LIHIR OPERATIONS

ANIOLAM ISLAND

PAPUA NEW GUINEA

NI 43-101 Technical Report

Report Prepared For:

Newcrest Mining Limited.

Qualified Person:

Mr. Kevin Gleeson, F.AusIMM

Mr. Steven Butt, F.AusIMM

Mr. John O'Callaghan, F.AusIMM

Mr. Craig Jones, FAusIMM.

Report Effective Date:

30 June, 2020.

NEWCREST

MINING LIMITED

CERTIFICATE OF QUALIFIED PERSON

I, Kevin Gleeson, FAusIMM, am employed as the Head of Mineral Resource Management with Newcrest Mining Limited (Newcrest), situated at Level 8, 600 St Kilda Road, Melbourne, Victoria, 3004, Australia.

This certificate applies to the technical report titled "Lihir Operations, Aniolam Island, Papua New Guinea, NI 43-101 Technical Report" that has an effective date of 30 June, 2020 (the technical report).

I am a Fellow of the Australasian Institute of Mining and Metallurgy (FAusIMM). I graduated with a Bachelor of Science (Hons) from the University of Melbourne, Victoria Australia, in 1987.

I have practiced my profession for over 30 years since graduation. I have been directly involved in exploration, interpretation, geological evaluation, development of resource models, ore control, and reconciliation for both open pit and underground mining in Australia, Papua New Guinea, and Indonesia. I have been directly involved in pre-feasibility and feasibility studies for gold and gold–copper deposits, and I currently manage a team of resource modellers and ore deposit knowledge specialists.

As a result of my experience and qualifications, I am a Qualified Person as defined in National Instrument 43–101 *Standards of Disclosure for Mineral Projects* (NI 43–101) for those sections of the technical report that I am responsible for preparing.

I visited have visited the Lihir Operations on a number of occasions, most recently for a five-day duration, from 14–18 April 2019.

I am responsible for Sections 1.1 to 1.8, 1.10, 1.11, 1.24; Section 2; Section 3; Section 4; Section 5; Section 6; Section 7; Section 8; Section 9; Section 10; Section 11; Section 12; Section 14; Section 23; Section 24; Sections 25.1 to 25.4, 25.6, Section 26; and Section 27 of the technical report.

I am not independent of Newcrest, as independence is described by Section 1.5 of NI 43–101.

I have been involved with the Lihir Operations since 2012 in my role as the Head of Mineral Resource Management.

I have read NI 43–101 and the sections of the technical report for which I am responsible have been prepared in compliance with that Instrument.

As of the effective date of the technical report, to the best of my knowledge, information and belief, the sections of the technical report for which I am responsible contain all scientific and technical information that is required to be disclosed to make the technical report not misleading.

Dated: 13 October, 2020

“Signed”

Kevin Gleeson, FAusIMM.

NEWCREST MINING LIMITED

CERTIFICATE OF QUALIFIED PERSON

I, Steven Butt, FAusIMM, am employed as the Group Manager – Mining Technical Services with Newcrest Mining Limited (Newcrest), situated at Level 8, 600 St. Kilda Road, Melbourne, VIC, 3004.

This certificate applies to the technical report titled "Lihir Operations, Aniolam Island, Papua New Guinea, NI 43-101 Technical Report" that has an effective date of 30 June, 2020 (the technical report).

I am a Fellow of the Australasian Institute of Mining and Metallurgy (FAusIMM). I graduated in 2001 from University of New South Wales with a Bachelor of Mining Engineering degree.

I have practiced my profession for 19 years. I have been directly involved in completing and managing open pit mine planning work, Mineral Reserves estimation, generating mining technical designs, and evaluating financial performance, in operations in Australia and Papua New Guinea.

As a result of my experience and qualifications, I am a Qualified Person as defined in National Instrument 43–101 Standards of Disclosure for Mineral Projects (NI 43–101).

I have visited the Lihir Operations on a number of occasions, most recently on for a ten-day duration from 6–15 January, 2020.

I am responsible for Sections 1.1, 1.2, 1.12, 1.13, 1.14, 1.16 to 1.24; Section 2; Section 3; Section 15; Section 16; Section 18; Section 19; Section 20; Section 21; Section 22; Sections 25.1, 25.7, 25.8, 25.10 to 25.17; Section 26; and Section 27 of the technical report.

I am not independent of Newcrest, as independence is described by Section 1.5 of NI 43–101.

I have been directly involved with the Lihir Operations since 2016 in my roles as Commercial Manager, Technical Services Manager, and most recently, as Group Manager – Mining Technical Services.

I have read NI 43–101 and the sections of the technical report for which I am responsible have been prepared in compliance with that Instrument.

As of the effective date of the technical report, to the best of my knowledge, information and belief, the sections of the technical report for which I am responsible contain all scientific and technical information that is required to be disclosed to make the technical report not misleading.

Dated: 13 October, 2020

“Signed”

Steven Butt, FAusIMM.

CERTIFICATE OF QUALIFIED PERSON

I, John O'Callaghan, FAusIMM, am employed as the Head of Metallurgy with Newcrest Mining Limited (Newcrest), situated at 600 St Kilda Road, Melbourne, Australia.

This certificate applies to the technical report titled "Lihir Operations, Aniolam Island, Papua New Guinea, NI 43-101 Technical Report" that has an effective date of 30 June, 2020 (the technical report).

I am a Fellow of the Australasian Institute of Mining and Metallurgy (FAusIMM). I graduated from RMIT University (Melbourne, Australia) in May 1985 with a Bachelor of Engineering in Chemical Engineering (with distinction)

I have practiced my profession for 34 years and have been directly involved in the gold industry for 20 years specialising in gold hydrometallurgy specifically pressure oxidation and cyanide recovery of gold. I have worked at several gold mines in Western Australia. I have been involved numerous gold-related engineering feasibility studies and have also been involved in the design of recently-constructed projects in Far East Russia and in Turkey. I have been involved in gold research and development for new and novel leaching and extraction technologies, including being a co-inventor of a patented chloride-based gold extraction technology.

As a result of my experience and qualifications, I am a Qualified Person as defined in National Instrument 43–101 *Standards of Disclosure for Mineral Projects* (NI 43–101) for those sections of the technical report that I am responsible for preparing.

I have visited the Lihir on a number of occasions, most recently commencing on 25 August, 2020, and intend to leave site on 20 November, 2020, for a total site visit duration of three months. At the signature date on this certificate I had been on site for 49 days.

I am responsible for Sections 1.1, 1.2, 1.9, 1.15, 1.18, 1.24; Section 2; Section 3; Section 13; Section 17; Section 19; Sections 25.1, 25.5, 25.9, 25.12; Section 26; and Section 27 of the technical report.

I am not independent of Newcrest, as independence is described by Section 1.5 of NI 43–101.

I have been involved with the Lihir Project since 2014 in my role as the Head of Metallurgy.

I have read NI 43–101 and the sections of the technical report for which I am responsible have been prepared in compliance with that Instrument.

As of the effective date of the technical report, to the best of my knowledge, information and belief, the sections of the technical report for which I am responsible contain all scientific and technical information that is required to be disclosed to make the technical report not misleading.

Dated: 13 October, 2020

“Signed”

John O’Callaghan, FAusIMM.

NEWCREST
MINING LIMITED

CERTIFICATE OF QUALIFIED PERSON

I, Craig Jones, FAusIMM, am employed as the Chief Operating Officer, Papua New Guinea, with Newcrest Mining Limited (Newcrest), situated at Level 8, 600 St Kilda Rd, Melbourne, Victoria, Australia.

This certificate applies to the technical report titled "Lihir Operations, Aniolam Island, Papua New Guinea, NI 43-101 Technical Report" that has an effective date of 30 June, 2020 (the technical report).

I am a Fellow of the Australasian Institute of Mining and Metallurgy (FAusIMM, # 337492). I graduated from the University of Newcastle, New South Wales, in 1995 with a Bachelor of Engineering degree.

I have practiced my profession for 25 years. I have been involved in minesite management in Papua New Guinea and Australia, and have held executive management roles for mine and business units in Australia, Indonesia, and Papua New Guinea. I have been involved in development roles in project and asset management, and have managed and led mining, prefeasibility and feasibility studies. I have also been involved in safety and environment, security, community relations and business improvement studies.

As a result of my experience and qualifications, I am a Qualified Person as defined in National Instrument 43–101 *Standards of Disclosure for Mineral Projects* (NI 43–101) for those sections of the technical report that I am responsible for preparing.

I visited the Lihir Operations most recently from 6 July to 18 August 2020.

I am responsible for Sections 1.1, 1.2, 1.4, 1.17, 1.18, 1.22, 1.23, 1.24; Section 2; Section 3; Sections 4.10, 4.12; Section 19; Section 20; Section 24; Sections 25.1, 25.2, 25.11, 25.12, 25.16, 25.17; Section 26; and Section 27 of the technical report.

I am not independent of Newcrest, as independence is described by Section 1.5 of NI 43–101.

I have been involved with the Lihir Operations since 2011 in my role as General Manager Projects and later as Chief Operating Officer, Papua New Guinea.

I have read NI 43–101 and the sections of the technical report for which I am responsible have been prepared in compliance with that Instrument.

NEWCREST MINING LIMITED

As of the effective date of the technical report, to the best of my knowledge, information and belief, the sections of the technical report for which I am responsible contain all scientific and technical information that is required to be disclosed to make the technical report not misleading.

Dated: 13 October, 2020

“Signed”

Craig Jones, FAusIMM

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1.1 Introduction

Mr. Kevin Gleeson, Mr. Steven Butt, Mr. John O'Callaghan, and Mr. Craig Jones prepared this Technical Report (the Report) for Newcrest Mining Limited (Newcrest) on the Lihir Operations (Lihir Operations or the Project) in Papua New Guinea (PNG). The host island, Aniolam Island, is also known as Niolam Island and Lihir Island, and is the largest of five islands that comprise the Lihir Island group.

The Lihir Project is 100% owned by Newcrest's wholly-owned subsidiary, Lihir Gold Limited (Lihir Gold).

Mineral Resources and Mineral Reserves are estimated for the Lihir deposit. The Lihir Operations consist of the active Lihir open pit.

1.2 Terms of Reference

This Report supports disclosure of Mineral Resource and Mineral Reserve estimates in Newcrest's 2020 Annual Information Form.

All measurement units used in this Report are metric unless otherwise noted, and currency is expressed in either United States (US$) dollars or Australian dollars (A$) as identified in the text. The Papua New Guinean currency is the Papua New Guinea kina (PGK). The Report uses Australian English. Years may be indicated as FY, or financial years, which run 1 July–30 June.

Mineral Resources and Mineral Reserves were initially classified using the 2012 edition of the Australasian Joint Ore Reserves Committee (JORC) Code (2012 JORC Code). The confidence categories assigned under the 2012 JORC Code were reconciled to the confidence categories in the Canadian Institute of Mining, Metallurgy and Petroleum (CIM) Definition Standards for Mineral Resources and Mineral Reserves (May 2014; the 2014 CIM Definition Standards). As the confidence category definitions are the same, no modification to the confidence categories was required. Mineral Resources and Mineral Reserves in this Report are reported in accordance with the 2014 CIM Definition Standards. Terminology differences were addressed in that the term "Ore Reserves" in the 2012 JORC Code is reported as "Mineral Reserves" using the 2014 CIM Definition Standards, and the term "Proved Ore Reserve" in the 2012 JORC Code is reported as "Proven Mineral Reserves" using the 2014 CIM Definition Standards.

1.3 Project Setting

Aniolam Island is located approximately 900 km northeast of the national capital, Port Moresby.

Most travel to and from the island is via aircraft. Access to Aniolam Island is through the Kunaye airport located about 7 km north of the mine and approximately 3 km north of the Londolovit town site. Newcrest employees are predominantly PNG nationals who are fly-in-fly-out (FIFO) of a number of different PNG communities or residents of Aniolam Island. The majority of senior management roles are residential based on Aniolam Island. Expatriate employees typically are FIFO from the hub of Cairns, in Australia.

Daily travel to the Lihir Operations from the Londolovit residential town site is by road.

Aniolam Island is located at latitude 3° south and does not experience distinct wet or dry seasons. Rainfall is high year-round. Temperatures at the mine site range from 21–34°C. Wind speeds at the mine site are generally light and variable. Mining activities are conducted year-round. Exploration activities may be curtailed by heavy rainfall.

The general mine area ranges in elevation from 0–200 masl. Mining is conducted at elevations below sea level. Natural vegetation on the island is predominantly tropical rain forest.

Papua New Guinea extends across several major tectonic plate boundaries and is one of the most seismically active regions in the world. Aniolam Island is located in the West Melanesian Arc seismic source zone where earthquakes of magnitude eight have been recorded. Most earthquakes in the region result from strike-slip movement but some occur along steeply-dipping reverse faults resulting in a strong vertical motion component and have potential to generate local tsunamis. Both tsunami and earthquake risks were assessed and incorporated into the Project design criteria.

Volcanic activity on Aniolam Island is limited to remnant hydrothermal venting in the Luise Caldera in the form of hot springs and fumaroles. Isolated geothermal activity in the form of hot springs is evident elsewhere on the island, such as within the southern Kinami caldera.

1.4 Mineral Tenure, Surface Rights, Water Rights, Royalties and Agreements

The Project consists of a granted Special Mining Lease, two granted Mining Leases, one granted Exploration Licence, five granted Leases for Mining Purposes, and three Mining Easements held in the name of Lihir Gold. The total area under licence is approximately 257 km^2.

The Project area is situated on land held variously under customary, State of PNG (State) and private ownership, including under State lease. The bulk of the land that is or will be affected by development, operations and closure of the Lihir Operations is customary owned. Newcrest has been granted rights to undertake mining and processing of gold and related activities, through negotiations with the state and local government, and landowners in the area.

Environment Permits for water extraction and waste disposal are in place to support mining operations.

A 2% royalty is payable to the State on the realised prices of all gold and silver doré produced. A production levy of 0.5% is also payable on the gross value of production (i.e., excluding the offsets of treatment and refining charges, payable terms and freight) to the Mineral Resource Authority (MRA).

1.5 Geology and Mineralisation

The Lihir deposit is considered to be an example of an epithermal gold deposit.

Aniolam Island is part of a 250-km long, northwest-trending, alkalic volcanic island chain that sits within an area where several micro-plates (Solomon Sea Plate, South Bismarck

Plate and North Bismarck Plate) developed between the converging Australian and South Pacific plates.

Aniolam Island comprises five volcanic blocks:

- Two Plio–Pleistocene volcanic blocks, Londolovit Block and Wurtol Wedge;
- Three Pleistocene volcanic edifices, Huniho, Kinami, and Luise.

Areas of hydrothermal alteration occur in each of the volcanic centres.

A 10–100 m thick limestone unit overlies and onlaps volcanic units and dips shallowly to the south.

The Luise volcano consists of a 4 by 3.5 km wide amphitheatre, elongated and breached to the northeast. This is inferred to be a remnant of the original approximately 1.1 km high volcanic cone that underwent sector collapse(s). The Lihir deposit is located in the footwall of the sector collapse detachment surface. Post sector collapse volcanism occurred during the modern geothermal-stage, with the emplacement of several diatreme breccia bodies.

The Lihir deposit has dimensions of about 1,500 x 3,000 m and has about 500 m in depth extent. The deposit remains open at depth, along strike, and to the east, where it is currently limited by the Pacific Ocean. Gold is the only metal of economic significance present within the Luise Caldera.

Gold mineralisation is a complex and refractory assemblage associated mainly with pyrite and marcasite veinlets, disseminations, replacements, and breccia fillings. The sector collapse event(s) superimposed late-stage, gold-rich, alkalic low-sulphidation epithermal mineralisation upon early-stage, porphyry-style alteration.

Gold occurs as solid solution gold in the crystal structure of pyrite grains. It locally occurs as electrum, as gold tellurides, and as native gold associated with quartz, calcite and bladed anhydrite.

A broad, three-fold vertical alteration zonation within the Lihir deposit consists of:

- Surficial, generally barren, steam-heated clay alteration zone that is a product of modern high-temperature geothermal activity;
- High-grade (>3 g/t Au), refractory sulphide and adularia alteration zone that represents the ancient epithermal environment;
- Comparatively low-grade (<1 g/t Au) zone rich in anhydrite ± carbonate, coupled with biotite alteration, that represents the ancient porphyry-style environment.

Newcrest constructed a detailed alteration model for process planning purposes.

The understanding of the Lihir deposit settings, lithologies, mineralisation, and the geological, structural, and alteration controls on mineralisation is sufficient to support estimation of Mineral Resources and Mineral Reserves.

1.6 History

Prior to Newcrest's Project interest, exploration and mining activity was conducted by PNG Bureau of Mineral Resources and the Geological Survey of PNG, Kennecott Explorations Australia (Kennecott), Niugini Mining Limited (Niugini), Rio Tinto Zinc Corporation (Rio Tinto), and Lihir Gold.

Work conducted included semi-detailed mapping, stream sediment and soil samples, rock chips, hand augers, hand-cut trenches and benches, airborne and ground geophysical surveys, and core drilling. The Lihir deposit was discovered in 1982. A feasibility study was conducted in 1988 and updated in 1992. The mine was constructed following grant of the special mining lease in 1995, and the first gold pour occurred in 1997. A geothermal power plant was built in 2007 and a flotation circuit was installed the same year.

Newcrest obtained ownership of Lihir Gold in 2010, continued exploration and mining activities, and completed plant expansions to the current nominal 15 Mt/a. Exploration activities include geological mapping, soil and rock chip sampling and ground geophysical surveys. Marine surveys in support of planned development of the Kapit sector of the open pit were conducted. Newcrest remains actively focused on exploration of Aniolam Island.

From mine start-up in 1997 to 30 June 2020, approximately 16.2 Moz of gold has been produced from the Lihir open pit.

1.7 Drilling and Sampling

Drilling completed to 30 June, 2020 comprises core drilling. Drilling was completed for exploration, resource delineation, metallurgical, geotechnical, pit cooling, and geothermal purposes, and totals 3,703 holes (721,105 m). A total of 2,295 drill holes (449,287.23 m) is used in estimation. Core sizes include PQ (84.8 mm core diameter), HQ (63.5 mm core diameter) and NQ (47.6 mm core diameter). Triple tube methods are routinely used for geotechnical drilling.

Reverse circulation (RC) drilling is conducted ahead of reclaim on some of the low-grade stockpiles. Sonic drill campaigns were completed for metallurgical and geotechnical purposes, but do not support Mineral Resource estimates.

Logging and data collection include collar, lithology, discontinuities, point load tests, bulk density and magnetic susceptibility. Lithology is logged based on the geological unit, with subdivisions created based on alteration and mineralisation.

Core recovery is generally excellent with core recoveries around 99%. Historical comparison of core data with blasthole data suggests no appreciable bias related to core recovery.

Drill collar locations were surveyed using either theodolite or differential global positioning system (DGPS) instruments. A variety of methods were used to measure down-hole deviation (dip and azimuth), including Eastman and electronic single shot instrument; the majority of readings were performed using the Eastman camera. Gyroscopic survey methods are typically used for geotechnical drill holes. Depending on the drill hole purpose, not all drill holes may be down-hole surveyed.

In the opinion of the QP, the quantity and quality of the logged geological data, collar, and downhole survey data collected in the exploration and infill drill programs conducted by Kennecott, Lihir Gold, Rio Tinto and Newcrest are sufficient to support Mineral Resource and Mineral Reserve estimation and mine planning

The nominal core sampling interval is 2 m; however, sampling intervals may vary.

Density determinations use calliper and weighing methods. There is a total of 11,535 determinations available for resource estimation. Density values range from 6.75 t/m^3 in fresh rock to 1.01 t/m^3 in altered and oxidised material.

A number of third-party, independent analytical and sample preparation laboratories were used prior to 1997, and include Pilbara Laboratories (subsequently underwent name change to Analabs, later Genalysis), SGS, Standard and Reference Laboratories and ALS Chemex. There are no accreditation data available in the Project database for the majority of the laboratories at the time of use. Standard and Reference Laboratories was accredited to ISO9001 at the time of use.

The onsite laboratory was constructed in 1997, and has been the primary preparation and analytical laboratory since that date. The laboratory is not independent and holds no accreditations. After commissioning the laboratory was operated by Lihir Gold until 2010. The laboratory has been operated by Newcrest since 2010. Currently, gold, sulphide sulphur, carbonate, arsenic, iron and copper assays are performed at the onsite laboratory.

From 2010, samples could be sent to SGS Lae, SGS Townsville, ALS Chemex Brisbane or the Newcrest Services Laboratory in Orange (NSLO) for check or additional analysis. Any of these laboratories were used for primary analysis for selected samples. There is no accreditation data available in the Project database for SGS Lae, or SGS Townsville. ALS Chemex Brisbane and the NSLO hold ISO17025 accreditations.

Sample preparation methodologies for the majority of the legacy data are not recorded in the Project database. Current sample preparation practice at the onsite laboratory consists of drying, and pulverising to 95% passing 106 µm.

Analytical methodologies for the majority of the legacy data are not recorded in the Project database. Information recorded typically consists of the element and detection limit. Legacy analyses were primarily for gold, but sulphur and a multi-element suite were also completed when requested.

Samples are routinely analysed for gold, sulphide sulphur, carbonate, arsenic, iron and copper at the onsite laboratory. Multi-elemental suite analyses are typically performed at NLSO.

All assays are checked and verified in accordance with the Newcrest Resource Development Quality Assurance Quality Control (QA/QC) and database management procedures. QA/QC procedures were in place for all of the Project legacy drilling programs. The process can involve submission and analysis of standard reference materials (SRMs), blanks, duplicates, replicates, and grind and crush size checks.

Data are stored in a SQL server database using acQuire software. Regular reviews of data quality are conducted by Lihir Operations site and Newcrest corporate teams prior to resource estimation, in addition to external reviews. The database is regularly backed up, and copies are stored in both offsite and in Newcrest facilities.

Sample security at the Lihir Operations has not historically been monitored. Sample collection from drill point to laboratory relies upon the fact that samples are either always attended to, stored in the locked on-site preparation facility, or stored in a secure area prior to laboratory shipment. Chain-of-custody procedures consist of sample submittal forms to be sent to the laboratory with sample shipments to ensure that all samples are received by the laboratory.

In the opinion of the QP, the sample preparation, analysis, and security methods and protocols in place for the Kennecott, Lihir Gold, Rio Tinto and Newcrest programs are acceptable, meet industry-standard practices, and are adequate for Mineral Resource and Mineral Reserve estimation and mine planning purposes.

1.8 Data Verification

Newcrest includes both internal verification processes and independent third-parties in the data verification steps:

- Internal verification: laboratory inspections; review of geological procedures, resource models and drill plans; sampling protocols, flow sheets and data storage; specific gravity data; logging consistency, down hole survey, collar coordinate and assay QA/QC data; geology and mineralisation interpretation;
- External verification: review of the 2016 resource model by SRK Consulting (Australasia) Pty Ltd (SRK).

The QP, who relies upon this work, reviewed the reports and is of the opinion that the data verification programs indicate that the data stored in the project database accurately reflect original sources and are adequate to support geological interpretations and Mineral Resource and Mineral Reserve estimation, and in mine planning.

Observations made during the QP's site visits, in conjunction with discussions with site-based technical staff also support the QP's conclusion that Newcrest's processes for geological interpretations, and analytical and database quality are being followed.

Newcrest has implemented a steering committee, the Resources & Reserves Steering Committee to ensure appropriate governance of development and management of resource and reserve estimates, and the public release of those estimates. This is achieved by ensuring regular Resources & Reserves Steering Committee review meetings, internal competent reviews, and independent external competent reviews. The QP's role as the chair of the Resources & Reserves Steering Committee includes review of the estimation processes in place for Mineral Resource and Mineral Reserve estimation, mine planning, and the control procedures in place to ensure the process is being executed as intended.

1.9 Metallurgical Testwork

Laboratories and testwork facilities used during metallurgical evaluation include: Sherritt International Corporation (Sherritt), Metso Minerals Process Technology (Metso), Hazen Research Inc. (Hazen), Pocock Industrial (Pocock), IPRC, Lakefield, E.L. Bateman, Eimco, RESCAN, Alberta Research Council, Dorr-Oliver, Lurgi, Davy McKee, and NSR Environmental.

Metallurgical testwork supporting the original process design included comminution (crushing (impact), rod mill, ball mill, abrasion, MacPherson's semi-autogenous grind (SAG) indices.), flotation, pressure oxidation (POX), and mineralogy.

Overall, samples selected for metallurgical testing during feasibility, development and expansion studies were representative of the various styles of mineralisation within the different mineralised zones. Samples were selected from a range of locations within the deposit zones. Sufficient samples were taken, and tests were performed using sufficient sample mass for the respective tests undertaken.

The plant commenced operations in 1997 at a nominal 2.8 Mt/a. Alterations to the plant have included: installation of heat exchangers, pebble crushing circuit and expansion to a nominal 4.6 Mt/a (2003); an additional grinding and flotation plant upgrade to 6 Mt/a (2007); plant upgrade consisting of primary jaw crushers, grinding circuit (HGO2), additional flotation capacity, additional autoclave (AC4) and oxygen plant, second carbon-in-leach (CIL) circuit, and theoretical capacity increase to 11–12 Mt/a (however, throughput typically was 9–10 Mt/a; 2013); and a change to partial pressure oxidation (2014).

Lithological, alteration and “oretype” models were developed for the Lihir deposit during the exploration and feasibility stages. The oretype model was used as the basis for process operations. In 2015, an “alteration domain” model was constructed, and subsequently refined. The alteration domain model provided improved processing response prediction, particularly for flotation and crushing.

Some limited ore blending is practiced prior to crushing.

Metallurgical assumptions are supported by 22 years of production data.

The average metallurgical recovery for gold over the LOM plan is predicted to be 80.7%. The period where open pit and stockpile material is treated is projected to be about 80.9%. The period at when stockpile material only will be treated is anticipated to have a recovery of approximately 78%. Daily and monthly recovery varies, based on ore grade, the fraction of milled ore sent to flotation, and the amount of stockpiled ore being treated. These values include recovery uplift from projects of 1.2% from the current base.

