	10.1	6	200	10.2	8	0.63	0.1	0.18	15	21	27	25.4	0.40	0.53	
		9R	4	10.0	7	200	10.2	7	0.53	0.4	0.19	18	22	28	21.5	0.40	0.50	
GR14 RT9	86	4	0.5	10.2	4	-	10.6	8	0.47	0.7	0.16	37	55	58	44.8	0.34	0.62	0.72
		5	4	10.2	8	-	9.9	8	0.62	0.4	0.20	38	40	52	46.3	0.32	0.60	
		6	4	10.2	7	100	9.9	8	0.60	0.3	0.21	41	49	50	50.2	0.32	0.64	
GR14 RT9 (V86 & V89)	62	10	2	10.2	9	100	10.2	8	0.76	0.1	0.12	53	55	59	54.7	0.21	0.46	0.50
		10R	2	10.0	8	100	10.0	7	0.63	0.4	0.16	52	49	37	42.0	0.29	0.49	
		11	4	10.1	12	100	10.2	16	0.59	0.1	0.16	55	57	57	53.9	0.22	0.48	
		11R	4	10.2	16	100	10.2	15	0.47	0.3	0.16	54	56	52	55.5	0.20	0.46	
		12	4	9.9	8	200	10.1	8	0.52	0.2	0.15	50	52	54	54.0	0.22	0.48	
		12R	4	10.0	9	200	10.1	8	0.52	0.4	0.20	49	51	53	55.4	0.21	0.47	

Table 10-26: Reproducibility of cyanidation tests on the Livengood Gold Project
(2017 PFS)

Sample number	CN	Reagent Cons.		Gravity Tail Leach Extraction (% Au)	Residue Grade Au, g/mt	Head grade (g/mt Au)
	Test No.	NaCN (kg/mt)	CaO (kg/mt)			Calc
RT 7 and RT7B	7	0.74	0.3	23.5	0.38	0.50
	7R	0.65	0.4	28.3	0.39	0.55
	8	0.65	0.2	23.9	0.39	0.52
	8R	0.61	0.3	25.7	0.38	0.52
	9	0.63	0.1	25.4	0.40	0.53
	9R	0.53	0.4	21.5	0.40	0.50
RT9	10	0.76	0.1	54.7	0.21	0.46
	10R	0.63	0.4	42.0	0.29	0.49
	11	0.59	0.1	53.9	0.22	0.48
	11r	0.47	0.3	55.5	0.20	0.46
	12	0.52	0.2	54.0	0.22	0.48
	12R	0.52	0.4	55.4	0.21	0.47

Important conclusions that can be drawn from the Phase 10 test program include:

- For the samples tested, there was no clear evidence of passivation in the leaching profiles using conditions that are efficient for ores containing antimony minerals;
- Given the level of antimony and arsenic minerals that are present, this is a very unusual response. Either these minerals did not interfere, perhaps because they were not liberated, or the samples tested were altered by the previous grinding/gravity tests that were performed on them. Ageing may have also been a contributing factor;
- The response runs counter to the good recovery results of RT9 in the FS optimization, where the average gravity tail leach extraction was 62.9%. It also runs counter to the RT7 mini-optimization testwork that resulted in an average gold recovery of 53.6%. Both of these sets of tests were run on fresh core, where the impact of antimony should have been quite pronounced, but yet gold recoveries were higher than the Phase 10 testwork. Particle size cannot be used to explain the differences in the Phase 10 tests, because the P_{80} of 60-90 µm was similar to that used in the FS optimization tests;
- The results reinforce the need to consider detailed gold deportment analysis of gravity and leaching products in the next phase of testwork;
- Seven tests with repeats indicated a good reproducibility of the results;
- Lead nitrate addition may have increased the gold leaching kinetics.

10.5.12 2021 PFS – Metallurgical Testwork

Five additional phases (9a, 9b, 11, 12, with addenda 1-5, and 13) of testwork have been completed since the 2017 PFS. These testwork were conducted to explore possible opportunities established through BBA's analysis of the FS and 2017 PFS testwork, to clarify certain questions regarding gold leach performance and reagent consumptions and to confirm the process flowsheet. Phase descriptors with a common numeric identifier mean that those programs were completed on replicate splits of the same large composites for each of the different rock types. For example, all the work for Phases 9, 9a, and 9b was completed on replicates of the same RC chip composites. Similarly, all the work for Phase 12, including addenda 1-5, was completed on replicates of the same core composites. The new phases are outlined as follows:

- Phase 9a: Cyanide leach testing on all rock types using reverse circulation (RC) drill chip composites;
- Phase 9b: Gravity recovery improvement, flowsheet optimization, STR testwork, ore blends testing, gold deportment, diagnostic leaching on two problematic rock types (RT7 and RT9) and flotation testing;
- Phase 11: Testing using RC rig duplicates to assess impact of the ore body location in relation with the 100 ppm antimony shell on the gold recovery and improvement of the understanding of the gold grade/recovery and grind size/recovery relationships;
- Phase 12: Original objectives are the same as Phase 11 but using core samples rather than RC rig duplicates; followed by Phase 12, Addenda 1-5 as described below;
- Phase 13: Testing using a blend of core and RC rig duplicates to assess impact of the ore body location and antimony concentrations of 200 ppm and above on gold recovery.

The nature of the testwork and resulting conclusions are discussed below.

10.5.13 2021 PFS – Phase 9a - Cyanide Leach Testing

The Phase 9a was conducted by SGS Vancouver on approximately 50 kg of product rejects from the Phase 9 composites processed by FLSmidth/AMIRA and returned to SGS in 2015 where each sample had previously been prepared from reverse circulation rig duplicates (rock chips).

The objectives were to confirm the process flowsheet developed in Phase 8, to avoid nugget effects from influencing the projected metallurgical recoveries and to determine the effect of leach conditions using samples taken from a homogenous feed composite.

The Phase 9a testwork were completed in triplicate on 1 kg splits to compare different leach tests conditions:

- CIL vs CIP;
- Lead nitrate addition at PFS concentration vs no lead nitrate;
- Sodium cyanide concentration at 0.4 kg/t vs 0.8 kg/t;
- pH 10 vs pH 10.5.

The composite sample selection was described previously in the section 10.5.10.1. Figure 10-22 illustrates the testwork that was conducted.

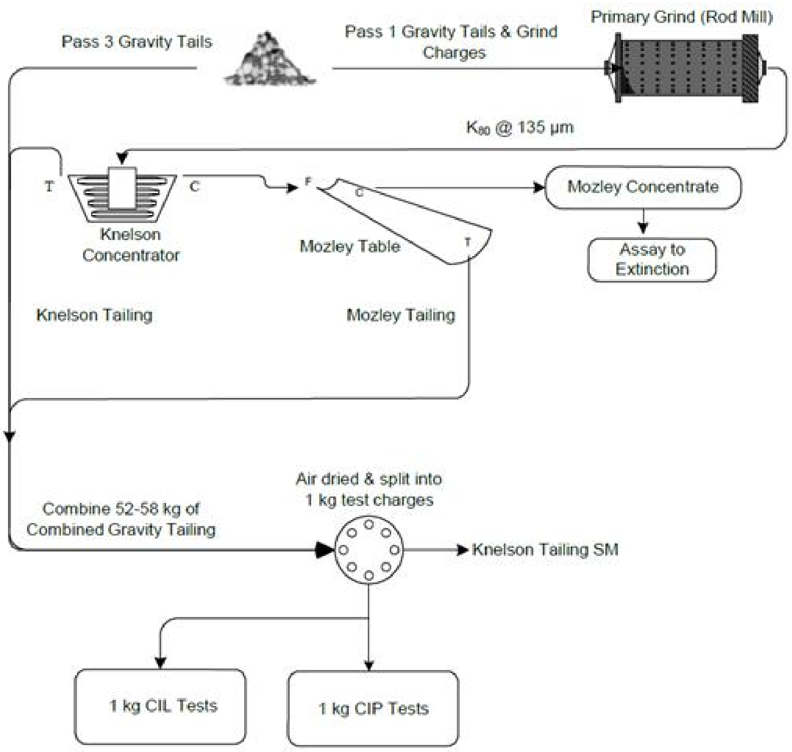


Figure 10-22: 2021 PFS (Phase 9a) testwork outline

Table 10-27 presents the test conditions and Table 10-28 present the gold recoveries obtained for each rock type. The average gold recovery were similar when using CIL or CIP methodologies for Rock Types 4, 5 and 9 while better gold recovery was obtained when using CIL methodology for Rock Types 6 and 7.

Table 10-27: Test conditions (2021 PFS – Phase 9a)

Test ID	Lead Nitrate concentration (g/mt)	Sodium cyanide dosage (kg/mt)	Test pH
CIL-1	100	0.4	10
CIL-2	100	0.8	10
CIL-3	100	0.4	10.5
CIL-4	100	0.8	10.5
CIL-5	0	0.4	10
CIL-6	0	0.8	10
CIL-7	0	0.4	10.5
CIL-8	0	0.8	10.5
CIP-1	100	0.4	10
CIP-2	100	0.8	10
CIP-3	100	0.4	10.5
CIP-4	100	0.8	10.5
CIP-5	0	0.4	10
CIP-6	0	0.8	10
CIP-7	0	0.4	10.5
CIP-8	0	0.8	10.5

Table 10-28: Test results for all Rock Types (2021 PFS – Phase 9a)

Test ID	RT4 Au recovery (%)	RT5 Au recovery (%)	RT6 Au recovery (%)	RT7 Au recovery (%)	RT9 Au recovery (%)
CIL-1	78.1	72.2	58.8	43.9	46.7
CIL-2	77.4	72.8	64.3	40.6	47.9
CIL-3	73.7	73.9	64.1	36.8	49.1
CIL-4	75.3	72.0	62.9	43.9	47.6
CIL-5	76.8	68.9	61.3	41.3	46.6
CIL-6	75.3	72.5	56.3	38.1	46.8
CIL-7	74.2	56.9	57.8	35.6	43.8

Test ID	RT4 Au recovery (%)	RT5 Au recovery (%)	RT6 Au recovery (%)	RT7 Au recovery (%)	RT9 Au recovery (%)
CIL-8	78.4	65.7	56.5	39.6	45.6
CIP-1	75.6	71.8	56.0	32.4	50.2
CIP-2	75.5	69.3	55.5	34.4	51.6
CIP-3	73.9	71.8	58.8	33.8	45.5
CIP-4	75.6	74.3	53.7	35.3	46.7
CIP-5	78.9	66.5	52.8	31.0	46.8
CIP-6	74.9	70.2	52.0	35.3	49.7
CIP-7	73.9	59.6	43.8	32.1	44.4
CIP-8	76.1	66.4	54.2	33.7	45.8

Figure 10-23 to Figure 10-27 show the residue averages of three replicates at each test condition. These conditions are identified in the legend of each figure with the four variables being CIL or CIP, concentration of lead nitrate added (ppm), initial cyanide concentration (kg/t) and pH.

The residue grades were the same in the CIL and CIP for Rock Types 4, 5 and 9. Lower residual gold grades were obtained for Rock Types 6 and 7 when using the CIL. These results confirm that CIL seems to be the better methodology compared to CIP.

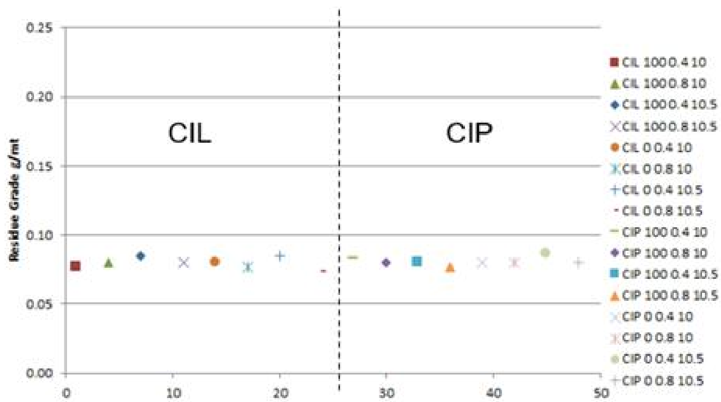


Figure 10-23: RT4 Average CIL and CIP residue grades at a P_{80} of 112 µm
(2021 PFS – Phase 9a)

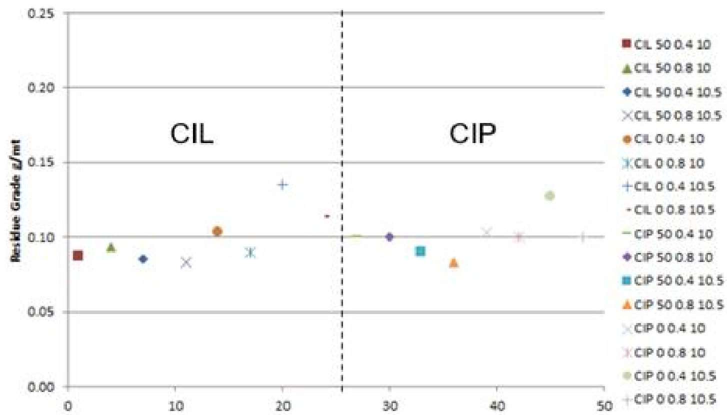


Figure 10-24: RT5 Average CIL and CIP residue grades at a P_{80} of 111 µm
(2021 PFS – Phase 9a)

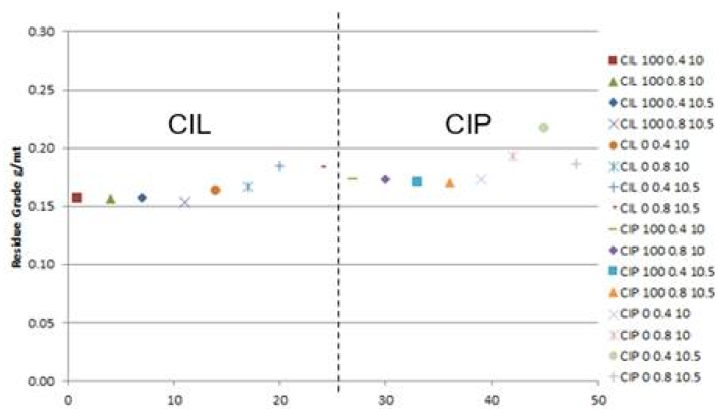


Figure 10-25: RT6 Average CIL and CIP residue grades at a P_{80} of 99 µm
(2021 PFS – Phase 9a)

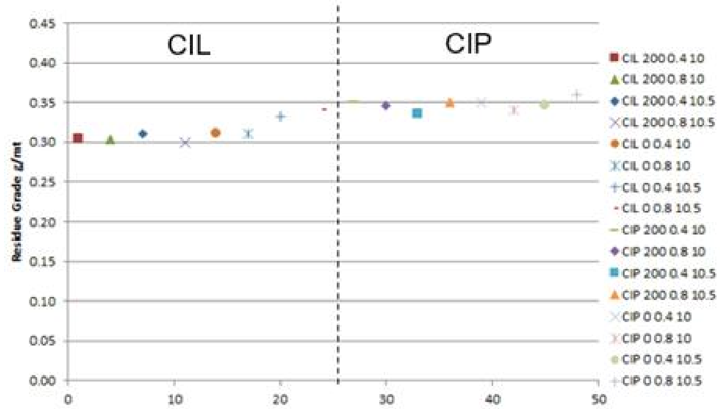


Figure 10-26: RT7 Average CIL and CIP residue grades at a P_{80} of 120 µm
(2021 PFS – Phase 9a)

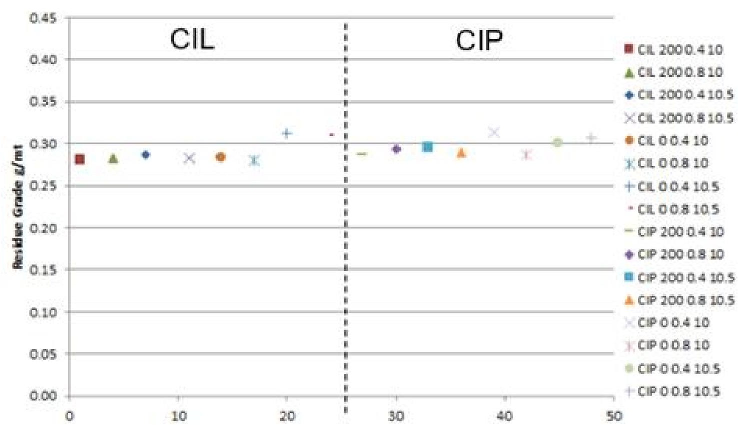


Figure 10-27: RT9 Average CIL and CIP residue grades at a P_{80} of 113 µm
(2021 PFS – Phase 9a)

The gold leach kinetic profiles of the CIP test replicates are presented in Figure 10-28 for each conditions listed in Table 10-27 and for each rock type. The plots suggest that gold recovery plateaued after 18 hours of leaching for all rock types. RT4, RT7 and RT9 appeared to reach maximum gold dissolution by 12 hours.

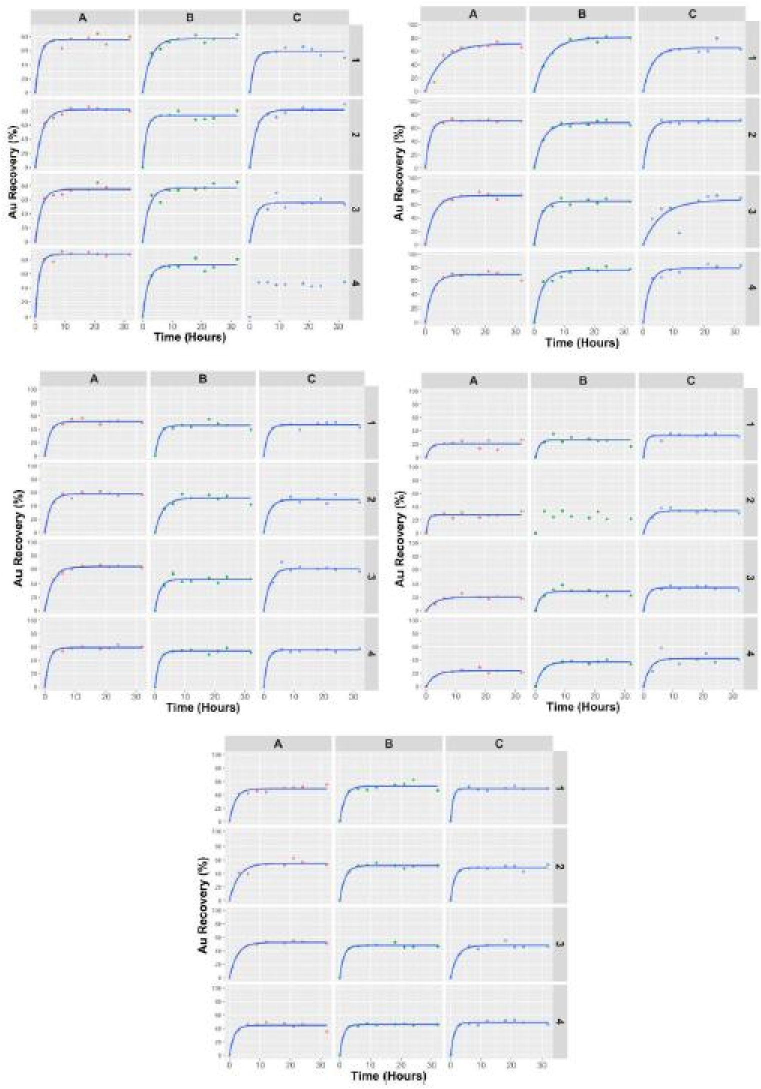


Figure 10-28: Leach kinetics results for RT4, RT5, RT6, RT7 and RT9
(2021 PFS – Phase 9a)

The potential preg-robbing level of each rock type was determined by the analysis Au31 and Au31a performed in quadruplicate. The preg-robbing levels for each rock type are shown in Figure 10-29. Values approaching 0% have low potential for preg-robbing while negative values near -40% have a significant potential for preg-robbing.

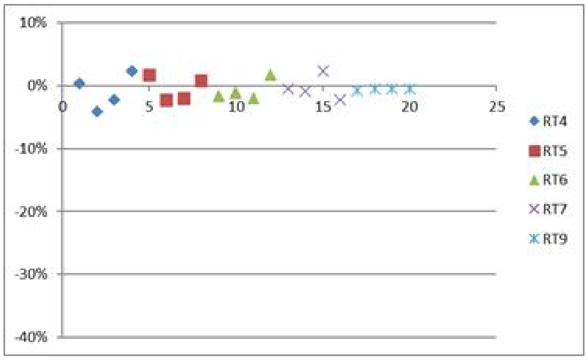


Figure 10-29: % Au gain preg-robbing level
(2021 PFS – Phase 9a)

The important conclusions to be drawn from the leach residue assay interpretation of Phase 9a are as follow:

- RT7 and RT6 showed better recovery both with CIL. The other rock types appeared insensitive to CIL vs CIP;
- Leach residue grades were consistently as low as what was obtained during previous testwork at SGS for all rock types;
- None of the five rock types (RT4, RT5, RT6, RT7 and RT9) were sensitive to the addition of lead nitrate at PFS concentration at the test condition at pH 10;
- None of the five rock types were sensitive to the leach variable of cyanide concentration at either 0.4 kg/t vs 0.8 kg/t;
- RT5, RT6, RT7 and RT9 showed better results at pH 10 without lead nitrate. However, the variance is slightly above 0.02 g/t of the method detection limit, which indicates that this is not significant;
- RT4 appeared insensitive to either pH 10 or pH 10.5 or with and without lead nitrate addition;
- Geochemical analysis of the samples showed all rock types with low preg-robbing levels of 5% or less.

10.5.14 2021 PFS – Phase 9b - Gravity, Grind, Leaching, STR and Flotation Testing

The Phase 9b was conducted by SGS Vancouver on the remaining 100 kg of the 500 kg June 2015 reverse circulation Phase 9 composites from each rock type. The key objectives of this phase were to:

- Attempt to demonstrate improved gravity recovery on a bulk sample to the level predicted by previous E-GRG testwork;
- Develop reliable grind and recovery data by completing five data points at six grind sizes between 90 and 250 microns;
- Complete additional screening flotation work;
- Develop additional kinetic and reagent consumption data to optimize the flowsheet;
- Test representative ore blends to assess impact on recovery and reagents;
- Complete additional gold deportment and diagnostic leach work on RT7 and RT9 leach residues;
- Complete stirred reactor testing in attempt to assess and reduce antimony impacts on recovery.

The composite sample selection was described previously in the Section 10.5.10.1. Figure 10-30 illustrates the testwork that were conducted.

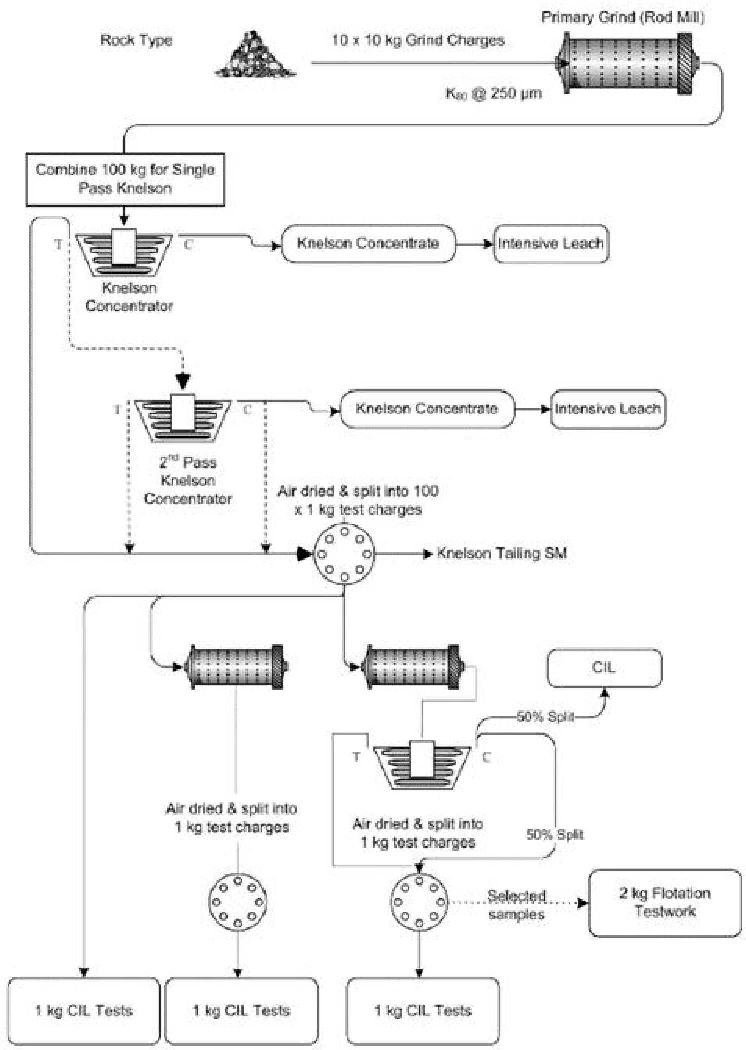


Figure 10-30: 2021 PFS (Phase 9b) testwork outline

10.5.14.1 Phase 9b – Gravity / Intensive Leach Testwork

Phase 9b gravity testwork was performed at a grind of 250 µm (P_{80}). One 100 kg composite by rock type was processed in a single pass through a Knelson concentrator at 40% solids. The entire gravity concentrate was intensive leached, and the tailings were assayed to determine the gold deportment of the gravity products. The results presented in the Table 10-29 demonstrates that the gravity recovery modeled by FLSmidth/AMIRA and the Feasibility Study E-GRG work can be achieved.

Table 10-29: Average gold gravity recovery results for each rock type
(2021 PFS – Phase 9b)

Rock type	Phase 9			Phase 9b	
	Calc. head (Au g/mt)	FLSmidth/AMIRA Stage 1 % GRG recovery P_{100} – 850 µm	SGS Vancouver Gravity recovery with Mozley P_{80} – 250 µm	Calc. head (Au g/mt)	SGS Vancouver Gravity recovery without Mozley P_{80} – 250 µm
RT4	0.70	38%	24%	0.68	49%
RT5	0.63	44%	16%	0.63	64%
RT6	0.71	46%	25%	0.76	53%
RT7	0.78	35%	16%	0.81	38%
RT9	0.69	33%	10%	0.73	36%

Table 10-30 shows higher gravity recovery of each rock type obtained during Phase 9b testwork leading to an improvement in the overall recovery as compared to splits from the same composites in Phase 9. The gravity recovery improvement in Phase 9b appears to have removed leachable gold from the pulp and resulted in lower CIL recovery than Phase 9. The early gravity recovery of otherwise leachable gold could result in reductions in CAPEX and OPEX in the leach circuit.

Table 10-30: Phase 9 and Phase 9b recovery results comparison
(2021 PFS – Phase 9b)

Rock type	Phase 9				Phase 9b			
	Average gravity recovery	Average CIL recovery	Overall recovery	Average tails (Au g/mt)	Average gravity recovery	Average CIL recovery	Overall recovery	Average tails (Au g/mt)
RT4	24%	78%	83%	0.10	49%	69%	84%	0.11
RT5	16%	77%	80%	0.11	64%	62%	86%	0.10
RT6	25%	64%	72%	0.18	53%	51%	77%	0.17
RT7	16%	43%	52%	0.31	38%	37%	61%	0.31
RT9	10%	48%	53%	0.29	36%	41%	62%	0.32

The Knelson concentrate from each rock type was intensive leached to determine the recoverable gold. Gold recoveries exceeding 98% were achieved for all rock types. The leach rates of the Knelson concentrates are shown in Figure 10-31. The leach kinetics of all rock types were substantially completed after 8 hours of leaching and reached 99% by 24 hours.

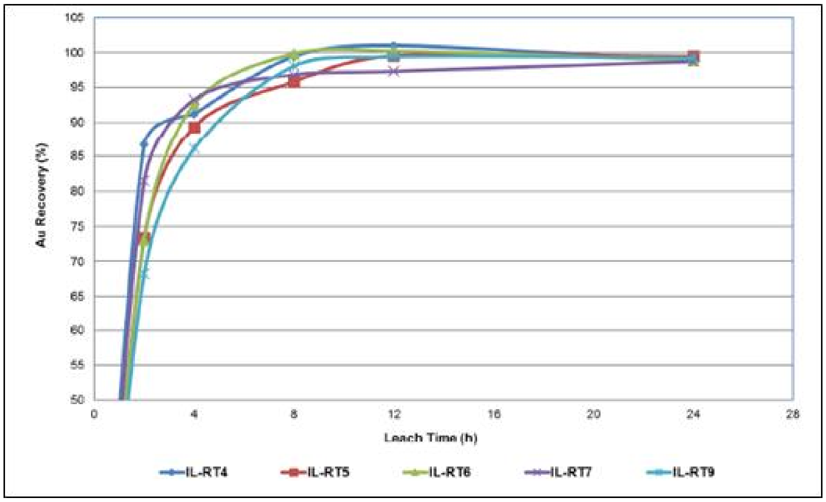


Figure 10-31: Leach kinetics of the Knelson concentrate
(2021 PFS – Phase 9b)

10.5.14.2 Phase 9b – CIL Tests on Knelson Tailings

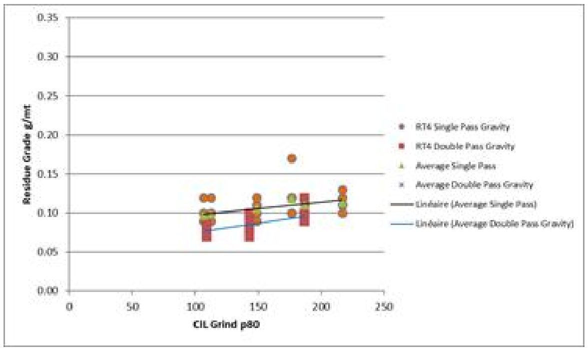
A total of 345 standard bottle roll tests were performed on Knelson tailings to determine the extractable gold for each rock type as a function of different parameters: grind size, preconditioning, pH, and cyanide dosage.

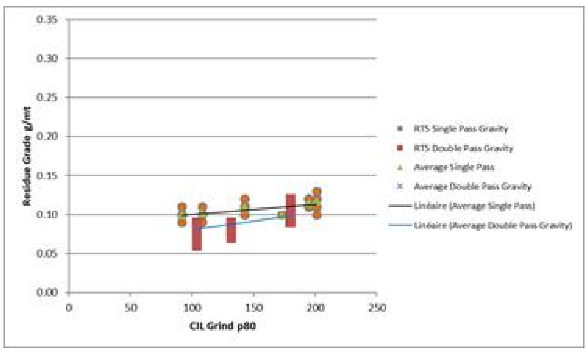
Figure 10-32 shows the CIL residue grades for each rock type at different grind sizes, between 90 µm and 250 µm. Between five and seven data points are represented at each grind size for the single pass gravity results and ten data points for the double pass gravity results.

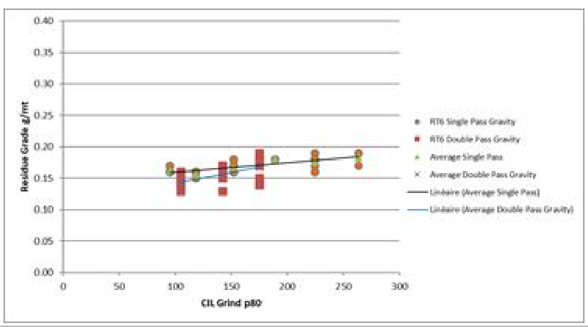
Some observations that can be drawn from this testwork are the following:

- Slightly better recoveries were obtained with the double pass gravity;
- Some of the residues have the same assay and plot on top of each other. The well clustered data are interpreted to reflect an improvement in the test protocol as a consequence of gravity recoverable gold not reporting to conventional leaching and potentially impacting the repeatability of leach residue assays;

- The results of overall recovery versus grind size do not show any inflection point neither for single pass gravity nor for the second pass gravity, which can suggest that there is an opportunity to conduct testwork on coarser sizes in the future;
- There was no correlation shown between cyanide consumption and grind size.







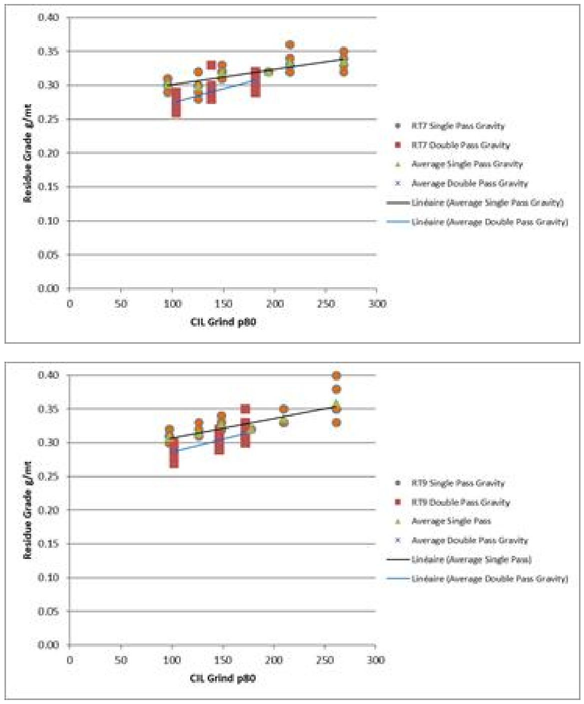


Figure 10-32: CIL residue grade according to grind size
(2021 PFS – Phase 9b)

10.5.14.3 Phase 9b – Regrind and Gravity Separation Testing

A total of 46 regrinds were performed at six different grind sizes, including 215, 180, 150, 135, 120 and 90 µm (P_{80}) for all rock types and blend composites. After regrinding, a total of 15 gravity tests were carried out on each rock type at 180, 135 and 90 µm (P_{80}). The Knelson concentrates were split in half; one half was forwarded to intensive leach and the other was returned with the Knelson tailings. The second pass gravity as well as the intensive leach results are presented in Table 10-31 to Table 10-33.

The results show that regrinding followed by gravity separation and intensive leach can recover more gold than a single pass in gravity followed by CIL. The increased amount gain average from 0.02 to 0.04 g/t. These results reflect the same opportunity identified in the gold deportment and diagnostic leach work that is discussed in Section 10.5.14.6. Enhanced gold recovery is possible by intensive leaching, but improved grinding and/or gravity, or even whole ore intensive leach may be required.

Table 10-31: Result summary of the second pass gravity test at 180 µm
(2021 PFS – Phase 9b)

Rock type	2nd pass grav. con. calc. head (Au g/mt)	Residue after IL (Au g/mt)	Au recovery from con. (%)	2nd pass grav. Au into con. (Au g/mt)	Net Au possible 2nd pass grav. (Au g/mt)	1st pass grav. CIL tail (Au g/mt)	2nd pass grav. CIL tail (Au g/mt)	Difference 1st to 2nd pass (Au g/mt)	Gravity intensive leach gain (Au g/mt)
RT4	7.29	2.82	61.3	0.07	0.04	0.11	0.10	0.01	0.03
RT5	6.04	2.29	62.1	0.05	0.03	0.11	0.10	0.01	0.02
RT6	9.62	3.53	63.3	0.09	0.06	0.18	0.17	0.01	0.05
RT7	6.11	3.56	41.7	0.05	0.02	0.32	0.31	0.01	0.01
RT9	6.24	2.42	61.2	0.05	0.03	0.33	0.30	0.03	0.00

Table 10-32: Result summary of the second pass gravity test at 135 µm
(2021 PFS – Phase 9b)

Rock type	2nd pass grav. con. calc. head (Au g/mt)	Residue after IL (Au g/mt)	Au recovery from con. (%)	2nd pass grav. Au into con. (Au g/mt)	Net Au possible 2nd pass grav. (Au g/mt)	1st pass grav. CIL tail (Au g/mt)	2nd pass grav. CIL tail (Au g/mt)	Difference 1st to 2nd pass (Au g/mt)	Gravity intensive leach gain (Au g/mt)
RT4	11.4	3.58	68.7	0.11	0.08	0.10	0.08	0.02	0.06
RT5	7.81	2.75	64.8	0.07	0.05	0.10	0.09	0.01	0.04
RT6	8.23	4.01	51.3	0.08	0.04	0.16	0.16	0.00	0.04
RT7	7.40	3.73	49.6	0.07	0.04	0.30	0.29	0.01	0.03
RT9	5.69	3.41	40.1	0.05	0.02	0.31	0.30	0.01	0.01

Table 10-33: Result summary of the second pass gravity test at 90 µm
(2021 PFS – Phase 9b)

Rock type	2nd pass grav. con. calc. head (Au g/mt)	Residue after IL (Au g/mt)	Au recovery from con. (%)	2nd pass grav. Au into con. (Au g/mt)	Net Au possible 2nd pass grav. (Au g/mt)	1st pass grav. CIL tail (Au g/mt)	2nd pass grav. CIL tail (Au g/mt)	Difference 1st to 2nd pass (Au g/mt)	Gravity intensive leach gain (Au g/mt)
RT4	10.3	3.06	70.3	0.09	0.07	0.10	0.08	0.02	0.05
RT5	7.44	3.04	59.1	0.07	0.04	0.10	0.08	0.02	0.02
RT6	12.0	4.91	59.1	0.13	0.07	0.16	0.14	0.02	0.05
RT7	10.3	3.61	64.8	0.11	0.07	0.30	0.27	0.03	0.04
RT9	8.36	3.58	57.2	0.09	0.05	0.31	0.29	0.02	0.03

10.5.14.4 Phase 9b – Flotation Testwork

Flotation testwork was completed on three replicates of each rock type and on three replicates from ore blends representative of Year 1, Year 2, Year 4 and LOM at a grind size of 180 µm (P_{80}). The test conditions for all rock types were based on previously optimized flotation conditions for RT7 and RT9. The intent was to achieve a 15% mass pull. Table 10-34 shows the averages of the replicate results for each sample. Table 10-35 presents the comparison of the overall recovery by test condition. As shown in this table, overall recovery for gravity followed by flotation was 3% to 12% lower compared to recovery for gravity followed by CIL. These poor results eliminated the flotation in the selected process flowsheet.

Table 10-34: Flotation testwork results
(2021 PFS – Phase 9b)

Sample	Mass Pull	Flotation recovery
RT4	27%	46%
RT5	12%	44%
RT6	15%	34%
RT7	16%	32%
RT9	16%	30%
Y1	16%	38%
Y2	12%	32%
Y4	12%	42%
LOM 180	18%	36%
LOM 135	18%	38%
LOM 90	17%	38%

Table 10-35: Overall recovery comparison
(2021 PFS – Phase 9b)

Rock Type	Gravity recovery	CIL recovery	Gravity CIL recovery	Flotation recovery	Gravity flotation recovery	Difference
RT4	49%	69%	84%	46%	72%	12%
RT5	64%	62%	86%	44%	77%	8%
RT6	53%	51%	77%	34%	67%	9%
RT7	38%	37%	61%	32%	58%	3%
RT9	36%	41%	62%	30%	53%	8%

10.5.14.5 Phase 9b – Effect of Ore Blend

A series of blend composites was prepared for the first time to evaluate potential impacts of mixing the chemical and physical properties of the ore types on recovery and reagent consumptions. The composition of the blends is presented in Table 10-36.

Table 10-36: Composition of blend composites
(2021 PFS – Phase 9b)

Rock type	RT4	RT5	RT6	RT7	RT9
Blend Year 1	40%	27%	27%	0%	7%
Blend Year 2	9%	9%	45%	0%	36%
Blend Year 3	9%	82%	9%	0%	0%
Blend LOM	15%	23%	23%	15%	23%

The effect of ore blend on recoveries and mass pull are presented in the Table 10-37. The results show that there are no significant adverse recovery issues introduced by mixing ore types. The difference between measured and projected data were varying between -7% to 1% for the CIL recovery, flotation recovery and mass pull. There was no statistically significant difference in measured CIL residue grades as compared to predicted grades.

Table 10-37: Effect of ore blend on CIL recovery, leach residue, flotation recovery and mass pull
(2021 PFS – Phase 9b)

Rock Type	Year 1 blend	Year 2 blend	Year 4 blend	LOM blend
Projected tails (Au g/mt)	0.14	0.21	0.11	0.20
Measured tails (Au g/mt)	0.13	0.21	0.11	0.19
Difference (measured-projected)	**-0.01**	**0.00**	**0.00**	**-0.01**
Projected CIL recovery	61%	50%	61%	52%
Measured CIL recovery	56%	44%	59%	45%
Difference (measured-projected)	**-5%**	**-6%**	**-3%**	**-7%**
Projected float recovery	41%	34%	43%	37%
Measured float recovery	38%	32%	42%	37%
Difference (measured-projected)	**-3%**	**-2%**	**-1%**	**0%**
Projected mass pull	19%	16%	14%	17%
Measured mass pull	16%	12%	12%	18%
Difference (measured-projected)	**-3%**	**-4%**	**-2%**	**1%**

10.5.14.6 Phase 9b – Residue Characterization

AMTEL completed a gold deportment study on three replicate samples selected from the Phase 9b RT7 and RT9 gravity/CIL leach residues from the 105 µm metallic screen undersize. The gold deportment study demonstrated that approximately 17% of gold in these samples was recoverable from both rock types by intensive leaching. Some of the gold in the tailings was observed to have developed a coating, interpreted as silver and silver oxide developed in part by gold depletion during leaching. Figure 10-33 shows the gold deportment.

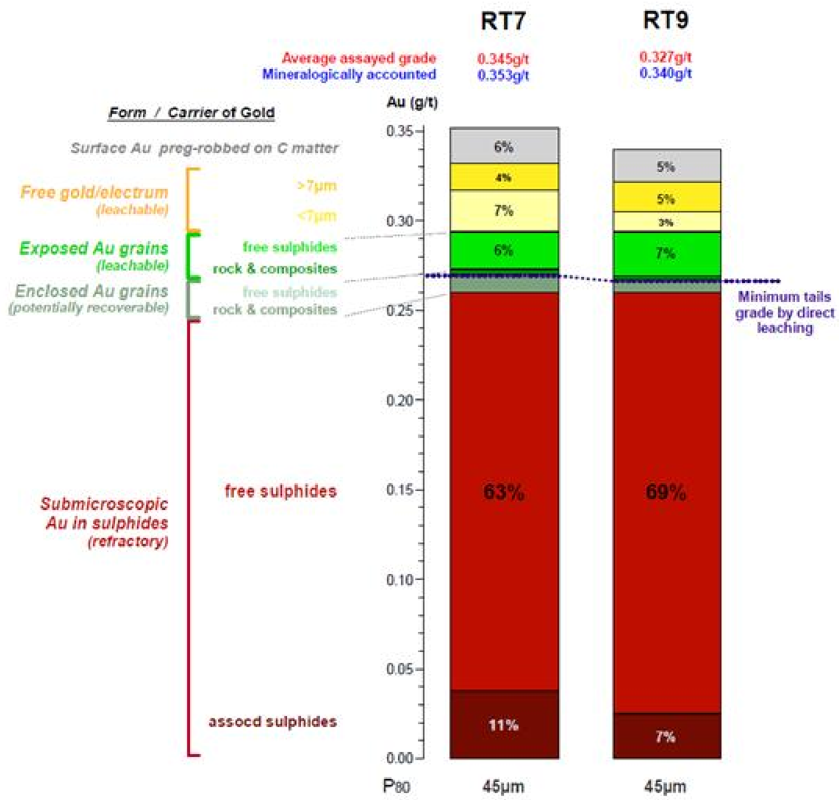


Figure 10-33: Deportment of gold by leach form and carrier
(2021 PFS – Phase 9b)

SGS completed six diagnostic leach tests on triplicates of both RT7 and RT9 gravity/CIL residues at a grind size of 120 µm from the 105 µm metallic screen undersize to diagnose the presence of gold encapsulated by other minerals. The diagnostic leach work indicates that 14.7% of the gold in RT7 residues and 18.1% of the gold in the RT9 residues is recoverable by intensive leach at this particle size. This result corroborates the AMTEL gold deportment work shown previously. Figure 10-34 shows the average diagnostic leach results for RT7 and RT9.

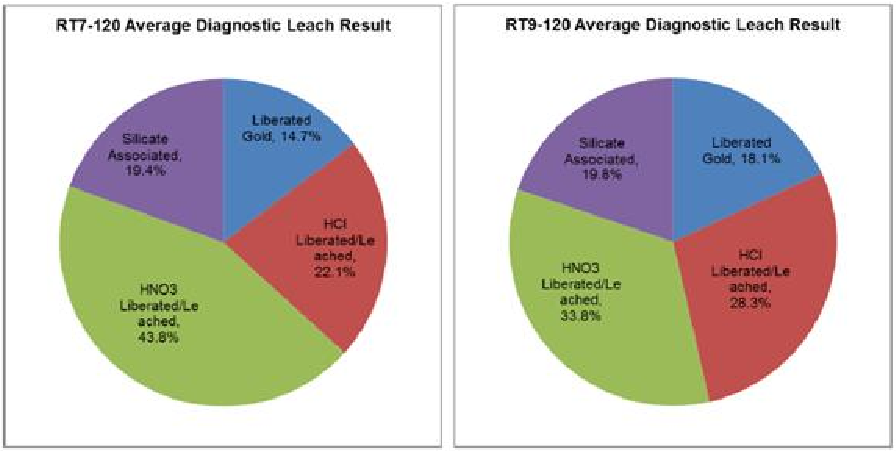


Figure 10-34: Diagnostic leach result distribution
(2021 PFS – Phase 9b)

10.5.14.7 Phase 9b – Stirred Tank Reactor (STR) Leach Tests

A stirred tank reactor testwork program was completed under the direction of BBA. The program was initiated at SGS Vancouver in British Columbia. Samples were shipped to BBA laboratory in Hamilton, Ontario. Leaching products were assayed at SGS Lakefield in Ontario. The test program included the use of lead nitrate to study the influence of passivation of the gold surfaces during grinding and leach sample preparation. Phase 9b included testing of six aliquots, all weighing approximately 1 kg from each rock type (RT4, RT5, RT6, RT7 and RT9).

The objectives of the testwork program were to:

- Compare the leaching performance at 16 and 24 hours;
- Assess whether controlled leaching conditions could improve Au recovery;
- Search opportunities to reduce the leaching time and reagent consumptions.

The test program was conducted on Knelson gravity tails at a grind size of 180 µm (P_{80}). Tests were conducted in stirred tank reactor (STR) under controlled conditions of the following variables: temperature, agitation, pH, oxidation reduction potential (ORP), free cyanide, and dissolved oxygen (DO). Table 10-38 shows the matrix conditions. To study possible passivation of the Au surface during the leaching testwork, the use of DO in the 12-14 ppm range instead of 6-8 ppm was used for one of the aliquots for each rock type.

Table 10-38: STR leach matrix conditions
(2021 PFS – Phase 9b)

Rock Type	Lead nitrate		pH	DO pre-cond. (ppm)	DO during leaching (ppm)	Initial NaCN dosage (kg/mt)	NaCN during leach (kg/mt)	Leaching time
	During re-grinding (g/mt)	During pre-cond. (g/mt)						
RT4	100	25	10.2	6 - 8	6 - 8	0.4	0.2	16 & 24
RT5	50	18						
RT6	100	25						
RT7	200	50						
RT9	200	50						

Table 10-39 presents a summary of the average results of the STR testwork program. Some observations that can be drawn from this table are listed below:

- The Au residue was similar (within the experimental error of 0.02 g/t) for the 16 and 24-hour tests, for all rock types;
- The Au recovery based on the carbon adsorption was higher in all cases at 16-hour vs 24-hour tests, except RT7;
- The Au recovery based on the residue was higher in RT4, RT6 and RT9 at 16-hour vs 24-hour, except RT5 and RT7.
- Higher DO (range 12 to 14 ppm O_2 instead of 6 to 8 ppm O_2) did not have an impact on Au leaching;
- The NaCN consumptions were between 0.25 and 0.40 kg/t with an average of 0.33 kg/t. Since the STR testwork are closer to the reality than the bottle roll tests, it can be expected that the NaCN consumption will be lower than what was used in the testwork of the other phases;
- The NaCN consumptions were lower for all rock types at 16-hour vs 24-hour, except for RT5. It could be explained by the lower lead nitrate addition for this rock type;
- The CaO consumptions were between 0.74 to 1.09 kg/t with an average of 0.87 kg/t. Since the STR testwork are closer to the reality than the bottle roll tests, it can be expected that the CaO consumption will be lower than what was used in the testwork of the other phases;
- The CaO consumptions were higher for all rock types at 16 hours, except RT5;
- These controlled leach tests were not able to reduce leach residue assays below the bottle roll results from SGS shown previously in Figure 10-32 at a grind size of 180 µm.

Table 10-39: Average STR testwork results
(2021 PFS – Phase 9b)

Rock Type	Leach time (hours)	Reagent consumption		Residue grade (Au g/mt)	Head grade		Au recovery	
		NaCN (kg/mt)	CaO (kg/mt)		Calculated (Au g/mt)	Direct (Au g/mt)	Carbon ads (%)	Residue (%)
RT4	24	0.40	0.91	0.12	0.36	0.35	67.7	66.3
	16	0.32	1.05	0.11	0.37		71.2	70.0
RT5	24	0.25	0.82	0.09	0.25	0.23	60.7	62.5
	16	0.33	0.77	0.11	0.28		61.3	61.2
RT6	24	0.37	0.74	0.19	0.34	0.36	43.3	42.4
	16	0.27	0.84	0.21	0.38		46.8	43.5
RT7	24	0.36	0.88	0.31	0.51	0.47	42.2	38.7
	16	0.34	1.09	0.32	0.49		37.7	35.2
RT9	24	0.34	0.76	0.33	0.50	0.47	36.5	34.6
	16	0.29	0.81	0.32	0.52		39.4	37.6

Figure 10-35 shows kinetic plots of Au leaching residue vs time. Similar kinetic rates can be observed in both the 16-hour and 24-hour. These tests confirm Phase 9a work showing that the leach kinetics appeared to reach maximum gold dissolution by 12 hours as shown previously in Figure 10-28.

The addition of lead nitrate during regrind and pre-conditioning did not improve Au leaching kinetics or Au leaching tails. A lead nitrate optimization program is suggested to study the impact of the addition of lead nitrate in Au leach kinetics and cyanide consumption.

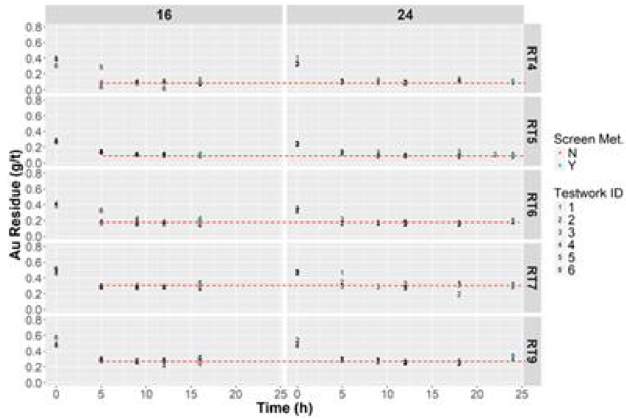


Figure 10-35: Leach kinetics 16 vs 24 hours
(2021 PFS – Phase 9b)

10.5.14.8 Phase 9b – Reprocessing of CIL Residues

Various CIL tailing metallic screen undersize residues, after being pulverized to approximately 50 µm (P_{80}) from different particle sizes, were reconstituted to make up a sample for each rock type. These samples were reprocessed through a gravity concentrator in a single pass. The concentrates were forwarded to intensive leaching and the gravity tails were sent to CIL to determine if the liberated gold identified by AMTEL and SGS diagnostic leach can be recovered significatively.

Table 10-40 presents the results of the concentrate regrinding followed by intensive leaching. Modest improvement in tail residue grades and recoveries were obtained. The 3.5% and 3.0% values for RT7 and RT9 (as a percentage of gold in the CIL tails) compares to the 15%-17% obtained by AMTEL and SGS diagnostic leach, which means that the liberated gold appears to be too small to be recovered by gravity circuit.

Table 10-40: Knelson concentrate intensive leach results
(2021 PFS – Phase 9b)

Sample ID	Residue grade (Au g/mt)	Au recovery (%)
KnelCon of RT4 Residues	0.09	14.9
KnelCon of RT5 Residues	0.10	8.14
KnelCon of RT6 Residues	0.17	5.35
KnelCon of RT7 Residues	0.33	3.52
KnelCon of RT9 Residues	0.30	3.05

Reprocessing the Knelson tailings by the CIL methodology liberated additional leachable gold and obtained tail residue grades and recovery shown in Table 10-41. The 16.9% and 23.8% recovery improvement for RT7 and RT9 (as a percentage of gold in the CIL tails) compares favorably to the 15%-17% obtained by AMTEL and SGS diagnostic leach. The overall recovery increase by rock type is shown in the right column. These data warranted a re-examination of the grind/recovery characteristics, which was completed in Phases 11 and 12, following the success at improving the gravity circuit test protocols.

Table 10-41: Knelson tailings CIL results
(2021 PFS – Phase 9b)

Sample ID	Residue grade (Au g/mt)	Au recovery in CIL tails (%)	Au overall recovery increase (%)
RT4 Knelson Tail of CIL residues	0.06	29.1	4.9
RT5 Knelson Tail of CIL residues	0.06	35.8	3.4
RT6 Knelson Tail of CIL residues	0.13	16.9	4.0
RT7 Knelson Tail of CIL residues	0.24	16.9	6.4
RT9 Knelson Tail of CIL residues	0.23	23.8	12.4

10.5.15 2021 PFS – Phase 11

The Phase 11 was conducted by SGS Vancouver on 100 kg composites prepared from the RC rig duplicates store at Livengood site since 2012 drilling from each of the five rock types. The objectives of this phase were to:

- Assess whether gold recovery is dependent upon orebody location in relation to the 100 ppm antimony shell;
- Improve the understanding of the gold grade/recovery and grind size/recovery relationships.

The samples were based on rock type, oxide/sulfide zone type, gold concentration, antimony concentration and location with respect to the antimony 100 ppm shell. The samples were composited to achieve three targeted grades; resource average grade (RTXX-1), average grade plus cut-off (RTXX-2) and average grade plus two times cut-off (RTXX-3). When adequate samples were available for compositing, three composites for each targeted grade were prepared from outside the 100 ppm antimony shell (RTXO-X) and three composites from inside the 100 ppm antimony shell (RTXS-X). The antimony shell is a complex 3D solid modeled to include the areas of highest antimony concentration in the orebody. All composites were selected to have less than 100 ppm antimony so as to determine whether mere proximity to generally higher antimony levels resulted in an impact on gold recovery, even at approximately similar antimony concentrations of the composites themselves. Rock types RT4 and RT5 did not have sufficient samples to prepare the “inside the 100 ppm antimony shell” composites. Table 10-42 presents some characteristics of the composites.

Samples were ground to a grind size of 250 µm (P_{80}), processed twice in a gravity concentrator, the tailings were split and reground to grind sizes of 180 µm and 50 µm (P_{80}). The gravity concentrates from both passes for a given rock type were combined and intensive leached while the gravity tailings were CIL leached according to the same protocol as Phase 9b. Figure 10-36 illustrates the metallurgical test procedures that were conducted.

Table 10-42: Composites characteristics
(2021 PFS – Phase 11)

Sample ID	Drill assay head grade (Au g/mt)	Arsenic concentration (As ppm)	Antimony concentration (Sb ppm)
RT4O-1	0.64	5 159	28
RT4O-2	0.99	3 227	28
RT4O-3	1.38	1 800	27
RT5O-1	0.59	1 944	24
RT5O-2	0.93	3 301	27
RT5O-3	1.31	4 286	27
RT6S-1	0.72	4 327	55
RT6S-2	0.97	2 271	48
RT6S-3	2.48	2 730	76
RT6O-1	0.70	2 447	26
RT6O-2	1.05	3 171	32
RT6O-3	1.41	3 772	30
RT7S-1	0.80	5 418	58
RT7S-2	1.45	4 776	57
RT7S-3	1.84	4 677	59
RT7O-1	0.77	3 077	37
RT7O-2	1.20	3 144	40
RT7O-3	1.69	3 440	31
RT9S-1	0.84	4 859	51
RT9S-2	1.20	12 001	71
RT9S-3	1.69	6 871	57
RT9O-1	0.83	6 446	47
RT9O-2	1.21	7 855	43
RT9O-3	1.61	8 642	43

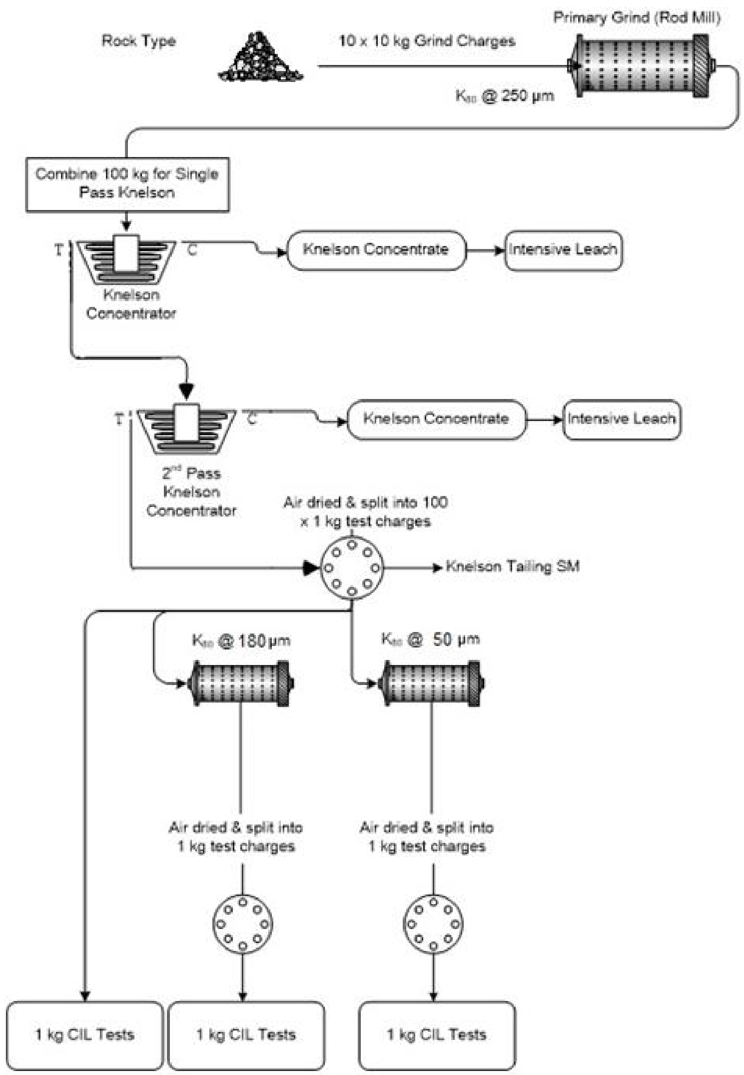


Figure 10-36: 2021 PFS (Phase 11) testwork outline

10.5.15.1 Phase 11 – Gravity / Intensive Leach Testwork

Phase 11 gravity testwork was performed at a grind of 250 µm (P_{80}). The results obtained from the two-stage gravity test are presented in the Table 10-42. Phase 9b and Phase 11 make two consecutive test programs with gravity results near those predicted by AMIRA for the Phase 9 composites. These results confirm the gravity circuit performance and demonstrate the need for a robust gravity circuit. As shown in Figure 10-37, gravity recovery does not appear to be a function of head grade.

Table 10-43: Gravity separation results
(2021 PFS – Phase 11)

Composite Name	Calculated head (Au g/mt)	1st pass grav. recovery (%)	2nd pass grav. recovery (%)	Total gravity recovery (%)	Gravity tail (Au g/mt)
RT4O-1	0.54	47.9	3.9	51.8	0.26
RT4O-2	1.02	53.0	8.8	61.8	0.39
RT4O-3	0.75	44.0	13.3	57.3	0.32
RT5O-1	0.63	45.7	5.3	51.0	0.31
RT5O-2	1.03	49.7	7.6	57.3	0.44
RT5O-3	1.23	33.3	7.6	40.9	0.73
RT6S-1	0.95	54.1	4.2	58.3	0.40
RT6S-2	0.74	46.0	9.3	55.3	0.33
RT6S-3	1.74	50.6	21.4	72.0	0.49
RT6O-1	0.74	42.7	3.4	46.1	0.40
RT6O-2	0.91	40.9	11.9	52.8	0.43
RT6O-3	0.99	38.9	6.8	45.7	0.54
RT7S-1	1.12	54.5	5.3	59.8	0.45
RT7S-2	1.24	51.2	8.7	59.9	0.50
RT7S-3	1.04	44.4	3.8	48.2	0.54
RT7O-1	0.91	57.0	5.7	62.7	0.34
RT7O-2	1.01	58.6	4.0	62.6	0.38
RT7O-3	1.12	70.7	3.4	74.1	0.29
RT9S-1	0.92	46.0	3.0	49.0	0.47
RT9S-2	1.27	31.0	3.5	34.5	0.83
RT9S-3	1.16	44.8	5.5	50.3	0.58
RT9O-1	1.09	41.0	2.4	43.4	0.62
RT9O-2	1.44	42.0	4.8	46.8	0.77
RT9O-3	1.18	29.3	7.1	36.4	0.75

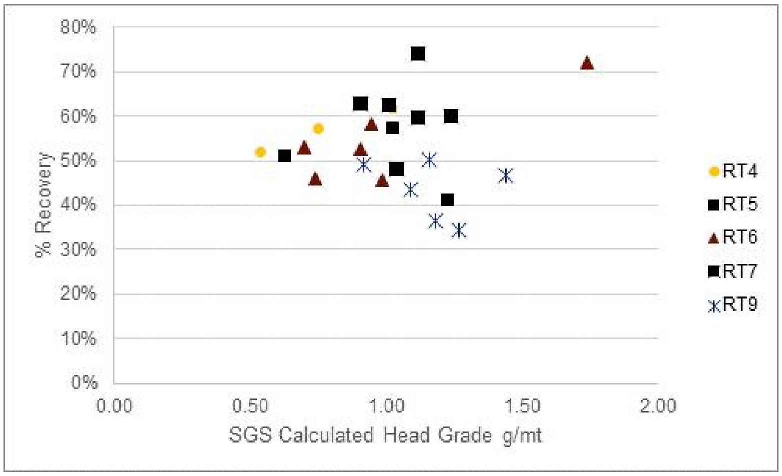


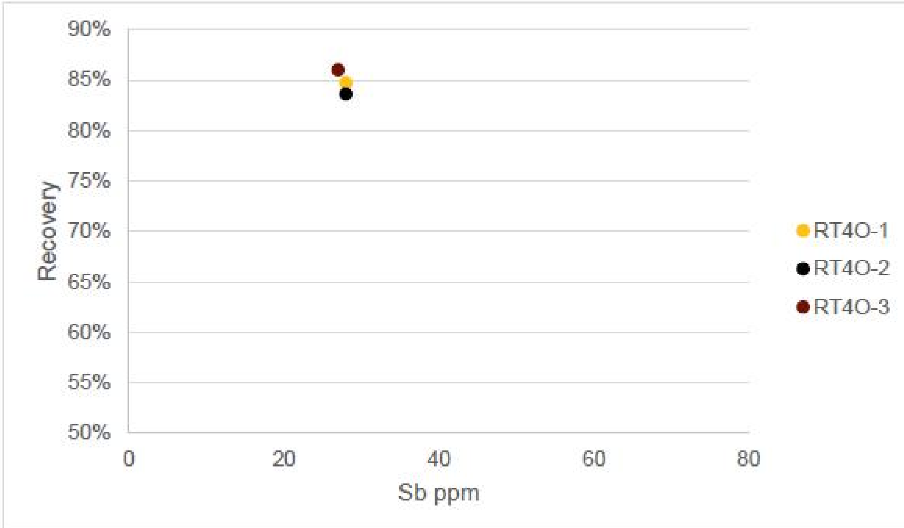
Figure 10-37: Gravity recovery vs calculated head by rock type
(2021 PFS – Phase 11)

The 1st pass Knelson concentrate and the 2nd pass Knelson concentrate were forwarded separately for intensive leach cyanidation. High gold recoveries exceeding 94% to 99% were achieved by 1st pass concentrates and gold recoveries of 73% to 98% were achieved by 2nd pass concentrates.

10.5.15.2 Phase 11 – CIL Tests on Knelson Tailing Leach Testwork and Overall Recovery

A total of 720 bottle roll tests on the 24 variability samples were conducted to determine the extractable gold from the Knelson tailing as a function of grind size. For each variability sample, ten replicate bottle roll tests were performed at three different grind sizes, 250, 180 and 50 µm (P_{80}).

Figure 10-38 presents the overall recovery related to the antimony concentration. The results show that, if related to only one parameter, RT6 and RT7 recoveries seem to be not dependent on the sample location being inside or outside the 100 ppm antimony shell. RT9 has one composite that showed reduced recovery that could be related to location, antimony concentration or other factors. RT4 and RT5 did not have composites from within the antimony shell. However, a statistical analysis that is discussed in Section 10.6.2, demonstrated in a 3D model that gold recoveries appear to be slightly dependent on the sample location being inside or outside the 100 ppm antimony shell when they are related to grind size and head grades.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85%
80%
75%
70%
65%
60%
55%
50%
Recovery
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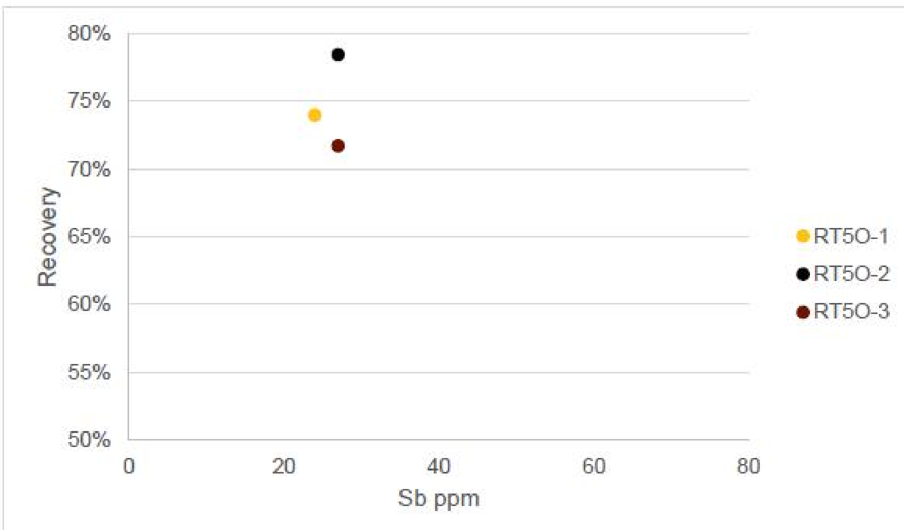
20
40
60
80
Sb ppm
RT4O-1
RT4O-2
RT4O-3


80%
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50%
Recovery
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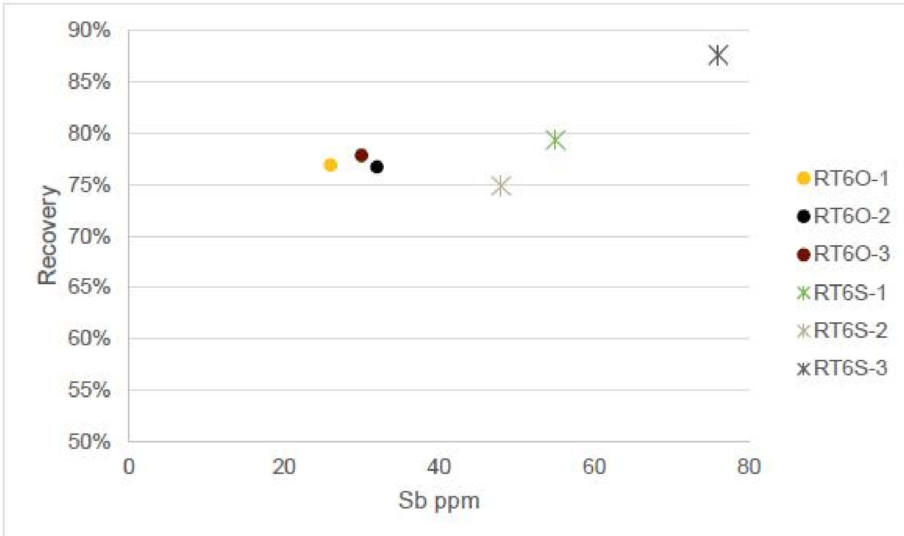
80
Sb ppm
RT5O-1
RT5O-2
RT5O-3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Recovery
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Sb ppm
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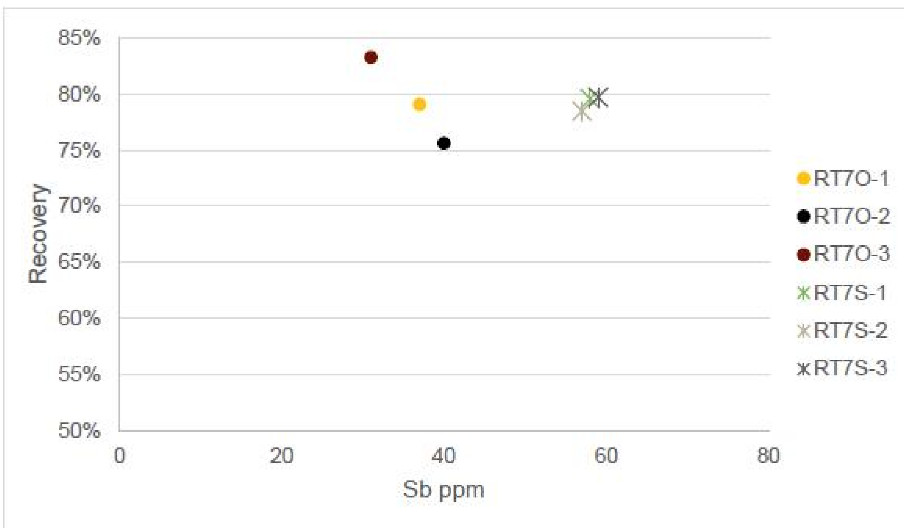
RT6S-2
RT6S-3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Recovery
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Sb ppm
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RT7S-2
RT7S-3

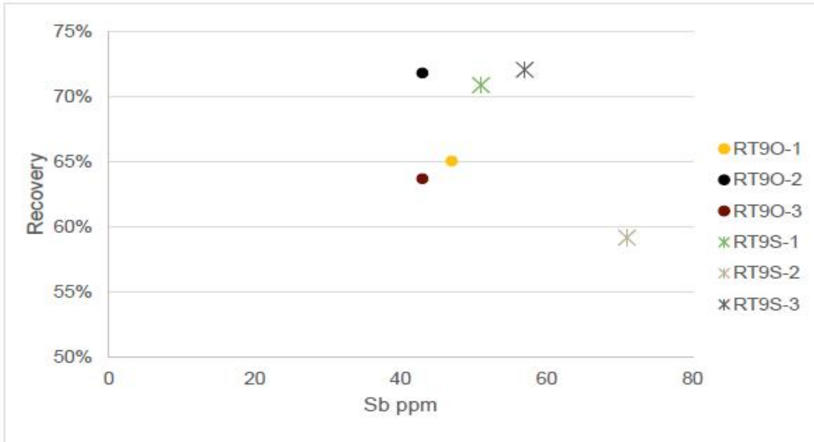
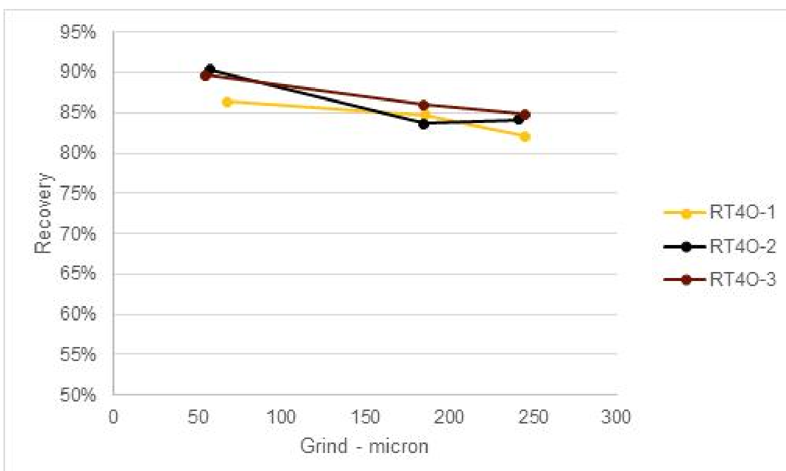
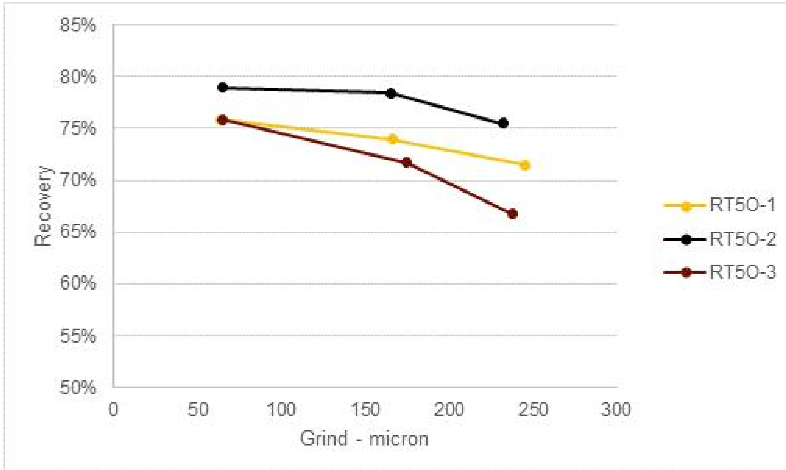


Figure 10-38: Overall gold recovery according to location inside or outside the 100 ppm Sb shell
(2021 PFS – Phase 11)

Figure 10-39 shows the overall gold recovery according to the grind size. Coarsening the grind to 250 µm (P_{80}) results in gold recovery losses between 1% and 4% depending on the rock type. However, similar to the results of Phase 9b, these results do not show any inflection point between 250 and 180 µm, which can suggest that there is an opportunity to conduct testwork on coarser sizes in the future.