Naturally fine-grained ores (mostly argillic materials) and clays (from fresh or stockpile ore) can impact on both plant throughput and recovery. For the crushing and materials handling areas, wet and sticky ores are managed through blending and on-going mechanical modifications to conveyors and chutes etc. Once in slurry form, these ores can display high and variable non-Newtonian shear-thinning behaviour, which can impact the milling, flotation, POX and CIL circuits. However, dilution with fresh or sea water has been found to be effective in controlling slurry rheology to date.

The maximum proportion of fines and clays (mainly from argillic ores) that can be treated within the plant is not known with certainty. There is some risk that high proportions of such ore types in plant feed may lead to both lower recovery and throughput, until an adjustment to the mine plan and/or additional plant modifications can be implemented.

There are no penalty elements that are expected to affect doré sales. Deleterious components in the ore such as clays, chloride, copper and carbonate content can affect various aspects of plant operation, but are typically localised and to date, have had only short-term effects.

1.10 Mineral Resource Estimation

The database close-out date for the Mineral Resource estimate is 25 November, 2016. Geological interpretation is supported by core, RC, rotary drilling, in-pit mapping, and grade control (blast hole) sampling data. Only core drill holes are used to support estimation.

Five structural domains and three alteration domains were used in estimation. Domain boundary contacts were defined as either soft, firm, or hard. All core data are composited 12 m downhole; this composite length corresponds to the mining bench height. Outliers are capped such that the tail of the distribution is reasonably contiguous. Cap limits vary by domain and range from 5–30 g/t Au. No capping was applied to sulphide sulphur composites. Block density data were estimated via ordinary kriging (OK), based on alteration domains. Variograms were calculated for gold, sulphide sulphur, arsenic, silver, calcium, carbonate, copper, and molybdenum.

Gold and sulphide sulphur were estimated with the non-linear uniform conditioning (UC) method into large 100 x 100 x 12 m panels in their respective domains. The panel UC grade–tonnage curve was subdivided into 20 x 20 x 12 m selective mining unit blocks for the final output model. Local uniform conditioning (LUC) post-processing from the UC panels was performed. Minor elements (silver, copper, arsenic, carbonate, calcium, and molybdenum) were estimated directly into the selective mining unit blocks using OK.

The block model and informing composites were validated using a combination of visual inspection in plan and section, nearest-neighbour model comparison, swath plots, grade–tonnage curves, and direct block simulation.

Reconciliation based on blasthole sampling is considered to be acceptable, and the results are adequate to provide validation support for the Mineral Resource estimate.

Mineral Resources (other than Mineral Resources within stockpiles) were classified as either Indicated or Inferred Mineral Resources, based on a combination of the estimation slope of regression and the variogram-weighted distance. Mineral Resources are reported within a conceptual open pit shell that used the parameters summarised in Table 1-1. A conceptual deep water coffer dam alignment east of the original shoreline constrains the maximum seaward extent of reasonable mining scenarios for open pit mining. Mineral Resources are reported using a marginal cut-off grade of 1 g/t Au. Mineral Resources contained within stockpiles are classified as Measured as they are derived from grade control models.

1.11 Mineral Resource Statement

Mineral Resources are reported with an effective date of 30 June, 2020 and are reported inclusive of those Mineral Resources converted to Mineral Reserves. Mineral Resources that are not Mineral Reserves do not have demonstrated economic viability. Mineral Resources are tabulated in Table 1-2 and Table 1-3.

The Qualified Person for the estimate is Mr. Kevin Gleeson, FAusIMM, whose job title at Newcrest is Head of Mineral Resource Management. Mr. Gleeson is a Newcrest employee.

Table 1-1: Mineral Resource Constraining Pit Shell Input Parameters

Mining Cost	US$/t ex-pit (average)
Total mining costs	4.31
Processing Cost	**US$/t milled (average)**
Average processing unit cost	25.57
Sustaining capital	5.02
G&A	9.87
Total	***40.46***
Other Parameters	**Value**
Slope angles	10–55°
Whittle calculated metallurgical recoveries	83.8%

Table 1-2: Measured and Indicated Mineral Resource Statement

Confidence Category	Tonnage (Mt)	Grade (g/t Au	Contained Metal (Moz Au)
Measured	81	1.9	5.0
Indicated	520	2.3	39
Total Measured and Indicated	***600***	***2.2***	***44***

Table 1-3: Inferred Mineral Resource Statement

Confidence Category	Tonnage (Mt)	Grade (g/t Au	Contained Metal (Moz Au)
Inferred	67	2.3	4.9

Notes to accompany Mineral Resource tables:

1. Mineral Resources are reported with an effective date of 30 June, 2020 using the 2014 CIM Definition Standards. The Qualified Person responsible for the estimate is Mr. Kevin Gleeson, FAusIMM, whose job title at Newcrest is Head of Mineral Resource Management, and who is a Newcrest employee.
2. Mineral Resources are reported inclusive of those Mineral Resources converted to Mineral Reserves. Mineral Resources that are not Mineral Reserves do not have demonstrated economic viability.
3. The Mineral Resource estimate is reported within a conceptual open pit shell that is based on the following assumptions: gold price of US$1,300/oz, variable pit slope angles that range from 10–55°; metallurgical recovery from Whittle optimisation of 83.8%; mining costs of US$4.31/t, and processing and general and administrative (G&A) costs of $40.46/t.
4. Tonnages are metric tonnes. Gold ounces are estimates of metal contained in tonnages and do not include allowances for processing losses.
5. Rounding as required by reporting guidelines may result in apparent differences between tonnes, grade and contained metal content. Rounding is to two significant figures.

Areas of uncertainty that may materially impact the Mineral Resource estimates include: the lack of stationarity in gold domains; changes to long-term gold price assumptions; changes in local interpretations of mineralisation geometry and continuity of mineralised zones; changes to geological shape and continuity assumptions; changes to metallurgical recovery assumptions; changes to the operating cut-off assumptions for open pit mining methods; changes to the input assumptions used to derive the pit shell used to constrain the estimate; changes to the marginal cut-off grade assumptions used to constrain the estimate; variations in geotechnical, geothermal, hydrogeological and mining assumptions; and changes to environmental, permitting and social license assumptions.

1.12 Mineral Reserve Estimation

Indicated Mineral Resources were converted to Probable Mineral Reserves. Inferred Mineral Resources within the mine plan are reported as waste. The Mineral Reserve estimation assumes 100% mining recovery with no dilution or ore loss.

Mineral Reserves are confined within an optimised open pit shell that assumes the following: a marginal cut-off grade of 1.0 g/t Au; gold price of US$1,200/oz Au; treatment charges/refining charges of US$2.12/oz; 2% royalty and mining levy of 0.5%; mining costs of US$4.31/t mined ex-pit; processing costs of US$25.57/t milled; sustaining capital costs of US$5.02/t milled and general and administrative (G&A) costs of US$9.87/t milled, an average metallurgical recovery of 83.8% used in Whittle optimisation, and pit slope angles that range from approximately 10–55°. The estimate assumes that cold water injection will sufficiently cool rock temperatures to allow mining to progress. This assumption is supported by an internal pre-feasibility-level study and associated trial work.

The final reserves design was based on the revenue factor = 1 (RF1.0) optimum shell. A sequence of seven cutbacks was used to develop the remainder of the reserves ultimate pit. Cutbacks to develop the Kapit sector were created in a lateral sequence from south to north to facilitate pit cooling and drainage, to allow time for overlying stockpile reclaim and processing, and for completion of the Kapit seepage barrier to be constructed between Luise Harbour and the pit crest. Cutback shells were chosen with a sufficient size to allow practical mining and ramp access. Cutback designs conform to the Lihir open pit design procedures, which include use of approved slope parameters, 28 m wide ramps at 10% gradient, and a minimum mining width of 40 m. The planned final dimensions of the pit are approximately 2,000 m by 1,400 m, with a final depth of approximately 300 m below sea level.

As the Lihir Operations are constrained by the ore tonnes that can be processed by the mill, only the higher-grade fraction of ore is processed through the mill while the lower-grade fraction is stored in long-term stockpiles. As a result, a period of low-grade stockpile processing is expected at the end of the mine life when mining operations have been completed.

1.13 Mineral Reserve Statement

Mineral Reserves are reported in Table 1-4 with an effective date of 30 June, 2020. The Qualified Person for the estimate is Mr. Steven Butt, FAusIMM, whose job title at Newcrest is Group Manager – Mining Technical Services. Mr. Butt is a Newcrest employee.

The Mineral Reserves are forward-looking information and actual results may vary.

Table 1-4: Mineral Reserves Statement

Confidence Category	Tonnage (Mt)	Grade (g/t Au)	Contained Metal (Moz Au)
Proven	81	1.9	5.0
Probable	230	2.4	18
Total Proven and Probable	***310***	***2.3***	***23***

Notes to accompany Mineral Reserves table:

1. Mineral Reserves are reported using the 2014 CIM Definition Standards, and have an effective date of 30 June, 2020. The Qualified Person for the estimate is Mr. Steven Butt, FAusIMM, whose job title at Newcrest is Group Manager – Mining Technical Services, and who is a Newcrest employee.
2. The Mineral Reserve estimate is reported based on the following assumptions: open pit mining method; gold price of US$1,200/oz, open pit mining method, 2% royalty, 0.5% mining levy, treatment and refining charges of US$2.12/oz; variable pit slope angles (inter-ramp) that range from 10º to 55º; metallurgical recovery applied in Whittle optimisation of 83.8%, and output life-of-mine average modelled metallurgical recovery of 80.7%; dilution and mining recovery of 0 and 100% respectively; average stripping ratio of 1.9:1 (waste:ore); mining costs of US$4.31/t mined; processing costs of US$25.57/t milled, sustaining capital costs of US$5.02/t milled, and general and administrative costs of US$9.87/t milled.
3. Tonnages are metric tonnes. Gold ounces are estimates of metal contained in tonnages and do not include allowances for processing losses.
4. Rounding as required by reporting guidelines may result in apparent differences between tonnes, grade and contained metal content. Rounding is to two significant figures.

Areas of uncertainty that may materially impact the Mineral Reserve estimates include: changes to long-term gold price assumptions; changes to exchange rate assumptions; changes to the resource model or changes in the model reconciliation performance including operational mining losses; changes to geometallurgical recovery and throughput assumptions; changes to the input assumptions used to generate the open pit design; changes to operating, and capital assumptions used, including changes to input cost assumptions such as consumables, labour costs, royalty and taxation rates; variations in geotechnical and mining assumptions; including changes to designs, schedules, and costs, changes to geotechnical, hydrogeological, geothermal and engineering data used; changes to assumptions as to pit cooling and seepage barrier development and operation; ability to source sufficient quality water supplies to support process plant operations; changes to the assumed permitting and regulatory environment under which the mine plan was developed; continued ability to use sub-sea waste and tailings disposal methods; ability to maintain mining permits and/or surface rights; and the ability to maintain social and environmental license to operate.

Newcrest is currently undertaking a range of studies (collectively referred to internally by Newcrest as the "Lihir mine optimisation study") that are reviewing mining rates, waste disposal options, stockpile feed sequences, processing assumptions including material blend constraints, and the relationship to the planned ex-pit mining sequence. This could include an upper mill feed limit or additional penalties on argillic and or stockpile feed that may impact on mine schedule and or recovery assumptions. The current Mineral Reserve estimate does not include a mill feed constraint on proportions of argillic and or stockpile feed. As with all forward study work there is risk that the future outcomes of these studies could result in changes to costs, schedule, mining rate, equipment requirements, reclassification of the confidence category assigned to some or all of the stockpiled material, and ultimately the Mineral Reserve estimate. The studies are partly dependent on the outcomes of the major studies projects listed in Section 1.19.

1.14 Mining Methods

Production mining is conducted by Newcrest using Owner-operated equipment fleet and an Owner workforce. A separate mining contractor uses a smaller pioneering fleet to develop new working areas on the steep caldera slopes.

Production mining is by conventional open pit methods, using a fleet of 500 t class (operating weight) hydraulic face shovels loading into 135 t capacity rear-dump haul trucks, with a recently demonstrated mining rate of 33 Mt/a ex-pit. Ore and waste are drilled and blasted on 12 m benches and mined in a single pass. Where practicable, walls are drilled with a pre-split to assure stable wall rock conditions. The ground is frequently too hot for conventional explosives, requiring high-temperature blasting products and specialised blasting procedures for mining in hot ground.

A majority of ex-pit ore is allocated by gold and sulphur grade into a blend plan agreed with process plant staff along with existing stockpiled ore. Mill feed is based on the blend plan and can be comprised of reclaimed ore from the ROM stockpiles, direct ex-pit ore and existing stockpile ore.

Waste rock from the mine is either placed into 1,500 t capacity barges for off-shore submarine disposal or stockpiled for use as road base, bench sheeting, stemming or construction fill. Submarine waste disposal is carefully planned and controlled to achieve a continuous rill along the steeply-sloping sea floor and minimise the potential for uncontrolled slumping.

Pit slope designs were developed in conjunction with recommendations from external consultants. Slope performance is continuously monitored and reviewed, with local adjustments to slope designs made where necessary. Slope parameters are incorporated into a set of contiguous slope domain solids which cover the extents of the resource model framework. Each domain solid is assigned an appropriate inter-ramp angle (IRA) and batter and berm configurations for pit design work. IRAs vary from 10–55° with batter angles varying from 25–70°.

The Lihir Operations receive on average 4.4 m of annual rainfall, and have extensive groundwater volumes, both of which are managed through a pit dewatering program and surface water management facilities incorporated into pit designs.

The Luise Caldera is still geothermally active, with temperature modelling indicating current rock temperatures in some areas within the ultimate pit design exceeding 100°C. The active zone is extensive within the Kapit area. Geothermal depressurisation for Kapit area has been underway since 2004, using a program of steam relief and monitoring wells. Temperature modelling and pressure trends to date indicate that depressurisation alone will ultimately be insufficient in some locations to allow mining to proceed in accordance with current life-of-mine plans. From 2017–2019, progressive trials and studies were completed to test the practicality and effectiveness of cold-water injection as a means of actively reducing rock temperatures in targeted areas in advance of mining. The work to date has demonstrated the practicalities of construction, measured the rate of cooling and costs associated with cold water injection to a pre-feasibility level of study. This work supports that the cold-water injection project can cool mining areas to below 150ºC as required in the mine plan as input to the Mineral Reserve estimate.

Current operational technology allows mining of hot ground with temperatures up to 130ºC, after which the bulk explosive formulation required for production blasting becomes a constraint. A procedure is used to control all mining activities in areas identified as containing potential borehole geysering or geothermal outburst areas. Additional projects and trials to mitigate the risk to mining activities in hot ground, and to extend successful blasting and mining of ground with temperatures of 130–150ºC are under evaluation.

Development of the Kapit area of the open pit will require development of a seepage barrier between Luise Harbour and the pit crest to prevent seawater ingress into the open pit. The seepage barrier will be a significant structure, and will be engineered to cope with earthquake and tsunami events. It will also require the concurrent processing and/or relocation of the Kapit Flat low-grade stockpile, currently situated on top of the Kapit deposit sector; pre-stripping/development of >200 Mt of overlying argillic clay waste rock; construction of a perimeter drainage channel around Kapit to divert rainfall run-off from the caldera slopes around the pit footprint; and geothermal cooling and depressurisation of the Kapit zone to a temperature at which mining can be safely undertaken.

An elevated cut-off strategy is employed where only high- and medium-grade material is fed to the mill, while the lower-grade fraction is stockpiled for later processing. An average of approximately 30% of ore mined is sent to long-term low-grade stockpiles. High-grade ore (typically >3 g/t Au) and medium-grade ore (2–3 g/t Au) is generally prioritised to the plant first, while stockpile feed is used to achieve the required feed quantity, and where practicable, blend properties of ore type and sulphur grade. The planned cut-off between medium-grade and low-grade material can be adjusted if needed, depending on ore supply and phase development.

Material above the marginal cut-off grade of 1 g/t Au is stored in long-term stockpiles for processing progressively over the LOM. The marginal cut-off grade assumes a reduction in sustaining capital and G&A costs at the end of mine life, allowing marginal material to be economically processed. Over the life of the mine it is expected that up to 80–90 Mt of low-grade material will be stockpiled, progressively reclaimed as mill feed during the mining period as required and to be fed to the plant after the end of the active mining operation. Only 40–50 Mt of stockpiling capacity is available outside the ultimate pit footprint at the Kapit North stockpile. In-pit stockpiling accommodates the balance, and will be reclaimed during development of the final cutback.

On average approximately 40 Mt/a of material is planned for mining ex-pit with approximately 20–25 Mt/a of additional movement required for stockpile reclaim, ore blending for mill feed purposes, and rehandle movements. The remaining ex-pit LOM strip ratio is approximately 1.9:1 (waste:ore). Environmental and difficult operational conditions in soft argillic mining domains can impact mining rates, and there is some risk that the mining rates may not be achieved as planned.

Newcrest is currently undertaking the Lihir mine optimisation study, a collection of studies that are reviewing mining rate, waste disposal options, stockpile feed sequence, processing assumptions including material blend constraints and the relationship to the planned ex-pit mining sequence. This could include an upper mill feed limit or additional penalties on argillic and or stockpile feed that may impact on mine schedule and or recovery assumptions. The current mine schedule does not include a mill feed constraint on proportions of argillic and or stockpile feed. As with all forward study work there is risk that the future outcomes of these studies could result in changes to the production schedule, mining rate, and/or equipment requirements.

The other key drivers of the LOM schedule include the lead time on construction of the Kapit seepage barrier, the removal and concurrent feeding of the existing Kapit Flat stockpiles, the effectiveness of pit cooling and hot ground mining techniques, and ultimately the throughput capacity of the process plant. The forecast completion date for the mining operation is FY38, and the forecast completion date for the processing operation is FY41, giving a mine life of 18 years, and a process life of 21 years, with the last year a partial year.

1.15 Recovery Methods

As the gold mineralisation is refractory, the process plant consists of crushing and grinding followed by partial flotation, pressure oxidation, and recovery of gold from washed oxidised slurry using conventional cyanidation.

The plant currently has a nameplate capacity of 15 Mt/a, and has undergone a number of alterations and expansions since first commissioning in 1997.

The Lihir Operations have changed from a “full oxidation” treatment plant to a partial oxidation plant. The current operating strategy, termed the “Lihir operating strategy” or LOS, exploits the benefits of partial oxidation to maximise gold production rates. The LOS is a self-correcting system. If a feed is presented to the autoclave that is too low in sulphide sulphur, then the autoclaves will slow down to maintain front-end temperatures; hence, forcing more ore to flotation which increases sulphur grade, allowing increased throughput, and reaching a new operating equilibrium. The LOS maximises and optimises the gold production rate at all times irrespective of equipment downtime or ore type (within reason) and reflects a flowsheet with a wide operating window. In normal operation there is significantly more milling capacity than autoclave capacity. As a result, a substantial amount of ore is typically sent to flotation to match autoclave throughput.

The plant has two primary crushing circuits. The crushing equipment includes a gyratory crusher and toothed MMD rolls crusher in one circuit and two jaw crushers operating in parallel in the second circuit.

There are three grinding circuits. One circuit (HGO2) generally treats high-grade ore that is fed direct to the downstream oxidising autoclaves. The second and third circuits (FGO circuit and HGO circuit) are generally directed to the flotation plants. All three circuits can be directed to flotation as necessary and all three circuits can go “direct” to the autoclaves as necessary. All three grinding circuits have a primary semi-autogenous grinding (SAG) mill, followed by a secondary ball mill in closed circuit with classifying hydro-cyclones. Pebbles from the HGO and HGO2 circuits are combined and directed to two cone pebble crushers. Crushed pebbles are directed back to the HGO circuit via the crushed ore stockpile.

Two rougher flotation circuits are installed. No “cleaning” of concentrate is practiced. The first circuit uses simple bulk rougher flotation in a single roughing stage using a bank of five 150 m^3 flotation tank cells. The second, newer circuit has five 300 m^3 flotation tank cells.

Some limited gold recovery from flotation tailings occurs. Flotation tailings from effectively two of the three milling circuits are directed to two separate hydro-cyclone clusters, where separation based on size is completed. The fines are recovered at a cut-size of 40 µm and sent to a re-purposed thickener. After thickening to approximately 30–40% solids they are then pumped to the autoclave discharge tanks, effectively by-passing the autoclaves. About 45% of the mass in the flotation tailings stream is recovered as fines and gold can be recovered by direct cyanidation at 60–75% recovery. Hydro-cyclone underflow coarse solids are directed to tailings for disposal. The currently installed counter-current-decantation circuit capacity prohibits full exploitation of this process; however, on average, the circuit operates at least 50% of the time.

Thickened ore slurry, which is a mixture of flotation concentrate and whole ore, is pumped to four parallel autoclave circuits via six slurry storage tanks. This buffer between the milling and autoclave circuits help stabilise autoclave operations. Feed slurry can be first preheated in heat recovery vessels before being pumped under pressure to each of the eight agitator horizontal autoclave vessels. If sulphide sulphur grades are high enough, operation without pre-heating is often practiced. Three operating cryogenic oxygen plants provide oxygen to the autoclaves. Autoclave temperature is controlled via the addition of fresh water.

Oxidised slurry (with some fine flotation tailings) passes through two trains of a two-stage counter-current decantation (CCD) circuit, where it is washed with process water and seawater, and neutralised with lime. Gold is recovered from the neutralised slurry by cyanide leaching using conventional CIL technology in a series of agitated tanks. Loaded carbon from the CIL circuit is stripped of gold in an elution system. The resulting gold solution is circulated through electro-winning cells where gold is recovered through electrowinning to form a gold sludge. The sludge is dried and then smelted to produce doré bars which are shipped to a refinery.

The CIL leach residue tailings are detoxified by formation of strong metal complexes such as ferrocyanide, and through dilution with seawater (oxygen plant cooling water return). The tailings gravitate to a common disposal system which also collects the flotation tailings; remaining CCD wash water as well as oxygen plant and power plant cooling water return streams. The tailings disposal method is by deep sea tailings placement (DSTP). The combined stream flow discharges through a de-aeration tank to the ocean via a pipeline outfall at a depth of 125 m below sea level. The depth of the outfall discharge is below the surface mixing layer of the ocean. Being denser than the receiving seawater, the tailings gravitate down the steep submarine slope.

The average power demand from the process plant is 115–126 MW/a. This is met by a combination of heavy fuel oil (HFO) and geothermal sources.

The processing plant uses a combination of seawater, untreated fresh water and various treated water streams. Seawater is used for cooling the oxygen production plants and power station, quenching and scrubbing in the pressure oxidation areas, and in the post-oxidation CCD circuit. The plant currently uses about 21,000 m^3/hr of seawater. Untreated fresh water is mainly used in the milling circuits and in the grinding thickeners for washing the ground ore and control of ore chloride concentrations. Some fresh water is provided from rainfall collection on site. Most of the fresh water is drawn from a small weir on the Londolovit River, situated approximately 8.4 km north of the process plant, and pumped via pipeline to the plant raw water storage tank. The maximum permitted extraction rate from the Londolovit River is 3,168,000 m^3 per month or 32,016,000 m^3/a (in accordance with the existing Environment Permit WEL3(143) and the Lower Londolovit River Management Plan). During 2020 the average water demand for ore processing is approximately 2,600,000 m^3 per month Newcrest has developed and implemented a water conservation strategy to support operations during low rainfall periods. This includes minimising non-essential usage, maximising use of seawater throughout the process plant and maintaining a minimum base flow in the Londolovit River.

Key processing reagents are oxygen (generated on site), lime and cyanide. Grinding media are also required. Other minor reagents are for flotation (collector and frother) and flocculent for thickening.

1.16 Project Infrastructure

Roads connect the mining operation with the village of Put Put, the accommodation centre at Londolovit, and the airstrip at Kunaye. Haul roads run between the crushing facilities and ROM stockpiles, the barge-loading dock in Luise Harbour, and the low-grade stockpiles. A wharf was constructed at Put Put for general cargo ships and tankers.

Mine facilities, including ROM stockpiles, crushing facilities, and mine support facilities, are located in the Ladolam Creek valley, immediately to the east of the ultimate pit boundary. An explosive magazine is located to the west of the ultimate pit boundary. The processing plant is on the northwestern side of Put Put Point on relatively flat land adjacent to the shoreline and on the gentler lower slopes of the eastern end of the Luise Caldera. Support buildings include a main office, laboratory, training building, warehouses, plant workshop, and an emergency and security services building. Facilities for handling and transport of the various fuels, reagents, and consumables required by the processing plant are located near the general ship berth and the processing plant. Port facilities are installed to service oil tankers, general cargo ships, passenger ferries and work boats.

Infrastructure for the workforce includes housing and camp accommodation, and related community facilities such as a school, medical centre, supermarkets, an open market and a police station, as well as associated messing and recreation facilities, and plants for water and sewerage treatment. The Londolovit accommodation centres provide housing for senior staff living on site and a number of government employees. Single persons' quarters are provided for commuting personnel.

Power is produced at site by a combination of heavy fuel oil (HFO) reciprocating engines and geothermal steam turbines. The existing total mine site power demand is around 115–126 MW, when all equipment is at full capacity (peak usage). Geothermal power provides an average of 13 MW, and the balance is derived from the HFO-fired generators. The HFO power supply consists of twelve 6.3 MW units, and ten 8.8 MW units. Geothermal supply consists of five turbines feeding from 10 production wells. The system is constrained by suitable steam availability. Geothermal power is forecast to decline in the medium term as a result of mining impacting producing wells, seepage barrier construction and the gradual depletion of the heat reservoir. The mine plan allows capital for replacement of geothermal power with HFO-generated power aligned with the forecast ramp down.

Communications at the site, across the island and within the PNG mainland and overseas are provided through the national telephone network carrier and internet access for the operation is provided via a dedicated satellite link.