85%
80%
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65%
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Recovery
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150
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250
300
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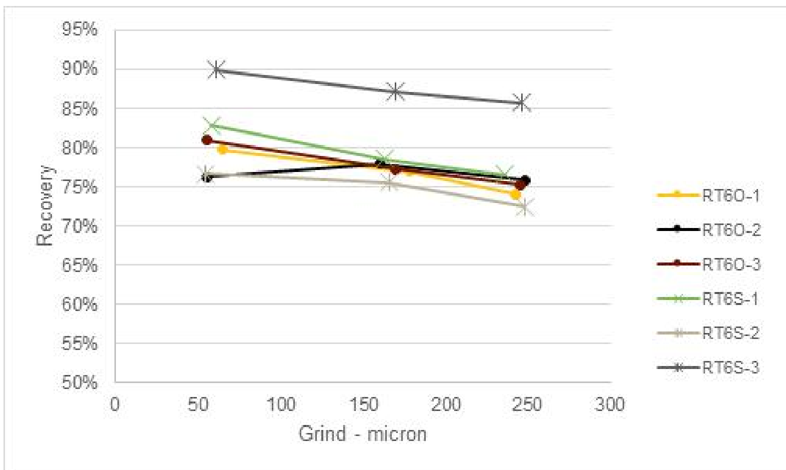
RT5O-1
RT5O-2
RT5O-3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Recovery
0
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150
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RT6S-2
RT6S-3

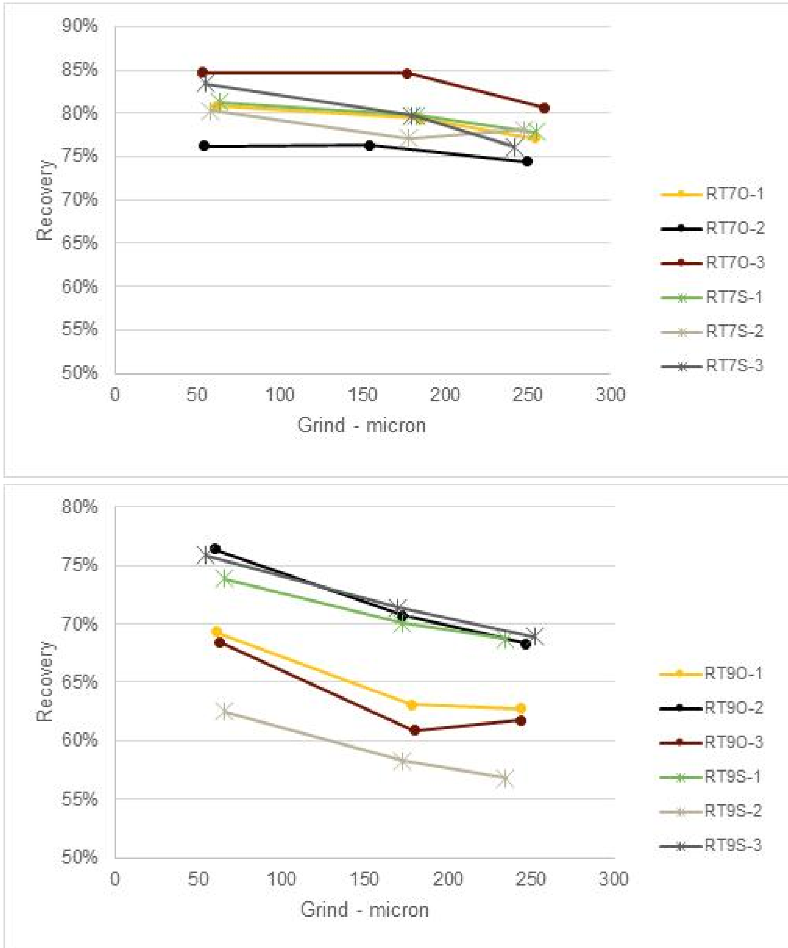


Figure 10-39: Overall gold recovery according to grind size
(2021 PFS – Phase 11)

10.5.15.3 Bulk CIP Tailings Production

A series of six bulk regrind and cyanidation leach tests were performed to produce fresh leach tailings slurry for off-site geotechnical testing. Three leach feed composites, RT4O, RT5O, and RT9S, were prepared in duplicate by blending 1 kg of Knelson tailings and grinding to a target P_{80} of 50 µm or 180 µm. The entire ground slurry was then forwarded for carbon-in-pulp (CIP) testing. Table 10-44 shows the obtained results, which yielded similar gold recovery to the 1 kg CIL bottle roll tests; however, a slight increase in residual gold grade may be evident in the CIP tests. The geotechnical characteristics of these leach residues are discussed in Section 10.5.16.7.

Table 10-44: 10kg Bulk results from Phase 11
(2021 PFS)

Rock type	Target leach P_{80} (µm)	Au grade (Au g/mt)	Au leach recovery (%)
RT4O	50	0.32	73.7%
	180	0.32	64.6%
RT5O	50	0.49	53.3%
	180	0.49	49.2%
RT9S	50	0.63	47.7%
	180	0.63	40.1%

Important conclusions that can be drawn from the Phase 11 test program include:

- The good results obtained with the gravity testwork confirm the gravity circuit performance and demonstrate the need for a robust gravity circuit;
- Depending on the rock type, gold recovery is slightly related to the location either inside or outside the 100 ppm antimony shell.

10.5.16 2021 PFS – Phase 12

The Phase 12 was completed by SGS Vancouver on 100 kg composites prepared from split core from each of the five major rock types. Two new composites with higher antimony concentration were added during this phase. The objectives were the same as Phase 11:

- To assess whether gold recovery is dependent upon orebody location in relation to the 100 ppm antimony shell;
- To improve the understanding of the gold grade/recovery and grind size/recovery relationships.

The main differences were that Phase 12 was completed on core samples rather than RC rig duplicates and the availability of core allowed for a more specific selection of sample location and grade distribution. The samples were based on rock type, gold concentration, antimony concentration and location with respect to the antimony 100 ppm shell. The samples were composited to achieve three targeted grades, same as described in Section 10.5.15 and were processed as shown in Figure 10-36 from this same section. Table 10-45 presents some characteristics of the composites.

Table 10-45: Composites characteristics
(2021 PFS – Phase 12)

Sample ID	Drill assay head grade (Au g/mt)	Arsenic concentration (As ppm)	Antimony concentration (Sb ppm)
CRT4O-1	0.61	3 682	37
CRT4O-3	2.46	11	35
CRT5O-1	0.61	2 513	18
CRT5O-2	0.93	3 723	19
CRT5O-3	1.25	2 744	17
CRT6S-1	0.45	2 285	58
CRT6O-1	0.69	3 699	33
CRT6O-2	1.03	3 934	33
CRT6O-3	1.40	2 649	21
CRT7S-1	0.75	3 310	55
CRT7S-2	1.18	3 934	45
CRT7S-3	1.94	4 129	45
CRT7O-1	0.77	2 393	28
CRT7O-2	1.19	2 302	25
CRT7O-3	1.60	3 503	38
CRT9S-1	0.83	5 831	60
CRT9S-2	1.17	6 672	67
CRT9S-3	2.03	8 484	61
CRT9O-1	0.84	6 231	44
CRT9O-2	1.21	6 743	42
CRT9O-3	1.60	4 729	35
CRT6 300	0.84	4 859	51
CRT6 Kin300	1.20	12 001	71

10.5.16.1 Phase 12 – Gravity / Intensive Leach Testwork

Phase 12 gravity testwork was performed at a grind of 250 µm (P_{80}). The results obtained from the two-stage gravity test are presented in the Table 10-46. Phase 12 confirmed the robust gravity recovery of Phases 9b and 11. As shown in Figure 10-40, gravity recovery increased as a function of head grade for all rock types. This may be explained by the larger spread in grades tested.

Table 10-46: Gravity separation results
(2021 PFS – Phase 12)

Composite Name	Calculated head (Au g/mt)	1st pass grav. recovery (%)	2nd pass grav. recovery (%)	Total gravity recovery (%)	Gravity tail (Au g/mt)
CRT4O-1	0.76	34.7	4.0	38.7	0.47
CRT4O-3	3.20	38.8	5.7	44.5	1.78
CRT5O-1	0.77	46.8	2.6	49.4	0.39
CRT5O-2	0.99	40.7	4.9	45.6	0.54
CRT5O-3	1.38	54.7	4.0	58.7	0.57
CRT6S-1	0.49	25.6	4.6	30.2	0.34
CRT6O-1	0.76	31.3	13.3	44.6	0.34
CRT6O-2	1.03	42.2	5.5	47.7	0.54
CRT6O-3	2.70	74.6	3.2	77.8	0.60
CRT7S-1	0.78	25.3	11.7	37.0	0.49
CRT7S-2	1.06	42.0	5.6	47.6	0.56
CRT7S-3	2.36	60.0	5.3	65.3	0.82
CRT7O-1	0.90	38.7	8.2	46.9	0.48
CRT7O-2	0.82	37.4	7.7	45.1	0.45
CRT7O-3	1.55	58.0	5.3	63.3	0.57
CRT9S-1	0.98	17.2	1.5	18.7	0.80
CRT9S-2	1.11	15.1	1.9	17.0	0.92
CRT9S-3	2.25	42.9	4.3	47.2	1.19
CRT9O-1	1.03	25.0	2.6	27.6	0.75
CRT9O-2	1.44	27.7	2.8	30.5	1.00
CRT9O-3	2.03	45.0	2.4	47.4	1.07
CRT6 300	0.67	18.6	5.0	23.6	0.52
CRT6 Kin300	0.89	23.5	4.3	27.8	0.65

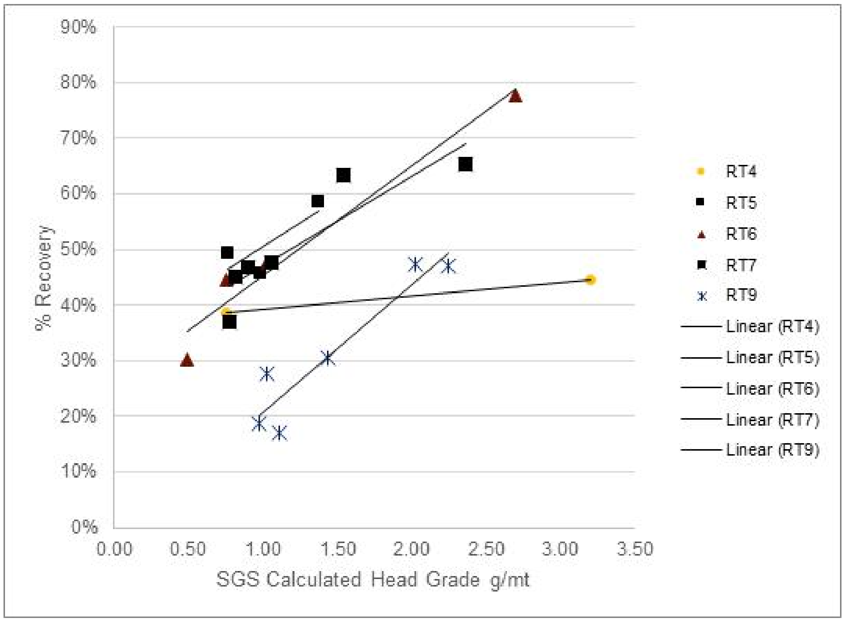


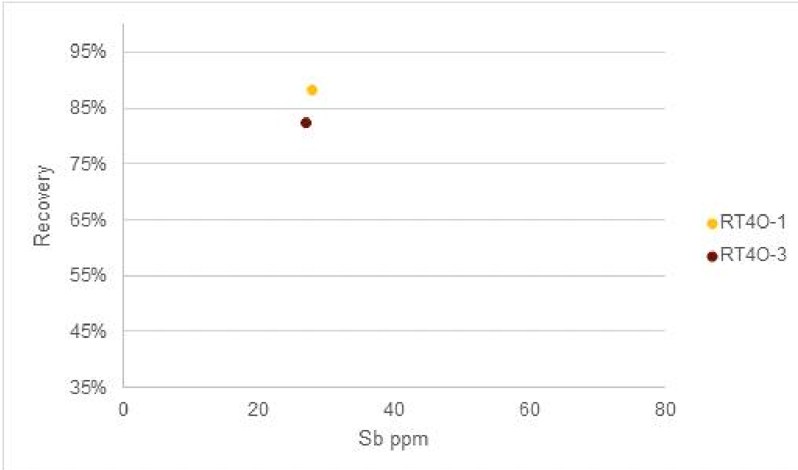
Figure 10-40: Gravity recovery vs calculated head by rock type
(2021 PFS – Phase 12)

The 1st pass Knelson concentrate and the 2nd pass Knelson concentrate were forwarded separately for intensive leach cyanidation. High gold recoveries exceeding 70% to 99.6% were achieved by the 1st pass concentrates and gold recoveries of 36% to 97% were achieved by the 2nd pass concentrates.

10.5.16.2 Phase 12 – CIL Tests on Knelson Tailing Leach Testwork and Overall Recovery

A total of 665 bottle roll tests on the 23 variability samples were conducted to determine the extractable gold from the Knelson tailing as a function of grind size. For each variability sample, ten replicate bottle roll tests were performed at three different grind sizes, 250, 180 and 50 µm (P_{80}).

Figure 10-41 presents the overall recovery related to the antimony concentration. The results show that, if related to only one parameter, recoveries seem to be not dependent on the sample location being inside or outside the 100 ppm antimony shell. RT4 and RT5 did not have composites from within the antimony shell. However, a statistical analysis that is discussed in Section 10.6.2, demonstrated in a 3D model that gold recoveries appear to be slightly dependent on the sample location being inside or outside the 100 ppm antimony shell when they are related to grind size and head grades.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85%
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65%
55%
45%
35%
Recovery
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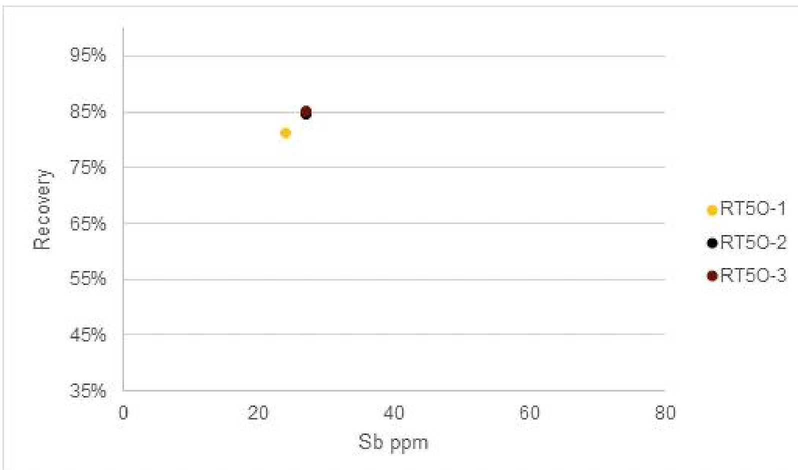
80
Sb ppm
RT4O-1
RT4O-3


95%
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35%
Recovery
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20
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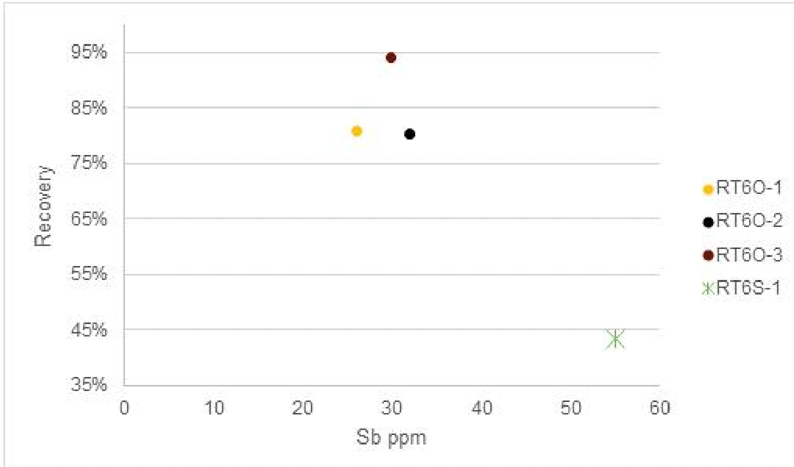
60
80
Sb ppm
RT5O-1
RT5O-2
RT5O-3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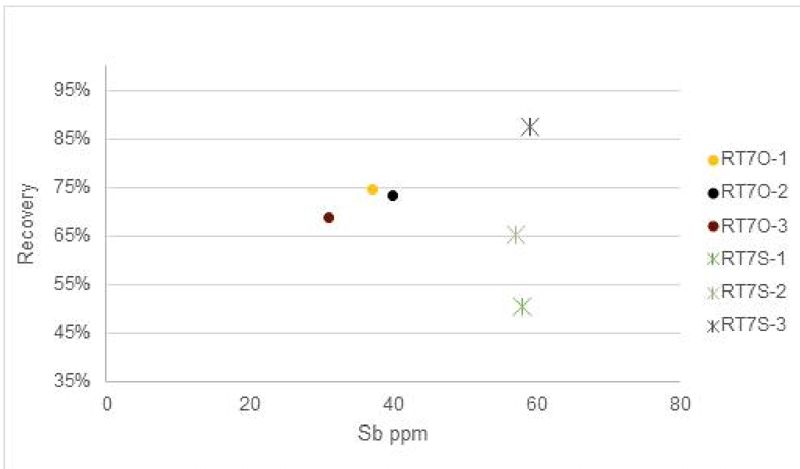
RT6O-3
RT6S-1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Recovery
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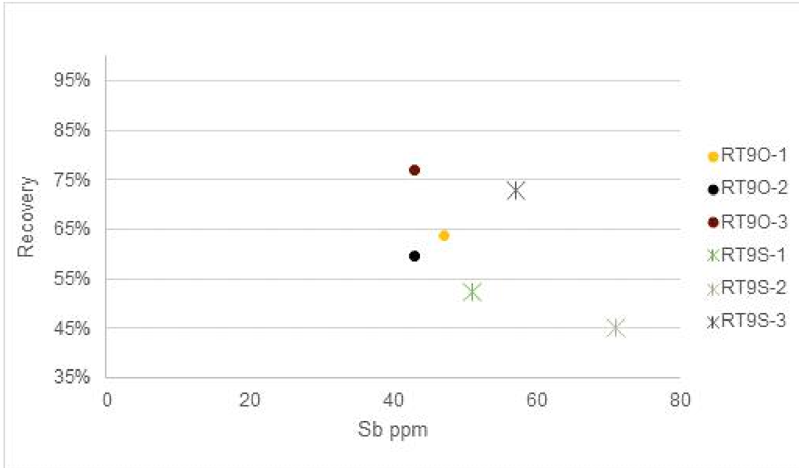
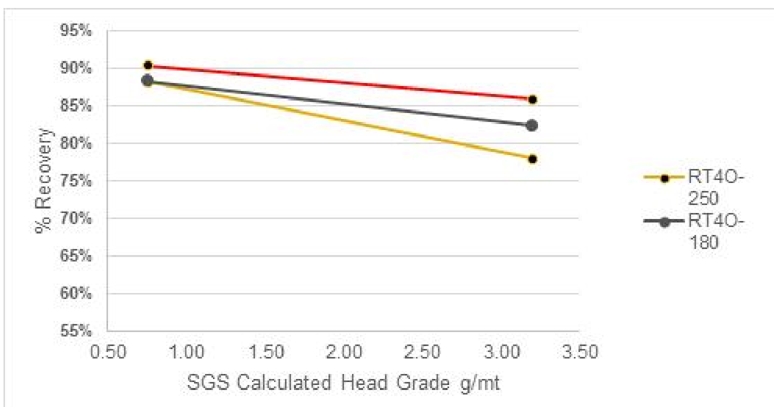
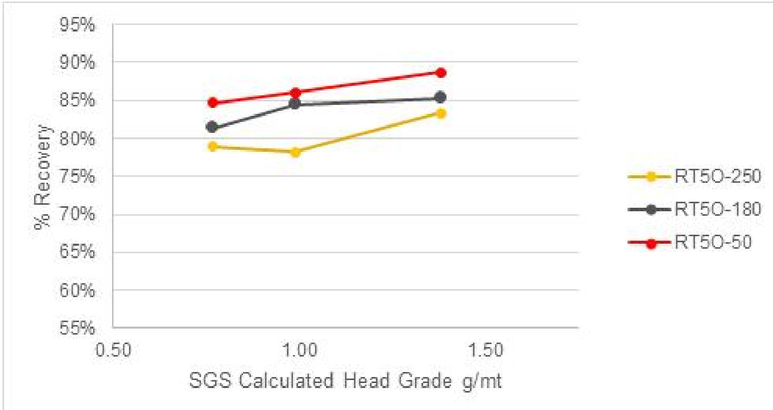
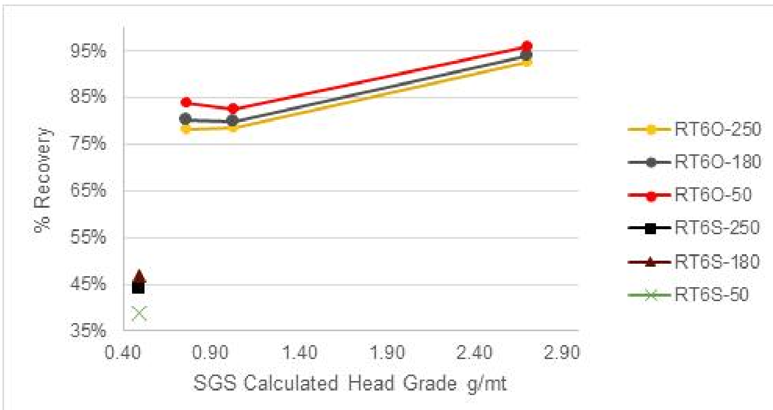


Figure 10-41: Overall gold recovery according to location inside or outside the 100 ppm Sb shell
(2021 PFS – Phase 12)

Figure 10-42 shows that RT5O, RT6(O&S), RT7S and RT9(O&S) revealed a positive gold recovery according to calculated head grade relationship, while RT4O and RT7O revealed a negative relationship.




95%
90%
85%
80%
75%
70%
65%
60%
55%
% Recovery
0.50
1.00
1.50
SGS Calculated Head Grade g/mt
RT5O-250
RT5O-180
RT5O-50


95%
85%
75%
65%
55%
45%
35%
% Recovery
0.40
0.90
1.40
1.90
2.40
2.90
SGS Calculated Head Grade g/mt
RT6O-250
RT6O-180
RT6O-50
RT6S-250
RT6S-180
RT6S-50

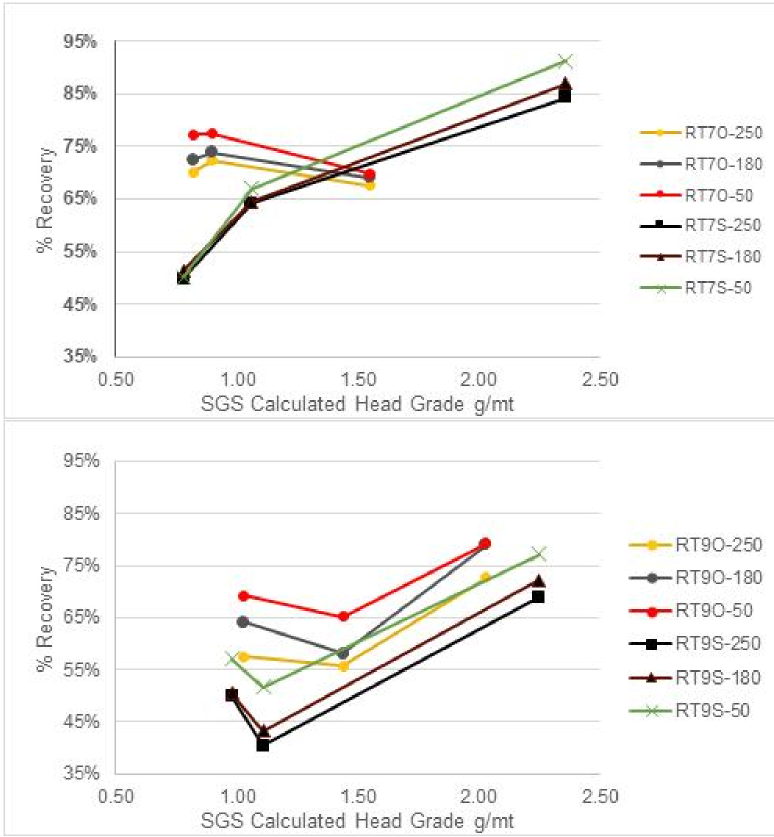


Figure 10-42: Overall gold recovery according to calculated head grade
(2021 PFS – Phase 12

10.5.16.3 Phase 12 – Solid-Liquid Separation

Solid-liquid separation and geotechnical testing was conducted by SGS Canada, Burnaby laboratory on all five rock types at three grind sizes, 50 µm, 180 µm and 250 µm (P_{80}). A total of 15 charges were prepared representing five composites in triplicate to perform flocculant scoping, static and dynamic thickening, underflow rheology, pressure filtration and geotechnical testing. The objective was to obtain the solid-liquid separation and pressure filtration data from different grind sizes necessary to evaluate the trade-off between thickener/slurry tailings and thickener/pressure filtration/dry stack tailings. This trade-off was part of the Whittle optimization study and is discussed in Section 10.7.2.1 while the geotechnical results are discussed in Section 10.5.16.7.

10.5.16.4 Phase 12 – Impact of Lead Nitrate on Gold Recovery

A total of 80 cyanide bottle roll leach tests on Knelson tailings were performed to evaluate the impact of lead nitrate and cyanide concentrations in the CIL circuit on overall gold recovery of the five rock types at a grind size of 180 µm (P_{80}), at resource average grade and based on the source location, i.e., outside or inside the Sb 100 ppm shell.

The results shown in Table 10-47 confirmed earlier testwork which indicated that the overall gold recovery does not appear to be highly sensitive to either lead nitrate (0-200 ppm) or cyanide (0.4-0.8 kg/t) concentrations. These data were used to support the Whittle optimization study that is discussed in Section 10.7.2.1.

Table 10-47: Average CIL testwork results
(2021 PFS – Phase 12)

Sample ID	Lead nitrate conc. (g/mt)	NaCN dosage (kg/mt)	NaCN cons. (kg/mt)	CaO cons. (kg/mt)	Au residue grade (Au g/mt)	Au calc. head (Au g/mt)	Au recovery (%)
CRT4O	0	0.80	0.20	1.82	0.08	0.44	79.9
CRT4O	50	0.60	0.32	1.85	0.08	0.43	80.7
CRT5O	0	0.80	0.21	0.77	0.13	0.36	59.8
CRT5O	100	0.60	0.17	0.81	0.14	0.38	60.8
CRT6O	0 - 50	0.60 – 0.80	0.18	0.89	0.20	0.48	59.1
CRT6O	100	0.40	0.15	0.94	0.20	0.51	61.3
CRT6S	0 - 50	0.60 – 0.80	0.20	0.53	0.25	0.32	23.6
CRT6S	100	0.40	0.18	0.58	0.26	0.34	24.9
CRT7O	0 - 100	0.60 – 0.80	0.19	0.85	0.21	0.43	50.7
CRT7O	200	0.40	0.19	1.17	0.47	0.54	12.8
CRT7S	0 - 100	0.60 – 0.80	0.22	0.88	0.39	0.47	18.3
CRT7S	200	0.40	0.15	0.81	0.33	0.80	59.1
CRT9O	0 - 100	0.60 – 0.80	0.20	0.73	0.38	0.71	45.9
CRT9O	200	0.40	0.16	1.16	0.63	1.02	38.6
CRT9S	0 - 100	0.60 – 0.80	0.21	1.16	0.47	0.77	39.6
CRT9S	200	0.40	0.17	1.18	0.62	0.94	34.0

10.5.16.5 Phase 12 – Flotation Testwork

Flotation concentrates were prepared from unprocessed gravity tails for two rock types, RT7 and RT9, that had previously been ground to 250 µm (P_{80}). These gravity tails were reground to a grind size of 90 µm (P_{80}) and processed through five stages of flotation using optimal flotation condition from Phases 8 and 8b. The concentrates were then reground to 9 µm prior to be split into four equal parts. One part was processed by CIL, one part by hot alkaline leach (HAL), one by pressure oxidation (POX) and the last one was preserved.

The results from five stages of flotation presented in Table 10-48 shows that 20% to 25% mass pull can be achieved and that 88% to 91% of the gold contained in the gravity tailings reported to the flotation concentrate.

Table 10-48: Flotation testwork results
(2021 PFS – Phase 12)

Sample ID	Calculated head (Au g/mt)	Mass pull (%)	Au from gravity tails into concentrate (%)	Concentrate grade (Au g/mt)	Flotation tails grade (Au g/mt)
RT7S-1	0.38	22	90	1.56	0.05
RT7S-2	0.43	21	91	1.88	0.05
RT9S-1	0.75	25	88	2.67	0.12
RT9S-2	0.88	20	88	3.87	0.13

The results presented in Table 10-49 show that ultra-fine grinding (UFG) followed by CIL recovered 38% to 49% of the gold from the flotation concentrate, while UFG followed by POX recovered 86% to 92% and UFG followed by HAL recovered 39% to 72%.

Table 10-49: Flotation concentrate leach results
(2021 PFS – Phase 12)

Sample ID	NaCN add'n (kg/mt)	NaCN cons. (kg/mt)	CaO add'n (kg/mt)	CaO cons. (kg/mt)	S^{2-} residue grade (%)	Au residue grade (g/mt)	Au calc. Head (g/mt)	Au recovery – carbon adsorption (%)	Au recovery – leached from residue (%)
RT7S-1-CIL-UFG	1.18	0.95	1.0	1.0	5.8	1.00	1.63	37.6	38.6
RT7S-1-CIL-POX	1.09	0.74	7.4	7.4	0.2	0.16	1.95	90.9	91.6
RT7S-1-CIL-HAL	1.08	0.71	0.8	0.8	3.3	0.72	1.18	37.5	38.7
RT7S-2-CIL-UFG	1.31	1.07	1.3	1.3	5.3	1.11	1.92	42.0	42.4
RT7S-2-CIL-POX	1.04	0.57	3.4	3.3	0.7	0.18	2.60	92.3	92.9
RT7S-2-CIL-HAL	1.02	1.02	0.7	0.7	2.6	0.40	1.18	58.1	65.8
RT9S-1-CIL-UFG	1.10	1.05	1.3	1.3	11.9	1.27	2.52	49.4	49.7
RT9S-1-CIL-POX	1.48	1.25	21.9	21.9	1.9	0.32	2.39	85.7	86.8
RT9S-1-CIL-HAL	1.46	1.20	2.3	2.3	10.4	0.72	2.60	71.8	72.3
RT9S-2-CIL-UFG	1.28	1.23	1.4	1.4	14.9	2.10	3.40	38.0	38.2
RT9S-2-CIL-POX	2.10	1.77	43.0	42.7	1.0	0.28	3.70	92.0	92.3
RT9S-2-CIL-HAL	1.33	1.11	2.7	2.7	13.6	1.66	3.74	55.2	55.6

Table 10-50 shows overall recoveries when the flotation concentrate is reground, then POX/CIL on the reground concentrates and CIL on the flotation tails compared to the same flowsheet without POX. The results show that an average increase of 32% can be achieved on the overall recovery when using POX.

Table 10-50: Overall recovery comparison when using POX
(2021 PFS – Phase 12)

Sample ID	Gravity/Flotation/UFG/POX/CIL + CIL float tails overall recovery (%)	Gravity/Flotation/UFG/CIL + CIL float tails overall recovery (%)	Difference (%)
RT7S-1	89.9	58.0	31.9
RT7S-2	92.8	65.4	27.4
RT9S-1	87.7	59.7	28.0
RT9S-2	88.7	46.9	41.8
Average			**32.3**

10.5.16.6 Phase 12 – Enhanced Gravity and POX/CIL Testwork

Enhanced gravity concentrates were prepared from Phase 12 unprocessed gravity tails for two rock types, RT7 and RT9, that had previously been ground to 250 µm (P_{80}), processed twice through a Knelson gravity concentrator, split into 1 kg aliquots, processed through CIL leach and pulverized to pass a 105-micron screen for metallic screen assay of the CIL residues. These residues were processed four times through a Knelson concentrator to obtain a 5% mass pull. This concentrate was then ground at a grind size of 9 µm (P_{80}) and then POX/CIL leached.

Table 10-51 presents the obtain results. These enhanced gravities and POX/CIL recoveries resulted in overall recoveries varying between 66% to 86% representing an increase of 24% compared to the previous Phase 12 recoveries presented in Section 10.5.16.2.

Table 10-51: Enhanced gravity followed by POX/CIL results
(2021 PFS – Phase 12)

Sample ID	Calculated head grade (Au g/mt)	Mass pull (%)	Au from gravity tails into concentrate (%)	Concentrate grade (Au g/mt)	Four pass gravity tails (Au g/mt)	POX recovery (%)
RT7S-1	0.44	4.1	45.7	4.92	0.25	87.9
RT7S-2	0.41	4.1	44.3	4.43	0.24	91.5
RT9S-1	0.49	5.3	43.6	3.98	0.29	92.8
RT9S-2	0.63	5.6	35.4	4.00	0.43	98.3

10.5.16.7 Phase 12 – Geotechnical Testwork

Geotechnical testing was conducted by SGS Canada, Burnaby laboratory and by Knight Piésold, Denver, Colorado laboratory on all five rock types at two grind sizes, 50 µm and 250 µm (P_{80}). Testing included particle size analysis, Atterberg limits, laboratory compaction (Proctor), strength (consolidated-undrained triaxial compression), and permeability on a total of 10 samples. The objective was to obtain data from different grind sizes necessary to evaluate the trade-off between thickener/slurry tailings and filtration/dry stack tailings. This trade-off was part of the Whittle optimization study and is discussed in Section 10.7.2.1. Table 10-52 and Table 10-53 present the results of the testing completed.

Index and strength testing show that material properties change with grind size. The finer grind (50 µm) results in tailings with a lower sand content and a higher clay content, as expected. This difference in particle size results in tailings material that achieves a lower compacted density and a slightly lower effective stress. When evaluating the dry stack tailings facility alternative, it was determined that the coarser grind tailings (250 µm) provided a better product for compaction, stability and overall capacity efficiency.

Table 10-52: Index and Strength testing results (all samples)

SAMPLE INFORMATION			UNIFIED SOILS CLASSIFICATION (USCS)	Description	GRADATION (%)					ATTERBERG LIMITS			STANDARD PROCTOR		CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION (CU w/ Pore Pressure)						
Sample ID	Rock Type	Grind (Microns)			Gravel (>#4)	Sand (<#4 & >#200)	Silt & Clay (<#200)	Hydrometer - Silt (<#200 & >0.002mm)	Hydrometer - Clay (<0.002mm)	Liquid Limit	Plastic Limit	Plasticity Index	Maximum Dry Density (pcf)	Optimum Moisture Content (%)	Remolded Dry Unit Weight (pcf)	Remolded Moisture Content (%)	% Compaction	Effective Stress Phi (ϕ)	Effective Stress Cohesion (psi)	Total Stress Phi (ϕ)	Total Stress Cohesion (psi)
RT4O-50-Bulk 28h Barren Pulp	4	50	CL	lean clay	0	14.1	85.9	73.0	12.9	26	18	8	113.0	16.0	103.2	19.8	91.4	33.3	0.0	15.7	6.3
RT5O-50-Bulk 28h Barren Pulp	5	50	CL	lean clay	0	6.0	94.0	77.3	16.7	25	17	8	112.1	16.7	103.3	19.7	92.2	31.9	1.5	20.9	0.1
RT6SO-50-Bulk 28h Barren Pulp	6	50	CL-ML	silty clay	0	5.7	94.3	79.5	14.8	22	18	4	113.6	16.0	104.1	18.7	91.6	31.5	1.9	20.1	2.4
RT7SO-50-Bulk 28h Barren Pulp	7	50	CL-ML	silty clay	0	5.0	95.0	80.0	15.0	24	17	7	113.0	16.3	103.9	20.2	91.9	33.2	1.2	16.4	5.8
RT9SO-50-Bulk 28h Barren Pulp	9	50	ML	silt	0	6.2	93.8	81.0	12.8	23	21	2	115.1	15.5	105.8	19.1	92.0	33.5	0.4	20.2	3.3
RT4O-250-Bulk 28h Pulp	4	250	SC-SM	silty, clayey sand	0	52.0	48.0	38.3	9.7	21	15	6	124.9	12.0	114.5	15.2	91.7	35.6	0.6	18.2	1.6
RT5O-250-Bulk 28h Pulp	5	250	SM	silty sand	0	51.3	48.7	38.8	9.9	NLL	NPL	NP	123.0	12.4	113.1	15.8	91.9	35.1	0.6	19.5	3.6
RT6SO-250-Bulk 28h Pulp	6	250	SM	silty sand	0	54.5	45.5	35.9	9.6	17	14	3	123.3	11.5	112.6	14.8	91.4	35.6	0.7	15.2	2.6
RT7SO-250-Bulk 28h Pulp	7	250	SM	silty sand	0	55.7	44.3	35.6	8.7	NLL	NPL	NP	126.1	11.0	115.2	13.9	91.4	36.9	0.0	13.0	6.4
RT9SO-250-Bulk 28h Pulp	9	250	SM	silty sand	0	59.6	40.4	33.8	6.6	NLL	NPL	NP	125.2	11.0	115.5	13.6	92.3	34.8	0.6	15.0	3.2

Table 10-53: **Permeability testing (select samples)**

SAMPLE INFORMATION	UNIFIED SOILS CLASSIFICATION (USCS)	Description	HYDRAULIC CONDUCTIVITY - FLEX WALL														
Sample ID			Confining Pressure (psi)	Remolded Dry Unit Weight (pcf)	Remolded Moisture Content (%)	% Compaction	Hydraulic Conductivity (cm/s)	Confining Pressure (psi)	Remolded Dry Unit Weight (pcf)	Remolded Moisture Content (%)	% Compaction	Hydraulic Conductivity (cm/s)	Confining Pressure (psi)	Remolded Dry Unit Weight (pcf)	Remolded Moisture Content (%)	% Compaction	Hydraulic Conductivity (cm/s)
RT5O-50-Bulk 28h Barren Pulp	CL	lean clay	25	103.1	19.7	92.0	7.0E-07	50	102.8	19.7	91.7	5.2E-07	100	103.9	19.7	92.7	3.9E-07
RT7SO-50-Bulk 28h Barren Pulp	CL-ML	silty clay	25	104.1	20.3	92.1	8.6E-07	50	104.1	20.3	92.1	6.8E-07	100	103.5	20.1	91.6	5.3E-07
RT5O-250-Bulk 28h Pulp	SM	silty sand	25	112.6	15.8	91.6	9.3E-07	50	113.1	15.8	92.0	4.7E-07	100	113.5	15.8	92.3	3.2E-07
RT7SO-250-Bulk 28h Pulp	SM	silty sand	25	115.5	13.9	91.6	3.5E-06	50	115.7	13.9	91.7	3.0E-06	100	114.5	13.9	90.8	1.2E-06

Hydraulic conductivity (permeability) testing was performed on two rock types (RT5 and RT7) at the two grinds (50 µm and 250 µm) to determine if grind size effected the permeability characteristics of the samples. It was determined that when the samples were compacted to similar criteria (3% over optimum moisture and 92% compaction) there was minimal difference. Therefore, it was determined that when considering seepage and draindown of the dry stack tailings, grind size was not a critical factor.

Important conclusions that can be drawn from the Phase 12 test program include:

- The good results obtained with the gravity testwork confirm the gravity circuit performance and demonstrate the need for a robust gravity circuit;
- Coarsening the grind to 250 µm (P_{80}) results in gold recovery losses between 1% and 7% depending on the rock type and head grades. However, similar to the results of Phases 9b and 11, these results do not show any inflection point between 250 and 180 µm, which can suggest that there is an opportunity to conduct testwork on coarser sizes in the future;
- Depending on the rock type, gold recovery is slightly related to the location either inside or outside the 100 ppm antimony shell;
- Overall gold recovery does not appear to be highly sensitive to either lead nitrate (0-200 ppm) or cyanide (0.4-0.8 kg/t) concentrations;
- The good results obtained with the POX and enhance gravity testwork demonstrate that there is an opportunity to increase recovery. However, the Whittle optimization work did not demonstrate this would add value. Additional enhanced gravity testwork could be conducted.

10.5.17 2021 PFS – Phase 13

The Phase 13 was conducted by SGS Vancouver on approximately 100 kg composites (a total of 1,940 kg), prepared from a blend of core and RC rig duplicates. The objective was to obtain overall gold recovery data from all five rock types at antimony concentrations of approximately 250, 750, and +1,000 ppm. Figure 10-43 illustrates the testwork that was conducted.

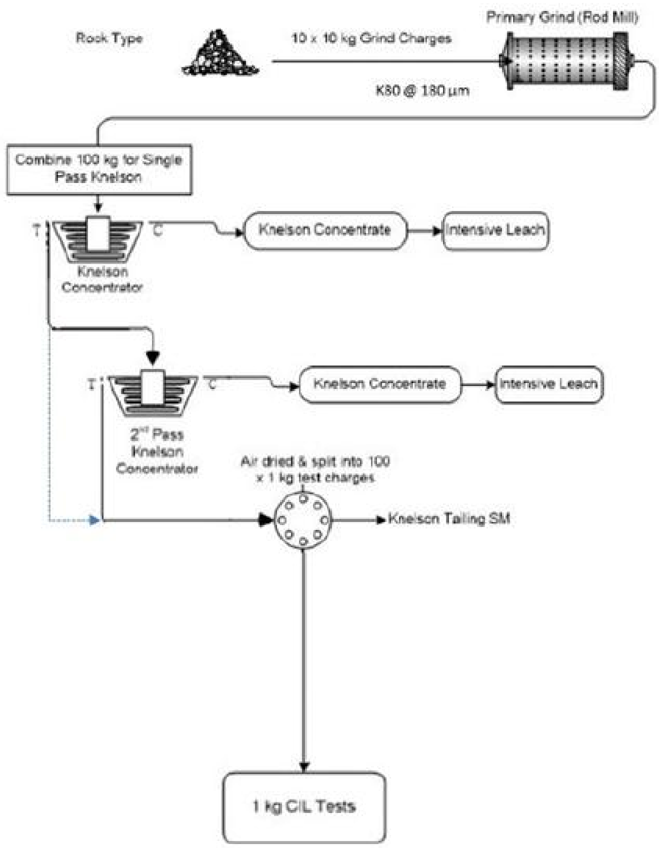


Figure 10-43: 2021 PFS (Phase 13) testwork outline

Figure 10-44 shows that composites having an antimony grade above 200 ppm, regardless of whether they are in or out of the 100 ppm antimony shell, achieved an overall recovery as shown by the linear equation presenting on the chart.

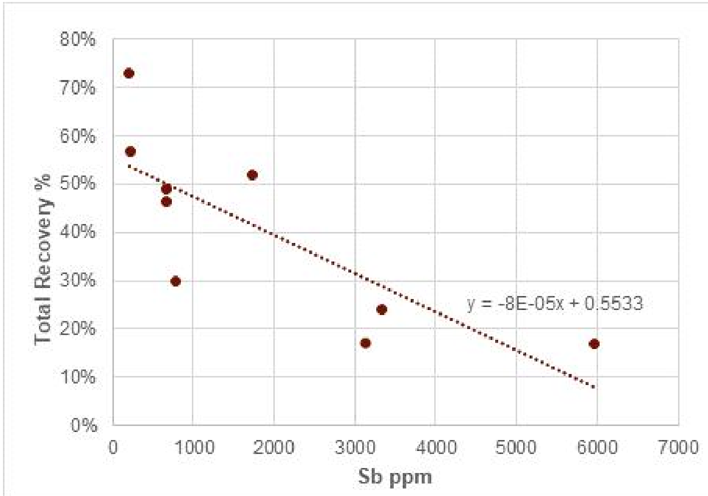


Figure 10-44: Overall recovery related to the antimony concentration
(2021 PFS – Phase 13)

As explained in Chapter 15, massive stibnite will not be separated from the host country rock during mining. An average recovery for the diluted massive stibnite tonnage was estimated based on the 2013 feasibility study stibnite recovery results as shown in Table 10-54. The results presented in Figure 10-44 support the equations that are discussed in Section 10.6.2, which will be applied if antimony is above 200 ppm.

Table 10-54: Massive Stibnite shell recovery estimation

Sample	Au grade (g/mt)	Sb grade (ppm)	Estimated average recovery in massive stibnite shell (%)
Pure massive stibnite	8.07	18,000	22
Country rock	0.90	4,000	

10.6 Recovery Equations

10.6.1 2017 PFS Recovery Equations – Grind Sizes of 90 µm and 180 µm

Recovery equations were developed using the results of the optimization, variability, continuous, and Phase 9 and Phase 10 test programs.

Table 10-55 presents the average recovery estimated for each of the five rock types within the Livengood gold deposit. With the exception of RT9, the gold recovery results include a 2% reduction for coarser grind at 180 µm (P_{80})

Table 10-55: Average gold recovery estimated for each rock type

Rock type	Au Recovery (%)
RT4	78.4
RT5	84.5
RT6	76.3
RT7	62.0(1)
RT9	69.2(2)

(1) Weighted average based on recovery correlation to quartz – stibnite + jamesonite

(2) Weighted average based on grade/frequency distribution of the 15 × 15 ×10 meter block model.

The data from all of the testwork programs was analyzed using several criteria to discard possible testwork with less-than ideal or erroneous conditions (i.e. tests with low DO or low CN level, wrong particle size, etc.). The filtered data (“qualified data”) of tests including all grind sizes was used to develop a recovery estimates for all rock types based on calculated head grade. For example, the optimization and Phase 9 results were averaged and each testwork program contributed one point to the data set. It was understood that this was the most appropriate treatment, especially considering that both optimization and Phase 9 testwork was conducted on a master composite of each rock type.

Rock Types: RT4, RT5 and RT6

The results from the entire body of testwork were analyzed with the objective of developing relationships to characterize the gold leaching performance of rock types RT4, RT5 and RT6. It was not possible to develop a gold grade vs gold recovery model(s), based on the available data for these rock types.

An average gold recovery for each rock type was estimated from the results of the different testwork programs. A 2% recovery reduction was applied when converting leach test results from 90 to 180 µm (F_{80}).

The cyanide and lime consumptions were estimated as an average of the reagent consumptions observed from both the continuous and Phase 9 testwork programs. Variability or optimization results were not used, because when comparing testwork results, it was found that the higher cyanide additions did not improve the gold recovery results.

Rock Types: RT7 and RT9

Testwork results were analyzed to characterize the most important gold recovery drivers for the RT7 and RT9 rock types. A strong relationship between quartz - stibnite + jamesonite and grade was found for RT7, which is depicted in Figure 10-45. Stibnite and jamesonite are antimony-bearing minerals.

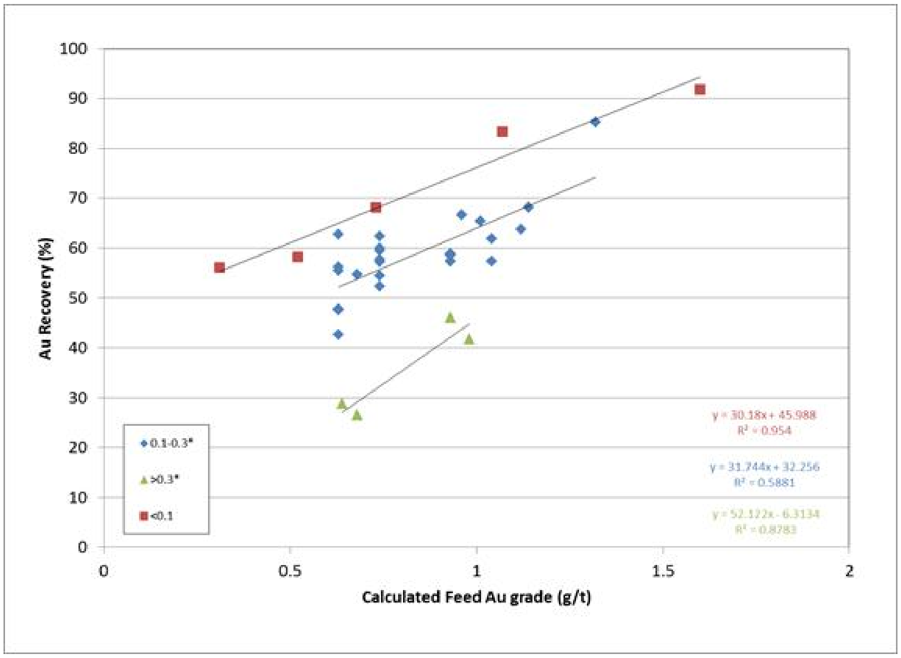


Figure 10-45: 2017 PFS (Phase 9) - RT7 gold recovery vs head grade at different Quartz-Stibnite+Jamesonite levels

The RT9 testwork results were examined using advanced statistical techniques (R/ggplot2 software) in a number of ways in an attempt to establish the most defensible relationship to estimate gold recovery.

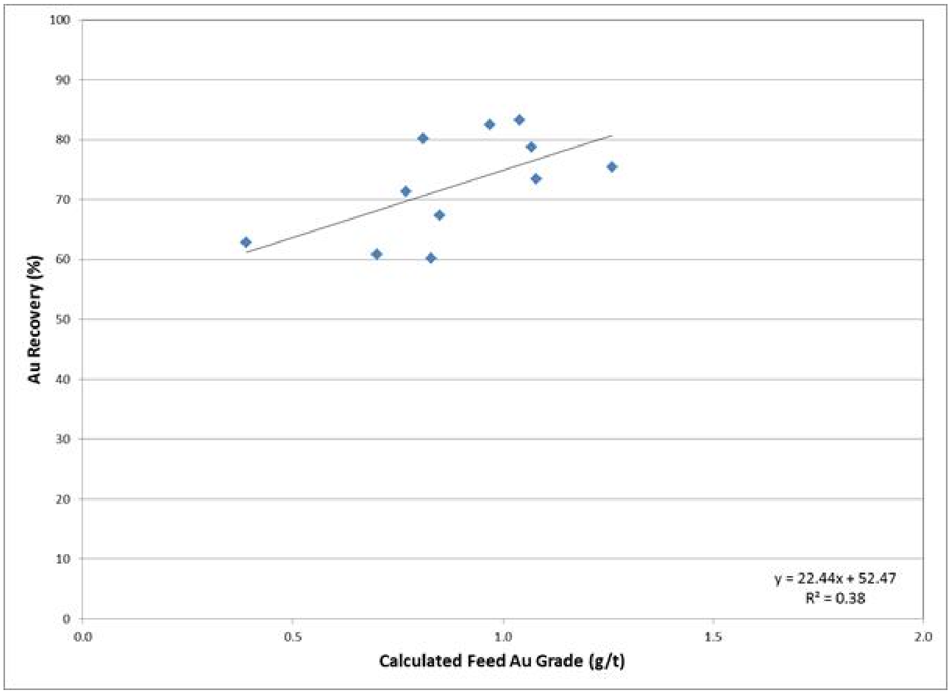


Figure 10-46:2017 PFS (Phase 9) - RT9 gold recovery vs head grade

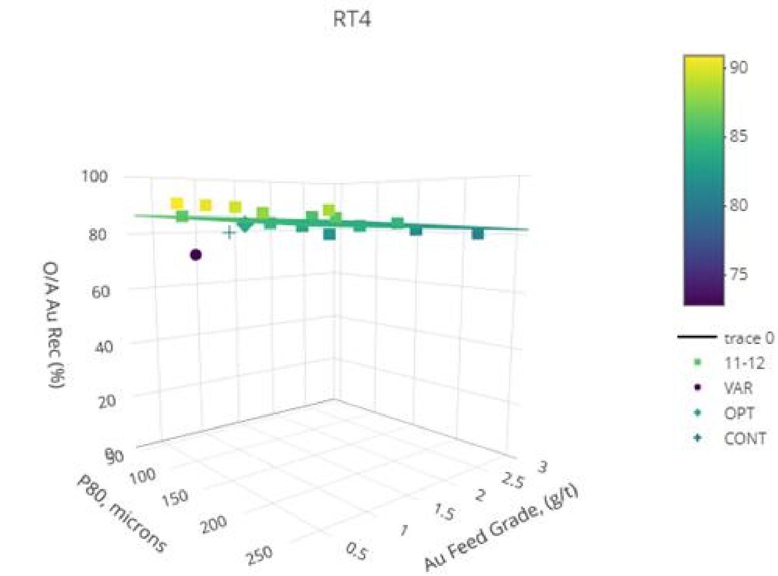
In the case of rock type RT9, a head grade/recovery relationship was found (Figure 10-46), but it is probable that there is a quartz - stibnite + jamesonite or antimony relationship as well. However, the current available data suggests that the quartz - stibnite + jamesonite index is under 0.1 and it is not possible to establish a strong relation showing any detrimental effect on gold leaching.

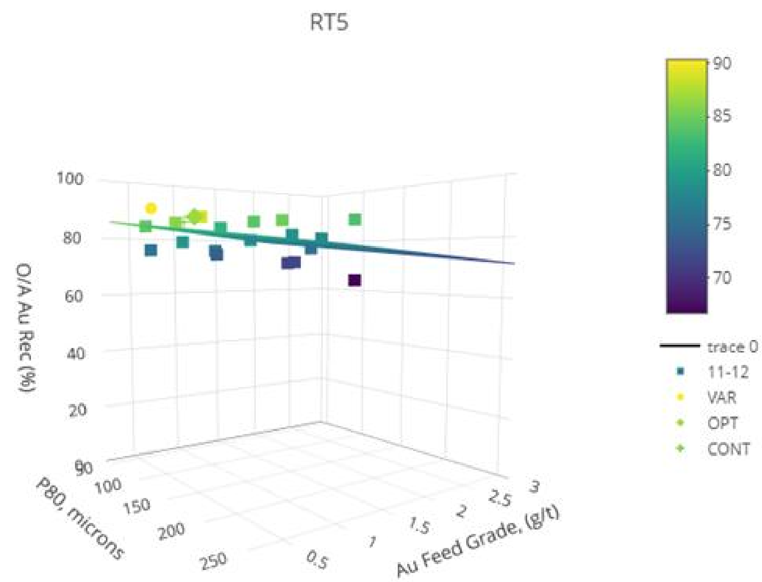
Given that the curve for rock type RT9 was developed using all qualified data, including grinds of between (P_{80}) 80 and 250 µm, it was decided not to apply a deduction in gold recovery to compensate for a coarser grind of product (P_{80} of 180 µm). For the other rock types, a 2.5% reduction was considered appropriate.

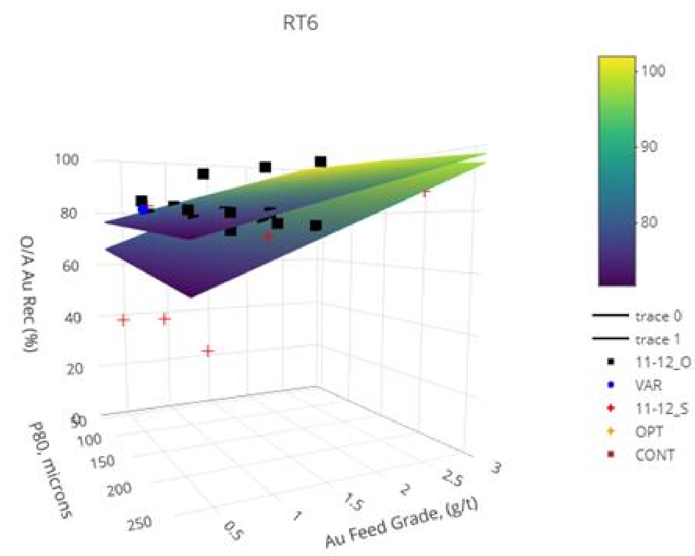
10.6.2 2021 PFS Recovery Equations – Grind Size of 50-250 µm

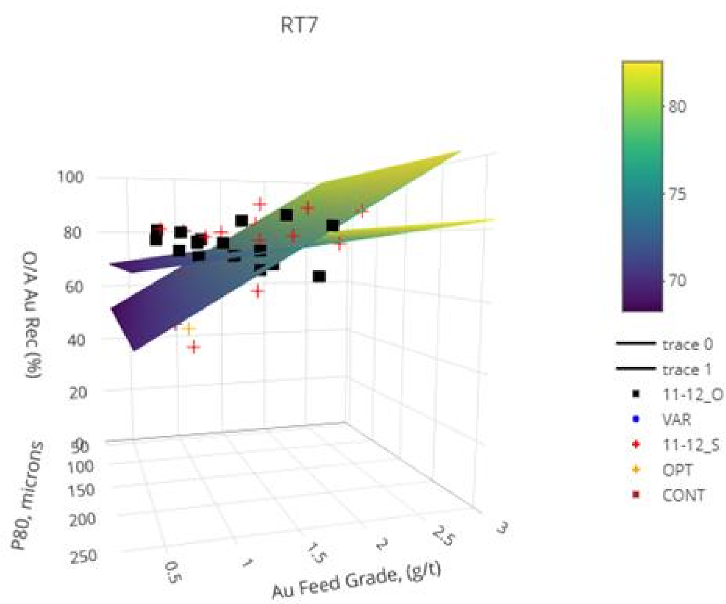
Subsequent to the 2017 PFS, a focused effort to better understand the implications of antimony concentrations in the orebody on gold recovery was performed. BBA constructed a Leapfrog geologic model with antimony shells at different antimony concentrations. The antimony shell of 100 ppm was selected to test a metallurgical recovery hypothesis based on approximately 25% of the orebody being within this shell. Phases 11 and 12 composites were selected based on the 100 ppm antimony shell location, being inside or outside, and tested for metallurgical recovery based on different grind sizes and gold grades. Phase 13 composites were selected to test the implication of high antimony at approximate levels of 250, 750, and +1,000 ppm on gold recovery and to develop a specific recovery equation, which is presented on Figure 10-44 and that will be applied to the proportion of the projected blocks that are massive stibnite.

The data collected during Phases 11, 12 and 13 were processed using R/RStudio to estimate linear recovery equations for each of the five rock types, both inside and outside the 100 ppm antimony shell, as a function of antimony concentration, grind sizes and gold grade as well as to develop 3D representations that are presented in Figure 10-47. These recovery equations were incorporated into the block model by the BBA mining team using a grind size of 250 µm (P_{80}) and were used for the Whittle optimization that is discussed in Section 10.7.2.1.The linear recovery equations are shown below and the methodology to apply these equations into the block model and the coefficient values are described in Section 12.3.2.


RT4
100
80
60
40
20
0
O/A Au Rec (%)
50
100
150
200
250
P80, microns
0.5
1
1.5
2
2.5
3
Au Feed Grade, (g/t)
90
85
80
75
trace 0
11-12
VAR
OPT
CONT


RT5
100
80
60
40
20
0
O/A Au Rec (%)
50
100
150
200
250
P80, microns
0.5
1
1.5
2
2.5
3
Au Feed Grade, (g/t)
90
85
80
75
70
trace 0
11-12
VAR
OPT
CONT


RT6
100
90
80
O/A Au Rec (%)
100
80
60
40
20
0
50
100
150
200
250
P80, microns
0.5
1
1.5
2
2.5
3
Au Feed Grade, (g/t)
trace 0
trace 1
11-12_O
VAR
11-12_S
OPT
CONT


RT7
80
75
70
O/A Au Rec (%)
100
80
60
40
20
0
50
100
150
200
250
P80, microns
0.5
1
1.5
2
2.5
3
Au Feed Grade, (g/t)
trace 0
trace 1
11-12_O
VAR
11-12_S
OPT
CONT

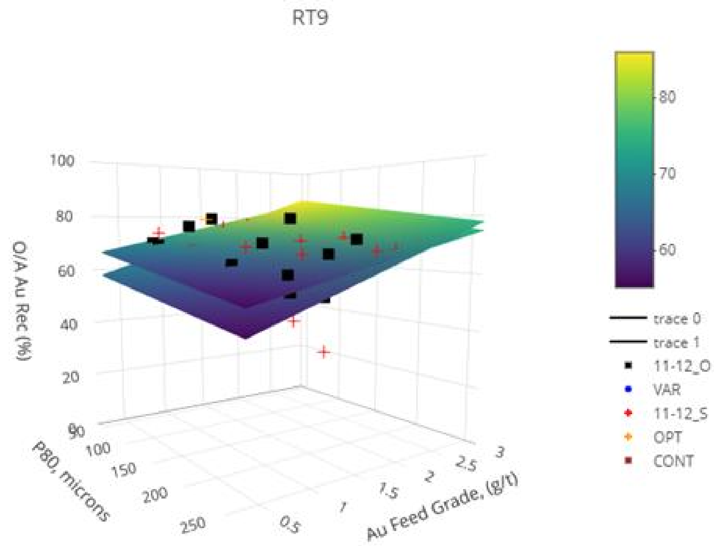


Figure 10-47: 3D representation of the overall Au recovery versus Au grade and P_{80} (2021 PFS)

Table 10-56 presents the average gold recoveries per rock type as well as the blended overall recovery when applying the 2021 PFS recovery equations at a grind size of 250 µm and the methodology described in Section 12.3.2 into the block model.

Table 10-56: Average gold recovery estimated for each rock type (2021 PFS)

Rock type	Au Recovery - Outside the 100 ppm antimony shell (%)	Au Recovery - Inside the 100 ppm antimony shell (%)	Au recovery - Antimony grade above 200 ppm (%)	Average Au recovery (%)
RT4	83.4	-	74.0	83.3
RT5	79.9	-	74.8	79.8
RT6	76.4	63.9	48.9	73.5
RT7	72.8	64.0	48.5	66.4
RT8	59.3	52.0	43.5	58.7
RT9	60.0	55.1	48.9	57.1
Tonnage weighted average mill recovery (%)	**75.1**	**60.4**	**50.1**	**71.4**

In summary, the models were developed for each rock type and location, being inside or outside the 100 ppm antimony shell, based on the results of the metallurgical testwork of Phases 11 and 12. A specific recovery equation was developed for the massive stibnite, higher than 200 ppm, based on the Phase 13 testwork results.

- The models indicate that the overall gold recovery is a function of gold head grade and grind size (P_{80});
- No equation was developed for RT4 and RT5 for the inside 100 ppm antimony shell since very little antimony is present in these zones;
- In general, for rock types with samples outside and inside of the 100 ppm antimony shell:
  - The difference in gold recovery between outside and inside the shell is bigger at lower Au head grades;
  - At higher Au head grades the Au recovery is in the same order for samples outside and inside the shell.

10.7 Flowsheet Development

10.7.1 2017 PFS Comparative Studies

10.7.1.1 Comminution Optimization with Drilling and Blasting (D&B)

Establishing Run-of-Mine (ROM) particle size distribution (PSD) estimates represents an important step for developing a baseline for mineral processing costs. Given that the drilling and blasting process is typically regarded as the first stage of comminution, its efficiency will directly impact the subsequent activities, namely crushing and grinding. To assess and quantify these impacts for the Project, various blast design scenarios were compiled and simulated for each ore-bearing geological domain, namely RT4 (Cambrian), RT5 and RT6 (Upper and Lower Seds), and RT9 (Volcanics).

The first step towards generating ROM PSD curve estimates consists of compiling all available geological and geo-mechanical parameters. These parameters were then imported into a break radius modeling software (AEGIS), which estimated the degree of breakage and area of influence of a typical blast hole charge. Based on the resultant break radii, preliminary burden and spacing values were then determined for each rock type and/or explosive charge.

After determining burden and spacing values, the remaining blast design and geo-mechanical parameters were compiled and integrated in a JKMRC Fragmentation (software) model. The software will use the inputs to generate PSD curves for the ROM material produced by various blast designs, in the different geological domains. This is referred to as a drill & blast (D&B) analysis.

The results of the D&B exercise were used in conjunction with comminution design software (Bruno and JKSimMet) to study the impact of the PSD on throughput and specific energy.

The impact of the D&B in the 2017 PFS was an increase of 6.4% in the average throughput of the Project from 49,468 to 52,630 t/d (or 44,877 to 47,745 mt/d).

Future work

With regards to the Volcanics domain, it must be noted that geo-mechanical test results were not available and were therefore assumed. To confirm the resulting ROM PSD values obtained for the Volcanics (RT9) domain, a re-iteration of the simulation work is recommended once geo-mechanical testing is completed.

10.7.1.2 Comminution Optimization with Pre-crushing

Simulations were conducted during the 2017 PFS to study the opportunities to increase throughput by adding a pre-crusher. The simulations indicate that a 25% to 30% increase in tonnage can be achieved by including a pre-crushing step.

10.7.1.3 Throughput Studies

The higher tonnage comminution circuit from the 2013 FS was challenged during the development of the 2017 PFS via an extensive throughput rationalization study. The 2017 PFS investigated the impact of grinding circuit configuration, ROM particle size, pre-crushing and target particle size would have on equipment size, power efficiency, overall throughput, OPEX and CAPEX. The scenarios that were investigated include the following:

- Pre crushing + single line SABC Circuit;
- Dual line pre crushing + SABC Circuit;
- SAG mill motor type (Twin Pinon versus wrap around);
- Grinding circuit product size target of 90 µm vs 180 µm;
- Impact of drill and blast (Finer ROM) on throughput.

Analysis of the leaching testwork conducted in parallel to the throughput studies, indicated that the gold recovery was relatively insensitive to grind in the range of 90 to 180 µm (P_{80}). Based on this observation, it was decided to coarsen the grind to 180 µm (P_{80}), which resulted in a significant throughput increase of 25%, which more than compensated for the gold losses of 2%.

Due to the significantly reduced capital cost and lower Project execution risk, a single line (SABC + pre-crushing) circuit was adopted for further development and use as the base case for the 2017 PFS even though its throughput capability would be lower than the circuit proposed by the 2013 FS study. The final configuration also assumes additional throughput by applying optimized drill and blast techniques to produce a finer ROM product for the primary crusher.

10.7.1.4 Leach Time, Lead Nitrate, and Pre-oxidation

Testwork evidence also indicates that the gold recovery kinetics slow down significantly after 21 hours of leaching time. The gain/loss in gold recovery (estimate = +/- 1% Au recovery) does not justify the addition of extra leaching tanks (21 to 32 hours represent an addition of 6 leach tanks).

Pre-oxidation was normalized to four hours in the course of completing Phases 8 and 9 testwork from the 2017 PFS and it showed that by combining lead nitrate and O_2 during the pre-conditioning stage, it was possible to reduce the leaching time and also reduce the cyanide consumption as a result of reducing leach time and by oxidizing any sulfides that could consume cyanide.

10.7.1.5 2017 PFS WOL vs Flotation

A trade-off study was conducted during the 2017 PFS between a whole gravity tails CIL configuration (WOL) and a flotation configuration (Flotation or FLOT), where gravity tails float concentrates undergo CIL.

The result of the trade-off study supported the decision to select gravity, followed by CIL of the gravity tailings as the design process.

Recovery – WOL vs Flotation

The summarized results of WOL and Flotation testing from both the FS and Phase 8 (2017 PFS) are presented in Table 10-57. At the bottom of the table the differences in recovery between the WOL and Flotation options are also presented. Due to different composites being used in the FS as compared to the Phase 8 testwork, the differences calculated for the Phase 8b and Phase 8d results were calculated not against the WOL recovery results from the FS, but against corresponding WOL results from the same samples of Phase 8 test program. Some results suggested slightly higher recoveries for the Flotation option, but generally, the WOL option resulted in a significantly higher recovery.

Table 10-57: Summary of recovery results from different testwork programs

Testwork Program	FS		Phase 8a	Phase 8b	Phase 8b	Phase 8d
Configuration	WOL	FLOT	WOL	FLOT	FLOT	FLOT
P_{80} (µm)	90	90	60/75	90	180	180
Rock types	**Au Recovery (%)**					
RT4	84.2	-	-	-	-	-
RT5	87.7	76.1	82	81	68	72.6
RT6	76.7	67.4	-	-	-	-
RT7	58.2	-	-	-	-	-
RT9	78.1	66.8	62	68	65	67.4
Rock types	**Au Recovery difference compared to WOL (%)**					
RT4	-	-	-	-	-	-
RT5	-	-11.6	-	-1	-14	-9.4
RT6	-	-9.3	-	-	-	-
RT7	-	-	-	-	-	-
RT9	-	-11.3	-	5	2	4.4

In the absence of consistent comparable between WOL and Flotation between the different composites, the decision was taken to assume a recovery difference (Flotation – WOL) for each rock type that was likely to be favorable to the Flotation option. In the case of rock types RT4, RT5, and RT6, a relative difference of -5% was assumed, which was generally less than what had been observed, at least for RT5 and RT6. In the case of RT7 and RT9, the recovery difference was assumed to be +5%, implying a higher recovery for the Flotation option as compared to the WOL option. These assumptions were developed as a means of evaluating the Flotation option in the best light for the purpose of conducting the trade-off (Table 10-58). If the WOL option delivered higher NPV than the Flotation option, even under these assumptions, it would validate the selection of the WOL flowsheet. Using these assumed recovery differences, weighted average recoveries were calculated for both options, with the results of 76 wt% avg. gold recovery for WOL and 74 wt% avg. gold recovery for flotation.

Table 10-58: Simulated gold recoveries for the WOL vs Flotation trade-off

Rock types	Relative difference	WOL	FLOT
RT4	-5%	78%	73%
RT5	-5%	85%	80%
RT6	-5%	76%	71%
RT7	5%	62%	67%
RT9	5%	69%	74%
Wt. Avg.		**76%**	**74%**

Capital Cost Estimate

The 2017 PFS crushing and grinding configuration produces a particle size (P_{80}) of 180 µm that is fed to each of the configurations (WOL or FLOT). Both process configurations are equipped with the same gravity circuit.

In the FLOT configuration, a flotation concentrate (12% mass pull) is produced and is fed to a CIL circuit that is substantially smaller than the CIL circuit in the WOL configuration. Additionally, the equipment required for cyanidation detoxification is smaller.

In the WOL configuration, a greater volume of slurry would need to go through thickening and detoxification prior to going to the tailings management facility (TMF). The cyanide detoxification tanks are smaller in the FLOT than WOL configurations due to the smaller volumetric flow of CIL tails in the FLOT configuration. On the other hand, the CN concentration in the FLOT configuration is higher than WOL, meaning that the unit requirements of SO_2 are higher in the Detox system of the FLOT configuration.

All equipment costs for the WOL and FLOT configurations were estimated using equipment cost information from BBA's projects database. Total CAPEX indicates an increase of $11.7M by adopting the WOL option.

Operating Cost Estimate

Operating cost estimates were prepared for both alternatives. The WOL option indicated a slight increase in operating cost over the Flotation option $7.44/t ($8.21/mt) vs $7.13/t ($7.86/mt).

Cash flow analysis

Discounted cash flow models (5% discount rate and $1,250/oz gold) where developed to determine the Net Present Value (NPV) for each alternative based on the revenues, capital costs and operating costs. The weighted average distribution of rock types from the 2017 PFS LOM plan was used to determine the overall gold recovery for each alternative.

The NPV values were very similar for both configurations: $5,322M for WOL and $5,200M for Flotation with the WOL alternative being slightly more profitable (+$120M). Since the WOL and Flotation alternatives have similar capital costs, this result could be explained by the WOL having a better gold recovery while the Flotation alterative having lower operating costs.

10.7.1.6 CIL vs CIP

The review of the underlying geology has allowed for a better understanding of the preg-robbing nature and distribution of the deposit. Using the preg-robbing index, the main observation is that the volcanics typically present very low preg-robbing values, while both sediment rock types (upper and lower) present a higher level of preg-robbing. This can be classified as a very systematic behavior. On that basis, the Livengood resources are probably best processed using carbon in leach (CIL), instead of Carbon in Pulp (CIP). Furthermore, the sediment rock types are important contributors to the gold resource and will likely have to be mined concurrently to the main volcanics. As well, in some cases there is the inclusion of sediments cutting through the volcanics that will induce preg-robbing.

10.7.1.7 Sulfur Burner

In the 2013 FS, sodium metabisulfite (SMBS) was used to supply SO_2 to the cyanide detoxification process at a rate of 1.63 lb/t (0.82 kg/mt). At 100,000 t/d (90,718 mt/d) and based on a price of $0.37/lb, the total annual operating cost for producing SO_2 with SMBS was approximately $22.0M. Upon review of the SMBS consumption estimate, BBA concluded that an opportunity to reduce the cost of SO_2 was highly probable.

A trade-off was conducted by BBA comparing the available options on the basis of their operating and capital costs. This comparative study evaluated three possible options for the production or supply of SO_2: 1) mixing of sodium metabisulfite (base case); 2) burning of elemental sulfur using a sulfur burner; and 3) direct injection of liquid SO_2.

Key Assumptions

The following list contains the assumptions used in conducting this study:

- The throughput of the process plant for all options was 100,000 t/d (90,718 mt/d) or the plant throughput of the 2013 FS;
- SO_2 to CN ratio was determined by testwork (SGS post feasibility testwork program - Project report 50223-002 – December 2013);
- This trade-off study covers only the cost (capital and operating) for the supply of SO_2 for the cyanide detoxification process. Any other costs outside of this scope are not covered, including mining, front-end process, infrastructure, tailings pond and tailings management. These other costs are neglected in the analysis, since they would not impact the selection of the SO_2 supply;
- Equipment pricing was determined through updated budget quotes for the major equipment or historical prices. The other equipment costs were determined using BBA's equipment cost database and were based on the required equipment size;
- A quotation has been recently obtained from the supplier for elemental sulfur and sodium metabisulfite. The cost of liquid SO_2 was estimated based on BBA's pricing database;
- When using a sulfur burner with less than 100% availability, SMBS is used as a back-up during operation downtime.

Feasibility Study Versus Trade-Off Cost Comparison

Table 10-59 presents the annual operating cost and the cost of the reagent.

Table 10-59: Annual operating cost comparison

	Annual Cost (M$/y)	Reagent Cost ($/t)	Reagent Reference
Sodium metabisulfite	22.0	820	2013 Feasibility Study
Elemental sulfur	5.4	552	2016 Supplier Quote
Liquid SO_2	34.0	1,830	BBA Estimate

Even using the 2013 FS consumption numbers, burning of elemental sulfur to produce SO_2 would have been advantageous. The yearly operating cost for the Project would have been approximately $17.0M less.

Conclusions and Recommendations

Based on the cash flow analysis, the liquid SO_2 option is the costliest followed by the SMBS option. Although the highest initial capital cost expenditure is required, burning of elemental sulfur in a sulfur burner presents the lowest cost method to produce SO_2 over the LOM. Even at 50% sulfur burner availability and SMBS compensating for the difference, the sulfur option is the most economical with over $100M in savings over the LOM.

The sensitivity analysis on the price of sulfur also demonstrates that the sulfur burner option is the most attractive. Payback of the equipment is within one year even at double the sulfur price.

The QP recommends that THM pursue the sulfur burner option for the Livengood Gold Project.

10.7.2 2021 PFS Comparative Study

10.7.2.1 Whittle Enterprise Optimization

At the onset of the 2021 PFS, ITH retained Whittle Consulting and BBA to collaborate on an enterprise optimization study (the "Whittle and BBA Study") to review various technologies and project configurations with the objective of recommending an optimum configuration for the 2021 PFS. The Whittle and BBA Study compared different scenarios such as secondary crushing with SAG and ball mill, tertiary crushing with ball mill, gravity/CIL at a grind size of 90 µm to 250 µm (P_{80}), a stand-alone and an auxiliary heap leach configuration, gravity only gold recovery, gravity/flotation with pressure oxidation and CIL of flotation concentrate. These configurations were evaluated at various combinations of project ramp up strategies, annual throughput, primary, secondary, and tertiary grind size, as well as mining fleet size and ore stockpile management strategies. Several tailings technologies were reviewed including conventional tailings and pressure filtered tailings.

The starting base case was the 2017 PFS mine plan and flowsheet that was input into the optimizer to verify that it was properly calibrated. The base case was then re-run with a new ID^3 block model and all CAPEX and OPEX costs were updated from 2017 to reflect Q4 2020 pricing. Mill recovery equations were also adjusted using the latest metallurgical testwork results. A gold price of $2,000 US per ounce was used for the financial optimization.

Grind Size Scenarios

A grind size throughput recovery model was generated from comminution power data and grind recovery curves for each rock type. The model incorporated five grind sizes from 90 µm to 250 µm (P_{80}) to obtain the best financials for the base case flowsheet of two stage crushing, SABC circuit and CIL process. It was observed that the IRR and NPV increases with the grind size due to increased throughput albeit a slight drop in gold recovery. Increasing the grind size from 180 µm (2017 PFS) to 250 µm increases the throughput of the grinding circuit from 55,000 mt/d to 62,000 mt/d. The additional CAPEX required to debottleneck the rest of the installations and the mine was included in the analysis. The operating costs were recalculated for each of the grinding sizes. It was concluded that 250 µm was the financially best grind size and was therefore recommended for the 2021 PFS.

Heap Leach Scenario

Since the Livengood deposit has 50 million metric tons of oxidized gold mineralization close to surface that is amenable to heap leaching, an option for heap leaching as a first phase of the Project was investigated. The capital costs for the three-stage crushing as well as the operating costs and recovery equations were developed as inputs to the Whittle optimization software. The simulations showed that it was not economic to include a first phase of heap leaching due to the lower gold recoveries and relatively high operating costs.

Flotation, Ultra-fine Grinding, and Pressure Oxidation Scenarios

Several flotation cases were developed, and the POX option was run as a final case. None of the cases improved the Project financials. Although the POX option showed improved gold recoveries, this option was not favorable due to the increase in capital and operating costs of the grinding and the POX reagents including oxygen. Sensitivity analyses were done assuming improved flotation conditions (lower mass pull of flotation concentrate and correspondingly higher gold grade); however, the results did not add value.

Gravity Only Scenario

A case was developed for a gravity only circuit at a grind size of 90 µm (P_{80}). This option had lower CAPEX and OPEX, but due to the lower gold recoveries this scenario did not improve the financials of the Project.

Dry Stack Tailings/Commingled Waste Facility

A dry stack tailings option, commingled in a single facility with waste rock, was developed. This included a pressure filtration plant for the tailings and new phasing due to the reduced tailings impoundment construction material requirements. This case has a lower NPV than the slurry tailings case and would be conceivable only if near pit co-disposal areas with waste rock were available. This scenario should be evaluated further since it potentially reduces the environmental footprint of the Project.

Observations and Recommendations from the Study:

- The Whittle and BBA Study determined that the gravity/CIL plant at a grind size of 250 µm (P_{80}) with conventional tailings provided the highest NPV, which is the configuration recommended and detailed in the 2021 PFS.

- Grinding above 250 µm should be investigated, since it is possible to separate the activated carbon from the pulp at coarser grind sizes.
- Many options were identified as being unfavorable and should not be further pursued. These options include; heap leaching of near surface mineralization, flotation, ultra-fine grinding, and pressure oxidation.

10.7.2.2 Gravity Concentration

A gravity recovery modeling was performed by FLSmidth during the 2021 PFS to confirm the number and size of Knelson concentrators and Acacia. The modeling included the results of E-GRG testing by Curtin University on five ore samples corresponding to RT4, RT5, RT6, RT7 and RT9 and the results from SGS on RT4, RT5, RT6 and RT9.

The gravity modeling confirmed that the Livengood ores tested are highly amenable to gravity recovery. The GRG is “coarse to very coarse” on the AMIRA classification scale, which is highly favorable for gravity recovery. To achieve the better recovery, a gravity circuit with two parallel lines, each with four Knelson concentrators (KC-QC70) with one Acacia (CS10000) per line is recommended.

10.7.3 Flowsheet Development Summary

Livengood gold ore has demonstrated that it is very amenable to gravity concentration as a substantial proportion of the gold is free and liberated at a reasonably coarse grind. GRG results confirmed the great potential for gravity recoverable gold.

The fact that Livengood gold ores contain coarser gold particles makes analytical measurement of samples more difficult. Ultimately, on the basis of mineralogical observation and of practical assaying knowledge, larger sample sizes were chosen (1 kg) and the coarser gold particles screened out and weight averaged back into the undersize assays to smooth the effect of the erratic gold dispersion in the low grade deposit.

The effect of these erratic assays made initial metallurgical results difficult to interpret, in part because the mass balances were often further apart than the effect of the test changes. Under these circumstances, it was difficult to determine whether test condition changes were making improvements to the process. The program at SGS in Vancouver made the initial choice to go with screen fire assays, allowing better gold averages for samples and improving gold mass balances.

Gold deportment studies indicated that a substantial amount of the finer gold had at least a 25% or greater exposure, allowing it to be recovered by cyanidation.

However, some of the exposed gold was not contained in sulfide aggregates and was therefore less amenable to sulfide flotation. A considerable amount of testing of flotation with cyanidation of the flotation concentrate compared to direct cyanidation verified the mineralogical observations.

On the basis of the substantial testwork conducted on the major rock types and trade-off study (WOL vs Flotation), the results warranted the selection of directly leaching the gravity tails versus the leaching of the flotation concentrate.

The incorporation of activated carbon in the cyanide leach was utilized to obviate the gold robbing presence of some organics in the ore at Livengood. The activated carbon removes solubilized gold before the naturally occurring organics can rob it from solution. The daily tonnage proposed for milling at Livengood is large and the resulting amount of carbon in the leach circuit will also be large.

The mineralogical studies indicating that silver is only a minor contributor to the precious metals at Livengood further justified the choice of carbon. Livengood gold ore contains some soluble copper minerals. The copper that does solubilize will load onto carbon in the CIL leach and as a result will increase the required amount and advance frequency of carbon. The copper is removed from the carbon in a desorption process by using a cold strip prior to stripping the gold from the carbon. The stripped copper will be used to reduce the copper requirements for the cyanide destruction process.

Analysis of leaching (CIL) kinetic tests with preconditioning with O_2 (4h) and lead nitrate has shown that the gold is leached within 24 hours of retention time. The reduction of leaching time from 32 hours in the 2013 FS to 24 hours impacts the CAPEX (fewer leach tanks) and OPEX (lower CN consumption).

The incorporation of pre-crushing was recommended by BBA to enhance the operation of the SAG mill, by providing a narrower feed particle size, thereby reducing variability, which will translate into increased efficiency. The estimated increase in throughput from the addition of pre-crushing is 25% to 30%.

Grinding simulations of a single line SABC + pre-crushing circuit has shown that there is a 19% increase in throughput if the grind size is relaxed from 180 µm to 250 µm (P_{80}) and by using optimized drill and blast techniques.

Sulfur dioxide (SO_2) produced by a sulfur burner will significantly reduce the OPEX costs for cyanide detoxification.

Based on the metallurgical testwork results from SGS and Pocock, BBA developed a Process Design Criteria and Process Flow Diagrams as described in Chapter 14.

10.8 Opportunities for Further Investigation

Product Grind Size (P_{80})

The QP recommends performing new testwork using the optimized conditions of Phases 12 and 13 but at a grind size (P_{80}) higher than 250 µm. The recoveries obtained during Phases 9b, 11 and 12 did not show any inflection point between 250 µm and 180 µm, which may suggest that there is an opportunity for testwork on coarser sizes to add value.

Solid / Liquid Separation Testwork

Flocculant testwork on tailings were performed at a product size of 250 µm (P_{80}) for the Project before the samples went for geotechnical testing. The QP recommends performing further settling testwork: static as well as dynamic settling testwork. The static work can be used to screen potential flocculant suppliers for the Livengood mill feed. Dynamic settling testwork by vendors is recommended as part as the equipment sizing and bidding process.

Cyanide Detoxification Testwork

For cyanide detoxification, the following reagent consumptions were assumed for the 2021 PFS:

- Lime = 0.62 lb/t (0.28 kg/mt);
- Copper sulfate = 0.09 lb/t (0.045 kg/mt);
- S (elemental) = 0.52 lb/t (0.26 kg/mt);
- Sodium metabisulfite = 0.38 lb/t (0.19 kg/mt).

Confirmatory detoxification testwork with a particle size distribution target of 250 µm (P_{80}) is recommended. Potential reagent savings are expected as a result of lower liberation of detrimental metals that could otherwise consume cyanide reagents.

Stirred Tank Reactor (STR) Optimization

Further stirred tank reactor (STR) testwork should be conducted with fresh drill cores with and without lead nitrate to optimize the lead nitrate, sodium cyanide and lime consumptions.

Carbon Loading Testwork and Simulation (CIL)

Both a qualified laboratory and equipment vendor(s) should be approached to undertake carbon loading testwork and simulation work of the proposed CIL carbon handling system to confirm the assumptions made in this study. This work will lead to the selection of the most appropriate carbon elution system (high pressure ZADRA vs AARL).

Oxygen Uptake Tests

The QP recommends that oxygen uptake tests be performed by more than one service supplier to confirm the oxygen consumption for the Livengood Gold Project.

11. MINERAL RESOURCE ESTIMATES

11.1 Mineral Resource Estimation Methodology

The global mineral resource estimate was prepared based on a resource model constructed using Vulcan Geomodeller ® and Whittle ® scientific software programs. The Livengood mineral resource was estimated using Inverse Distance Weighting (IDW) interpolation techniques.

Three sources of volumetric determination were used for the resource model. One was a three-dimensional (3D) stratigraphic model used to assign rock type codes to the block model. The second was an implicit model that interpolated a 100-ppm antimony halo or “shell” for the mineral deposit, with blocks flagged as either inside or outside this halo. The third was 54 individually interpreted massive stibnite veins that were used to determine the volume percentage and grade of veins within each model block that is intersected by the veins.

Gold contained within each block was estimated using Inverse Distance cubed (ID3). The block model was flagged with the stratigraphic models using a block majority coding method except for blocks that intersected the combination of bedrock and overburden or blocks that intersected the combination of bedrock and massive stibnite veins. This was necessary to better calculate individual block densities due to significantly variable specific gravity measurements in those rock types. Grade discontinuities at stratigraphic contacts were evaluated to determine hard and soft boundaries for the estimation of mineralization within the stratigraphic domains of the mineral deposit.

Note that the resource modeling work described and the analytical measures reported in this chapter are done using metric units. Where it is deemed pertinent (i.e. to support summary production statistics), the equivalent measure in imperial units have been provided.

The estimates of mineral resources may be materially affected if mining, metallurgical, or infrastructure factors change from those currently assumed at Livengood. Estimates of inferred mineral resources have significant geological uncertainty and it should not be assumed that all or any part of an inferred mineral resource will be converted to the measured or indicated categories. Mineral resources that are not mineral reserves do not meet the threshold for reserve modifying factors, such as estimated economic viability, that would allow for conversion to mineral reserves.

11.2 Data Used

The total Livengood drilling and sampling datasets are shown in Table 11-1. Drilling performed by THM is shown in Table 11-2. Of the 797 listed sampling locations, 776 are directly related to the 2021 mineral resource estimate (2021 MRE). The historical data (pre-2006) represent approximately 2% of the total information used. The use of historical data is based on its statistical consistency with current data and the small portion of the total data represented as shown in past technical reports (Klipfel and Giroux, 2008a, 2008b, and 2009; Klipfel et al., 2009a and 2009b). For data validation purposes, in 2011, SRK checked the assay data on a representative subset of drill holes (10%) used for the resource estimate against the original assay certificates (Carew, 2011). An error rate of less than 1% was identified and is well within acceptable standards for accuracy and use in mineral resource estimates. These minor errors have been addressed in the mineral estimation procedures. Lechner (2017) and Carew (2011) identified minor assaying concerns related to potential assay value cyclicity in RC drilling. These have been addressed in the 2021 MRE such that there is not a material impact on the estimation of gold throughout the Livengood mineral deposit.

The topographic surface used is based on a 4 m Digital Elevation Model derived from 2008 aerial photography.

Densities used in the resource are based on 98 determinations from core and RC chip samples, and are shown in Table 11-3. Based on empirical observations, massive stibnite vein density was estimated at 2.86, country rock density was estimated at 2.7 and overburden density was estimated at 2.

Table 11-1: Historical drilling and sampling

Year	Company	Method	Number of Sites	Feet	Meters
1976	Homestake	Percussion	5	994	303
1981	Occidental	Percussion	6	988	301
1989	AMAX	Trench	2	525	160
1990	AMAX	RC	3	1,050	320
1997	Placer Dome	Core	8	3,467	1,057
2003	AngloGold	RC	8	4,968	1,514
2004	AngloGold	Trench	8	892	272
2004	AngloGold	Core	4	2,500	762
		Total	**44**	**15,384**	**4,689**

Table 11-2: THM resource drilling and sampling

Year	Company	Method	Number of Sites	Feet	Meters
2006	THM	Core	7	4,027	1,227
2007	THM	Core	15	14,471	4,411
2008	THM	Core	9	7,185	2,190
2008	THM	Trench	4	261	80
2008	THM	RC	109	93,402	28,469
2009	THM	Core	12	15,003	4,573
2009	THM	RC	195	196,243	59,815
2010	THM	Core	38	43,472	13,250
2010	THM	RC	195	184,717	56,302
2011	THM	RC	111	94,219	28,718
2011	THM	Core	53	44,260	13,490
2012	THM	Core	5	6,469	1,972
		Total	**753**	**703,730**	**214,497**

Table 11-3: Density determinations

Lithology Unit	Density
Money Knob Rock type 2 (RT2)	2.67
Cambrian Rock type 4 (RT4)	2.82
Upper Sediments North Rock type 5 (RT5)	2.68
Upper Sediments South Rock type 6 (RT6)	2.68
Lower Sediments Rock type 7 (RT7)	2.74
Main Volcanics Rock type 8 (RT8)	2.72
Main Volcanics Rock type 9 (RT9)	2.72
Country Rock	2.70
Overburden	2.00

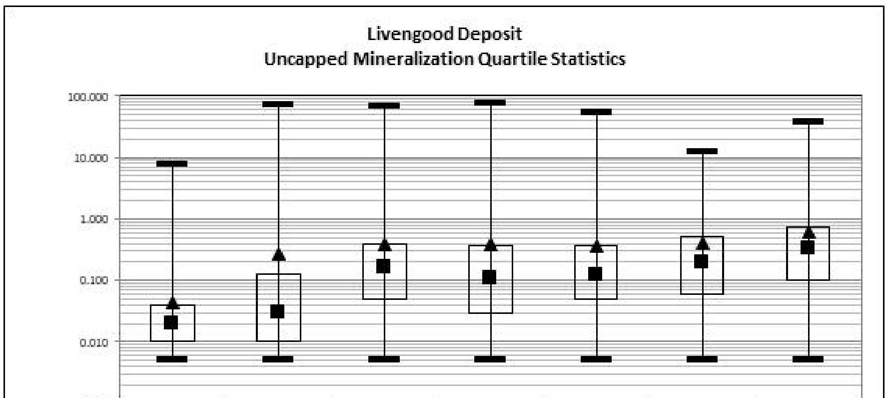
11.3 Data Analysis

A statistical summary of Au and Sb above detection limit is shown in Table 11-4. The elements of concern for the 2021 mineral resource are gold and antimony distributions. These elements are of major interest and drive the mining, metallurgical and economic considerations for the Livengood mineral deposit, with gold adding positive value and antimony having a negative correlation with gold recovery.

Table 11-4: Au assay statistics for Livengood

Element	Unit	N	Mean	Maximum	Std. Dev.	C.V.
Au	ppm	147,658	0.36	76.5	1.12	3.07
Sb	ppm	90,090	122	174,000	1,821	15

Each of the database assay intervals were logged for lithology, stratigraphy, alteration and mineralization. Disseminated mineralization displays varying average grades of gold controlled by the stratigraphy of the deposit (Figure 11-1). Sampled assay values have high coefficients of variation due to high grade outliers, which skew the mean average grades above the third quartile. Evaluation of the following graph suggests that capping the gold grades by stratigraphy is required to estimate the contained metal content of the deposit. A coefficient of variation (C.V.) below 2.00 is desirable to assist in estimating the recoverable ounces for the mineral deposit.



	RT2	RT4	RT5	RT6	RT7	RT8	RT9
Q1	0.010	0.010	0.050	0.030	0.050	0.060	0.100
Min	0.005	0.005	0.005	0.005	0.005	0.005	0.005
Median	0.020	0.030	0.160	0.110	0.120	0.190	0.330
Mean	0.046	0.275	0.382	0.393	0.360	0.416	0.634
Max	7.550	72.000	67.300	76.500	54.500	12.100	37.400
Q3	0.040	0.130	0.400	0.370	0.360	0.510	0.730
NSamples	6274	25287	41139	22376	29137	2657	15808
Std. Dev.	0.181	1.537	1.007	1.174	0.927	0.673	1.260
C.V.	3.973	5.591	2.632	2.983	2.573	1.617	1.984

Figure 11-1: Uncapped gold grade distribution by stratigraphic unit

11.4 Grade Capping – Handling of Outliers

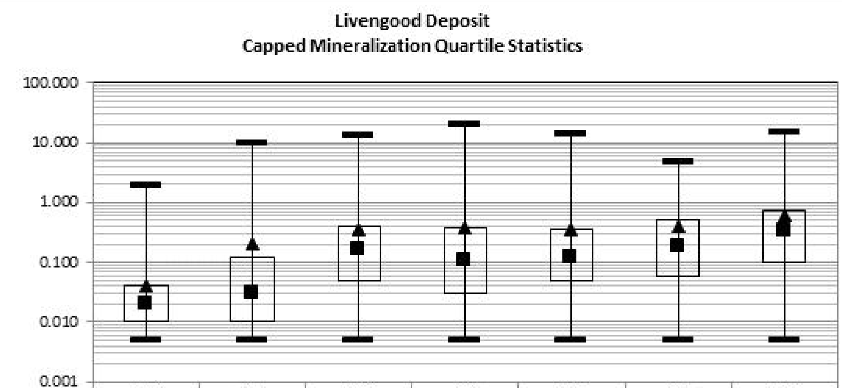
Treatment of outliers is generally a perplexing problem. There is no generally accepted solution of handing outliers; however, diligence needs to be exerted with the assay database to ensure the ability to estimate the true average grade of the mineral deposit. Therefore, a generally accepted practice of capping grades at the 90th through 99th percentile has been employed to limit the impact of high-grade outliers for the deposit.

Table 11-5 summarizes the capping statistics. Figure 11-2 shows the resulting box plot quartile statistics after subsequent capping with the extreme outliers reduced to the capping levels listed in Table 11-1.

Antimony grades were not capped. Antimony is a deleterious element in which it is industry standard practice not to perform grade capping.

Table 11-5: Capping statistics

Stratigraphy	Uncapped Grade	Number of Capped Assays	Capped Grade	Number Samples Capped
RT 2	0.05	6,266	0.04	8
RT 4	0.28	25,220	0.21	67
RT 5	0.38	41,119	0.37	20
RT 6	0.39	22,367	0.38	9
RT 7	0.36	29,125	0.35	12
RT 8	0.42	2,649	0.40	8
RT 9	0.63	15,789	0.61	19



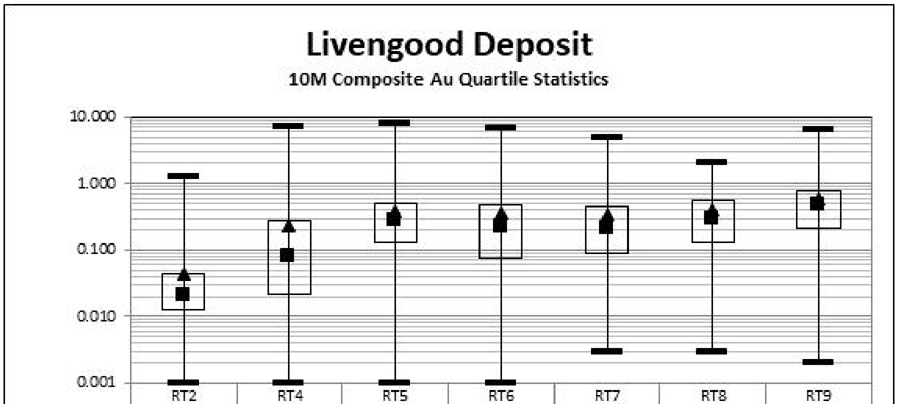
	RT2	RT4	RT5	RT6	RT7	RT8	RT9
Q1	0.010	0.010	0.050	0.030	0.050	0.060	0.100
- Min	0.005	0.005	0.005	0.005	0.005	0.005	0.005
■ Median	0.020	0.030	0.160	0.110	0.120	0.190	0.330
▲ Mean	0.040	0.214	0.368	0.382	0.350	0.397	0.610
- Max	1.970	9.710	13.600	19.950	13.950	4.840	14.850
Q3	0.040	0.120	0.400	0.370	0.360	0.510	0.730
NSamples	6266	25220	41119	22367	29125	2649	15789
Std. Dev.	0.096	0.644	0.706	0.964	0.755	0.568	1.028
C.V.	2.376	3.009	1.917	2.525	2.153	1.428	1.684

Figure 11-2: Capped quartile statistics

11.5 Compositing

Compositing reduces the impact of short assay intervals and helps to better estimate the average grade of the deposit. Compositing incorporates a certain amount of dilution into the raw assay data prior to estimation. The open pit mining operation envisioned for the Project will be at a larger scale than the assays intervals sampled for the deposit. The selective mining unit for the Project is expected to be 10 m, therefore, the assays for the database have been composited to 10 m. Composites are length weighted down hole composites of the capped Au assay values.

Figure 11-3 details the final composite statistics, by stratigraphy, that have been used for the mineral resource estimate; C.V.(s) are within acceptable ranges, high grade outliers have been accounted for. and average Au values are within acceptable ranges. The manipulation from assays to composites has been carried out using industry accepted practices and RDA recommends that the final composite database can be used for mineral resource estimation of the Livengood deposit.



	RT2	RT4	RT5	RT6	RT7	RT8	RT9
Q1	0.013	0.022	0.128	0.076	0.088	0.127	0.209
- Min	0.001	0.001	0.001	0.001	0.003	0.003	0.002
■ Median	0.021	0.079	0.270	0.219	0.209	0.285	0.464
▲ Mean	0.044	0.239	0.380	0.368	0.345	0.408	0.593
- Max	1.247	7.204	8.009	6.651	4.983	2.060	6.371
Q3	0.045	0.270	0.496	0.473	0.444	0.570	0.778
NSamples	905	3580	6033	3124	3855	374	2128
Std. Dev.	0.078	0.455	0.413	0.477	0.418	0.381	0.588
C.V.	1.770	1.898	1.085	1.293	1.211	0.934	0.990

Figure 11-3: Capped composite statistics

11.6 Declustering

Cell declustering was evaluated to ensure more densely drilled out portions of the deposit that are not biased by a large sample set of high grades localized to one area. Figure 11-4 demonstrates that the mean values do not show a minimum, followed by a maximum, as the cell size increases. Therefore, cell declustering was not used in the 2021 MRE.

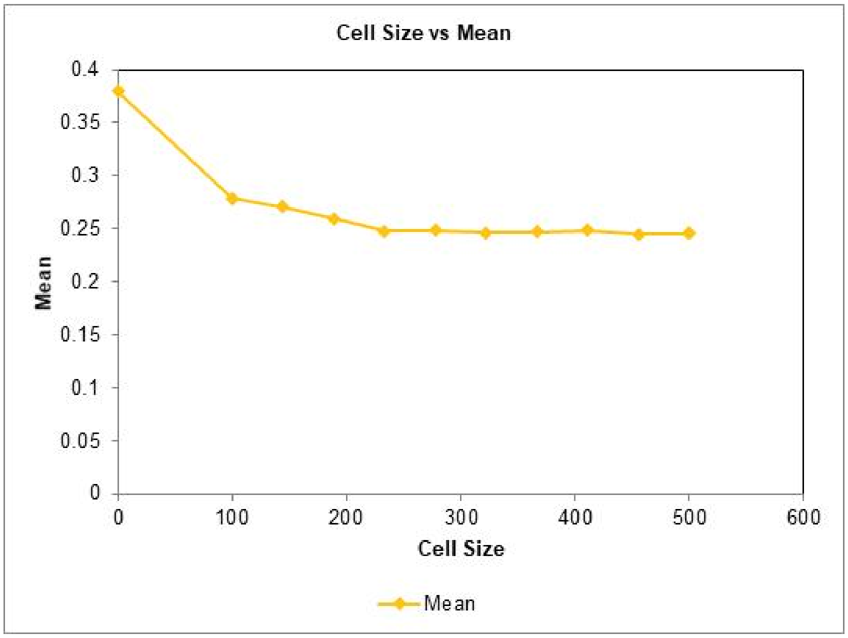


Figure 11-4: Cell declustering chart demonstrates sample clustering is not a factor for the deposit

11.7 Contact Profile Analysis

The Au values of the individual stratigraphic units of the deposit were evaluated to determine whether the mineralization of the units is separate and distinct from every other unit. If mineralization is continuous or convergent across stratigraphic contacts, then it is possible to estimate mineralization from both assay populations. The average grades of the units do not need to be similar. If the grades appeared graphically to converge at the contact, then these units were to be estimated as one unit. The upper sediments (RT6), lower sediments (RT7), and the main volcanics (RT9) show convergence at the boundaries and were estimated as one domain. All other stratigraphic units were estimated as separated domains, using no assay values from other domains.

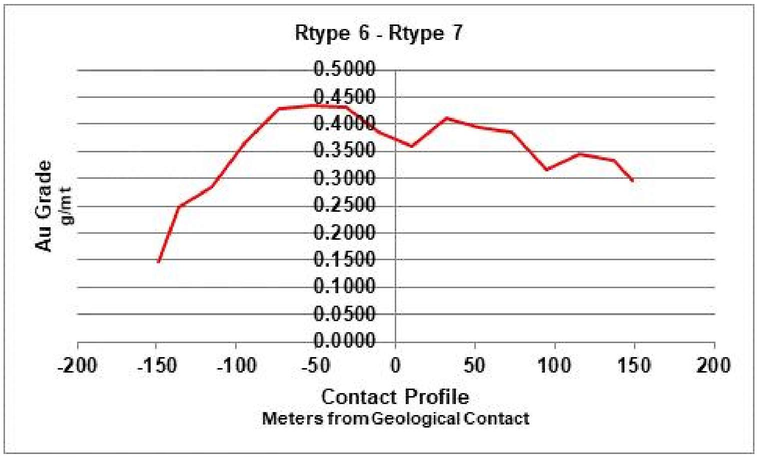


Figure 11-5: Contact profile of RT6 and RT7. Grades converge at the contact. Soft boundary

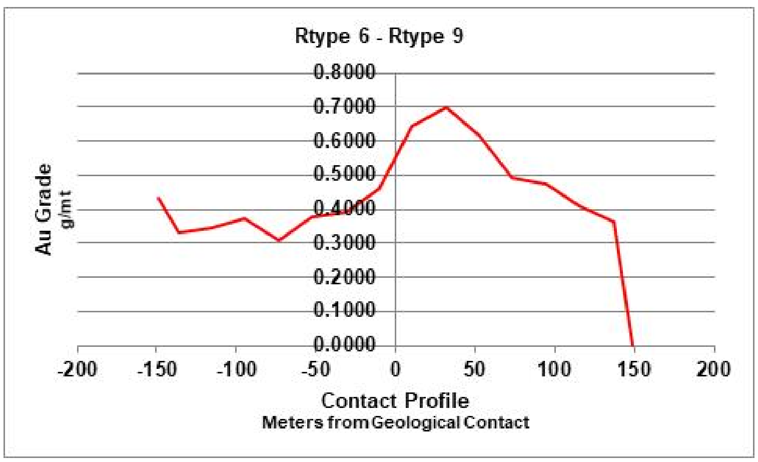


Figure 11-6: RT6 and RT9. Grades converge at contact. Soft boundary

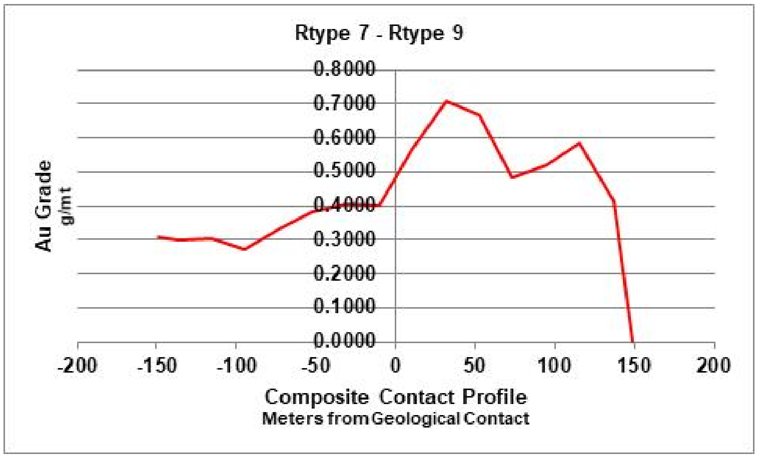


Figure 11-7: RT7 and RT9 Grades converge at the contact. Soft boundary

11.8 Anisotropy

Anisotropy of mineralization was evaluated with Sage spatial modeling software to determine appropriate search ellipses for grade estimation. Mineralization at Livengood can be considered fairly homogeneous across the extents of the deposit, which is typical of many of the large disseminated deposits throughout the world. Drilling across the deposit has been developed on a fairly regular grid in many cases due to the large size of the mineral footprint. Evaluations with spatial modeling software yield fairly large search ellipses, which suggest low variances of gold grades across large distances. Search ellipses were developed for the Cambrian RT4, Upper Sediments North of the Lillian Fault RT5, Upper Sediments South of the Lillian Fault RT6, Lower Sediments RT7, Devonian Volcanics RT8 Main Volcanics RT9. RT6, RT7 and RT9 use the same anisotropic search distances.

Search ellipse regions are displayed in Figure 11-8, Figure 11-9 and Figure 11-10.

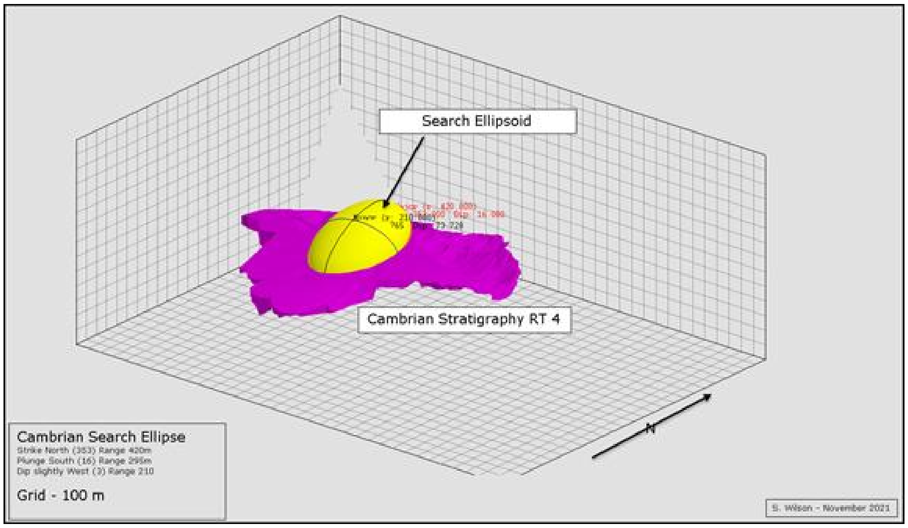


Figure 11-8: Cambrian stratigraphy search ellipse

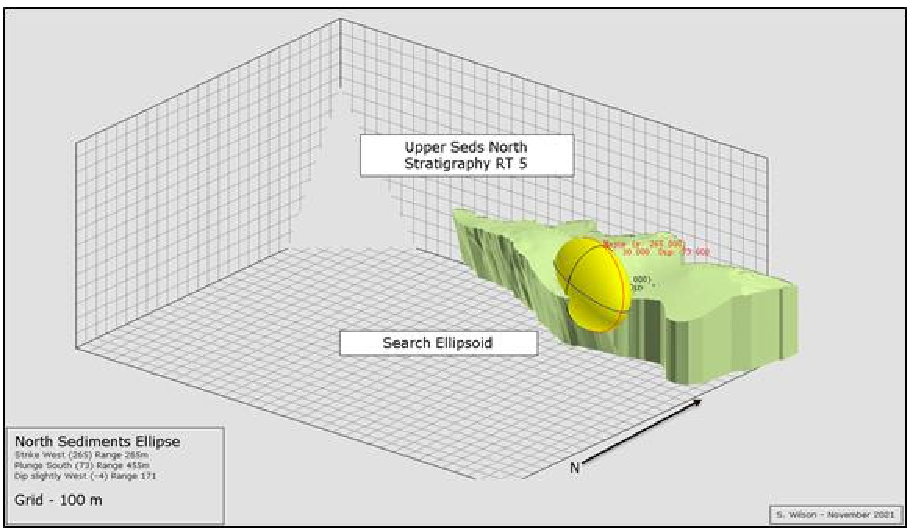


Figure 11-9: Upper Sediments North search ellipse

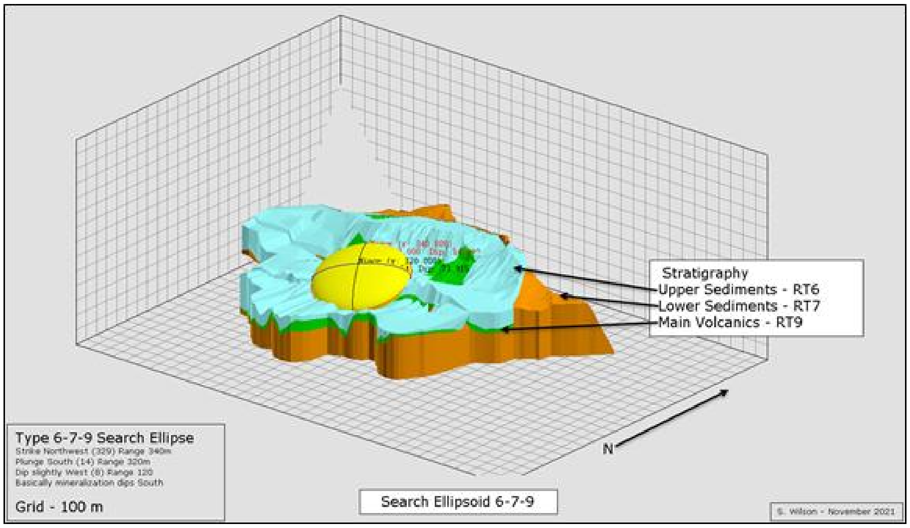


Figure 11-10: Type 679 search ellipse

All other sedimentary and rock types within the deposit were estimated using the 679 search parameters. Massive stibnite vein grades are modeled explicitly as explained later in this chapter.

11.9 Block Model

A 3D block model was constructed to encompass the drilling data and the interpreted geologic models for the Project. Block model dimensions are shown in Table 11-6. All coordinates are in the UTM NAD27 Alaska coordinate system. All units are metric.

Table 11-6: Model extents

	Minimum (m)	Maximum (m)	Extent (m)	Block Size (m)	No. of Blocks
East	427,600	430,850	3,250	10	325
North	7,264,310	7,266,710	2,400	10	240
Elevation	-290	610	510	900	90

The Livengood block model has been coded with several interpreted shapes that are representative of the deposit. These include topography, stratigraphy, massive stibnite veins and the implicit 100 ppm antimony shell. Figure 11-11 to Figure 11-13 show a representative view, south to north looking west. These show the physical attributes of the model on a representative section of the geology of the mineral deposit.

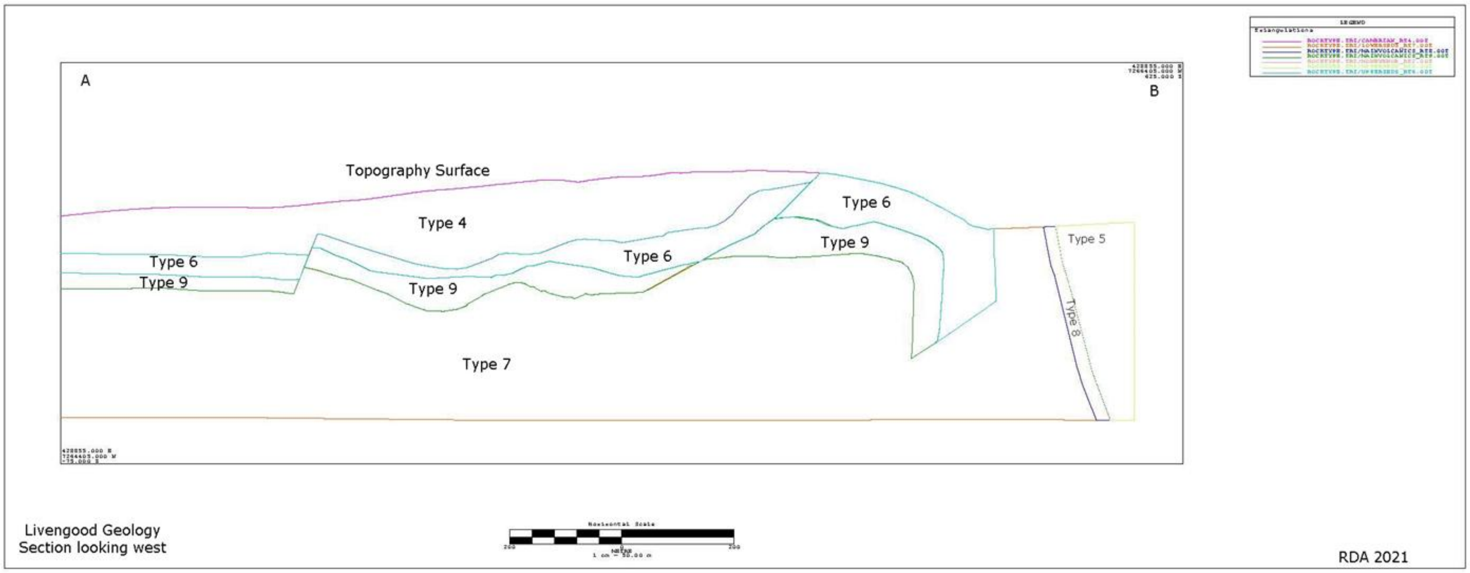


Figure 11-11: Section A-B looking west. Geologic models used to flag the Livengood block model

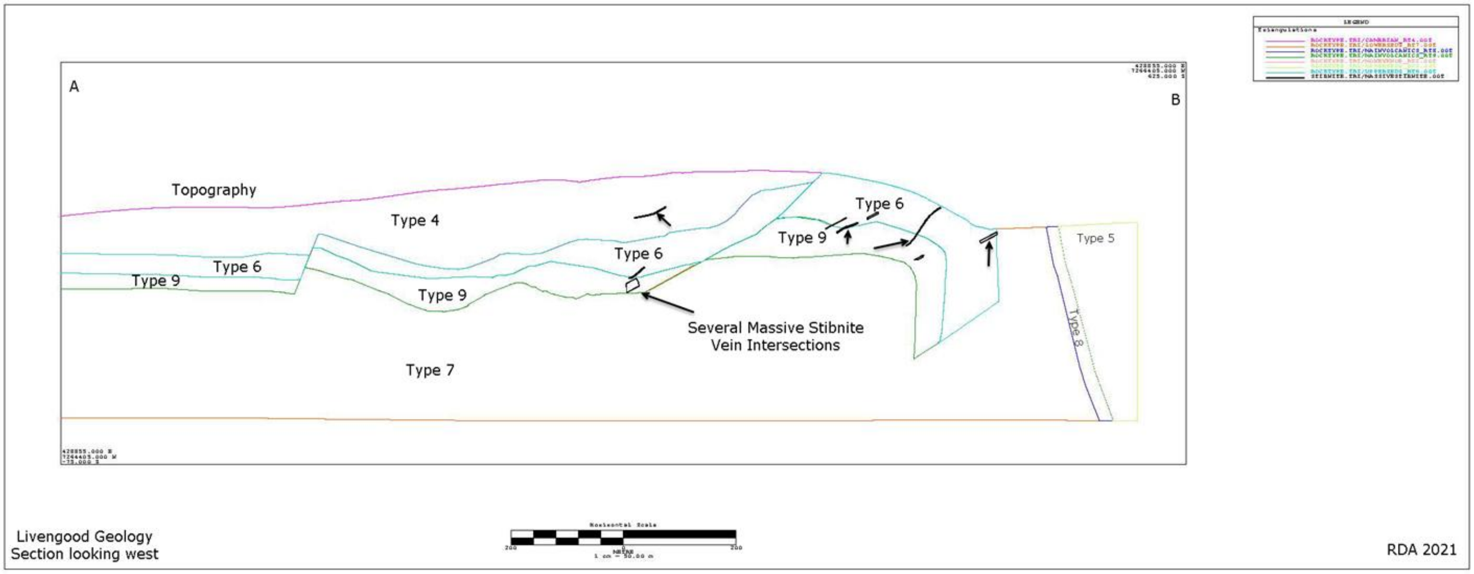


Figure 11-12: Intersection of massive stibnite veins on cross section A-B

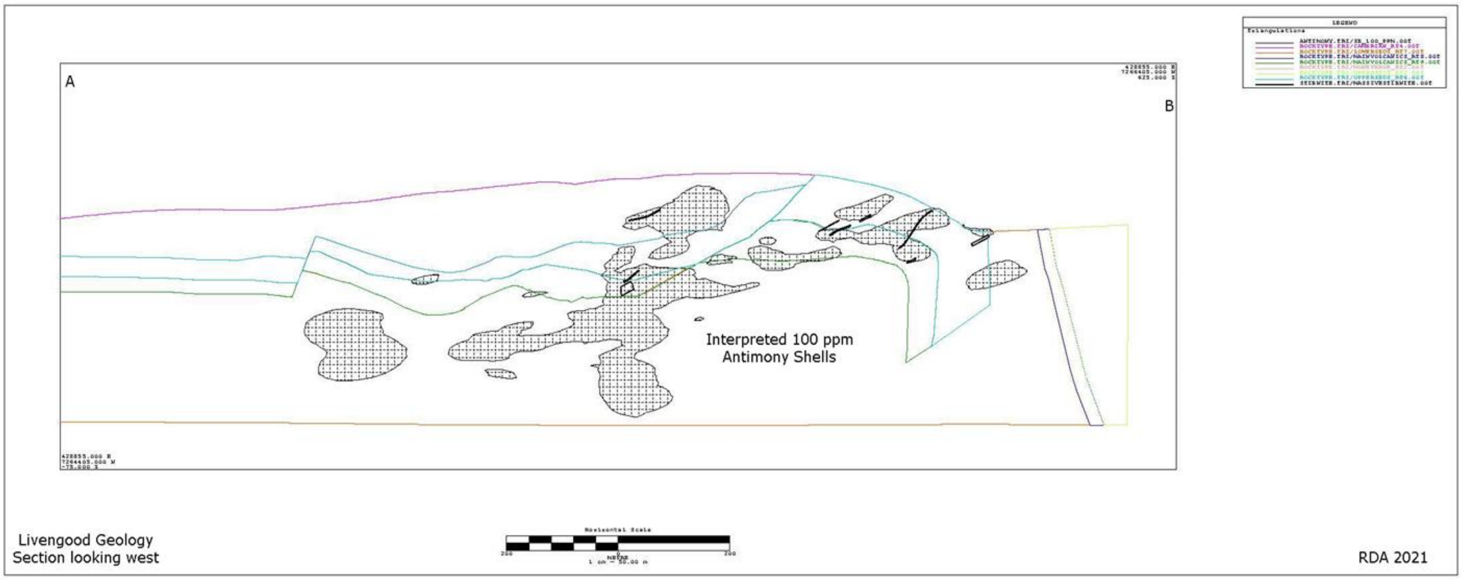


Figure 11-13: Cross section A-B showing the 100 ppm antimony halo for Livengood

11.10 Grade Estimation

Gold grades for the mineral resource are estimated using Inverse Distance Weighting. Inverse distance methods are a suite of weighted average estimation methods. These result in estimates that are smoothed versions of the original sample data. Inverse distance methods are based on calculating weights for the samples based on the distance from the samples to the centroid of a model block. This is essentially a linear estimate where sample weights are assigned to composite values for all composites used in the estimate. The calculation of the weights is based on the inverse of the distance between the composite and the center of the block being estimated. Sample weights are standardized to a sum of 1 to ensure there is not a globally biased estimate. In the mining industry there are two common exponents used, Inverse Distance squared (ID2) and Inverse Distance cubed (ID3). ID3 is used when large weights are desired for the closest composites. This is applicable when the variable being estimated is erratic and the current data spacing is large relative to the data that would be available for mineral boundary decision making. Such as with open pit gold grade distributions. ID3 methodologies are widely used in the mining industry and have proven through the decades to be an acceptable and reliable methodology for the estimation of gold distributions in large scale low grade disseminated gold deposits.

Gold grades have been interpolated throughout the block model. They are stored as a grade in each model block based on the estimation parameters associated with each stratigraphic unit. Five individual estimation domains were run on the model; Type 2, Type 4, Type 5, Type 8 and Type 679. Only samples and blocks matching the stratigraphic criteria were used in each of the five estimation runs. This honors the hard and soft boundaries identified by the contact profile analysis. Antimony (Sb) grades have been interpolated using the same parameters as gold. Antimony grades within the veins were not used in the determination of the block interpolated grades.

Table 11-7: ID3 Estimation Parameters

Estimation ID	Minimum Samples	Max Samples	Max Samples Allowed per Hole	Sample Rock Type	Block Rock Type	Number of Blocks Estimated
2	5	8	2	2	2	43,618
4	5	8	2	4	4	106,552
5	5	8	2	5	5	361,056
8	5	8	2	8	8	2,466
679	5	8	2	6, 7 or 9	6, 7 or 9	682,830

Gold grades for the massive stibnite veins have been explicitly modeled based on the average gold grade of the composites that are intersected by the veins. Gold and antimony grades for each of the 54 interpreted grades are identified in Table 11-8. These values have been directly applied to their respective percentages of the associated model blocks.

Table 11-8: Livengood deposit massive stibnite grade estimates

Vein	Au Grade (ppm)	Sb Grade (ppm)	Vein	Au Grade (ppm)	Sb Grade (ppm)
1	1.520	49,340	28	1.835	10,440
2	2.025	6,840	29	1.259	20,869
3	1.038	7,323	30	1.100	10,700
4	7.397	10,210	31	1.100	3,378
5	1.608	12,247	32	4.430	53,750
6	4.223	18,250	33	0.965	7,995
7	2.533	15,167	34	3.740	10,580
8	1.767	7,428	35	3.020	1,467
9	1.685	9,065	36	13.925	69,550
10	1.409	6,679	37	1.778	18,362
11	1.682	2,977	38	1.614	10,914
12	4.806	16,746	39	1.280	16,220
13	3.392	4,583	40	0.516	4,769
14	1.749	15,362	41	0.153	79
15	1.165	5,339	42	1.200	0
16	1.495	9,865	43	2.804	10,276
17	0.196	26	44	1.180	117
18	1.168	2,547	45	1.380	3,737
19	1.875	6,410	46	3.853	16,476
20	2.317	20,349	47	1.000	16,700
21	0.960	7,325	48	1.480	40,800
22	2.270	2,190	49	1.250	13,350
23	0.570	53,473	50	9.530	19,667
24	3.432	10,731	51	1.000	5,480
25	7.180	46,537	52	1.040	5,940
26	3.924	11,885	23	4.495	24,900
27	8.278	51,332	54	1.000	3,607

11.11 Model Validation

Block model validation can be quantified numerically in certain aspects and in many cases is visual and sometimes subjective. Many locations throughout the mineral deposit have been checked for biased estimates. One such validation is to compare the ID3 estimate against the nearest neighbor (NN) estimation. A NN estimate should have a globally higher grade and higher variance than the NN estimation. Bias can be surmised visually if high grades of mineralization have been estimated over known low grade areas of the deposit. A comparison of estimated mineralization should mimic the same visual characteristics as seen against an overlay of the composites used for the estimation as in Figure 11-14. Another visual characteristic to ensure no bias is that there are no obvious streaks of high grade, which can be an indicator of high-grade bias in the estimate. The blocks on Section A-B demonstrate that the estimate of mineralization compares well with the Livengood exploration drilling data.

Table 11-9 compares the global ID3 estimate against the global NN estimate at a 0.00 g/t Au cut-off grade. The same conditions and criteria used for the ID3 interpolation were used for the NN interpolation. Variance, standard deviation and coefficient of variance should display the same behavior, i.e. higher than the ID3 estimation. Model Au grade variance, standard deviations and coefficients of variation are also presented in the Table 11-9. These comparisons satisfy the QP that there is no global bias in the 2021 MRE. An acceptable smoothing of the original assayed grades of the deposit has been achieved.

Table 11-9: Comparison of ID3 to NN estimates to evaluate for biases in the 2021 MRE

ID3 Model Grade vs. NN Model Grade	Unit	Au	Au Variance	Std. Dev.	C.V.
ID3 Global Resource Estimate	(g/t)	0.254	0.017	0.266	1.047
NN Global Resource Estimate	(g/t)	0.255	0.204	0.452	1.775
Variance	%	0.393	-91	-41	-41

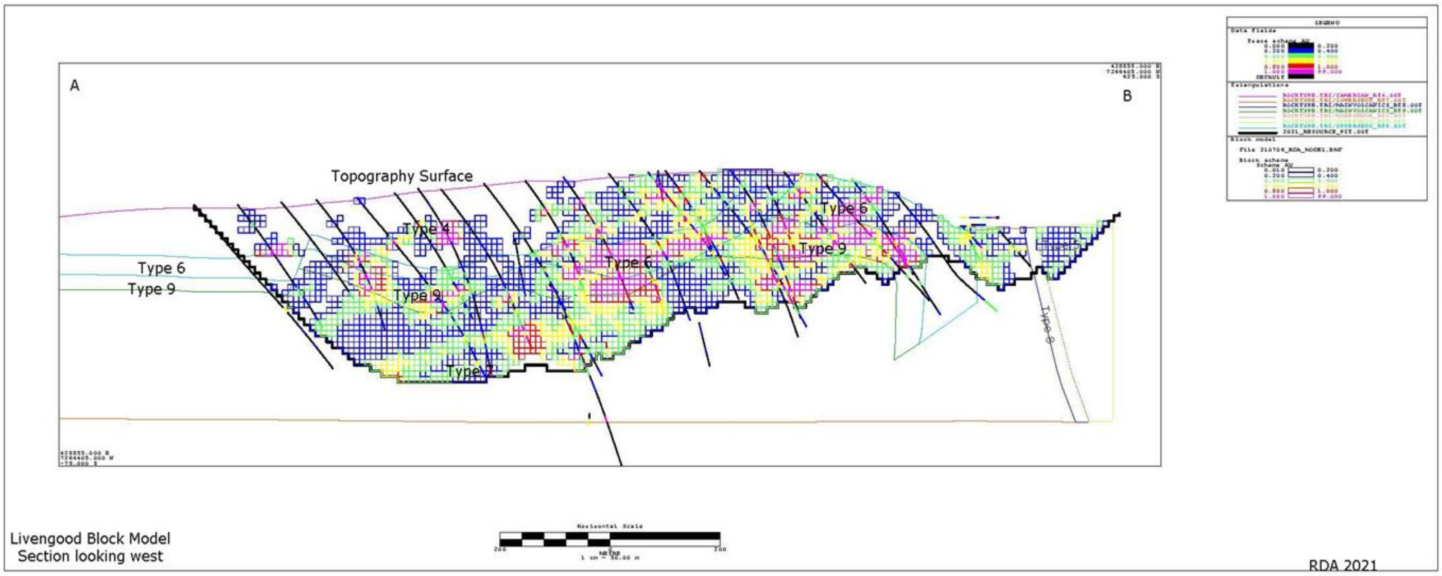


Figure 11-14: Visual comparison of composite database with estimated Au grades for Section A-B

A scattergram comparing the composite Au grades to the modeled Au grades is shown in Figure 11-15. The highest grade is in the composite data, which is expected. The highest variance is in the composites as expected. The mean average grade is identical as expected. The QP is confident that there are no biases in the 2021 MRE for the Livengood Gold Project. The Livengood 2021 MRE can be relied upon for economic analyses.

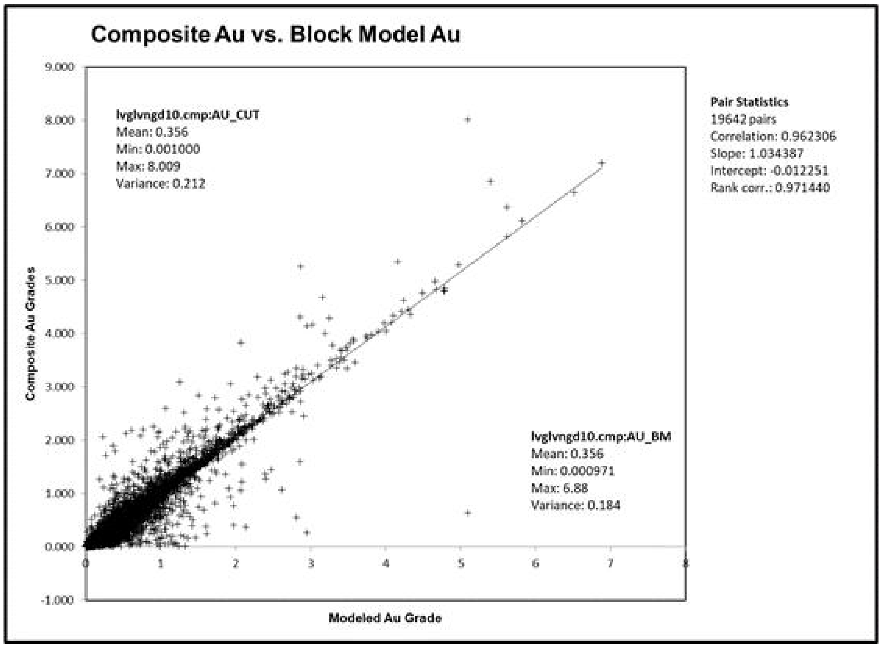


Figure 11-15: Scattergram comparing global estimated Au grade to composite database Au values

One final validation of the model is summarized in Figure 11-16. Here is displayed the grades from south to north on 10-meter increments. This chart is a swath plot; often referred to as a drift analysis. This is used to verify that there is no local bias to the estimation of gold grades. The light dotted line represents the nearest composite grades that were used to estimate the block grades. A visual check shows that the sample grades are most erratic, which is indicative of the highest variance. The blue solid line represents the NN estimate, which is smoother than the sample grades yet less smooth than the ID3, which is represented by the solid red line. These results indicate that there is no bias in the local estimation of grades for Livengood.

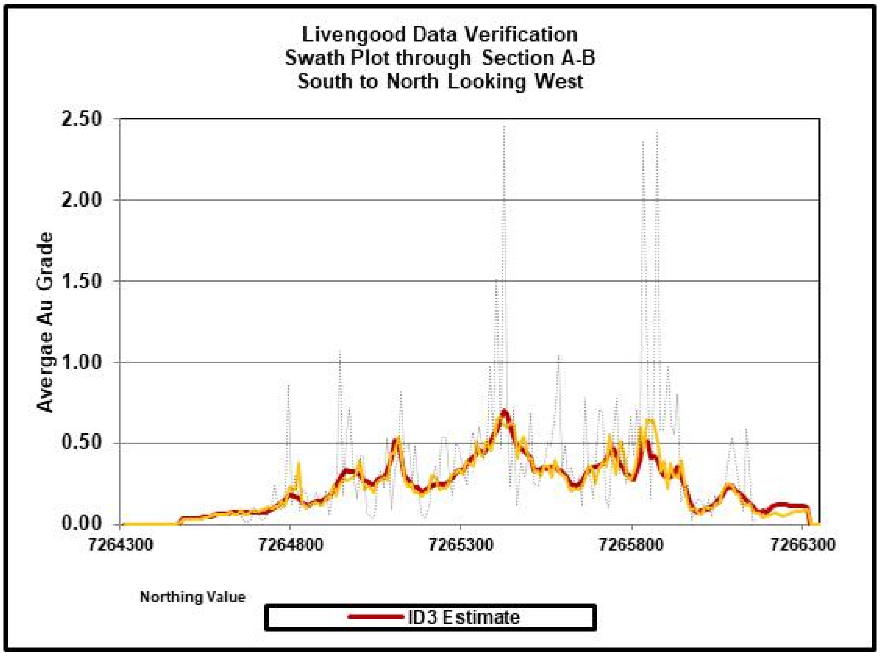


Figure 11-16: Swath plot through Section A-B

11.12 Resource Classification

Mineral resources are classified in accordance with §229.1302(d)(1)(iii)(A) (Item 1302(d)(1)(iii)(A) of Regulation S-K). Mineralization at Livengood has been categorized as Inferred mineral resources, indicated mineral resources and measured mineral resources, based upon increasing levels of confidence in various physical characteristics of the deposit. Drill hole spacing, search neighborhoods, metallurgical characterization, geological confidence and many other factors were used to give the QP confidence in the mineral resource estimate for the Project (2021 MRE). RDA is satisfied that the geological modeling for Livengood honors the geological information and knowledge of the mineral deposit. The location of the samples and the assay data are sufficiently reliable to support resource evaluation.

Classification of mineral resources for Livengood are based on the distance to the nearest samples used to derive the gold grade for each individual block in the deposit. Massive stibnite veins are classified as Indicated mineral resources. No massive stibnite veins have been classified as Measured mineral resources. RDA has classified the mineral resources according to Table 11-10 which summarizes the sources and degree of uncertainty considered by RDA.