1.17 Environmental, Permitting and Social Considerations

1.17.1 Introduction

Baseline studies were completed in support of permitting and operations in the period from 1988–1992. Additional studies were conducted to support the Production Improvement Program Environmental Impact Statement (completed in 2005) and the Million Ounce Plant Upgrade Project Environmental Impact Statement (completed in 2009).

Mine development and operations commenced in 1997 in accordance with the agreed development plans stipulated in the Approved Proposal for Development, which forms the basis of the Mining Development Contract (MDC) and the subsequently issued SML6. The original Environmental Plan associated with mine development was completed in 1995 and approved by the PNG Environment Minister.

The *Water Resources Act* and associated environmental legislations that governed various water use permits in 1997 were repealed and amalgamated under the *Environment Act 2000*. Under the *Environment Act 2000* there are environmental permits for waste discharge and water extraction. Two environmental impact statements (EISs) were prepared under the Environment Act 2000, namely the 2005 Production Improvement Program EIS and the 2009 Million Ounce Plant Upgrade EIS.

Newcrest completed a major plant upgrade in 2013, which did not require any change to the then-current rate of mining or to the extent of the pit footprint. Instead, additional ore processing was made possible by increasing the rate of processing for stockpiled low-grade ore and increases to tailing disposal. The EIS for this expansion was submitted to the PNG Department of Environment and Conservation (DEC) and ultimately approved by the Environment Minister in February 2011. The existing discharge and abstraction permits were updated in March 2012.

A regulatory-approved Environmental Management and Monitoring Plan is used to manage and monitor the predicted environmental impacts associated with the Project, which is updated every four years for review and endorsement by the PNG Conservation and Environment Protection Authority (CEPA; formerly DEC). The current version of the EMMP for the Lihir Operations for the period 2019 to 2022, was approved by CEPA in December 2018. In addition, an annual environmental report is prepared and submitted to CEPA. Newcrest has an operating environmental management system (EMS).

1.17.2 Environmental Considerations

Newcrest maintains a central compliance system for all sites, including the Lihir Operations, to report environmental incidents, notifications, investigations, tracking of actions, reporting, inspections and track action completion.

Newcrest conducts additional reviews, research and monitoring in-house or with external specialists and consultants and independent experts to examine company activities that have a potential risk of impacting the environment. Newcrest's applied research and management plans aim to develop a better understanding of the surrounding environment in which the mine operates and to provide plans to minimise the impacts associated with mining activities.

1.17.3 Stockpile and Waste Management

All stockpiles, except Kapit North, are within the planned final pit boundary, and will need to be consumed or relocated to allow final pit development. Stockpiles other than Kapit North are all scheduled to be reclaimed over the next eight years. It is planned to use the Phase 9 pit void for low-grade stockpiling to meet LOM plan requirements. There is acid and metalliferous drainage (AMD) generated from storage of ore stockpiles prior to processing. This requires management of runoff and drainage to ensure discharges comply with the requirements of the site's Environment Permits. Newcrest is currently conducting studies to assess appropriate means of treating, mitigating and/or managing AMD as the basis for an amendment to the Environment Permit for Waste Discharge.

Waste rock from the mine is either transferred into 1,500 t capacity barges for off-shore submarine disposal within the boundaries of the Special Mining Lease, or stockpiled for use as road base, bench sheeting, stemming or construction fill. Submarine waste disposal is carefully planned and controlled to achieve a continuous rill along the steeply-sloping sea floor and minimise the potential for uncontrolled slumping. Alternate deposition strategies are under review.

Tailings are disposed using a DSTP methodology. The DSTP was selected as the preferred tailings management option from an environmental and social point of view because the Lihir Operations have limited space for terrestrial tailings storage and the mine is located in a seismically active region. Baseline studies were completed prior to the approval by PNG environmental authorities and commencement of the DSTP. Process tailings consist of a dilute mixture of treated mineralised material and seawater from the cooling water systems and are discharged through the DSTP system at a depth of approximately 125 m within the boundaries of the Special Mining Lease. Given that the waste rock and tailing materials contain sulphide minerals (including pyrite), submerging these materials prevents oxidation and potential AMD generation.

Ongoing monitoring of DSTP is conducted under a regulatory-approved Environmental Management and Monitoring Plan (EMMP). Detailed seabed and tailings footprint surveys are regularly conducted as per EMMP requirements; these surveys include seabed bathymetry, ocean water quality, seabed physio-chemical characterisation, and abundance of deep-sea marine fauna. There have been no significant operational, compliance, environmental or social issues related to the operation of the DSTP system since Newcrest's acquisition of Lihir Gold in 2010.

1.17.4 Water Management and Supply

The rugged topography, steep stream gradients and high earthquake risk on Aniolam Island mean that there are few locations suitable for cost effective construction of large volume water storages. Furthermore, those locations most amenable to large dam construction are also those most suitable for human habitation, and have the greatest population density and resource value to the local community. As a consequence, development of water supply yield on the island is necessarily focused on run-of-river and/or groundwater resources.

The operational water demand is currently met by a combination of raw water from a weir constructed on the Londolovit River, caldera extraction via the Kapit spring and seawater supplement. Fresh water from pit diversion can also be substituted into the process plant supply.

Prolonged drought conditions are a risk to continued plant operations due to the lack of water. Sea water substitution measures can be implemented in the plant under major drought conditions and can mitigate a portion, but not all, of the drought-related effects on production.

Pit perimeter diversion drains are installed to intercept as much surface runoff as possible from the Luise Caldera, which is diverted around the mining operation and into the ocean. Remaining surface runoff, groundwater seepage and rainfall is collected by drainage berms incorporated into pit designs and directed into sumps. Water is then pumped by in-pit dewatering pumps to external holding dams before ocean discharge.

1.17.5 Seepage Barrier

Optimisation studies on the mine plan indicated that inner harbour infill, in combination with a cut-off wall, could provide a dual seepage barrier to reduce seepage into the Lihir open pit and provide protection to the planned Kapit pit phase from inflow during earthquake and/or tsunami events.

1.17.6 Closure and Reclamation Planning

In compliance with regulatory requirements, Lihir Gold commissioned a conceptual mine closure plan in 1995, which was submitted to the PNG government, and which has been periodically updated. A detailed Mine Rehabilitation and Mine Closure Plan is required to be submitted to the regulator a minimum of two years prior to the planned cessation of operations.

A mine closure risk assessment to guide future updates to the closure plan was completed in 2018. An estimate for anticipated expenditure to be made on restoration and rehabilitation to be undertaken after mine closure is internally reviewed and externally audited each year.

The Lihir Operations currently has a bond in place with MRA for PGK111,000. A 2016 conceptual closure cost assumption of approximately US$89 M was used in the cash flow analysis that supports the 30 June, 2020 Mineral Reserve estimate. Newcrest expects that as a result of the 2019 introduction of the Mining Project Rehabilitation and Closure Guidelines, a review of bonding and financial assurance payable will be undertaken to determine what Newcrest's financial assurance will be to cover the existing and proposed disturbances. It is expected that the revised provision will be higher than current assumptions; however, due to the nature and end of life timing of this cost, it is not considered material to the Mineral Reserve.

1.17.7 Permitting Considerations

Newcrest currently holds all key permits in support of current operations. Permit renewals are applied for where required. Amendments to currently granted Environment Permits are submitted as required and where operational changes trigger a formal amendment process under the *Environment Act 2000* and associated regulations.

Additional permits will be required for the seepage barrier (requires sign off by the Chief Inspector of Mines pursuant to the *Mining (Safety) Act 1977*), the HFO power generation infrastructure to replace geothermal ramp down (permitting through CEPA and MRA), and installation of any additional processing tertiary grinding and flotation capacity. The process to obtain the additional permits has commenced for the majority of these projects. Depending on outcomes of current studies into AMD management and alternate waste rock deposition strategies, future permit changes may be required.

The Lihir Operations are conducted in accordance with the development plans stipulated in the MDC and the accompanying Approved Proposal for Development (APFD) signed between the State and Lihir Gold in 1995. The MDC and APFD provide details of the conditions and implementation of the Project's approved environmental, financial, business, training/localisation, land-owner agreements and infrastructure plans.

The operations have an approved Environmental Plan also known as the Environmental Management and Monitoring Program (EMMP). The EMMP lists the various monitoring requirements, which arose from the identification of key environmental issues documented in the Environmental Plan and subsequent EIS documents.

1.17.8 Social Considerations

Newcrest's ongoing commitment to sustainable development on Aniolam Island is encapsulated in its 2019 Community and Environment Policy.

Commitments to the local community around compensation and community development are embodied in an Integrated Benefits Package Revised Agreement signed in 2007, which incorporates the Lihir Sustainable Development Plan. As at 31 August 2020, the terms of the suite of agreements that are to replace the 2007 Integrated Benefits Package Revised Agreement have been agreed and the final draft agreements have been reviewed by the affected landholder groups and submitted to the Mineral Resources Authority for confirmation of regulatory compliance. On receipt of confirmation of regulatory compliance, the agreements will be executed and form the basis of future compensation and community development activities.

The Lihir Sustainable Development Plan is the overall implementation plan and provides a framework for future development initiatives to be aligned and focused over the life of the project.

Newcrest has in place a Social Impact Monitoring Program through which the company monitors social issues related to the mine and uses the reports to develop mitigation strategies in consultation with the local community.

A Cultural Heritage Management Plan was developed during 2018, and adopted by Newcrest in 2019.

Newcrest has established generally good working relationships with local communities and although occasional disputes do occur, they are relatively minor in nature. The last disputes that resulted in brief disruptions to operations occurred in 2014–2015.

1.18 Markets and Contracts

No market studies have been conducted in support of this Report. Gold is a freely-traded commodity with spot pricing readily available, and the Lihir Operations consist of an operating mine with refining contracts in place.

The Lihir Operations produce gold doré bars, which are securely transported to a refinery. A number of refineries within the Asia-Pacific region have the capacity to refine doré; the West Australian Mint refinery in Perth is currently the preferred refinery.

Metal price assumptions are provided by Newcrest management. Newcrest considers analyst and broker price predictions, and price projections used by peers as inputs when preparing the management pricing forecasts.

There are currently eight major contracts in place to support the Lihir Operations. These contracts cover items such as refining, security transport, data management and invoicing, mining contracts, sea freight, catering and accommodations support, air transport, and labour hire. Contracts are negotiated and renewed as needed. Contract terms are in line with industry norms, and typical of similar contracts in Papua New Guinea that Newcrest is familiar with.

1.19 Capital Cost Estimates

Cost estimates were prepared as part of the Lihir Operations FY20 LOM plan supporting Mineral Reserves for the Lihir deposit.

The LOM plan assumes owner-operated ex-pit mining activities supported by specialist contractors primarily in pioneering and blasting. Ex-pit mining continues partway through FY38 when there is a transition to processing only low-grade stockpile material through to FY41.

As the Lihir Operations consist of an operating mine, the majority of costs are based on current period budget-level detailed forecasts, adjusted for Newcrest's long-term economic parameters inclusive of key consumables price forecasts. The cost estimates for major projects required to mine the Mineral Reserves include costs based on the latest study outcomes for these projects.

Newcrest's internal study guidelines require project scope definition for a feasibility study to have an accuracy level of ±15%. Pre-feasibility studies must have a project scope definition accuracy level of ±25%. The capital and operating cost estimates in this section are at a minimum at pre-feasibility accuracy levels (±25%).

As the Lihir Operations are a steady-state operation, sustaining capital costs largely comprise site infrastructure upkeep and mobile equipment replacement costs. An allowance for miscellaneous equipment, small projects, and other minor capital costs has been included for mining, processing, and site general. The sustaining capital cost estimate is based on current budget level costs, combined with recent average sustaining capital expenditure. Sustaining capital costs total $1,834 M (Table 1-5).

Table 1-5: Sustaining Capital Cost Estimate

Sustaining Capital Description	Average Sustaining Capital Cost (US$M/a)	Sustaining Capital Cost (US$M)
Mining	28	530
Processing	42	877
Infrastructure (power and utilities)	11	237
General and administrative	9	191
Totals	***90***	***1,834***

Provision has been made in the capital estimate for a number of major studies required to support LOM plan assumptions. These include: seepage barrier; pit cooling; front-end recovery; power generation; and high voltage upgrade. The non-sustaining capital cost estimate for major projects contemplated in the Mineral Reserves estimate was developed in accordance with Newcrest standards and guidelines. Non-sustaining capital costs total $1,172 M.

Capital costs will total US$3,006 M over the anticipated LOM.

1.20 Operating Cost Estimates

The operating costs used in the financial model were derived from a variety of sources. The mining costs were derived from a purpose-built, activity-based cost model, while ore treatment and G&A costs were based on budgeted numbers adjusted for Newcrest's long-term consumable price forecasts.

Costs based on budgeted activity were factored to match LOM activity levels for estimated fixed/variable components for existing assets and a bottom-up build for new infrastructure or activities.

All operating costs are presented in US$, and reflect 2019 market terms. Inputs in currencies other than US$ were converted at exchange rates as per Newcrest's economic parameters. A summary of the projected operating costs is included as Table 1-6.

1.21 Economic Analysis

Newcrest is using the provision for producing issuers, whereby producing issuers may exclude the information required under Item 22 for technical reports on properties currently in production and where no material production expansion is planned.

Mineral Reserve declaration for the Lihir Operations is supported by a positive cash flow.

Table 1-6: Operating Cost Estimate

Cost Area	Units	Value
Mining cost	US$/t ore milled	9.76
Ore treatment	US$/t ore milled	23.48
G&A	US$/t ore milled	9.59
Site costs	***US$/t ore milled***	***42.83***

1.22 Risks and Opportunities

1.22.1 Project

The Lihir Operations are located in a volcanic amphitheatre, in a seismically-active area, and mining is conducted at elevations below sea level. Earthquake, tsunami and landslide events have been recorded at the site. Slope failures have occurred historically, including a major failure of the caldera wall in the Kapit area in 2005. There is a risk to the operations should the area be subject to a large magnitude earthquake. Sea surges can also pose a risk to operations.

The Luise Caldera is still geothermally active. Areas with rock temperatures greater than 100ºC can cause groundwater to instantaneously flash to steam when containing pressure is released by mining, with the potential for rock outburst events to occur. Mining methods have to accommodate the potential for geothermal outburst areas and use careful blast management practices.

The planned Kapit sector mining will require a seepage barrier, removal of the low-grade stockpile, significant waste stripping, and a strategy to deal with hot ground. There is a risk to the mine plan if depressurisation and geothermal cooling measures are not sufficient in some locations to allow mining at forecast rates. There is also a risk to the LOM plan if the seepage barrier cannot be permitted as envisaged.

The current mine plan includes an ex-pit mining rate ramp-up from the recently-demonstrated 33 Mt/a capability to approximately 40 Mt/a. Environmental and difficult operational conditions in soft argillic mining domains can impact mining rates, and there is a risk that the mining rates may not be achieved as planned.

Newcrest is currently undertaking the Lihir mine optimisation study, a range of studies that are reviewing the mining rate, waste disposal options, stockpile feed sequence, processing assumptions including material blend constraints and the relationship to the planned ex-pit mining sequence. This could include an upper mill feed limit or additional penalties on argillic and or stockpile feed that may impact on mine schedule and or recovery assumptions. The current Mineral Reserve estimate does not include a mill feed constraint on proportions of argillic and or stockpile feed. As with all forward study work, there is risk that the future outcomes of these studies could result in changes to costs, schedule, mining rate, equipment requirements, reclassification of the confidence category assigned to some or all of the stockpiled material, and ultimately the Mineral Reserve estimate. The studies are partly dependent on the outcomes of the major studies projects listed in Section 1.19.

Naturally fine-grained ores (mostly argillic material) and clays (from fresh or stockpile ore) can impact on both plant throughput and metallurgical recovery. For the crushing and materials handling areas, wet and sticky ores are managed through blending and on-going mechanical modifications to conveyors and chutes etc. Once in slurry form, these ores can display high and variable non-Newtonian shear-thinning behaviour, which can impact the milling, flotation, POX and CIL circuits. However, dilution with fresh or sea water has been found effective in controlling slurry rheology to date.

The maximum proportion of fines and clays (mainly from argillic ores) that can be treated within the plant is not known with certainty. There are several types of clay minerals with varying impact on plant performance. There is some risk that high proportions of such ore types in plant feed may lead to both lower recovery and throughput, until an adjustment to the mine plan and/or additional plant modifications can be implemented.

Prolonged drought conditions are a risk to continued plant operations due to the lack of water. Sea water substitution measures can be implemented in the plant under major drought conditions and can mitigate a portion, but not all, of the drought-related effects on production. Water security remains a risk to operations.

The Lihir Operations dispose of waste and tailings using sub-sea disposal methods. There is no ready alternative to DSTP, due to the heavy rainfall typically experienced on Aniolam Island, the lack of suitable area for a tailings storage facility, and the high seismicity of the region.

Equipment and infrastructure mechanical failures and fires are operational risks.

Although the mine maintains good stakeholder relations, social unrest is a risk to continued operations.

These risks are managed on a day to day basis by the Lihir Operations with regular reviews and audits to ensure compliance to the process as well as to ensure risks that have diminished are removed and new and emerging risks are placed onto the register.

1.22.2 In-Country

Mining and exploration tenure are subject to renewal. There can be no certainty that renewals will be granted, including in a timely manner. Similarly, there can be no assurance that Newcrest will be able to successfully convert exploration tenure into mining tenure to support future mining operations, or successfully maintain its exploration and mining interests and deliver development projects.

Although Newcrest to date has been able to negotiate commercially reasonable and acceptable arrangements with native title claimants or land owners where it operates, there can be no assurance that claims will not be lodged in the future, including upon expiry of current mining leases, which may impact Newcrest’s ability to effectively operate in relevant geographic areas.

Disagreements between national and regional governments in Papua New Guinea have historically created an uncertain business environment for Newcrest and may increase its costs of business. Such disagreements may resurface in the future and could adversely affect Newcrest’s operations in Papua New Guinea.

The State is undertaking a broad review of mining laws, with potential reforms extending the level of local equity participation in projects; more stringent requirements for local participation in mining-related businesses, local mineral smelting and processing; and implementing broader changes to the regulatory regime for mining and related activities. There can be no certainty as to what changes, if any, will be made to the *Papua New Guinea Mining Act 1992* under the current or future governments. Material changes to the *Papua New Guinea Mining Act 1992* may have a material adverse impact on Newcrest's ability to own or operate its respective properties and to conduct its business in PNG.

The State is also working on a set of new policies concerning geothermal energy, mine closure, sustainability, biodiversity offsets, carbon offsets, offshore mining and resettlement. Policies under consideration that, if adopted, may adversely affect Newcrest's PNG operations include introduction of royalty payments for geothermal energy, increasing the State's entitlement to acquire equity in new mines, restriction on FIFO operations, a limit on the number of exploration licenses that can be held by one party, local smelting and processing requirements, mine closure planning and funding obligations, and other changes to the regulatory regime for mining and related activities.

1.23 Interpretation and Conclusions

Under the assumptions in this Report, the Project shows a positive cash flow over the life-of-mine and support Mineral Reserves. The mine plan is achievable under the set of assumptions and parameters used.

1.24 Recommendations

The Lihir Operations have a long operational history. Material engineering studies and exploration programs have largely concluded. As a result, the QPs are not able to provide meaningful recommendations.

2 INTRODUCTION

2.1 Introduction

Mr. Kevin Gleeson, Mr. Steven Butt, Mr. John O'Callaghan and Mr. Craig Jones prepared this Technical Report (the Report) for Newcrest Mining Limited (Newcrest) on the Lihir Operations (Lihir Operations or the Project) in Papua New Guinea (PNG). The Project location is shown in Figure 2-1. The host island, Aniolam Island, is also known as Niolam Island and Lihir Island, and is the largest of five islands that make up the Lihir Island group (Mali, Mahur, Masehet, Sanambiet and Aniolam).

The Lihir Project is 100% owned by Newcrest's wholly-owned subsidiary, Lihir Gold Limited (Lihir Gold).

Mineral Resources and Mineral Reserves are estimated for the Lihir deposit. The operations consist of the active Lihir open pit.

2.2 Terms of Reference

This Report supports disclosure of Mineral Resource and Mineral Reserve estimates in Newcrest's 2020 Annual Information Form.

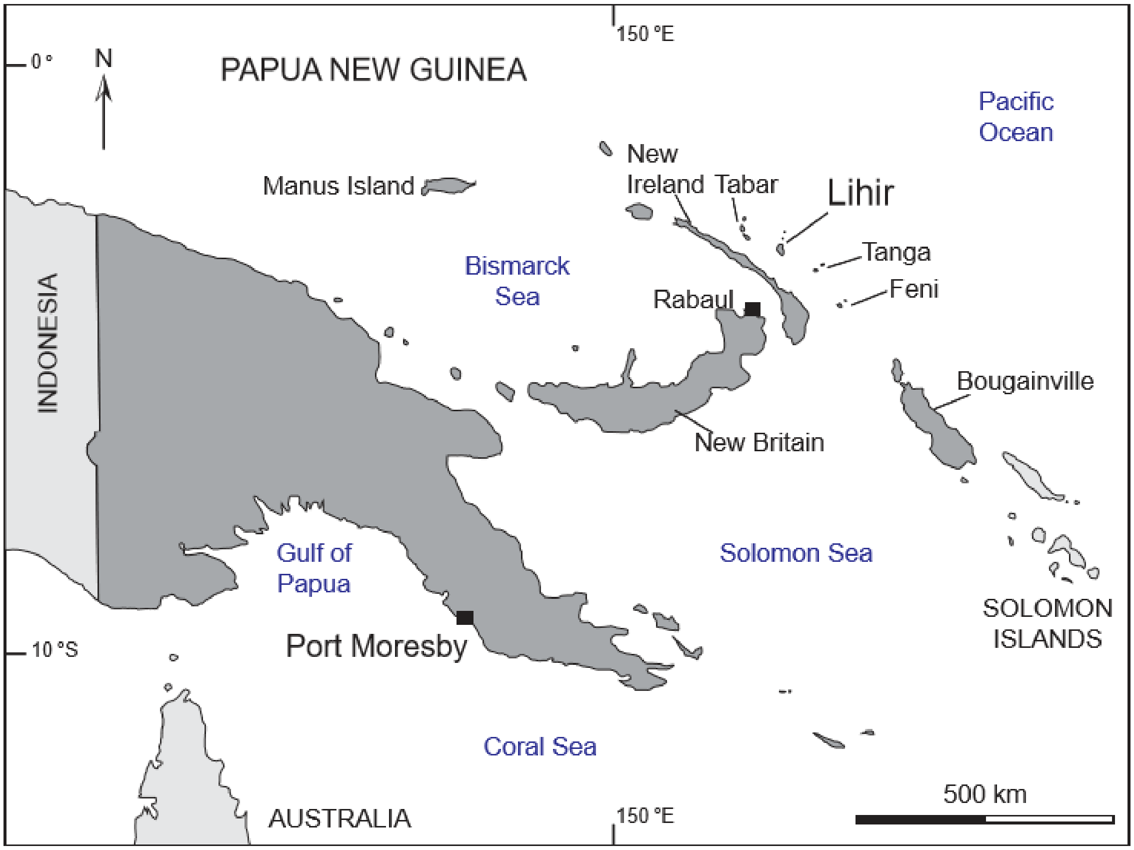
All measurement units used in this Report are metric unless otherwise noted, and currency is expressed in either United States (US$) dollars or Australian dollars (A$) as identified in the text. The Papua New Guinean currency is the Papua New Guinea kina (PGK). The Report uses Australian English. Years may be indicated as FY, or financial years, which run 1 July–30 June.

Mineral Resources and Mineral Reserves were initially classified using the 2012 edition of the Australasian Joint Ore Reserves Committee (JORC) Code (2012 JORC Code). The confidence categories assigned under the 2012 JORC Code were reconciled to the confidence categories in the Canadian Institute of Mining, Metallurgy and Petroleum (CIM) Definition Standards for Mineral Resources and Mineral Reserves (May 2014; the 2014 CIM Definition Standards). As the confidence category definitions are the same, no modifications to the confidence categories was required.

Mineral Resources and Mineral Reserves in this Report are reported in accordance with the 2014 CIM Definition Standards. Terminology differences were addressed in that the term "Ore Reserves" in the 2012 JORC Code is reported as "Mineral Reserves" using the 2014 CIM Definition Standards, and the term "Proved Ore Reserve" in the 2012 JORC Code is reported as "Proven Mineral Reserves" using the 2014 CIM Definition Standards.

The Mineral Reserve estimates are forward-looking information and actual results may vary. The risks regarding Mineral Reserves are summarised in the Report (see Section 15.5 and Section 25). Assumptions used in the Mineral Reserve estimates are summarised in the footnotes of the Mineral Reserve table and outlined in Section 15 and Section 16 of the Report.

Figure 2-1: Location Plan



Note: Figure from Blackwell, 2010.

2.3 Qualified Persons

This Report was prepared by the following Newcrest Qualified Persons (QPs):

- Mr. Kevin Gleeson, FAusIMM, Head of Mineral Resource Management;
- Mr. Steven Butt, FAusIMM, Group Manager – Mining Technical Services;
- Mr. John O'Callaghan, FAusIMM, Head of Metallurgy;
- Mr. Craig Jones, FAusIMM, Chief Operating Officer, Papua New Guinea.

2.4 Site Visits and Scope of Personal Inspection

Mr. Kevin Gleeson visited the Project most recently from 14–18 April 2019. He has also visited from 6–10 August 2018, 9–13 April 2018, 8–12 January 2018, and conducted numerous visits between 2012 and 2017. During site visits Mr. Gleeson inspected the mining operations, reviewed the resource reconciliation performance of the mining operations at the time of the visit, observed collection of ore control samples, visited the on-site laboratory facilities, and viewed drill operations including the sampling methodology from drill collar to laboratory pick-up. The site visits included discussion of the geological interpretation at both resource and ore control scales.