In reference to Table 11-10, sources and degree of uncertainty in the categories and are defined as follows:

- Measured Resources – Measured mineral resources are limited to areas where in opinion of RDA the quality and quantity of the grade and tonnage are based on low levels of uncertainty. Only areas within the model where the criteria and uncertainty correspond to the Low Degree of Uncertainty column in Table 11-10 have been used to classify this category of resource.
- Indicated Resources - RDA has limited the Indicated part of a mineral resource for which in RDA's opinion the quantity and grade are estimated on the basis of adequate geological evidence and sampling. This includes all the sources of data used in under the Measured category. The main controlling feature on the uncertainty is considered to be the drill spacing with a minimum of 2 holes within 60m – 120m used within different domains, to determine an adequate level of grade uncertainty. The criteria and uncertainty correspond to the Medium Degree of Uncertainty column in Table 11-10.
- Inferred Resources - RDA has limited the Inferred part of a mineral resource for areas in the geological model where the quantity and grade are estimated on the basis of limited geological evidence and sampling. RDA considers this to have the highest levels of uncertainty with limited drilling information resulting in grades not being able to be estimated with adequate confidence between drill holes for the application of modifying factors for mining. These areas of the model represent the lowest drilling density (wide spaced), which are beyond the ranges where valid estimates can be assigned with confidence. RDA considers these areas of the mineral resource will require additional exploration drilling prior to mining. The criteria and uncertainty correspond to the High Degree of Uncertainty column in Table 11-10.

Table 11-10 Sources and Degree of Uncertainty

	Degree of Uncertainty		
Source	**Low**	**Medium**	**High**
Drilling	Exploration - no significant issues identified. Protocols consistent with industry standards.		
Sampling	Industry standard sampling utilized for core and RC drilling		
Sample Preparation/ Assay	Sample handling, preparation and analysis methods at accredited, independent laboratories meet current industry standards.		
QA-QC	Sample preparation and analysis procedures for Livengood meet current industry standards, assay results suitable for use in resource estimation.		

	Degree of Uncertainty		
Source	**Low**	**Medium**	**High**
Data Verification	Density and clustering of drilling has been demonstrated to have little-to-no impact on estimates mineralization volumes.		
Database	Location, analytical and geological data in the database were verified to the QP's satisfaction.		
Geologic Modeling	Geologic models have been reviewed and conform with the geological interpretations of the deposit		
Bulk Density		Measurements based on only 98 determinations. Massive stibnite veining based on empirical observations.	
Grade Estimation	Grade model verification in terms of visual verification, comparative statistics and swath plots indicate that estimated grades are largely visually representative, unbiased and within acceptable tolerances.		
Drill Spacing and Estimation Criteria	Model blocks estimated with a minimum of five samples and a minimum of three drillholes. Limit of two samples per hole. Distance within 60m of nearest drill hole.	Model blocks estimated with a minimum of five samples and a minimum of three drillholes. Limit of two samples per hole. Distance to nearest hole > 60m and <= 120m.	Model blocks estimated with a minimum of five samples and a minimum of three drillholes. Limit of two samples per hole. Distance to nearest hole > 120m.
Continuity of Classification Volumes	Smoothing applied to re-classify isolated volumes (groups of blocks) to ensure reasonable continuity of Measured and Indicated categories, using implicit modeling techniques. Also adjusted for depth consistent with high confidence drill density near surface.	Massive stibnite vein mineral estimates classified only as indicated mineralization even in very close proximity to geological drilling intercepts.	

11.13 Qualified Person Opinion – Further Work

The qualified person is of the opinion that, with consideration of the recommendations listed in Section 23.1, that any issues relating to all applicable technical and economic factors likely to influence the prospect of economic extraction can be resolved with further work.

11.14 Mineral Resource Summary

Mineral resources must demonstrate reasonable prospects for eventual economic extraction. The “reasonable prospects” test generally implies that the quantity and grade estimates meet certain economic thresholds and modifying factors that that take into account extraction scenarios and processing recoveries. The deposit gold mineralization is amenable for open pit extraction. To determine the quantities of material meeting the reasonable prospects of eventual economic extraction by an open pit, RDA used the Lerchs-Grossman © economic algorithm, which constructs lists of related blocks that should or should not be mined. The final list defines a surface pit shell that has the highest possible total value, while honoring the required surface mine slope and economic parameters.

Economic parameters used in the analysis are based on an average gold price of $1,650/oz on the date of August 20, 2021. Pit optimization parameters are shown in Table 11-11. Gold recoveries are tonnage-weighted and include the recovery from massive stibnite of 22%.

Table 11-11: Pit constraining parameters used for the Livengood Gold Project

Parameter	Unit	Rock Type 4	Rock Type 5	Rock Type 6	Rock Type 7	Rock Type 8	Rock Type 9
Mining Cost	$/total mt	1.76	1.74	1.74	1.68	1.76	1.76
Au Cut-off	g/mt	0.21	0.20	0.25	0.25	0.33	0.33
Processing Cost	$/process mt	9.27	9.15	9.17	9.50	9.71	9.71
Au Recovery	%	84	80	71	67	55	56
Administrative Cost	$/process mt	1.55	1.55	1.55	1.55	1.55	1.55
Royalty	%	3	3	3	3	3	3
Au Selling Price	$/oz	1,650	1,650	1,650	1,650	1,650	1,650
Overall Slope Angle	Degrees	45	45	45	45	45	45

The parameters listed in Table 11-11 above define a realistic basis to estimate the mineral resource for the Livengood Gold Project and are representative of similar mining operations throughout North America. The mineral resource has been limited to mineralized material that occurs within the pit shells and that could be scheduled to be processed based on the defined cut-off grade by rock type. All other material within the defined pit shells, other than the six predominant mineralized sedimentary units, was characterized as non-mineralized material. The QP used the gold selling price of $1,650/oz which is based a 5% premium on the three-year trailing average gold selling price of $1585/oz at August 2021. The QP applied the premium to the gold price to recognize the continued upward trend of metal prices entering in to the fourth quarter of 2021.

The reader is cautioned that the results from the pit optimization are used solely for reporting the reasonable prospects for eventual economic extraction by an open pit and do not represent an economic study, using modifying factors that could convert mineral resources to mineral reserves. RDA considers that blocks located within a conceptual pit shell are amenable for open pit extraction and can be reported as the mineral resource for the Project.

The mineral resource estimate for the Project (2021 MRE) is summarized in Table 11-12. Mineral resources are reported at various cut-off grades to reflect the throughput factors and varying costs by rock type for processing at Livengood as shown in Table 11-11. Mineral resources are not mineral reserves and do not meet the threshold for reserve modifying factors, such as estimated economic viability, that would allow for conversion to mineral reserves.

This TRS discloses mineral reserves in Chapter 12. The mineral resources disclosed in Table 11-12 are exclusive of the mineral reserves disclosed in Chapter 12. Table 11-13 discloses the Livengood mineral resource estimate inclusive of mineral reserves.

Table 11-12: Livengood Gold Project mineral resource estimate (exclusive of mineral reserves) (2021 MRE), August 20, 2021 – Resource Development Associates Inc.

Classification	Metric tons (Mmt)	Au (g/mt)	Contained Au (Koz)
Measured	234.50	0.53	3,990.49
Indicated	40.01	0.49	629.61
Total M & I	**274.51**	**0.52**	**4,620.10**
Inferred	15.98	0.40	206.98

1. The effective date of the estimate is August 20, 2021.
2. Mineral resources for the Project are enumerated as per §229.1302(d)(1)(iii)(A) (Item 1302(d)(1)(iii)(A) of Regulation S-K).
3. Mineral resources are not mineral reserves and do not meet the threshold for reserve modifying factors, such as estimated economic viability, that would allow for conversion to mineral reserves. There is no certainty that any part of the mineral resources estimated will be converted into mineral reserves;
4. Open pit resources stated as contained within a potentially economically minable open pit; pit optimization was based on an assumed price for gold of US$1,650/oz, variable mining and recoveries as described in Table 11-11, and G&A cost of US$1.55/t, and a pit slope of 45 degrees;
5. Numbers in the table have been rounded to reflect the accuracy of the estimate and may not sum due to rounding;
6. Mineral resources are reported exclusive of mineral reserves. The reserves reported in Chapter 12 represent measured mineral resources and indicated mineral resources that were evaluated with modifying factors related to open pit mining.

**Table 1113: Livengood Gold Project mineral resource estimate (inclusive of mineral reserves)-
(2021 MRE), August 20, 2021 – Resource Development Associates Inc.**

Classification	Metric tons (Mmt)	Au (g/mt)	Contained Au (Koz)
Measured	646.00	060	12,482.49
Indicated	58.51	0.61	1,141.61
Total M & I	**704.51**	**0.60**	**13,624.10**
Inferred	15.98	0.40	206.98

1. The effective date of the estimate is August 20, 2021.
2. Mineral resources are not mineral reserves and do not meet the threshold for reserve modifying factors, such as estimated economic viability, that would allow for conversion to mineral reserves. There is no certainty that any part of the mineral resources estimated will be converted into mineral reserves;
3. Open pit resources stated as contained within a potentially economically minable open pit; pit optimization was based on an assumed price for gold of US$1,650/oz, variable mining and recoveries as described in Table 11-11, and G&A cost of US$1.55/t, and a pit slope of 45 degrees;
4. Numbers in the table have been rounded to reflect the accuracy of the estimate and may not sum due to rounding;
5. Mineral resources are reported inclusive of mineral reserves. The reserves reported in Chapter 12 represent measured mineral resources and indicated mineral resources that were evaluated with modifying factors related to open pit mining.

11.15 Grade Sensitivity Analysis

Mineralization at Livengood is sensitive to the selection of the reporting cut-off grade. To illustrate this sensitivity, the block model quantities and grade estimates within the constraining pit are presented in Table 11-14 at linear increases in the cut-off grades for Measured, Indicated and Inferred mineral mineralization at Livengood. The same results are presented graphically in Figure 11-17. The reader is cautioned that Table 11-14 should not be misconstrued as a mineral resource. The reported quantities and grades are only presented as a sensitivity of the resource model to the selection of cut-off grade. Mineral resources are not mineral reserves and do not meet the threshold for reserve modifying factors, such as economic viability, that would allow for conversion to mineral reserves.

Table 11-14: Sensitivity of block model to cut-off grade

Cut-off Au g/mt	Measured			Indicated			Measured & Indicated			Inferred		
	Metric Tons (000)	Grade Au g/mt	Au oz (000)	Metric Tons (000)	Grade Au g/mt	Au oz (000)	Metric Tons (000)	Grade Au g/mt	Au oz (000)	Metric Tons (000)	Grade Au g/mt	Au oz (000)
0.2	816,569	0.53	13,914	73,263	0.53	1,248	889,832	0.53	15,162	20,423	0.37	243
0.3	626,843	0.61	12,293	55,069	0.63	1,115	681,912	0.61	13,409	13,359	0.43	185
0.4	464,710	0.71	10,608	37,347	0.76	913	502,057	0.71	11,520	6,017	0.52	101
0.5	332,891	0.81	8,669	25,437	0.91	744	358,328	0.82	9,413	2,142	0.65	45
0.6	234,524	0.92	6,937	17,976	1.06	613	252,500	0.93	7,549	1,079	0.75	26
0.7	164,938	1.03	5,462	13,645	1.19	522	178,583	1.04	5,984	614	0.84	17
0.8	117,098	1.15	4,329	10,648	1.31	448	127,746	1.16	4,778	335	0.92	10
0.9	83,825	1.26	3,396	8,372	1.44	388	92,197	1.28	3,783	180	0.98	6
1.0	61,474	1.38	2,727	6,479	1.58	329	67,953	1.40	3,057	59	1.04	2

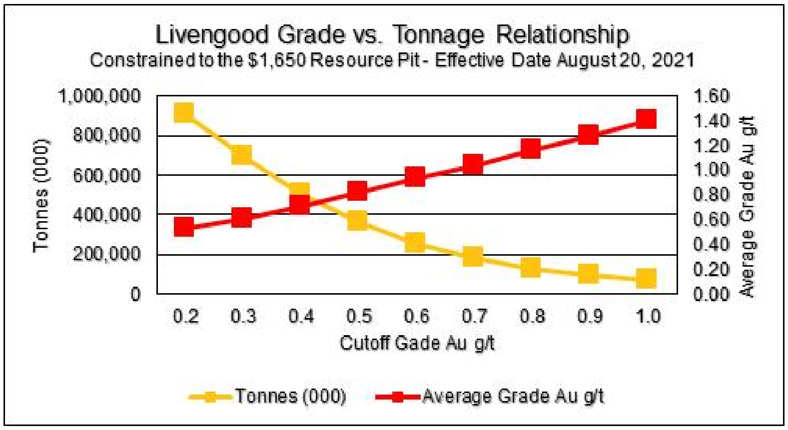


Figure 11-17: Livengood grade vs tonnage relationship

11.16 Sensitivity of Mineralization to Gold Price

The sensitivity of mineralization defined by the evaluation of the mineralization inventory at different gold prices was performed for gold prices of $984/oz (-20%), $1,320/oz (resource base case) and $1,980/oz (+20%). The input parameters defined in Table 11-11 above were used in the analysis. Table 11-15 lists the amount of the mineralization contained within the pit shells that could be scheduled to process.

Table 11-15: Sensitivity of mineralization inventory contained in pit shells defined by Whittle™ Analyses at different gold prices within pit shells

Whittle™ Pit Gold Price	Classification	Metric Tons (Mmt)	Au (g/t)	Contained Au (Koz)
$1,320	Measured	423.84	0.70	9,496.30
	Indicated	24.35	0.85	666.13
	Total M & I	**448.19**	**0.71**	**10,162.43**
	Inferred	2.02	0.55	35.93
$1,650	Measured	646.00	0.60	12,482.49
	Indicated	58.51	0.61	1,141.61
	Total M & I	**704.51**	**0.60**	**13,624.10**
	Inferred	15.98	0.40	206.98
$1,980	Measured	845.60	0.54	14,668.81
	Indicated	108.98	0.49	1,717.27
	Total M & I	**954.58**	**0.53**	**16,386.08**
	Inferred	31.97	0.37	377.99

12. MINERAL RESERVE ESTIMATES

12.1 Introduction

The Livengood deposit will be mined using conventional open pit mining methods consisting of drilling, blasting, loading, and hauling with large-scale mining equipment. The processing flowsheet consists of primary crushing, secondary crushing, and a comminution circuit (SABC configuration) producing a final grind size of 250 µm (P_{80}), with gravity recovery followed by whole ore leaching (CIL) of the gravity tailings. The mill has been designed with a nominal throughput of 65,000 t/d (59,000 mt/d). Tailings will be stored in a conventional slurry tailings facility.

The mine production plan and subsequent mineral reserves are based on a gold price of $1,680/oz. The mineral reserves for the Livengood Project were prepared by BBA USA Inc. and have an effective date of October 22, 2021.

Development of the mine production plan included pit optimization, pit and phase designs, mine scheduling and the application of modifying factors to the Measured and Indicated Mineral Resources. The reference point for the mineral reserves is the feed to the primary crusher. The tonnages and grades reported are inclusive of mining dilution and operational mining losses.

The mine design and mineral reserve estimates have been completed to a level appropriate for a PFS. The mineral reserve estimate stated herein is consistent with the S-K 1300 requirements and is suitable for public reporting. As such, the mineral reserves are based on Measured and Indicated Mineral Resources, and do not include any Inferred Mineral Resources. The Qualified Person is not aware of any legal, political, or other risks that could materially affect the development of the mineral reserve.

Table 12-1 presents the mineral reserves for the Project, which include 411.5 Mmt of Proven Mineral Reserves at an average gold grade of 0.64 g/mt, and 18.5 Mmt of Probable Mineral Reserves at an average gold grade of 0.86 g/mt for a total of 430.1 Mmt of Proven and Probable Mineral Reserves at an average gold grade of 0.65 g/mt. To access these mineral reserves, 496.1 Mmt of overburden and waste rock must be mined, resulting in a strip ratio of 1.15:1.

The mill recoveries developed for the Project, discussed in further detail in Section 12.3.2, depend on the rock type and are calculated using linear equations that are a function of antimony concentration, grind size and gold grade. As a result, it is not possible to calculate a cut-off grade for the mineral reserves that can be uniformly applied across each resource block. The determination of ore and waste was done by evaluating the recovery and economics of each block. For Measured and Indicated blocks within the open pit, if the revenue less the processing and general and administration cost is positive, the block is considered as ore. Table 12-2 presents the lowest grades processed by rock type in the LOM.

Table 12-1: Livengood Project mineral reserves (October 22, 2021- BBA USA Inc.)

Classification	Ore Metric tons (Mmt)	Au Grade (g/mt)	Contained Au Koz
Proven			
RT4	75.4	0.54	1,314
RT5	110.5	0.55	1,972
RT6	91.7	0.65	1,922
RT7	61.0	0.70	1,367
RT8	2.4	0.73	56
RT9	70.5	0.82	1,861
Total Proven	**411.5**	**0.64**	**8,492**
Probable			
RT4	2.5	0.48	39
RT5	4.0	0.47	62
RT6	3.0	0.99	94
RT7	4.8	0.98	152
RT8	0.3	0.76	6
RT9	3.9	1.26	159
Total Probable	**18.5**	**0.86**	**512**
Proven and Probable Totals	**430.1**	**0.65**	**9,004**

1. The effective date of the estimate is October 22, 2021.
2. Mineral reserves for the Project are enumerated as per added §229.1302(e)(2)(iii)(A) (Item 1302(e)(2)(iii)(A) of Regulation S-K).
3. Mineral reserves are estimated using a gold price of US$1,680 per ounce, and consider a 3% royalty, 1.80/oz for smelting, refining, and transportation costs, and a gold payable of 99.9%.
4. Metallurgical recovery curves were developed for each rock type, with the Mineral Reserves having the following tonnage weighted averages: 83.3% for RT4, 79.8% for RT5, 73.5% for RT6, 66.4% for RT7, 58.7% for RT8 and 57.1% for RT9, including 22% for massive stibnite mineralization.
5. As a result of the complex metallurgical recovery equations, it is difficult to determine specific cut-off grades. The following presents the lowest gold grades for each rock type that are processed in the life of mine plan: 0.26 g/t for RT4, 0.28 g/t for RT5, 0.31 g/t for RT6, 0.31 g/t for RT7, 0.42 g/t for RT8 and 0.42 g/t for RT9.
6. The strip ratio for the open pit is 1.15 to 1.
7. The mineral reserves are inclusive of mining dilution and ore loss.
8. The reference point for the mineral reserves is the primary crusher.
9. Totals may not add due to rounding.

Table 12-2: Lowest grades processed

Rock Type	Au Grade g/mt
RT4	0.26
RT5	0.28
RT6	0.31
RT7	0.31
RT8	0.42
RT9	0.42

12.2 General Parameters Used to Estimate the Mineral Reserves

The following section discusses the geological information that was used for the mine design and mineral reserve estimate. This information includes the topographic surface, the geological block model and the material properties for ore, waste rock and overburden.

The mine design and mine planning were done using Hexagon's MinePlan 3D software Version 15.8 (formerly known as MineSight). The mine design work was completed using the UTM NAD27 coordinate system, in metric units, to be aligned with the geology and mineral resource work.

12.2.1 Topographical Data

The topographic information used for the Project originates from a file called "Aero_Elev_Contours_2m_NAD27.dwg". These contours contain an adequate resolution deemed appropriate for a PFS level.

There are no lakes or rivers in the Project area that are of importance for the mine design. The creeks are easily identifiable using the topographic information available.

12.2.2 Mineral Resource Block Model

The mineral resource block model was provided to BBA by Resource Development Associates Inc. on June 4, 2021, in a Vulcan format block model file called "210526_rda_model.bmf", which BBA then imported into the MinePlan 3D. Table 12-3 presents the block model specifications and Table 12-4 presents the items that were provided with the block model. The block model does not have a rotation applied.

Table 12-3: Block model specifications

Item	Unit	X	Y	Z
Model Origin (min)	m	427,600	7,264,310	-290
Model Extent (max)	m	430,850	7,266,710	610
Block Dimension	m	10	10	10
Number of Blocks		325	240	90

Table 12-4: Block model item list

Item	Description
CRAU	Au grade of country rock before combination with Massive Stibnite (g/mt)
CRSB	Sb grade of country rock before combination with Massive Stibnite (ppm)
MSVAU	Au grade of Massive Stibnite before combination with country rock (g/mt)
MSVSB	Sb grade of Massive Stibnite before combination with country rock (ppm)
AU	Average Au grade considering country rock and Massive Stibnite (g/mt)
SB	Average Sb grade considering country rock and Massive Stibnite (ppm)
CLASS	Resource Classification (1 = Measured, 2= Indicated, 3 = Inferred)
MSVP	Massive Stibnite percentage in block
DENS	Block density based on rock type
RTYPE	Rock type (see Table 12-5)

A surface representing the overburden/bedrock contact was provided by the BBA geology team as a triangulated surface called “OVB__F200917.dxf”. Overburden is classified as loess, colluivum, and weathered bedrock that lies above the bedrock. Blocks have been coded as overburden if a majority of the block is above this surface. The QP is of the opinion that no further precision is required for the overburden quantities and is comfortable using this “whole block” approach for the PFS.

The overburden thickness within the open pit area for the Project averages 30 ft (9 m), ranging from 6 ft to 80 ft (2 m to 24 m). The majority of the pit area has less than 16 ft (5 m) of overburden, while the only area that has considerable thickness is in the northeast corner of the pit.

Table 12-6 presents the rock code numbering system that was used. It is important to note that only the Cambrian, Upper and Lower Sediments as well as the Volcanics contain potentially economic mineralization.

An average topsoil thickness of 12 inches (30 cm) was assumed for mine design purposes. This material will be stripped and placed separately in growth media stockpiles to be used for closure and reclamation activities.

Table 12-5: Rock type numbering

Rock type	Rock code
Overburden	1
Money Knob	2
Cambrian	4
Upper Sediments North of the Lilian Fault	5
Upper Sediments South of the Lilian Fault	6
Lower Sediments	7
Volcanics North of the Lilian Fault	8
Volcanics South of the Lilian Fault	9
Background (outside of modeled areas)	99

The Livengood deposit contains a rock type called Massive Stibnite that has very high head grades but a very low gold recovery in the mill. A DXF file containing solids that represent the Massive Stibnite zones was provided by the BBA geology team in a file called “GM_InterpretationSb_20200824.dxf”. The value “MSVP” was coded in the block model to represent the percentage of Massive Stibnite for each block. It is important to note that the Massive Stibnite represents approximately 0.3% of the mineralized material in the deposit. Gold and antimony grades have been interpolated separately for the Massive Stibnite and country rock portions of each block containing Massive Stibnite. The block densities, however, represent a combination of the country rock and Massive Stibnite densities. Densities are discussed in Section 12.2.3.

A DXF file called “SB_ PPM QtzStibVns Trended_NO MSV_100 ppm.dxf” was provided by the BBA geology team containing a series of triangulated solids representing areas of the deposit where the antimony grades are generally above 100 ppm. These solids were used to calculate mill recoveries, which is discussed in further detail in Section 12.3.2.

12.2.3 Bulk Density

Bulk density is an important measurement that converts volumes modeled by the geologists into tonnages and contained ounces of gold. It is also used to estimate mine equipment requirements. The densities used for the PFS have been measured using 98 different samples from diamond drill cores and reverse circulation (RC) chip samples and are presented by rock type in Table 12-6.

Table 12-6: Bulk dry densities

Rock type	Bulk dry density (mt/m^3)
RT1	2.00
RT2	2.67
RT4	2.82
RT5 / RT6	2.68
RT7	2.74
RT8 / RT9	2.72
Massive Stibnite	2.86

12.2.4 Moisture Content

Mineral resources and mineral reserves are reported as in situ dry metric tons. The mill process reports wet metric tons, which include the moisture content. The moisture content reflects the amount of water present within the rock formation. It affects the estimation of haul truck requirements and must be considered during the payload calculations. The moisture content is also a contributing factor for the process water balance. A moisture content of 4% has been used for all rock types, which is based on crushing simulation work completed for the Project. A moisture content of 10% has been used for overburden.

12.2.5 Swell Factor

The swell factor reflects the increase in volume of the material from its in situ state to its state after it has been blasted and loaded into the haul trucks. The swell factor is an important parameter that is used to determine the loading and hauling equipment requirements, as well as the rock pile and stockpile designs. A swell factor of 30% was used for all rock types and 20% overburden, which are typical values for these material types. Once the rock is placed on the rock pile, the swell factor is reduced by 10% due to compaction.

12.3 Modifying Factors That Affect the Mineral Reserves

The following section presents the modifying factors that were applied to convert mineral resources into mineral reserves for the Project, as well as the pit optimization analysis and open pit design. The mineral reserves for the Livengood Project could be materially affected by changes to the modifying factors such as a decrease in the estimated mill recoveries, a decrease in the gold price, or an increase to the operating costs.

12.3.1 Mine Dilution

In every mining operation, it is impossible to perfectly separate the ore and waste due to the large scale of the mining equipment and the use of drilling and blasting. For the Livengood Project, a diluted grade was calculated for every block by considering an amount of 5% from each of the four neighboring blocks in plan view. The value of 5% represents a width of 1.6 ft (0.5 m), which is considered reasonable considering the size of the loading equipment and nature of the deposit. Only the grades have been diluted, the tonnages remain intact since it is just a transfer of tons from one block to another. After calculation of dilution, the in situ grade within the ultimate pit design drops from 0.653 g/mt to 0.649 g/mt.

Considering the nature of the deposit and the methodology used to estimate mining dilution, the mining recovery has been set at 100% for the PFS.

12.3.2 Open Pit Optimization

A pit optimization analysis has been completed to determine the extent of the deposit that can be mined and processed economically. The pit optimization was done using the pseudo-flow algorithm in the Project Evaluator module of MinePlan 3D. The algorithm determines the economic limits of the open pit at a range of selling prices based on input of mining and processing costs, revenue per block, and operational parameters such as the mill recovery, pit slopes and other imposed physical constraints. The pseudo-flow algorithm provides similar results as the Lerch-Grossman algorithm with the benefit of shorter computing times. Since this study is at a PFS level, Inferred Mineral Resources have been considered as waste rock in the pit optimization and mine plan.

The pit optimization considered the activity-based costing methodology that distinguishes fixed costs from variable costs. Fixed costs are time related with no direct production drivers while variable costs are directly related to a production driver in the system. The total fixed costs per year are then allocated to the system bottleneck, which, for the Project, is the SAG mill processing capacity. Table 12-7 presents the hourly processing throughputs by rock type that were developed for the Project by the BBA process team.

Table 12-7: Processing throughput capacities by rock type

Rock type	Processing throughput capacities (t/h)
RT4	3,208
RT5	2,866
RT6	2,888
RT7	2,866
RT8 / RT9	2,745

Table 12-8 presents the fixed costs for the operation that were developed by BBA at the start of the PFS, representing those of a 65,000 t/d (59,000 mt/d) milling operation and a 61 Mt/y (55 Mmt/y) mining operation.

Table 12-8: Fixed costs by area

Area	Fixed costs (M$/y)
Mine	24.2
Process Plant	33.5
General & Administration	27.0
Total Fixed Costs	**84.7**

The fixed costs are then divided by the SAG mill hours of operation, which are estimated to be 7,949 hours per year, resulting in a bottleneck cost of $10,655 applied to every hour of milling.

The variable cost parameters for the pit optimization analysis were developed at the start of the PFS and are based on previous studies on the Project and BBA's relevant experience. These costs are presented in Table 12-9. The mining cost represents drilling, blasting, loading and hauling at a reference elevation of 420 m (bottom of bench). The mining cost is incremented by $0.02/mt for every 10 m drop in elevation to account for longer haulage times. Benches above the 420 m reference elevation are assigned the base mining costs. The costs vary by rock type due to the different hardness and rock characteristics. The processing costs consider the power cost, consumable cost and tailings cost and are based on an electricity cost of $0.16/kWh. The table also includes the bottleneck cost for each rock type, which is equal to the annual bottleneck cost of $10,655/h divided by the processing throughput (Table 12-7).

Table 12-9: Pit optimization cost inputs ($/mt)

Rock type	Mining cost (ore)	Mining cost (waste)	Processing cost	Bottleneck cost
RT1	n/a	0.86	n/a	n/a
RT2	n/a	1.34	n/a	n/a
RT4	1.32	1.34	7.34	3.66
RT5	1.30	1.32	7.22	4.10
RT6	1.30	1.32	7.24	4.07
RT7	1.24	1.26	7.57	4.10
RT8 / RT9	1.32	1.34	7.78	4.28

Table 12-10 presents the revenue parameters that were used for the pit optimization. A gold price of $1,650/oz was used, in line with the 3-year trailing average. Note that the financial analysis for the PFS was completed at a slightly higher gold price of $1,680/oz.

Table 12-10: Revenue parameters

Item	Unit	Value
Selling Price	$/oz	1,650
Conversion Factor		31.1035
Smelting, refining and transport	$/oz	1.80
Gold Payable	%	99.50
Royalty	%	3.00
Net Gold Price	$/oz	1,591

Table 12-11, Table 12-12, and Table 12-13 present the mill recovery formulas developed by the BBA process team at the start of the PFS. The recoveries depend on the rock type and are calculated using linear equations, which are a function of antimony concentration, grind size and gold grade. The blocks have been flagged with an item called "OSX" according to the following rules:

- Blocks that are outside of the 100 ppm antimony shell are coded as "1";
- Blocks that are inside the 100 ppm antimony shell are coded as "2";
- Blocks that have an antimony grade above 200 ppm, regardless of whether they are in or out of the 100 ppm antimony shell are coded as "3".

The tables present the formulas and also include either a minimum recovery (floor) or maximum recovery (ceiling) where applicable. Note that all calculated recoveries including the floor and ceiling are multiplied by 0.997 to reflect a carbon efficiency factor.

Also note that the Cambrian (Rock Type 4) and Upper Sediments North of the Lilian Fault (Rock Type 5) were only coded with an OSX value of either "1" or "3" since no recovery formula was developed for these rock types if the antimony grade was above 100 ppm. This was deemed acceptable since there are very few of these occurrences in the block model.

Table 12-11: Mill recoveries (OSX = 1)

Rock code	Formula [1]	a	b	n	Ceiling
4	b x 250 + n		-0.011	86.65	n/a
5	b x 250 x n		-0.038	89.56	n/a
6	a x Au + b x 250 + n	8.04	-0.024	76.15	96.12
7	a x Au + b x 250 + n	0.53	-0.020	77.98	84.67
8 / 9	a x Au + b x 250 + n	5.73	-0.049	67.27	79.39

(1) The gold (Au) grade is in g/mt

Table 12-12: Mill recoveries (OSX = 2)

Rock code	Formula [1]	a	b	n	Ceiling
4 / 5	n/a				n/a
6	a x Au + b x 250 + n	15.05	-0.017	56.27	89.98
7	a x Au + b x 250 + n	19.55	-0.007	48.01	91.33
8 / 9	a x Au + b x 250 + n	13.00	-0.035	50.84	77.12

(1) The gold (Au) grade is in g/mt

Table 12-13: Mill recoveries (OSX = 3)

Rock code	Formula [1]	c	b	n	Floor
4 / 5	n			75.00	n/a
6 / 7 / 8 / 9	c x Sb + b x 250 + n	-0.008		55.33	20.00

(1) The antimony (Sb) grade is in ppm

For blocks that contain Massive Stibnite, due to the large size of the mining equipment and general narrow thickness of the Massive Stibnite veins, it was decided that the Massive Stibnite will not be separated from the host country rock during mining. An average mill recovery was therefore calculated for each block in the model, which considers the mill recovery of the country rock and a mill recovery of 22% for the Massive Stibnite portion. The average mill recovery for the block is mass weighted.

Table 12-14 presents the average mill recoveries for each rock type within the ultimate pit design.

Table 12-14: Average mill recoveries by rock type (%) [1]

Rock type	OSX			Average [2]
	1	2	3	
RT4	83.4		74.0	83.3
RT5	79.9		74.8	79.8
RT6	76.4	63.9	48.9	73.5
RT7	72.8	64.0	48.5	66.4
RT8	59.3	52.0	43.5	58.7
RT9	60.0	55.1	48.9	57.1
Tonnage Weighted Average Mill Recovery	**75.1**	**60.4**	**50.1**	**71.4**

[1] Including massive stibnite at 22% mill recovery.
[2] Grams weighted.

An overall pit slope of 37 degrees was considered in the pit optimization. The slope is shallower than the 42 degree inter-ramp angle that has been recommended in the geotechnical study, discussed in Section 12.3.3.1, since it accounts for the future addition of access ramps and geotechnical berms during the pit design process.

A minimum offset of 25 m has been considered from the Livengood property limit.

Using the cost, revenue, and operating parameters, a series of nested pit shells was generated by varying the gold price (revenue factor). The software then generated best-case and worst-case mining sequences using the series of shells and produced two net present values (NPV) for each revenue factor. The best-case scenario considered that mining will be sequenced using each of the nested shells while the worst-case scenario considered that mining will be done without phasing. The NPVs have been generated using a discount rate of 5%.

Figure 12-1 and Table 12-15 present the results for each of the revenue factor pit shells along with their associated best-case and worst-case NPVs. The 0.7 revenue factor pit shell was selected as a guide for the ultimate pit design. This pit contains 439 Mmt of resources at an average diluted grade of 0.66 g/mt and has a strip ratio of 1.3:1.

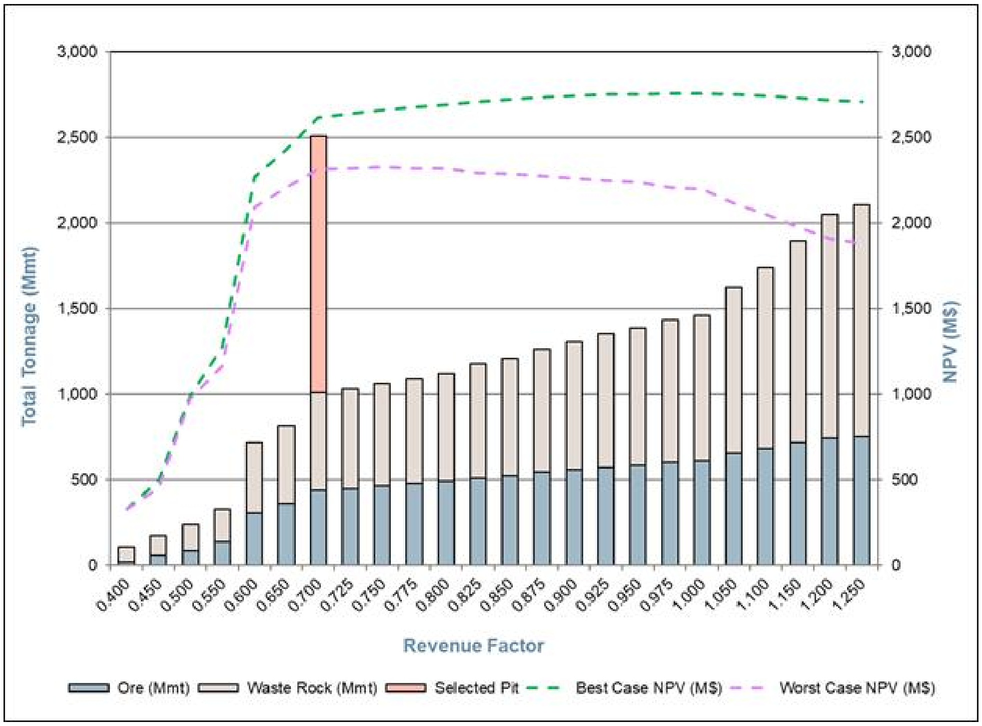


Figure 12-1: Pit optimization results

Table 12-15: Pit optimization results

Revenue Factor	Mineral Resources (Mmt)	Au Grade (g/mt)	Recovered Ounces (oz)	Waste Rock (Mmt)	Strip Ratio	Incremental Strip Ratio	Mine Life (yrs)	Best-Case NPV (M$)	Worst-Case NPV (M$)
0.400	18.8	0.79	368,293	90.7	4.83	4.83	0.9	330	330
0.450	58.9	0.72	1,032,340	115.3	1.96	0.61	2.9	499	453
0.500	86.5	0.73	1,508,170	151.3	1.75	1.30	4.3	994	974
0.550	136.6	0.70	2,240,991	190.6	1.40	0.78	6.8	1,273	1,164
0.600	306.8	0.68	4,746,964	411.5	1.34	1.30	15.3	2,270	2,095
0.650	358.4	0.67	5,434,880	455.2	1.27	0.85	17.9	2,431	2,209
0.700	**438.6**	**0.66**	**6,508,236**	**570.7**	**1.30**	**1.44**	**21.9**	**2,616**	**2,312**
0.725	449.1	0.66	6,638,791	581.3	1.29	1.02	22.5	2,635	2,320
0.750	464.5	0.66	6,825,639	598.3	1.29	1.10	23.2	2,658	2,326
0.775	477.1	0.65	6,972,121	613.0	1.28	1.17	23.9	2,675	2,319
0.800	490.2	0.65	7,126,148	629.7	1.28	1.27	24.5	2,690	2,317
0.825	510.1	0.64	7,359,540	666.5	1.31	1.85	25.5	2,709	2,293
0.850	521.5	0.64	7,492,819	686.1	1.32	1.73	26.1	2,719	2,289
0.875	543.1	0.64	7,734,885	720.0	1.33	1.57	27.2	2,734	2,275
0.900	558.3	0.63	7,902,338	745.8	1.34	1.70	27.9	2,743	2,261
0.925	573.6	0.63	8,079,758	782.6	1.36	2.40	28.7	2,750	2,246
0.950	583.5	0.63	8,185,086	800.0	1.37	1.76	29.2	2,753	2,237
0.975	600.4	0.62	8,361,830	832.9	1.39	1.94	30.0	2,756	2,209
1.000	609.8	0.62	8,457,497	850.2	1.39	1.85	30.5	2,757	2,197
1.050	654.2	0.61	8,923,982	970.8	1.48	2.71	32.7	2,752	2,115
1.100	682.8	0.61	9,218,524	1,058.0	1.55	3.06	34.1	2,745	2,050
1.150	716.1	0.60	9,565,917	1,177.0	1.64	3.57	35.8	2,730	1,977
1.200	742.9	0.59	9,861,747	1,306.0	1.76	4.80	37.1	2,716	1,909
1.250	754.3	0.59	9,972,314	1,350.7	1.79	3.95	37.7	2,708	1,883

12.3.3 Open Pit Design

Using the results of the pit optimization analysis, an operational pit was designed, which is the basis of the LOM. This pit design uses the selected pit shell as a guide and includes smoothing the pit wall, adding ramps to access the pit bottom and ensures that the pit can be mined safely and efficiently. The following section provides the parameters that were used for the open pit design and presents the results.

12.3.3.1 Pit Slope Geotechnical Evaluation

The following information summarizes the findings of the SRK (2013a) feasibility pit slope evaluation as well as supplemental stability analyses completed for the interim pit phase designs by SRK (2016).

Data Collection

A field data collection program was designed and carried out for the Project with the primary objective of rock mass characterization and defining the dominant discontinuity orientations. Field data collection consisted of geotechnical core logging and discontinuity orientation, point load testing and laboratory strength testing. The Livengood site has very minimal outcrop exposure and, consequently, geotechnical mapping could not be carried out to a significant degree.

Tower Hill Mines (THM) technicians logged geotechnical data for all of the 2010 resource drill holes providing the first geotechnical data for mine design; 17 of the 2010 holes (totaling 22,227 ft (6,470 m)) were located within the proposed open pit area and were considered in the development of the geotechnical model. Based on the 2010 information, two supplemental geotechnical specific drilling campaigns were undertaken in 2011 (three holes totaling 2,700 ft (823 m)) and in 2012 (four holes totaling 4,508 ft (1,374 m)). Core from these geotechnical specific holes was logged by SRK personnel at the drill rig on a 24-hour basis. The locations of the 24 combined geotechnical drill holes are shown on Figure 12-2.

A total of 107 core samples were selected from the geotechnical core for laboratory testing including 68 uniaxial compressive strength, 15 triaxial compressive strength, 19 Brazilian tensile strength, and 29 direct shear tests.

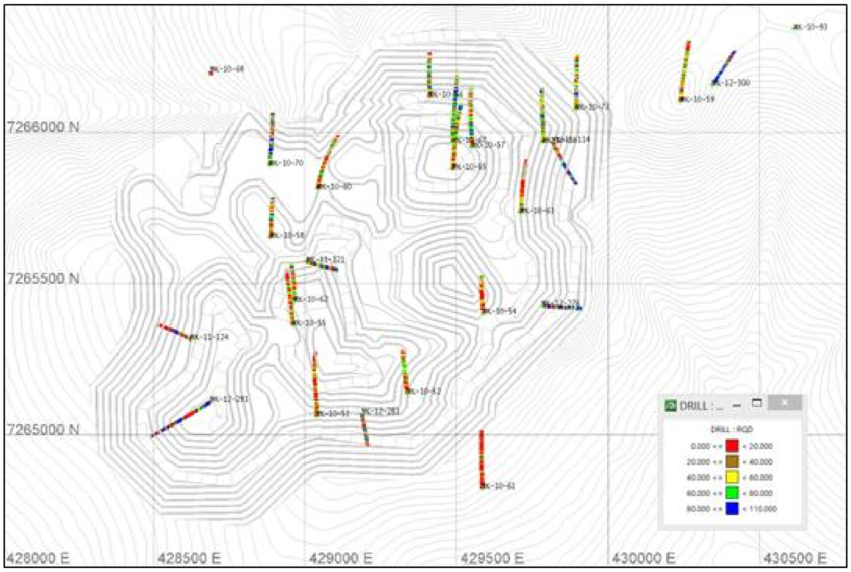


Figure 12-2: Location of geotechnical drill holes

Geotechnical Model

The Project is located within a geologically complex environment composed of interlayered sediments and volcanics that have undergone intense thrusting and faulting. Results of the data collection programs support this, showing heavily fractured, weak to moderate strength rock with various types of alteration.

The field and laboratory data were used to calculate rock mass rating (RMR) values according to the Bieniawski (1989) system for each core run or shorter intervals where conditions varied within a run. This data was used as the primary means of evaluating the overall quality of the various rock types and stratigraphies encountered.

It was determined from data analysis that the materials within each of the main lithologies (i.e. Money Knob Sequence, Upper Sediments, Main Volcanics, Lower Sediments (including the Lower Sand) and Cambrian units) are geotechnically similar and that the data within each could be grouped to form individual engineering units for pit slope analysis. Given that nearly all of the Sunshine area geologic materials are believed to be within the Upper Sediments unit and demonstrated similar geotechnical characteristics, the materials were classified together as one engineering unit, i.e., Sunshine Upper Sediments. RMR statistics for each engineering unit are summarized in Table 12-16.

Table 12-16: Distributions of RMR (Bienawski, 1989) per engineering unit

Engineering Unit	No.	Mean	Std. Dev.
Money Knob	106	54	10
Cambrian	166	55	14
Main Volcanics	64	52	13
Upper Seds (Core Zone)	211	56	14
Lower Seds	190	53	13
Upper Seds (Sunshine)	193	62	14

In order to develop a large population of uniaxial compressive strength (UCS) data for statistical analysis, a total of 1,923 valid point load tests (PLTs) were multiplied by correlation factors to estimate a UCS value for each PLT. A correlation factor was developed for each individual engineering unit according to ASTM standards by pairing each laboratory UCS test with adjacent PLTs, which generally resulted in linear relationships between the two variables. Table 12-17 contains a statistical summary of the overall UCS data per engineering unit.

Table 12-17: Distributions of UCS per engineering unit

Engineering Unit	No.	Mean	Std. Dev.
Money Knob	65	20	15
Cambrian	227	88	172
Main Volcanics	106	69	47
Upper Sediments (Core Zone)	249	32	34
Lower Sediments	290	36	26
Upper Sediments (Sunshine)	808	59	42

Slope Stability Analyses

SRK evaluated both inter-ramp/overall and bench scale stability using probabilistic methods of analysis. Representative inter-ramp/overall slope models were analyzed for a total of six critical design sections as shown on Figure 12-3 to confirm stability of ultimate pit slopes. The critical sections were selected to represent the anticipated most adverse stability conditions such as where the slope height is at its maximum, pit wall materials are low strength and/or pore water pressures may be the highest. The 2012 Livengood three-dimensional stratigraphic and structural models were used to generate the two–dimensional cross sections for modeling. The analyses were conducted using limit equilibrium methods using the Hoek-Brown (2002) rock mass shear strength criteria and the end of mining groundwater surface was developed as part of the SRK (2013b) hydrogeologic model.

Figure 12-3: Critical slope stability sections for the (2013) ultimate pit

Based on accepted engineering experience, inter-ramp/overall slope designs subject to probabilities of failure (POF) ranging from 20% to 30% for slopes with low failure consequences and approximately 5% to 10% for high failure consequences are considered appropriate by SRK for most open pit mines. Slopes of high failure consequence are generally those slopes that are critical to mine operations, such as those on which major haul roads are established, those providing ingress or egress points to the pit, or those underlying infrastructure such as processing facilities or structures. Given the relatively high variability in rock quality and groundwater levels, a maximum POF of 20% was considered acceptable for the non-critical slopes. Results of the analyses are summarized in Table 12-18. While Section C demonstrates a slightly higher POF than targeted, it was considered acceptable due to the short slope length and the flexibility to re-design the ramp should an instability occur.

Table 12-18: Overall slope stability analysis results for the ultimate pit

Section	Probability of Failure	Mean Factor of Safety	Recommended Geotechnical Berm Elevations
A	3%	1.7	NA
B	3%	1.9	NA
C	22%	1.2	NA
D	8%	1.4	Elev. 220, 320
E	14%	1.3	Elev. 220
F	18%	1.3	Elev. 120, 220, 320

Geotechnical berms were incorporated into the design to reduce the overall slope angles, where necessary, to achieve acceptable POF. The geotechnical berms are designed at a total width of 82 ft (25 m).

Pit Slope Design Recommendations for the Ultimate Pit

The final pit slope design recommendations for the ultimate pit are summarized in Table 12-19 with corresponding sectors shown on Figure 12-4.

Table 12-19: Pit slope design recommendations for ultimate pit

Pit Sector	Max. Overall Slope Angle	Max. Inter-ramp Slope Angle	25 m Geotech. Berms (Approx. Elev.)	Bench Height (m)	Bench [(1)] Width (m)	Bench [(1)] Face Angle
A	40	42	220, 320	20	12/14.9	63/70
B	41	42	220, 320	20	12/14.9	63/70
Remaining Areas	42	42	N/A	20	12/14.9	63/70

[(1)] The 42° inter-ramp may be achieved by either 14.9 m width with 70° bench face angles or 12 m width with 63° bench face angles.

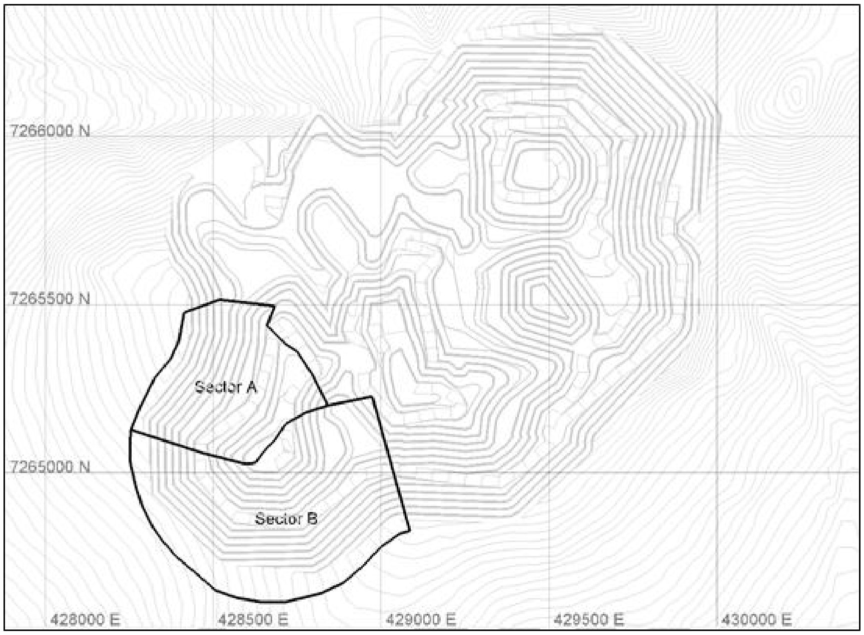


Figure 12-4: Pit Slope Design Sectors for the Ultimate Pit

Recommendations were provided for both 63º and 70º bench faces angle configurations. The 63º bench face angle represents the lowest risk of local bench instabilities, particularly for the Sunshine pit north wall, where bedding will dip shallowly into the pit; however, depending on the mining equipment selected and on operational considerations, excavation of 70º bench face angles may be more practical. Considering the relatively wide catch benches (14.9 m) that would be required to achieve the 42º inter-ramp angle, localized bench sloughing that may occur with the 70º bench face angles is expected to be retained by the catch bench beneath. Regardless of which bench configuration is selected, inter-ramp slope angles should not be increased over 42°.

Pit Slope Design Recommendations for Early Mine Phase Interim Pit Walls

Subsequent to the initial SRK (2013a) feasibility pit slope study, additional analyses were completed by SRK (2016) to optimize interim pit wall angles, minimizing waste handling during the critical payback period. A total of six critical slope stability sections were analyzed for the interim slopes with the maximum inter-ramp slope heights ranging between 120 m and 160 m.

The average properties were used for the deterministic analyses to represent the rock mass strength inputs for each of the primary rock types (Table 12-16 and Table 12-17). Groundwater surfaces were estimated for each model based on the SRK (2013b) hydrogeologic model. Acceptability criteria for the work included a 1.3 safety factor and a 5% to 10% maximum POF (high failure consequence slopes) due to the proximity of the haul roads to the interim slopes analyzed. The analyses indicated safety factors between 1.5 and 2.4 for the optimized slopes with probabilities of failure ranging between 1 % and 10 %.

The results of the interim slope stability analyses indicated that stability of lower, interim slope heights will be controlled primarily by achievable bench face angles and, to a lesser extent, the stability of high inter-ramp and overall slopes. Calculated safety factors could be considered relatively high for typical open pit slope designs. However, steepening of the inter-ramp slope angles beyond 47° would require steeper bench face angles or reducing the design catch bench width, which is not recommended at the feasibility level due to the lack of rock exposure and actual geologic structural information. With detailed geotechnical bench face mapping and good quality wall control blasting practices, opportunity may exist to steepen the inter-ramp angles based on more accurate information acquired during pit development.

Based on the (SRK, 2013a) feasibility study geotechnical characterization and subsequent slope stability analyses (SRK, 2016) described above, SRK recommends that a maximum inter-ramp slope angle of 47° be used for inter-ramp slope heights of less than 160 m.

12.3.3.2 Pit Wall Configuration

Table 12-20 presents the pit wall configurations that were used by BBA for the PFS pit and phase designs.

Table 12-20: Pit wall configuration

Description	Unit	Initial Phases	Later Phases
Bench Height	ft	65.6	65.6
Bench Configuration		Double	Double
Bench Face Angle	deg	70	70
Catch Bench Width	ft	37.4	48.9
Inter-ramp Angle	deg	47	42

The pit design includes an 82 ft (25 m) wide berm at the 250 m elevation in the southwest part of the pit, as per the geotechnical recommendation.

With respect to the pit wall configuration in the overburden, the pit slope report states the following: "At Livengood, overburden soil cover is generally thin, thereby limiting permafrost melting and flowing to a mostly operational issue. In response, extra-wide berms or access points should be left within or at the base of overburden materials to provide catchment and to permit clean-up of sloughing areas if necessary". Since the overburden thickness in the pit area is very limited, as discussed in Section 12.2.2, especially along the final pit walls, the QP has not considered a modified pit wall configuration in the overburden nor a catchment berm since this was deemed to have a very small overall impact on the stripping ratio. The next level of study would warrant more detail in the pit design related to the overburden slopes.

12.3.3.3 Haul Ramp Design

The haul ramps within the pit have been designed for haulage with 320 t (291 mt) sized rigid frame mining trucks, with an overall width of 112 ft (34 m). For double lane traffic, industry practice indicates the running surface width to be a minimum of three times the width of the largest truck.

The overall width of a 320 t rigid frame mining truck is 30 ft (9.1 m), resulting in a running surface of 89.6 ft (27.3 m). The allowance for berms and ditches increases the overall haul road width to 112 ft (34 m). Single-lane traffic has been considered for the final 4 benches (40 m in elevation), reducing the overall ramp width to 85 ft (26 m). Figure 12-5 presents the haul road configuration for 2-way traffic. A maximum ramp grade of 10% has been considered.

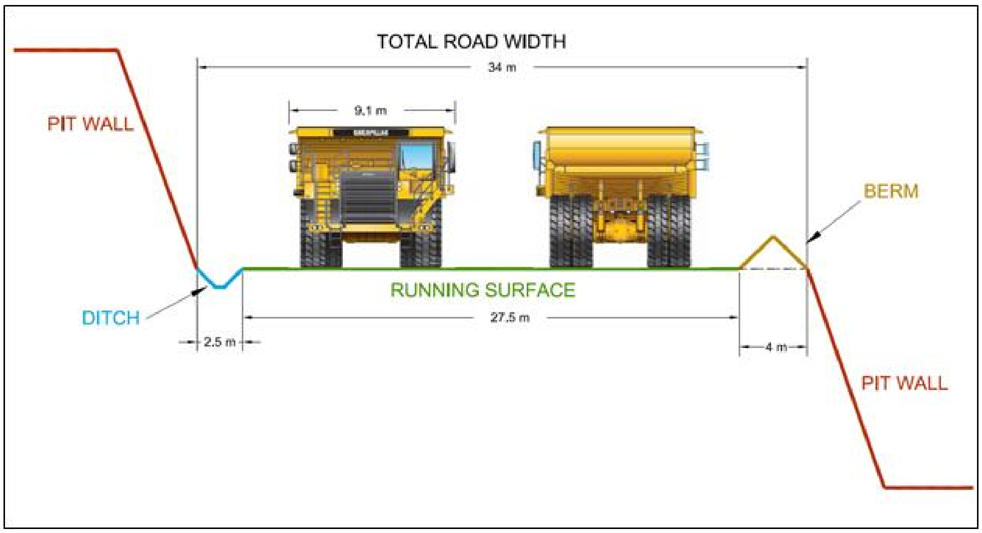


Figure 12-5: Haul road configuration

12.3.3.4 Minimum Mining Width

A minimum mining width of 165 ft (50 m) has been considered for the pit design. This width must be respected to ensure that a 320 t haul truck, which has a turning radius of 105 ft (32 m), can safely enter the mining area and make a 180° turn to be positioned for loading.

12.3.3.5 Final Bench Access

In order to reduce the stripping ratio as much as is feasibly safe and efficient, the access ramp has not been designed to the bottom of the lowest benches. When mining the final bench, the haul trucks will be positioned on the bench crest rather than on the bench toe. Figure 12-6 illustrates this operating scenario, commonly referred to in the industry as a good-bye cut. This final bench has been designed at a height of 16.4 ft (5 m) high.

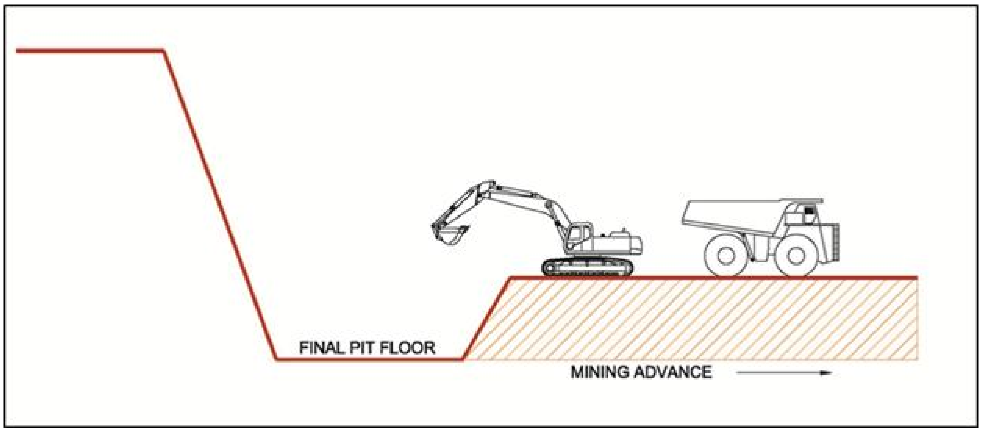


Figure 12-6: Final bench access

12.3.3.6 Open Pit Design Results

The open pit that has been designed for the Project is approximately 7,500 ft (2,300 m) long and 3,900 ft (1,200 m) wide at surface. The total surface area of the pit is roughly 220 ha. The pit ramp on the final wall enters at the 380 m elevation on the north east side. The ramp branches off into two segments at the 370 m elevation, a first one to access a small area on the far east side of the pit, and a second one that runs along the north wall towards the west. At the 290 m elevation, the main ramp branches off again into two segments, a first one to access the central part of the pit and a second one that accesses the west part of the pit. The deepest part of the pit is at the 85 m elevation, 985 ft (300 m) below surface.

Accounting for mining dilution, the open pit includes 453.6 Mt (411.5 Mmt) of Proven Mineral Reserves at an average gold grade of 0.64 g/mt and 20.4 Mt (18.5 Mmt) of Probable Mineral Reserves at an average gold grade of 0.86 g/mt for a total of 474.1 Mt (430.1 Mmt) of Proven and Probable Mineral Reserves at an average gold grade of 0.65 g/mt. In order to access these mineral reserves, 546.9 Mt (496.1 Mmt) of overburden and waste rock must be mined, resulting in a strip ratio of 1.15:1. There are only a few hundred thousand metric tons of Inferred Mineral Resources in the open pit. The pit contains 1.2 Mt (1.1 Mmt) of Massive Stibnite at an average gold grade of 2.93 g/mt.

Figure 12-7 presents an isometric view of the open pit design.

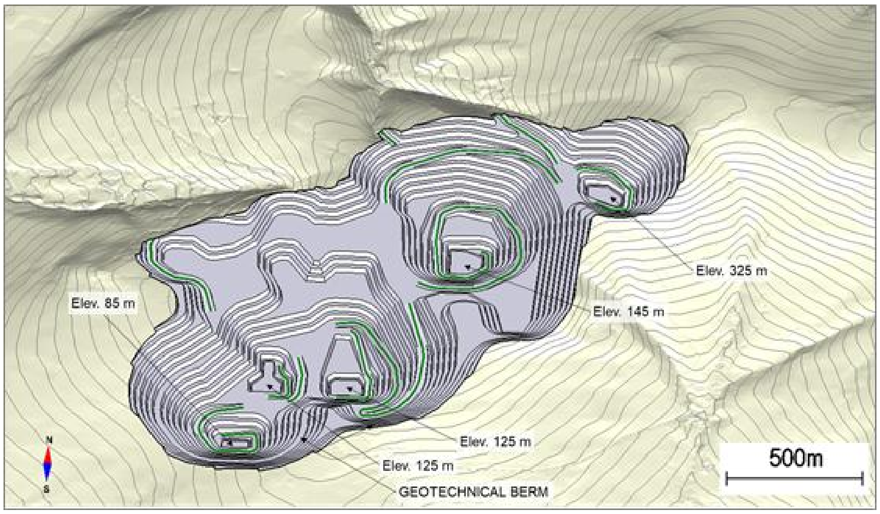


Figure 12-7: Open pit design

13. MINING METHODS

13.1 Introduction

The Livengood deposit will be mined using conventional open pit mining methods consisting of drilling, blasting, loading, and hauling with large-scale mining equipment. Vegetation, topsoil, and overburden will be stripped and stockpiled for future reclamation use. The ore and waste rock will be drilled and blasted with 32.8 ft (10 m) high benches and loaded into haul trucks with a fleet of diesel-powered hydraulic excavators and front-end wheel loaders.

13.1.1 Geotechnical Pit Slope Parameters

The geotechnical pit slope parameters were presented in Section 12.3.3.1.

13.1.2 Hydrogeology

A hydrogeological investigation was completed by SRK on the Livengood Project in 2012, and summarized in a report titled, “2012 Hydrogeological Investigations and Modeling Results – Draft 3” (SRK, 2013b). The study included numerical groundwater flow modeling to evaluate pit water inflows during mining operations and to understand the formation of the pit lake after mining ceases. The results of the study showed that the maximum amount of groundwater expected to enter the pit will be in the range of 2,406 m^3/d. This quantity of water is manageable with dewatering pumps, which are discussed in Section 13.5.8.

13.2 Phase Designs

To maximize the NPV of the Project, mining phases (pushbacks) have been designed and incorporated into the mining sequence to bring higher-grade material forward and to defer waste rock stripping.

13.2.1 Starter Pit

During the preproduction phase of the Project, a total of 89 Mt (81 Mmt) of waste rock has been estimated to be required for the construction of certain infrastructure such as the tailings management facility (TMF) starter dike, mine haul roads, site access roads, and platforms for the processing facilities and other buildings. It has been assumed that all waste rock types will be acceptable as construction material except for overburden.

A starter pit, also referred to as Phase 1, was designed on the eastern side of the open pit, which targets the waste rock requirements and minimizes the amount of ore that would have to be stockpiled during preproduction. A trade-off study was carried out early in the Project, which evaluated a starter pit on the westside of the open pit. The western starter pit targeted an area that would expose ore quicker but was not used in the PFS due to the longer haul distances relative to the eastern starter pit.

The Phase 1 starter pit contains 5.6 Mt (5.1 Mmt) of overburden, 91.4 Mt (82.9 Mmt) of waste rock and 5.4 Mt (4.9 Mmt) of ore. The bottom of the starter pit is at the 385 m elevation, and the total depth of the starter pit is 328 ft (100 m).

13.2.2 Phase Design Results

The phase designs were guided by the lower revenue factor pit shells from the pit optimization analysis. A total of five phases have been designed in addition to the starter pit. To ensure the phases can be mined safely and efficiently with the selected fleet of mining equipment, a minimum width of 400 ft (122 m) has been considered between each phase. Narrower widths down to 130 ft (40 m) have been allowed for short segments.

For all phases, the haul ramp exits have been located on the northside of the pit to avoid haul road construction requirements on the south side, which would negatively impact the visual effects of the Project.

Table 13-1 presents the mineral reserves for each phase and Figure 13-1 presents a plan view showing the limits of each phase.

Table 13-1: Mineral reserves by phase

Phase	Ore (Mt)	Au Grade (g/mt)	Overburden (Mt)	Waste Rock (Mt)	Strip Ratio
Phase 1	5.6	0.45	5.6	91.3	17.3
Phase 2	35.8	0.60	2.2	7.8	0.3
Phase 3	76.5	0.75	4.4	68.0	0.9
Phase 4	45.1	0.57	1.1	31.4	0.7
Phase 5	118.3	0.60	3.1	106.5	0.9
Phase 6	192.7	0.68	6.9	218.7	1.2
Total (1)	**474.0**	**0.65**	**23.4**	**523.7**	**1.2**

(1) Numbers may not add up due to rounding.

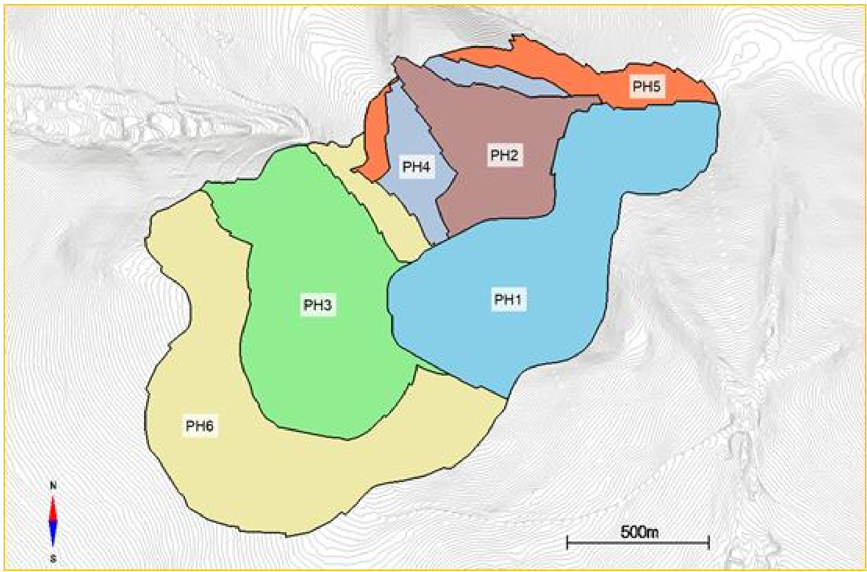


Figure 13-1: Phase designs

Phase 2 targets an area on the east side of the pit with a very low strip ratio of 0.3 to 1. The bottom of Phase 2 is at the 305 m elevation, and the total depth of Phase 2 is 540 ft (165 m).

Phase 3 targets a high grade area on the west side of the pit with an average grade of 0.75 g/mt. The stripping ratio is relatively low at 0.9 to 1.0. The bottom of Phase 3 is at the 210 m elevation, and the total depth of Phase 3 is 920 ft (280 m). Both Phase 2 and Phase 3 will be mined at the same time to separate the equipment fleet, which will allow for higher productivities.

Phase 4 is an expansion of Phase 2. The bottom of Phase 4 is at the 245 m elevation, and the total depth of Phase 4 is 820 feet (250 m).

Phase 5 mines the pit to its final limits on the east side and Phase 6 mines the pit to its final limits on the west side. Since the Phase 5 ramp cuts off access to the remaining benches above the 350 m elevation, a ramp has been included in the northwest corner of the pit in Phase 6 to access this material.

Figure 13-2 to Figure 13-7 present the designs for each phase.