Mr. Steven Butt was based at Lihir Operations between January 2016 and March 2019. During this period, Mr. Butt held roles at the Lihir Operations of Commercial Manager and Technical Services Manager in which he participated directly in all aspects associated with the execution of annual business plans for the Lihir Operations, performed detailed reviews of operational performance, mining technical designs and financial performance; and led discussions and decision processes associated with long-term strategic planning including annual life-of-mine planning processes. Mr. Butt has held the role of Group Manager – Mining Technical Services since April 2019, and this role includes oversight of, and providing support for, strategic mine planning (including life of mine planning and Mineral Reserve preparation) for the Lihir Operations. As this current role is not based on site, Mr. Butt maintains regular visits to site, the most recent being on 6–15 January, 2020, 6–11 December, 2019, 11–15 November, 2019 and 26 June, 2019. During these site visits, he reviewed mining operations, Mineral Reserve and life of mine planning assumptions and outputs, pit slope stability and geotechnical discussions, operating and capital costs assumptions, and infrastructure related to the mining operations.

Mr. John O'Callaghan's most recent site visit commenced on 25 August, 2020 and is projected to extend to 20 November, 2020. Since mid-2014, Mr. O'Callaghan has visited the site more than 20 times. Whilst on site, he has assisted process plant operations, overseen installation of new equipment, fine-tuned the current operational strategy, and discussed aspects of mineralogy, lithology and operational issues with site staff.

Mr. Craig Jones visited the Lihir Operations from 6 July to 15 August 2020. Mr Jones has been visiting the site since 2011; however, since being appointed Chief Operating Officer for PNG in September 2019, he has visited the site 11 times. During his site visits, he has viewed operational infrastructure, was involved as project manager with major upgrades to the process plant, and has discussed business management plans, improvement projects, and risk management measures with operations staff. Mr. Jones has participated in reviews of aspects of environmental, permitting and social operations, including environmental compliance, permitting status, and stakeholder, community, and government relations. He also held discussions with local landowner representatives, local level, provincial and national government representatives.

2.5 Effective Dates

There are a number of effective dates pertinent to the Report, as follows:

- Date of the latest information on environmental, permitting, and social considerations: 30 June, 2020;
- Date of the latest information on ongoing drill programs: 30 June, 2020;
- Database close-out date for Mineral Resource estimates: 25 November, 2016;
- Effective date of the Mineral Resource estimates: 30 June, 2020;
- Effective date of the Mineral Reserve estimates: 30 June, 2020;

The overall Report effective date is taken to be 30 June, 2020; and is based on the effective date of the Mineral Reserve estimates and economic analysis that supports the Mineral Reserves.

2.6 Information Sources and References

This Report is based, in part, on internal company reports, maps, published government reports and public information, as listed in Section 27 of this Report.

The following Newcrest employees or consultants retained by Newcrest contributed to various aspects of the Report under the supervision of the QPs:

- Ms. Lisa Bowyer, Manager Land Tenure, 10 years of experience with the Project;
- Ms. Karyn Gardner, Manager Ore Deposit Knowledge, eight years of experience with the Project;
- Mr. David Grigg, Senior Lead – OP Mine Planning, 14 years of experience with the Project;
- Dr. Graham Hancock, Consultant, 25 years of experience with the Project;
- Mr Nicholas Kerr, Senior Engineer – Geotechnical Projects, four years of experience with the Project;
- Mr. Fraser MacCorquodale, General Manager, Exploration, 10 years of experience with the Project;
- Mr. Frank Pothitos, Principal Open Pit Geotechnical Engineer, five years of experience with the Project;
- Mr. Stuart Roseby, Manager Environment Projects and Permitting, four years of experience with the Project;
- Mr. Ryden Runco, Senior Business Analyst, three years of experience with the Project;
- Mr. Colin Russell, Project Manager (Lihir Seepage Barrier), three years of experience with the Project;
- Mr. Blair Sands, Head of Environment, seven years of experience with the Project;
- Mr. Vikash Singh, Group Evaluation Geologist, 10 years of experience with the Project.

All figures were prepared by Newcrest personnel for the Report unless otherwise noted.

2.7 Previous Technical Reports

Newcrest initially listed with the Toronto Stock Exchange (TSX) in March 2012, and voluntarily delisted from the TSX effective 4 September 2013. During its 2012–2013 listing period, Newcrest filed the following technical report on the Lihir Operations:

- Moorhead, C., 2013: Technical Report on the Lihir Property in Papua New Guinea: report prepared for Newcrest, effective date 31 December, 2013, 88 p.

3 RELIANCE ON OTHER EXPERTS

This section is not relevant to this Report.

4 PROPERTY DESCRIPTION AND LOCATION

4.1 Introduction

The Project is on Aniolam Island, which is part of the Lihir Group in the Province of New Ireland. The island is located approximately 900 km north–northeast of the national capital, Port Moresby.

The Project is located at approximately 3º06’54” S latitude, 152º38’27” E longitude.

4.2 Property and Title in Papua New Guinea

Key laws that regulate mining activity in PNG include the *Mining Act 1992* and Regulations, the *Environment Act 2000* and Regulations, the *Mineral Resource Authority Act 2018*, and the *Mining (Safety) Act 1977* and Regulations.

4.2.1 Mineral Title

Mineral rights are held by the State of PNG (State), and mining is regulated at the national level. A Special Mining Lease is issued by the Head of State acting on advice from the National Executive Council (Cabinet). Otherwise mineral titles are issued by the Minister for Mining on recommendation from the Mining Advisory Council (MAC) subject to the *Mining Act 1992*. The types of licences are summarised in Table 4-1. The Minerals Resources Authority (MRA) has overall responsibility for the promotion, management and regulation of the mining sector under the *Mining Act 1992*.

4.2.2 Surface Rights

The holder of a tenement under the *Mining Act 1992* is liable to pay compensation to the landholders for all loss or damage suffered or foreseen to be suffered by the landholders from the exploration or mining or ancillary operations (but not for grant of access, nor in respect of the value of any mineral, nor by reference to any rent, royalty or other amount in respect of mining).

4.2.3 Environmental Regulations

The *Environment Act 2000* sets out the requirement for proponents to obtain an environment permit for activities prescribed in the Environment (Prescribed Activities) Regulations 2002 that have the potential to cause environmental harm. The *Environment Act 2000* is administered by the Conservation and Environment Protection Authority (CEPA), previously the Department of Environment and Conservation (DEC).

Under the *Environment Act 2000*, activities are classified as Level 1, Level 2 or Level 3 based on their risk of causing environmental harm and each requires a different level of environmental and social assessment.

Table 4-1: Mineral Titles

Title Type	Comment
Exploration Licence (EL)	Can be granted for a term not exceeding two years, and may be extended for periods not exceeding two years. Cannot exceed 750 sub-blocks in size; requirements as to contiguousness of sub-blocks at application.
Alluvial Mining Lease (AML)	An Alluvial Mining Lease may only be granted over land that is a riverbed and land that extends no further than 20 m from any riverbed. An Alluvial Mining Lease may be granted for a term not exceeding five years which may be extended for periods not exceeding five years. Licence cannot be more than 5 ha in area, and must have a rectangular or polygonal shape.
Mining Lease (ML)	Generally issued for small to medium-scale alluvial and hard rock mining operations. Can be granted for a term not exceeding 20 years, and may be extended for periods not exceeding 10 years. Licence cannot be more than 60 km^2 in area, and must have a rectangular or polygonal shape.
Special Mining Lease (SML)	Generally issued to an Exploration Licence holder for large-scale mining operations. The Minister for Mining may also require the Exploration Licence holder to be a party to a Mining Development Contract with the government. A Special Mining Lease can be granted for a term not exceeding 40 years, which may be extended for periods not exceeding 20 years. Before grant of a Special Mining Lease, the Minister for Mining is required to convene a development forum to consider the views of the persons and authorities whom the Minister believes will be affected by the grant of the Special Mining Lease. Those represented at this forum will include the applicant for the Special Mining Lease; the landholders of the land that is the subject of the application for the Special Mining Lease and other tenements to which the applicant's proposals relate, the State, and the provincial government, if any, in whose province the land the subject of application for the special mining lease is situated. The Head of State, acting on advice from the National Executive Council is the authority responsible for issuing a Special Mining Lease.
Lease for Mining Purpose (LMP)	May be granted in connection with mining operations. Covers aspects such as the construction of buildings and other improvements, and operating plant, machinery and equipment; installation of a treatment plant and the treatment of minerals therein; deposition of tailings or waste; housing and other infrastructure required in connection with mining or treatment operations; transport facilities including roads, airstrips and ports; and any other purpose ancillary to mining or treatment operations or to any of the preceding purposes which may be approved by the Minister. The term of a Lease for Mining Purposes is identical to the term of the Special Mining Lease or Mining Lease in relation to which the Lease for Mining Purpose is granted; where there is no associated lease, a term not exceeding 20 years. The term of a Lease for Mining Purpose can be extended. A Lease for Mining Purpose cannot be more than 60 km^2 in area, and must have a rectangular or polygonal shape.
Mining Easement (ME)	Can be granted in connection with mining, treatment or ancillary operations conducted by the applicant for the Mining Easement or some other person for the purpose of constructing and operating one or more of the following facilities: a road; an aerial ropeway; a power transmission line; a pipeline; a conveyor system; a bridge or tunnel; a waterway; any other facility ancillary to mining or treatment or ancillary operations in connection with any of the preceding purposes which may be approved by the Minister. The term of a Mining Easement is identical to the term of the tenement in relation to which the Mining Easement was granted. The area of land over which a Mining Easement may be granted is sufficient for the purpose or purposes for which it was granted and shall be in a rectangular or polygonal shape.

Note: one sub-block = approximately 3.41 km^2

Level 3 activities are considered to have the highest risk of causing environmental harm. The grant of a Level 3 environment permit is subject to a comprehensive environmental impact assessment, presented in an Environmental Impact Statement (EIS) and reviewed by the CEPA in consultation with the public.

An Environmental Inception Report (EIR) is also required upon formal classification. The EIR identifies potential environmental and social issues and studies to be undertaken to support the EIS. As an outcome of their assessment, CEPA will advise on any additional requirements or changes to the EIR and then approve it as the basis for EIS studies to proceed.

The content of an EIS is described in the Guideline for Conduct of Environmental Impact Assessment and Preparation of Environmental Impact Statement prepared by CEPA (DEC, 2004). This includes documenting all environmental and social issues associated with the planned project, together with the proponent's commitment to relevant management measures, monitoring and reporting.

4.2.4 Closure

Section 99 of the *Environment Act 2000* gives the Director of CEPA the power to require an environmental bond. Mine closure financial assurance is not a specific requirement under the *Mining Act 1992*. However, the (then) Department of Mining issued a Mine Closure Policy and Guideline 2005. The policy requires the developer to "put in place security for mine closure costs and establish a Mine Closure Trust Fund" or alternate mechanism that can be in the form of "bank guarantees, parent company guarantees, insurance policies and cash deposits". This policy could be implemented by the MRA via conditions on mining leases. MRA has been working with the Intergovernmental Forum on new rehabilitation and closure guidelines, entitled "Mining Project Rehabilitation and Closure Guidelines – Papua New Guinea", which were released in September, 2019 and formally endorsed by MRA in December 2019.

4.2.5 Royalties

The holder of a mining lease must pay a royalty to the State that is equivalent to 2% of the net proceeds of sale of minerals (calculated as either a net smelter return (NSR) or free-on-board (FOB) export value, as appropriate). The State may elect to retain its right to royalty or to distribute it between the provincial government of a mine's host province and the landholders of the land upon which the mineral resource is mined.

Where the State agrees to distribute any royalties, the landholders are entitled to at least 20% of the total amount of royalties paid to the State.

A production levy of 0.5% is payable to the MRA under the *MRA Act 2018* on the gross value of production (i.e., excluding the offsets of treatment and refining charges, payable terms and freight).

4.2.6 Fraser Institute Survey

The QP used the 2019 Fraser Institute Annual Survey of Mining Companies report (the 2019 Fraser Institute Survey) as a reasonable source for the assessment by peers in the mining industry of the overall political risk facing an exploration or mining project in Papua New Guinea. Each year, the Fraser Institute sends a questionnaire to selected mining and exploration companies globally. The Fraser Institute survey is an attempt to assess how mineral endowments and public policy factors such as taxation and regulatory uncertainty affect exploration investment.

The QP relied on the 2019 Fraser Institute survey because it is globally regarded as an independent report-card style assessment to governments on how attractive their policies are from the point of view of an exploration manager or mining company and forms a proxy for the assessment by industry of political risk in specific political jurisdictions from the mining industry's perspective.

Of the 76 jurisdictions surveyed in the 2019 Fraser Institute survey, Papua New Guinea ranks 54^{th} for investment attractiveness, 63^{rd} for policy perception and 38^{th} for best practices mineral potential.

4.3 Project Ownership

The Lihir Project is 100% owned by Newcrest's wholly-owned subsidiary, Lihir Gold.

4.4 Mineral Tenure

The Project consists of a granted Special Mining Lease, two granted Mining Leases, one granted Exploration Licence, five granted Leases for Mining Purposes, and three Mining Easements. The total area under licence is approximately 257 km^2.

The Lihir deposit is located on SML6.

SML6, LMP34–LMP40, and ME71–ME73 expire on 16 March 2035. An extension of term application from 1 April 2020 to 31 March 2022 has been lodged for EL485. ML125 and ML126 expire 20 July 2025.

Mineral tenure is summarised in Table 4-2, and shown in Figure 4-1.

Newcrest must lodge annual and bi-annual reports on activities. As at 30 June, 2020, all statutory reporting requirements had been met.

4.5 Surface Rights

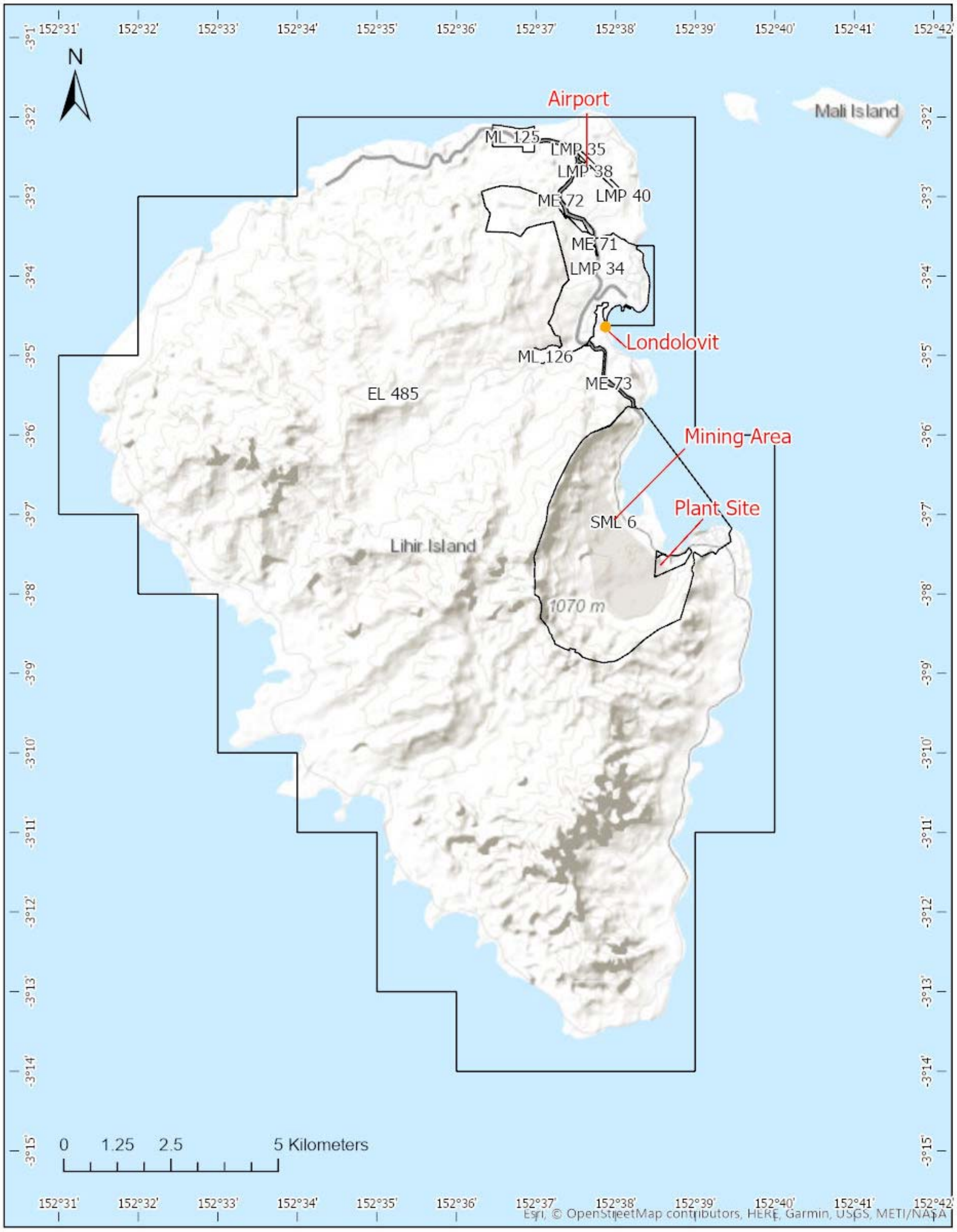
The Project area is situated on land held under customary, State and private ownership, including under State lease. The bulk of the land that will be affected by Project development, operations and closure is customary owned.

Newcrest has been granted rights to undertake mining and processing of gold and related activities, through negotiations with the state and local government, and landowners in the area.

Table 4-2: Mineral Title

Lease	Lease Type	Lease Status	Grant Date	Expiry Date	Area (km^2)
EL485	Exploration Licence	Renewal pending	19/06/1983	31/03/2020	231.49
LMP34	Lease for Mining Purpose	Granted	21/07/1995	16/03/2035	0.34
LMP35	Lease for Mining Purpose	Granted	21/07/1995	16/03/2035	6.74
LMP38	Lease for Mining Purpose	Granted	18/10/1997	16/03/2035	0.04
LMP39	Lease for Mining Purpose	Granted	18/10/1997	16/03/2035	0.00
LMP40	Lease for Mining Purpose	Granted	18/10/1997	16/03/2035	0.02
ME71	Mining Easement	Granted	21/07/1995	16/03/2035	0.06
ME72	Mining Easement	Granted	21/07/1995	16/03/2035	0.21
ME73	Mining Easement	Granted	21/07/1995	16/03/2035	0.19
ML125	Mining Lease	Granted	21/07/1995	20/07/2025	0.48
ML126	Mining Lease	Granted	21/07/1995	20/07/2025	0.24
SML6	Special Mining Lease	Granted	17/03/1995	16/03/2035	17.39
				Total	***257.2***

Figure 4-1: Exploration and Mining Tenements



Note: Figure prepared by Newcrest, 2020.

Newcrest holds a granted special mining lease which encompasses all of the area where Mineral Reserves are estimated. There are some areas of the lease where Mineral Resources are estimated where agreements are not yet in place with local landowners or the community.

Land within SML6 is customarily owned and has been divided into blocks of varying sizes. Each block is owned by landowners belonging to one of the six main clan groups: the Tengawom Clan, Lamatlik Clan, Nikama Clan, Nissal Clan, Tinetalgo Clan and Unawos Clan. The landowners that claim ownership over the individual blocks are represented by a nominated clan Block Executive. The Special Mining Licence entitles Newcrest to enter and occupy the land for the purpose of mining and the ancillary mining purposes for which the Mining Lease was granted.

4.6 Water Rights

An Environment Permit for Water Extraction is in place to support Project operations and water rights and usage are discussed in Section 20.9.

4.7 Royalties and Encumbrances

Newcrest is entitled to 100% of the minerals produced from the tenements subject to the payment of prescribed annual rents and royalties. A 2% royalty is payable to the State of PNG on the realised prices of all gold and silver doré produced. Under the Memorandum of Agreement (MoA), the State is responsible for direct distribution of all royalties derived from the Lihir Operations to SML6 landowners (20%), Nimamar Local Level Government (30%) and the New Ireland Provincial Government (50%).

A production levy of 0.5% is also payable on the gross value of production (i.e., excluding the offsets of treatment and refining charges, payable terms and freight) to the MRA.

There are no other known encumbrances.

4.8 Property Agreements

There are no property agreements relevant to operations. Agreements with local stakeholders are discussed in Section 20.

4.9 Permitting Considerations

Permitting considerations are discussed in Section 20.

4.10 Environmental Considerations

Environmental considerations are discussed in Section 20.

4.11 Social License Considerations

Social license considerations are discussed in Section 20.

4.12 QP Comments on "Item 4; Property Description and Location"

In the opinion of the QP:

- Information provided by Newcrest's legal and tenure experts on the mining tenure held by Newcrest in the Project area supports that the company has valid title that is sufficient to support declaration of Mineral Resources and Mineral Reserves;
- Newcrest holds sufficient surface rights to allow mining activities;
- Newcrest holds the key permits required to support current operations (see discussion in Section 20);
- Newcrest holds permits that allow abstraction of groundwater, and use of surface water (see discussion in Section 20);
- Royalties are payable to the Government of Papua New Guinea, consisting of 2% of the net proceeds of sale of minerals (calculated as either an NSR or FOB export value, as appropriate), and a 0.5% production levy;
- Environmental liabilities for the Project are typical of those that would be expected to be associated with an active mining operation in an active geothermal setting in a high rainfall tropical area, and include mining, earthworks, ore pads and waste rock storage areas, roads, settling ponds, accommodations facilities, and associated support infrastructure.

To the extent known to the QP, there are no other significant factors and risks that may affect access, title, or the right or ability to perform work on the Project that are not discussed in this Report.

5 ACCESSIBILITY, CLIMATE, LOCAL RESOURCES, INFRASTRUCTURE, AND PHYSIOGRAPHY

5.1 Accessibility

Most travel to and from the island is via aircraft. Access to Aniolam Island is through the Kunaye airport located about 7 km north of the Lihir Operations and approximately 3 km north of the Londolovit town site. Newcrest employees are predominantly PNG nationals who are fly-in-fly-out (FIFO) of a number of different PNG communities or residents of Aniolam Island. The majority of senior management roles are residential based on Aniolam Island while most expatriate employees typically are FIFO from the hub of Cairns, in Australia.

Daily travel to the mining operations from the Londolovit residential town site is by road.

Sea passenger services operate to local islands. Marine facilities are established to service oil tankers, general cargo ships, passenger ferries, and work boats.

Additional information on transportation required to support mining operations is provided in Section 18.

5.2 Climate

Aniolam Island is located at latitude 3° south and does not experience distinct wet or dry seasons. The Lihir Operations experience high rainfall, averaging about 4.4 m per annum based on the 17-year average of rainfall data collected between 2000–2017, with mean relative humidity of 80%. Periods of rainfall extremes often, but not always, correlate with the El Niño Southern Oscillation.

Air temperatures at the Lihir Operations are relatively constant from month to month. Temperatures at the mine site range from 21–34°C while the sea temperature remains relatively constant at approximately 27–28°C throughout the year.

Winds close to sea level are generally light and variable, ranging from 0.6–16.6 km/h, with monthly mean wind speeds of <5 knots. There are two wind seasons of variable duration. Between May and September/October, winds are mainly from the south-east and east and between December and March, winds are mainly from the north and west. November and April are transitional months. The Luise Caldera has a noticeable effect on wind flow.

Mining activities are conducted year-round. Exploration activities may be curtailed by heavy rainfall.

5.3 Local Resources and Infrastructure

Prior to the discovery of gold, the population of Aniolam Island was approximately 7,100. The economy was centred on subsistence agriculture and the population lived in many small villages around the island.

A mine village was constructed at Londolovit to house mine staff, contractors and families who are not year-round Aniolam Island residents, as the local area is unable to supply the workforce required by the mining operations. The Mining Leases are accessed by sealed road from Londolovit, which is approximately 4 km north of the mine.

Additional information on the infrastructure supporting the Project and the availability of local resources is discussed in Section 18.

5.4 Physiography

The mine is located within the Luise Caldera of the Luise Volcano which is located on the east coast of the island. The caldera is an extinct volcanic crater that is geothermally active. It has a 6 x 4 km elliptical crater with steep walls reaching 600 m above sea level. The eastern, seaward, portion of the Luise Caldera has collapsed, sending debris flows 25–40 km eastward. The submerged slope forms Luise Harbour.

Natural vegetation on the island is predominantly tropical rain forest. Subsistence-level agriculture is practiced, with typical crops including taro, coconuts, betelnut, and tobacco.

Parts of the narrow coastal plain, particularly in the northern and eastern areas, have formed on coral platforms. This includes the regions around the Put Put ore processing plant, Londolovit town site, and Kunaye Airport.

The general mine area ranges in elevation from 0–200 masl. Mining is conducted at elevations below sea level.

At the mine site, flooding effects are generally limited to a need for increased pit sump pumping, an increase in local backwater and occasional inundation of the Luise Harbour foreshore region.

5.5 Seismicity

Papua New Guinea extends across several major tectonic plate boundaries and is one of the most seismically active regions in the world. Aniolam Island is located in the West Melanesian Arc seismic source zone where earthquakes of up to magnitude eight have been recorded. Most earthquakes in the region result from strike-slip movement but some occur along steeply-dipping reverse faults resulting in a strong vertical motion component and have potential to generate local tsunamis. Both tsunami and earthquake risks were assessed and incorporated into the Project design criteria.

Volcanic activity on Aniolam Island is limited to remnant hydrothermal venting in the Luise Caldera in the form of hot springs and fumaroles. Steam and gas (including H_2S) naturally discharge within the pit area and along the Kapit beach and near shore region. The hydrothermal reservoir temperatures can reach 100°C at the water table and exceed 200°C at depth. Isolated geothermal activity in the form of hot springs is evident elsewhere on the island, such as within the southern Kinami caldera.

5.6 QP Comments on “Item 5; Accessibility, Climate, Local Resources, Infrastructure, And Physiography”

In the opinion of the QP:

- The existing local infrastructure, availability of staff, methods whereby goods can be transported to the Project area are well-established and well understood by

Newcrest, and can support the declaration of Mineral Resources and Mineral Reserves (see discussion in Section 18);

- All necessary primary infrastructure has been built on site and is sufficient for the projected life-of-mine (LOM) plan; see discussion in Section 18);
- Surface rights for infrastructure and mining are discussed in Section 4.5;
- There is sufficient suitable land available within the mineral tenure held for installations such as the process plant and related mine infrastructure. The mine uses deep sea tailings placement (DSTP) for tailings disposal (see discussion in Section 20). Waste transported in barges for off-shore submarine disposal (see discussion in Section 18)

Operations are conducted year-round.