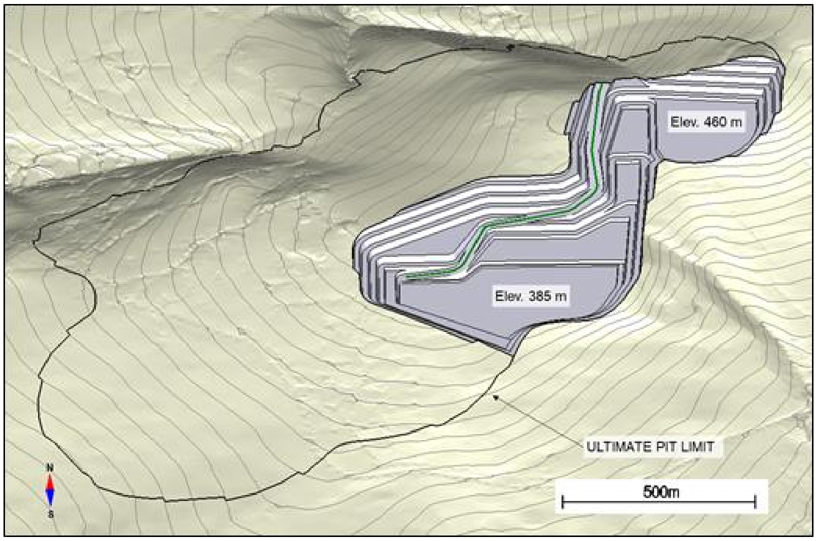


Figure 13-2: Phase 1 design

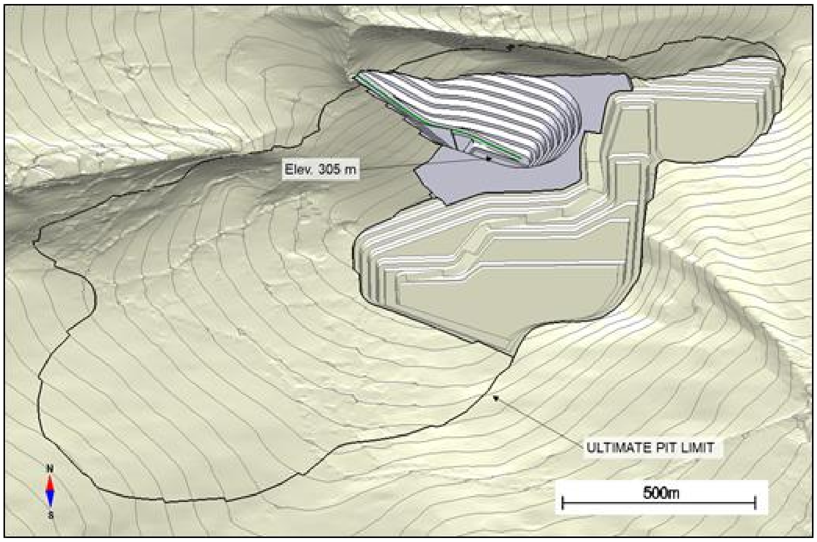


Figure 13-3: Phase 2 design

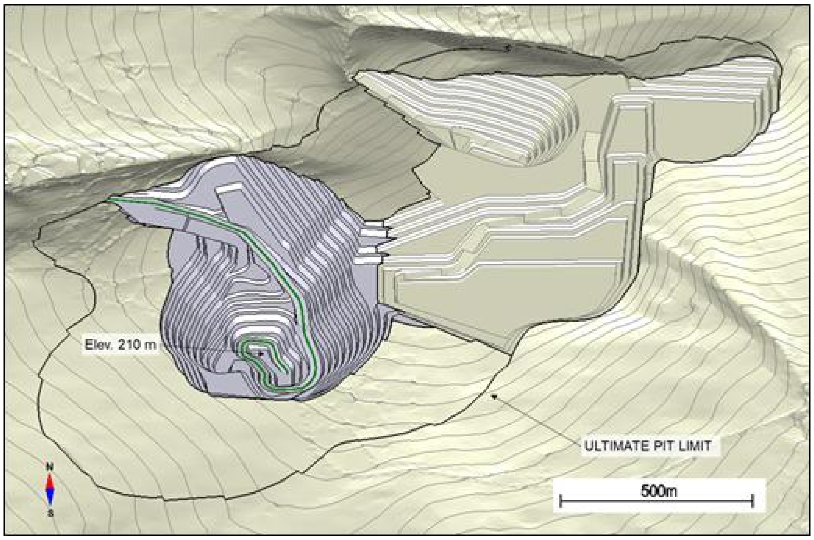


Figure 13-4: Phase 3 design

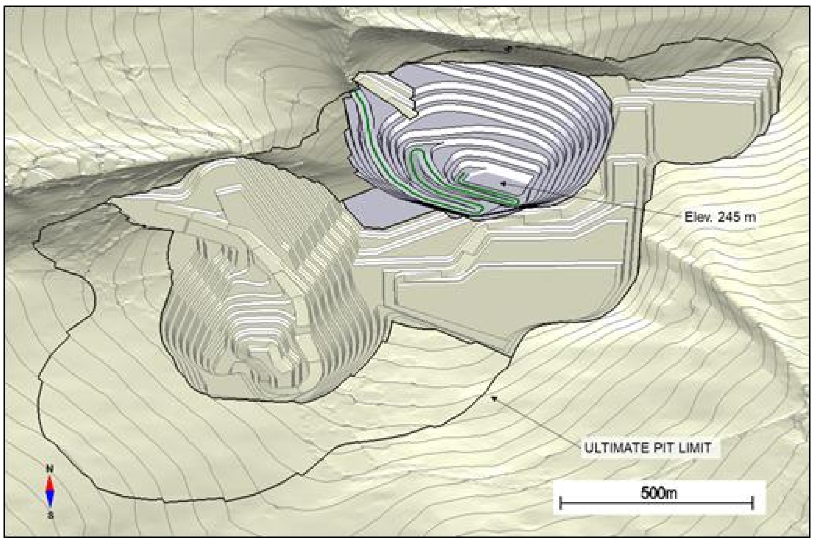


Figure 13-5: Phase 4 design

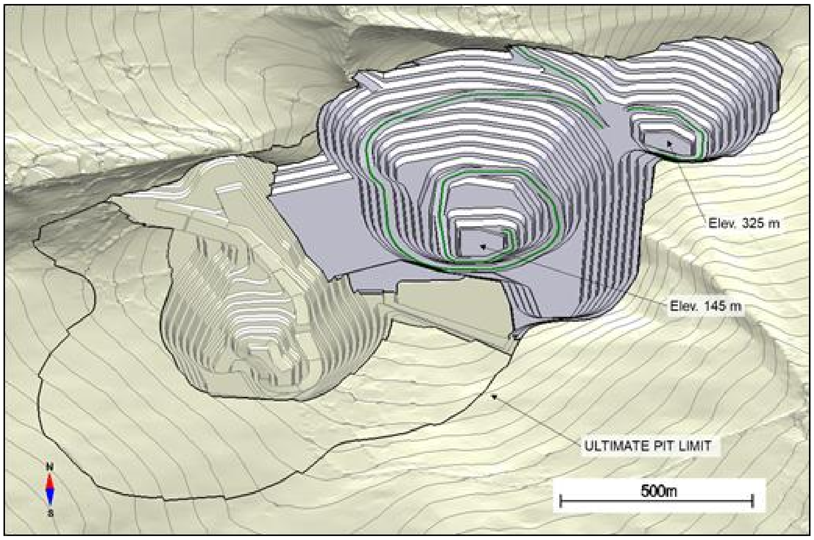


Figure 13-6: Phase 5 design

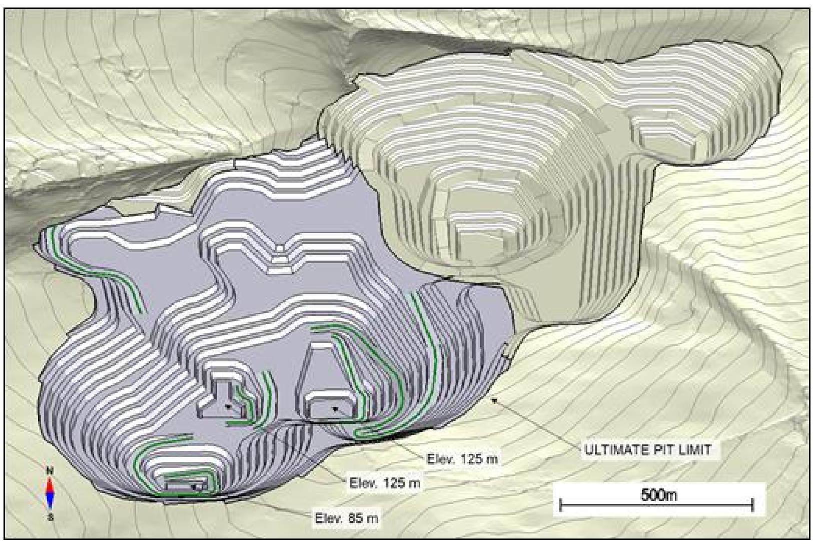


Figure 13-7: Phase 6 design

13.3 Waste Rock Storage Facility and Stockpile Designs

Material mined from the open pit that is not directly hauled to the primary crusher will be placed in several storage facilities across the Livengood site. These facilities, discussed in further detail below, include growth media stockpiles, the overburden stockpile, the waste rock storage facility (WRSF), the low grade ore stockpile, and an emergency ore stockpile. Waste rock will also be used as construction material both during preproduction, as discussed in Section 13.2.1, and to raise the height of the TMF dike as the mine life progresses. Note that trees will be cleared prior to placing material in these piles.

13.3.1 Growth Media Stockpiles

As discussed in Section 12.2.2, a topsoil thickness of 12 inches (30 cm) has been assumed for mine design purposes. This material will be stripped and placed separately in growth media stockpiles to be used for closure and reclamation activities. Several growth media stockpiles will be strategically located around the site. Depending on the mining sequence and closure activities, topsoil may be hauled directly to certain areas if they are available for reclamation, thus reducing costs by limiting re-handling activities.

13.3.2 Overburden Stockpile

Overburden will be stripped and hauled to the overburden stockpile located in the Gertrude Creek Valley to the east of the plant site. The overburden stockpile will be built on the side of the hill, has a footprint area of 67 ha and a capacity of 15.7 Myd^3 (12 Mm^3). The bottom of the overburden stockpile is at the 420 m elevation and the top is at the 540 m elevation for a total height of 395 feet (120 m). The overburden stockpile has been designed with 150 ft (45 m) wide catch benches every 100 ft (30 m) in elevation and has an overall slope of 18.4 degrees.

13.3.3 Waste Rock Storage Facility

Waste rock not used for construction will be hauled to the WRSF located in the Gertrude Creek Valley to the east of the plant site, below the overburden stockpile. The PFS considers the same design parameters for the WRSF that were prepared by AMEC for the 2013 FS and presented in the report titled "Geotechnical Design Report August 6, 2013.pdf" (AMEC, 2013).

Since the WRSF will be built along the side of a hill, a buttress called the "Gertrude Creek Embankment" will be built at the base of the WRSF to provide additional stability. The buttress will separate the TMF and the WRSF. Stacking of the waste rock will begin at the base of the pile, against the Gertrude Creek Embankment, and advance up the slope in a "bottom-up" sequence. Access to each lift will be from the haul road that will be built to the east of the plant site to access the TMF. Table 13-2 presents the slope configuration for the WRSF.

Table 13-2: WRSF slope configuration

Description	Unit	Value
Lift Height	ft	100
Overall Slope	deg	18.4 (3H:1V)
Bench Face Angle	deg	33.7
Berm Width	ft	150

The WRSF was designed with a footprint area of 215 ha and a capacity of 163 Myd^3 (125 Mm^3). The bottom of the WRSF is at the 330 m elevation and the top is at the 420 m elevation for a total height of 295 ft (90 m). The PFS requires 105 Myd^3 (80 Mm^3) of storage capacity in the WRSF and will be built to the 390 m elevation.

A trade-off study was completed to evaluate the merits of placing waste rock in mined-out areas of the pit. Although the mine sequencing does allow for in-pit dumping, it was determined that too much potential mineralization would be sterilized by in-pit dumping.

13.3.4 Low Grade Ore Stockpile

To maximize the NPV of the Project, lower grade ore will be placed in a stockpile so that higher grade ore can be accessed and sent to the process plant earlier in the mine life. The lower grade ore is then reclaimed at the end of the life of the mine. The low grade ore stockpile is located to the east of the open pit on the ridge above Gertrude Creek. Material placed in the stockpile will be classified into low grade (< 0.5 g/mt), medium grade (> 0.5 g/mt and < 0.7 g/mt) and high grade (> 0.7 g/tm), with each category being placed in a different part of the pile.

The peak low grade ore stockpile balance from the mine plan, presented in Section 13.4, is 87.7 Mt (79.6 Mt), resulting in a capacity requirement of 45 Myd^3 (34 Mm^3). The low grade stockpile will also be built on the side of the hill and has a footprint area of 100 ha. The bottom of the low grade stockpile is at the 300 m elevation and the top is at the 570 m elevation for a total height of 886 ft (270 m) at its highest point. The low grade stockpile has been designed with 150 ft (45 m) wide catch benches every 100 ft (30 m) in elevation and has an overall slope of 18.4 degrees.

13.3.5 Emergency Ore Stockpile

To ensure the primary crusher can be fed when the mine will be shut down during extreme weather events, an emergency ore stockpile has been located on the run of mine (ROM) pad. The emergency ore stockpile has a 65,000 t (58,967 mt) capacity to provide 24 hours of crusher feed. The emergency ore stockpile has a height of 16 ft (5 m) and a surface area of 65,000 ft^2 (6,040 m^2). Ore from this stockpile will be rehandled with wheel loaders that will either dump directly into the hopper of the primary crusher or load haul trucks that will haul and dump into the hopper.

13.3.6 Acid Rock Drainage

SRK previously completed a report on the acid rock drainage (ARD) potential of the Livengood waste rock, titled "Metal Leaching and Acid Rock Drainage Assessment, Livengood Project, Alaska. Progress Report 3 - Final" (SRK, 2012)., The SRK study concluded that the Volcanic and Lower Sediment rock types have the greatest potential to produce ARD. These rock types represent approximately 15% of the waste rock within the open pit and should easily be mixed with the non-potentially ARD rock types when placed in the WRSF. The QP recommends that the design and sequencing of placement of ARD material into the WRSF be updated for the next phase of study.

13.4 Mine Production Plan

The mine production plan has been prepared using the MinePlan Schedule Optimizer (MPSO) tool in the Hexagon MinePlan 3D software. Provided with economic input parameters and operational constraints such as phase sequencing, maximum bench sink rates, and mining and milling capacities, the software determines the optimal mining sequence and low grade ore stockpiling strategy, which maximizes the NPV of the mine production plan.

The mine plan has been prepared quarterly for the first 2 years of production and annually thereafter. The mine plan also includes a period of preproduction that has been scheduled annually over 3 years. The purpose of the preproduction period is for the mine to provide waste rock for construction material and to prepare the pit for mining operations.

The mine plan has been prepared using cuts that are 200 m x 200 m x 10 m high. Partial mining was not allowed so cuts are mined in their entirety within a given period.

The mine plan considers a maximum bench sink rate of eight benches per year per phase, for a maximum vertical sink of 262 ft (80 m) per year per phase.

For low grade stockpile rehandling, since the low grade ore stockpile will be quite large and can be reclaimed from many sides, the mine plan considers "average grade" reclaim strategy.

The mine plan targets the nominal mill throughput capacity of 65,000 t/d (58,967 mt/d) and varies based on the blend of ore by rock type. Table 15-7 in Section 12.3.2 presenting the mill throughput rates in t/h for each rock type have been considered in the mine plan. The mine plan also considers an overall mill utilization of 93%, which results in 8,147 hours per year of operation.

The mine plan accounts for the following process plant utilization ramp-up prior to achieving 93%, at the start of Year 2. This results in an average plant utilization of 75% for the first year of operation, which falls between Class 1 and Class 2 of the McNulty start-up benchmarking curves.

- Q1: 45%;
- Q2: 75%;
- Q3: 80%;
- Q4: 95%.

The Livengood Project has a 20.3-year mine life plus 3 years of preproduction development. A contractor will operate the pit during the first year of preproduction to develop the first benches in the Phase 1 starter pit and construct the network of mine haul roads. By the second year, the owner's fleet of equipment will be on-site and assembled and will take over from the contractor.

Mining of Phases 2 to 6 is planned as follows:

- Phase 2 – Mined between Year 1 and Year 2;
- Phase 3 – Mined between Year 1 and Year 4;
- Phase 4 – Stripping begins in Year 3 and will be completely mined out in Year 7;
- Phase 5 – Mining begins in Year 4 and completes in Year 10;
- Phase 6 – Mining begins in Year 6 and completes in Year 17.

The total material mined from the open pit peaks at 66 Mt (60 Mmt) from Year 2 to Year 5 and averages 55 Mt/y (50 Mmt/y) between Year 1 and Year 17. A total of 105 Mt (95 Mmt) of ore is sent to the low grade ore stockpile over the life of the mine, with an average gold grade of 0.38 g/mt. A total of 84% of the low grade ore is rehandled and sent to the mill during the final five years of production, with smaller amounts rehandled in earlier years.

During the life of mine, a total of 271 Mt (246 Mmt) is hauled to the TMF for dike construction, representing 52% of the total waste rock.

The average gold grade for ore to the mill is fairly consistent on a year to year basis, ranging from 0.58 g/mt to 0.93 g/mt when the open pit is in operation, and drops to 0.36 g/mt during stockpile rehandling at the end of the mine life.

A peak gold production of 482 koz is achieved in Year 3, when higher grades will be fed to mill, which also coincides with higher mill recoveries. Gold production averages 342 koz per year between Year 1 and Year 17 and 154 koz per year during stockpile rehandling.

Table 13-3 presents the mine production schedule (summarized by year) and Table 13-4 presents the mill feed by rock type (summarized by year). Figure 13-8 to Figure 13-12 present various charts which display the mine production schedule and Figure 13-13 to Figure 13-16 present the pit advances for at the end of Preproduction, Year 05, Year 10, and Year 15.

Table 13-3: Mine production schedule

Year	Unit	-3	-2	-1	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	Total
Mill Feed	**Mt**	**0.0**	**0.0**	**0.0**	**18.0**	**24.4**	**24.3**	**23.2**	**23.6**	**23.6**	**23.6**	**23.4**	**23.5**	**24.2**	**23.9**	**23.8**	**23.4**	**23.1**	**23.2**	**23.2**	**23.4**	**23.8**	**23.8**	**23.8**	**6.8**	**474.0**
Gold Grade	g/mt	**0.00**	**0.00**	**0.00**	**0.76**	**0.69**	**0.93**	**0.93**	**0.61**	**0.61**	**0.64**	**0.64**	**0.69**	**0.58**	**0.61**	**0.72**	**0.77**	**0.77**	**0.71**	**0.73**	**0.65**	**0.36**	**0.36**	**0.36**	**0.37**	**0.65**
Ounces Rec.	koz	**0**	**0**	**0**	321	388	482	437	314	328	340	329	357	306	296	336	339	322	308	316	293	188	188	188	54	6,430
Mill Recovery	%	**0%**	**0%**	**0%**	**80%**	**79%**	**73%**	**69%**	**74%**	**78%**	**77%**	**75%**	**76%**	**75%**	**70%**	**67%**	**65%**	**62%**	**64%**	**64%**	**66%**	**75%**	**75%**	**75%**	**74%**	**71%**
ROM to Mill	**Mt**	**0.0**	**0.0**	**0.0**	**16.7**	**23.3**	**24.3**	**22.9**	**22.4**	**23.6**	**23.6**	**23.4**	**23.5**	**15.8**	**19.6**	**23.8**	**23.4**	**23.1**	**23.2**	**23.2**	**13.4**	**0.0**	**0.0**	**0.0**	**0.0**	**369.2**
Gold Grade	g/mt	**0.00**	**0.00**	**0.00**	**0.76**	**0.70**	**0.93**	**0.94**	**0.61**	**0.61**	**0.64**	**0.64**	**0.69**	**0.67**	**0.66**	**0.72**	**0.77**	**0.77**	**0.71**	**0.73**	**0.86**	**0.00**	**0.00**	**0.00**	**0.00**	**0.73**
ROM to Stkp	**Mt**	**1.2**	**2.7**	**1.1**	**16.1**	**8.1**	**12.1**	**17.0**	**6.6**	**6.6**	**3.3**	**3.3**	**3.3**	**3.3**	**3.3**	**3.3**	**3.3**	**3.3**	**3.3**	**3.3**	**0.3**	**0.0**	**0.0**	**0.0**	**0.0**	**104.8**
Gold Grade	Mt	**0.47**	**0.45**	**0.44**	**0.38**	**0.34**	**0.40**	**0.40**	**0.33**	**0.34**	**0.35**	**0.36**	**0.35**	**0.33**	**0.35**	**0.44**	**0.38**	**0.41**	**0.40**	**0.38**	**0.40**	**0.00**	**0.00**	**0.00**	**0.00**	**0.38**
Stkp to Mill	**Mt**	**0.0**	**0.0**	**0.0**	**1.3**	**1.1**	**0.0**	**0.3**	**1.3**	**0.0**	**0.0**	**0.0**	**0.0**	**8.4**	**4.3**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**10.0**	**23.8**	**23.8**	**23.8**	**6.8**	**104.8**
Gold Grade	g/mt	**0.00**	**0.00**	**0.00**	**0.73**	**0.45**	**0.62**	**0.75**	**0.59**	**0.00**	**0.00**	**0.00**	**0.00**	**0.42**	**0.36**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.38**	**0.36**	**0.36**	**0.36**	**0.37**	**0.38**
OB to Stkp	**Mt**	**3.9**	**1.5**	**0.2**	**4.7**	**1.6**	**0.8**	**1.6**	**2.0**	**0.6**	**1.5**	**1.4**	**1.4**	**1.7**	**0.5**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**23.3**
Waste to WRSF	**Mt**	**11.2**	**3.2**	**2.6**	**2.5**	**8.7**	**15.2**	**10.9**	**21.4**	**20.4**	**22.8**	**23.1**	**23.0**	**31.5**	**31.1**	**9.6**	**8.0**	**3.1**	**3.0**	**1.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**252.5**
Waste to TMF	**Mt**	**2.4**	**27.8**	**31.5**	**24.4**	**24.4**	**13.8**	**13.8**	**13.8**	**9.4**	**9.4**	**9.4**	**9.4**	**11.6**	**11.6**	**11.6**	**11.6**	**10.7**	**10.7**	**10.7**	**3.0**	**0.0**	**0.0**	**0.0**	**0.0**	**271.1**
Total Material Moved	Mt	**18.8**	**35.2**	**35.3**	**65.6**	**67.3**	**66.1**	**66.5**	**67.4**	**60.6**	**60.6**	**60.6**	**60.6**	**72.3**	**70.4**	**48.4**	**46.3**	**40.2**	**40.3**	**38.3**	**26.6**	**23.8**	**23.8**	**23.8**	**6.8**	**1,125.7**
Total Material Mined (ROM)	Mt	**18.8**	**35.2**	**35.3**	**64.3**	**66.1**	**66.1**	**66.1**	**66.1**	**60.6**	**60.6**	**60.6**	**60.6**	**63.9**	**66.1**	**48.4**	**46.3**	**40.2**	**40.3**	**38.3**	**16.6**	**0.0**	**0.0**	**0.0**	**0.0**	**1,020.9**
Strip Ratio		**14.8**	**12.3**	**31.8**	**1.0**	**1.1**	**0.8**	**0.7**	**1.3**	**1.0**	**1.2**	**1.3**	**1.3**	**2.4**	**1.9**	**0.8**	**0.7**	**0.5**	**0.5**	**0.4**	**0.2**	**0.0**	**0.0**	**0.0**	**0.0**	**1.2**

Table 13-4: Mill feed by rock type

Year	Unit	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	Total
Tonnes	**Mt**	**18.0**	**24.4**	**24.3**	**23.2**	**23.6**	**23.6**	**23.6**	**23.4**	**23.5**	**24.2**	**23.9**	**23.8**	**23.4**	**23.1**	**23.2**	**23.2**	**23.4**	**23.8**	**23.8**	**23.8**	**6.8**	**474.0**
RT4	Mt	4.0	9.3	9.7	0.6	2.9	2.8	2.8	2.0	2.8	8.2	7.7	8.0	4.7	2.3	0.7	0.0	1.8	4.7	4.7	4.7	1.3	85.8
RT5	Mt	12.9	9.3	0.4	5.9	10.8	14.8	11.1	11.2	12.3	3.8	2.0	0.0	0.0	0.0	0.0	0.0	3.3	8.7	8.7	8.7	2.5	126.3
RT6	Mt	1.0	5.6	9.7	7.7	7.4	4.5	7.7	3.9	0.5	5.7	7.0	5.6	5.9	4.0	4.7	3.2	3.0	5.2	5.2	5.2	1.5	104.4
RT7	Mt	0.1	0.0	0.0	2.3	0.9	0.7	0.8	2.9	5.2	3.9	0.4	0.8	2.2	4.2	12.8	16.8	10.8	2.3	2.3	2.3	0.7	72.6
RT8	Mt	0.0	0.1	0.0	0.3	0.3	0.4	0.1	0.2	0.6	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.0	2.9
RT9	Mt	0.0	0.0	4.5	6.3	1.4	0.4	1.2	3.3	2.2	2.2	6.6	9.5	10.7	12.5	5.0	3.2	4.4	2.7	2.7	2.7	0.8	82.1
Gold Grade	**g/mt**	**0.76**	**0.69**	**0.93**	**0.93**	**0.61**	**0.61**	**0.64**	**0.64**	**0.69**	**0.58**	**0.61**	**0.72**	**0.77**	**0.77**	**0.71**	**0.73**	**0.65**	**0.36**	**0.36**	**0.36**	**0.37**	**0.65**
RT4	g/mt	0.78	0.58	0.73	0.58	0.58	0.79	0.51	0.53	0.58	0.50	0.55	0.51	0.64	0.49	0.61	0.00	0.31	0.31	0.31	0.31	0.31	0.54
RT5	g/mt	0.75	0.73	0.65	0.68	0.52	0.54	0.63	0.59	0.66	0.45	0.36	0.48	0.00	0.00	0.00	0.00	0.36	0.36	0.36	0.36	0.36	0.55
RT6	g/mt	0.78	0.82	1.05	0.90	0.73	0.67	0.70	0.67	0.58	0.55	0.54	0.72	0.67	0.69	0.59	0.60	0.43	0.37	0.37	0.37	0.37	0.66
RT7	g/mt	0.71	0.54	0.64	0.89	0.76	0.54	0.55	0.63	0.75	0.88	0.49	0.86	0.80	0.78	0.73	0.73	0.82	0.36	0.36	0.36	0.36	0.72
RT8	g/mt	0.78	0.58	0.77	0.88	0.72	0.75	0.85	0.65	0.97	0.63	0.45	0.53	0.00	0.00	0.00	0.00	0.45	0.45	0.45	0.45	0.45	0.73
RT9	g/mt	0.00	0.00	1.15	1.26	0.68	1.00	0.69	0.89	0.78	0.64	0.84	0.90	0.87	0.85	0.79	0.85	0.76	0.46	0.46	0.46	0.46	0.84

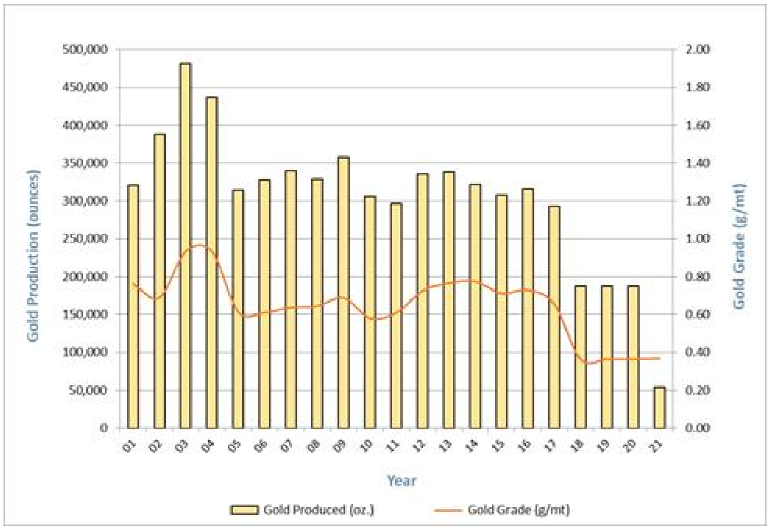


Figure 13-8: Gold production

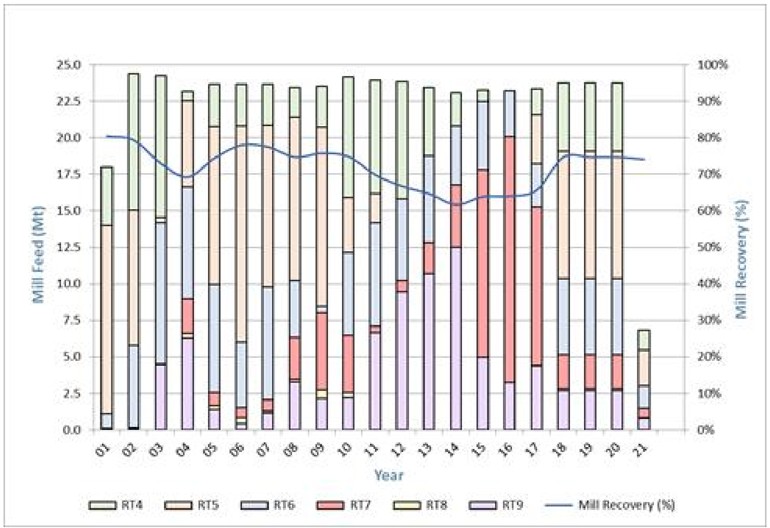


Figure 13-9: Mill feed

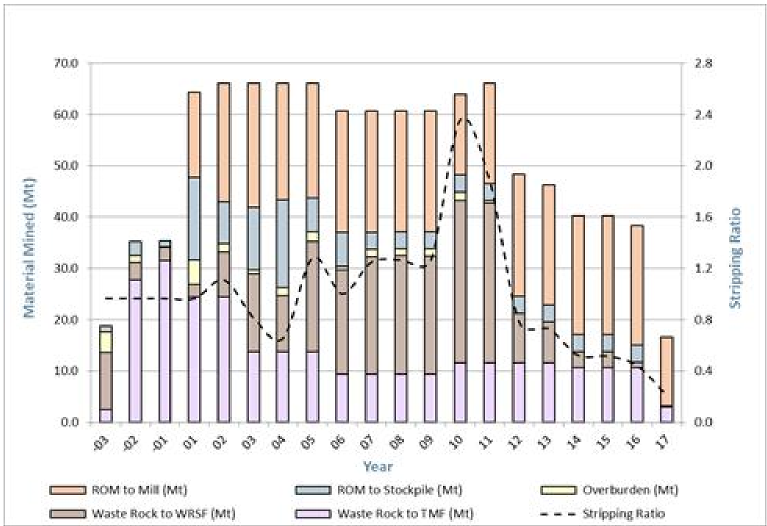


Figure 13-10: Material mined (ROM)

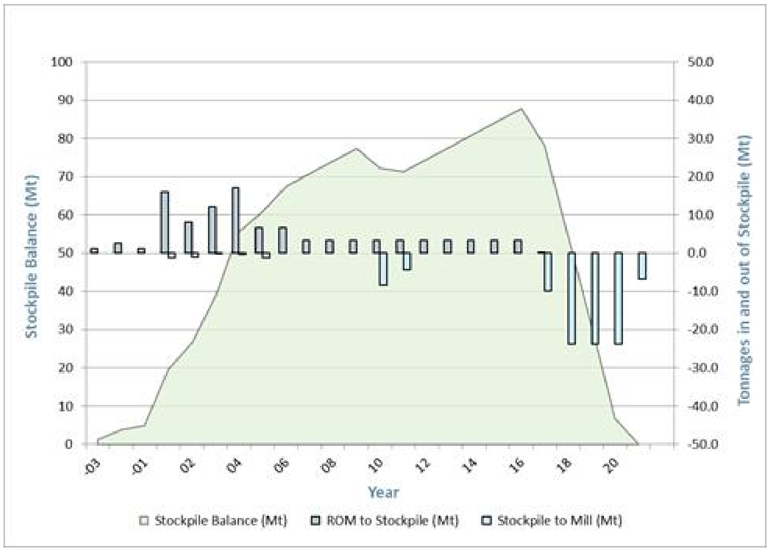


Figure 13-11: Low grade ore stockpile balance

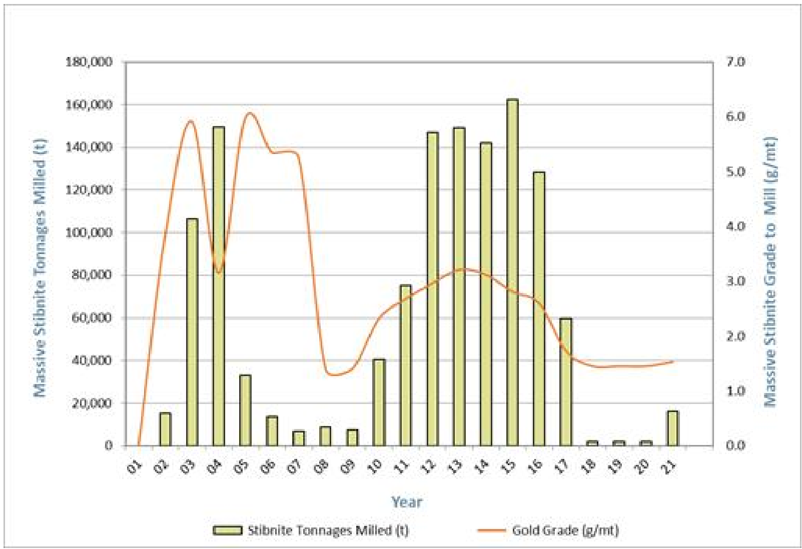


Figure 13-12: Massive stibnite tonnages milled

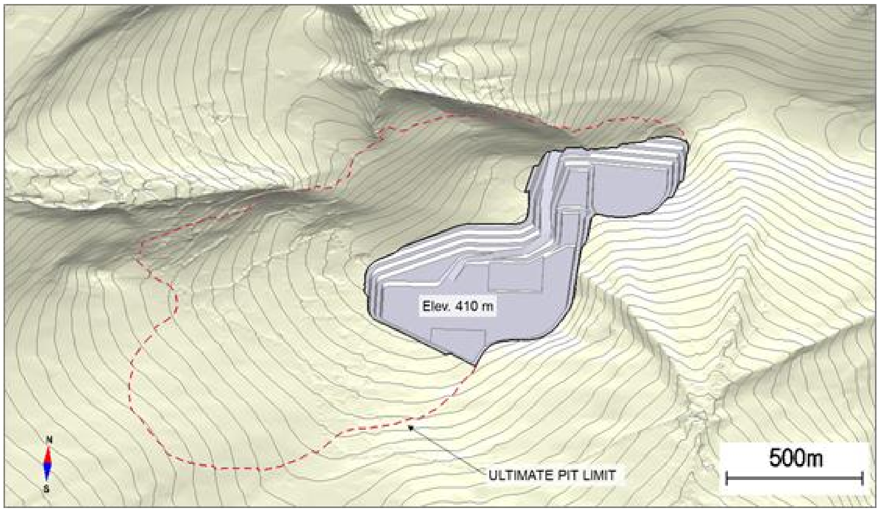


Figure 13-13: End of preproduction

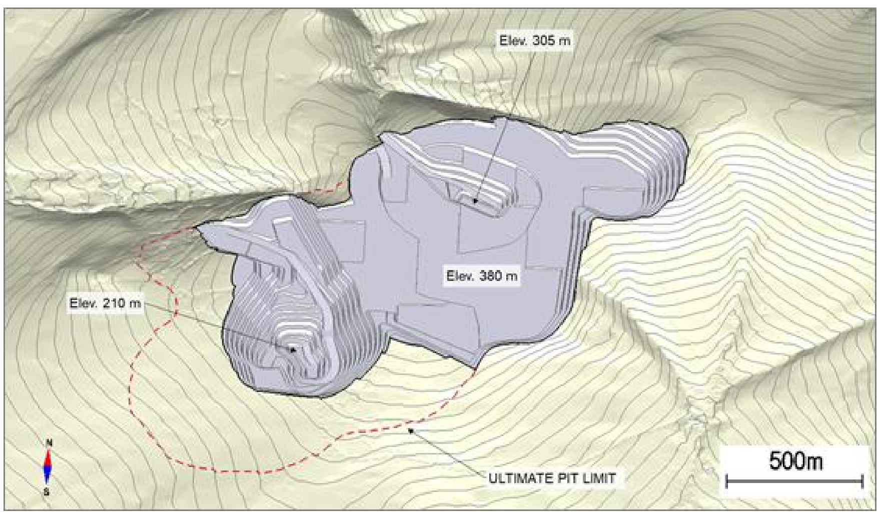


Figure 13-14: End of Year 05

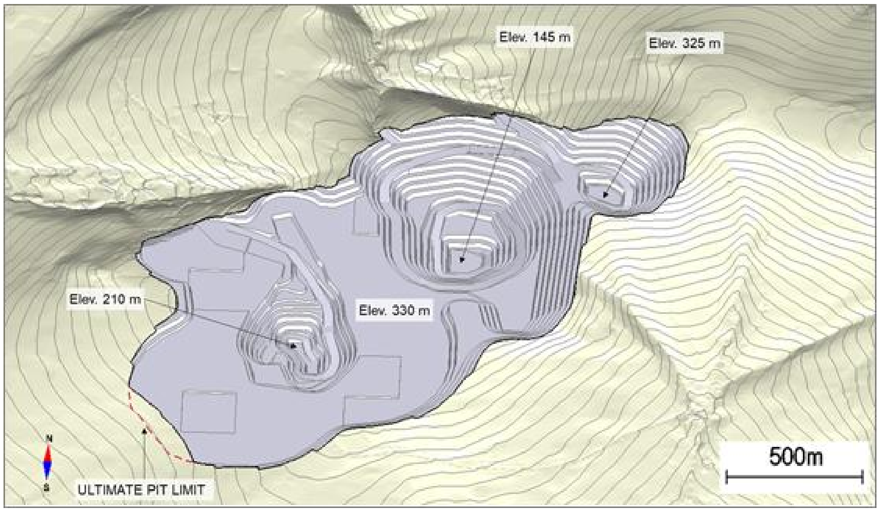


Figure 13-15: End of Year 10

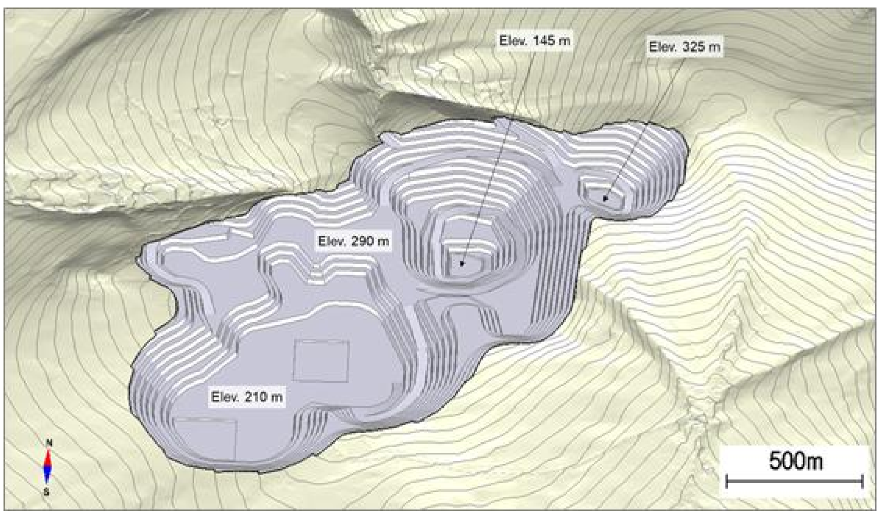


Figure 13-16: End of Year 15

13.5 Mine Equipment Fleet

The following section discusses equipment selection and fleet requirements to carry out the mine plan. The mine will be operated by an owner fleet with the peak requirements presented in Table 13-5. The table identifies the Komatsu trucks, shovel, loader, and support equipment as well as the Epiroc drill to give the reader an appreciation for the equipment size. It is important to note that the specific equipment selection will be done during the procurement phase of the Project.

Table 13-5: Mine equipment fleet

Equipment	Model	Description	Units
Haul Truck	Komatsu 930E-5	Payload – 320 t	18
Hydraulic Excavator	Komatsu PC5500-11	Bucket Payload – 40 yd^3	2
Wheel Loader	Komatsu L1850	Bucket Payload – 40 yd^3	2
Production Drill	Epiroc PV-231	n/a	5
Secondary Drill	Epiroc D65	n/a	1
Track Dozer (Small)	Komatsu D375A-8	Net Power – 609 hp	3
Track Dozer (Large)	Komatsu D475A-8	Net Power – 890 hp	3
Road Grader	CAT 16M3	Net Power – 259 hp	4
Water Truck	Komatsu HD1500-8	Capacity – 37,000 gal	2
Utility Excavator (Small)	Komatsu PC490LC-11	Net Power – 359 hp	2
Utility Excavator (Large)	Komatsu PC800LC-8	Net Power – 363 hp	2
Small Loader (Stemming)	CAT430	n/a	1
Lighting Plant	n/a	n/a	12
Explosives Truck	n/a	n/a	2
Fuel & Lube Truck	CAT 740	n/a	2
Mechanic Service Truck	n/a	n/a	3
Welding Truck	n/a	n/a	2
Flatbed with Crane	n/a	n/a	2
Lowboy	n/a	n/a	2
Tire Handler	n/a	n/a	1
Mobile Crane (Small)	n/a	n/a	1
Mobile Crane (Medium)	n/a	n/a	1
Mobile Crane (Large)	n/a	n/a	1
Pickup Truck	n/a	n/a	20
Transport Bus	n/a	n/a	4
Dewatering Pump	Godwin HL260	Net Power – 600 hp	4

13.5.1 Operating Schedule

The mine will be operated with an owner fleet, 365 days per year, 24 hours per day, running 2-12-hour shifts per day. For equipment calculations, a total of five days of lost production time has been considered for poor weather conditions.

13.5.2 Equipment Utilization Model

Figure 13-17 presents the equipment utilization model that is used to understand the key performance indictors (KPI) that govern the fleet requirements. The definitions for each time component are presented below using haul trucks as an example.

Scheduled Time				
Available Time			Down Time	
Utilized Time (GOH)		Standby Time	Planned Loss	Breakdown Loss
Operating Time (NOH)	Operating Delay			
Travelling empty	Waiting for Shovel	Shift Change	Scheduled Maintenance	Breakdown
Spotting at Shovel	Shovel Repositioning	Lunch & Coffee Breaks	Preventative Maintenance	Waiting for Parts
Loading	Crusher Down	Refueling	Inspections	Repair Time
Travelling Full	Queuing at Shovel	Pre-start Checks	Overhauls	
Spotting at Dump	Weather	No Operator Available		
Dumping				

Figure 13-17: Equipment utilization model

- Scheduled Time – full calendar year less unplanned shutdowns;
- Down Time – the unit is inoperable due to either a scheduled maintenance or an unplanned breakdown;
- Available Time – scheduled time less down time;
- Standby Time – the unit is available mechanically but not being used (the engine will typically be shut off while the unit is on standby);
- Utilized Time – available time less standby time. This time is also referred to as the Gross Operating Hours (GOH);
- Operating Delays – the unit is available and not on standby but not effectively producing (the engine will be running during the operating delays);
- Operating Time – utilized time minus operating delays. This time is also referred to as the Net Operating Hours (NOH).

The following KPIs can be calculated from the different time components using the formulas below:

- Availability – (NOH + Op. Delays + Standby) / (NOH + Op. Delays + Standby + Down);
- Use of Availability – (NOH + Op. Delays) / (NOH + Op. Delays + Standby);
- Machine Utilization – (NOH + Op. Delays) / (Scheduled Time);
- Operating Efficiency – (NOH) / (NOH + Op. Delays);
- Effective Utilization – (NOH) / (Scheduled Time).

Table 13-6 presents the KPIs and time assumptions that were used for the fleet of trucks, shovels, loaders, and drills.

Table 13-6: Mine equipment KPIs

Description	Units	Trucks	Shovels / Loaders	Drills
Availability	%	85.0	85.0	80.0
Use of Availability	%	86.3	86.3	96.2
Machine Utilization	%	73.3	73.3	77.0
Operating Efficiency	%	85.6	85.6	91.4
Effective Utilization	%	62.8	62.8	70.4
Scheduled Time	h/y	8,760	8,760	8,760
Down Time	h/y	1,314	1,314	1,752
Standby Time	h/y	1,024	1,024	264
Operating Delays	h/y	922	922	581
Utilized Time (GOH)	h/y	6,422	6,422	6,745
Operating Time (NOH)	**h/y**	**5,500**	**5,500**	**6,163**

13.5.3 Drilling and Blasting

Production drilling will be done with a fleet of autonomous diesel-powered down-the-hole (DTH) drills that will drill 9.8 inch (251 mm) diameter holes on 32.8 ft (10 m) high benches. Drilling productivities have been calculated per rock type based on an instantaneous drill penetration rate of 82 ft/h (25 m/h) and the fixed time drilling components presented in Table 13-7.

Table 13-7: Fixed drilling time per hole

Description	Unit	Value
Steel Retract	min	0.40
Jack Up	min	0.30
Tramming	min	2.50
Jack Down	min	0.50
Collar	min	3.00
Bit Change	min	0.30
Total	**min**	**7.00**

The drill productivities have been applied to the number of holes drilled per year to determine the annual hours of drilling and number of units required. In addition to the number of holes, which is based on the blast patterns presented in Table 13-8 and Table 13-9, an additional 2% will be considered for holes that will require re-drilling.

Blasting will be carried out using Ammonium Nitrate Fuel Oil (ANFO). Although ANFO has a lower explosive density than emulsion products, which therefore requires a tighter drill pattern to achieve the same fragmentation, a trade-off study was carried out and demonstrates that the lower cost for ANFO in the region outweighs the additional drilling requirements. The ANFO used will have a density of 0.031 lb/in^3 (0.85 g/cm^3). Table 13-8 and Table 13-9 present the blast patterns for ore and waste rock for each rock type that were developed in order to achieve the desired fragmentation. Blasting will be done using electric detonation and drill holes will be double primed (two detonators and two boosters per hole). Emulsion was considered for 10% of the holes to account for wet conditions.

Table 13-8: Blast patterns (ore)

Description	Unit	RT4	RT5 / RT6	RT7	RT8 / RT9
Burden	ft	19.4	20.0	21.3	19.4
Spacing	ft	19.4	20.1	21.3	19.4
Subdrilling	ft	3.3	3.3	3.3	3.3
Stemming	ft	11.5	11.5	11.5	11.5
Powder Factor	lb/ft	0.68	0.66	0.58	0.68

Table 13-9: Blast patterns (waste)

Description	Unit	RT2 / RT4	RT5 / RT6	RT7	RT8 / RT9
Burden	ft	21.7	22.3	24.6	21.7
Spacing	ft	21.7	22.3	24.6	21.7
Subdrilling	ft	3.3	3.3	3.3	3.3
Stemming	ft	11.5	11.5	11.5	11.5
Powder Factor	lb/ft	0.50	0.48	0.42	0.50

Pre-split blasting will be done on the final pit walls using 45 mm diameter packaged emulsion with explosive densities of 0.043 lb/in^3 (1.20 g/cm^3). Pre-split blasting will be double benched (65.6 ft) using 5 in (127 mm) diameter holes, with 3.3 ft (1 m) of sub-drilling. The pre-split holes will be spaced 5 ft (1.5 m) apart, resulting in a power factor of 0.24 lb/ft^2 (1.16 kg/m^2).

A total of five production drills and one secondary drill for pre-splitting and secondary blasting are required during most of the mine life.

Explosives products and accessories will be delivered to site by a local explosives supplier and stored in a facility that will be located to the east of the pit, south of the low grade ore stockpile. The facility will include two, 100-t ammonium nitrate silos as well as a smaller silo for emulsion. The explosives products will be mixed with diesel fuel at this facility to produce the explosives that will be transported to the blast patterns and loaded into the holes by the Livengood blasting team. Approximately 15,430 t (14 million kg) of explosives will be used every year.

13.5.4 Loading

Loading will be done on 32.8 ft (10 m) benches using a mix of diesel-powered hydraulic shovels and frontend wheel loaders, both equipped with 40 yd^3 (31 m^3) buckets. Productivities have been calculated considering shovel bucket swing times of 35 seconds and loader cycle times of 50 seconds. A 90% fill factor has been considered for both machines.

During peak production, the fleet will include two shovels and two wheel loaders.

13.5.5 Hauling

Hauling will be done with 320 t (291 mt) rigid frame haul trucks. Haul productivities have been calculated considering effective payloads of 317 t (288 mt), which have been reduced from the nominal payloads to account for a carryback of 1%.

A haulage network was established in MPSO that considers the hauls for each mining cut to each potential dumping destination. Using rimpull curves provided by the truck manufacturers, MPSO calculated the travel times for each haul. The travel times were then added to the fixed haulage cycle times to arrive at the total cycle times. The fixed cycle times consider 55 seconds for truck spotting, 35 seconds for each shovel bucket (50 seconds for the front-end loaders), and 90 seconds for spotting and dumping at the destination. It is assumed that the shovel/loader will be waiting for a truck with a loaded bucket 50% of the time, resulting in a 5-second first bucket pass in those instances. A total of five buckets is required to load each truck, resulting in an average total fixed cycle time of 305 seconds. In addition to these haulage parameters, the truck productivity calculations consider a 3% rolling resistance, a maximum speed of 25 mph (40 km/h) and a downhill maximum speed of 15 mph (25 km/h).

A total of 12 trucks are required in preproduction, ramping up to 18 in Year 1. Truck requirements remain constant between 15 and 18 for most of the mine life, ramping down when the operation is limited to stockpile rehandle.

The following are the average one-way haul distances for the open pit over the life of mine:

- Ore to the crusher: 1.6 miles (2.6 km);
- Ore to the low grade stockpile: 2.1 miles (3.4 km);
- Overburden to the overburden stockpile: 3.4 miles (5.4 km);
- Waste rock to the WRSF: 3.1 miles (5.0 km);
- Waste rock to the TMF: 4.4 miles (7.1 km);
- Stockpile rehandle: 0.9 miles (1.4 km).

13.5.6 Auxiliary Equipment

A fleet of support equipment has been included for haul road maintenance, drill pad preparation, material placement on the WRSF, and cleaning around the loading face. Material spreading on the tailings dike has been accounted for in the TMF construction costs. The fleet of support equipment includes dozers, graders, water trucks, and utility loaders and excavators.

A fleet of service equipment such as fuel and lube trucks, lowboys to transport the tracked equipment, personnel buses, maintenance vehicles, and pick-up trucks is also included.

13.5.7 Mine Dispatch System

A mine dispatch system has been included to optimize the use of the loading and hauling fleets.

13.5.8 Mine Dewatering

Mine water will be collected in in-pit sumps that will be strategically located on the lower benches of the pit. Water collected in the sumps will be pumped to surface using electrically powered pumps and will be discharged into the site drainage network for treatment and clarification prior to discharge into the environment. A total of four pumps have been included in the equipment fleet during peak production.

13.6 Mine Workforce

The mine workforce has been estimated for each period of the mine plan, which includes management and supervisory personnel, mine technical services, mine operations, and mine maintenance personnel.

All workers will be bussed to site from Fairbanks daily. Mine operations and mine maintenance personnel who will work on shift will be part of a 4-crew system to provide 24 h/d coverage and staff workers will be on site 5 days per week.

The mine workforce during peak production totals 221 employees, comprising 165 in mine operations, 42 in mine maintenance, and 14 in mine technical services. The workforce for the mine has been categorized into Mine Operations. Table 13-10 presents the workforce requirements for the open pit during peak production.

Table 13-10: Mine workforce

Description	Number
Mine Operations	
Mine Manager	1
Mine Operations Superintendent	1
Mine Operations Foreman	8
Mine Clerk	1
Mine Trainer	4
Shovel Operator	7
Loader Operator	7
Truck Operator	62
Blaster	2
Blast Helper	2
Driller	6
Dozer Operator	24
Grader Operator	16
Water Truck Driver	8
Utility Operator	16
Mine Maintenance	
Maintenance Superintendent	1
Maintenance Foreman	12
Maintenance Planner	2
Mechanics	27
Mine Technical Services	
Mine Technical Superintendent	1
Mining Engineer	4
Geologist	2
Surveyor	2
Sampler	4
Geotechnical Engineer	1
Total	**221**

14. RECOVERY METHODS

14.1 Introduction

The recovery methods for the Livengood Gold Project were established on the basis of laboratory-scale testwork as described in Chapter 10, equipment information from suppliers, and BBA's experience on similar projects. The resulting flowsheet reflects the results of this testwork and forms the basis for the plant design, capital costs and operating costs developed in this study. Design work and equipment descriptions in this Chapter are reported in imperial units, with metric units shown in parentheses. Every effort has been made to clearly display the appropriate units being used throughout this TRS, certain tables show results in metric units only.

14.2 Process Plant Production Schedule

The mine is scheduled to deliver an average tonnage of approximately 65,000 t/d (59,000 mt/d) of ore to the primary crusher and process plant on a 365-day-per-year basis. The process plant is designed to operate with an availability of 93%. The primary crusher and main process plant will operate 24 hours per day and 7 days per week. The operating teams will work on a schedule of two 12-hour shifts. The main process plant will be stopped periodically to perform preventive maintenance on equipment, for which there is no standby unit. The operations and maintenance teams will be supported by an Integrated Remote Operating Control Center (IROC) to be located in Fairbanks. More information on the IROC is given in Chapter 15.

The overall gold recovery of the proposed circuit is estimated at 71.4% based on the rock types to be processed according to the LOM plan. Average annual gold production is estimated to be 388,600 oz/year for the first 5-years and approximately 317,000 oz/year life of mine.

14.3 Conceptual Process Flow Diagram

The processing plant consists of primary crushing, ore reclaiming, pre-crushing, grinding, gravity recovery, carbon in leach (CIL) with adsorption, desorption and reactivation (ADR) circuits, cyanide detoxification, water and tailings management, and reagent preparation circuits geared to produce gold doré for delivery to the refinery. Figure 14-1 describes the conceptual process flow from the ore delivery to the crusher to doré production and tailings and water management.

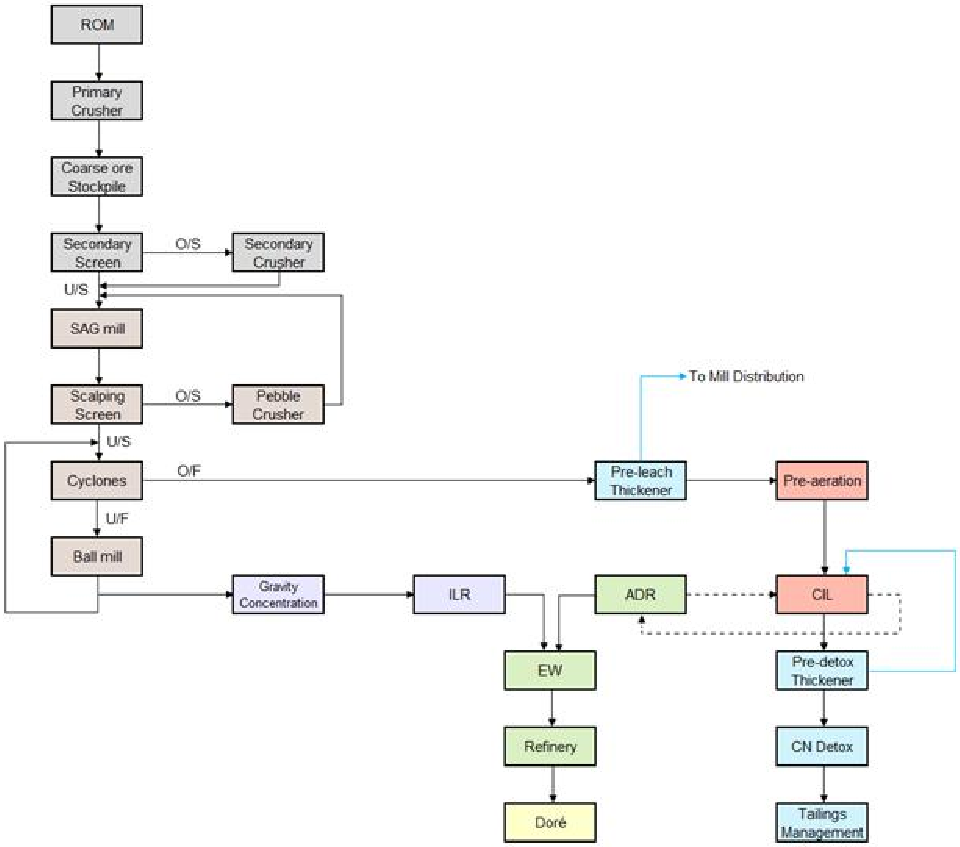


Figure 14-1: Conceptual process block flow diagram

14.4 Plant Operating Design Parameters

The design criteria to determine sizing of the equipment is based on a nominal daily processing plant throughput capability of 65,000 t/d (59,000 mt/d) with a 93% availability factor. A design factor of 1.15 was typically considered for areas where flow rates are not affected by the feed grades of the ore processed. Table 14-1 presents an overview of the main design criteria factors employed and sizes of the most significant process equipment.

Table 14-1: General process design criteria

Criterion	Unit	Value
General Design Data		
Process Plant Operating Life	y	21
Overall Process Plant Availability	%	93
Operating Hours Per Year	h	8,147
Design Factor		1.15
Production Rates		
Life of Mine	Mt (Mmt)	474 (430)
Annual	Mt/y (Mmt/y)	23.7 (21.5)
Daily	t/d (mt/d)	65,000 (59,000)
Process Plant Feed		
Gold Grade (LOM Average)	g/mt	0.65
Feed Size (ROM, F_{80})	in (mm)	31.5 (800)
Primary Crushing		
Crusher Type / Size - (Gyratory (60' × 89'))	hp (kW)	1,000 (746)
Utilization	%	65
Product Size (P_{80})	in (mm)	5.4 (138)
Hourly Throughput (nominal)	t/h (mt/h)	4,167 (3,780)
Stockpile Retention Time (Live)	h	12
Secondary Crushing (Pre-crushing)		
Crusher Type / Size - Cone	hp (kW)	1,250 (932)
Number of Secondary Crushers	no.	1
Utilization	%	90.8
Product Size (P_{80})	in (mm)	1.65 (42)
Hourly Throughput (nominal)	t/h (mt/h)	1,612 (1,463)
Grinding and Pebble Crushing		
Hourly Throughput	t/h (mt/h)	2,912 (2,642)
Number of SAG Mills	no.	1
SAG Mill Size	D × L, ft	36 x 20
Scalping Screen Transfer Size (T_{80})	in, (µm)	0.11 (2,800)
SAG Circuit Product Size (P_{80})	in (µm)	0.06 (1,500)
SAG Mill Specific Energy (motor output)	kWh/t (kWh/mt)	4.74 (5.22)
SAG Mill (Installed Power)	hp (kW)	20,115 (15,000)
Pebble Crusher Type / Size - Cone	hp (kW)	(1,250) 932
Pebble Crusher Product Size (P_{80})	in (mm)	0.55-0.63 (14-16)

Criterion	Unit	Value
Number of Ball Mills	no.	1
Ball Mill Size	D × L, ft	26.0 × 40.5
Ball Mill (Installed Power)	hp (kW)	20,115 (15,000)
Ball Mill Specific Energy (motor output)	kWh/t (kWh/mt)	4.9 (5.4)
Ball Mill Product Size (P_{80})	in (µm)	0.01 (250)
Ball Mill Circulating Load	%	300
Gravity Circuit		
Screens	no.	8 (1 / gravity concentrator)
Gravity Concentrator Size (Diameter)	in	127
Number of Gravity Concentrators	no.	8 (2 lines x 4 units)
Intensive Leach Reactor (ILR)	no.	2
Cyanide Leaching and ADR		
Pre-Leach Thickener diameter	ft (m)	213 (65)
Pre-Conditioning Tank Dimension	D x H, ft	47 x 61
Number of Pre-Conditioning Tanks	no.	4 (2 lines x 2 tanks)
Pre-Conditioning Retention Time	h	4.04
CIL Slurry Volume – per line	m^3 (yd^3)	57,939 (75,784)
CIL Tank Dimension	D x H, ft	63 x 79
Number of CIL Tanks	no.	14 (2 lines × 7 tanks)
CIL Retention Time	h	24
pH	-	10.5
Carbon Concentration	g/L (lb/gallon)	20 (0.17)
Carbon Tonnage per tank	t (mt)	157 (143)
Carbon Transfers per Day	no.	1
Average Carbon Loading	g/mt (lb/t)	500 (1.02)
Carbon Stripping Capacity	t/day (mt/day)	79 (72)
Cyanide Detoxification		
Pre-Detox Thickener Diameter	ft (m)	213 (65)
CIL Discharge Cyanide Concentration	ppm (mg/L)	150
Detoxification Tank Dimension	D x H, ft	47 x 58
Detoxification Circuit Retention Time	h	1.5
Sulfur Burner Capacity	mt SO_2/d	40
Detox Circuit Discharge Target (WAD Cyanide)	ppm	22
Tailings Slurry Density	%	50

14.5 Process Plant Facilities Description

The Livengood process facilities will consist of a comminution circuit (one SAG and one ball mill) followed by a gravity concentration circuit. The tailings from the gravity concentration circuit will be fed to a CIL circuit. Gold will be recovered by an adsorption, desorption and recovery (ADR) circuit, where the final product will be doré. Process tailings will be thickened, treated to detoxify cyanide, and discharged to the tailings management facility (TMF). The gravity gold will be intensively leached from the gravity concentrate. Figure 14-2 presents a schematic process flow diagram while the following subsections describe the selected flowsheet in more detail.

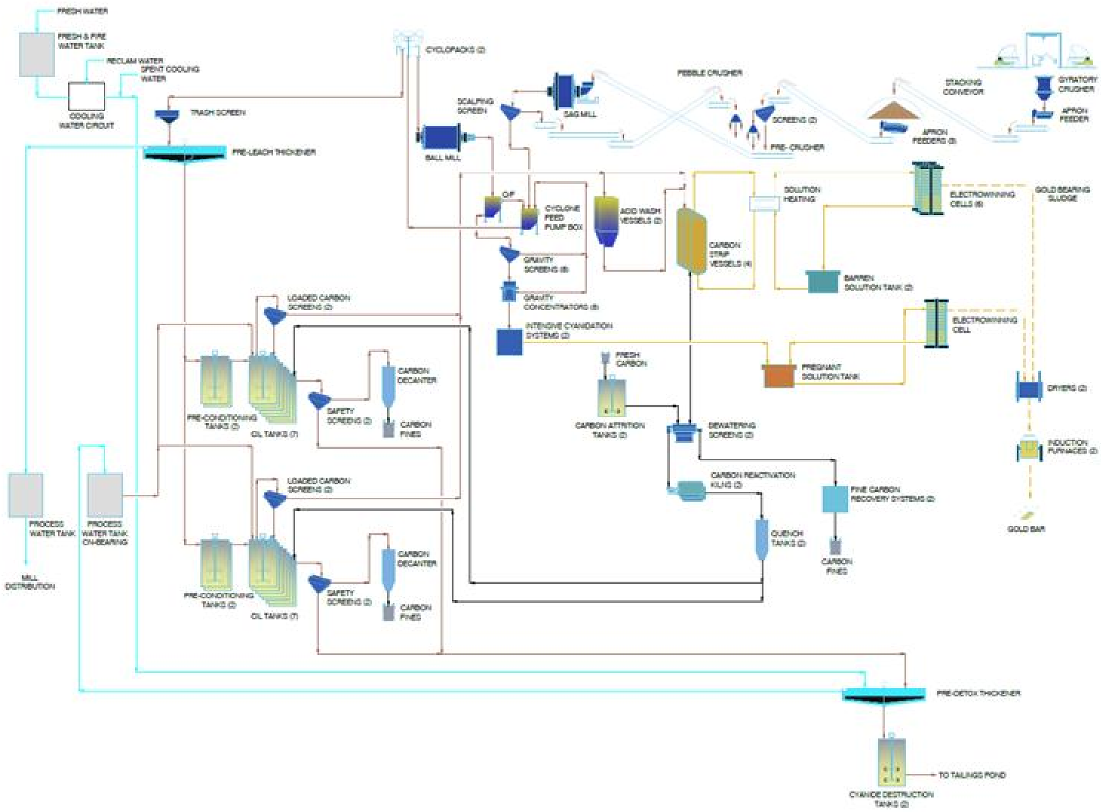


Figure 14-2: Conceptual process flowsheet

14.5.1 Primary Crushing

The primary crushing system is a single stage open circuit (60 × 89) gyratory crusher (1,000 hp, 746 kW). The crusher selection is based upon a feed (F_{80}) size of 31.5 in (800 mm) and a product (P_{80}) of 5.4 in (138 mm), with an expected utilization of 65% at 65,000 t/d (59,000 mt/d). The live capacity of the feed and discharge hoppers to the gyratory crusher are designed for slightly over two truckloads, assuming a nominal payload of 320 t (291 mt). The gyratory crusher's instantaneous throughput is 4,167 t/h (3,780 mt/h) and the system is equipped with a sacrificial conveyor.

14.5.2 Crushed Ore Stockpile

The crushed ore storage pile is designed for a live capacity corresponding to approximately 12 hours of crushing or 34,946 t (31,703 mt). The total capacity of the storage pile (live + dead) is 113,961 t (103,384 mt). The coarse ore stockpile is covered by a dome.

14.5.3 Secondary Crushing (Pre-Crushing)

Ore reclaim from the stockpile is fed from a reclaim tunnel. The reclaim tunnel is equipped with three apron feeders that feed a secondary cone crusher installed in an open circuit. Two screens 12 ft × 27 ft (3.7 m × 8.2 m) receive the gyratory crusher product, which directs oversize material to a cone crusher (1,250 hp, 932 kW) that crushes the oversize to a P_{80} of 1.65 in (42 mm). The screen undersize and secondary crusher product is subsequently fed to the SAG mill. The secondary crusher is equipped with a by-pass chute to maintain high plant availability.

14.5.4 Grinding and Pebble Crushing

A SAG mill / ball mill, in a SABC configuration has been selected (Figure 13-5) for the Livengood Gold Project; this configuration provides increased efficiency for competent to medium hard ores. In a SABC circuit, the SAG mill operates in closed circuit with a pebble crusher. The SAG mill is equipped with pebble ports, which evacuate the hard, critical size pebbles that are then conveyed to the pebble crusher, before being returned to the SAG mill. The ball mill operates in closed circuit with hydrocyclones. The required SAG mill power is estimated at 4.7 kWh/t (5.2 kWh/mt), while the required ball mill power is estimated at 4.9 kWh/t (5.4 kWh/mt), for a combined total of 9.6 kWh/t (10.6 kWh/mt) at the pinion, excluding the pebble crusher and secondary crusher power. The grinding circuit product used to design the mill power is 250 µm (P_{80}). The total power required to grind from primary crusher to final ball mill product is 10.2 kWh/t (11.3 kWh/mt). Note that all estimated power values cited are based on the motor output.

The grinding circuit is based on one grinding line, which is comprised of a SAG mill (D×L: 36 ft × 20 ft,) with installed power of 20,115 hp (15,000 kW) and a ball mill (26 ft × 40.5 ft) with installed power of 20,115 hp, (15,000 kW).

The product from the SAG mill will fall onto a classification screen. The oversize from the scalping screen will be conveyed to a single cone (pebble) crusher (1,250 hp (932 kW)), the product of which is returned to the SAG mill. A scalping screen undersize product of 2,800 µm (P_{80}) is discharged into the cyclone feed pumpbox, from which the slurry is pumped to two hydrocyclone clusters. The cyclone underflow is fed to the ball mill. The product is discharged into the gravity feed pumpbox which feeds the gravity circuit. The overflow of the gravity feed pumpbox is returned to the cyclone feed pumpbox along with the tails of the gravity circuit. The feed to the gravity circuit (93,600 t/d (84,910 mt/d)) goes to a distributor that feeds eight gravity screens (four per line), each of which feeds its own gravity concentrator (127 in). The gravity screen oversize and gravity concentrator tails are returned to the cyclone feed pumpbox. The gravity concentrate, amounting to approximately 0.05 wt% mass pull, is sent to the intensive cyanidation (ILR) system.

Pebble lime will be added continuously at the ball mill to maintain ball mill discharge pH above 9.0 to promote sodium cyanide leaching downstream and limit the amount of conditioning required prior to CIL.

14.5.5 Gravity and Intensive Leaching

The Livengood gold ore contains significant amounts of free gold, which responds well to gravity concentration. The gravity circuit consists of two parallel lines composed of four Knelson concentrators each fed by a portion of the ball mill discharge. Based on testwork and simulations conducted by FLSmidth, the design gold recovery of the gravity circuit is estimated to be 30% for an average feed blend.

A batch intensive cyanidation system composed of two units will be used to process the gravity concentrate. The extraction performance of gold from the gravity concentrate by the intensive cyanidation system is designed at 98%. The pregnant solution will be pumped to a tank in the gold room, followed by electrowinning in a dedicated cell.

14.5.6 Carbon in Leach

The hydrocyclone overflow product will be pumped to a trash screen, before discharging into the pre-leach high rate thickener with a diameter of 213 ft (65 m). This thickener will thicken the slurry to 60 wt% in the thickener underflow stream. The thickener overflow will report to the process water tanks. The underflow from the thickener will feed CIL lines 1 and 2 at the pre-conditioning stage.

Pre-conditioning with oxygen and lead nitrate will be conducted in four large tanks. The designed retention time is four hours when the plant operates at 65,000 t/d (59,000 mt/d). Lead nitrate will be added to the pre-conditioning tank based on the concentration of antimony in the feed. When the concentration is sufficiently low, no lead nitrate will be added to the pre-conditioning circuit.

The CIL circuit is comprised of two lines of seven large CIL tanks each and all within their own concrete containment areas. Overflow from the pre-detox thickener is added to the first CIL tanks of each line to adjust the slurry percent solids to 50%. The designed retention time is 24 hours when the plant operates at 65,000 t/d (59,000 mt/d). The design carbon loading is 800 g/mt, but is to be confirmed by additional CIL testwork and simulation.

The slurry will flow counter-currently to the carbon from tank 1 through to tank 7. Fresh carbon will be added to tank 7 and flow to tank 1, by way of the carbon advance pumps located in each CIL tank. Slurry will exit tank 7 over the carbon safety screens, before heading to the pre-detox thickener. Loaded carbon exiting tank 1 will report to the carbon stripping system (ADR) for recovery of the adsorbed metals.

14.5.7 Adsorption, Desorption and Recovery (ADR)

Loaded carbon from the CIL tanks reports to the loaded carbon stripping circuit, where gold will be stripped, and the carbon reactivated for recycle to the CIL circuit. Based on the information available, it is assumed that one strip per day will be sufficient to recover the gold loaded onto the carbon.

The ADR circuit includes an acid wash stage (two vessels) and High Pressure “modified” Zadra process for gold stripping from the loaded carbon. The Zadra stripping circuit (four vessels) is considered “modified”, as the electrowinning is done in-line, with no pregnant tank between stripping and electrowinning. The barren solution is collected in two 20,236 gal (76.6 m^3) barren tanks. The stripping cycle will be two stages, in which copper is stripped first, followed by gold. The stripped copper is converted to copper sulfate for use in the cyanide detoxification circuit downstream.

The stripped carbon will flow to the carbon regeneration kilns (2) possessing the same carbon capacities and conservatively include provision for 100% regeneration of the carbon. The regenerated carbon will be combined with fresh carbon, making up for carbon losses that occur through the process. This regenerated/fresh carbon mixture will maintain an adequate supply to the CIL circuits.

The flow of pregnant solution from the Zadra circuit and the gravity ILR is split to feed a total of seven electrowinning cells. The refining equipment is designed to handle both the gold from the stripping circuit and from the gravity recovery system. The electrowinning sludge is filtered, dried, and mixed with fluxes, before being smelted in an induction furnace.

14.5.8 Pre-Detox Thickening and Cyanide Detoxification

Thickener overflow reports to the process water tank and will be used for water needs upstream and to dilute the slurry prior to cyanide detoxification. The underflow of the pre-detox thickener (213 ft (65 m) diameter) is diluted to 50% from 60%.

The selected cyanide detoxification process is the Inco SO_2/air process. A sulfur burner will be used to produce SO_2. Cyanide detoxification was designed with 1.5 hours of retention time in two tanks. The tailings slurry will be pumped at 50 wt% solids coming out of the cyanide detoxification unit.

Water recovered by the reclaim barge pumps from the settled tailings will be returned upstream to meet process water requirements.

All cyanide process tanks are provided with appropriately sized secondary containments and all process solution pipelines are contained within the mill complex (mill building, CIL/leach tank farm, and detoxification plant) and are provided with secondary containment in association with the major tanks that they serve.

14.6 Consumables

The main consumables for the processing plant are represented by the grinding media and liners for the SAG and ball mills, as well as the reagents used in the leaching, gold recovery and cyanide detoxification circuits.

All process reagents are contained in a separate area within the process plant building to prevent any contamination of any surrounding areas in case of a spill. Safety showers are provided in the different reagent mixing and utilization areas for safety, in case of contact with the reagents. HCN monitors will be installed in appropriate locations to ensure the safety of the employees. Grinding media will be in pits located indoors, close to usage points.