6 HISTORY

6.1 Exploration History

A summary of the exploration in the Project area is provided Table 6-1. Early studies on the Project separated the mineralisation into four zones or "orebodies". The early descriptions are summarised in Table 6-2, and the zone locations are provided in Figure 6-1. Each zone was interpreted to be localised along north-dipping structural trends separated by about 100–200 m of unmineralised to low-grade (<1.0 g/t Au) altered rocks. This nomenclature has been discontinued with the adoption of an alteration domain model for the Project (refer to discussions on the alteration model in Section 7 and Section 13). Some research studies refer to the Lihir deposit as the Ladolam deposit; however, for the purposes of this Report, the deposit is referred to as the Lihir deposit.

Exploration activities have included geological mapping, geochemical sampling, geophysical surveys, trenching, auger, reverse circulation (RC) and core drilling, hydrogeology, petrology and mineralogy studies, metallurgical testwork, and mining studies.

A feasibility study was completed in 1988, based on open pit mining methods, and updated in 1992. The Special Mining Lease for the Project was granted in 1995, and the first gold pour occurred in 1997.

Mining commenced with the development of the Minifie pit sector using a conventional truck and shovel operation. Mining of the Lienetz pit sector commenced in 2004, and mining has continued in both areas from a number of subsequent cutbacks.

An internal pre-feasibility study (PFS) was conducted in 2016 to evaluate optimisation of the mine plan, including mining of the Kapit sector. The life-of-mine (LOM) strategy considered alternative material selection, mine sequencing and process scheduling options, appropriate mining methods and civil engineering options to potentially improve project economics. The study reviewed the use of a near-shore cut-off wall (seepage barrier) in place of a coffer dam.

6.2 Production

Table 6-3 provides a summary of the mine production from mine start-up to 30 June, 2020.

Table 6-1: Exploration History

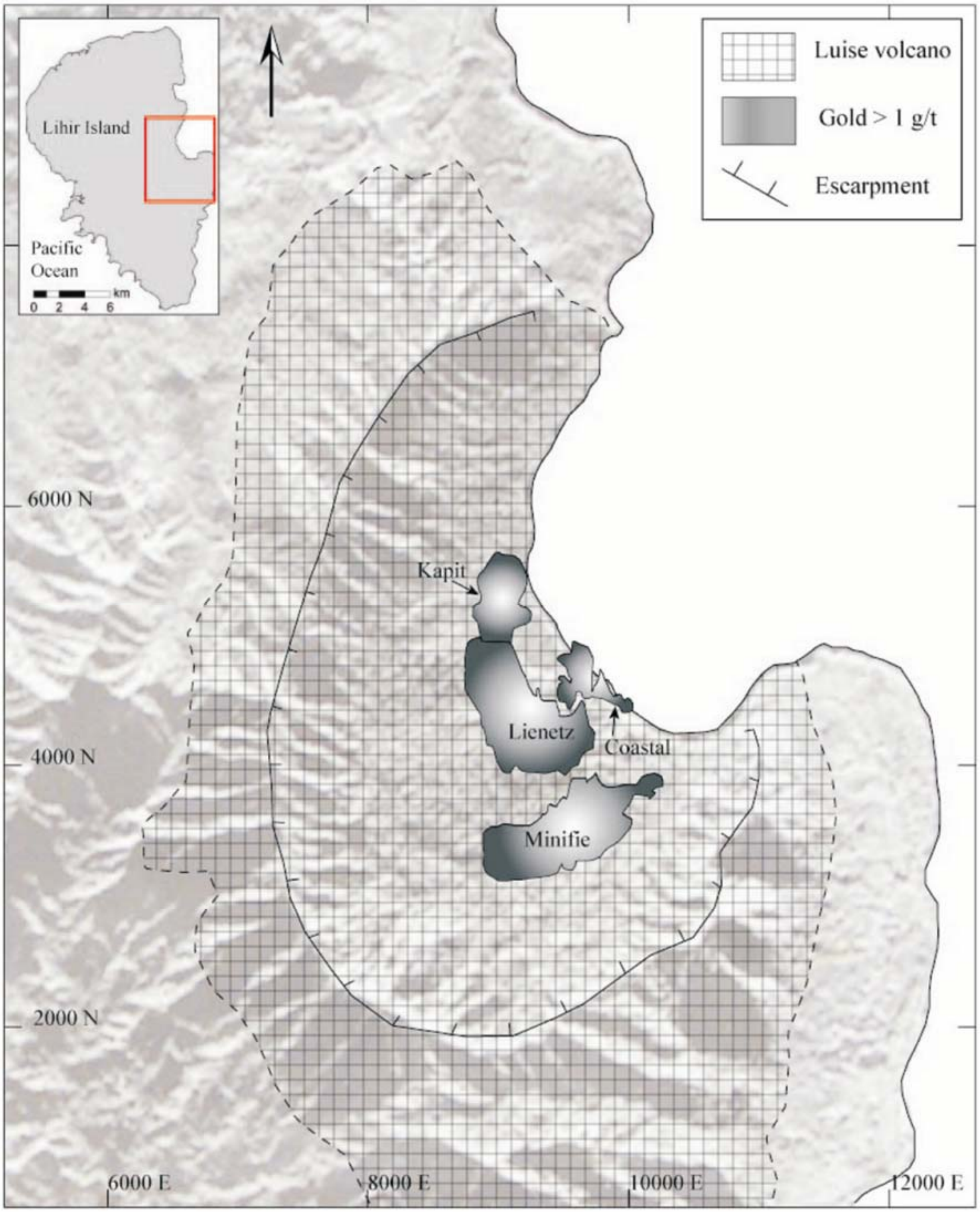
Year	Company/Operator	Work Program
1969–1974	PNG Bureau of Mineral Resources and the Geological Survey of PNG	Regional exploration. Stream-sediment sampled for porphyry copper-style mineralisation, identified areas of hydrothermal alteration and mineralisation.
1982	Kennecott Explorations Australia (Kennecott) and Niugini Mining Limited (Niugini)	Discovered gold in rock chip samples taken in Luise Harbour. Exploration Licence applied for and granted. Lihir Management Company was the operator of the Kennecott and Niugini joint venture (JV).
1983–1984	Kennecott and Niugini	Commenced drilling, identified Lienetz zone. Completed semi-detailed mapping, stream sediment and soil samples, rock chips, hand augers, and hand-cut trenches and benches.
1985–1987	Kennecott and Niugini	Drilling and bulldozer trenching identified the Minifie zone in 1986. Further exploration defined several other adjacent and partly overlapping zones during 1987, referred to as the Camp and Kapit areas. Ground magnetic survey in 1985 within Luise Caldera. Airborne aeromagnetic/radiometric survey in 1987.
1988	Kennecott	Completed feasibility study; economics not positive. Airborne aeromagnetic/radiometric survey coverage extended island-wide.
1988	Rio Tinto Zinc Corporation (Rio Tinto)	Rio Tinto acquired Kennecott from BP Minerals America and took over as the joint venture partner with Niugini.
1990–1991	Rio Tinto	Ground magnetic surveys at Minifie and within Luise Caldera; Time-domain induced polarisation (IP) survey at Minifie and within Luise Caldera. Controlled-source audio-frequency magneto-telluric (CSAMT) survey in 1991
1992	Rio Tinto and Niugini	Updated feasibility study
1995	Rio Tinto and Niugini	Special mining lease granted. Lihir Gold was incorporated for the purpose of acquiring formal ownership of the Project. Lihir Gold listed on Australian Securities Exchange (ASX).
1997	Rio Tinto and Niugini	First gold pour
2004	Rio Tinto and Niugini	Magneto-telluric (MT) ground geophysical survey
2005	Rio Tinto	Divests interests in Lihir Gold.
2005	Lihir Gold	Lihir Gold becomes sole mine owner and operator.
2007	Lihir Gold	Construction of 20 MW geothermal power plant. MT geophysical survey extended. Commissioning of flotation plant allowing throughput increase to 7 Mt/a capacity; expansion of geothermal power plant to 50 MW capacity.
2008	Lihir Gold	Million ounce plant upgrade" (MOPU) project commenced
2010	Newcrest	Acquires Lihir Gold
2011	Newcrest	Installation of 60 MW floating interim power station
2012	Newcrest	Offshore shallow seismic reflection survey

Year	Company/Operator	Work Program
2013	Newcrest	Process plant and power upgrade commissioned; throughput increase to 10 Mt/a capacity
2015	Newcrest	Autoclave partial oxidation tested and confirmed allowing throughput increase to nominal 15 Mt/a capacity
2016	Newcrest	Pre-feasibility study on Kapit sector
2017	Newcrest	Trial of a range of geophysical techniques in the inner harbour area including side-scan sonar, seismic reflection profiling, seismic refraction Microtremor methods, MASW (a seismic surface wave method for geotechnical applications), resistivity profiling and Tromino (passive seismic).
2018	Newcrest	Mapping, soil and rock chip sampling on Target B (Kinami). Conducted marine seismic refraction and MASW surveys.
2019	Newcrest	Continued mapping, soil and rock chip sampling on Target B (Kinami). Wurtol exploration camp established.

Table 6-2: Deposit Zones Description

Zone	Note
Minifie	Located in the southern portion of the Luise caldera. Occupied an area of approximately 700 x 400 m and between +50 and -250 masl. Mushroom shape. Shallow-level refractory sulphide ore was associated with pervasive adularia–sulphide alteration, and had a concave, blanket-like geometry. Underlying the refractory sulphide mineralisation was quartz–calcite vein stockwork material.
Lienetz	Located north of Minifie. The two zones were separated by unmineralised, propylitically-altered igneous units and breccias. Lienetz occupied an area of approximately 600 x 300 m and between +140m and -350 masl.
Kapitz	Located between Lienetz and Luise Harbour; approximately 500 m due north of the western limit of Lienetz. Kapit is linked to Lienetz by a sub-horizontal zone of low-grade mineralisation (generally <2.0 g/t Au) that reaches 100 m in thickness. Funnel-shaped zone associated with adularia–pyrite alteration and open-space breccias.
Coastal	Northwesterly-trending, moderately to steeply dipping to the northeast. Mineralisation hosted within leached, vuggy breccias as well as more discrete calcite–quartz–pyrite–anhydrite vein/breccias. Remains poorly drilled due to its proximity to Luise Harbour and to the apparent relatively small and narrow nature of the mineralised zones

Figure 6-1: Early Deposit Zones Locations



Note: Figure from Rutter et al., 2008.

Table 6-3: Production History

Period	Mill Throughput (t 000's)	Feed Grade (g/t Au)	Gold Recovery (%)	Gold Production (oz)
Jan–Dec 1997	717	6.69	88.0	135,975
Jan–Dec 1998	2,352	6.94	93.7	530,000
Jan–Dec 1999	2,911	7.04	95.1	625,147
Jan–Dec 2000	3,413	6.01	91.6	606,311
Jan–Dec 2001	3,619	6.18	90.0	647,942
Jan–Dec 2002	3,828	5.46	89.6	607,087
Jan–Dec 2003	3,926	4.95	88.0	550,772
Jan–Dec 2004	4,158	5.11	88.5	599,399
Jan–Dec 2005	3,482	5.98	89.7	595,966
Jan–Dec 2006	4,344	5.14	90.2	650,811
Jan–Dec 2007	4,816	5.25	86.0	700,211
Jan–Dec 2008	6,154	4.76	82.5	771,456
Jan–Dec 2009	6,509	4.99	81.3	853,391
Jan–Jun 2010 *	3,316	4.37	81.9	377,199
Jul 2010–Jun 2011 #	6,285	4.62	83.4	790,974
Jul 2011–Jun 2012	6,042	3.96	81.1	604,336
Jul 2012–Jun 2013	6,941	3.41	85.2	649,340
Jul 2013–Jun 2014	10,057	2.72	81.9	721,264
Jul 2014–Jun 2015	10,768	2.47	80.6	688,714
Jul 2015–Jun 2016	12,093	3.06	75.6	900,034
Jul 2016–Jun 2017	13,001	2.84	79.1	940,060
Jul 2017–Jun 2018	14,274	2.67	78.1	955,156
Jul 2018–Jun 2019	13,350	2.86	75.8	932,784
July 2019–Jun 2020	13,798	2.38	73.5	775,978
Total	***160,154***	***3.77***	***83.4***	***16,210,307***

Notes: *: Six-month period from January to June 2010. #: change to financial year reporting, from July to June.

7 GEOLOGICAL SETTING AND MINERALIZATION

7.1 Regional Geology

Aniolam Island is part of a 250-km long, northwest-trending, alkalic volcanic island chain consisting of the Tabar, Lihir, Tanga and Feni Groups. The island chain sits within an area where several micro-plates (Solomon Sea Plate, South Bismarck Plate and North Bismarck Plate) developed between the converging Australian and South Pacific plates (Figure 7-1).

The island chain is located in the ~100 km wide, 250 km long, Eocene to Recent New Ireland Basin, which is parallel to, and east of, New Ireland, and consists of a 5-km thick sediment pile. Each island group is localised along submarine ridges that rise from depths of 2000 m below sea level, are spaced ~75 km apart and are oriented perpendicular to New Ireland. The islands primarily consist of Pliocene to Pleistocene lavas and volcaniclastic deposits fringed by Quaternary limestone.

7.2 Project Geology

The Project geology is summarised from Ageneau (2012), Blackwell (2010), Carman (1994), Davies and Ballantyne (1987) and Sykora (2016).

Aniolam Island comprises five volcanic blocks surrounded by limestone (Figure 7-2; Figure 7-3). Based on geomorphology, the five volcanic blocks are:

- Two Plio–Pleistocene volcanic blocks, Londolovit Block and Wurtol Wedge;
- Three Pleistocene volcanic edifices, Huniho, Kinami, and Luise.

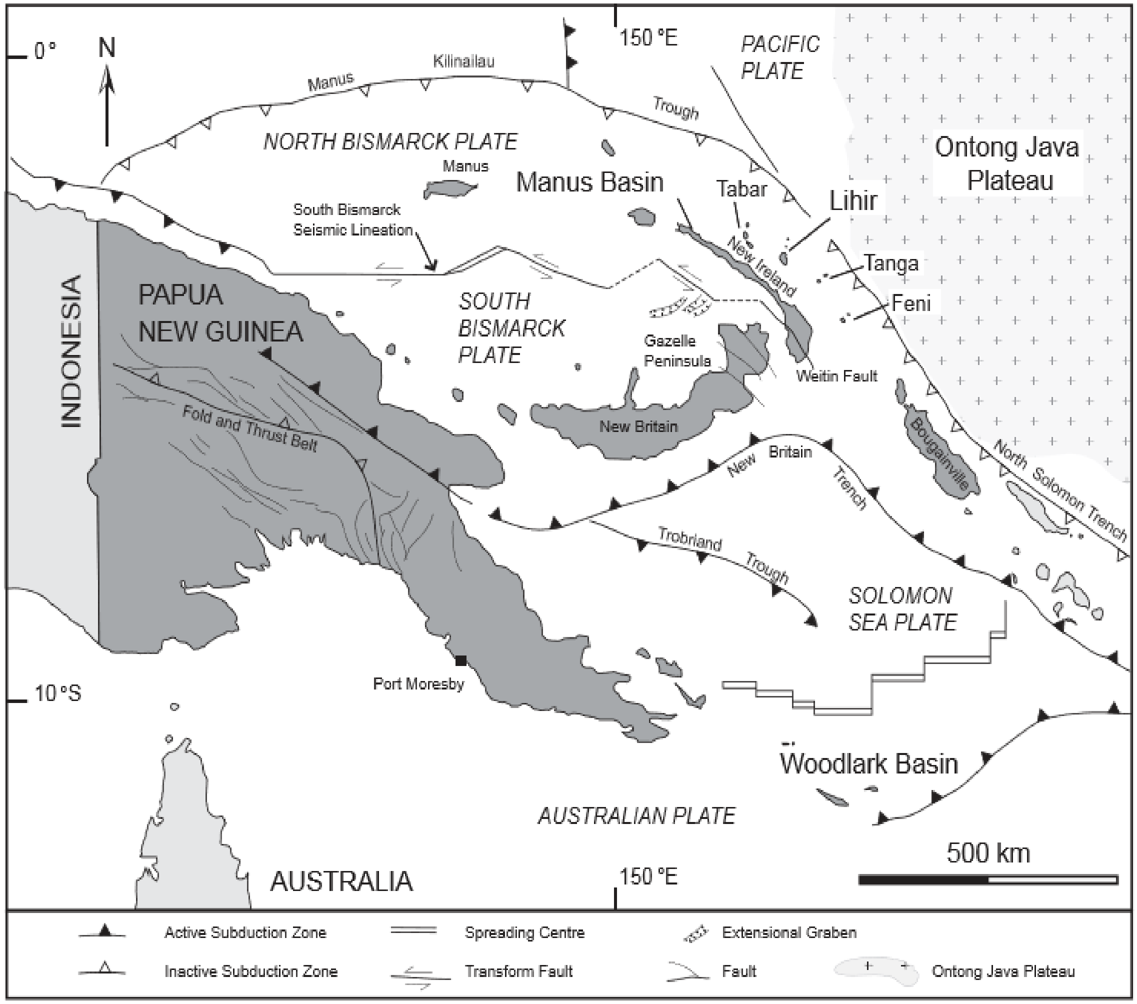
A 10–100 m thick limestone unit overlies and onlaps volcanic units and dips shallowly to the south.

Compositions of the Aniolam Island rocks range from tephrite, basalt, trachybasalt, basaltic trachyandesite, trachyandesite, phonolitic tephrite to tephritic phonolite. The volcaniclastic facies on Aniolam Island are dominated by polymictic volcanic breccia; pyroclastic facies are minor. A 10 m thick ash sequence may have been sourced from the Luise volcano.

Lavas and hypabyssal rocks are predominantly clinopyroxene- and feldspar-phyric and have a fine- to medium-grained feldspar-dominated groundmass. Plutonic rocks are equigranular to porphyritic, medium-grained monzodiorites. Pyroclastic rocks consist of lapilli and ash tuffs, as well as phreatic and phreatomagmatic breccias.

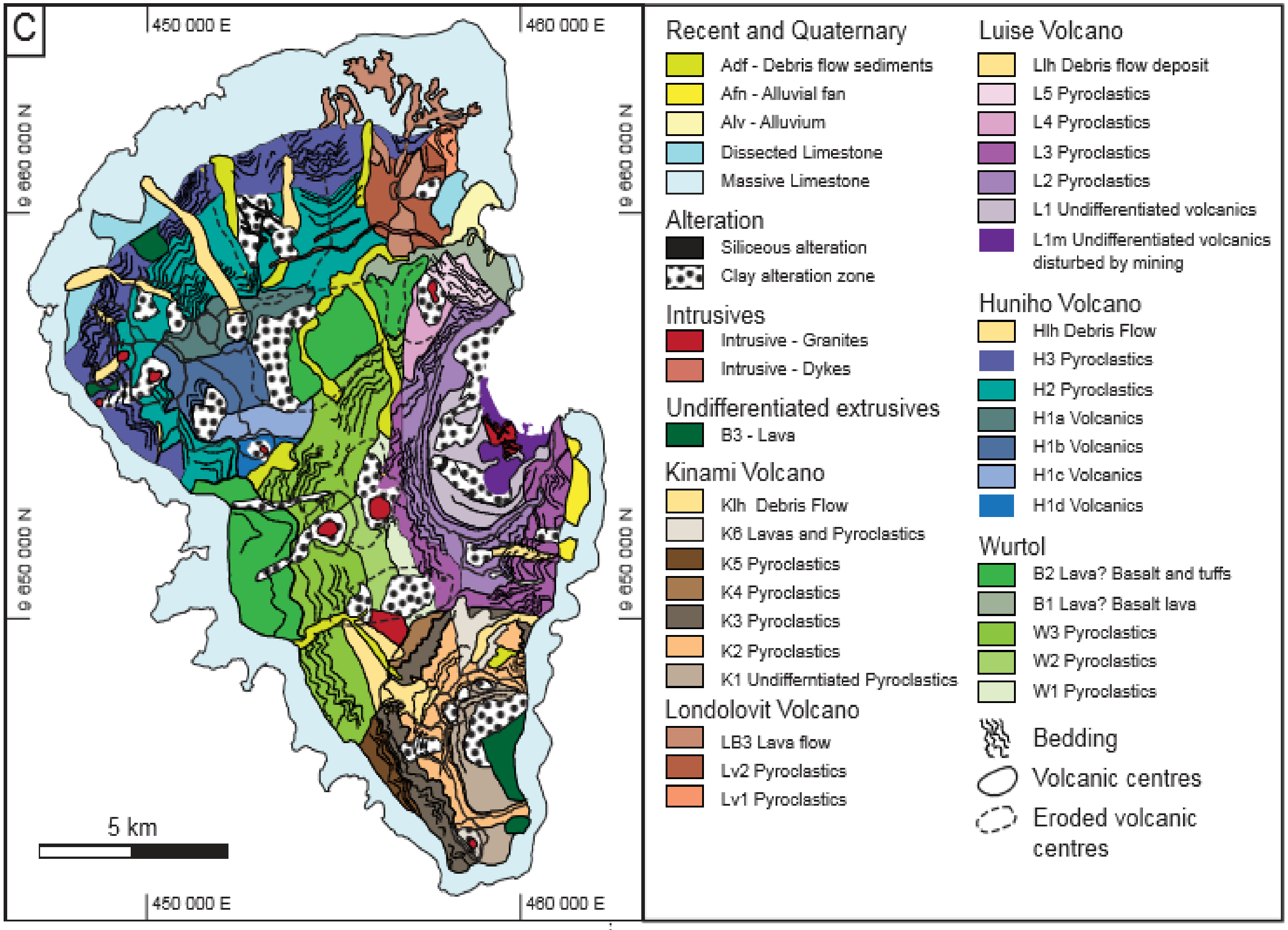
Areas of hydrothermal alteration occur in each of the volcanic centres and locally appear as vegetation anomalies and/or as demagnetised zones. Modern geothermal activity is interpreted to be the waning stages of the ore-forming Luise hydrothermal system and is expressed as structurally-controlled hot mud pools, solfataras, hot springs of neutral chloride and acid sulphate waters, and low-temperature fumaroles.

Figure 7-1: Regional Tectonic Elements



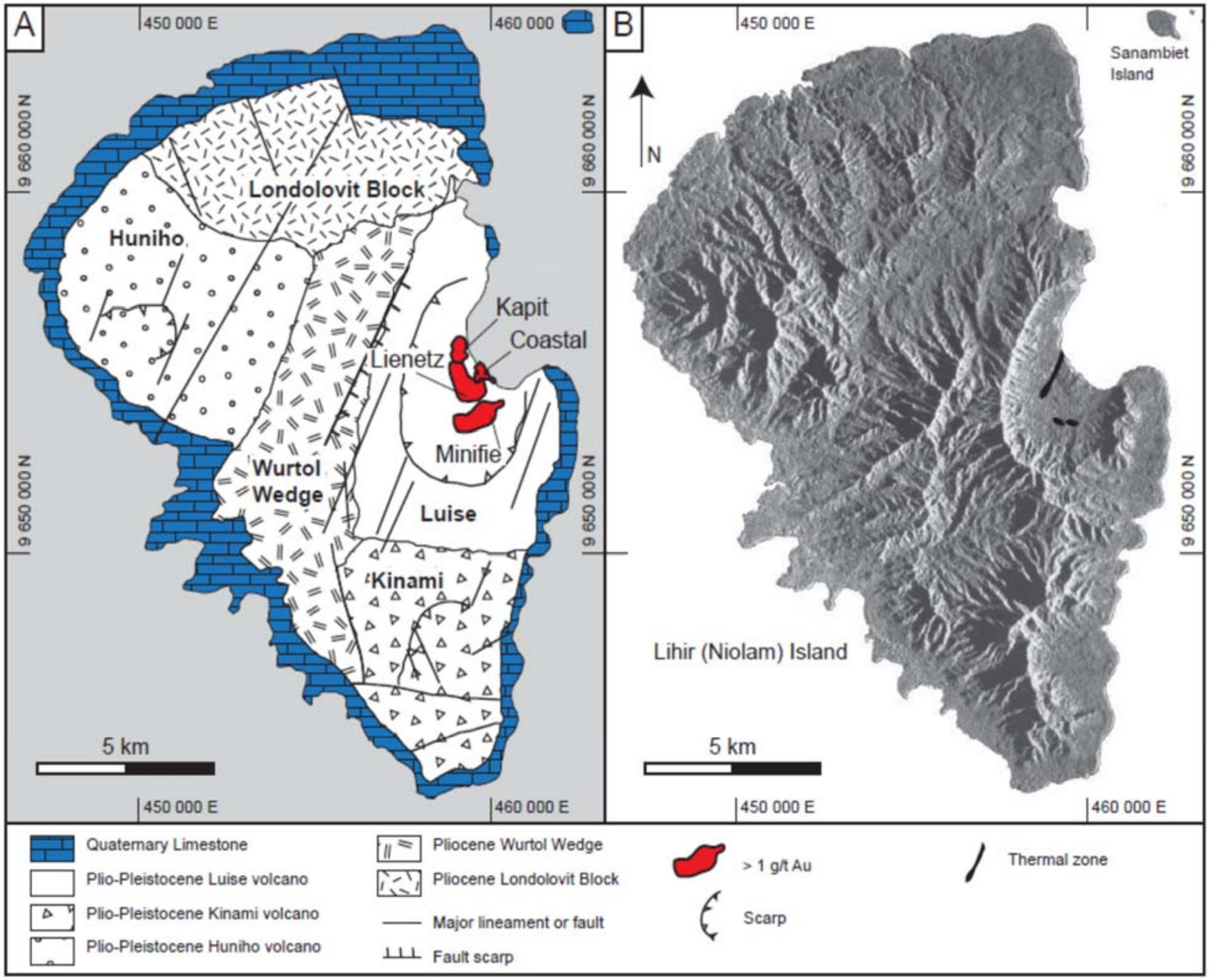
Note: Figure from Blackwell, 2010

Figure 7-2: Volcanic Blocks Comprising Aniolam Island



Note: Figure from Sykora, 2016. As indicated by grid markers, map north is to top of figure.