The primary reagents used in the process include sodium cyanide (NaCN), lime (CaO), oxygen (O_2), elemental sulfur (S), sodium hydroxide (NaOH), hydrochloric acid (HCl), carbon, copper sulphate ($CuSO_4$), lead nitrate ($Pb(NO_3)_2$) and flocculant. Consumption rates are mostly based on results from bench-scale testwork, with reductions as deemed applicable to recycle streams and implementation of control strategies at industrial scale.

Table 14-2 and Table 14-3 list all reagents, media, areas of usage and their purpose.

Table 14-2: Reagents and area of use

Reagent	Area	Use	Consumption (mt/y)
Lead nitrate ($PbNO_3$)	Pre-treatment ahead of carbon in leach and intensive leach	Surface passivation	1,028
Sodium cyanide (NaCN)	Carbon in leach and carbon elution	Dissolution of gold and elution	7,357
Oxygen (O_2)	Carbon in leach	Dissolution of gold	54,913
Carbon (C)	Carbon in leach	Gold adsorption	526
Quicklime (CaO)	Ball mills Carbon in leach Cyanide detoxification	pH control	30,410
Sodium hydroxide (NaOH)	Acid wash and Carbon elution	Neutralization of acid and elution	1,250
Hydrochloric acid (HCl)	Carbon elution	Acid wash	696
Elemental sulfur (S)	Cyanide detoxification	Cyanide detoxification	5,127
SMBS ($Na_2S_2O_5$)	Cyanide detoxification	Cyanide detoxification (backup)	399
Copper sulphate ($CuSO_4$)	Cyanide detoxification	Catalyst cyanide detoxification reaction	965
Flocculant	Pre-leach thickener Pre-detox thickener	Flocculate solids to assist in solid/liquid separation	1,287

Table 14-3: Grinding media and area of use

Media	Area	Consumption (mt/y)
5-in forged steel ball	SAG mill	3,472
3-in forged steel ball	Ball Mill	7,304

Carbon is consumed regularly through abrasion in the CIL tanks and in transfer pumps, and by thermal disintegration from regeneration, etc. Carbon will be delivered by truck in 1,100 lb (500 kg) bulk super sacks. Before it can be used in the process, fresh carbon must be wetted and abraded in an attrition tank.

Caustic soda (50%) and hydrochloric acid (31.5%) will be used in the carbon stripping process. Caustic soda will be supplied by bulk tanker and the acid will be delivered in rubber-lined ISO containers. The individual feed lines will be equipped with flow meters and control valves to ensure that the appropriate dosages are achieved.

Sodium cyanide (NaCN), used in the cyanide leaching (CIL and ILR) and carbon stripping processes, will be delivered in briquette form in ISO tanks. The briquettes will be dissolved in water and the solution will be stored in a tank, from which it will be distributed by pumps to the appropriate process areas.

Oxygen is fundamental for gold leaching. Based on the previous trade-off studies by BBA, the implementation of a vacuum pressure swing adsorption (VPSA) oxygen production plant was selected to meet the oxygen requirements of the Project. Oxygen will then be bottom-sparged to the pre-treatment tank and CIL tanks. A liquid oxygen back-up system will be available when the VPSA plant is not in operation.

Flocculant will be required for the pre-leach and pre-detox thickeners. It will be delivered in solid form and dissolved in batches in a mixing tank using process water. The batch will then be pumped to a storage tank, from where the reagent will be continuously metered into the thickener feed slurry.

Copper sulphate ($CuSO_4$) will be delivered in solid form in 2,756 lb (1,250 kg) super sacks and dissolved in batches in a mixing tank using fresh water. The batch will then be pumped to a storage tank, from which the reagent will be continuously pumped to the cyanide detoxification tank.

Quicklime (CaO) is used in the cyanide detoxification and cyanide leaching processes (pre-aeration and CIL tanks). It will be delivered by truck in bulk containers and transferred pneumatically to a lime storage silo. A screw conveyor will transfer the quicklime from the silo to the lime slaker, where it will be wetted with water. The slaked lime will pass through grit separators and into the quicklime mixing tank, to which more water will be added to create slurry of the appropriate density. Grit will be removed from the separator and disposed of using a screw conveyor. The hydrated lime slurry will be pumped continuously from the mixing tank to the appropriate process areas.

Lead nitrate ($PbNO_3$), used in cyanide leaching, will be delivered in 2,200 lb (1,000 kg) bulk super sacks. Lead nitrate is dissolved in batches in a mixing tank. The solution will then be pumped to a holding tank, from which the reagent will be continuously pumped to the pre-conditioning tanks.

The Inco SO_2/air process will be used for cyanide detoxification. The sulfur dioxide (SO_2) will be generated using a sulfur burner that will burn elemental sulfur delivered to site in 2,200 lb (1,000 kg) bulk super sacks, which will be transferred to a storage silo. The SO_2 will be produced on demand and will be delivered to the cyanide detoxification tanks.

Sodium Metabisulfite ($Na_2S_2O_5$) will be the back-up source of SO_2 when the sulfur burner plant is under maintenance. Sodium metabisulfite will be received in 2,200 lb (1,000 kg) super sacks. Each sack will be emptied into the sodium metabisulfite mix tank and mixed with fresh water to 20 wt% and then transferred to the sodium metabisulfite solution holding tank. Sodium metabisulfite solution will be pumped by the sodium metabisulfite distribution pump to the cyanide detox reactor tanks.

Copper sulphate ($CuSO_4$) and quicklime (CaO) will be added to control the chemical reaction at the cyanide detoxification reactors. The detoxified slurry will then be pumped to the TMF.

Refining flux will be delivered to site in bags or buckets. Pre-mixed fluxes are mixed with the dried electrowinning sludge to adjust the chemistry of the material for refining. The proper flux mix and quantity, based on the electrowinning sludge chemistry, will be established by the smelting flux supplier during the first months of operation.

14.7 Ancillary Facilities

The process plant building will house various maintenance facilities including shops for mechanical, electrical and instrumentation repairs. Equipment requiring specialized maintenance or major rebuilds will either be dispatched to shops in the Fairbanks area or back to their suppliers.

Other facilities within the process plant building include a centralized control room located near the grinding area, metallurgical and sample preparation laboratory, change-rooms (dry), lunchroom, as well as offices, conference and training rooms.

14.8 Process Plant Controls

A plant control system with open architecture and a unique platform will be used. The main communication backbone will be provided by redundant Ethernet fiber optic cables. Where equipment is supplied as a packaged unit, the vendor packages will have standardized controllers that will communicate with and be controlled by the plant network.

The control system will include operator workstations with historian software to enable reporting of plant data, calculations, statistical analysis of process data, and to allow for metallurgical optimization of the plant operations.

An information system and an information management system will allow certain staff to monitor the process and the variables from their PCs, connected to the management information platform.

Monitors will be installed for a closed-circuit television (CCTV) system, a calling and searching system, fire protection systems, centralized panels, and other dedicated systems that require monitoring or controlling by the operator.

14.9 Process Water

Process water is distributed throughout the processing facility to dilute streams to the necessary solids pulp density that is required in each unit operation. The majority of the process water is reclaimed from the CIL thickener overflow stream and from the tailings pond via the reclaim pumps. The fresh water required for the process is taken from the wells located on the north side of Livengood Valley. Based on the mass and water balance, fresh make-up requirements will be approximately 233 gpm (53 m^3/h)

14.10 Energy Requirements

The total operating power demand for the process plant will be approximately 53 MW. The crushing and grinding circuit represent approximately 57% of the total operating power used by the plant. The processing power demand is shown in Table 14-4.

Table 14-4: Process plant power demand by area

Area	Power Demand (MW)
Primary Crushing	1.8
Stockpile	2.0
SAG Mill	18.4
Secondary Crushing and Pebble Crushing	0.6
Ball Mill	15.8
Gravity and ILR	2.2
Leaching	5.3
ADR and Gold Room	0.7
Detox and Plant Tailings	3.1
Reagents	2.4
Plant Services	1.3
Total Power Demand	**53.5**

Liquefied natural gas will be used for heating within the process plant building.

14.11 Process Plant Arrangement

The proposed Livengood process plant and ancillary facilities will be located approximately midway between the open pit mine to the south-east and the TMF to the north. The process plant comprises four main buildings: the primary crushing building, the covered stockpile area, the secondary/pebble crushing building and the main process plant building. Secondary process facilities such as the thickeners, reagent silos, oxygen plant and sulfur burner are in proximity to the main process building. A general arrangement of the process plant area is presented in Figure 14-3.

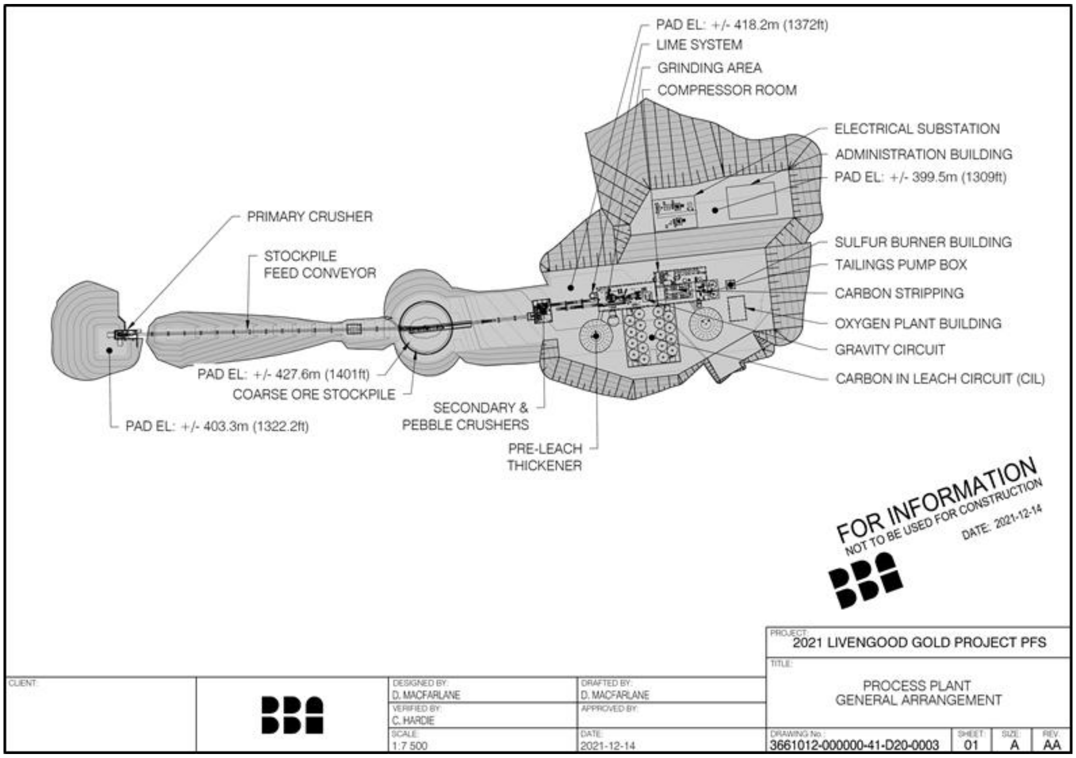


Figure 14-3: Process plant general arrangement

14.12 Process Plant Personnel

A total of 140 employees are required in the process plant, including 26 salaried staff and 114 hourly workers divided into management and technical services, operations and maintenance departments.

Table 14-5 and Table 14-6 present the salaried and the hourly manpower requirements, respectively, for the processing plant.

Table 14-5: Process plant salaried manpower

Position	Number of Employees
Mill manager	1
Mill secretary / clerk	1
Mill operations supervisor	4
Safety trainer & coordinator	1
Chief metallurgist	1
Metallurgist	2
Chief assayer	1
DCS engineer	1
Process data analyst	1
Mill maintenance superintendent	1
Electrical superintendent	1
E&I supervisor	2
Electrical engineer	1
Electrical maintenance planner	1
Mechanical engineer	1
Mill maintenance supervisor	2
Mill maintenance planner	2
Crusher supervisor	1
Tailings supervisor	1
Total – Salaried	**26**

Table 14-6: Process plant hourly manpower

Position	Number of Employees
Mill Operations	
Primary crushing operator	4
Crusher / conveyor helper	4
Mill control room operator	4
Grinding operator	4
Grinding helper	4
Gravity operator	4
Gravity helper	4
Leach / CIL operator	8
Stripping operator	4
Refiner	4
Detox operator	4
Tailing operator	4
Reagents operator	4
Metallurgical technician	2
Assayer	4
Sampler	4
Sub-total	**66**
Mill Maintenance	
Millwright	20
Mechanic / welder	16
Elect. / Inst.	4
Electrician	4
Instrument technician	4
Sub-total	**48**
Total – Hourly	**114**

15. PROJECT INFRASTRUCTURE

15.1 Introduction

The Livengood Gold Project area is located approximately 70 mi (113 km) by road (47 mi (75 km) by air) northwest of Fairbanks and is accessed by state Highway 2 (Elliott Highway), which provides paved, year-round access from Fairbanks. The property is adjacent to the Trans-Alaska Pipeline System (TAPS) corridor, which transports crude oil from the North Slope south and contains a fiber optic communications cable. A second fiber optic cable runs parallel to the Elliott Highway. Locally, a number of unpaved roads lead from the Elliott Highway into and across the deposit. A 3,000 ft (914 m) runway is located 3.7 mi (6 km) to the southwest of the Project and is suitable for light aircraft (see Figure 15-1).

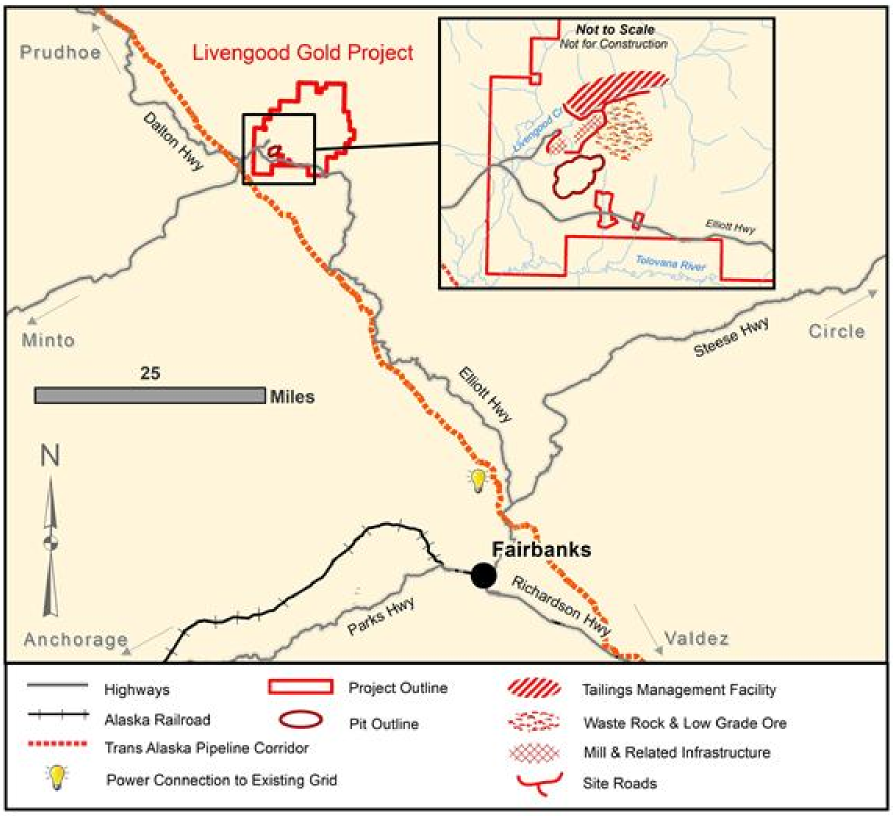


Figure 15-1: Livengood property – conceptual infrastructure arrangement drawing

15.2 General Site Arrangement

To the extent practicable, the infrastructure facilities for the Project have been designed to avoid or minimize impacts to wetlands by avoiding direct use of the Tolovana River watershed and by establishing a footprint as compact as possible within the historically mined Livengood Creek basin. The Project site has been configured for optimum construction access and operational efficiency as well as to take advantage of the existing roads and infrastructure.

The Project envisions construction of the following key infrastructure items:

- Temporary construction camp;
- Light vehicle access and mine haulage roads;
- O'Connor Creek substation and 50 miles of new 230 kV transmission line;
- Process plant and ancillary buildings;
- Administration and mine dry building
- Maintenance garage, truck wash, warehousing and explosive storage facilities;
- Bulk fuel storage and refueling station;
- Water and sewage treatment;
- Site wide electrical distribution and emergency power generators;
- Fresh water pumping and distribution system;
- Waste rock, overburden, ore and growth media stockpiles;
- Communications and information technology networks;
- Mine tailings and water management facilities;
- Fairbanks Integrated Remote Operations Center (IROC);
- Fairbanks employee parking area.

15.3 Power Demand

The total power demand of the Project is estimated to be approximately 57.8 MW, including network losses of 3%. An electrical load list was created based on a detailed mechanical equipment list that included the major power draw contributors. Minor power consumers and power for auxiliary systems were benchmarked based on BBA's past project experience. Based on this load list, the power demand was calculated taking into account the nominal operating loads (load factor), efficiency factors and a diversity factor. Table 15-1 shows the estimated power demand breakdown by area. The power demand presented represents the LOM average. The yearly nominal power demand will vary based on the rock type blend as the specific grinding energy varies per rock type. The projected annual electrical energy use is estimated to be approximately 450.9 GWh including the network losses of 3%.

Table 15-1: Estimated total project power demand

Area	Power Demand (MW)	% Site
Open Pit Mine and Mine Garage	0.3	1
Process Plant	53.5	93
Administration Building and General Infrastructure	0.3	1
Tailings and Water Management	2.0	3
Network Losses	1.7	3
Site total	**57.8**	**100**

15.4 Power Supply

Golden Valley Electric Association (GVEA), a member-owned cooperative, provides the only regulated electrical service to customers connected to the rail belt power grid north of the Alaska Range. Historic peak winter demand on the GVEA system is approximately 210 MW. GVEA is connected to South Central Alaska via a single 138 kV transmission line that has a capacity to import approximately 75 MW into the GVEA service area.

In 2012/2013, to support the 2013 FS, Electric Power Systems, Inc. (EPS) conducted a power supply study and determined that the GVEA system, with modifications, is capable of providing the Project with up to 100 MW of power, if required. To supply the 58 MW required for the PFS configuration, the additions and modifications to the electrical system that will be required include:

- A new substation at O’Connor Creek;
- GVEA transmission system upgrades;
- 50 mi (80 km) 230 kV transmission line up to the Livengood Project substation.

15.4.1 O’Connor Creek Substation

A new 138/230 kV substation at O’Connor Creek (OCS) will be required to connect the Livengood transmission line to the GVEA system. The OCS will contain two 100/150 MVAR transformers, each of which will be capable of transmitting the Livengood load. GVEA has obtained a lease from the Fairbanks North Star Borough for the land parcel required for the substation. The substation will be a 3-ring bus configuration and will step up the voltage from 138 kV to 230 kV for transmission to Livengood. The network stability study performed by Dryden & LaRue in 2013 determined that a 10 Mvar Static Var Compensator (SVC) will be required at the O’Connor Creek substation.

15.4.2 GVEA Transmission System Upgrades

GVEA currently provides 138 kV service to the Fort Knox mine through the Fort Knox transmission line that connects to the grid at the Gold Hill substation. The OCS will be built adjacent to and connect to the Fort Knox transmission line. Since a large part of the GVEA generation will be coming from their facilities near North Pole, Alaska, located approximately 15 mi (24 km) southeast of Fairbanks, upgrades to the GVEA transmission system will be required. Upgrades to the GVEA transmission system include double circuiting approximately 15 mi (24 km) of existing line and replacing 18 mi (29 km) of various sections of 69 kV and 138 kV lines with new 138 kV transmission line.

15.4.3 230 kV Transmission Line

Dryden & LaRue completed the design for the 50 mi (80 km) 230 kV transmission line. The route generally consists of flat to gently rolling terrain. It follows the Trans-Alaska Pipeline (TAPS) for the first 42.5 mi (68.4 km) from O'Conner Creek substation, crossing it three times. The route then traverses north and east away from the TAPS corridor for 7.25 mi (11.7 km) to the Livengood mine site substation.

The preliminary design is based on constructing the 230 kV transmission line with wood H-frame structures with guyed angle and dead-end structures. Wood poles will be directly embedded with native backfill where favorable soils exist. Where ice-rich permafrost or swampy conditions exist, driven pile foundations will be used to support the wood poles. The transmission line would be permitted in conjunction with the Project, would be constructed by THM, and operated by GVEA. EPS determined that a 25 MVAR SVC is required at the Livengood mine site substation to modulate the transient effects of the Project to GVEA specifications.

In the current study, the 25 Mvar SVC has been replaced by two Synchronous Condensers, which will provide the same benefit and will also contribute to the short-circuit capacity at the Livengood interconnection.

15.5 Site Electrical Distribution

The main substation at the plant site will consist of one 230 kV incoming circuit breaker and two 230 – 13.8 kV, 450/65/80 MVA, outdoor transformers, each with a 230 kV disconnect switch and a 230 kV circuit breaker on the primary side. The substation will distribute power to the plant at 13.8 kV, 60 Hz from a main switchgear installed in a pre-fabricated building located in the main substation. The main loads, each at 13.8 kV, are dedicated to the SAG and ball mills. This equipment will be driven by low-speed synchronous motors that will be run by a variable frequency drives complete with their own dedicated transformers. Two remote substations will be required. One 13.8-4.16 kV, 3 MVA substation at the tailing pond will feed the fresh water pumping station and one 13.8-4.16 kV, 1.5 MVA substation near the mining pit will feed the mine dewatering pumps. The electrical distribution to the site infrastructure (security gate, mine garage/administration complex and other facilities) will consist of a dedicated 13.8 kV overhead line distribution network. Approximately 3.7 mi (6 km) of aerial lines will supply all the infrastructure loads around the site.

15.5.1 Emergency Power

Two 2,000 kW diesel engine driven generators will serve as the emergency electrical power source for the whole plant. The generator sets will provide backup power to the plant for selected process loads that need emergency power to allow an orderly shutdown of the process in case of a main power failure or to simply maintain them in operation if they are critical. They will also provide backup power to the plant control system, critical remote 480 V loads and the security system. One of these generators will provide power at 4.16 kV while the other will provide power at 480 V.

Other smaller generators (480 V) may be considered for remote consumers when using the main generators is not practical.

Generators purchased for the construction camp will be used as backup generators for the infrastructure area once the operations phase commences. No emergency power capacity is planned for the open pit mine area.

15.6 Site Access

The main road and security gate to access the site will be located near the existing Alaska Department of Transportation facilities. Site access will be controlled with a guard/security house located at the entrance to the site on the main access road. The guard house will be a modular, pre-fabricated wood-frame building, with separate entrance and exit doors, potable water cooler (bottled), and a small toilet and sink connected to a pumpable holding tank. Visitor car, and bus and truck parking bays will be provided after passing the guard house. The security gate will be manned full time and is equipped with a weigh scale to monitor delivery of all bulk items required by the operation.

15.7 Site Roads

The Project site is very well situated and will make use of existing roads when possible. Project site roads will consist of both light vehicle access roads and mine truck haul roads. These roads will be constructed during the initial construction of the Project with adjustments to the alignments and profiles during the operational years as facilities change in size and shape. The on-site roads will be constructed of crushed waste rock available from site and other available materials. A dedicated mobile aggregate crushing plant will be utilized for the entire life of Project, including the period post ex-pit operation, when stockpiles are being reclaimed, to provide aggregate for continually resurfacing haul roads.

15.7.1 Light Vehicle Roads

Site roads are light vehicle access roads located throughout the Project site. Approximately 5 mi (8 km) of new site roads are planned to be constructed. These roads are designed to provide access to the administration complex, mine equipment assembly and truck shop/wash area, substation, diesel and LNG storage area, fresh water wells, process plant facilities, and the explosives storage facilities. These site roads have been designed with a two-way travel width of 26 ft (8 m) and 3 ft (1 m) high safety berms along each road shoulder. If necessary, transit of these roads by large vehicles will be by controlled one-way traffic.

15.7.2 Mine Haul Roads

Mine haul roads will be built to connect the open pit to the primary crusher, emergency ore stockpile pad, mine truck shop/wash area, mine equipment assembly area, refueling station, tailings management facility, overburden stockpile, waste rock storage facility, and low grade ore stockpile. The haul roads have been designed for a two-way travel width of 105 ft (32 m) and 6.5 ft (2.0 m) high safety berms along each road shoulder, which is suitable for the 320 t (291 mt) class trucks planned for Project use. Over the life of the mine, approximately 13.7 mi (22 km) of haul roads (ex-pit) will be built, of which 1.25 mi (2.3 km) will be built over the planned waste rock stockpile.

15.8 Explosives Storage Facilities

The explosives storage facilities have been located roughly 0.4 mi (700 m) to the east of the open pit and directly south of the low grade ore stockpile. Minimum distance requirements to mining activity and infrastructure have been respected. The explosives storage facilities include silos to store Emulsion and ANFO, as well as magazines to store the explosives accessories.

15.9 Process Plant

The process plant area consists of the primary crushing facility, covered stockpile, secondary/pebble crushing and main process plant building. The main process plant enclosed structure is approximately 165 ft (50 m) wide by 656 ft (200 m) long, and will house the grinding area (SAG and ball mills), carbon stripping, electrowinning, refining and reagent preparation areas as well as tailings pumps, mechanical services, maintenance areas, offices and the metallurgical laboratory. The pre-leach thickeners, CIL leach tanks, pre-detox, detox cyanide destruction tanks, and lime and sulfur burner facility are to be located outside, around the process building. The process building will be heated with liquefied natural gas (LNG).

15.10 Administration and Mine Services Facility

The administration offices and mine dry will be in a building with approximate dimensions of 295 ft (90 m) long by 197 ft (60 m) wide and will be located on the same pad as the substation north of the process plant. However, the mine fleet shop will be located on the same pad as the mine equipment assembly area.

The mine fleet shop will be designed as a permanent building with an expandable maintenance bay structure that will accommodate the addition of mining vehicles over time. A symmetrical design allows for repair bays to be added in pairs. The fleet bay dimensions, bay door sizing and overhead crane lifting capacities (70 t / 63 mt) are all based on a fleet of 320 t (291 mt) class mining trucks. All vehicle bays will have the same dimensions to allow for operations flexibility. As with the process facilities, this building will be heated with LNG.

15.10.1 Lube Storage and Distribution

The mine fleet shop will be equipped with an enclosed lube storage and distribution system for mine fleet maintenance. The storage area will consist of multiple vertical steel tanks sized according to their consumption rate and located within a containment dike. The storage area will be placed alongside the mine garage facility, and the large used oil and coolant tanks will be located outdoors for ease of access and servicing. A long-range overhead dispensing and evacuation system for transfer of oil, grease, transmission fluids, cooling fluids, windshield washer, service water and compressed air is planned for the mine fleet shop.

15.10.2 Warehouse and Storage

The warehouse storage facility is located adjacent to the mine fleet shop, with direct access between the sections, to facilitate heavy component transfer and increased productivity. Warehouse storage requirements will be defined according to the type of storage required. The assumption is made that only one set of major components will be housed at the site and sufficient “rolling” storage will be provided. Moreover, an exterior cold storage area has been allocated adjacent to the building.

15.10.3 Mechanical Workshop

The mechanical workshop will also serve as a light vehicle maintenance bay, and be equipped with a 10 t (9 mt) overhead crane and small bay doors. An allowance for equipment has been included in the capital cost estimate.

15.10.4 Administration Offices

The mine offices will include sufficient closed offices and workstations to accommodate the mining operations, mine maintenance, and environmental and technical services. Additional offices are foreseen in the warehouse as well as in the concentrator building for process personnel, maintenance group and administration groups.

15.10.5 Employee Dry

The mine dry facilities will consist of locker rooms and shower facilities for both men and women. Each mine employee will be assigned two distinct lockers. The shower facilities will be sufficient to handle the shift crossover.

15.11 Other Structures

The following additional surface infrastructure facilities are located at various locations on site and are described below. The mine services facilities will be positioned on the pad to ensure free and safe movement of the heavy vehicles and will include a “ready line” parking area for the mine haul trucks. These additional facilities include the following:

- Truck Wash Facility:
  - The truck wash facility will accommodate the mine trucks and auxiliary vehicles. This facility will have a specialized truck wash system, which will include a mud settling basin, oil separator, and water filtration and recirculation system to reduce overall water consumption. The truck wash facility will be located adjacent to the truck shop in the open pit mine area.
- Diesel Fuel Storage:
  - Diesel storage will consist of ten 13,000 gal (50,000 L) tanks located along the eastern edge of the process plant pad, providing up to an average of seven-day storage capacity, based on 24 hrs/d operation for the LOM. The tanks are double-walled and self-contained with leak detectors.

- Fuel Island:
  - The fuel dispensing system for mine fleet vehicles will be located near the fuel storage area and will consist of an open-ended pre-engineered building with high speed dispensers and hose reels. A concrete pad will be installed under the enclosure and will be equipped with a spill catchment. The fuel dispensing area will also serve as a top-off area for engine coolant, oil, grease and windshield washer fluid. For safety and practical reasons, a separate fuel dispensing station for light vehicles will be located nearby. Gasoline usage is minor and will be satisfied by purchase from local retail suppliers. The mine’s light vehicle fleet is expected to consist primarily of diesel pickup trucks.
- Sewage Treatment Plant:
  - A skid mounted sewage treatment plant will treat sewage from the administration building and process plant. Sludge from the sewage treatment plant will be collected by a vacuum truck and may be transported off site for disposal. The sewage treatment plant will be located adjacent to the administration building.
- Potable Water Treatment Plant:
  - A skid mounted potable water treatment plant is planned to supply water to the administration building, mine services facility and process plant. The treatment process consists of filtration, chlorination and UV sterilization units to produce potable quality water. The potable water treatment plant will be located adjacent to the administration building.
- Emergency services building:
  - The emergency services building will be connected to the administration building and is a modular and pre-fabricated wood-frame building. It contains two offices, an examination room, a treatment room, and a waiting room. Within the same complex, a covered garage houses the ambulance and fire truck.

15.12 Communications / Information Technology (IT)

The internet and phones services will be provided for the Project by a regional internet service provider, utilizing one of the existing networks currently installed near the TAPS corridor. A redundant fiber optic network will interconnect critical site areas including the gate house, administration and mine services facility and the process plant. Telecommunication services for non-critical remote locations will be provided by a wireless network. A hand-held radio system will be used for voice communication between personnel in the field. The site-wide fiber optic network will be utilized by the following systems:

- Process plant control system (process control network and electrical systems);
- Corporate IT (phone and data);
- Operations, maintenance and warehouse management systems;
- Fire detection;
- Video surveillance and access control systems.

The mining operation plans to use mobile mine radios with base stations to communicate between equipment operators and the mine staff. Some equipment will also be equipped with GPS technology to provide accurate location information through Wi-Fi communication.

15.13 Fire Protection

An underground fire water distribution network of 14-in pipe, feeding sprinkler systems, with 6-in hydrants will be installed around the process plant and the administration and mine services facility. The network will be supplied by a combined fresh/fire water tank and a dedicated fire water pump with sufficient water to meet demand for two hours.

Each facility will also be protected by manual fire alarm systems and will have portable fire extinguishers located at strategic points throughout.

15.14 Fresh Water

Fresh water for potable and process plant use will be sourced from an aquifer system located on the north side of the Livengood valley. Pumping tests and hydrological studies conducted in 2015 (Cope, L., SRK 2016) of the Amy Carbonate unit indicate that the aquifer could support five to ten water supply wells each, producing 500 to 1,000 gpm (1,900 to 3,800 L/m). It has been assumed that eight wells will be able to support the process plant start-up and operations requirements. Water from the wells and the fresh water reservoir will be pumped via a heat traced pipeline to the process plant pad for further distribution to other areas as required.

15.15 Construction Camp

A temporary 800 person construction camp will be mobilized for the construction phase of the Project. The camp would have single occupancy rooms in a common bathroom arrangement. The construction camp is planned to include a kitchen, dining complex, offices, recreation room, and laundry and gym facilities. Once construction activities are completed, the construction camp will be removed and sold.

15.16 Personnel Transportation

As a permanent camp is not planned for the operations phase of the Project, all personnel will be transported between Fairbanks and the mine site by charter buses. Multiple buses will be required to operate on different schedules to accommodate varying work schedules. All costs related to personnel transportation are covered by the General & Administration operating cost estimate.

15.17 Fairbanks Infrastructure

A prefabricated guard house, bus waiting building, small receiving area and parking lot for 300 vehicles are planned to be located in the city of Fairbanks.

15.17.1 Integrated Remote Operation Centre (IROC)

An IROC is planned to be established in the city of Fairbanks on a leased basis in an existing commercial building. The integration of operations is an essential addition in the implementation of new projects and offers an approach for reconciling people (culture), process and technology in the development of an efficient operating model in production mode. Outlined below are some of the programs that are planned to be established as part of the overall integrated operations strategy for the Livengood Gold Project:

- Operational Excellence (OE) and Lean Mining® Program;
- Asset Management Program;
- Reliability-Centred Maintenance (RCM) Program;
- Supply Chain Management;
- Human Factors Engineering;
- High-Performance Teams;
- Sustainability Program;
- Leveraging Technology.

15.18 Waste Rock Storage Facility (WRSF) and Stockpiles

Material mined from the open pit that is not directly hauled to the primary crusher will be placed in several storage facilities across the Livengood site. These facilities, discussed in more details below, include growth media stockpiles, overburden stockpile, WRSF, low grade ore stockpile, and an emergency ore stockpile.

15.18.1 Growth Media Stockpiles

Growth media (topsoil) material will be stripped and placed separately in growth media stockpiles to be used for closure and reclamation activities. Several growth media stockpiles will be strategically located around the site. Depending on the mining sequence and closure activities, topsoil may be hauled directly to certain areas if they are available for reclamation, thus reducing costs by limiting re-handling activities.

15.18.2 Overburden Stockpile

Overburden will be stripped and hauled to the overburden stockpile located in the Gertrude Creek Valley to the east of the plant site. The overburden stockpile will be built on the side of the hill, has a footprint area of 67 ha and a capacity of 15.7 Myd^3 (12 Mm^3). The bottom of the overburden stockpile is at the 1,378 ft (420 m) elevation and the top is at the 1,772 ft (540 m) elevation for a total height of 395 feet (120 m). The overburden stockpile has been designed with 150 ft (45 m) wide catch benches every 100 ft (30 m) in elevation and has an overall slope of 18.4 degrees.

15.18.3 Waste Rock Storage Facility (WRSF)

Waste rock not used for construction will be hauled to the WRSF located in the Gertrude Creek Valley to the east of the plant site, below the overburden stockpile. The PFS considers the same design parameters for the WRSF that were prepared by AMEC for the 2013 FS and presented in the report titled "Geotechnical Design Report August 6, 2013.pdf" (AMEC, 2013).

Since the WRSF will be built along the side of a hill, a buttress called the "Gertrude Creek Embankment" will be built at the base of the WRSF to provide additional stability. The buttress will separate the TMF and the WRSF. Stacking of the waste rock will begin at the base of the pile, against the Gertrude Creek Embankment, and advance up the slope in a "bottom-up" sequence. Access to each lift will be from the haul road that will be built to the east of the plant site to access the TMF. The WRSF has been designed with an overall slope of 18.4 degree (3H:1V).

The WRSF was designed with a footprint area of 215 ha and a capacity of 163 Myd^3 (125 Mm^3). The bottom of the WRSF is at the 1,083 ft (330 m) elevation and the top is at the 1,378 ft (420 m) elevation for a total height of 295 ft (90 m). The PFS requires 105 Myd^3 (80 Mm^3) of storage capacity in the WRSF and will be built to the 1,280 ft (390 m) elevation.

15.18.4 Low Grade Ore Stockpile

To maximize the NPV of the Project, lower grade ore will be placed in a stockpile so that higher grade ore can be accessed and sent to the process plant earlier in the mine life. The lower grade ore is then reclaimed at the end of the life of the mine. The low grade ore stockpile is located to the east of the open pit on the ridge above Gertrude Creek. Material placed in the stockpile will be classified into low grade (< 0.5 g/mt), medium grade (> 0.5 g/mt and < 0.7 g/mt) and high grade (> 0.7 g/mt), with each category being placed in a different part of the pile.

The peak low grade ore stockpile balance from the mine plan is 87.7 Mt (79.6 Mt), resulting in a capacity requirement of 45 Myd^3 (34 Mm^3). The low grade stockpile will also be built on the side of the hill and has a footprint area of 100 ha. The bottom of the low grade stockpile is at the 984 ft (300 m) elevation and the top is at the 1,870 ft (570 m) elevation for a total height of 886 ft (270 m) at its highest point.

The low grade stockpile has been designed with an overall slope of 18.4 degrees. Runoff from the low grade ore stockpile will be collected and discharged into the TMF.

15.18.5 Emergency Ore Stockpile

To ensure the primary crusher can be fed when the mine will be shut down during extreme weather events, an emergency ore stockpile has been located on the run of mine (ROM) pad. The emergency ore stockpile has a 65,000 t (58,967 mt) capacity to provide 24 hours of crusher feed. The emergency ore stockpile has a height of 16 ft (5 m) and a surface area of 65,000 ft^2 (6,040 m^2). Ore from this stockpile will be rehandled with wheel loaders that will either dump directly into the hopper of the primary crusher or load haul trucks that will haul and dump into the hopper.

15.19 TMF and Water Management

15.19.1 Tailings Management Facility

The TMF has been designed as a fully lined facility to provide safe and secure storage of approximately 486 Mt (441 Mmt) of mill tailings along with a supernatant pond for ore processing solutions. The TMF has expansion potential up to 529 Mt (480 Mmt). Expansions would require evaluations and design modifications to the Gertrude Creek embankment and fresh water reservoir.

The TMF is situated across the Livengood Creek valley and is formed by two cross-valley embankments, the west embankment and the east embankment. Both TMF embankments and the impoundment area between them are geomembrane lined. The TMF embankments require the removal of some native materials within the embankment footprints to improve stability characteristics of the foundation. These materials will be excavated and transported to growth media stockpiles in the general area for use during reclamation of the Project site. The embankments will then be constructed in phases beginning with starter dams, followed by a succession of five raises (six phases in total) to the final crest elevation. In addition to the phased embankment expansions, the basin of the TMF will also be expanded in phases. The embankment and basin expansions will be constructed concurrently, with the first expansion being constructed during the first two years of operation. The remaining five expansions will take approximately three years each to construct and will be completed every four years. After completion of the six TMF phases, the west embankment will have an ultimate height of approximately 450 ft (137 m) and the east embankment will have an ultimate height of 220 ft (67m).

The TMF embankments will be constructed with earth and rock fill materials generated from the open pit mine or borrowed from within the Project limits. The design of the embankments includes a 60 mil linear low-density polyethylene (LLDPE) geomembrane on the interior slope, underlain with Transition Zones, Select Rockfill and Rockfill material zones. The starter embankments also include a geosynthetic clay liner (GCL) below the LLDPE geomembrane. The GCL will further reduce the potential for seepage through the embankments during the initial years of operation when the supernatant pond will be located adjacent to the west embankment. The interior slope of the embankments is proposed to be 3H:1V (horizontal:vertical). Reclaim pipe benches are provided at each raise crest elevation. The downstream (exterior) slope of the west embankment is designed at a 2.5H:1V for the initial phases and steepening to a 1.8H:1V by Phase 6. The exterior slope of the east embankment is designed at a 2.5H:1V for all embankment phases.

A TMF groundwater drainage system will be installed within the major drainages in the Livengood Creek valley and will be located below the 60-mil LLDPE TMF impoundment geomembrane. These drains are designed to capture near surface groundwater flow and seepage from the fresh water reservoir and convey it to the underdrain collection sumps located immediately downstream of the TMF west embankment. Toe drains located along the downstream toe of the TMF west embankment will also be incorporated into this drain system. Water collected in the TMF groundwater drainage system sumps will be pumped into the TMF impoundment for reclaim.

A tailings underdrain collection system will be provided above the impoundment geomembrane to reduce the hydraulic head on the geomembrane and improve consolidation of the tailings. This underdrain system will collect solution that drains from the tailings and convey it to a collection sump located near the TMF west embankment south abutment. The collected solution will then be pumped into the TMF impoundment for reclaim. Mill tailings will flow by gravity to the TMF. The tailings pipeline will follow the road on the south side of the valley (road to access Gertrude Creek embankment) and along the two embankments to spigot tailings along the face of the embankments to minimize seepage potential. A reclaim barge will be utilized to recycle reclaim water to the mill. The barge will operate on the north side of the Livengood valley, keeping the deepest portions of the supernatant pond away from the TMF embankments.

15.19.2 Water Management

15.19.2.1 Contact Water Management

All contact water flowing on the mine site will be directed to the TMF via a series of ditches and culverts. Ditches will generally follow the roads until discharging to the TMF. The channels are sized to convey the storm events.

15.19.2.2 Management of Non-Contact Water to TMF

Non-contact surface water management consists of a fresh water reservoir located immediately east of the TMF. It is formed by the TMF east embankment. In addition to being used to manage non-contact water, this reservoir will be used as a fresh water supply facility. Excess water captured by the reservoir will be conveyed via a gravity flow-through drain to a discharge location in Livengood Creek located downstream of the TMF west embankment. The flow-through drain consists of dual 48-inch pipes to convey the flow and a vertical inlet structure. Similar to the TMF embankment, the freshwater reservoir embankment requires the removal of some native materials within the embankment footprint to improve stability characteristics of the foundation. These materials will be excavated and transported to growth media stockpiles in the general area for use during reclamation of the Project site. An injection grout curtain will then be installed along the embankment upstream toe to reduce seepage from the reservoir. The embankment will be constructed with earth and rock fill materials generated from the open pit mine or borrowed from within the Project limits. The design of the embankment includes a 60 mil LLDPE geomembrane on the upstream slope, underlain by a GCL, filter, drainage, and transition zones. Above the LLDPE, the geomembrane is composed of an overliner layer, geotextile, and riprap materials to protect the geomembrane and GCL liner system. At the upstream toe of the embankment, the LLDEP and GCL are connected to the grout curtain with a concrete plinth.

16. MARKET STUDIES AND CONTRACTS

16.1 Introduction

It was assumed in this PFS and TRS that the Livengood Gold Project will produce gold in the form of doré bars. The market for doré is well established and accessible to new producers. The doré bars will be refined in a certified North American refinery—of which there are many in the United States and Canada—and the gold will be sold on the spot market.

16.2 Market Studies

No market studies have been conducted by Tower Hill Mines (THM) nor its consultants on the gold doré that will be produced at Livengood. Gold is a freely traded commodity on the world market for which there is a steady demand from numerous buyers. The gold market is very liquid with many buyers and sellers active at any given time. Gold production is expected to be sold on the spot market.

Due to its widely traded nature, it is not difficult to determine the market value of gold at any particular time. Gold doré bullion is typically sold through commercial banks and metals traders with sales price obtained from the World Spot or London fixes. These contracts are easily transacted, and standard terms apply. BBA expects that the terms of any sales contracts would be typical of, and consistent with, standard industry practices and would be similar to contracts for the supply of doré elsewhere in the world.

16.3 Gold Price Projections

Figure 16-1 shows the gold spot price on a monthly basis since November 2018. As of October 29, 2021, the trailing three-year gold price average was US$1,630/oz and the trailing two-year gold price average was US$1,760/oz.

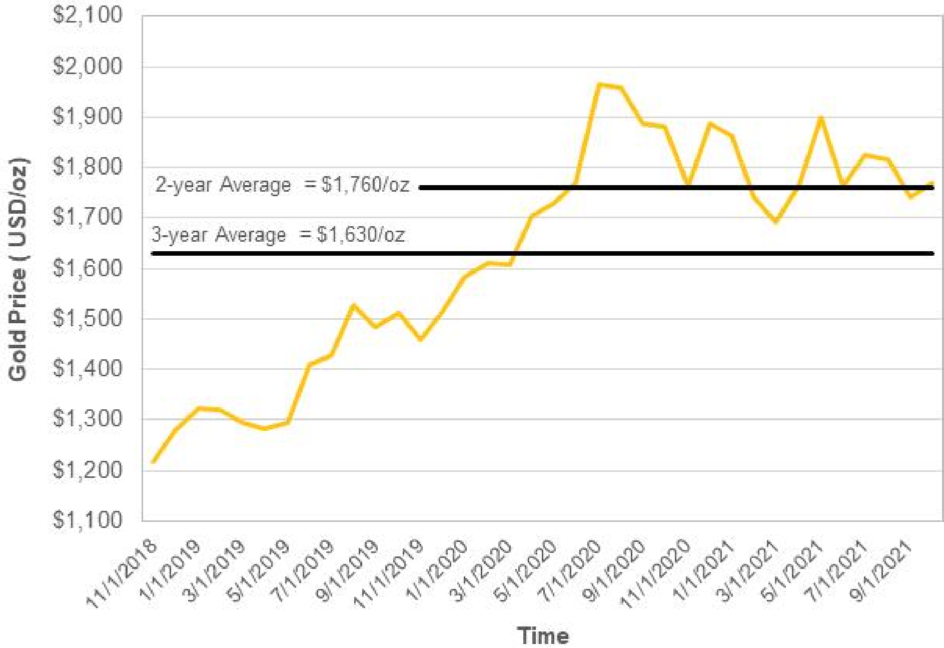


Figure 16-1: Gold spot price on a monthly basis since November 2018

For this TRS, a gold price of US$1,680/oz (base case) was assumed within the financial model (Chapter 19) to estimate revenue from the Project. The forecasted gold price is kept constant and is meant to reflect the average metal price expectation over the life of the Project. It should be noted that metal prices can be volatile and that there is the potential for deviation from the LOM forecasts. Refining and pricing assumptions are presented in Table 16-1.

Table 16-1: Refining and pricing assumptions

Assumption	Unit	Value
Gold Payable	%	99.9
Gold Refining Charge (including Insurance and Transport)(1)	$/oz	1.80
Gold Price	$/oz	1,680

(1) Gold refining charge including insurance, transport and gold payability = $3.48/oz

16.4 Contracts

There are no refining agreements or sales contracts currently in place for the Project that are relevant to this TRS. It is expected that terms contained within any sales contract that could be entered into would be typical of and consistent with standard industry practices and be similar to contracts for the supply of gold elsewhere in the world.

There are several large 3rd party gold refineries with well-established industry relationships in North America. Among the more notable ones are:

- Metalor Technologies USA; North Attleboro, Massachusetts;
- Johnson Matthey; Salt Lake City, Utah;
- Canadian Mint; Ottawa, Ontario.

None of the aforementioned companies have been contacted by THM to provide a competitive treatment bid.

17. ENVIRONMENTAL STUDIES, PERMITTING, AND PLANS, NEGOTIATIONS, OR AGREEMENTS WITH LOCAL INDIVIDUALS OR GROUPS

17.1 Environmental

17.1.1 Historical Project Activities and Permitting

Livengood Creek and the creeks draining Money Knob are mineralized and have been placer mined for over 100 years. Portions of the resource area on Money Knob have also hosted intermittent hard rock mineral exploration activities. The Project area contains federal mining claims (Bureau of Land Management), state mining claims (Department of Natural Resources), state leases (Alaska Mental Health Trust Land), and private land (as described in Chapter 3). THM has received all appropriate authorizations required to conduct exploration, geotechnical and baseline data collection activities.

17.1.2 Baseline Studies

THM has been conducting environmental baseline studies at the Livengood Gold Project since 2008 as part of THM's overall goal of providing environmentally relevant and supportable data for environmental permitting, engineering design and a basis for permit-required monitoring during construction, mining and closure of the Project. These investigations are summarized in Table 17-1 and Table 17-2.

Table 17-1: Environmental baseline studies (2008-2016)

Baseline Study	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017-2021
Surface Water										
Surface Water Quality		●	●	●	●	●	●	●	●	●
Sediment Quality						●	●	●	●	
Hydrology										
Surface Water Flow and Snow			●	●	●	●	●	●	●	●
Hydrogeology			●	●	●	●	●	●	●	●
Groundwater Quality			●	●	●	●	●	●	●	●
Hydrogeological Modeling			●	●	●	●	●	●	●	●
Permafrost Studies			●	●	●	●	●	●	●	●
Wetlands & Vegetation										
Wetlands Delineations		●	●	●	●	●	●			
Meteorology & Air Quality										
Meteorological Data			●	●	●	●	●	●	●	●
Precipitation			●	●	●	●	●	●	●	●
Ambient Air				●						

Baseline Study	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017-2021
Aquatic Resources										
Bio-monitoring		•	•	•	•	•	•	•	•	•
Resident Fish Surveys		•	•	•	•	•	•			
Rock Characterization										
Static ML/ARD Testing			•	•	•	•	•	•		
Kinetic ML/ARD Testing				•	•	•	•	•	•	•
On-Site Kinetic Testing					•	•	•	•	•	•
Wildlife Studies										
Habitat Mapping				•						
Mammal Surveys				•						
Avian Surveys				•	•					
Cultural Resources										
Cultural Site Surveys	•	•	•	•	•					
Socioeconomics (Section 17.6)				•	•	•				
Noise Studies										
Noise Surveys					•	•				

Table 17-2: Summary of environmental baseline studies

Baseline Study	Program Summary
Surface Water Quality	Surface water quality samples have been collected since 2009 over a wide range of hydrologic conditions. The network includes 20 stations in and around the Project area and 4 stations along the power line corridor. All samples have been analyzed for a comprehensive suite of analytes and include QC sample collection. Monitoring continued 2013-2017 at three stations located on the Tolovana River and the West Fork of the Tolovana River. While there are apparent local and seasonal spikes among some analytes, these are deemed to be mostly natural and, in part, a reflection of placer mining activity and regional mineralization.
Hydrology	The Project region is characterized by large areas of permafrost that limit groundwater recharge into local streams. As a result, many streams are ephemeral during periods of low precipitation. The USGS has maintained stream gauges in the Project area since 2010. Snow surveys have been completed in a variety of aspects, elevations, and vegetation types in late spring 2010-2021. Three years of surface flow data have been collected from Lower Amy Creek and the fifth year of data collection from Livengood Creek in the vicinity of the ADOT maintenance facility is underway. Regional data sources were used to characterize average, extreme drought, and flood conditions at the Project site, enabling the development of a long-term synthetic record of estimated monthly precipitation at the Project site, which forms the basis of the water balance model.
Groundwater Quality	THM has sampled 54 groundwater wells throughout the Project area. Water chemistry data indicates that groundwater varies locally and is controlled by geology and permafrost. Groundwater is most mineralized in the vicinity of the deposit; groundwater distal to the deposit has the least mineralization.

Baseline Study	Program Summary
Hydrogeological Modeling	Compilation of average static water levels collected from the site piezometer network and pump tests indicates that the groundwater surface generally follows topography, indicating groundwater flows from higher elevations to lower elevation areas. Groundwater recharge to the deposit area is from the ridge to the northeast of the resource area. The hydraulic conductivities observed down-gradient from the proposed pit and in the rocks of the Livengood Valley are relatively high. The lowest hydraulic conductivity values were observed to the north and east of the resource area. Groundwater is confined under permafrost. Predictive numerical simulations for project groundwater have been conducted for passive pit inflow conditions and indicate that the pit will take several hundred years to fill.
Permafrost Studies	Thermal analysis has been performed to provide a site-wide understanding of permafrost conditions and a basis for engineering design. In general, the permafrost beneath the Livengood Gold Project area is extensive, but relatively warm (>-2ºC) and discontinuous. Permafrost depths at the Project have been measured to reach nearly 600 ft (183 m) below ground surface.
Wetlands and Vegetation	A 62,000-acre (25,090 ha) wetlands map of the Project area and power line corridor was completed in December 2013. This mapping will form the basis for wetlands minimization, avoidance, and mitigation during mine design and permit application preparation. Approximately half of the mapped area has been delineated as wetlands, the majority of which are dominated by black spruce forests and near-surface permafrost. Despite the fairly wide distribution of 13 invasive species found within the study area, most of the populations are relatively small. The control and containment of these species will be considered during the development of project management and reclamation plans.
Meteorology & Air Quality	Two meteorological stations were installed in late 2010 for use in dispersion modeling, air quality permitting, facility design, and other baseline studies. One station is located on Gertrude Ridge, northeast of the resource area, and has collected data including temperature, year-round precipitation, wind direction and speed, and relative humidity. The other station is located to the southwest of the resource area at a lower elevation and has collected the same meteorological parameters as well as seasonal evaporation data. Two fine particulate matter ($PM_{2.5}$) meters were co-located with this station to monitor ambient air quality in 2011. In 2013, an all-season precipitation gauge was installed at the ADOT maintenance facility in the Livengood Creek Valley.
Resident Fish Surveys	As the most populous fish in the Project area, young of the year Arctic Grayling were targeted for full-body tissue analysis. Fish tissue sampling was conducted from 2009-2012. Tissues of the resident fish in the area contain detectable metals concentrations, as do many regional streams in naturally mineralized areas. The 2010 program included a summer fish presence/absence survey, a May Arctic Grayling spawning survey, a May Northern pike metals analysis, and a fall Whitefish otolith study. In 2011, a fish overwintering investigation was completed as well as a data gap analysis along the power line corridor. Survey results indicate that there are grayling overwintering in the West Fork of the Tolovana River and the old placer pond located in the Livengood Creek Valley. No salmon species have been found in the Project area. The three major drainages (Chatanika, Tatalina, and Tolovana Rivers) and their tributaries along the power line corridor are identified as fish-bearing.
Bio-monitoring	Macro-invertebrate sampling was conducted in 2009-2012; periphyton sampling was conducted in 2009-2017. The Project area supports a robust benthic population of less sensitive species, as would be expected in streams that have hosted long-term placer mining.

Baseline Study	Program Summary
Rock Characterization	In 2010, composites of various resource rock types, alterations, and oxidation were created and tested for metal content, sulfur speciation and acid rock drainage (ARD) potential. This work has since been expanded to include static and kinetic testing on selected samples obtained from the entire resource area data package, the resource dataset screened for gold grades less than 0.3 g/mt, ore composites, tailing samples, regional rock types, and overburden. The sample selection process included screening for rock type as well as sulfur, arsenic, mercury, selenium, and antimony content. Seventy-five humidity cell tests have undergone multi-year testing. Samples from the datasets have also been tested for meteoric water mobility potential (MWMP) and sequential MWMP. Twenty-eight 550 lb (250 kg) barrels of resource and regional materials are also undergoing on-site multi-year testing to establish scalability factors. The data indicates that certain stratigraphic units are potentially acid generating (PAG), while other rock types are non-PAG. Several rock types have metal leaching (ML) potential, with arsenic, antimony, and selenium being of primary interest. Mineral content and ARD potential tend to decrease outside the resource area. Management of these materials is discussed in Section 17.1.3.
Habitat Mapping	Wildlife studies were initiated in 2011 and included a review and synthesis of existing data in the Project area, GIS mapping of wildlife habitats and field surveys for key wildlife species. There are currently no threatened and endangered wildlife species known in the Project area. The majority of the wildlife habitats in the study area comprise black-spruce dominated upland open needle leaf forests.
Mammal Surveys	Aerial surveys of moose were conducted in the Project area to determine the population density and late winter distribution. During the survey, a total of 51 moose within 13 surveyed sample units were sighted.
Avian Surveys	In the Project area and the power line corridor, less than a third of the raptor nests were found to be occupied. Eight species of land birds that are considered high priority species for conservation were recorded in the Project area in 2012, although none of these species were confirmed to be nesting.
Cultural Resources	Cultural resource surveys have been completed on nearly 16,000 acres (6,475 ha) of the Project area and 5,000 acres (2,023 ha) of the power line corridor. To date, 124 historic features and 21 prehistoric sites have been identified. The majority of these historic features are remains of historic placer camps and workings. The majority of prehistoric sites contain surface and subsurface lithic materials. During the Project permitting process, all features will be reviewed by the State Historic Preservation Office (SHPO) and federal agencies working under Section 106 of the National Historic Preservation Act (NHPA). Mitigation plans will be developed as needed.
Noise Studies	Winter and summer noise monitoring was completed in March 2013 and July 2013, respectively. Seven locations were monitored employing two different techniques (short term and 24 hour).

17.1.3 Environmental Management Strategies

Tailings Management Facility – The TMF has been designed to safely contain process plant tailings and fluids through the use of a geosynthetic liner and a cross-valley embankment on the west end of the Livengood Valley. A rock fill underdrain system will be constructed in the basin to collect near surface groundwater and any seepage that may occur from the overlying liner system. During operations, seepage from the underdrain will be collected and pumped into the TMF. Modeling and pump tests suggest that permafrost underlying the basin isolates the TMF and restricts communication with the deep groundwater.

Mine Waste Rock Facility – To minimize ARD potential and achieve an ideal blend of PAG and non-PAG materials, the facility will be constructed in lifts to facilitate blending. If needed, rocks demonstrating high relative levels of ARD or metal leaching (ML) will be specifically managed within the waste rock facility. Underdrains will collect meteoric water that infiltrates the waste rock and carry it to a lined sump at the up-gradient base of the embankment constructed along the bottom of the Gertrude Creek basin. From there, the collected water will be pumped into the TMF. The Gertrude Creek basin is underlain by permafrost that restricts communication with the deep groundwater.

17.2 Closure Plan

A key to the successful closure of the Project is to incorporate as many environmental considerations into the initial design process as possible. These considerations are reflected in the PFS design and include the characterization studies of the mine waste rock and overburden, process plant tailings and water that have been underway since 2009.

The closure plan presented is conceptual and may not represent the executed closure plan should this Project advance to an operational facility. The plan will extend over a 36-year period, starting in production Year 17 with the construction of a water treatment plant, and ending in Year 52 with the decommissioning of the water treatment plant. The facility closure plan is divided into two main phases: closure and post-closure.

A reclamation and closure plan will be submitted to the relevant government agencies during the permitting process and will discuss the final outcome of the Project, including a final land use plan, re-grading, long-term water quality monitoring and management, test vegetation plots, the closure design, removal of facility components and financial assurances. In addition, the Project will need to prepare a U.S. Army Corps of Engineers Compensatory Mitigation Plan for mitigating unavoidable wetlands impacts that will include input from many reclamation and mitigation banking experts. It may require the setting up of mitigation banks with third parties.

17.2.1 Closure Activities

Closure will involve initial reclamation and salvage activities and will take approximately five years to complete.

Water Treatment Plant

A 5,500 gpm (1,249 m^3/h) water treatment plant will be constructed during Mine Year 20 and 21 to treat water removed from the TMF supernatant pond and seepage from the TMF underdrain system and the mine waste rock stockpile sump. Geochemistry and groundwater sampling suggest that the arsenic, selenium and antimony contained in pond, seepage and sump water will be treatable. The water treatment plant will be of modular construction, consisting of 500 gpm (114 m^3/h) units, so that over time, as the treatment requirements reduce, modules can be taken out of service.

Tailings Management Facility

A dry closure of the TMF has been incorporated into its design. The supernatant pond will be removed and treated. Four years will be required to place a 3 ft (0.92 m) thick layer of mine waste rock over the entire tailings surface. A 1.5 ft (0.46 m) layer of growth media will then be placed over the rock. The capped tailings surface will be seeded and fertilized. Diversion channels will be constructed along the perimeter of the tails basin; the flow will be diverted past the embankment through drop structures.

Surface Mine

At the end of mine life, active dewatering of the surface mine will cease and the pit will be allowed to naturally fill with groundwater. Groundwater modeling indicates that the pit will take several hundred years to fill.

Mine Waste Rock and Ore Stockpiles

The mine waste rock stockpile has been designed to minimize the impacts from potentially acid-generating waste rock. During closure, the waste rock will be contoured, covered with 1.5 ft (0.46 m) of growth media, seeded and fertilized. The ore stockpile area will be ripped prior to placement of growth media, seed, and fertilizer. The interface area between the graded stockpile toe and the natural ground will be riprapped to prevent erosion of the stockpile toe in areas where there will be concentrated runoff flows. Any runoff flow will be directed to the TMF diversion channels. Once flows to the sump have decreased, the pumps and other equipment will be salvaged.

Roads, Foundations, Buildings, and Equipment

During closure, buildings will be removed from their foundations, with the exception of the water treatment plant and other closure support buildings. All work pads and roads not needed for site access will be dozer ripped, covered with growth media, seeded and fertilized. Pre-construction drainage patterns will be restored or enhanced to minimize storm water impacts. Safety berms will be dozed over the road slope or into road ditches to further enhance drainage.

17.2.2 Post Closure Activities

The post closure period includes six years of site stabilization and maintenance after closure is complete, and a subsequent 20 years of water treatment and monitoring.

17.3 Permitting

17.3.1 Project Permitting Requirements

The Project will require numerous federal and state permits and authorizations. Table 17-3 lists the permits likely to be required based on the conditions at the time of this TRS. This list is based on government agency guidance and past Alaskan mining project development experience.

Since development of the Project will require a number of federal permits, the National Environmental Policy Act (NEPA) and Council of Environmental Quality (CEQ) Regulations will govern the federal permitting portion of the Project. The NEPA process requires that all elements of a project and their direct, indirect and cumulative impacts be considered. A reasonable range of alternatives are evaluated to assess their comparative environmental impacts, including consideration of feasibility and practicality. In fulfillment of the NEPA requirements, it is anticipated that the Project will be required to prepare an Environmental Impact Statement (EIS). Upon completion of the EIS and the associated Record of Decision by the lead federal agency, the federal and state agencies will then complete their own permitting actions and decisions. The State of Alaska is expected to take a cooperating role to coordinate the NEPA review with the state permitting process. Actual permitting timelines are controlled by the federal NEPA review and federal and state agency decisions.

Table 17-3: Project permit requirements

Agency	Authorization
Federal	
U.S. Army Corps of Engineers	CWA Section 404 Permit (wetlands dredge and fill)
	Section 106 Historical and Cultural Resources Protection
U.S. Environmental Protection Agency	Spill Prevention, Control and Countermeasure Plan (SPCC)
	EPA Air Quality Permit Review
	EPA Hazardous Waste Generator ID Resource Conservation and Recovery Act (RCRA)
National Marine Fisheries Service	Threatened and Endangered Species Act Applicability Consultation
U.S. Fish and Wildlife Service	Section 7 Threatened and Endangered Species Act Consultation
	Bald Eagle Protection Act Clearance
	Migratory Bird Protection
	Fish and Wildlife Coordination Act

Agency	Authorization
U.S. Bureau of Land Management	Plan of Operations Approval
	Decision Record
	Bond Approvals
U.S. Bureau of Alcohol, Tobacco & Firearms	Permit & License for Use of Explosives
	License to Transport Explosives
Mine Safety and Health Administration	Notification of Legal Identity
	Training of Miners Plan
Federal Aviation Administration	Notice of Controlled Firing Area (Blasting)
	Structure Warning Lights
Federal Communication Commission	Radio Station License
U.S. Department of Transportation	Approval to Transport Hazardous Materials
U.S. Regulatory Commission	Material License for Geotechnical Studies
State	
Alaska Department of Natural Resources Division of Mining, Land & Water	Miscellaneous Land Use Permits
	Plan of Operations
	Reclamation Plan Approval
	Reclamation Bond
	Mining License
	Land Use Permits and Leases
	Certificate of Approval to Construct a Dam
	Certificate of Approval to Operate a Dam
	Dam Safety Certification
	Material Sale (for construction material borrow areas)
	Temporary Water Use Permit (if not acquiring water rights)
	Water Appropriation Permits
	Road Right of Way/Access
	Power Line Right of Way
	Cultural Resource Protection
	Archeology Study Permits

Agency	Authorization
Alaska Department of Environmental Conservation	Alaska Pollution Discharge Elimination System (APDES)
	Section 401 Water Quality Certification (SWA 404 Permit)
	Storm Water Pollution Prevention Plan (SWPPP) Review Approval
	Oil Discharge Prevention and Contingency Plan Review Approval
	Plan Review and Approvals to Construct and Operate a Public Water Supply System
	Plan Review and Construction Approval for Domestic Wastewater System
	Solid Waste Management Permit
	Food Establishment Permit
	Air Quality Construction Permit (first 12 months)
	Air Quality PSD Permit
	Air Quality Title V Operating Permit
Alaska Department of Fish & Game	Fish Collection, Habitat, and Passage permits
Alaska Department of Transportation & Public Facilities	Notification of Blasting for Road Closure
	Controlled Firing Area for Blasting
	Right of Way/Access/Driveway
Alaska Department of Public Safety-FP	Fire Marshal Plan Review
Alaska Department of Labor and Workforce Development	Certificate of Inspection for Fired & Unfired Pressure Vessels
	Employer Registration
Alaska Department of Health and Social Services	Health Impact Assessment
Other Entities	
Alyeska Pipeline	Trans- Alaskan Pipeline System (TAPS) Right of Way (ROW) access/crossing approvals

The proposed preliminary project execution plan for the development and construction of the Livengood Gold Project summarized in Chapter 21 incorporates the permits previously noted in Table 17-3.

17.3.2 Status of Permit Applications

There have been no permit applications submitted for project construction.

17.4 Requirements for Performance or Reclamation Bonds

There are two State of Alaska agencies that require financial assurance in conjunction with approval and issuance of large mine permits. The Department of Natural Resources Division of Mining, Land and Water and the Department of Environmental Conservation require financial assurance, both during and after operations, and to cover short and long-term water treatment, if necessary, as well as reclamation and closure costs, monitoring and maintenance needs. The financial assurance amounts will be estimated in conjunction with development of the Reclamation and Closure Plan.

17.5 Mine Closure Requirements and Costs

A mine closure plan featuring dry closure of the tailings management facility has been developed. Closure costs track reclamation and closure expenses from Year 17 through Year 52. The reclamation and stabilization effort occurs from Year 22 through Year 28 and includes deconstruction of the facilities and closure of the tailings management facility, mine waste rock facility, roads and water storage reservoirs as described in Section 17.2. These costs total $226.4M, including contractor indirect costs. Subsequent post-closure costs incurred during Year 29 through Year 52 include pumping, water treatment, maintenance and post-closure monitoring. These costs total $76.7M. Year 52 is the last year with planned closure expenses.

The total closure cost is $316.9M, which is applied to the cash flow in Year 21. This cost, which includes indirect costs, includes closure of the mine waste rock stockpile, tailings management facility, solid waste landfill and ancillary facilities.

Closure cost funding will flow from a closure trust fund financed by mine cash flow. Annual contributions to the closure trust fund are included in the cash flow model. The annual contribution is $11.7M during Year 2 through Year 21. The model includes trust fund earnings at 3.0% annual percentage rate (APR), applied to the fund balance until closure is complete in Year 52.

17.6 Socioeconomic Conditions

The Livengood Mining District has a history of cyclical employment and development dating back to 1914, when placer gold mining became the primary economic activity in the area. The district has produced over 500,000 oz of placer gold, with two-thirds of that production coming prior to World War II. In 2021, there were two placer operations active in the Livengood area. Today, there are no year-round residents in the town-site, with only a handful of abandoned structures still standing.

17.6.1 Regional Economy

Livengood lies within the Yukon-Koyukuk Census Area, which encompasses a nearly 150,000 -square mile (m^2) (388,000-km^2) swath of Interior Alaska from the Canadian border to the lower Yukon River. In 2020, the Census Area held a total population of 5,343 widely dispersed residents in 38 communities, of which approximately 70% were Alaska Natives. Both Minto, which is approximately 40 mi (64 km) from Livengood, and Manley Hot Springs, approximately 80 mi (129 km) away from the Project, have road access to Fairbanks.

The Fairbanks area is the service and supply hub for Interior and Northern Alaska. Construction of the Trans-Alaska Pipeline System (TAPS) resulted in an economic boom in Fairbanks from 1975 to 1977. The oil industry remains an important part of the local economy, with Fairbanks providing logistical support for the North Slope activity, operation of a local refinery and the operation and maintenance of TAPS. Today, the University of Alaska, the Fairbanks Memorial Hospital, and the Fort Knox and Pogo gold mines are some of the Fairbanks area's largest employers. The Fairbanks North Star Borough (FNSB) economy included 37,400 non-agricultural wage and salary jobs in 2019, accounting for $2.24B in annual payroll.

17.6.2 Recreational and Subsistence Resources

The State of Alaska Tanana Area Basin plan designates mining as the primary land use for the Project area. The plan identifies recreation as a secondary use in the Project area. It will be important to consider both the present and likely future recreational uses of the area and how mining projects can cohabitate successfully.

Most of the small communities in rural interior Alaska are largely dependent on subsistence. Seventy-five percent of the Native families in Alaska's smaller villages acquire 50% of their food through subsistence activities (Federal Subsistence Board, 1992). For families who do not participate in a cash economy, subsistence can be the primary direct means of support; for others, it contributes indirectly to income by replacing household food purchases.

17.6.3 Socioeconomic and Project Consequences

Developing the Livengood Gold Project into a mine would offer residents and families from the surrounding communities the opportunity of year-round stable wage paying jobs. Continuing local hire efforts by THM will be a key focus of the Project. Training programs such as the Drill Helper Training Program conducted in May of 2011, a partnership with the State Department of Labor, will be used to attract, train and retain an Alaskan workforce for the various construction and operating jobs available.