Figure 7-3: Volcanic Blocks Showing Fringing Limestone



Note: Figure from Blackwell, 2010

7.3 Local and Deposit Geology

7.3.1 Overview

The local and deposit geology is summarised from Ageneau (2012), Blackwell (2010), Carman (1994), Davies and Ballantyne (1987), and Sykora (2016).

The Luise volcano consists of a 4 by 3.5 km wide amphitheatre, elongated and breached to the northeast. This is inferred to be a remnant of the original approximately 1.1 km high volcanic cone that underwent sector collapse(s). The Lihir deposit is located in the footwall of the sector collapse detachment surface.

Gold mineralisation at the Lihir deposit is a complex and refractory assemblage associated mainly with pyrite and marcasite veinlets, disseminations, replacements, and breccia fillings. The sector collapse event(s) superimposed late-stage, gold-rich, alkalic low-sulphidation epithermal mineralisation upon early-stage, porphyry-style alteration.

A broad, three-fold vertical alteration zonation is interpreted to represent this evolution. With increasing depth, the alteration zones consist of:

- 0.2–Ma, surficial, generally barren, steam-heated clay alteration zone that is a product of modern high-temperature geothermal activity;
- 0.6–0.2 Ma, high-grade (> 3 g/t Au), refractory sulphide and adularia alteration zone that represents the ancient epithermal environment;
- 0.9–0.3 Ma, comparatively low-grade (< 1 g/t Au) zone rich in anhydrite ± carbonate, coupled with biotite alteration, that represents the ancient porphyry-style environment.

Post sector collapse volcanism occurred during the modern geothermal-stage, with the emplacement of several diatreme breccia bodies.

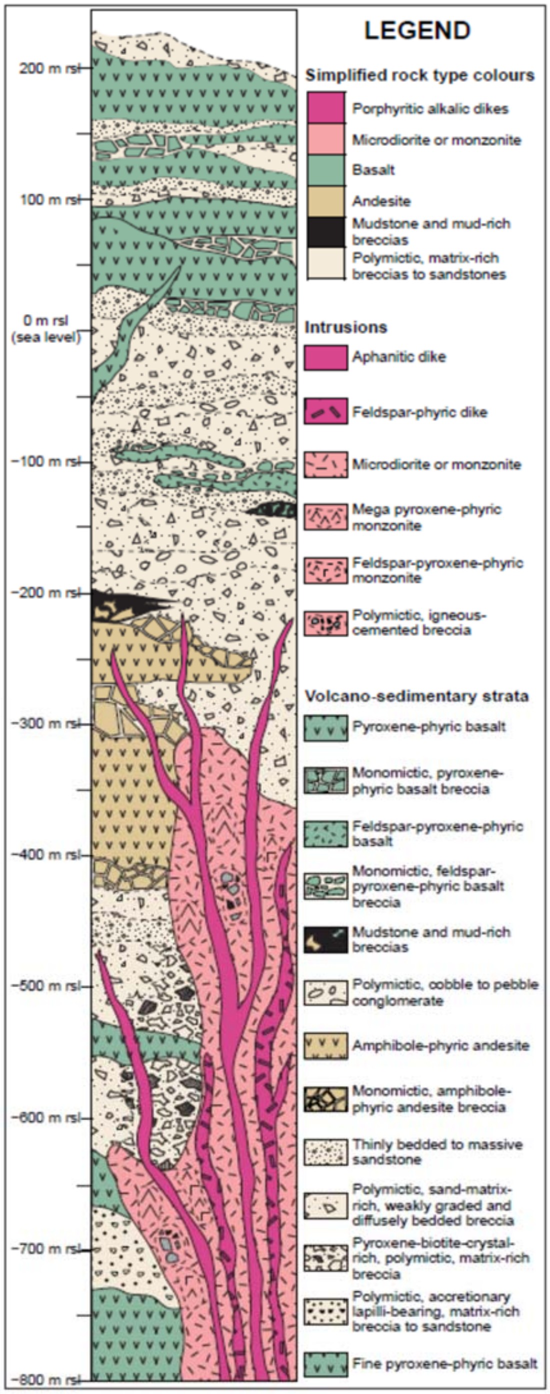
Texturally-destructive hydrothermal alteration and mineralisation often obscures texture and composition in volcanic and volcaniclastic rocks where these units are cut by multiple diatremes and subvolcanic intrusions.

7.3.2 Lithologies

Figure 7-4 is a stratigraphic column through the Luise amphitheatre area. Abundant volcaniclastic debris flows (i.e., polymictic, matrix-rich breccias and sandstones) were deposited throughout the succession.

The depositional environment may have been sub-aerial, or at least proximal to sub-aerial, as indicated by the presence of accretionary lapilli. Sedimentation was interspersed with the emplacement of dykes, sills and autoclastic facies associated with andesitic and basaltic lavas and/or shallow intrusions. Minor mudstone intercalations may represent sub-aqueous depositional periods.

Figure 7-4: Stratigraphic Column, Luise Area



Note: Figure from Sykora, 2016.

Lava, tuff and volcanic breccias are common in the upper parts of the deposit, and on the deposit margins. Breccias tend to dominate over lavas to the north. Primary pyroclastic rocks consist of agglomerate, pyroclastic breccia, lapilli tuff and tuff. Primary epiclastic facies include breccia, conglomerate and sandstone.

The polymictic matrix-rich breccias and sandstone are massive to weakly bedded. The mudstones are laminated to massive, and interbedded with, or transitional to, mud-rich breccias.

Andesites and basalts are generally tabular, sub-horizontal bodies that variably grade outwards to monomictic breccias. The basalts are volumetrically dominant over the andesites, and are particularly abundant in the upper portions of the strata, where they occur commonly as sub-horizontal lava flows and sills, and less commonly as sub-vertical dykes. Where in contact with mudstone, the margins of some andesite and basalt lavas are peperitic.

Clasts of basalt, andesite, as well as rare mudstone, occur within the polymictic breccias.

Multiple intrusive phases are recognised, ranging from coarse equigranular monzonites to porphyritic varieties, and thin, fine-grained dykes. These intrusions cross-cut the volcano–sedimentary strata. The largest and oldest intrusions are monzonite ± microdiorite stocks. Cross-cutting the stocks are a series of <20 m wide sub-vertical porphyritic to aphanitic dykes of syenitic composition that reach higher levels in the strata.

A series of matrix-rich, polymictic breccia bodies, interpreted to have formed by phreatomagmatic eruptions, form at least seven large north- to northeast-trending, coalescing, downward-tapering, elliptical pipes. The breccia bodies are both spatially and genetically linked to small (about 10 m wide) sub-vertical andesite dykes. Clasts contained within a fine-grained, rock-flour matrix include charcoal, internally stratified or juvenile volcanic components, as well as anhydrite-, pyrite–kaolinite–dickite- and pyrite-altered clasts. The diatreme breccias rarely contain mineralised clasts but locally have complex relationships with mineralisation.

7.3.3 Structure

Several structural trends appear important in localising and confining individual breccia units as well as gold mineralisation. The predominant regional orientation of dykes and faults on Aniolam Island are north–northeast-trending (~025°), which is interpreted to be associated with deep-seated tensional faults, and which may have controlled the long axis of the Luise volcanic edifice.

Other strong structural trends occurring within the Luise Caldera include:

- East–northeast-trending structures dipping moderately (60°) to the north;
- Arcuate generally east–west-trending, north-dipping, listric-shaped structures believed to be associated with the collapse of the volcanic edifice;
- Sub-vertical northwest-trending structures;
- Steeply eastward-dipping north–south-trending structures.

East–northeast- and northeast-trending structures are most common, and coincide with aligned offshore islands, aeromagnetic features and elongation of inferred volcanoes and intrusions. The most prominent faults on Aniolam Island are normal faults striking 040° to 050° and dipping 40 to 50° to the northwest. North-, northwest- and west–northwest-trending structures are defined by magnetic lineaments and truncations.

7.3.4 Alteration

Intense alteration was intimately associated with ore-forming events. Early-stage potassic alteration occurred as porphyry-style alteration associated with the emplacement of alkalic stocks within the volcanic edifice, with peripheral and broadly contemporaneous propylitic alteration. Sudden collapse of the volcanic edifice is interpreted to have resulted in the rapid depressurising of the system and subsequent telescoping of epithermal alteration and associated gold mineralisation upon the porphyry environment. Argillic and advanced argillic alteration assemblages developed through continued geothermal activity, driven by post mineralisation magmatism. Geothermal activity continues to this day.

Three alteration styles are recognised:

- Clay zone: equates to argillic ± advanced argillic alteration, about 250 m thick, and subparallel to basal topography of amphitheatre; represents the modern geothermal system;
- Sulphide–adularia zone: equates to epithermal-style low sulphidation alteration; sub-parallel to basal topography of amphitheatre with crenulated local downward projecting base, defined by pyrite-cemented breccias, abundant adularia alteration and disseminated pyrite in altered wall rocks, the lower parts of the sulphide–adularia zone transitions gradationally into the biotite- and K-feldspar-altered rocks of the anhydrite zone. The upper parts are typically more adularia ± illite-altered;
- Anhydrite zone: equates to porphyry-style potassic alteration; vertically and horizontally extensive basal alteration unit; lateral and lower limits not demarcated, defined by the presence of > 1% anhydrite ± calcite ± quartz occurring as veins, breccia cement and/or intergranular disseminations within wall rocks, it is atypical of calc–alkalic porphyries in terms of lacking well-developed quartz stockwork veining.

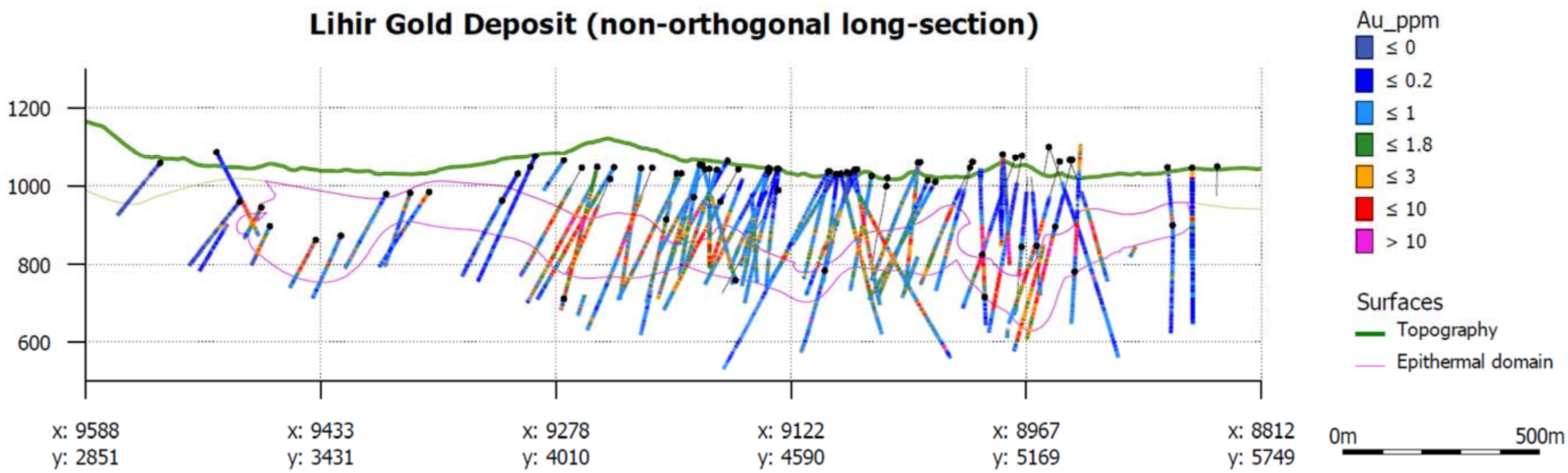
The three alteration zones overprint each other at their basal contacts, and reflect distinct stages in the evolution of the magmatic–hydrothermal system.

The intense alteration from the early porphyry-style, late epithermal, and modern high-temperature geothermal system has obscured many of the primary rock types, and extends vertically and laterally beyond the mineralised zones, with poorly-constrained limits.

7.3.5 Mineralisation

The Lihir deposit has dimensions of about 1,500 x 3,000 m and has about 500 m in depth extent. A long section through the Lihir deposit is included as Figure 7-5. The deposit remains open at depth, along strike, and to the east, where it is currently limited by the Pacific Ocean.

Figure 7-5: Long Section, Lihir Deposit



Note: Figure prepared by Newcrest, 2020.

Gold is the only metal of economic significance present within the Luise Caldera. Mineralisation consists of a number of styles, ranging from early porphyry to late-stage epithermal mineralisation. Two of these gold mineralisation styles represent economically significant phases.

The most important mineralisation style is refractory K feldspar–sulphide mineralisation. In this association, gold occurs as solid solution gold in the crystal structure of sulphide grains. Overall sulphide content is relatively high, with the average sulphide grade of the Mineral Reserves being above 6%. The main sulphide mineral is pyrite, with accessory marcasite and rare arsenopyrite and chalcopyrite. Gold also occurs as small (less than 100 µm) blebs within fine pyrite crystals. The sulphides are characterised by their fine-grained nature, and were deposited through wholesale flooding and deposition within all host rocks, imparting a sooty, dark-grey colouring to the host rocks. Mineralisation is locally associated with strong leaching of the original lithologies, creating pinhole to open, vuggy textures. Cavities as large as 10 m in extent were encountered. This secondary porosity is thought to be the result of dissolution of host rock by hot alkaline fluids, or alternatively as the result of boiling. Gold locally occurs as electrum, gold tellurides, and native gold associated with quartz, calcite and bladed anhydrite.

The second significant style of gold mineralisation occurs as a quartz–chlorite–bladed anhydrite association which is more typical of porphyry-style mineralisation. This mineralisation likely resulted from mixing of magmatic fluids with oxidising near-surface water. Native gold several millimetres in size has been observed, although it is rare.

7.3.6 Oxidation/Weathering

Oxidation locally extends to depths of 70 m but is negligible at the mine scale. Oxide has not been used in any resource model domaining, including density.

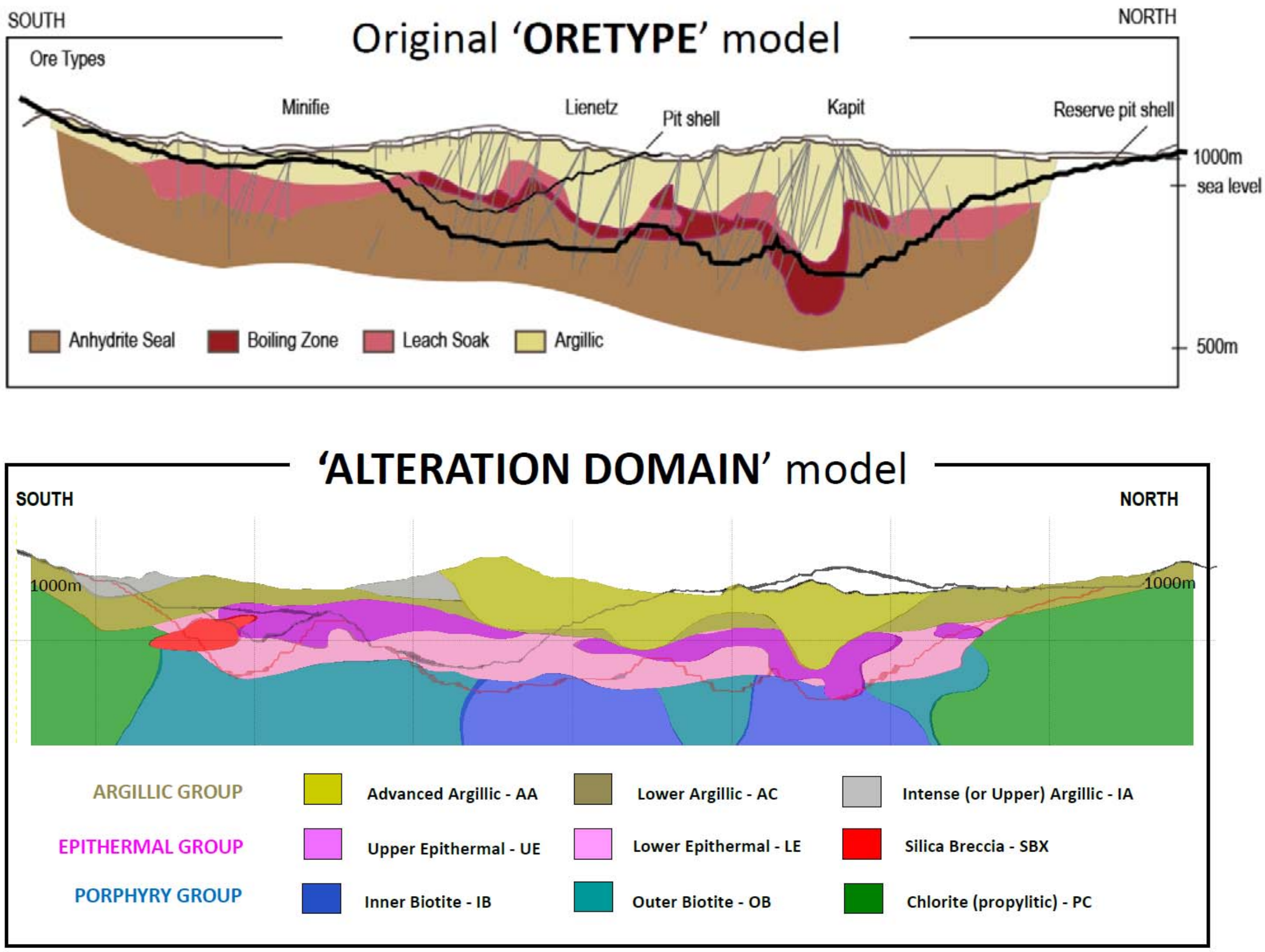
7.3.7 Geological Model

In 2016, Newcrest moved from an “oretype” model (refer to discussion in Section 13.2.5;) to an alteration model for process planning purposes. Figure 7-6 illustrates the two models.

The alteration model is based on a combination of logging, chemical (multi-element analysis results) and mineralogical (Corescan hyperspectral data) information:

- Core scan hyperspectral data: supports identification of dominant mineral assemblages, particularly relevant to the upper clay-bearing areas of the deposit (90 drill holes);
- Multi-element geochemical sample analysis: supports quantification of the chemical variation in key elements of the porphyry- and epithermal-related alteration (250 drill holes);
- Visual logging: provides information on the location of weak clay unit boundaries (160 drill holes).

Figure 7-6: Geological Model Evolution Schematic



Note: Figure from Gardner, 2019.

Three vertical partitions or alteration groups, namely argillic, epithermal and porphyry, were identified which reflect the different alteration environments that have cumulatively resulted in deposit formation. Nine separate alteration domains were defined (Table 7-1). The mineral variations that are observed within the alteration domains are summarised in Figure 7-7.

7.4 Prospects/Exploration Targets

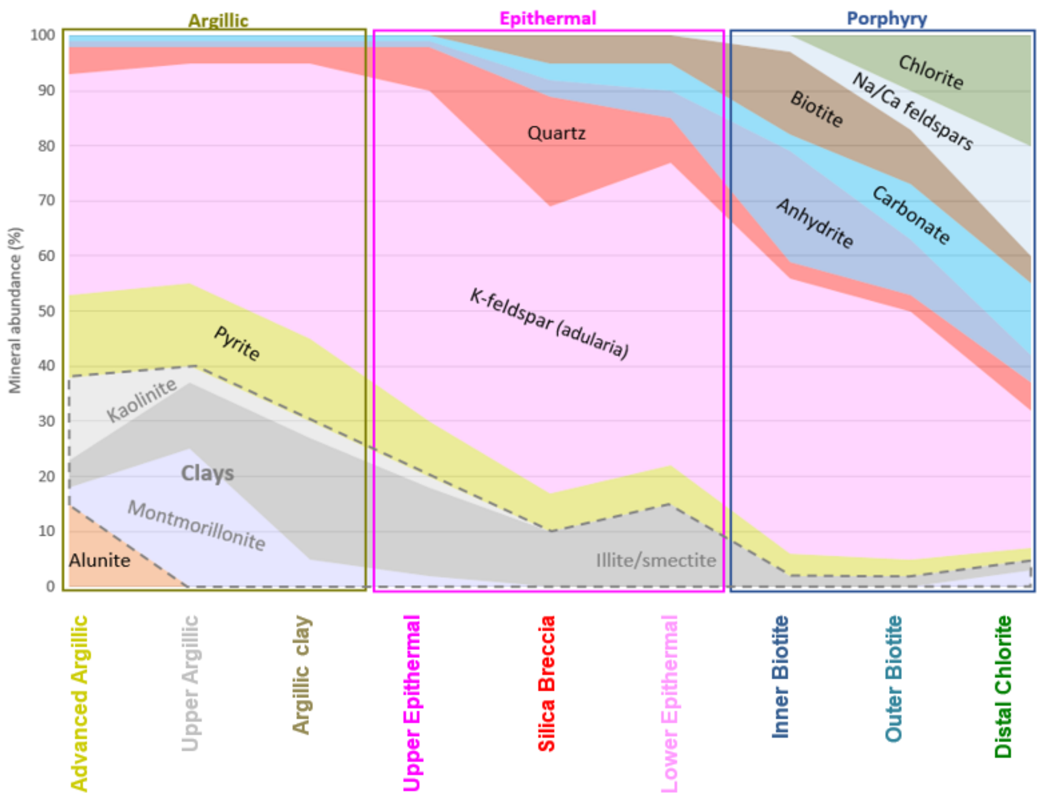
Exploration potential is discussed in Section 9.6.

Table 7-1: Alteration Domains

Alteration 'Group'	Alteration (sub) Domain	Distinctive Property (reason for lateral subdivision)
Argillic	**Advanced Argillic (AA)**	More likely to contain ore grade material than other 'argillic' sub-groups. Harder more competent unit may impact comminution.
	Upper Argillic (UA)	Typically waste. Contains 'weak' and 'swelling' clay minerals which are likely to impact pit wall stability.
	Argillic Clay (AC)	Clay-bearing material, variable competency. Likely to impact processing (particularly flotation and materials handling) if 'ore' grade material mined.
Epithermal	**Upper Epithermal (UE)**	Strongly altered and mineralised material. All calcium-bearing minerals (carbonate and anhydrite) leached. Higher proportion of 'micro-crystalline pyrite' which is likely to reduce flotation Au recovery
	Silica Breccia (SB)	Strongly altered and mineralised material. High silica content results in lower crushing throughput.
	Lower Epithermal (LE)	Less 'epithermally' altered material, with some remnant calcium-bearing minerals present.
Porphyry	**Inner Biotite (IB)**	High temperature core (most intense) area of initial porphyry alteration environment. Anhydrite and biotite dominant. Highest prevalence of dissolution cavities/voids (particularly in upper regions) and permeability. Higher likelihood of non-pyrite Au-bearing minerals
	Outer Biotite (OB)	Typically lower grade than IB. Moderate temperature porphyry alteration environment.
	Distal Chlorite (DC)	Un-mineralised, least altered rock.

Note: colours in the second column refer to schematic alteration zone locations shown in Figure 7-7.

Figure 7-7: Indicative Mineral Abundance Variation Chart



Note: Figure from Gardner, 2019.

7.5 QP Comments on "Item 7: Geological Setting and Mineralisation"

In the opinion of the QP:

- The understanding of the Lihir deposit settings, lithologies, mineralisation and the geological, structural, and alteration controls on mineralisation is sufficient to support estimation of Mineral Resources and Mineral Reserves;
- The geological knowledge of the Project area is acceptable to reliably inform mine planning.

8 DEPOSIT TYPES

8.1 Overview

The Lihir deposit is considered to be an example of an epithermal gold deposit.

General characteristics of such deposits are provided in Table 8-1, after Corbett (2002). An overview of the inter-relationships between porphyry and epithermal deposits is provided in the genetic model schematic in Figure 8-1.

8.2 QP Comments on "Item 8: Deposit Types"

Features of the Lihir deposit that classifies it as an alkalic epithermal gold deposit include:

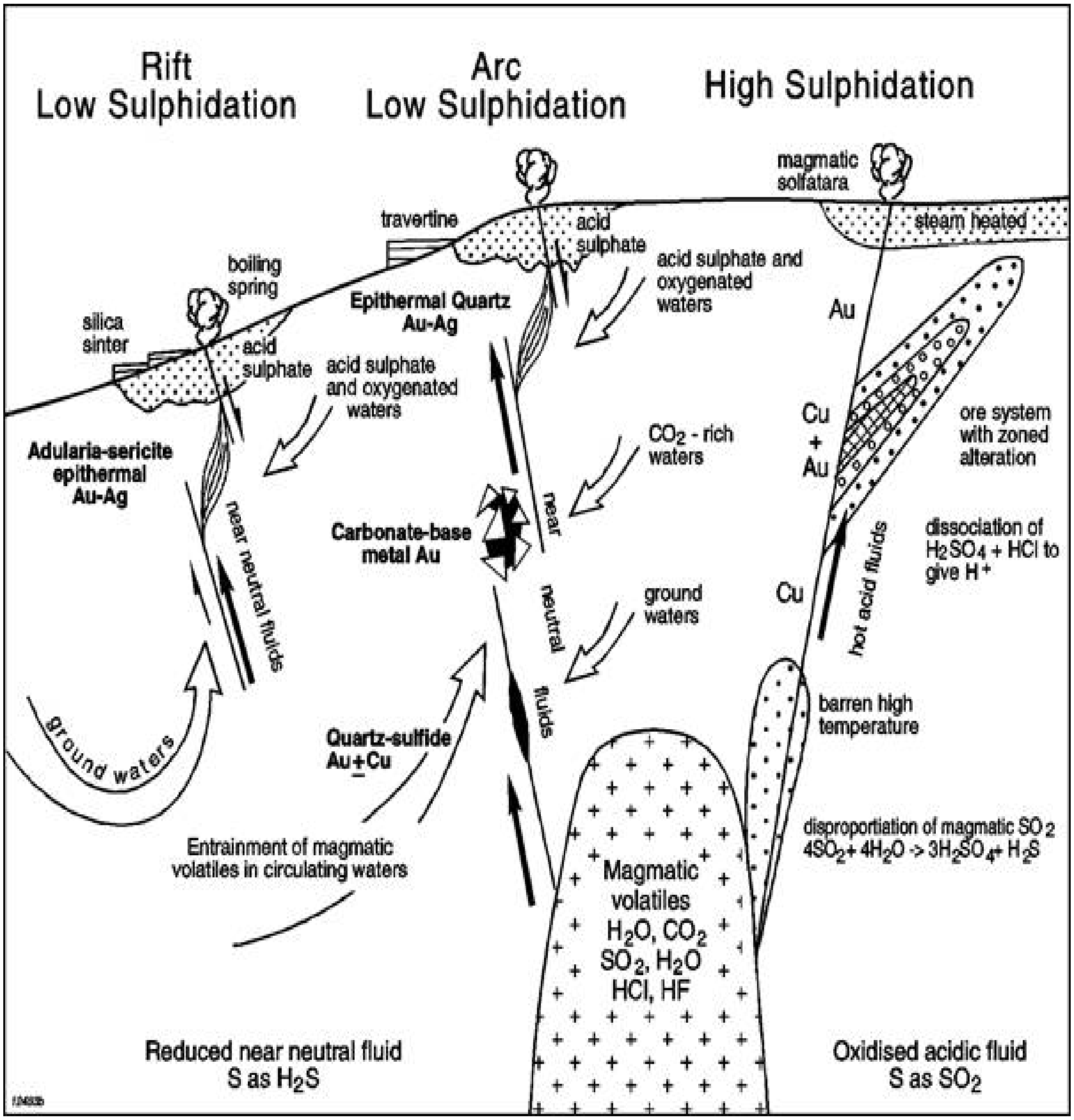
- Island arc association;
- Hosted in a sector-collapse amphitheatre developed in oxidised alkaline igneous rocks;
- Mineralisation hosted in vein stockworks, disseminated zones and breccias;
- Gold association with pyrite; often refractory;
- Low temperature/low salinity fluids.

The QP considers that exploration programs that use this model have a reasonable basis for exploration targeting for gold mineralisation in the Project area.

Table 8-1: Deposit Model Features

Item	Note
Global examples	Cripple Creek (Colorado, USA), Emperor (Fiji), and Porgera (Papua New Guinea)
Setting	Areas of thickened continental crust or in island arc environments
Host features	calderas, diatremes, hypabyssal intrusive stocks and volcanic sector-collapse amphitheatres
Host rocks	Oxidised alkaline igneous rocks to carbonaceous and sulphide-rich sedimentary rocks
Textures	Quartz and quartz-adularia veins, vein stockworks, disseminated zones and breccias
Mineralisation characteristics	Telluride-rich gold veins associated with quartz, carbonates, adularia, barite–celestite, fluorite (felsic rocks) and roscoelite (mafic rocks) Frequently refractory
Alteration characteristics	Neutral pH and K-silicate minerals such as adularia, illite, and muscovite. Near-surface zones of advanced argillic alteration (kaolinite–dickite–alunite–quartz) were identified at the Lihir deposit and the Emperor gold mine in Fiji
Sulphide associations	Pyrite-dominant Typically, base metal-poor, only containing traces of sphalerite, chalcopyrite, tetrahedrite and molybdenite, and typically containing more Au than Ag
Mineralising fluids	Temperature <300°C and are low salinity (less than 10 wt% NaCl eq.) with moderate to high CO_2 concentrations. Fluids must be relatively oxidised, based on the presence of sulphates (anhydrite, barite), hematite and/or magnetite
Isotopes	Some stable isotopes (δC, δS, δD and δO) suggest a high magmatic component but some δD values suggest a wider range of sources including groundwater and/or seawater

Figure 8-1: Genetic Model Schematic Porphyry–Epithermal Deposits



Note: Figure from Corbett, 2002.

9 EXPLORATION

9.1 Grids and Surveys

All models and drill holes are reported using the Lihir Mine Grid. This grid was established early in the Project history and is based on the Australian Geodetic Datum 1966 (AGD66). This was the principal datum for mapping and survey control in Australia (with a readjustment in some states in 1984) and Papua New Guinea until about 2000. UTM Grid coordinates in AGD66 are referred to as Australian Map Grid 1966 (AMG66) coordinates, with the Lihir deposit lying in Zone 56. 450000 metres is added to the Lihir Mine Grid eastings to obtain AMG66 Zone 56 eastings and 9650000 is added to the Lihir Mine Grid northings to obtain AMG66 northings.

The Papua New Guinea Geodetic Datum 1994 (PNG94) is the gazetted geodetic datum for Papua New Guinea and is the primary reference system for all cadastral surveys (including customary land surveys), airport surveys, and new resource sector surveys (commencing after 2000) in Papua New Guinea. UTM Grid coordinates in PNG94 are referred to as Papua New Guinea Map Grid 1994 (PNGMG94), with the Lihir deposit lying in Zone 56.

Site surveyors have established a set of geodetic datum transformations to support inter-grid conversions.

The topographic surface used to constrain the Mineral Resource and Mineral Reserve estimates is from a light detection and ranging (LiDAR) survey conducted in 2004.

9.2 Geological Mapping

As part of early-stage exploration activities, Kennecott conducted ridge-and-spur reconnaissance mapping. The Target B (Kinami prospect) area was mapped by Kennecott at 1:20,000 scale.

The 2018 mapping program at Target (B) Kinami conducted by Newcrest was at 1:10,000 scale.

Some in-pit mapping has been conducted as part of the research studies listed in Section 9.5. No regular pit mapping program is in place.

9.3 Geochemical Sampling

Geochemical sampling was initially performed by Kennecott, who completed an island-wide grassroots reconnaissance program. Soil, rock chip, and stream sediment samples were collected. These samples identified a number of areas of gold anomalism and alteration zones that could be indicative of epithermal-style mineralisation. As the work focus quickly shifted to the delineation of the Lihir deposit, the majority of these areas have had limited to no follow up.

Newcrest undertook a regional re-assessment of the exploration prospectivity of the island, and commenced exploration activities. The plan is to conduct systematic grid soil sampling in conjunction with geological mapping and rock chip sampling with low detection multielement analysis across existing anomalies to potentially define and rank drill targets.

As part of this program, 427 soil samples were collected during 2018–2019 over the Target B (Kinami) prospect. Sampling covered an area of 4.4 m^2, with samples spaced at 100 x 100 m. Infill sampling covered 1.8 km^2 at a 50 x 50 m spacing.

Creek mapping and sampling were conducted after the soil grid sampling was completed. Nearly all creek drainage within the Kinami caldera were traversed, mapped and sampled where alteration and mineralisation were noted. A total of 10.6 km was traversed and total of 326 samples collected. Sampling was done mostly as rock chips in the form of 2 m channels in alteration and mineralised zones and selective or single grabs in less altered/mineralised zones. Results are considered to warrant drill-testing.

9.4 Geophysics

The locations of the completed geophysical surveys are provided in Figure 9-1.

9.4.1 Airborne Surveys

A heliborne combined aeromagnetic/radiometric survey was flown by Geo Instruments Pty Ltd (Geo Instruments) in 1987, with coverage restricted to the Luise Caldera area and a small area to the north. The sensor was at a 60 m terrain clearance, with flight lines oriented north–south on 100 m line spacings.

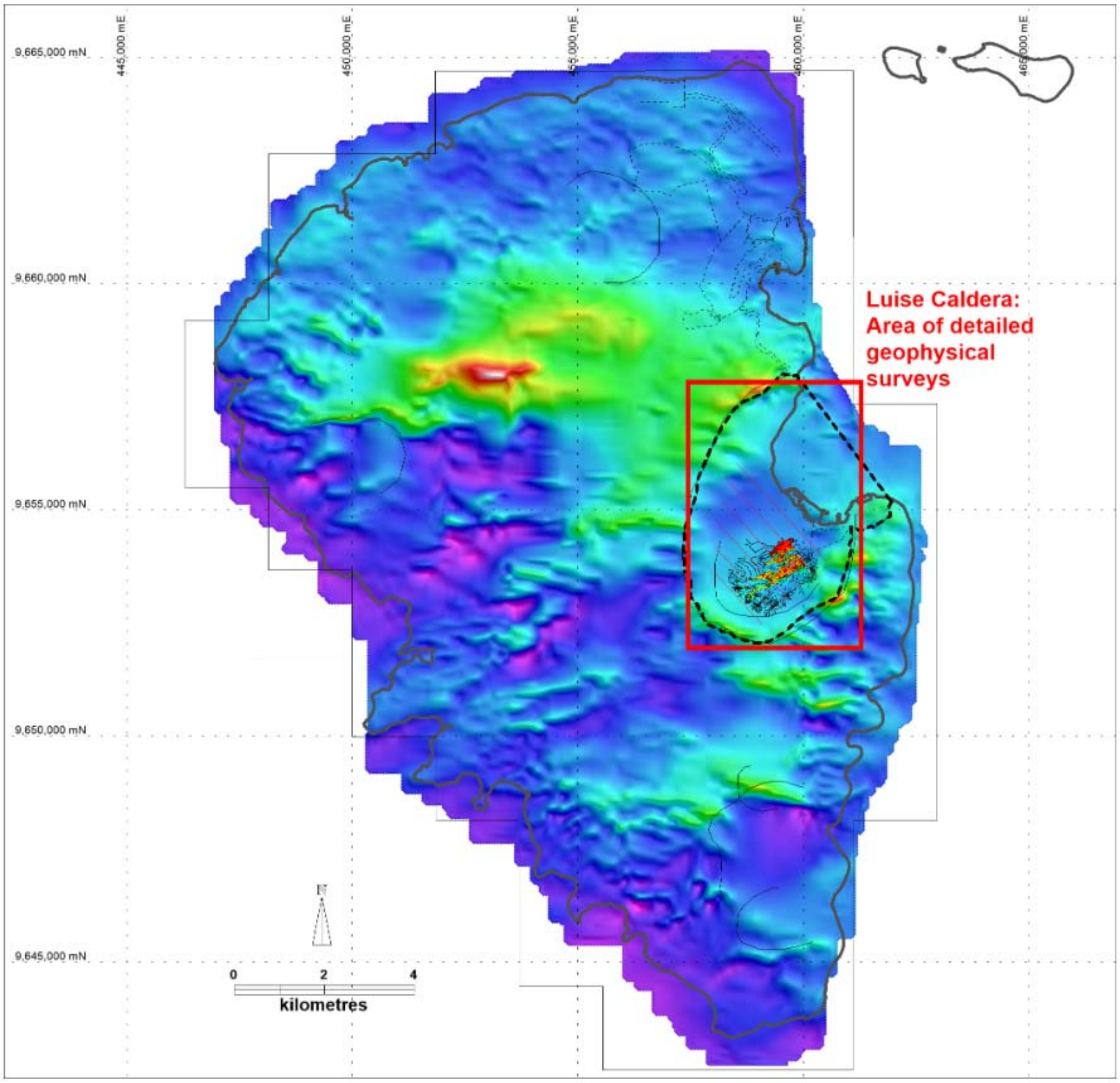
In 1988, the survey was extended island-wide. Lines were oriented north–south on 150 m line spacings, with a nominal 60 m terrain clearance. Due to levelling problems with the dataset, the survey information was not considered useable with the software available at the time.

World Geoscience Corporation re-levelled the data using new micro-levelling regimes in 1991, which produced usable images. Data interpretation showed a significant magnetic low co-incident with the Minifie pit sector.

9.4.2 Ground Surveys

Ground magnetic surveys were conducted in 1985 and 1990–1991. The 1985 orientation survey was within the Luise Caldera area, with readings taken at approximate 50 m spacings along variably-oriented lines following roads, tracks, ridges, spurs and the coastline. The survey prompted the 1987 airborne survey to be flown. The 1990 survey concentrated on the Minifie area, with 43.7 line-km of data collected on 10 m station spacing. The survey was extended in 1991 to cover much of the remaining Luise Caldera floor, using 100 m spaced lines and readings at 25 m intervals along the lines. The survey was used to determine if the mineralisation or alteration had a useable geophysical signature for exploration vectoring and targeting purposes.

Figure 9-1: Geophysical Survey Location Plan



Note: Figure prepared by Newcrest, 2020. Figure backdrop is the island-wide reduced-to-pole magnetic image. Surveys conducted within the Luise Caldera area include IP, ground magnetics, controlled-source audio-frequency magneto-tellurics and magneto-tellurics.

During 1990, a time-domain induced polarisation (IP) survey was undertaken, with the aim of better delineating structures that could potentially localise areas of higher grade. An initial 13 km of data was collected using a northwest–southeast oriented gradient-array survey with lines spaced 50 m apart. A total of 3.3 line km of pole–dipole survey was conducted using the same line orientations, but at 150 m spacing. These surveys were extended in 1991 to cover a total of 43.7 line km of gradient-array and 6.8 km of pole-dipole surveys, corresponding to most of the caldera floor. The surveys identified a resistivity and chargeability boundary along the southern edge of the Minifie pit sector.

The Luise Caldera area was subject to a controlled-source audio-frequency magneto-telluric (CSAMT) survey in 1991. The survey covered 12.25 line-km, using a 25 m station spacing and 400 m line spacing. The Minifie and Lienitz pit sector areas showed resistivity highs; and a similar boundary along the southern edge of the Minifie pit sector as identified in the IP data.

A 62-station magneto-telluric (MT) survey was conducted in 2004, in an attempt to define the area that had geothermal potential. An additional 57 stations were included in a 2007 survey. The 2007 survey and associated modelling results resulted in an expansion of the inferred geothermal resource to the west and north to that indicated by the 2004 survey. In addition, the 2007 geophysical survey results indicate that areas of warm spring activity evident elsewhere across Aniolam Island are not directly related to a high-temperature geothermal resource, and therefore have no geothermal power-generating potential.

9.4.3 Marine and Near-Shore Surveys

During 2012, an offshore shallow seismic reflection survey was conducted by Asian Geos Pty Ltd. in support of coffer dam designs, with the following aims:

- Determine accurate water depths within the survey site,
- Establish seafloor morphology through the survey area including checking for relevant seabed features related to obstructions;
- Evaluate sub-bottom (shallow) geological conditions, including the presence of palaeo-channels, evidence of anomalous structures (such as shallow faults);
- Assess intermediate geological conditions, including the presence of palaeo-channels, amplitude anomalies, anomalous structures (such as faults).

In January 2017, a trial of a range of geophysical techniques was completed by GBG Australia Pty. Ltd. in and around the inner harbour to investigate the sub-surface materials to better understand the nature of the geology to assist with geotechnical engineering design of the planned seepage barrier to be constructed between Luise Harbour and the open pit crest.

Marine hydrographical investigations included side-scan sonar, seismic reflection profiling, and seismic refraction Microtremor methods. Land-based surveys consisted of MASW (a seismic surface wave method for geotechnical applications), resistivity profiling and Tromino (passive seismic) readings. Interpretations of the surveys provided a provisional understanding of the inner harbour geological and geophysical setting, including evidence of a paleochannel and the extent of debris associated with the Kapit landslide.

A detailed geophysical survey was undertaken in January 2018 by Marine & Earth Sciences to assist with the site characterisation. Work completed included:

- Two continuous marine seismic refraction (CSMR) survey lines, oriented approximately north–south within the inner harbour;

- Two multi-channel marine seismic reflection survey along the same lines as the CSMR;
- Three MASW lines.

During April–May 2018, the geophysical survey was expanded to include additional five seismic refraction survey lines which were correlated to borehole data and a bathymetric survey of the Inner Harbour reflection surveys and three MASW lines. Survey data from the two programs will be subject to interpretation, and used in support of the seepage barrier designs.

9.5 Petrology, Mineralogy, and Research Studies

Newcrest and predecessor companies encouraged research on the Lihir deposit. A number of public papers on aspects of geology, mining and processing were presented by Newcrest and predecessor company staff, and by consultants working on the Project.

The following theses were completed:

- Ageneau, M., 2012: Geology of the Kapit Ore Zone and Comparative Geochemistry with Minifie and Lienetz Ore Zones, Ladolam Gold Deposit, Lihir Island, Papua New Guinea: unpublished PhD thesis, University of Tasmania, 269 p.;
- Blackwell, J.L., 2010: Characteristics and Origins of Breccias in a Volcanic-hosted Alkalic Epithermal Gold Deposit, Ladolam, Lihir Island, Papua New Guinea: unpublished PhD thesis, University of Tasmania, Australia, 203 p.
- Carman, G.D., 1994: Genesis of the Ladolam Gold Deposit, Lihir Island, Papua New Guinea: unpublished PhD thesis, Monash University, Australia, 381 p.
- Cater, G., 2002: Deep Hydrothermal Alteration at the Ladolam Epithermal Gold Deposit, Lihir Island, Papua New Guinea: unpublished MSc thesis, University of Auckland, New Zealand, 94 p.
- Lawlis, E., in prep.: Geology and Geochemistry of the Kapit NE Prospect, Lihir Gold Deposit, Papua New Guinea: unpublished PhD thesis, University of Tasmania, Australia.
- Sykora, S., 2016: Origin, Evolution and Significance of Anhydrite-Bearing Vein Arrays and Breccias, Lienetz Orebody, Lihir Gold Deposit, Papua New Guinea: unpublished PhD thesis, University of Tasmania, Australia.

Age date and fluid inclusions studies were conducted.

9.6 Exploration Potential

Newcrest undertook a desktop review of historical exploration information in 2016, which defined the following grassroots exploration targets:

- Target A (Upper Londolovit): potential porphyry target; consists of elevated copper and molybdenum values in rock chip samples with subordinate gold anomalism; elevated molybdenum values in stream sediment sampling, and an overall manganese-zinc depletion anomaly. Co-incident radiometric anomaly and visible surface clay alteration;

- Target B (Kinami): potential epithermal target; consists of anomalous gold and arsenic values in rock chip sampling. Co-incident large outcropping argillic alteration zone;
- Target C (Wurtol River): potential epithermal and porphyry target; consists of anomalous gold, copper and silver values in rock chip sampling; associated with elevated potassium, tellurium, antimony and arsenic assays. Anomalous gold, silver and tellurium values in stream sediment sampling. Co-incident visible argillic and phyllic alteration. Warm springs in vicinity. Visible gold noted in adjacent drainages; soil sampling observed rare veins;
- Target D (East Lakakot): potential porphyry target; consists of low-order copper–molybdenum anomalism in stream sediments; elevated copper, molybdenum, zinc, and manganese assays in soil sampling. Co-incident radiometric anomaly and visible surface clay alteration;
- Target E (Huniho): potential epithermal target; consists of low-order gold–copper anomalism in stream sediment samples; arsenic–antimony anomaly evident from soil sampling. Some evidence of silica alteration associated with northeast-trending structures; weak fracture-controlled argillic alteration;
- Target F (Illkot): potential epithermal target; consists of anomalous gold values in soils and elevated gold and silver values in rock chip samples. Associated with argillic alteration. Surface channel sampling encountered significantly anomalous gold values in association with banded quartz veins that display elevated arsenic, silver, tellurium and antimony grades.

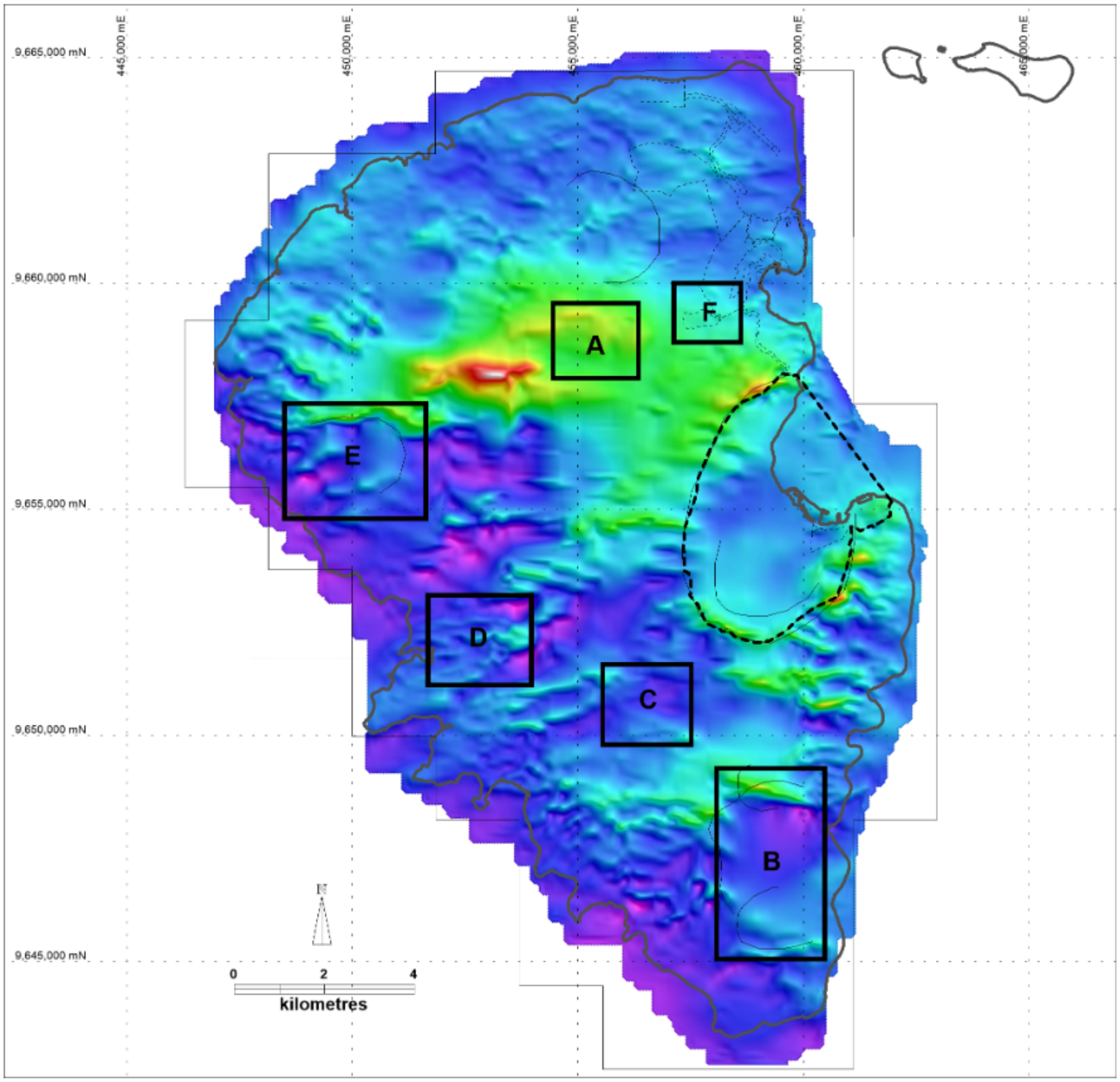
Target locations are shown in Figure 9-2.

9.7 QP Comments on "Item 9: Exploration"

In the QP's opinion:

- The exploration programs completed to date are appropriate to the style of the deposits and prospects;
- Exploration potential remains on the island, with six grass-roots targets that have potential for epithermal or porphyry-style mineralisation warranting investigation.

Figure 9-2: Exploration Targets



Note: Figure prepared by Newcrest, 2020.

10 DRILLING

10.1 Introduction

Drilling completed to 30 June, 2020 comprises core drilling. Drilling was completed for exploration, resource delineation, metallurgical, geotechnical, pit cooling, and geothermal purposes, and totals 3,703 holes (721,105 m). A total of 2,295 drill holes (449,287.23 m) is used in estimation.

Table 10-1 summarises the drilling to 30 June, 2020, by company; Table 10-2 provides the drill hole totals by purpose, on a Project-wide basis, and Table 10-3 summarized the drilling used in Mineral Resource estimation. Drill hole collars are shown in Figure 10-1 for the Project as a whole and in Figure 10-2 for the drill holes supporting the Mineral Resource estimate.

10.2 Drill Methods

Core sizes drilled included PQ (84.8 mm core diameter), HQ (63.5 mm core diameter) and NQ (47.6 mm core diameter). Triple tube methods are routinely used for geotechnical drilling.

RC drilling is conducted on low-grade stockpiles for the purpose of constructing run-of-mine (ROM) stockpiles.

10.3 Logging Procedures

All data collection and sampling are conducted on site at the Lihir Operations core processing facility, which includes logging sheds, core cutting, and storage areas.

Geological logging is performed using acQuire software to record observations made on core and percussion chips into touch screen and laptop computers. The data are then transferred into various database systems depending on desired end usage of the data.

The drill core logging system consists of seven log sheets (windows) into which data are entered, including:

- Collar;
- Lithology;
- Discontinuities;
- Point load tests;
- Geotechnical;
- Bulk density;
- Magnetic susceptibility.

Table 10-1: Drill Summary Table by Company

Company	Number of Drill Holes	Metres Drilled (m)
Kennecott	519	88,551
Lihir Gold	447	129,490
Lihir Gold/Rio Tinto	967	265,848
Newcrest	923	190,877
Unknown	843	46,101
Totals	***3,699***	***720,867***

Note: Unknown = no company name recorded in the current database. Metreage may not sum as totals were rounded.