The PFS estimates a total of 3.8 M man-hours during Project construction at Livengood, with a peak construction workforce of 800. The average wage of those workers is estimated at $50.00/hr. During the three years of preproduction mine development, the Owner's crew will be approximately 170 employees on average. During operations, the average number of employees is estimated at 331 peaking in year 6 at 430. Total annual wages paid during operations is estimated to be $38M based on an annual average wage of approximately $115,000/y.

17.6.4 Support Services

A 2011 study of the economic impact of the Fort Knox Mine on the Fairbanks North Star Borough determined that 62% of the mine's goods and services spending were with businesses located in the FNSB. For purposes of this TRS, we have assumed a local purchase volume of 50% for the Project. Using that assumption, the result would be an annual local expenditure of approximately $200M on consumables, supplies and purchases.

17.6.5 Employment and Training

The labor force in the communities nearest the mine is very small. The total population of Minto, Manley Hot Springs and Livengood combined is 312 residents in 2020. Skilled and unskilled labor to support mine development and operations will come primarily from the Fairbanks area, with a total labor force of nearly 40,000 workers. The training plan for the Project will be designed to promote safety, environmental stewardship, efficient production, and local hire.

18. CAPITAL AND OPERATING COSTS

The capital and operating cost estimates presented in this study are based on the development, construction and start-up of an open pit mine, process plant and tailings management facility capable of processing on average 65,000 t/d (59,000 mt/d) of gold bearing material. All capital and operating cost estimates cited in this TRS are referenced in nominal third quarter 2021 United States dollars. No provisions have been included to offset future escalation. Units presented in this chapter are presented as imperial unless otherwise stated.

18.1 Capital Cost Summary and Basis

THM engaged various consultants to provide estimate support for various cost portions of the Project that fall within their specialized scope of work (see Table 18-1). BBA consolidated the cost information from all sources to determine the overall project capital cost.

Table 18-1: Capital cost estimate contributors

Scope / Responsibility	Contributor(s)
Mine Equipment and Development	BBA
Process Plant & Ancillary Facilities	BBA
Surface Infrastructure and Buildings	BBA
Waste Rock and Tailings Management Facility	NewFields
Electrical Line and Substations	BBA
Indirect Cost	BBA
Owner's Cost	BBA
Reclamation and Remediation	Newfields
Contingency	All

The total estimated preproduction capital cost (-20% / +25%) to design, procure, construct and commission the Livengood Gold Project facilities is $1.93B including $220M in contingency funds. When spare parts/consumables/initial fills ($40M) and funding of the closure trust fund is included ($23M), the overall cost is estimated to be $1.99B. The estimated sustaining capital cost required by the Project is $658M not including reclamation trust funding, which totals $245M. The sustaining capital estimate includes the addition of certain contingencies and indirect costs. The cumulative life of mine (LOM) capital expenditure (preproduction and sustaining capital) is estimated to be $2.85B. Table 1-8 summarizes the initial capital and sustaining capital costs by major area.

Table 18-2: Initial capital and sustaining capital costs by major area
($ Millions)

Cost Item/Area	Initial ($M)	Sustaining ($M)
Mine Equipment	200	139
Mine Development	230	
Process Facilities	433	
Infrastructure Facilities	459	514
Power Supply	87	
Owners Costs	296	5
Contingency	220	
Sub-total before Reclamation	**1,925**	**658**
Spare parts, consumables, and initial fills(1)	40	
Funding of Reclamation Trust Fund(2)	23	245
Total	**$1,989M**	**$903M**

Note: Rounding of some figures may lead to minor discrepancies in totals.

(1) The $40M spent on spare parts, consumables and initial fills in preproduction are recaptured in the final year of operations (Year 21).

(2) Includes initial funding, total $317M estimated costs. The difference of $49M is projected trust fund earnings.

18.1.1 Accuracy

The overall capital cost estimate developed in this study generally meets the AACE Class 4 requirements and has an accuracy range of -20% and +25%. Estimate accuracy ranges are projections based upon cost estimating methods and are not a guarantee of actual project costs. The capital cost estimate of this pre-feasibility study (PFS) forms the basis for the approval of further development of the Project by means of a feasibility study (FS).

18.1.2 Assumptions

The capital cost estimate is based on the following assumptions:

- Reflects general accepted practices in the cost engineering profession;
- Assumes contracts will be awarded to reputable contractors on a lump sum basis;
- Craft all-in rates are trade union rates calculated based on an assumed 60-hour work week with 10-hour shifts worked daily. Rotation for craft and supervision personnel is 20 days on and 10 days off;
- Waste rock generated during the mine pre-stripping will be of suitable quality and quantity to be used as backfill material to construct the tailings management facility and other infrastructure facilities;

- Construction will consist of a mixture of contracted work and work performed by mine personnel;
- The following activities will be performed by the THM owners team (mine personnel) to support the construction of the tailings management facility and other geotechnical facilities:
  - Crushing and screening of waste rock for construction aggregate;
  - Load, haul and placement (spreading and compaction) of rock fill from mine;
- Soil conditions will not require special foundation designs such as piling;
- All excavated material will be disposed of on site;
- Project will adhere to the schedule in construction execution plan as detailed in Chapter 21;
- The estimate assumes that the contingency will be spent.

18.1.3 Exclusions

General exclusions from the capital estimate are as follows:

- Sunk costs (costs prior to a production decision);
- Land acquisition, permitting, licensing costs;
- Allowance for special incentives (schedule, safety, etc.);
- Interest and financing costs;
- Escalation beyond Q3 2021;
- Taxes and import duties;
- Salvage value, except for sale of construction camp;
- Risk due to labor disputes, permitting delays, weather delays or any other force majeure occurrences;
- Issues beyond the control of the Owner.

18.2 Initial Capital Costs

18.2.1 Open Pit Mine

The initial capital cost for mine development activities and the acquisition of mining equipment is $430M and summarized in Table 18-3.

Table 18-3: Open pit mine initial capital costs
($ Millions)

Cost Item/Area	Initial ($M)
Mine Development	230
Mine Equipment	200
Total	**$430M**

18.2.2 Mine Development

Mine development for the open pit will be carried out over a 3-year period. A contractor will be used during the first year of mine development, which will include tree clearing, pioneering work as well as haul road construction. The total cost for the contractor has been estimated to be $68M, which considers a unit rate of $3.62/t. Years 2 and 3 of mine development will be carried out using the owner's fleet of mining equipment and personnel. The owner's cost for mine development, plant road construction and temporary facilities has been estimated to be $162M, which considers workforce salaries, consumables, and the cost to operate the equipment fleet. The overall initial cost for mine development is estimated to be $230M.

18.2.3 Mining Equipment

Open pit mining mobile and ancillary equipment costs were estimated based on recent supplier quotations and BBA's in-house database. The initial mine equipment requirements are based on operating hours and production needs as described in Chapter 13. The mobile support equipment consists of dozers, graders, water trucks, fuel trucks and cranes required to support the mining operation. The initial mine equipment requirements along with the capital costs, which total $200M, are detailed in Table 18-4.

Table 18-4: Mining equipment initial capital costs
($ Millions)

Cost Item / Area	No.	Initial ($M)
Haul Truck (Payload - 291 mt)	18	113
Hydraulic Excavator (Bucket Payload – 31 m^3)	2	22
Wheel Loader (Bucket Payload – 31 m^3)	1	10
Production Drill	5	14
Secondary Drill	1	1
Mobile Support Equipment	-	38
GPS and Dispatch System	1	2
Total		**$200M**

18.2.4 Power Supply

The capital costs related to the electrical transmission line, O'Connor Creek substation and the Golden Valley Electrical Association (GVEA) system upgrade were estimated by specialized local firms (Dryden & LaRue, and Electric Power Systems) in 2013, escalated to 2021 and integrated into the estimate by BBA. The main on-site substation was estimated by BBA based on other recent projects of similar size, power rating and layout. Table 18-5 summarizes the initial capital cost estimate for the off-site and on-site electrical facilities.

Table 18-5: Power supply capital costs by major area
($ Millions)

Cost Item / Area	Initial ($M)
230 KV Transmission Line	32
O'Connor Creek Substation	11
GVEA Transmission System Upgrades	23
Primary Substation and Site Distribution	21
Total	**$87M**

18.2.5 Process Plant

The design and capital costs of the crusher area, the crushed ore stockpile area and the process plant has largely been based on BBA's experience on recent projects. To estimate the capital cost of the process plant, BBA used its project cost database, which includes as-built capital costs for a number of similar large gold processing facilities. Based on the proposed plant capacity, preliminary general arrangement layouts and project location, the capital costs were adjusted to match the requirements of the Project. For the major process and mechanical equipment packages, equipment datasheets and summary specifications were prepared, and budget pricing obtained from qualified suppliers. Regional data from Northern Canada and Alaska was compared to assess and adjust the labor and crew rates and productivity factors for Alaska based on BBA's standard estimating spreadsheet. The process plant preproduction capital costs are detailed by area in Table 18-6:

Table 18-6: Process plant capital costs by major area
($ Millions)

Cost Item / Area	Initial ($M)
Process Building	52
Primary Crushing	46
Stockpile, Pre-Crushing and Pebble Crushing	67
Primary and Secondary Grinding	121
Gravity Separation	9
Leaching	88
Carbon Stripping and Gold Room	16
Cyanide Destruction and Tailings	25
Reagents	5
Common Services	4
Total(1)	**$433M**

(1) Spare parts, consumables and initial fills are not included.

18.2.6 Infrastructure Facilities

The capital cost of infrastructure facilities required by the Project was estimated by BBA and NewFields. BBA estimated the initial capital costs based on the site/building layout drawings, specific project requirements and its in-house database for the following site infrastructure facilities:

- Site preparation and common underground services;
- Site security and main access gate;
- Mine haul and site access roads;
- Mine garage, dry, warehouse and administration complex;
- Mine truck wash and fuel/lubrication facility;
- Office, garage and warehouse equipment;
- Site communications and emergency power;
- Water and sewage treatment;
- Fresh water wells, pumping station and piping;
- Process plant tailings and water reclaim systems;
- Fairbanks Integrated Operations Center (IROC) equipment;
- Fairbanks guardhouse, storage and employee parking area (off-site).

NewFields developed the preliminary designs and estimated material quantities for the tailings management facility, fresh water reservoir and related infrastructure such as:

- Livengood Valley and Gertrude Creek TMF starter embankments (lined facility with 47.7 Mt (43.3 Mmt) storage capacity equivalent to approximately two years of production);
- Water reservoir flow through drain system;
- TMF North access road and pipe corridor;
- Surface water diversion ditches;
- Ground water collection systems;
- Growth media, waste rock and ore stockpiles.

The general approach of utilizing mine waste rock from the surface mine delivered by the mine operations to satisfy the major fill requirements for the TMF was employed to maximize savings in construction costs. Based on recent project experience in Northern Canada, BBA assisted NewFields in developing earthwork unit costs and overhead costs using a mixture of contracted work and work performed by mine personnel. To support the TMF cost estimate, budgetary quotes for the supply of the principal purchased materials, such as geosynthetics and piping, was obtained from potential vendors. Table 18-7 summarizes the initial infrastructure capital costs by area.

Table 18-7: Infrastructure capital costs by area
($ Millions)

Cost Item / Area	Initial ($M)
Site Preparation and Common Services	13
Main Control Gate and Access Roads	24
Truck Shop and Administration Building	47
Mine Truck Wash	9
General Infrastructure Buildings and Temporary Facilities	12
Fuel and Explosives Facilities	2
Tailings, Waste Rock and Water Management Infrastructure	305
Site Communications	13
Electrical Substation	33
Total	**$459M**

18.2.7 Indirect and Owner's Costs

For the Project, indirect costs included within the preproduction capital cost estimate, an itemized list of elements has been used to generate factored estimates. The Owner's costs were calculated using BBA's database, data from the 2013 Feasibility Study, THM requirements and adjusted to meet the requirements of the Project. The following costs have been covered within the estimate:

- Indirect costs:
  - Construction camp (800 rooms) procurement (including resale) and operations;
  - Engineering, procurement and construction management (EPCM);
  - Construction quality assurance, third party testing and surveying;
  - Construction of temporary facilities, erection and operation;
  - Land and ocean freight;
  - Pre-operational verifications, commissioning and start-up support;
  - Relocation costs to move the Alaska Department of Transport (DOT) Garage Facilities;
  - Vendor representatives during construction.
- Owner's costs:
  - Construction insurance;
  - Preproduction employment and training;
  - Corporate services and site support operations;
  - Environmental monitoring and community development;
  - Right of Way (ROW) and land acquisition;
  - Legal permits.

Table 18-8 provides a breakdown of the indirect and Owner's costs by area:

Table 18-8: Indirect and Owner's costs by area
($ Millions)

Cost Item / Area	Initial ($M)
Construction Camp (including resale)	40
Construction Operations Costs	52
Alaska DOT Garage Relocation Costs	20
EPCM Services	70
Sub-Consultants and Third-Party Services	5
Land and Ocean Freight	37
Vendor Representatives	3
Construction Mobile Equipment	6
Owner's Costs	55
Offsite and Other	8
Total	**$296M**

It should be noted that costs related to mine and mill initial fills, commissioning spares, start-up and capital spares totaling $40M, normally shown as indirect costs, are not included.

18.2.8 Contingency

Contingency provides an allowance to the capital cost estimate for undeveloped details within the scope of work covered by the estimate. Contingency is not intended to take into account items such as labor disruptions, weather-related impediments, changes to the scope of the Project from what is defined in the study, nor does contingency take into account price escalation or currency fluctuations.

To establish an adequate contingency estimate, BBA along with the other contributors, reviewed the overall capital cost estimate and categorized the major project work items in terms of level of definition and the nature of how the costs were established for labor, materials and equipment. Depending on the level of confidence, contingencies were allocated to each of the work items. Table 18-9 provides a summary of the contingency by major work area. The total contingency cost for the Livengood Gold Project is estimated to be $220M or approximately 12% of the Project's overall direct and indirect costs.

Table 18-9: Contingency by major area
($ Millions)

Cost Item / Area	Initial ($M)
Mine Equipment and Preproduction Work	10
Process Plant, Surface Facilities and Project Indirect Costs	157
Tailings, Waste Rock and Water Management Facilities	53
Total	**$220M**

18.3 Sustaining Capital Costs

The total estimated sustaining capital cost for the Livengood Gold Project is $658M (not including reclamation trust funding) and was developed by BBA and NewFields. This is the estimated expense required to maintain operations over the proposed 20.3-year mine life. Including the reclamation trust fund payments of $245M, the sustaining capital costs total $903M. Sustaining capital costs included are as follows:

- Open pit mining equipment (new and replacements), equipment rebuilds and spare parts;
- Phased (2 through 6) tailings management facility and water management system upgrades to achieve their ultimate capacity based on the design provided by NewFields;
- Lengthening and relocation of the process plant tailings pumping and pipeline systems;
- Purchase of site mobile equipment and light vehicles;
- Contingency related to the previously listed activities;
- Annual funding of the reclamation trust fund for eventual site closure beginning in Year 21.

Table 18-10 summarizes the sustaining capital requirements over life of mine.

Table 18-10: Sustaining capital costs by major area
($ Millions)

Cost Item / Area	Sustaining ($M)
Infrastructure Facilities	514
Mine Equipment	139
Mobile Equipment and Light Vehicles	5
Sub-total before Reclamation	**658**
Funding of Reclamation Trust Fund	245
Total	**$903M**

18.4 Operating Cost Summary and Basis

The operating cost estimate for the Livengood Gold Project includes all expenses incurred to operate the mine and process plant from the start of Year 1 through Year 21 at a daily average production rate of 65,000 t/d (59,000 mt/d). Units presented in this chapter are presented as imperial unless otherwise stated. The expected accuracy for the operating cost estimate is that of a pre-feasibility study level (+-/ 20%) and does not contain any allowances for contingency or escalation beyond Q3 2021. Any ore excavated during the preproduction period is considered as a capital expense. Life of mine averages presented in this section take into account all years of production, including the year of ramp-up and stockpile reclaim years at the end of the LOM.

Table 18-11: Operating cost estimate contributors

Scope / Responsibility	Contributor(s)
Mine Operations	BBA USA Inc.
Process Plant Operations	BBA USA Inc.
General and Administration (G&A)	THM and BBA USA Inc.

THM engaged various consultants to provide estimation support for various operating cost areas of the Project that fall within their specialized scope of work (see Table 18-11). Operating costs were estimated using cost models, laboratory testwork, budgetary quotations from suppliers, general knowledge and recent experience on similar projects. THM, in consultation with BBA, provided a list of personnel, based on mining, process plant and administrative requirements, along with the salaries benefits and bonuses associated with each position.

The three major operating costs (on-site) areas are mining, processing, and general and administration (G&A). Table 1-9 provides the breakdown of the projected operating costs for the Project. The unit cost areas including royalties and smelting, refining and transport costs are shown in terms of total cost LOM per ton mined, per ore ton processed and total cost per ounce of gold produced. The average operating cost, including royalties and smelting/refining fees (but not including reclamation fund payments), over the LOM is estimated to be $13.82/t ($15.23/mt) milled.

Table 18-12: Total operating cost breakdown (LOM average)

Cost Item / Area	Total ($M)	Average ($/t mined)	Average ($/t milled)	Average ($/oz)	OPEX (%)
Mining (including stockpile reclaim)	1,910	2.05	4.03	297	29
Processing	3,659	-	7.72	569	56
General and Administration	639	-	1.35	99	10
Onsite Mine Operating Costs	**6,208**	**-**	**13.09**	**965**	**95**
Royalties	323	-	0.68	50	5
Smelting, Refining and Transport	22	-	0.05	3	0.3
Sub-total before Reclamation	**6,553**	**-**	**13.82**	**1,019**	**100**
Funding of Reclamation Trust Fund	317	-	0.67	49	0
Total	**$6,893M**	**-**	**$14.50/t**	**$1,068/oz**	**100%**

The operating cash costs per ounce of gold vary significantly, depending on the mill feed grade, rock type composition, mine strip ratio and stockpiling activities. The annual variation in operating costs per ounce of gold produced can be seen in Figure 18-1. It should be noted that due to the processing of lower grade stockpile material (between 0.3 and 0.4 g/t), the overall operating costs per ounce increase significantly during the later years.

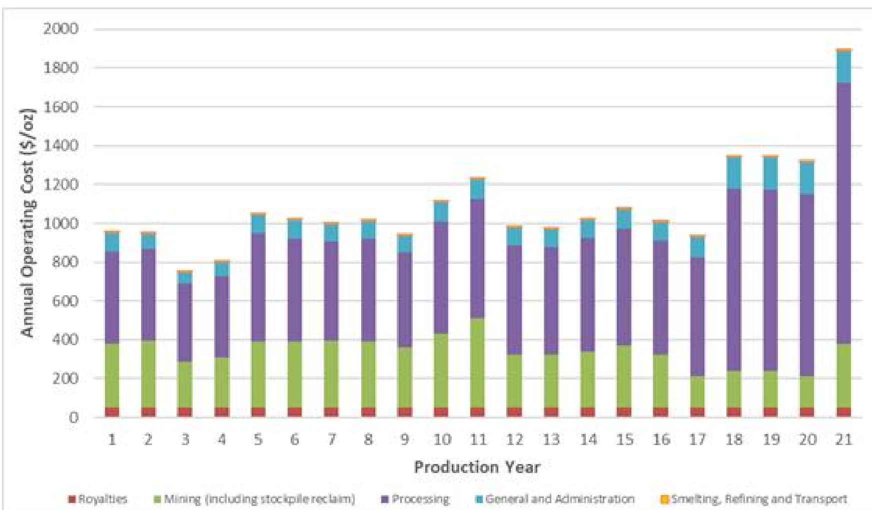


Figure 18-1: Annual operating cash costs ($/oz)

18.4.1 Electricity, Diesel and LNG

The cost of electrical power for the Project was estimated based on the GVEA 2-year trailing average industrial rate of $0.16 / kWh provided by THM. A diesel fuel unit cost of $2.40 / gal was used for estimating the operating costs of the mine and infrastructure mobile equipment. Liquefied natural gas (LNG) is planned to be used as the heat source for the process and ancillary facilities. At present, LNG is being supplied to Fairbanks and it is assumed that LNG will be available in sufficient quantities at the time mine operations commence. A supply unit rate of $21 / MMBTU has been used for LNG in this estimate.

18.4.2 Project Personnel

The mine and mill are planned to operate 365 days per year, primarily with two 12-hour shifts per day. Various crew schedules will be employed, including crews with 4 days on, 4 days off rotation, crews with 14 days on, 14 days off rotation, and staff with 4 days on, 3 days off. Most General and Administration personnel will work 12-hour day shifts with 4 days on, 3 days off rotation. Personnel will be transported to site from Fairbanks on a daily basis by third party contract highway coach.

The number of employees required by the Project during the production phase (Years 1 to 21) consists of personnel from the open pit mine, process plant and site administration (G&A). On average, over the life of mine, the total number of personnel will be approximately 355. As shown in Figure 18-2, the process plant and general and administrative employees remain fairly constant throughout the mine life, while the mine employees vary on an annual basis due to changes in operations and maintenance personnel requirements. The mine personnel requirements drop significantly in Year 17, due to the end of open pit mining and all process plant feed requirements being met with 100% stockpile material.

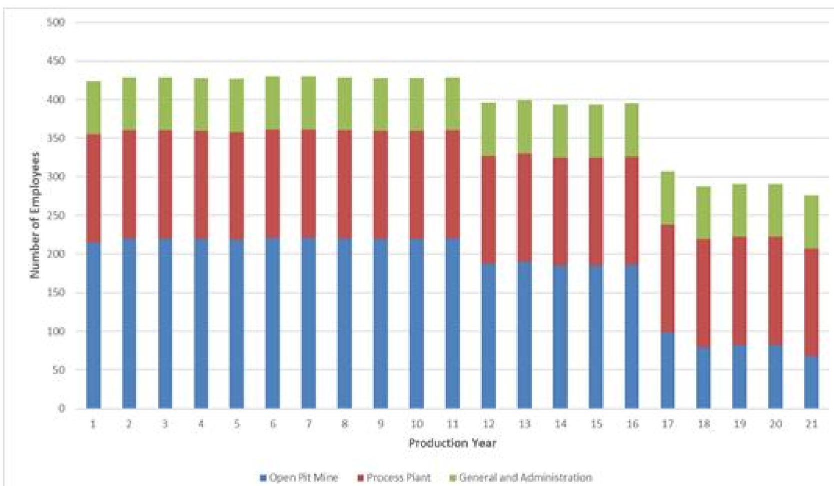


Figure 18-2: Operations Personnel

The total personnel for the Livengood Gold Project peaks in Year 6 at 430 employees as shown in Table 18-13.

Table 18-13: Project peak personnel (Year 6)

Area	No. of Employees
Open Pit Mine	221
Process Plant	140
General and Administration	69
Total	**430**

18.4.3 Open Pit Mine

18.4.3.1 Mine Operating Costs

Mine operating costs have been estimated for each period of the mine plan using supplier pricing, in-house databases, and outside sources particularly for materials, services, and consumables. The mine operating costs are based on operating the mining equipment, the labor associated with operating the mine, the cost for explosives as well as pit dewatering, road maintenance, stockpile rehandle, and other activities.

The mine operating cost was estimated to average $2.05/t mined for 20.3-year life of mine. Table 18-14 presents the mine operating cost by activity and Table 18-15 presents the mine operating cost by consumable.

Over the life of the mine, the mine operating costs have been calculated to total $1.91B. This amount includes $152M dedicated to rehandling of the low grade ore stockpile. When excluding the low grade ore stockpile rehandling costs, the mine operating costs, based purely on mining run of mine material from the pit equate to $1.89/t.

Table 18-14: Average annual and life of mine operating costs – by activity

Cost Item / Activity	LOM Cost ($M)	Average Annual Cost ($M/y)	Cost per Ton ($/t mined)	Cost per Ton ($/t milled)	OPEX (%)
Production Loading	187	8.9	0.20	0.39	10
Hauling	802	38.2	0.86	1.69	42
Drilling	168	8.0	0.18	0.36	9
Blasting	275	13.1	0.30	0.58	14
Support & Services	305	14.5	0.33	0.64	16
Mine Supervision & Technical Services	133	6.3	0.14	0.28	7
Other	39	1.9	0.04	0.08	2
Total	**$1,910M**	**$90.9M/y**	**$2.05/t**	**$4.03/t**	**100%**

Table 18-15: Average annual and life of mine operating costs – by consumable

Cost Item / Activity	LOM Cost ($M)	Average Annual Cost ($M/y)	Cost per Ton ($/t mined)	Cost per Ton ($/t milled)	OPEX (%)
Labor	573	27.3	0.61	1.21	30
Fuel	366	17.4	0.39	0.77	19
Lube	31	1.5	0.03	0.06	2
Tires	148	7.1	0.16	0.31	8
PM & Repair Parts	389	18.5	0.42	0.82	20
Ground Engaging Tools	99	4.7	0.11	0.21	5
Electricity	13	0.6	0.01	0.03	1
Explosives	266	12.7	0.29	0.56	14
Other	24	1.2	0.03	0.05	1
Total	**$1,910**	**$90.9M/y**	**$2.05/t**	**$4.03/t**	**100%**

18.4.3.2 Mine Equipment

The cost to operate the fleet of mining equipment considers fuel consumption, consumables such as tires, wear parts and ground engaging tools, preventative maintenance, and repair parts. For the major equipment such as haul trucks, shovels, wheel loaders, production drills, track dozers, and road graders, the maintenance costs have been calculated as a function of the hour intervals for each machine throughout the life of mine, while an average cost per hour was considered for the support and service equipment.

An extended life of up to 140,000 hours has been considered for the fleet of haul trucks and shovels with additional maintenance costs having been provided by the equipment suppliers. Costs related to engine rebuilds and truck reframes have been treated as sustaining capital costs.

It is important to note that the fuel costs consider the addition of diesel exhaust fluid (DEF) for the Tier 4 equipment. A cost of $5.11/gallon has been used for DEF which has been applied to 3% of the fuel burn. A cost of $15.14/gallon has been used for lubes and greases.

18.4.3.3 Explosives and Accessories

Explosives costs of $0.29/lb for ANFO and $0.69/lb for emulsion have been used, which are based on budgetary pricing from local explosive suppliers. The suppliers also provided pricing for explosive accessories such as detonators, boosters, connectors, and surface wire, as well as a cost for delivery to site.

18.4.3.4 Other Miscellaneous Costs

The mine operating costs include an additional $1.2M/y which consider the costs for ore grade control, dewatering costs that are in addition to the operation of the pumps, as well as other miscellaneous costs.

18.4.3.5 Mine Personnel

The workforce cost for the mining operations averages approximately $27.3M per year, which has been calculated based on the number of employees and their annual salaries. The salaries include 45% for fringe benefits and 5% overtime for non-supervisory positions.

18.4.4 Process Plant

Process plant operating costs over the 20.3-year mine life were calculated based on the metallurgical testwork program, the mine schedule, salary cost tables (THM), comparable projects, literature reviews and recent supplier quotations. Operating costs for each rock type were developed and then combined, based on the mine schedule, to calculate the overall operating cost on a per ton weighted average basis. The process plant operating costs including the tailings management area are estimated to be $7.72/t over the life of mine.

The average operating cost includes reagents, consumables, grinding media, personnel (Salaried and Labor), electrical power, liquefied natural gas and maintenance/operations parts. The consumables include spare parts, grinding media, liners and screen components. A breakdown of the process plant operating costs is shown in Table 18-16. The main cost areas for the process plant are electrical power, crushing and grinding steel, and reagents and chemicals. The majority of the reagent costs are associated with sodium cyanide and lime required for leaching.

Table 18-16: Average annual and life of mine operating costs – process plant

Cost Item / Activity	LOM Cost ($M)	Average Annual Cost ($M/y)	Cost per Ton ($/t milled)	OPEX (%)
Labor (incl. tailings management)	277	13	0.58	8
Power (incl. tailings management)	1,415	67	2.98	39
Grinding Steel	497	24	1.05	14
Reagents	1,136	54	2.40	31
Fuel	129	6	0.27	4
Maintenance and Operations (incl. tailings management)	186	9	0.39	5
Crushing Steel	19	1	0.04	1
Total	**$3,659M**	**$174M/y**	**$7.72/t**	**100%**

18.4.4.1 Crushing and Grinding Steel

The replacement costs of major equipment consumables, such as the primary crusher liners, pre-crusher/pebble crusher mantles and bowls, SAG and ball mill liners, and screen decks, were calculated based on recommended change-out schedules, recent budgetary quotations and BBA's internal database.

The Livengood process flowsheet includes two types of grinding media for the SAG and ball mills. The consumption rates for the 5-inch SAG mill and 3-inch ball mill media were calculated using MolyCop (V 3.0) tools and the abrasion index (Ai) distribution measured at the 50th percentile for the five rock types to be processed over the LOM. The input data considered the average operating conditions for the SAG and ball mills, in terms of power draw, rotational speed, pulp density and media loading. The wear and annual media consumption rates for each type are presented in Table 18-17. Crushing and grinding steel represents approximately 15% of the total process operating cost at $1.09/t milled.

Table 18-17: Average LOM media wear and consumption rates

Media Type	Wear Rate (lb/kWh)	Annual Consumption (t)
SAG mill – 5-in steel media	0.081	3,161
Ball mill – 3-in steel media	0.110	6,734

18.4.4.2 Reagents and Chemicals

The reagent and chemical consumptions were estimated based on testwork, industrial references, literature and assumed operational practice. Sodium cyanide and lime have a higher consumption variability depending on rock type and, therefore, have been estimated based on an analysis of the various testwork campaigns performed to date, as well as adjusted using scale-up factors and assumed process water recirculation rates within the process plant.

The reagent unit costs ($/t reagent) were established through recent vendor quotations and comparison to prices at reference sites and include delivery to site. The Reagents and chemicals category represents approximately 31% of the total process operating cost at $2.40/t milled.

18.4.4.3 Electrical Power

The largest power consumers within the process plant are the SAG and ball mills. The respective power required for the SAG mill and ball mill were calculated based on the comminution testwork program, which provided the material hardness indices (A x b value) for the SAG mill and the BWi of the ball mill for the five rock types expected to be processed during the LOM.

The SAG mill specific energy (kWh/t) was estimated from the analyzed relationships derived from testwork between the A x b value and the SAG motor input specific energy as determined by JKSimMet. The ball mill specific energy (kWh/t) was calculated from the BWi and the Bond formula, assuming the ball mill will grind the rock from 2,900 µm (F_{80}) to 250 µm (P_{80}).

The overall process plant energy consumption was estimated based on the SAG and ball mill grinding energy requirements and factored balance of plant equipment running loads. Various factors (efficiency, load, diversity, and annual factors) were applied to adjust for equipment motor efficiency, the power used versus installed, the synchronous operation of equipment and average plant operating availability. The electrical power of the process plant represents approximately 39% of the total process operating costs at $2.98/t milled.

18.4.4.4 Liquefied Natural Gas

Liquefied natural gas (LNG) is planned to be used for heating of the primary and secondary crusher buildings, the main process plant building and surface ancillary facilities. LNG will also be used for process heat in the ADR circuit. LNG requirements have been estimated based on the building requirements and similar sized installations. LNG represents approximately 4% of the total process operating costs at $0.27/t milled.

18.4.4.5 Maintenance and Operations Supplies

Maintenance supplies and materials are intended to cover the costs of maintaining the process facilities. Operations supplies are intended to cover the cost of personnel protection wear, minor tools, oil and other consumables. The costs of maintenance and operations supplies were derived using a percentage of the capital cost of plant mechanical equipment. Combined maintenance and operations supplies represent approximately 5% of the total process operating costs at $0.39/t milled.

18.4.4.6 Personnel

A total of 140 employees (26 salaried and 114 hourly) divided into management and technical services, operations and maintenance departments are required to operate and maintain the process plant and tailings management facility. No allowance for contractors has been allocated. The list of personnel (Chapter 14), along with the salaries and benefits, was provided by THM. The estimated personnel cost (salaried and hourly combined) represents approximately 8% of the total process operating cost at $0.58/t milled.

18.4.5 General and Administration (G&A)

General and Administration (G&A) costs are expenses not directly related to the production of goods and encompass items not included in the mining and processing sectors of the Project. These costs were developed based on THM's past project experience, similar sized operations and BBA's in-house database.

The General and Administration area includes the following items:

- Site administration, accounting and payroll labor;
- Human Resources, Information Technology (IT) and Health Services labor;
- Computer hardware and software costs/license fees;
- Electricity and LNG requirements for the Project's surface infrastructure, such as the mine garage, administration building and the freshwater pumping system;
- Health and Safety supplies;
- Insurance (Earthquake, Physical Plant, and Rolling Stock including loss of production);
- Security, maintenance, laundry, snow removal and janitorial service contracts;
- Warehouse administration and supplies;
- Waste collection and recycling services;
- Environmental testwork and permitting fees;
- Mobile equipment and building maintenance;
- Fairbanks Integrated Operations Centre (IROC) operating costs;
- Telecommunications and data service fees;
- Staff and labor training;
- Employee transportation fees.

The total G&A operating cost equals $1.35/t milled. Table 18-18 shows life of mine and average annual operating costs for G&A expenses. The largest costs within the G&A category is employee transport, representing approximately 15%, while insurance is the second largest cost, accounting for approximately 13%. Electricity and heating, followed by costs related to the integrated operations center, environmental, and health and safety departments are also significant contributors.

Table 18-18: Average annual and life of mine operating costs – general and administration

Cost Item / Activity	LOM Cost ($M)	Average Annual Cost ($M/y)	Cost per Ton ($/t milled)	OPEX (%)
General Management and Administration Labor	21	1.0	0.04	3%
Environmental	51	2.4	0.11	8%
Community Relations	19	0.9	0.04	3%
Human Resources	24	1.2	0.05	4%
Health, Safety & Security	53	2.5	0.11	8%
Accounting	31	1.5	0.06	5%
Information Technology and Communications	24	1.1	0.05	4%
Warehouse	25	1.2	0.05	4%
Purchasing	13	0.6	0.03	2%
Integrated Operations Personnel	58	2.8	0.12	9%
Employee Transport	97	4.6	0.20	15%
Land	11	0.5	0.02	2%
Electricity and Heating	75	3.6	0.16	12%
Fuel, Tires and Maintenance for Mobile Equipment and Process Plant Vehicles	40	1.9	0.08	6%
Insurance	82	3.9	0.17	13%
Integrated Operations - Collaborative Work, Building Lease and Overhead	14	0.7	0.03	2%
Total	**$639M**	**$30.4M/y**	**$1.35/t**	**100%**

18.4.5.1 Personnel

A total of 69 employees are required by the general and administration group. The number of employees allocated to each administration department is shown in Table 18-19.

Table 18-19: G&A employee list

Department	No. of Employees
General Management and Administration	2
Environmental	10
Community Relations	1
Human Resources	5
Health, Safety & Security	13
Accounting	8
Information Technology and Communications	3
Warehouse	7
Purchasing	4
Integrated Operations (IROC) Personnel	16
Total	**69**

18.5 Royalties

The annual royalty costs are based on the PFS mine design and production profile, along with the terms of the individual royalty agreements. Over the life of the Project, based on an assumed 3.0% average royalty fee, approximately $323M in royalties is expected to be paid.

18.6 Transportation and Refining

A weekly shipment of doré bars will be transported to a refinery. A flat rate transportation cost will be incurred by the refinery in addition to a cost by weight and a variable liability fee. A treatment cost per troy ounce of material shipped to the refinery will also be charged. THM will be paid for a set recovery of the assayed gold content, which is assumed to be 99.9% based on typical contract terms. Over the LOM, a transport and refining cost including the payability discount of $22M ($3.48/oz) is estimated based on typical terms and pricing.

19. ECONOMIC ANALYSIS

19.1 Introduction

The economic/financial assessment of the Livengood Gold Project is based on a financial model developed by Tower Hill Mines (THM) and BBA USA Inc. (BBA). The model calculates revenues based on the recovered ounces determined by the mining plan and a gold price of $1,680/oz (base case). The model then subtracts costs to generate the Project cash flow. The financial model provides the means to evaluate the Project's discounted cash flow and can guide future development decisions for the Project. The economic evaluation was carried out using a discounted cash flow approach on a pre-tax and after-tax basis, based on Q4 2021 metal price projections. No provision was made for the effects of inflation. Current tax regulations were applied to assess the federal income tax liabilities, while the most recent state regulations were applied to assess the Alaska income and mining tax liabilities.

The internal rate of return (IRR) on total investment was calculated based on 100% equity financing, even though THM may decide in the future to finance part of the Project with debt financing. The net present value (NPV) was calculated from the cash flow generated by the Project, based on a discount rate of 5%. The payback period based on the undiscounted annual cash flow of the Project is also indicated as a financial measure. Furthermore, a sensitivity analysis has been performed for the after-tax base case to assess the impact of the following variations on the Project economics: capital costs, operating costs, and price of gold.

The economic analysis presented in this section contains forward-looking information with regard to the mineral reserve estimates, commodity prices, proposed mine production plan, projected recovery rates, operating costs, construction costs and Project schedule. The results of the economic analysis are subject to a number of known and unknown risks, uncertainties and other factors that may cause actual results to differ materially from those presented here. The reader is cautioned that this PFS is preliminary in nature and there is no certainty that the PFS economics will be realized.

19.2 Assumptions and Basis

The economic analysis was performed using the following assumptions and basis:

- The conceptual mine plan developed in Chapter 13 provided the following inputs to the financial model: mine life, annual ore and waste tons mined, and annual mill tons and head grade, annual ounces recovered based on recovery algorithms internal to the block model;
- The preproduction period and construction period financial inputs flow from the Project execution schedule developed in Chapter 21, taking into consideration key Project milestones;
- The financial model applies metal pricing of $1,680/oz, which was estimated on the basis of historical trailing averages and consensus analyst estimates that were deemed to be credible. The forecasts used are meant to reflect the average metal price expectation over the life of the Project. It is understood that metal prices can be volatile and that there is the potential for deviation from the LOM forecasts;

- All cost and sales estimates are in constant Q3 2021 United States dollars with no inflation or escalation factors taken into account;
- All metal products are assumed sold in the same year that they are produced;
- Class specific capital cost depreciation rates for tangible property under the Modified Accelerated Cost Recovery System (MACRS) are used for the purpose of determining the allowable taxable income;
- All project related payment and disbursements incurred prior to the effective date of this TRS are considered as sunk costs. Disbursements that may occur after the effective date of this TRS, but before the start of construction, are considered as sunk costs;
- Net present value (NPV) was calculated using the middle of period approach;
- The after-tax model includes Alaska state taxes and Federal taxes according to 2021 guidelines;
- The model applies 3% royalties on net smelter returns across the life of mine based on an average royalty calculation;
- Project revenue is derived from the sale of gold doré into the international marketplace. No contractual arrangements for doré smelting or refining exist at this time. Provisions for gold transportation, insurance, refining and payable charges have been included in the financial model;
- Final rehabilitation and closure costs will be incurred after production Year 21.

This financial analysis was performed on both a pre-tax basis and after-tax basis with the assistance of an external tax consultant hired by THM. The general assumptions used for this financial model and the LOM plan tonnage and grade estimates are summarized in Table 19-1, and outlined in Table 19-3.

Table 19-1: Financial model criteria

Description	Value	Unit
Construction/Preproduction Period	36	Months
Mine Life (after preproduction)	20.3	Years
Total Ore Processed	474	Mt
Total Waste Mined (including 84Mt during preproduction)	547	Mt
Gold Head Grade (LOM)	0.65	g/mt
Gold Head Grade (Year 1-5)	0.79	g/mt
Gold Recovery (LOM)	71.4	%
Gold Production (LOM)	6,430,178	Troy oz
Average Annual Process Gold Production Rate (LOM)	317,000	Troy oz
Average Annual Process Gold Production Rate (Year 1-5)	388,600	Troy oz
Daily Milling Rate	65,000	t/d
Open Pit Mining Operating Cost (LOM Avg.)	2.05	$/t mined

Description	Value	Unit
Processing Operating Cost (LOM Avg.)	7.72	$/t milled
General and Administration Operating Cost (LOM Avg.)	1.35	$/t milled
Gold Transportation and Insurance, Refining, and Payable Charges	3.48	$/oz
Doré Gold Payable Terms	99.90	%
Royalty on Net Smelter Return (NSR)	3.00	%
Base Case Gold Price	1,680	$/oz
Discount Rate	5	%
Initial Capital Cost	1.93	$B
Sustaining Capital Cost	658	$M
Reclamation and Closure Cost	317	$M

19.3 Royalties

The annual royalty costs are based on the conceptual open pit mine design and production profiles described in Chapter 13. Due to the fact that there are numerous individual royalty agreements, for the purposes of this financial evaluation, a fixed 3.0% NSR has been assumed. Over the life of the Project, approximately $323M in royalties is expected to be paid based on the base case metal prices and Project assumptions.

19.4 Third Party Smelting, Refining and Transportation

A weekly shipment of doré bars will be transported to a refinery. A flat rate transportation cost will be incurred by the refinery in addition to a cost by weight and a variable liability fee. A treatment cost per troy ounce of material shipped to the refinery will also be charged. THM will be paid for a set recovery (99.9%) of the assayed gold content. Over the life of the mine, the transport and refining cost including payable charges are estimated to be $3.48/oz.

19.5 Taxes

The Livengood Gold Project is subject to three levels of taxation, including federal income tax, Alaska State income tax, and an Alaska State mining license tax. THM compiled the taxation calculations for the Project with assistance from third party taxation experts. This information was not verified by BBA.

The current US tax system applicable to mineral resource income was used to assess the annual tax liabilities for the Project. The US Federal corporate income tax, Alaska State corporate income tax and Alaska State license mining tax rates currently applicable over the operating life of the Project are 21.0%, 9.40% and 7.0% of taxable income, respectively.

The tax calculations are underpinned by the following key assumptions:

- The Project is held 100% by a corporate entity and the after-tax analysis does not attempt to reflect any future changes in corporate structure or property ownership;
- Assumes 100% equity financing and therefore does not consider interest and financing expenses;
- Projected payments relating to Net Smelter Return (NSR) or Net Profits Interest (NPI) royalties, as applicable, are allowed as a deduction for federal and state income tax purposes, but are added back for state mining tax purposes; and
- Actual taxes payable will be affected by corporate activities, and current and future tax benefits have not been considered.

The combined effect on the Project of the three levels of taxation, including the elements described above, is a cumulative effective tax rate of 38%, based on the Project's LOM Operating Income (gross income less operating costs and depreciation). It is anticipated, based on the Project assumptions, that THM will make tax payments of approximately $280M over the life of the Project.

19.6 Closure Costs

NewFields developed a dry closure plan for the tailings management facility. Closure costs track reclamation and closure expenses over a period of 36 years (Year 17 through 52), including costs to build and operate a water treatment plant in Years 17-21, prior to the termination of operations. The main closure construction effort occurs from Year 22 through 31, accounting for 96% of the overall closure costs. Costs for pumping and management operations are included in Years 23 through 52. Year 52 is the last year with planned closure expenses.

The total closure cost is $317M. This total closure cost is applied to the cash flow in Year 21. This cost includes closure of the overburden stockpile, tailings management facility, solid waste landfill, and ancillary facilities, including indirect costs.

Closure cost funding will flow from a closure trust fund financed by mine cash flow. Annual contributions to the closure trust fund are included in the cash flow model. The annual contribution is $11.7M during Years -2 through 21. The model includes trust fund earnings at a 3.0% annual percentage rate (APR), applied to the fund balance until closure is complete.

19.7 Working Capital

Working capital is the maximum funding required during the initial operating period to offset expenses prior to the cumulative revenue offsetting the cumulative expenses; that is, when the operation becomes self-sustaining in its cash flow. Working capital is recovered at the end of the Project.

The revenue was calculated on a weekly basis using the amount and price of the saleable product produced, allowing for the following ramp-up, which corresponds to the mine production schedule:

Quarter 1:	15.3% of 1st year production
Quarter 2:	25.4% of 1st year production
Quarter 3:	27.1% of 1st year production
Quarter 4:	32.2% of 1st year production
Total:	100% of 1st year production (75% of design capacity)

Revenue receipt was projected based on shipping and receipt of 85% of funds four weeks after the shipping date, with the balance of 15% of funds received eight weeks after shipping doré.

Average weekly expenditure rates were calculated from the operating costs for Year 1. The average weekly expenditure of funds starts immediately in week one of Year 1.

The maximum cash flow deficiency would occur in week 12, totaling $46.1M. The model contains this working capital cost in Year 1 and recovers the equivalent amount in Year 21.

19.8 Gold Production

Figure 19-1 highlights the anticipated gold production schedule for the Livengood Gold Project. Total life of mine production is anticipated to be 6,430,178 oz or approximately 317,000 oz/y based on the PFS mine plan, estimated feed grade and recovery estimates. The average feed grade is expected to be 0.65 g/mt and process plant recovery is estimated to be 71.4% over the life of mine. Over the first five years, the operation is expected to produce approximately 388,600 oz/y due to higher grade material being preferentially sent to the process plant. Low grade material will be stockpiled in these early years to be used for future process plant feed. During Years 18 through 21, the process plant feed will consist entirely of reclaimed ore from the low-grade stockpile.

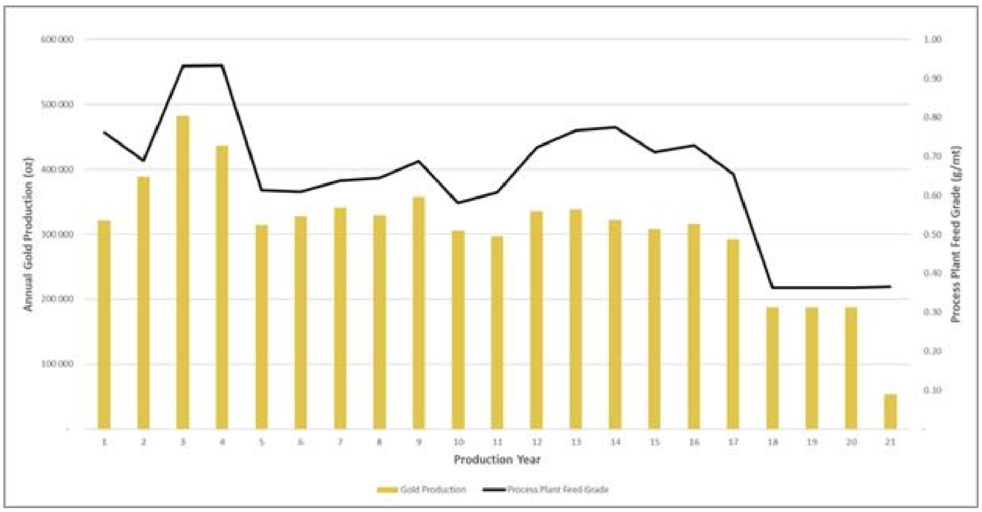


Figure 19-1: Annual gold production schedule

19.9 Operating, All-in Sustaining, and All-in Costs

The operating costs over the LOM to produce gold at Livengood total $6.87B or $1,068/oz. The all-in sustaining costs (AISC) including sustaining capital total $7.53B or $1,171/oz. All-in costs including operating, capital (initial and sustaining) and reclamation funding are estimated to be $9.72B or $1,512/oz. Table 19-2 highlights the all-in sustaining costs (AISC) and all-in cost of production over the first 5 years and the life of the Project.

Table 19-2: Operating, All-in Sustaining, and All-in costs (pre-tax)

	Years 1-5		LOM	
	$/oz	$Million	$/oz	$Million
Operating Costs	**887**	**1,724**	**1,068**	**6,870**
Sustaining Capital Expenditures (1)	151	292	102	658
All-In Sustaining Costs (AISC)	**1,038**	**2,016**	**1,171**	**7,529**
Initial Capital Expenditures (2) (3)	0	0	299	1,925
Funding of Reclamation Trust Fund (4)	30	58	42	268
All-In Costs	**1,068**	**2,075**	**1,512**	**9,722**

Notes:

Rounding of some figures may lead to minor discrepancies in totals.

(1) Excludes $18M upfront funding included in reclamation and remediation above and $37M of recoverable initial stores inventory.

(2) Includes initial capital expenditures only under LOM.

(3) Excludes $40 million of recoverable initial stores inventories.

(4) Total $317 million estimated costs.

19.10 Financial Analysis

A 5% discount rate was applied to the cash flow to derive the NPV for the Project on a pre-tax and after-tax basis. The summary of the financial evaluation results for the Project base case, at a gold price of $1,680/oz, is presented in Table 19-3.

Table 19-3: Financial analysis summary (pre-tax and after-tax)

Description		Base Case	Unit
Pre-Tax	Net Present Value (0% disc)	1,397.1	$M
	Net Present Value (5% disc)	168.5	$M
	Internal Rate of Return	6.1%	%
	Simple Payback Period	9.8	Year
After-Tax	Net Present Value (0% disc)	1,137.1	$M
	Net Present Value (5% disc)	44.6	$M
	Internal Rate of Return	5.3%	%
	Simple Payback Period	10.4	Year

The pre-tax base case financial model resulted in an IRR of 6.1% and an NPV of $ 168.5M using a discount rate of 5%. The simple pre-tax payback period is 9.8 years. On an after-tax basis, the base case financial model resulted in an IRR of 5.3% and an NPV of $ 44.6M with a discount rate of 5%. The simple after-tax payback period is 10.4 years.

The summary of the Livengood Gold Project discounted cash flow financial model (pre-tax and after-tax) is presented in Table 19-4.

Table 19-4: Simplified cash flow table

Year	-3	-2	-1	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	Total/Average
Period	**Preproduction**			**Production**																					
Production Summary																									
Total Ore Mined (Mt)	1	3	1	33	31	36	40	29	30	27	27	27	19	23	27	27	26	27	27	14	0	0	0	0	**474**
Total Waste Mined (Mt)	18	33	34	32	35	30	26	37	30	34	34	34	45	43	21	20	14	14	12	3	0	0	0	0	**547**
Total Milled (Mt)	0	0	0	18	24	24	23	24	24	24	23	24	24	24	24	23	23	23	23	23	24	24	24	7	**474**
Mill Head Grade Au (g/mt)	0	0	0	0.76	0.69	0.93	0.93	0.61	0.61	0.64	0.64	0.69	0.58	0.61	0.72	0.77	0.77	0.71	0.73	0.65	0.36	0.36	0.36	0.37	**0.65**
Gold Recovery (%)	0%	0%	0%	80%	79%	73%	69%	74%	78%	77%	75%	76%	75%	70%	67%	65%	62%	64%	64%	66%	75%	75%	75%	74%	**71%**
Revenue																									
Gross Revenue ($M)	0	0	0	540	653	810	734	528	550	572	553	601	514	498	564	569	540	518	531	492	315	315	315	90	**10,803**
Operating Expenditures																									
Mining ($M)	0	0	0	-106	-134	-115	-114	-107	-111	-117	-111	-112	-117	-136	-92	-93	-93	-99	-86	-47	-36	-36	-31	-18	**-1,910**
Processing ($M)	0	0	0	-153	-184	-193	-182	-174	-174	-174	-175	-175	-178	-182	-188	-187	-188	-186	-186	-180	-176	-176	-176	-72	**-3,659**
General and Administration ($M)	0	0	0	-31	-31	-31	-31	-31	-31	-31	-31	-31	-31	-31	-31	-31	-31	-31	-31	-31	-31	-31	-31	-9	**-639**
Smelting, Refining and Transport Costs ($M)	0	0	0	-1	-1	-2	-2	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	0	**-22**
Royalty Payments ($M)	0	0	0	-16	-20	-24	-22	-16	-16	-17	-17	-18	-15	-15	-17	-17	-16	-16	-16	-15	-9	-9	-9	-3	**-323**
Capital Expenditures																									
Preproduction ($M) (1)	-58	-982	-926	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	40	**-1,925**
Sustaining ($M)	0	0	0	-81	-94	-41	-37	-38	-34	-38	-26	-29	-41	-37	-38	-23	-35	-17	-15	-18	-15	0	0	0	**-658**
Reclamation and Closure ($M)	0	-12	-12	-12	-12	-12	-12	-12	-12	-12	-12	-12	-12	-12	-12	-12	-12	-12	-12	-12	-12	-12	-12	-12	**-268**
Working Capital ($M)	0	0	0	-46	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	46	**0**
Pre-Tax Cash Flow																									
Annual Pre-Tax Cash Flow ($M)	-58	-994	-937	93	177	392	334	148	171	181	180	223	119	84	185	203	164	156	184	188	36	51	56	63	**1,397**
Cumulative Pre-Tax Cash Flow ($M)	-58	-1,051	-1,989	-1,896	-1,719	-1,327	-993	-846	-675	-494	-314	-92	27	111	296	499	664	820	1,003	1,192	1,228	1,279	1,334	1,397	**1,397**
Taxes																									
Alaska State Income and Mining Taxes ($M)	0	0	0	-5	0	-7	-10	-0.5	-3	-5	-7	-13	-6	-4	-15	-16	-13	-11	-14	-18	-3	-3	-4	0	**-157**
Federal Income Tax ($M)	0	0	0	-2	0	-3	-3	-0.1	-1	-1	-2	-3	-4	-4	-15	-16	-13	-11	-15	-19	-3	-3	-4	0	**-123**
After-Tax Cash Flow																									
Annual After-Tax Cash Flow ($M)	-58	-994	-937	89	177	386	326	147	168	177	175	207	109	76	155	171	138	134	154	151	30	45	48	63	**1,137**
Cumulative After-Tax Cash Flow ($M)	-58	-1,051	-1,989	-1,900	-1,723	-1,338	-1,012	-864	-696	-519	-344	-137	-28	48	203	374	512	646	800	951	982	1,026	1,074	1,137	**1,137**
Summary																									
Pre-Tax NPV @ 5% ($M)	**168**																								
Pre-Tax IRR (%)	**6.1%**																								
After-Tax NPV @ 5% ($M)	**45**																								
After-Tax IRR (%)	**5.3%**																								

(1) $40M of recoverable initial stores inventory in Year 21.

Figure 19-2 shows the cumulative cash flows for the Project projected for the life of the mine on a pre-tax and after-tax basis.

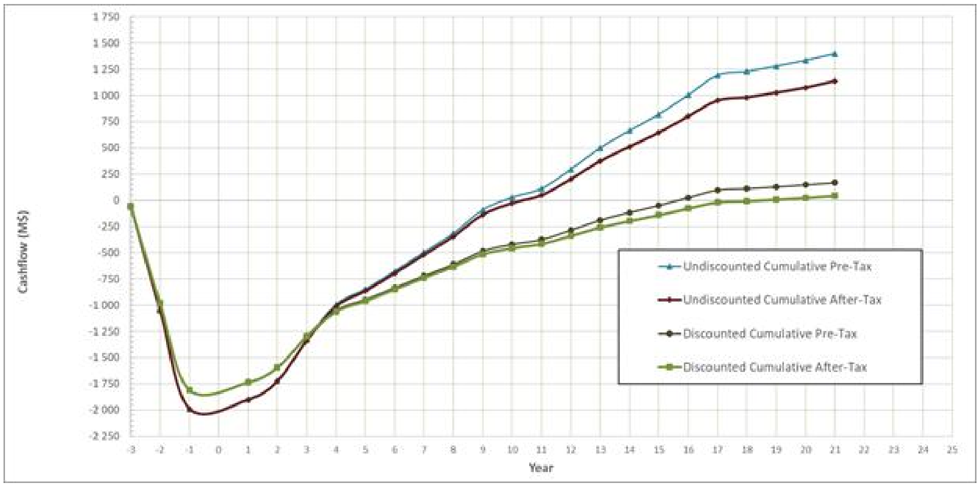


Figure 19-2: Life-of-mine cash flow projection (pre-tax and after-tax, discount rate: 5%)

19.11 Sensitivity Analysis

The economic evaluation includes an analysis of the Project sensitivity to key financial parameters compared to the base case. Sensitivity measures how much impact a change in a given parameter has on the base Project value, all other factors remaining constant. Table 19-5 presents the after-tax IRR and NPV (@ 5% discount rate) sensitivity results for varying gold recovery, gold price, total operating cost and total capital cost. Figure 19-3 and Figure 19-4 present each sensitivity analysis graphically, steeper curves represent greater sensitivity.

This sensitivity analysis shows that both gold price and recovery variations cause the greatest and almost equivalent impact on the Project value. A 30% increase in gold price to $2,184/oz would yield an IRR of 14.1% and a NPV of $1,493. A 30% decrease in gold price to $1,176/oz would yield a reduced IRR of -22.5% and NPV of -$1,647M. The impact of variations in operating and capital cost on both financial metrics is fairly similar, with the operating cost changes resulting in marginally larger Project returns than capital cost changes, meaning that reducing operating expenses would benefit the Project more than reducing capital costs by the same percentage.

Table 19-5: Project sensitivity analysis – after-tax IRR and NPV

Base Case Variance	-30%	-20%	-15%	-10%	-5%	Base Case	5%	10%	15%	20%	30%
Gold Recovery (%)	50%	57%	61%	64%	68%	**71.4%**	75%	78%	82%	86%	93%
After Tax IRR (%)	-16.2%	-4.2%	-1.1%	1.4%	3.5%	**5.3%**	7.0%	8.6%	10.1%	11.5%	14.1%
After Tax NPV @ 5% ($M)	-1,637	-1,044	-753	-469	-209	**45**	293	536	776	1,014	1,483
Gold Price ($/oz)	1,176	1,344	1,428	1,512	1,596	**1,680**	1,764	1,848	1,932	2,016	2,184
After Tax IRR (%)	-22.5%	-4.5%	-1.2%	1.4%	3.5%	**5.3%**	7.0%	8.6%	10.1%	11.5%	14.1%
After Tax NPV @ 5% ($M)	-1,647	-1,051	-758	-472	-$210	**45**	295	540	781	1,020	1,493
Operating Cost ($M)	4,345	4,966	5,276	5,587	5,897	**6,208**	6,518	$6,828	7,139	7,449	8,070
After Tax IRR (%)	10.6%	9.0%	8.1%	7.3%	6.3%	**5.3%**	4.3%	3.1%	1.9%	0.5%	-3.1%
After Tax NPV @ 5% ($M)	877	609	470	330	189	**45**	-$103	-$251	-403	-567	-906
Initial Capital Cost ($M)	1,391	1,589	1,689	1,789	1,889	**1,989**	2,089	2,190	2,290 M	$2,391 M	2,594
After Tax IRR (%)	10.4%	8.4%	7.5%	6.7%	6.0%	**5.3%**	4.7%	4.1%	3.6%	3.1%	2.2%
After Tax NPV @ 5% ($M)	580	402	312	223	134	**45**	-$45	-$134	-223	-312	-491

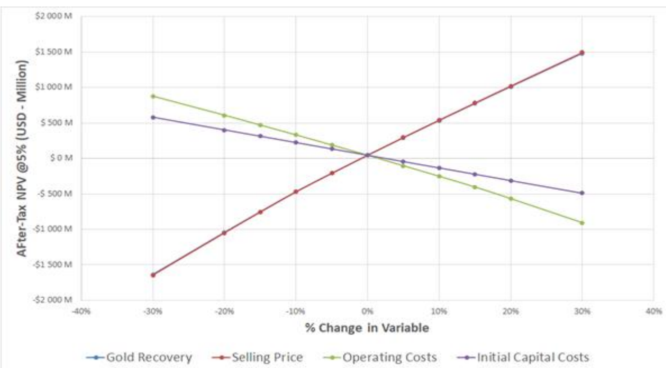


Figure 19-3: After-tax sensitivity analysis for project net present value (NPV @ 5% discount rate)

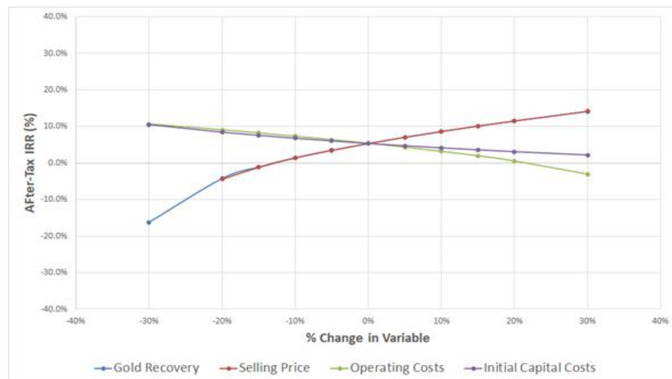


Figure 19-4: After-tax sensitivity analysis for project internal rate of return (IRR %)

20. ADJACENT PROPERTIES

This chapter provides public source information on producing and exploration properties adjacent to the Livengood Gold Project. The information related to adjacent properties is not necessarily indicative of the mineralization on the Livengood Gold property.

20.1 Producing Properties

The Fort Knox Gold Mine is an open pit mine owned and operated by Toronto-based Kinross Gold (TSX:K). A conventional gravity/carbon-in-pulp (CIP) mill processes up to 50,000 t/d (45,000 mt/d) of higher grade ore (0.6 g/mt), with a heap leach for lower grade ore (0.3 g/mt). The mine is located 26 mi (42 km) northeast from the city of Fairbanks via a combination of paved and unpaved roads. In production since 1996 and surpassing production of 8 Moz, Fort Knox is the single largest producer of gold in the history of the State of Alaska and is the largest single property taxpayer in the Fairbanks North Star Borough. This information has no relation to Livengood.

The Pogo Gold Mine is an underground mine owned and operated by Northern Star Resources. A conventional gravity/flotation/flotation concentrate CIP leach processes up to 3,000 t/d (2,722 mt/d) of ore generally 7-10 g/mt. The mine is located 85 mi (137 km) southeast from the city of Fairbanks via a combination of paved and unpaved roads. In production since 2006 and surpassing production of 4 Moz, Pogo is the largest underground gold mine in Alaska. This information has no relationship to Livengood.

20.2 Exploration Projects

In 2014, Freegold Ventures Limited (FVL:TSX) acquired control of the Shorty Creek property comprising 27,000 acres (10,800 hectares) of State of Alaska mining claims directly adjacent to and south of the Livengood Gold Project. During 2015, the company released a technical report on the property (Abrams, Mark J., “Technical Report for the Shorty Creek Project, Livengood-Tolovana Mining District, Alaska”, March 31, 2015), completed a geophysical program and conducted limited drilling.

In 2016, Freegold released an updated technical report on the property (Abrams, Mark J., “Updated Technical Report for the Shorty Creek Project, Livengood-Tolovana Mining District, Alaska”, March 25, 2016), and conducted additional drilling. Hole SC 16-01 intersected 434.5 m grading 0.57% copper equivalent from the base of oxidation at 86.1 m to EOH at 520.6 m. Within this broad intercept, a higher grade interval of 207 m grading 0.73% copper equivalent from 138.6 m to 345 m was also intersected. Mineralization remains open to depth with the last 12 m grading 0.82% copper equivalent (Cu 0.55%, Au 0.145 g/t and Ag 9.67 g/t). (Freegold Ventures Limited press release September 8, 2016).

In March 2019, Freegold announced that it had entered into an Agreement with a wholly owned subsidiary of South32 Limited (South32) whereby South32 has the option to earn a 70% interest in the Shorty Creek property. Drilling was conducted during 2019 and 2021.

The QP has been unable to verify the information related to Shorty Creek and the information is not necessarily indicative of the mineralization at Livengood. Shorty Creek has no relationship to Livengood.

21. OTHER RELEVANT DATA AND INFORMATION

21.1 Execution Plan and Schedule

The execution plan is conceptual in nature and will be adjusted and refined during a future phase of the Project. The plan covers the period from the initiation of the Environmental Impact Study (EIS) process to commercial production in Q2 Year 1. It is based on a recommended Project configuration that includes an open pit mine, a processing plant with a capacity of 65,000 t/d (59,000 mt/d), surface infrastructure and a tailings management facility (TMF) with storage capacity for 21 years of production. The durations and milestones for the major Project activities are shown in Table 1-12 and Figure 21-1.

Table 21-1: Key project activities (preliminary)

Activity	Start date	Completion date	Duration (months)
Environmental Impact Statement and Permitting	Q1 YR -7	Q3 YR -3	48
Engineering Studies in Support of Permitting	Q1 YR -7	Q3 YR -3	48
Process Plant Detailed Engineering	Q1 YR -3	Q3 YR -2	21
Project Authorization		Q3 YR -3	
Pit Pre-Stripping / Waste Rock Supply for Construction	Q3 YR -3	Q4 YR -1	30
Tailings Management Embankment Construction	Q3 YR -3	Q4 YR -1	30
Process Plant Construction	Q4 YR -3	Q4 YR -1	27
Process Plant Dry Commissioning Completed		Q1 YR 1	
Start Process Plant Ramp-up to Commercial Production	Q1 YR 1		

After the PFS, the next step for the Project would be a full feasibility study and detailed engineering necessary to support permit applications. In parallel, environmental studies will be continued.

The Project schedule includes consideration of early work requirements, the permitting process, stakeholder engagement, engineering studies, the procurement of long lead items and critical equipment, construction, and facility commissioning, including the power line and main substation, processing plant, tailings management facility, and site infrastructure.

Off-site construction of a sub-station and a transmission line for the Project will need to be permitted, constructed, and operational by Q2 Year -1 to allow for commissioning of the processing facilities.

On-site construction at the Livengood site is planned to start with a major civil contractor preparing the site access roads, while contractor equipment and crews begin preproduction stripping and site work in Q3 Year -3. THM mining equipment and crews will assume preproduction stripping and site work in Q3 Year -2. The overall construction period from start of the access road construction to completion of the process plant is expected to last 32 months. The civil contractor will begin the TMF embankment foundations in Q4 Year -3, while the ground is frozen. Waste rock excavated from the pit by the mining team will be used for the construction of the embankment, haul roads, and other facilities. Waste rock fill will be delivered, placed and compacted by the THM mining operations team. The civil contractor will be responsible for the installation of liners and smaller volume excavations and backfills. Once road foundations and embankment foundations are completed, work will be maximized in warmer weather and scaled back during the coldest winter months. The preproduction TMF embankment will be raised by the end of Q3 Year -1 to a height sufficient to accumulate process water required for start-up and operations.

The construction of other surface facilities, including the main substation, process plant and surface fleet maintenance shop will begin in Q4 Year -3 with the aim of completing construction and commissioning in Q1 Year 1. This schedule is in line with recent projects of similar scope and size.

An analysis of the construction schedule developed during the PFS facilitated the development of a preliminary site workforce plan, which is expected to peak at approximately 800 workers during construction. The total estimated workforce takes into account the development of the open pit, direct and indirect construction labor for the tailings and water management facilities, process plant construction, and the construction of other site facilities. The estimate also incorporates commissioning crews and an allowance for THM operating and supervision personnel. A construction camp will be built to lodge the labor force.

Figure 21-1 shows the summary schedule for the Project.

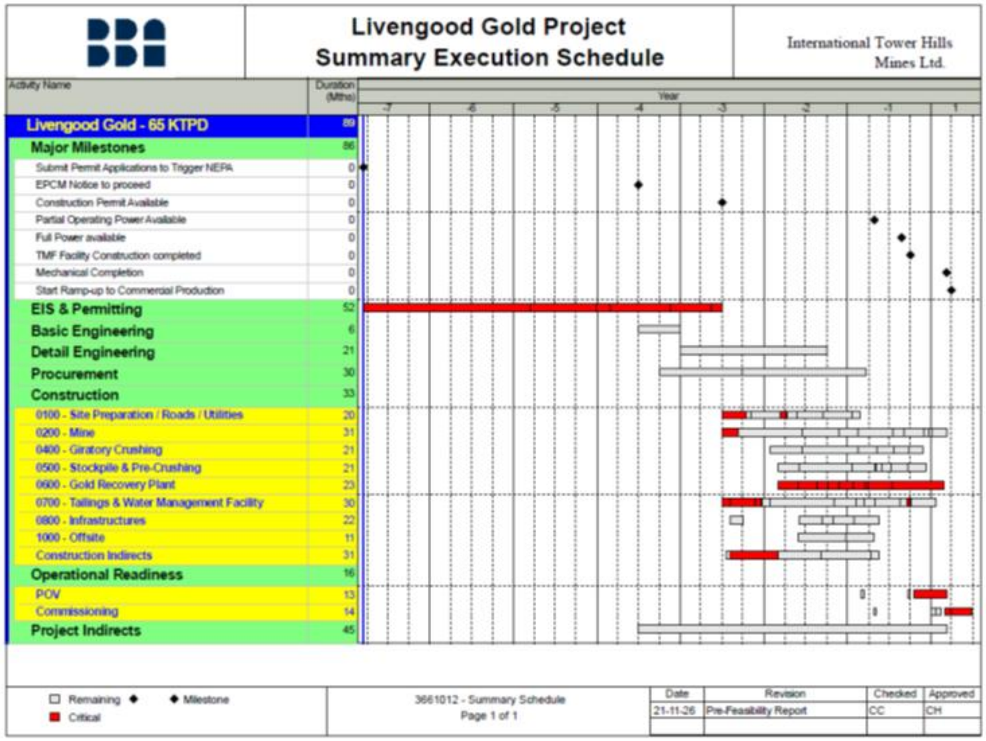


Figure 21-1: Summary project execution schedule

21.2 Logistics and Transportation

21.2.1 Introduction

In 2012, SR International Logistics (SRIL) completed a logistics and transportation study to support the FS. SRIL reviewed and compiled extensive data to plan a seamless and uninterrupted flow of materials and equipment from global suppliers to the Project site. SRIL, with input from shippers Lynden Transport and Totem Ocean Express, created a comprehensive report detailing the logistics and transportation needs of the Project. This study will need to be updated as part of a future FS, including pricing details for ocean freight, inland freight, air freight, heavy haul requirements, rail freight, consolidation and marshaling points, and warehousing.

21.2.2 Freight Options Considered

The construction and commissioning of the Project will require effective frontend planning and a complete, schedule-driven transportation and logistics plan. All freight forwarding activities will feature identification of critical path items. Expediting and inspection personnel will control, verify and facilitate the movement of goods to the Project site.

Key Project personnel and/or agents acting on behalf of the Project will be located at strategic points to ensure that ocean freight and inland freight schedules are met and that freight inspections/inventories and import customs documentation are compliant with US government requirements.

Foreign shipments will be pre-inspected to verify quantities, purchase order engineer's compliance (EC) certification, customs documentation and completeness. The B-Harmonization classification number will be incorporated in all import documents to expedite customs clearance and delivery of goods to the Project site; duties and taxes will also be based on this number.

Designated key equipment will require pre-inspections to verify quality and quantities, EC certification and packing/handling compliance.

THM will set up a primary receiving yard to hold and consolidate freight near the Project site. It is assumed that the primary receiving yard would be located on the northern outskirts of Fairbanks, near Highway 2. Alternatively, THM may decide to place the primary receiving yard closer to site, near the current Alaska DOT station.

Ocean freight will be the dominant mode of transporting materials and equipment not readily available in Alaska. All methods of ocean freight may be utilized. Ships may take five days and barges ten days duration from Puget Sound (Seattle, WA) to Anchorage.

Trucking will be the primary method to move materials and equipment to the Project yards from Alaskan arrival ports. Freight will be consolidated at a primary receiving yard assumed to be located near Fairbanks. The distances and drive time elements between Alaska ports and the prospective Fairbanks yard are given below:

- Anchorage Port to Fairbanks yard: 360 mi (576 km) (6 hours) via State Highways 1 and 3. The road has year-round state maintenance and regulations.
- Valdez Port to Fairbanks yard: 365 mi (584 km) (7 hours) via State Highway 4 with year-round state maintenance and regulations.
- Seward Port to Fairbanks yard: 485 mi (776 km) (8 hours 30 min) via State Highways 1 and 3 with year-round state maintenance and regulations. This route holds little benefit and should be avoided, but ocean shipping situations may dictate its use.
- Whittier Port to Fairbanks yard: 417 mi (667 km) (7 hours 30 min) via State Highways 1 and 3 with year-round state maintenance and regulations. The primary size restriction is the Anton Anderson Tunnel, which all road and rail must use. This is not a desirable location for on-forwarding freight by road. The port is primarily used for rail. Ocean alternatives may dictate this route.

Railroads have very detailed size-weight restrictions but are, pound for pound, the most cost-effective method to move materials and equipment to Fairbanks. Regularly scheduled rail service connects with US and Canadian lines via hydro-train barges.

Caterpillar, Komatsu and other mining and construction equipment dealers use rail as their primary method to move equipment to the Alaskan market. Rail should be considered for any producer with national rail contracts selling FOB Fairbanks. Also, any mining contractor moving equipment from the lower 48 states to Alaska should consider rail.

21.2.3 Recommended Base Routes

The preferred base route for most project equipment and materials contains four legs and is shown in Figure 21-2. The legs are listed below with the approximate distances:

Table 21-2: Preferred base route legs and distances

Number	Leg	Distance (miles)
1	EX-works to Puget Sound	-
2	Puget Sound to Anchorage	1,726
3	Anchorage to Fairbanks	352
4	Fairbanks to Livengood	71
Total	**Puget Sound to Livengood**	**2,109**

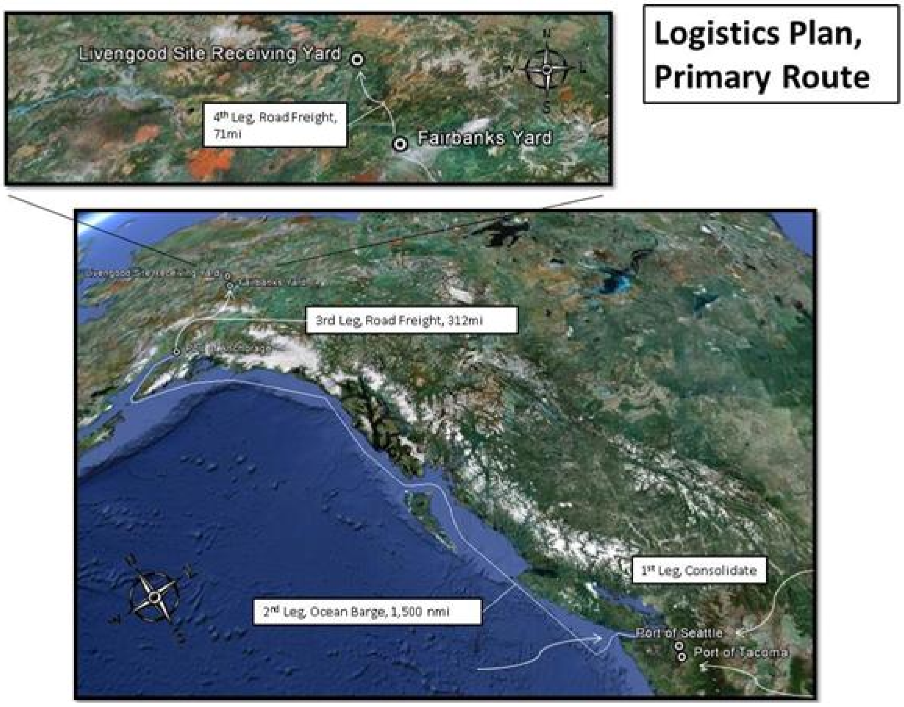


Figure 21-2: Primary route, Livengood logistics plan (Google Earth)

22. INTERPRETATION AND CONCLUSIONS

22.1 Overview

This TRS was prepared by a group of independent consultants (QPs) to demonstrate the economic viability of an open pit mine and process plant complex based on the reserves estimated for the Livengood Gold Project. This TRS provides a summary of the results and findings from each major area of investigation, to a level that is equivalent and normally expected for a PFS of a resource development project. Standard industry practices, equipment and processes were used in this study.

This TRS is based on an updated resource estimate effective as of August 20, 2021, and has an optimized Project configuration with a throughput of 65,000 t/d (59,000 mt/d) compared to the 52,600 t/d (47,700 mt/d) Project evaluated in the 2017 PFS.

22.2 PFS Improvements

The Project configuration evaluated in the PFS remains a conventional, owner operated surface mine that will utilize large-scale mining equipment in a blast/load/haul operation. Mill feed would be processed in a 65,000 t/d (59,000 mt/d) comminution circuit consisting of primary and secondary crushing (pre-crushing), wet grinding in a single semi-autogenous (SAG) mill and single ball mill, a gravity gold circuit, two parallel conventional carbon in leach (CIL) circuits, followed by an ADR system and dewatering.

This configuration is estimated to have an initial capital cost of $1.93B, process operating costs of $7.72 per ton, and sustaining costs of $658M, excluding a $317M reclamation and closure cost.

The slightly higher initial capital cost as compared to the 2017 PFS ($1.84B) can mostly be attributed to higher mine equipment and mine development costs and escalation offset by cost savings forecast from design modifications and project execution strategy. Only minor changes were made to the process equipment selection, which, in combination with a decision based on the Whittle EO project led to coarsen the grind, resulting in a higher throughput and overall annual gold production.

A slightly higher OPEX was estimated in this PFS as compared to the 2017 PFS. This can largely be attributed to escalation in mining, process and G&A costs. However, cost escalation was also mitigated by such developments as incorporating autonomous drilling and an integrated remote operations center, as examples. One of the most significant developments reflected in this study was the decision to increase the grind size from 180 µm to 250 µm (P_{80}), which allowed a higher throughput, effectively distributing many fixed OPEX costs to more tons, e.g. operating personnel, and lowering the power consumption per ton milled. Reagent costs were also further optimized as a result of the testwork leading up to this PFS.

The total G&A costs, developed on a similar basis to the 2017 PFS, went up due to escalation, but were also offset somewhat on a unit basis due to the higher throughput.

22.3 Key Outcomes

The key outcomes of this PFS study are:

- The Livengood Gold Project mineral resource is estimated at 646.0 M measured metric tons at an average grade of 0.60 g/mt (12.48 Moz) and 58.5 M indicated metric tons at an average grade of 0.61 g/mt (1.14 Moz), for a total of 704.5 M metric tons at an average grade of 0.60 g/mt (13.6 Moz). Mineral resources are inclusive of mineral reserves.
- This PFS has converted a portion of these mineral resources into proven mineral reserves of 411.5 Mmt at an average grade of 0.64 g/mt (8.5 Moz contained) and probable mineral reserves of 18.5 Mmt at an average grade of 0.86 g/mt (0.5 Moz contained), for a total of 430.1 Mmt at an average grade of 0.65 g/mt (9.0 Moz contained). To access these mineral reserves, 496.1 Mmt of overburden and waste rock must be mined, resulting in a strip ratio of 1.15:1
- The mine plan developed for the PFS provides sufficient ore to support an annual production rate of approximately 317,000 oz/y over an estimated 20.3 year mine life, producing a total of approximately 6.4 Moz of gold.
- The material mined from the open pit peaks at 66 Mt (60 Mmt) per year and averages 57 Mt (52 Mmt). A total of 105 Mt (95 Mmt) of ore is sent to the low grade ore stockpile over the life of the mine, with an average gold grade of 0.38 g/mt. The maximum size of the low grade ore stockpile is 88 Mt (80 Mmt).
- The peak mine fleet requirements have been estimated at 18 -320 t haul trucks, 2 -40 yd^3 hydraulic shovels, 2 -40 yd^3 wheel loaders and 5- production drills.
- Metallurgical testwork has confirmed the preferred flowsheet consisting of primary crushing, secondary crushing and a comminution circuit (SABC configuration) producing a final grind size of 250 µm (P_{80}), with gravity recovery followed by whole ore leaching of the gravity tailings (CIL). LOM gold recovery is estimated to be 71.4% based on the rock types tested.
- Important Project surface infrastructure include:
  - O'Connor Creek Substation and 50 mi (81 km) of new 230 kV transmission line;
  - Administration, dry, maintenance, and warehouse complex;
  - Fresh water wells, pumping and distribution system;
  - Process plant including mechanical workshop, offices, cafeteria, HVAC, electrical rooms within the complex. The oxygen plant and sulfur burner are stand-alone buildings found near the process plant;
  - Waste rock, low grade ore and growth media stockpiles;
  - Tailings management facility with capacity for approximately 486 Mt (441 Mmt) of mill tailings along with a supernatant pond. Design incorporates best practices, including lined rock fill embankments with a lined tailings basin;
  - Off-site Integrated Remote Operations Center (IROC) located in Fairbanks.

- The initial capital cost (-20% / +25% accuracy) of the open pit mine, 65,000 t/d (59,000 mt/d) process plant and general site infrastructure is estimated at $1.93B, including a contingency of $220M. Additional pre-production costs include $40M for spare parts and initial fills (the costs are recovered during the last year of operations) and $23M for funding of the reclamation trust fund.
- LOM Project sustaining capital costs total $658M, which include mine equipment, tailings management facility construction and mobile equipment in the mill. Additional sustaining costs of $317M are required for the reclamation and closure.
- The mining cost is estimated at $2.05/t mined, process plant operating cost is estimated at an average of $7.72/t ore processed, and general and administrative costs of $1.35/t ore processed.
- The total power demand is estimated to be approximately 57.8 MW, including network losses.
- Over the life of mine, the total number of personnel averages 355, including mining, processing and G&A. The total personnel numbers peak in Year 6 at 430 employees.
- Based on review of the studies completed to date, there are no known environmental issues that are anticipated to materially impact the Project's ability to extract the gold resource.

22.4 Indicative Economics

The financial analysis performed as part of this PFS using the base case assumptions results in an after-tax net present value (NPV) of $44.6M at a 5% discount rate and an internal rate of return (IRR) of 5.3% after mining and income taxes. The payback period is 10.4 years. The all-in sustaining costs (AISC), including sustaining capital, total $7.53B or $1,171/oz. All-in costs including operating, capital (initial and sustaining) and reclamation funding are estimated to be $9.72B or $1,512 /oz.

The results of the PFS indicate that the proposed Livengood Gold Project is technically feasible, and has marginally positive economics at the base case gold price of ($1,680/oz). However, development of the Project could have the potential to generate improved results with additional efforts as detailed by the opportunities in Table 22-2. The Project QPs recommend advancing the Project to the feasibility study level including the completion of additional metallurgical testwork and various confirmatory studies to improve the Project's economics, study potential opportunities and reduce overall implementation risk. The decision and timeline to pursue the feasibility study is at the discretion of THM.

22.5 Project Risks and Opportunities

As with most mining projects, there are risks that could affect the economic viability of the Project. Many of these risks are based on a lack of detailed knowledge and can be managed as more sampling, testing, design, and engineering are conducted at the next study stages. Table 22-1 identifies what are currently deemed to be the most significant internal Project risks, potential impacts, and possible mitigation approaches that could affect the technical feasibility and economic outcome of the Project.

External risks are, to a certain extent, beyond the control of the Project proponents and are much more difficult to anticipate and mitigate. Although, in many instances, some risk reduction can be achieved. External risks are things such as the political situation in the Project region, metal prices, exchange rates and government legislation. These external risks are generally applicable to all mining projects. Negative variance to these items from the assumptions made in the economic model would reduce the profitability of the mine and the mineral resource estimates.

There are opportunities that could improve the economics, timing, and/or permitting potential of the Project. The major opportunities that have been identified at this time are summarized in Table 22-2 excluding those typical to all mining projects, such as changes in metal prices, exchange rates, etc. Further information and assessments are needed before these opportunities should be included in the Project economics.

Table 22-1: Project risks (preliminary risk assessment)

Area	Risk and Potential Impact	Possible Mitigation Approach
Geology and Resource Estimation	1. *Use of Reverse Circulation drilling.* TMH has used both core and reverse circulation (RC) drilling above and below the water table. The use of RC drilling beneath the water table can result in inaccurate assay data, due to cyclicity and/or downhole contamination.	1. Detailed analysis of drilling data indicated the potential for cyclicity contamination in portions of 12 holes. The data for the suspect intervals was removed from the database used for resource calculation. Similar analyses for downhole migration of mineralized material indicated that significant downhole contamination is not an issue.
Open Pit Mining	1. *Unable to provide sufficient construction material from the open pit during pre-production.* This may result in delays to the start of operations and potential cost overruns. 2. *Construction material sourced from mine waste.* Uncertain what proportion of mine waste can be used for construction purposes.	1. Develop a detailed Project Execution Plan (PEP) to determine appropriate productivities and ensure adequate fleet sizing. Develop a more detailed earthworks mass balance. 2. Testwork supports PFS construction plan but future regulatory changes will need to be monitored.

Area	Risk and Potential Impact	Possible Mitigation Approach
Metallurgy and Process Plant	1. *Local utility short-circuit capacity too low for motor mill starting.* Local utility short-circuit capacity might cause issues to start the mill motors. 2. *Electrical availability and network studies date back to 2013.* 3. *Foundation design.* Foundation quantities were estimated according to available preliminary geotechnical investigation report that does not provide details for all areas. The actual soil/rock conditions encountered during construction may differ from what is currently understood. The result could have negative implications to both the execution schedule and CAPEX. 4. *Circuit design.* The thickener design was based on best practice as recent sedimentation testwork results were inconsistent. 5. *Circuit design.* Cold stripping design was based on best practice as no testwork was performed.	1. Instead of a STATCOM compensation for the 230 kV power line, the design has been done using two 15 MVAR synchronous condensers at the Livengood substation. The synchronous condensers will contribute positively to the short-circuit capacity available. A mill motor starting study should also be performed during the next development phase of the Project. 2. Update all required electrical and network studies before or in parallel to a future feasibility study. 3. Additional geotechnical investigations should be performed in the next engineering stage to improve the confidence in the design parameters for foundation works for the selected locations for crushing and processing areas. 4. Perform additional thickening and sedimentation tests to confirm thickener sizing and flocculant dosages for the next study phase. 5. Cold stripping should be investigated and modeled in the next study phase.
Environment	1. *Impact of climate change on site conditions.* Climate change could have impacts on weather and soil conditions. 2. *Evolving ESG and government guidelines.* Over time, social acceptance of the Project could be a risk as ESG becomes a more critical deciding factor in project advancement.	1. Review Project designs to take into consideration the impact of climate change on site conditions. 2. Ensure that permitting guidelines are carefully monitored and ESG trade-offs are performed.
Water Management	1. *Operation of flow-through drain.* The flow-through drain conveys stormwater from upstream to downstream, under the TMF. The integrity of the flow-through drain system in perpetuity is critical to the permitting and long-term stability of the TMF.	1. Further the refinement of hydrological modeling and flow-through drain system design focusing on system redundancy, integrity and cost.

Area	Risk and Potential Impact	Possible Mitigation Approach
Waste and Tailings Management	1. *Deleterious waste rock.* Some waste rock proposed to be used as construction material may have acid generating or arsenic leaching potential. 2. *Large area of liner installation.* The Project will require the surface preparation and placement of approximately 24 Mft^2 (2.2 Mm^2) of LLDPE liner at the TMF during the construction of the starter facility and prior to production. There is a risk that the contractor may not be able to place the quantity of liner required in the time available. The result could have significant negative implications to both the execution schedule and cost.	1. Identify additional testing, incorporate the results into the geological block model. Include TMF construction material requirements in the waste rock management plan. 2. A detailed PEP should be developed, which will identify required milestones for the earthworks and production rates for the liner installation.
Execution Plan	1. *Less than optimum Project start date.* The PFS execution plan assumes a July 1st mobilization date for construction activities. The actual Project release date is uncertain given the combination of market variables and the multi-year permitting process that must be completed prior to a construction decision. There is a risk that a Project release date that is substantially different than July 1st could have negative implications to both the execution schedule and Project cost.	1. A detailed PEP should be developed, which will identify alternative approaches to minimize the construction timeline and Project cost.

Table 22-2: Project opportunities (preliminary opportunity assessment)

Area	Opportunity Explanation	Benefit
Open Pit Mining	1. *In-Pit backfilling of waste rock.* Waste rock can be placed back in the pit once the eastern portion is mined to final design.	1. Reduction in hauling distances and provide a cost savings. However, future potential resources may be sterilized.
Metallurgy and Process Plant	1. *Revision of the local utility network modification study. The* latest study available stating the required local utility modifications was completed in 2013 and is based on a plant power demand of 90 MW. Some decisions, such as the selection of 230 kV for power transmission, could prove not to be the most cost-effective solution. 2. *Reagent optimization.* The impact of lead nitrate is not fully developed and shows minor improvements to gold recovery considering the high OPEX associated to the reagent. 3. *Product grind size*. No testwork has been conducted to investigate a grind size above 250 µm (P_{80}). 4. *ADR circuit design is adequate*; however, value engineering could lead to reduction of equipment and building space. 5. *Reagent optimization.* Perform leaching tests in stirred leach reactor test to further optimize lime and cyanide consumption.	1. Potentially reducing the Project CAPEX if electrical power transmission is proved to be more cost-effective at 138 kV. In general, the CAPEX will benefit from a lower voltage. However, the cost of energy for the OPEX may increase. It is mainly a matter of validating if 230 kV is still the best decision for the Project in 2021 and moving forward. 2. Perform additional testwork with and without lead nitrate using CIL methodology and optimized reagent conditions (O_2, NaCN, CaO and pH) to determine whether and how to incorporate the addition of lead nitrate into the circuit. 3. Coarser grinds would allow for higher throughput, which could be achieved, and it is possible to separate the activated carbon from the pulp at coarser grind sizes. 4. Potential reduction in required equipment and building space thus leading to CAPEX savings. 5. Lower reagent consumption would lead to a lower OPEX
Water and tailings management	1. *Reduce earthworks quantities.* Continue to refine the TMF design through a detailed grading and layer definition in the basin of the Livengood Valley.	1. This opportunity could reduce the volume of waste rock required during construction and reduce the volume of processed gravels required. Potential CAPEX reduction
Execution Plan	1. *Alternative construction techniques.* Investigate the application of the following concepts to the Project: – Pre-assembly of leach tank bridges, structural steel, and pipe racks; – Pre-welding of tanks and piping off-site; – Use of pre-cast foundations; – Use of prefabricated buildings for offices and non-industrial use facilities.	1. These concepts could compress the construction schedule and reduce pre-production CAPEX.

23. RECOMMENDATIONS

23.1 Summary

This Technical Report Summary on Tower Hill Mines Livengood Gold Project was prepared by experienced and competent independent consultants using accepted engineering methodologies and standards. It provides a summary of the results and findings from each major area of investigation including exploration, geological modelling, mineral resource, mine design, metallurgy, process design, infrastructure, environmental management, tailings and water management, capital and operating costs, and economic analysis. The level of investigation for each of these areas is considered to meet or exceed what is normally expected of a preliminary feasibility study (PFS).

The 2021 PFS details a project which will process 65,000 tons per day and produce 6.4 million ounces of gold over 21 years at an all-in-sustaining cost of $1,171/oz. Based on the results of the PFS, the QPs recommend that Tower Hill Mines proceed with a feasibility study (FS) as part of the Livengood Mine development plan. Timing for the proposed FS and associated data collection activities is at the discretion of Tower Hill Mines. Recommendations and associated budgets are provided by the QPs to ensure sufficient information is available going forward. It is also recommended that the ongoing environmental work continue to support project development and maintain continuity of baseline information.

It is estimated that the full feasibility study including the recommended field activities, metallurgical testwork and environmental studies would cost approximately $10.2M including a 20% contingency. A breakdown of the key components of this study is summarized in Table 23-1

Table 23-1: Cost estimate for feasibility study recommendations

Activities	Estimated Cost ($M)
Sampling Program (5,000 ft)	2.5
Metallurgical Studies and Testwork	1.0
Feasibility Study	4.0
Environmental Baseline	1.0
Sub-total	**8.5**
Contingency (20%)	1.7
Total	**$10.2M**

Sections 23.2 to 23.5 summarize the key recommendations arising from this study.

23.2 Sampling Program to Obtain Fresh Core

Metallurgical testwork completed in Phases 7 to 13 between 2013 and 2021 were conducted on core and RC chips obtained by drilling programs completed between 2008 and 2012. There has been a considerable evolution and improvement in the laboratory protocols and testwork flowsheet applied to the composite samples during this period of time. As a recommended best practice, the final laboratory protocols and the final flowsheet recommended in the PFS should be applied to recently obtained fresh core and the recovery estimates confirmed.

It is estimated that approximately 5,000 feet (1,500 m) of PQ core should be drilled targeting all 5 major rock types of the Livengood deposit.

23.3 Metallurgical Testwork

Additional metallurgical testwork using the fresh rock samples gathered above should be performed and include the following:

- PFS recovery equations and reagent consumptions by rock type should be validated.
- The PFS work has indicated that net operating income increases as the grind size (P_{80}) is increased up to the limits of existing testwork at 250 µm. Additional testwork should be completed to establish the upper economic boundary of a coarser grind size (above 250 µm)
- Sedimentation and filtration testwork at a P80 of 250 µm and coarser.
- Column leach results of 12.5 mm show a negative sloping linear grade/recovery relationship over the grade ranges tested (approximately 0.5 to 1.0 g/mt). When evaluating the potential economics of an auxiliary heap leach that might process material with gold grades below mill cut-off (approximately 0.25 to 0.5 g/mt). extrapolation of the negative sloping linear relationship into the lower grade ranges resulted in low recovery and unfavorable economics. If the grade/recovery relationship is not linear into the lower grade ranges, it could alter the economics of the auxiliary heap leach. Additional column leach testwork should be completed on 12.5 mm crush to assess gold recovery at 0.25 to 0.5 g/mt.

23.4 Feasibility Study

A feasibility study that includes the additional metallurgical testwork results, as detailed in Section 23.3, should be completed to detail out designs to a feasibility level of engineering, including the open pit, stockpiles, mine haul and site roads, mine maintenance facilities, electrical supply & distribution, process plant, infrastructure, and reclamation and closure. These designs will be required to estimate the initial capital cost, sustaining capital cost and operating costs at the feasibility study level (+/- 15%), which will be in turn used to support a financial analysis and a potential development decision. Additional studies as listed below should be undertaken as part of the FS or prior to the start of the FS as internal studies:

- Additional tailings studies are recommended to confirm the selected approach for the FS. These studies should be completed in coordination with the mining team to optimize the use of in-pit material to construct portions of the facilities to save costs, but also understand the overall cost to the mine with different configurations;
- Update the 2013 detailed hydrologic/hydrogeological analysis and water balance to determine water intake, storage and discharge requirements;
- Evaluate proposed and alternative designs for the flow-through drain system of the TMF for cost reductions and operational improvements;
- Update of the geotechnical study to support the most recent designs for the mine, process plant, TMF and general site infrastructure is recommended to verify foundation conditions for consideration in the FS design work.

23.5 Environment

Environmental baseline studies and geochemistry studies should continue to be progressed to support a timely environmental approvals process, as well as to support the feasibility study engineering design.

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25. RELIANCE ON INFORMATION PROVIDED BY REGISTRANT

The consulting firm's and their Qualified Persons (QPs) have relied upon written reports and statements of other individuals and companies with whom they do business. It is believed that the basic assumptions are factual and accurate, and that the interpretations are reasonable. This data has been relied upon in the prefeasibility study and there is no reason to believe that any material facts have been withheld or misstated. The QPs have taken all appropriate steps, in their professional judgment, to ensure that the work, information, or advice from the below listed employees of THM or others, is sound and the QPs do not disclaim any responsibility for the Technical Report Summary. THM personnel who have been instrumental in supporting this study are as follows:

- Karl L. Hanneman – Chief Executive Officer
- Debbie L. Evans – Corporate Controller
- Denise A. Herzog – Environmental Affairs Manager

All of these individuals have had a longstanding affiliation with the Project.

For the specific purpose of this Technical Report Summary, the QPs relied upon legal, environmental, and tax matters provided by the registrant as follows:

- Ownership and legal status of the mineral tenures comprising the Livengood Gold Project provided by THM as of September 30, 2021 as set forth in Section 3.1, Appendix A, and the relevant portions of Chapter 1. The various agreements under which THM holds title to the mineral claims for this Project have not been reviewed by the QPs, and the QPs offer no legal opinion as to the validity of the mineral title claimed.
- Environmental status of the LIvengood Gold Project, the required permits for project development and the socioeconomic conditions in the Project area as provided by THM, as of November 13, 2021, as set forth in Chapter 17 and in the relevant portions of Chapter 1.
- Taxes, royalties, and other government levies or interests applicable to revenue or income from the Livengood Gold Project, relevant to and incorporated into the financial model developed as summarized in Chapter 19 and the relevant portions of Chapter 1.

Appendix A: Properties and Claims

Table A1: State of Alaska Claims – 100% Owned

Claim Owner	ADL Number	Parcel Name	Meridian Township Range and Section	Acres	Count
Tower Hill Mines, Inc.	330936	LUCKY 55	F009N004W33	40	1
Tower Hill Mines, Inc.	330937	LUCKY 56	F009N004W33	40	2
Tower Hill Mines, Inc.	330938	LUCKY 64	F009N004W32 F009N004W33	40	3
Tower Hill Mines, Inc.	330939	LUCKY 65	F009N004W33	40	4
Tower Hill Mines, Inc.	330940	LUCKY 66	F009N004W33	40	5
Tower Hill Mines, Inc.	330941	LUCKY 72	F008N004W05	40	6
Tower Hill Mines, Inc.	330942	LUCKY 73	F008N004W05	40	7
Tower Hill Mines, Inc.	330943	LUCKY 74	F008N004W05	40	8
Tower Hill Mines, Inc.	330944	LUCKY 75	F008N004W04	40	9
Tower Hill Mines, Inc.	330945	LUCKY 76	F008N004W04	40	10
Tower Hill Mines, Inc.	330946	LUCKY 82	F008N004W05	40	11
Tower Hill Mines, Inc.	330947	LUCKY 83	F008N004W05	40	12
Tower Hill Mines, Inc.	330948	LUCKY 84	F008N004W05	40	13
Tower Hill Mines, Inc.	330949	LUCKY 85	F008N004W04	40	14
Tower Hill Mines, Inc.	330950	LUCKY 86	F008N004W04	40	15
Tower Hill Mines, Inc.	330951	LUCKY 91	F008N004W05	40	16
Tower Hill Mines, Inc.	330952	LUCKY 92	F008N004W05	40	17
Tower Hill Mines, Inc.	330953	LUCKY 93	F008N004W05	40	18
Tower Hill Mines, Inc.	330954	LUCKY 94	F008N004W05	40	19
Tower Hill Mines, Inc.	330955	LUCKY 95	F008N004W04	40	20
Tower Hill Mines, Inc.	330956	LUCKY 96	F008N004W04	40	21
Tower Hill Mines, Inc.	330957	LUCKY 101	F008N004W05	40	22
Tower Hill Mines, Inc.	330958	LUCKY 102	F008N004W05	40	23
Tower Hill Mines, Inc.	330959	LUCKY 103	F008N004W05	40	24
Tower Hill Mines, Inc.	330960	LUCKY 104	F008N004W05	40	25
Tower Hill Mines, Inc.	330961	LUCKY 105	F008N004W04	40	26
Tower Hill Mines, Inc.	330962	LUCKY 106	F008N004W04	40	27
Tower Hill Mines, Inc.	330963	LUCKY 202	F008N004W08	40	28
Tower Hill Mines, Inc.	330964	LUCKY 203	F008N004W08	40	29
Tower Hill Mines, Inc.	330965	LUCKY 204	F008N004W08	40	30
Tower Hill Mines, Inc.	330966	LUCKY 205	F008N004W09	40	31
Tower Hill Mines, Inc.	330967	LUCKY 206	F008N004W09	40	32
Tower Hill Mines, Inc.	330968	LUCKY 207	F008N004W09	40	33
Tower Hill Mines, Inc.	330969	LUCKY 208	F008N004W09	40	34

Claim Owner	ADL Number	Parcel Name	Meridian Township Range and Section	Acres	Count
Tower Hill Mines, Inc.	330970	LUCKY 302	F008N004W08	40	35
Tower Hill Mines, Inc.	330971	LUCKY 303	F008N004W08	40	36
Tower Hill Mines, Inc.	330972	LUCKY 304	F008N004W08	40	37
Tower Hill Mines, Inc.	330973	LUCKY 305	F008N004W09	40	38
Tower Hill Mines, Inc.	330974	LUCKY 306	F008N004W09	40	39
Tower Hill Mines, Inc.	330975	LUCKY 307	F008N004W09	40	40
Tower Hill Mines, Inc.	330976	LUCKY 308	F008N004W09	40	41
Tower Hill Mines, Inc.	330977	LUCKY 404	F008N004W08	40	42
Tower Hill Mines, Inc.	330978	LUCKY 405	F008N004W09	40	43
Tower Hill Mines, Inc.	330979	LUCKY 406	F008N004W09	40	44
Tower Hill Mines, Inc.	338477	LUCKY 198	F008N004W07	40	45
Tower Hill Mines, Inc.	338478	LUCKY 199	F008N004W07	40	46
Tower Hill Mines, Inc.	338479	LUCKY 295	F008N005W12	40	47
Tower Hill Mines, Inc.	338480	LUCKY 296	F008N005W12	40	48
Tower Hill Mines, Inc.	338481	LUCKY 297	F008N004W07	40	49
Tower Hill Mines, Inc.	338482	LUCKY 298	F008N004W07	40	50
Tower Hill Mines, Inc.	338483	LUCKY 299	F008N004W07	40	51
Tower Hill Mines, Inc.	338484	LUCKY 392	F008N005W11	40	52
Tower Hill Mines, Inc.	338485	LUCKY 395	F008N005W12	40	53
Tower Hill Mines, Inc.	338486	LUCKY 396	F008N005W12	40	54
Tower Hill Mines, Inc.	338487	LUCKY 397	F008N004W07	40	55
Tower Hill Mines, Inc.	338488	LUCKY 398	F008N004W07	40	56
Tower Hill Mines, Inc.	338489	LUCKY 399	F008N004W07	40	57
Tower Hill Mines, Inc.	338490	LUCKY 400	F008N004W07 F008N004W08	40	58
Tower Hill Mines, Inc.	338491	LUCKY 491	F008N005W11	40	59
Tower Hill Mines, Inc.	338492	LUCKY 492	F008N005W11	40	60
Tower Hill Mines, Inc.	338493	LUCKY 493	F008N005W12	40	61
Tower Hill Mines, Inc.	338494	LUCKY 494	F008N005W12	40	62
Tower Hill Mines, Inc.	338495	LUCKY 495	F008N005W12	40	63
Tower Hill Mines, Inc.	338496	LUCKY 496	F008N005W12	40	64
Tower Hill Mines, Inc.	338497	LUCKY 497	F008N004W07	40	65
Tower Hill Mines, Inc.	338498	LUCKY 498	F008N004W07	40	66
Tower Hill Mines, Inc.	338499	LUCKY 499	F008N004W07	40	67
Tower Hill Mines, Inc.	338500	LUCKY 500	F008N004W07 F008N004W08	40	68
Tower Hill Mines, Inc.	338501	LUCKY 504	F008N004W08	40	69

Claim Owner	ADL Number	Parcel Name	Meridian Township Range and Section	Acres	Count
Tower Hill Mines, Inc.	338502	LUCKY 505	F008N004W09	40	70
Tower Hill Mines, Inc.	338503	LUCKY 589	F008N005W14	40	71
Tower Hill Mines, Inc.	338504	LUCKY 590	F008N005W14	40	72
Tower Hill Mines, Inc.	338505	LUCKY 591	F008N005W14	40	73
Tower Hill Mines, Inc.	338506	LUCKY 592	F008N005W14	40	74
Tower Hill Mines, Inc.	338507	LUCKY 593	F008N005W13	40	75
Tower Hill Mines, Inc.	338508	LUCKY 594	F008N005W13	40	76
Tower Hill Mines, Inc.	338509	LUCKY 595	F008N005W13	40	77
Tower Hill Mines, Inc.	338510	LUCKY 596	F008N005W13	40	78
Tower Hill Mines, Inc.	338511	LUCKY 597	F008N004W18	40	79
Tower Hill Mines, Inc.	338512	LUCKY 598	F008N004W18	40	80
Tower Hill Mines, Inc.	338513	LUCKY 599	F008N004W18	40	81
Tower Hill Mines, Inc.	338514	LUCKY 689	F008N005W14	40	82
Tower Hill Mines, Inc.	338515	LUCKY 690	F008N005W14	40	83
Tower Hill Mines, Inc.	338516	LUCKY 691	F008N005W14	40	84
Tower Hill Mines, Inc.	338517	LUCKY 692	F008N005W14	40	85
Tower Hill Mines, Inc.	338518	LUCKY 693	F008N005W13	40	86
Tower Hill Mines, Inc.	338519	LUCKY 694	F008N005W13	40	87
Tower Hill Mines, Inc.	338520	LUCKY 697	F008N004W18	40	88
Tower Hill Mines, Inc.	338521	LUCKY 698	F008N004W18	40	89
Tower Hill Mines, Inc.	338522	LUCKY 699	F008N004W18	40	90
Tower Hill Mines, Inc.	347943	LC 407	F008N004W09	40	91
Tower Hill Mines, Inc.	347944	LC 408	F008N004W09	40	92
Tower Hill Mines, Inc.	347945	LC 502	F008N004W08	40	93
Tower Hill Mines, Inc.	347946	LC 503	F008N004W08	40	94
Tower Hill Mines, Inc.	347947	LC 506	F008N004W09	40	95
Tower Hill Mines, Inc.	347948	LC 507	F008N004W09	40	96
Tower Hill Mines, Inc.	347949	LC 600	F008N004W17 F008N004W18	40	97
Tower Hill Mines, Inc.	347950	LC 601	F008N004W17	40	98
Tower Hill Mines, Inc.	347951	LC 602	F008N004W17	40	99
Tower Hill Mines, Inc.	347952	LC 603	F008N004W17	40	100
Tower Hill Mines, Inc.	347953	LC 604	F008N004W17	40	101
Tower Hill Mines, Inc.	347954	LC 605	F008N004W16	40	102
Tower Hill Mines, Inc.	347955	LC 695	F008N005W13	40	103
Tower Hill Mines, Inc.	347956	LC 696	F008N005W13	40	104

Claim Owner	ADL Number	Parcel Name	Meridian Township Range and Section	Acres	Count
Tower Hill Mines, Inc.	347957	LC 700	F008N004W17 F008N004W18	40	105
Tower Hill Mines, Inc.	347958	LC 701	F008N004W17	40	106
Tower Hill Mines, Inc.	347959	LC 702	F008N004W17	40	107
Tower Hill Mines, Inc.	347960	LC 703	F008N004W17	40	108
Tower Hill Mines, Inc.	347961	LC 704	F008N004W17	40	109
Tower Hill Mines, Inc.	347962	LC 790	F008N005W14	40	110
Tower Hill Mines, Inc.	347963	LC 791	F008N005W14	40	111
Tower Hill Mines, Inc.	347964	LC 792	F008N005W14	40	112
Tower Hill Mines, Inc.	347965	LC 793	F008N005W13	40	113
Tower Hill Mines, Inc.	347966	LC 794	F008N005W13	40	114
Tower Hill Mines, Inc.	347967	LC 795	F008N005W13	40	115
Tower Hill Mines, Inc.	347968	LC 796	F008N005W13	40	116
Tower Hill Mines, Inc.	347969	LC 797	F008N004W18	40	117
Tower Hill Mines, Inc.	347970	LC 798	F008N004W18	40	118
Tower Hill Mines, Inc.	347971	LC 799	F008N004W18	40	119
Tower Hill Mines, Inc.	347972	LC 800	F008N004W17 F008N004W18	40	120
Tower Hill Mines, Inc.	347973	LC 801	F008N004W17	40	121
Tower Hill Mines, Inc.	347974	LC 802	F008N004W17	40	122
Tower Hill Mines, Inc.	347975	LC 803	F008N004W17	40	123
Tower Hill Mines, Inc.	347976	LC 891	F008N005W14	40	124
Tower Hill Mines, Inc.	347977	LC 892	F008N005W14	40	125
Tower Hill Mines, Inc.	347978	LC 893	F008N005W13	40	126
Tower Hill Mines, Inc.	347979	LC 894	F008N005W13	40	127
Tower Hill Mines, Inc.	347980	LC 895	F008N005W13	40	128
Tower Hill Mines, Inc.	348802	LC 688	F008N005W15	40	129
Tower Hill Mines, Inc.	348803	LC 787	F008N005W15	40	130
Tower Hill Mines, Inc.	348804	LC 788	F008N005W15	40	131
Tower Hill Mines, Inc.	348805	LC 884	F008N005W16	40	132
Tower Hill Mines, Inc.	348806	LC 885	F008N005W15	40	133
Tower Hill Mines, Inc.	348807	LC 886	F008N005W15	40	134
Tower Hill Mines, Inc.	348808	LC 887	F008N005W15	40	135
Tower Hill Mines, Inc.	348809	LC 888	F008N005W15	40	136
Tower Hill Mines, Inc.	348810	LC 984	F008N005W21	40	137
Tower Hill Mines, Inc.	348811	LC 985	F008N005W22	40	138
Tower Hill Mines, Inc.	348812	LC 986	F008N005W22	40	139

Claim Owner	ADL Number	Parcel Name	Meridian Township Range and Section	Acres	Count
Tower Hill Mines, Inc.	348813	LC 987	F008N005W22	40	140
Tower Hill Mines, Inc.	348814	LC 1083	F008N005W21	40	141
Tower Hill Mines, Inc.	348815	LC 1084	F008N005W21	40	142
Tower Hill Mines, Inc.	348816	LC 1085	F008N005W22	40	143
Tower Hill Mines, Inc.	348817	LC 1086	F008N005W22	40	144
Tower Hill Mines, Inc.	348818	LC 1183	F008N005W21	40	145
Tower Hill Mines, Inc.	348819	LC 1184	F008N005W21	40	146
Tower Hill Mines, Inc.	348820	LC 1185	F008N005W22	40	147
Tower Hill Mines, Inc.	348821	LC 1186	F008N005W22	40	148
Tower Hill Mines, Inc.	348822	LC 1282	F008N005W21	40	149
Tower Hill Mines, Inc.	348823	LC 1283	F008N005W21	40	150
Tower Hill Mines, Inc.	348824	LC 1284	F008N005W21	40	151
Tower Hill Mines, Inc.	348825	LC 1285	F008N005W22	40	152
Tower Hill Mines, Inc.	348826	LC 1286	F008N005W22	40	153
Tower Hill Mines, Inc.	348827	LC 1287	F008N005W22	40	154
Tower Hill Mines, Inc.	348828	LC 1288	F008N005W22	40	155
Tower Hill Mines, Inc.	348829	LC 1382	F008N005W28	40	156
Tower Hill Mines, Inc.	348830	LC 1383	F008N005W28	40	157
Tower Hill Mines, Inc.	348831	LC 1384	F008N005W28	40	158
Tower Hill Mines, Inc.	348832	LC 1385	F008N005W27	40	159
Tower Hill Mines, Inc.	361326	LUCKY 90	F008N004W06	40	160
Tower Hill Mines, Inc.	361327	LUCKY 100	F008N004W06	40	161
Tower Hill Mines, Inc.	361328	LUCKY 200	F008N004W07	40	162
Tower Hill Mines, Inc.	361329	LUCKY 294	F008N005W12	40	163
Tower Hill Mines, Inc.	361330	LUCKY 300	F008N004W07	40	164
Tower Hill Mines, Inc.	361331	LUCKY 394	F008N005W12	40	165
Tower Hill Mines, Inc.	361332	LUCKY 401	F008N004W08	40	166
Tower Hill Mines, Inc.	361333	LUCKY 402	F008N004W08	40	167
Tower Hill Mines, Inc.	361334	LUCKY 403	F008N004W08	40	168
Tower Hill Mines, Inc.	361335	LUCKY 501	F008N004W08	40	169

Table A2: State of Alaska Claims – 100% Owned

Claim Owner	ADL Number	Parcel Name	Meridian Township Range and Section	Acres	Count
Tower Hill Mines, Inc.	669377	LVG 1	F008N004W09	40	170
Tower Hill Mines, Inc.	669378	LVG 2	F008N004W16	40	171
Tower Hill Mines, Inc.	669379	LVG 3	F008N004W16	40	172
Tower Hill Mines, Inc.	669380	LVG 4	F008N004W16	40	173
Tower Hill Mines, Inc.	669381	LVG 5	F009N004W20	160	174
Tower Hill Mines, Inc.	669382	LVG 6	F009N004W20	160	175
Tower Hill Mines, Inc.	669383	LVG 7	F009N004W21	160	176
Tower Hill Mines, Inc.	669384	LVG 8	F009N004W21	160	177
Tower Hill Mines, Inc.	669385	LVG 9	F009N004W22	160	178
Tower Hill Mines, Inc.	669386	LVG 10	F009N004W22	160	179
Tower Hill Mines, Inc.	669387	LVG 11	F009N004W20	160	180
Tower Hill Mines, Inc.	669388	LVG 12	F009N004W20	160	181
Tower Hill Mines, Inc.	669389	LVG 13	F009N004W21	160	182
Tower Hill Mines, Inc.	669390	LVG 14	F009N004W21	160	183
Tower Hill Mines, Inc.	669391	LVG 15	F009N004W22	160	184
Tower Hill Mines, Inc.	669392	LVG 16	F009N004W22	160	185
Tower Hill Mines, Inc.	669393	LVG 17	F009N005W25	160	186
Tower Hill Mines, Inc.	669394	LVG 18	F009N005W25	160	187
Tower Hill Mines, Inc.	669395	LVG 19	F009N004W30	160	188
Tower Hill Mines, Inc.	669396	LVG 20	F009N004W30	160	189
Tower Hill Mines, Inc.	669397	LVG 21	F009N004W29	160	190
Tower Hill Mines, Inc.	669398	LVG 22	F009N004W29	160	191
Tower Hill Mines, Inc.	669399	LVG 23	F009N005W25	160	192
Tower Hill Mines, Inc.	669400	LVG 24	F009N005W25	160	193
Tower Hill Mines, Inc.	669401	LVG 25	F009N004W30	160	194
Tower Hill Mines, Inc.	669402	LVG 26	F009N004W30	160	195
Tower Hill Mines, Inc.	669403	LVG 27	F009N004W29	160	196
Tower Hill Mines, Inc.	669404	LVG 28	F009N004W29	160	197
Tower Hill Mines, Inc.	669405	LVG 29	F009N005W35	160	198
Tower Hill Mines, Inc.	669406	LVG 30	F009N005W35	160	199
Tower Hill Mines, Inc.	669407	LVG 31	F009N005W36	160	200
Tower Hill Mines, Inc.	669408	LVG 32	F009N005W36	160	201
Tower Hill Mines, Inc.	669409	LVG 33	F009N005W35	160	202
Tower Hill Mines, Inc.	669410	LVG 34	F009N005W35	160	203
Tower Hill Mines, Inc.	669411	LVG 35	F009N005W36	160	204

Claim Owner	ADL Number	Parcel Name	Meridian Township Range and Section	Acres	Count
Tower Hill Mines, Inc.	669412	LVG 36	F009N005W36	160	205
Tower Hill Mines, Inc.	669413	LVG 37	F008N005W03	160	206
Tower Hill Mines, Inc.	669414	LVG 38	F008N005W03	160	207
Tower Hill Mines, Inc.	669415	LVG 39	F008N005W03	160	208
Tower Hill Mines, Inc.	669416	LVG 40	F008N005W03	160	209
Tower Hill Mines, Inc.	669417	LVG 41	F009N004W27	160	210
Tower Hill Mines, Inc.	669418	LVG 42	F009N004W27	160	211
Tower Hill Mines, Inc.	669419	LVG 43	F009N004W27	160	212
Tower Hill Mines, Inc.	669420	LVG 44	F009N004W27	160	213
Tower Hill Mines, Inc.	669421	LVG 45	F009N004W34	160	214
Tower Hill Mines, Inc.	669422	LVG 46	F009N004W34	160	215
Tower Hill Mines, Inc.	669423	LVG 47	F009N004W34	160	216
Tower Hill Mines, Inc.	669424	LVG 48	F009N004W34	160	217
Tower Hill Mines, Inc.	669425	LVG 49	F008N004W04	160	218
Tower Hill Mines, Inc.	669426	LVG 50	F008N004W03	160	219
Tower Hill Mines, Inc.	669427	LVG 51	F008N004W03	160	220
Tower Hill Mines, Inc.	669428	LVG 52	F008N004W02	160	221
Tower Hill Mines, Inc.	669429	LVG 53	F008N004W02	160	222
Tower Hill Mines, Inc.	669430	LVG 54	F008N004W04	160	223
Tower Hill Mines, Inc.	669431	LVG 55	F008N004W03	160	224
Tower Hill Mines, Inc.	669432	LVG 56	F008N004W03	160	225
Tower Hill Mines, Inc.	669433	LVG 57	F008N004W02	160	226
Tower Hill Mines, Inc.	669434	LVG 58	F008N004W02	160	227
Tower Hill Mines, Inc.	669435	LVG 59	F008N004W10	160	228
Tower Hill Mines, Inc.	669436	LVG 60	F008N004W10	160	229
Tower Hill Mines, Inc.	669437	LVG 61	F008N004W11	160	230
Tower Hill Mines, Inc.	669438	LVG 62	F008N004W11	160	231
Tower Hill Mines, Inc.	669439	LVG 63	F008N004W10	160	232
Tower Hill Mines, Inc.	669440	LVG 64	F008N004W10	160	233
Tower Hill Mines, Inc.	669441	LVG 65	F008N004W11	160	234
Tower Hill Mines, Inc.	669442	LVG 66	F008N004W11	160	235
Tower Hill Mines, Inc.	669443	LVG 67	F008N004W16	160	236
Tower Hill Mines, Inc.	669444	LVG 68	F008N004W15	160	237
Tower Hill Mines, Inc.	669445	LVG 69	F008N004W15	160	238
Tower Hill Mines, Inc.	669446	LVG 70	F008N004W14	160	239
Tower Hill Mines, Inc.	669447	LVG 71	F008N004W14	160	240
Tower Hill Mines, Inc.	669448	LVG 72	F008N004W16	160	241

Claim Owner	ADL Number	Parcel Name	Meridian Township Range and Section	Acres	Count
Tower Hill Mines, Inc.	669449	LVG 73	F008N004W16	160	242
Tower Hill Mines, Inc.	669450	LVG 74	F008N004W15	160	243
Tower Hill Mines, Inc.	669451	LVG 75	F008N004W15	160	244
Tower Hill Mines, Inc.	669452	LVG 76	F008N004W14	160	245
Tower Hill Mines, Inc.	669453	LVG 77	F008N004W14	160	246
Tower Hill Mines, Inc.	669454	LVG 78	F008N004W21	160	247
Tower Hill Mines, Inc.	669455	LVG 79	F008N004W21	160	248
Tower Hill Mines, Inc.	669456	LVG 80	F008N004W22	160	249
Tower Hill Mines, Inc.	669457	LVG 81	F008N004W22	160	250
Tower Hill Mines, Inc.	669458	LVG 82	F008N004W23	160	251
Tower Hill Mines, Inc.	669459	LVG 83	F008N004W23	160	252
Tower Hill Mines, Inc.	669460	LVG 84	F008N004W21	160	253
Tower Hill Mines, Inc.	669461	LVG 85	F008N004W21	160	254
Tower Hill Mines, Inc.	669462	LVG 86	F008N004W22	160	255
Tower Hill Mines, Inc.	669463	LVG 87	F008N004W22	160	256
Tower Hill Mines, Inc.	669464	LVG 88	F008N004W23	160	257
Tower Hill Mines, Inc.	669465	LVG 89	F008N004W23	160	258
Tower Hill Mines, Inc.	700008	LVG 90	F009N004W17	160	259
Tower Hill Mines, Inc.	700009	LVG 91	F009N004W17	160	260
Tower Hill Mines, Inc.	700010	LVG 92	F009N004W16	160	261
Tower Hill Mines, Inc.	700011	LVG 93	F009N004W16	160	262
Tower Hill Mines, Inc.	700012	LVG 94	F009N004W17	160	263
Tower Hill Mines, Inc.	700013	LVG 95	F009N004W17	160	264
Tower Hill Mines, Inc.	700014	LVG 96	F009N004W16	160	265
Tower Hill Mines, Inc.	700015	LVG 97	F009N004W16	160	266
Tower Hill Mines, Inc.	700016	LVG 98	F008N005W09	160	267
Tower Hill Mines, Inc.	700017	LVG 99	F008N005W09	160	268
Tower Hill Mines, Inc.	700018	LVG 100	F008N005W09	160	269
Tower Hill Mines, Inc.	700019	LVG 101	F008N005W09	160	270
Tower Hill Mines, Inc.	703377	LVG 116	F009N004W14	160	271
Tower Hill Mines, Inc.	703378	LVG 117	F009N004W14	160	272
Tower Hill Mines, Inc.	703379	LVG 118	F009N004W13	160	273
Tower Hill Mines, Inc.	703380	LVG 119	F009N004W13	160	274
Tower Hill Mines, Inc.	703381	LVG 120	F009N004W15	160	275
Tower Hill Mines, Inc.	703382	LVG 121	F009N004W14	160	276
Tower Hill Mines, Inc.	703383	LVG 122	F009N004W14	160	277
Tower Hill Mines, Inc.	703384	LVG 123	F009N004W13	160	278

Claim Owner	ADL Number	Parcel Name	Meridian Township Range and Section	Acres	Count
Tower Hill Mines, Inc.	703385	LVG 124	F009N004W13	160	279
Tower Hill Mines, Inc.	703386	LVG 125	F009N004W23	160	280
Tower Hill Mines, Inc.	703387	LVG 126	F009N004W23	160	281
Tower Hill Mines, Inc.	703388	LVG 127	F009N004W24	160	282
Tower Hill Mines, Inc.	703389	LVG 128	F009N004W24	160	283
Tower Hill Mines, Inc.	703390	LVG 129	F009N004W23	160	284
Tower Hill Mines, Inc.	703391	LVG 130	F009N004W23	160	285
Tower Hill Mines, Inc.	703392	LVG 131	F009N004W24	160	286
Tower Hill Mines, Inc.	703393	LVG 132	F009N004W24	160	287
Tower Hill Mines, Inc.	703394	LVG 133	F009N004W26	160	288
Tower Hill Mines, Inc.	703395	LVG 134	F009N004W26	160	289
Tower Hill Mines, Inc.	703396	LVG 135	F009N004W25	160	290
Tower Hill Mines, Inc.	703397	LVG 136	F009N004W25	160	291
Tower Hill Mines, Inc.	703398	LVG 137	F009N004W26	160	292
Tower Hill Mines, Inc.	703399	LVG 138	F009N004W26	160	293
Tower Hill Mines, Inc.	703400	LVG 139	F009N004W25	160	294
Tower Hill Mines, Inc.	703401	LVG 140	F009N004W25	160	295
Tower Hill Mines, Inc.	703402	LVG 141	F009N004W35	160	296
Tower Hill Mines, Inc.	703403	LVG 142	F009N004W35	160	297
Tower Hill Mines, Inc.	703404	LVG 143	F009N004W36	160	298
Tower Hill Mines, Inc.	703405	LVG 144	F009N004W36	160	299
Tower Hill Mines, Inc.	703406	LVG 145	F009N003W31	160	300
Tower Hill Mines, Inc.	703407	LVG 146	F009N004W35	160	301
Tower Hill Mines, Inc.	703408	LVG 147	F009N004W35	160	302
Tower Hill Mines, Inc.	703409	LVG 148	F009N004W36	160	303
Tower Hill Mines, Inc.	703410	LVG 149	F009N004W36	160	304
Tower Hill Mines, Inc.	703411	LVG 150	F009N003W31	160	305
Tower Hill Mines, Inc.	703412	LVG 151	F008N004W01	160	306
Tower Hill Mines, Inc.	703413	LVG 152	F008N004W01	160	307
Tower Hill Mines, Inc.	703414	LVG 153	F008N003W06	160	308
Tower Hill Mines, Inc.	703415	LVG 154	F008N004W01	160	309
Tower Hill Mines, Inc.	703416	LVG 155	F008N004W01	160	310
Tower Hill Mines, Inc.	703417	LVG 156	F008N003W06	160	311
Tower Hill Mines, Inc.	703418	LVG 157	F008N004W12	160	312
Tower Hill Mines, Inc.	703419	LVG 158	F008N004W12	160	313
Tower Hill Mines, Inc.	703420	LVG 159	F008N003W07	160	314
Tower Hill Mines, Inc.	703421	LVG 160	F008N003W07	160	315

Claim Owner	ADL Number	Parcel Name	Meridian Township Range and Section	Acres	Count
Tower Hill Mines, Inc.	703422	LVG 161	F008N004W12	160	316
Tower Hill Mines, Inc.	703423	LVG 162	F008N004W12	160	317
Tower Hill Mines, Inc.	703424	LVG 163	F008N003W07	160	318
Tower Hill Mines, Inc.	703425	LVG 164	F008N003W07	160	319
Tower Hill Mines, Inc.	703426	LVG 165	F008N004W13	160	320
Tower Hill Mines, Inc.	703427	LVG 166	F008N004W13	160	321
Tower Hill Mines, Inc.	703428	LVG 167	F008N003W18	160	322
Tower Hill Mines, Inc.	703429	LVG 168	F008N004W13	160	323
Tower Hill Mines, Inc.	703430	LVG 169	F008N004W13	160	324
Tower Hill Mines, Inc.	703431	LVG 170	F008N004W24	160	325
Tower Hill Mines, Inc.	703432	LVG 171	F008N004W24	160	326

Table A3: Federal Unpatented Placer Claims – 100% Owned

Township	Range	Section	BLM Claim #	Claim Name
8 North	5 West	15NW	61477	Patsy Bench
9 North	4 West	31SE	61478	Black Bench
9 North	4 West	32SW	61479	Little Ben Bench
9 North	4 West	32SW	61480	Oregon
9 North	4 West	32SW	61481	Moonshine
9 North	4 West	32SW	61482	Blue Bird
9 North	4 West	32SW	61483	Nerma Fisko
9 North	4 West	32NE	61484	Prosper
9 North	4 West	32NE	61485	#2 Below Heine Creek
9 North	4 West	32NE	61486	Windy Association
9 North	4 West	32NE	61487	Triangle
9 North	4 West	32NE	61488	Black Dimond
9 North	4 West	29SE	61489	Robin
9 North	4 West	28SW	61490	Dimond Ski Association
9 North	4 West	28SW	61491	Hoover Devide
9 North	4 West	29SE	61492	Mellon
8 North	5 West	6SW	61498	#9 Above Discovery Association
8 North	4 West	6NE	61499	#10 Above Bench
8 North	4 West	5NW	61500	Gem Association
9 North	4 West	32SW	61501	#18 Above Discovery Association
9 North	4 West	32SE	61502	Sunshine
9 North	4 West	32SE	61503	Last Chance Fraction
9 North	4 West	32SE	61504	#23 above Discovery Association
9 North	4 West	32SE	61505	Star Association
9 North	4 West	32SE	61506	May Association
9 North	4 West	32SE	61507	Hot Air Association
9 North	4 West	32SE	61508	Option Association
9 North	4 West	32NE	61493	Tomtit Association
9 North	4 West	1SE	61494	LaFrance Association

Table A4: Patented Claims – 100% Owned

Mineral Survey	Patent Number	Claim Names	LPI Ownership
832	743623	Wagner Association Bench	100%
1604	1041577	Snow Bird Bench	100%
1604	1041577	Mint Bench	100%
1604	1041577	Black Jack	100%
1609	1043895	Navada Bench Placer	100%
1609	1043895	Gold Brick Fraction Placer	100%
1623	1073686	Italy	100%
1624	1073687	Trustworthy Association	100%
1624	1073687	Imperial Association	100%
1625	1075872	Etna-Sunnyside Association	15/16
1625	1075872	Sunny Bench Association	100%
1640	1069069	Duncan	100%
1641	1069097	Eureka or No. 22 Creek Above on Livengood	100%
1641	1069097	Placer Mining Claim No. 21 Above Discovery on Livengood Creek	100%
1641	1069097	Placer Mining Claim No. 20 Above Discovery on Livengood Creek	3/4
1641	1069097	Placer Mining Claim No. 19 Above Discovery on Livengood Creek	100%
1641	1069097	Last Chance	100%
1641	1069097	Tolovana Bench	100%
1960	1036259	No.1 Above Discovery on Livengood Creek	100%
1960	1036259	The Tolovana Placer Mining Bench Claim on Right Limit of Livengood Creek	100%
1960	1036259	No.1 Above Discovery Bench	100%
1960	1036259	No. One Bench Fraction Above Discovery Right Limit Livengood Creek	100%
1960	1036259	Ready Bullion Placer Mining Bench Claim on Right Limit of Livengood Creek	100%
1963	1045457	Deep Channel Association	100%
1966	1031406	Golden Rod Association	100%
2060	1117204	Eldorado Bench	100%
2071	1117929	Marietta Association	100%
2152	1127946	Hidden Treasure	100%
2152	1127946	Hot Day	100%

Table A5: Federal Unpatented Placer Claims – 100% Owned

Township	Range	Section	BLM Claim #	Claim Name
8 North	5 West	11SE	61249	#5 above Discovery
8 North	5 West	11SE	61250	Star fraction
8 North	5 West	11SW	61256	#3 above discovery
8 North	5 West	11SE	61257	#4 above discovery
8 North	5 West	11NE	61258	Dickey-fraction
8 North	5 West	11SE	61259	#4-a above discovery
8 North	5 West	11NE	61260	#5 above discovery bench
8 North	5 West	11NE	61261	#5 bench fraction, 1st tier
8 North	5 West	11NE	61262	Leitrim a/k/a letruim, letrium, letram association
8 North	5 West	12NW	61263	#7 bench right limit 1st tier above discovery
8 North	5 West	12NW	61264	#7 above discovery
8 North	5 West	12NW	61265	Rosalind fraction
8 North	5 West	12NW	61266	#8 above discovery
8 North	5 West	1SW	61267	Chatham bench association
8 North	5 West	1SW	61268	Gold dollar association claim
8 North	4 West	7NW	61269	Basin association claim
8 North	4 West	6SW	61270	Dorothy association bench claim
8 North	4 West	6SW	61271	Riffle association claim
8 North	4 West	6SE	61272	Montana association
8 North	5 West	11NE	61273	High grade fraction
8 North	5 West	11NE	61274	Triangle fraction
8 North	5 West	12NW	61275	#6 above discovery
8 North	5 West	12NW	61276	o.k. fraction
8 North	5 West	12NW	61277	#1 frank (franklin) gulch
8 North	5 West	1SW	61278	#2 franklin gulch
9 North	4 West	33SW	61292	Cloud association
9 North	4 West	33SW	61293	Ruby bench
8 North	5 West	28SW	61322	Pete
8 North	5 West	28NW	61323	Mike
8 North	5 West	21SE	61324	Ike
8 North	5 West	21NE	61325	Carolyn
8 North	5 West	21SE	61326	Sunshine Fraction
8 North	5 West	16SE	61327	Frio
8 North	5 West	16SW	61328	Ring
8 North	5 West	16SW	61329	Pilot
8 North	5 West	16SE	61330	Dan

Township	Range	Section	BLM Claim #	Claim Name
8 North	5 West	16SE	61331	Nyuk
8 North	5 West	16SE	61332	Sweede Association
8 North	5 West	15SW	61333	Eureka Banch claim
8 North	5 West	15SW	61334	Bessie Bench
8 North	5 West	15NW	61335	Jeanne
8 North	5 West	16NE	61336	Hawk
8 North	5 West	16NE	61337	Gypsy
8 North	5 West	15NW	61338	Reef Association
8 North	5 West	15NW	61339	California Fraction
8 North	5 West	15NW	61340	No. 1 Below Discovery
8 North	5 West	9SE	61341	Horse
8 North	5 West	9SE	61342	Close
8 North	5 West	10SW	61343	No. 2 Below Myrtle Creek
8 North	5 West	15NW	61344	No. 1 Bench Right Limit
8 North	5 West	15NW	61345	No. 1 Bench Fraction
8 North	5 West	15NE	61346	Discovery Livengood Cr. Association
8 North	5 West	10SW	61347	Placer Mining Claim No. 1 Below Discovery
8 North	5 West	9SE	61348	Destiny
8 North	5 West	9NE	61349	Jackpot
8 North	5 West	10NW	61350	Nancy
8 North	5 West	10NW	61351	Paystreak Bench Claim
8 North	5 West	10NW	61352	Eureka Bench Claim on Left Limit
8 North	5 West	10SW	61353	Deep Channel Fraction
8 North	5 West	10NW	61354	Colorado Association
8 North	5 West	10SE	61355	George Association, 2nd Tier
8 North	5 West	10SE	61356	Gan Fraction, 2nd Tier right limit
8 North	5 West	10NE	61357	Colorado Fraction, 3rd tier right limit
8 North	5 West	10NE	61358	Sacramento Bench
8 North	5 West	10NE	61359	Three Star Association
8 North	5 West	10SE	61360	Toni Placer Mining Claim
8 North	5 West	10NE	61361	Little Butch
8 North	5 West	10NE	61362	Horseshoe claim
8 North	5 West	10NE	61363	Carryall
8 North	5 West	10NE	61364	Fish Association
8 North	5 West	11NW	61365	Homesite Bench
8 North	5 West	11NW	61366	Virgina Association
8 North	5 West	10NW	61367	Eagle Bench Association
8 North	5 West	11NE	61368	Birch Fraction

Township	Range	Section	BLM Claim #	Claim Name
8 North	5 West	2SE	61369	Brendan or Brandon Bench
8 North	5 West	2SW	61370	Xmas
8 North	5 West	2SE	61371	Blanche
8 North	5 West	1SW	61372	Audrey Fraction
8 North	5 West	1SW	61373	Gold Dollar Fraction
8 North	5 West	1SW	61374	Livengood Bench Right Limit
8 North	5 West	1NW	61375	Snow
8 North	5 West	1NE	61376	Ice
8 North	5 West	1SE	61377	Harding (Pearson)
8 North	5 West	1SE	61378	Mayflower Claim
8 North	5 West	1SE	61379	Golden Gusher Bench Claim
8 North	4 West	6SW	61380	Bonznza Bench
8 North	4 West	6NW	61381	North Star Association
8 North	4 West	6NW	61382	Black Bear Association
8 North	4 West	6NW	61383	Tom Cat Bench
8 North	4 West	6NW	61385	Flat Association
8 North	4 West	6SW	61386	Magnus Opus
8 North	4 West	6NE	61387	Banner Bench claim
8 North	4 West	6NE	61388	Jewel Bench
8 North	4 West	6NW	61389	Wild Cat bench
9 North	4 West	31SE	61391	Hum Dinger
8 North	4 West	6NE	61392	Red Claim
9 North	4 West	31SE	61393	Jerry Association
9 North	4 West	32SW	61394	Alaska
9 North	4 West	32NW	61395	California Association claim
9 North	4 West	32NW	61396	Gol Run Bench, 2nd Tier
9 North	4 West	29SE	61399	Spring Association
9 North	4 West	28SE	61406	Wedge Claim
9 North	4 West	28SE	61407	Bulldozer
9 North	4 West	28SE	61408	Eve
9 North	4 West	27SW	61409	Resavoir Association
9 North	4 West	28SW	61420	Alabam on the divide
9 North	4 West	29SW	63462	Dome a/k/a Dome Association
9 North	4 West	1SW	63466	Marjorie Bench

Table A6: State of Alaska Claims – 100% Owned

Claim Owner	ADL Number	Parcel Name	Meridian Township Range and Section	Acres	Count
Livengood Placers, Inc.	361349	Galaxy 1	F008N005W10	40	327
Livengood Placers, Inc.	361350	Galaxy 2	F008N005W10	40	328
Livengood Placers, Inc.	361351	Galaxy 3	F008N005W02	40	329
Livengood Placers, Inc.	361352	Galaxy 4	F008N005W02 F008N005W03 F008N005W10 F008N005W11	40	330
Livengood Placers, Inc.	361353	Galaxy 5	F008N005W10 F008N005W11	40	331
Livengood Placers, Inc.	361354	Galaxy 6	F008N005W02	40	332
Livengood Placers, Inc.	361355	Galaxy 7	F008N005W02 F008N005W11	40	333
Livengood Placers, Inc.	361356	Galaxy 8	F008N005W11	40	334
Livengood Placers, Inc.	361357	Galaxy 9	F008N005W02	40	335
Livengood Placers, Inc.	361358	Galaxy 10	F008N005W02 F008N005W11	40	336
Livengood Placers, Inc.	361359	Galaxy 11	F008N005W01 F008N005W02	40	337
Livengood Placers, Inc.	361360	Galaxy 12	F008N005W01 F008N005W02	40	338
Livengood Placers, Inc.	361361	Galaxy 13	F008N005W01 F008N005W02	40	339
Livengood Placers, Inc.	361362	Galaxy 14	F008N005W01	40	340
Livengood Placers, Inc.	361363	Galaxy 15	F008N005W01	40	341
Livengood Placers, Inc.	361364	Galaxy 16	F008N005W01	40	342
Livengood Placers, Inc.	361365	Galaxy 17	F008N004W06 F008N004W07 F009N004W31	40	343
Livengood Placers, Inc.	361366	Galaxy 18	F008N004W06 F009N004W31	40	344
Livengood Placers, Inc.	361367	Galaxy 19	F009N004W31	40	345
Livengood Placers, Inc.	361368	Galaxy 20	F009N004W31	40	346
Livengood Placers, Inc.	603474	FM9N4W28SW	F009N004W28	160	347
Livengood Placers, Inc.	603475	FM9N4W28SE	F009N004W28	160	348
Livengood Placers, Inc.	603476	FM9N4W28NE	F009N004W28	160	349
Livengood Placers, Inc.	603477	FM9N4W28NW	F009N004W28	160	350

Table A7: Hudson/Geraghty Lease - Federal Unpatented Lode Claims

BLM File Number	Parcel Name	Owner
55452	SHARON	HUDSON
55453	DOROTHEA	HUDSON
55454	LENORA	HUDSON
55455	FOSTER	HUDSON
55456	VANCE	HUDSON
55457	TWERPIT	HUDSON
55458	SAUNDERS	HUDSON
55459	NICKIE	HUDSON
55460	PATRICK	HUDSON
55461	WHITE ROCK	HUDSON
55462	SUNSHINE #1	GERAGHTY
55463	SUNSHINE #2	GERAGHTY
55464	OLD SMOKY	HUDSON
55465	WITTROCK	HUDSON
55466	BLACK ROCK	HUDSON
55467	TRAPLINE	HUDSON
55468	PATRICIA	HUDSON
55469	ANNE	HUDSON
55470	EILEEN	HUDSON
55471	BRIDGET	HUDSON

The Property consists of the following six (6) unpatented Federal Lode and Placer claims:

Table A8: Tucker Lease – Federal Unpatented Lode and Placer Claims

File Number	Parcel Name	Date Acquired	Acres	Type
37580	Lillian No. 1	30-Sep-1968	21	Lode Claim
37581	Satellite	30-Sep-1968	20	Lode Claim
37582	Nickel Bench R.L.	30-Jun-1972	20	Placer Claim
37583	The Nickel	12-Aug-1965	19	Placer Claim
37584	Overlooked	6-Sep-1975	18	Placer Claim
37585	The Lad	12-Aug-1965	20	Placer Claim

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