Table 10-2: Drill Summary Table by Drill Purpose

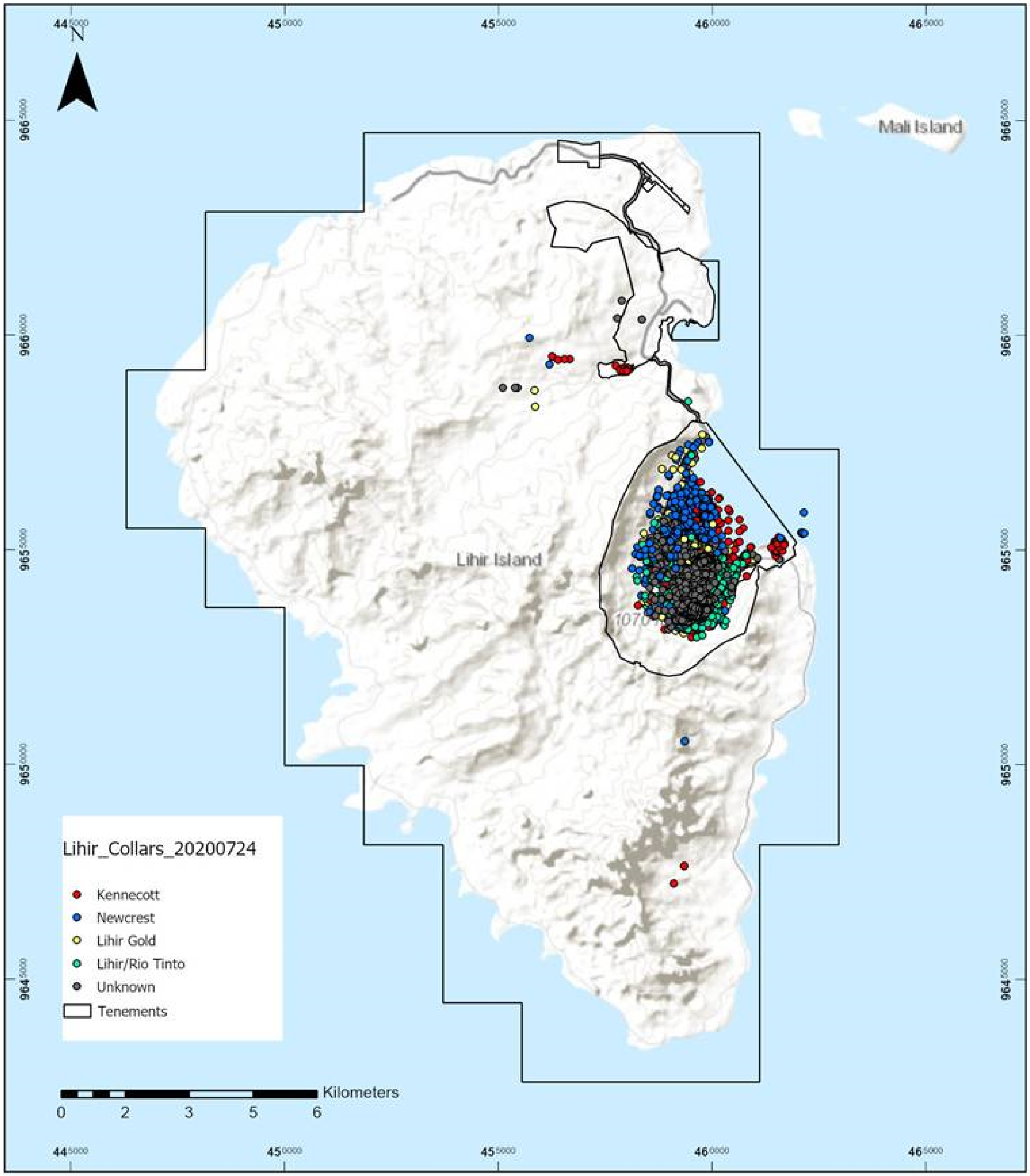
Purpose	Number of Drill Holes	Metres Drilled (m)
Exploration	23	4,383
Geotechnical	1,077	100,297
Geothermal	298	163,815
Pit cooling	5	1,307
Resource/mine	2,279	443,839
Metallurgy	17	7,226
Totals	***3,699***	***720,867***

Note: Metreage may not sum as totals were rounded.

Table 10-3: Drilling Used in Mineral Resource Estimation

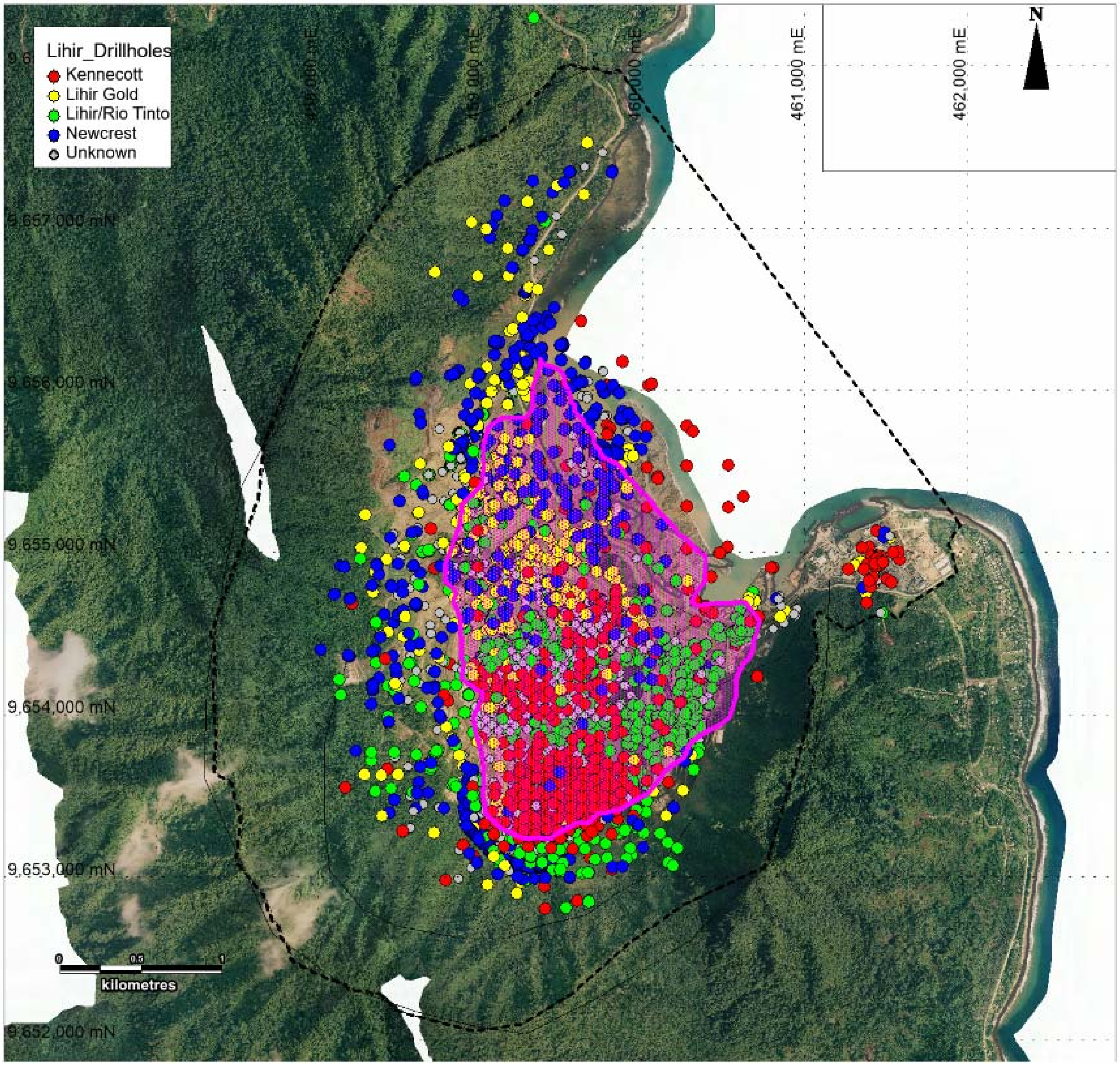
Company	Drill Purpose	Number of Drill Holes	Metres Drilled
Kennecott	Geothermal	1	750.3
	Resource/mine	409	83,815.1
Lihir Gold	Geotechnical	1	125.3
	Geothermal	2	800.26
	Resource/mine	165	49,220.47
Lihir Gold/Rio Tinto	Geotechnical	1	1,044.39
	Resource/mine	787	211,729.9
Newcrest	Geotechnical	12	2,410.6
	Geothermal	3	1,150
	Resource/mine	176	55,709.24
Unknown	Resource/mine	737	42,531.67
Totals		***2,295***	***449,287.23***

Figure 10-1: Project Drill Collar Location Plan



Note: Figure prepared by Newcrest, 2020.

Figure 10-2: Drill Collar Locations Supporting Mineral Resource Estimate



Note: Figure prepared by Newcrest, 2020. Magenta outline shown is the outline of the resource model. Dashed outline is the ML boundary.

The individual logger is required to ensure data validation is complete prior to merging new data into the central database.

Lithology is logged based on the geological unit, with subdivision created based on alteration and mineralisation. The lithology intervals form the base cases for all geotechnical domains.

Detailed geotechnical data are not routinely obtained from all core drill holes; however, basic geotechnical parameters such as rock quality designation (RQD), recovery and fracture frequency) are collected.

All core holes are processed in-house by, in order, orienting, marking-up, and then photographing.

10.4 Recovery

There are only minor zones of lost core or poor core recovery, which are usually restricted to broken or faulted ground and areas of high clay contents in the upper sections of the deposit. Core recovery is generally excellent with core recoveries around 99%.

Historical comparison of core data with blasthole data suggests no appreciable bias related to core recovery.

10.5 Collar Surveys

Drill collar locations were surveyed using either theodolite or differential global positioning system (DGPS) instruments.

Current drill collars are surveyed using the Lihir Mine Grid. Mine surveyors either locate, or lay out design locations for drill collars using DGPS instruments.

10.6 Downhole Surveys

A variety of methods were used to measure down-hole deviation (dip and azimuth), including Eastman and electronic single shot instrument; the majority of readings were performed using the Eastman camera. Gyroscopic survey methods are typically used for geotechnical drill holes. Depending on the drill hole purpose, not all drill holes may be down-hole surveyed.

Survey station spacing generally ranges from 30–50 m down-hole intervals, depending on the age of the drill hole and the survey instrument used. However, in some drill holes there can be several hundreds of metres between survey depths.

10.7 Grade Control

Grade control spacing is carried out at 5 x 6 m spacing, with hole depths of 12–14 m. Holes are completed using Sandvik D55, Atlas Copco PV271 or Atlas Copco D65 blast hole drill rigs. A separate grade control database is maintained at the mine site.

10.8 Drilling Completed Since Close-out Date for Database Supporting Mineral Resource Estimation

A total of 370 geotechnical, pit cooling, and geothermal drill holes (approximately 25,544 m) were completed since the Mineral Resource estimate database close-out date. These drill holes are included in the totals in Table 10-1, but have not been assayed. A total of 141 geotechnical, pit cooling, and geothermal drill holes (approximately 11,242 m) fall within the resource outline.

The geotechnical drilling typically consists of short drill holes, drilled at a very small diameter, frequently using tri-cone blades or RC techniques, that are used to provide geotechnical and hydrological information on the pit walls, in particular information on structures that represent distinct competency contrasts that can localize geothermal outbursts. These drill holes may also serve as pit wall drainage. The sample size is not suitable for use in resource estimation, and therefore is not assayed.

The pit cooling drill holes, including steam relief wells, are used ahead of mining, to depressurize any potential high pressure traps and also to cool down the ground. The pit cooling holes are specialist small-diameter drill holes, generally completed using tri-cone blades. The sample generated is not suitable for use in resource estimation, and therefore is not assayed.

Geothermal steam is used to support the power requirements of the mining and processing operations. Because of restricted access due to mining operations, and to keep the wellheads outside the pit boundaries, geothermal wells are typically directionally drilled, and angled so as to pass under the LOM base of the open pit (i.e. not to intersect the main mineralization) and intercept permeable zones that can be tapped for geothermal power production. Geothermal drill holes are specialist drill holes that are usually completed using tri-cone blades, and are usually also small diameter holes (“slim-holes”). The sample generated is not suitable for use in resource estimation, and therefore is not assayed.

The structural information from the geotechnical drilling, where those drill holes have been geotechnically logged, may have a local effect on the structural interpretations, but is not expected to have a material effect on the Mineral Resource estimate.

10.9 Sample Length/True Thickness

As discussed in Section 7.3.7, the geological model is based on alteration domains. These domains are essentially horizontally layered, with clay-altered argillic materials at the surface, and relic porphyry alteration at depth. A horizon of epithermal-style mineralisation exists between these two alteration domains, as epithermal fluids have flooded laterally through porous and fractured host rock.

Drilling is typically near-vertical. This drill orientation is acceptable for the majority of the mineralisation orientation, and results in drilled widths that approximate true widths.

Drill spacing is variable, as there are limited drill platform sites available due to the rugged topography. Drilling can vary from 40–100 m spacing, depending on the available drill platform locations.

10.10 QP Comments on "Item 10: Drilling"

In the opinion of the QP, the quantity and quality of the logged geological data, collar, and downhole survey data collected in the exploration and infill drill programs conducted by Kennecott, Lihir Gold, Rio Tinto and Newcrest are sufficient to support Mineral Resource and Mineral Reserve estimation and mine planning as follows:

- Collar surveys were performed using industry-standard instrumentation at the time the drill program was conducted;
- Downhole surveys were performed using industry-standard instrumentation at the time the drill program was conducted;
- Recovery data from core drill programs are acceptable;
- Drill orientations are generally appropriate for the mineralisation style and the orientation of mineralisation for the bulk of the deposit area (refer to drill sections in Section 7);
- Drilling practices, logging, collar surveys and downhole surveys were periodically reviewed by Newcrest personnel and independent auditors (refer to Section 12) and indicate no material issues with the data practices or collection methodologies;
- The drilling pattern provides adequate sampling of the gold mineralisation for the purpose of estimating Mineral Resources;
- Sampling is representative of the gold grades in the deposit areas, reflecting areas of higher and lower grades;

To the knowledge of the QP, no material factors were identified with the data collection from the drill programs that could significantly affect Mineral Resource estimation for the Lihir deposit.

11 SAMPLE PREPARATION, ANALYSES, AND SECURITY

11.1 Sampling Methods

11.1.1 Geochemical Sampling

No information as to the early Kennecott geochemical sampling is available.

The soil sampling completed by Newcrest in 2018–2019 used a manual auger drill to sample the C-horizon.

11.1.2 Core Sampling

After core logging, the current procedure is to draw a cut-line on the core and photograph the core. Intact and competent drill core is cut in half along the cut-line using a diamond saw. Where the core is too soft to be cut with a diamond saw, a knife is used to cut the core in the core tray. Where the core is too broken or brittle to be cut by the saw, the fragments are manually sampled.

The nominal sampling interval is 2 m; however, sampling intervals may vary. In particular, samples taken for metallurgical purposes may be significantly longer than the nominal sample interval.

The left-hand half of the core is placed in a calico bag marked with the appropriate sample number and sent to the laboratory for sample preparation and assaying.

11.1.3 RC Sampling

The historical RC holes were drilled to 36 m depth with one sample collected every 6 m rod for a 100 mm diameter hole. No sample recovery records are collected for RC drilling.

Prior to 2019 the primary RC samples were collected after a straight flush through a cyclone and cone splitter. The sample was transferred by plastic tubs to a multi-deck riffle splitter for the collection of a 3 kg sample. During 2019, a cone splitter was adopted as the principal sample splitter.

11.1.4 Sonic Sampling

Sonic drill campaigns were completed for metallurgical and geotechnical purposes, and are not used to support Mineral Resource estimates.

Sonic drill holes completed for geotechnical purposes were selectively sampled to provide samples for unconfined compressive strength (UCS), point load, and other geotechnical tests.

Sonic drill holes completed for metallurgical purposes were sampled at interval lengths ranging from 6–15 m, length to align with compositional variation as determined via Corescan.

11.1.5 Ore Control (Blasthole) Sampling

Blasthole sampling is conducted in the open pits on the cone of material produced when drilling an open hole percussion hole, approximately 229 mm diameter to a depth of 14 m. This generates approximately 1.2 t of sample of mixed clay and gravel.

During the earlier mining programs, sampling was carried out with a push tube (pipe spear) manually inserted into the blast cone at 5–8 locations and deposited in a calico bag for an approximate 2.5–3 kg sample. From 2012, the sample tube was replaced with an electric auger. A sampling investigation was conducted by Agoratek International to confirm similar precision in both sampling styles.

11.2 Density Determinations

The physical density determination was undertaken on solid pieces of core, typically, 10 cm in length. Intervals for density determination are selected according to lithology or alteration/mineralisation type (as defined by the geologist). The measurements are performed on site as part of the logging process by geological assistants.

Measurements are generally taken at 50 m intervals down hole, or more frequently if required. Density is determined by calculating the volume after measuring the diameter and length of the core with a Vernier calliper then weighing the selected interval on a balance. The density is then calculated by the following formula;

- Density = weight/(π * (diameter/2)^2 * length).

There is a total of 11,535 determinations available for resource estimation. Density gravity values range from 6.75 t/m^3 in fresh rock to 1.01 t/m^3 in altered and oxidised material.

11.3 Analytical and Test Laboratories

A number of third-party, independent analytical and sample preparation laboratories were used prior to 1997, including Pilbara Laboratories (subsequently underwent name change to Analabs, later Genalysis), SGS and ALS Chemex. There is no accreditation data available in the Project database for these laboratories at the time of use.

The onsite laboratory was constructed in 1997, and has been the primary preparation and analytical laboratory since that date. The onsite laboratory is not independent and holds no accreditations. After commissioning, the onsite laboratory was operated by Lihir Gold until 2010. The onsite laboratory has been operated by Newcrest since 2010.

Standard and Reference Laboratories, located in Perth, Western Australia, was used as a check laboratory during 2012. The laboratory was independent, and accredited to ISO9001 at the time of use. Standard and Reference Laboratories became part of the Inspectorate group, now Bureau Veritas.

From 2010, samples were sent to SGS Lae, SGS Townsville, ALS Chemex Brisbane or the Newcrest Services Laboratory in Orange (NSLO) for check or additional analysis. Any of these laboratories could be used for primary analysis for selected samples. There is no accreditation data available in the Project database for SGS Lae, or SGS Townsville. ALS Chemex Brisbane and the NSLO hold ISO17025 accreditations.

11.4 Sample Preparation and Analysis

Currently, gold and sulphide sulphur assays are performed at the onsite laboratory. Samples can be sent to NSLO; however, this is primarily done for metallurgical samples and samples requiring multi-element analyses.

11.4.1 Sample Preparation

11.4.1.1 Legacy

Sample preparation procedures for the majority of the legacy data are not recorded in the Project database.

Standard and Reference Laboratories used a wet screen sizings at 75 µm, and this was reported as the percentage passing 75 µm. No other information is available.

Preparation methodologies for the legacy data are not recorded in the Project database.

11.4.1.2 Current

The current procedure at the onsite laboratory is to:

- Samples are dried in an oven at 105°C;
- Each 3 kg sample is pulverised using a Labtechnics LM5 pulverising mill to specified grind parameters of 95% passing 106 µm;
- A 200 g sub-sample is collected for analysis and submitted to the assay laboratory.

A similar preparation protocol is used at NSLO.

11.4.2 Analysis

Where known, analytical methods and detection limits are provided in Table 11-1.

11.4.2.1 Legacy

Analytical methodologies for the majority of the legacy data are not recorded in the Project database. Information recorded typically consists only of the element and detection limit.

Standard and Reference Laboratories used method code FA9 for gold analysis, whereby a gold–silver prill was dissolved in aqua regia and determined instrumentally via AAS.

11.4.2.2 Current

Samples are routinely analysed for gold, copper and sulphide sulphur. The onsite laboratory uses a 25 g aliquot that is fire assayed with an AAS finish for gold. Sulphur is assayed via a LECO instrument, using a proprietary LMC technique.

The NSLO uses a 30 g aliquot that is fire assayed with an AAS finish for gold. The major analytical focus at the NSLO is multi-element analysis.

Results are electronically recorded and sent to the Geology Department to be uploaded to the resource database for checking and validation.

Table 11-1: Assay Techniques and Detection Limits

Laboratory	Method	Element
ALS Chemex	ME-ICP41	Hg (1 ppm); K (0.01%); La (10 ppm); Mg (0.01%); Mn (5 ppm); Mo (1 ppm); Na (0.01%); Ni (1 ppm); P (10 ppm); Pb (2 ppm); S (0.01%); Sb (2 ppm); Sc (1 ppm); Th (20 ppm); Ti (0.01%); Tl (10 ppm); U (10 ppm); W (10 ppm); Zn (2 ppm);
Onsite laboratory (Lihir Gold)	AU25	Au (0.02, 0.1 ppm)
	*	Cu (0.1 ppm)
	*	S (0.01%)
Onsite laboratory (Newcrest)	AU25	Au (0.01 ppm)
	LECO	C (0.01%)
	*	Cu (0.01%)
	LECO	S (0.01%)
NSLO	MEAD4MS	Ag (0.05, 0.1 ppm); As (1 ppm); Ba (0.05, 0.1 ppm); Be (0.1, 0.2 ppm); Bi (0.005, 0.05 ppm); Cd (0.02, 0.05 ppm); Cs (0.005, 0.1 ppm); Ga (0.02, 0.2 ppm); Ge (0.05, 0.2 ppm); Hf (0.01, 0.1 ppm); In (0.005, 0.05 ppm); Li (0.02, 0.1 ppm); Mo (0.02, 0.1 ppm); Nb (0.01, 0.1 ppm); Rb (0.02, 0.1 ppm); Re (0.005, 0.5 ppm); Sb (0.05, 0.1 ppm); Sc (0.05, 0.1 ppm); Se (0.1, 2 ppm); Sn (0.1 ppm); Sr (0.05, 0.5 ppm); Ta (0.01, 1 ppm); Te (0.01, 0.1 ppm); Th (0.005, 0.5 ppm); Tl (0.01, 0.02 ppm); U (0.005. 0.05 ppm); Y (0.01, 0.1 ppm); Zr (0.05, 0.5 ppm)
	MEAD4OES	Ag (0.2 ppm); Al (0.01%, 50, 100 ppm); As (2 ppm); Ba (0.5 ppm); Ca (0.01%, 50, 100 ppm); Cd (0.2 ppm); Ce (2 ppm); Co (0.5, 3 ppm); Cr (1, 2 ppm); Cu (2, 3 ppm); Fe (0.01%, 100 ppm); Hf (0.5 ppm); K (0.01%, 40, 100 ppm); La (1 ppm); Mg (0.01%, 20, 100 ppm); Mn (0.5, 1 ppm); Na (0.01%, 50, 100 ppm); Ni (1, 2, 5 ppm); P (5, 10 ppm); Pb (2, 10, 15 ppm); S (0.01%, 50, 100 ppm); Sc (0.2, 5 ppm); Sr (10 ppm); Ta (1 ppm); Ti (0.01%, 50, 100 ppm); V (2, 5 ppm); W (1, 3, 5 ppm); WO3 (0.005%); Y (0.2 ppm); Zn (0., 1, 2 ppm); Zr (0.1 ppm)
	CUAD5AAS	AsCu (10 ppm)
	FA301	Au (0.01 ppm)
	LECO	C (0.01%, 0.02%; S (0.01%, 0.2%)
	AAS3A	Cu (0.01%)
	ICP3AO	Cu (0.01 ppm)
	CuCN	CuCN (5 ppm)
	XRFOR1	Fe (0.01%), S (0.01%); SO_4 (0.01%, 0.2%)
Standard and Reference Laboratories	*	Ag (1 ppm); As (20 ppm); Ba (1 ppm); Sb (1 ppm)

Note: * method not recorded in database.

11.5 Quality Assurance and Quality Control

11.5.1 Procedures

All assays are checked and verified in accordance with the Newcrest Resource Development quality assurance quality control (QA/QC) and database management procedures. QA/QC procedures were in place for all of the legacy drilling programs. A detailed QA/QC program is in place for ongoing assessment of sampling and analytical procedures. The process can involve submission and analysis of some or all of the following:

- Blind submissions of standard reference materials (SRMs) to the onsite laboratory;
- Duplicates from the LM5 pulveriser pulp, assayed during the same batch;
- Blind resubmission of pulps to the onsite laboratory;
- Replicate submissions of pulps to an alternative laboratory for analysis;
- Replicate submissions of coarse duplicates to an alternative laboratory for analysis;
- Submission of coarse blank samples (non-Aniolam Island barren rock samples);
- Checks on grind and crush size from the sample preparation steps;
- Visits to the laboratory for confirmation of actual procedures applied;
- Monthly QA/QC meetings with laboratory personnel.

A monthly report is prepared for the site Mineral Resource Manager detailing QA/QC performance and an annual report is prepared to support the documentation of the Mineral Resource estimate.

11.5.2 Pre-2012 QA/QC

11.5.2.1 Standard Reference Materials

A total of 14 SRMs were used. The LMC series (LMC1-6) were used until the end of 2008 and the LGL series (LGL7-14) were brought into use progressively from November 2008 (LGL7) until July 2010 (LGL13). Both the LMC and LGL series were matrix-matched to materials from the Lihir deposit. Ore Research and Exploration Pty Ltd prepared the LGL SRMs. Best values for the LGL series were estimated for gold, sulphide sulphur and total sulphur.

Best values for the LMC series may have been estimated for gold only; there are no sulphur best values data in the database and the certificates are not available. SRM performance is generally unacceptable for the evaluation period, largely because of the extreme number of SRMs that appear to have been mislabelled or swapped with routine samples.

11.5.2.2 Blanks

Blank samples were inserted in the sample stream. The database contains records for 598 gold blanks, all dating from between March 2008 and the end of 2010. There are two groups of blanks, and two different lower detection limits. There are few spikes in the data with the higher detection limit. The other data; however, show poorer control, frequent results above 0.2 ppm and some spikes that appear to be sample swaps.

11.5.2.3 Duplicates

A total of 10,006 pulp duplicates were analysed prior to November 2009. The mean bias is +10% suggesting the likely presence of a number of sample swaps. There are 1,137 duplicate samples after November 2009. Precision was 13.7% for the entire data set improving to 8.3% for pair averages of 0.5 ppm or better and 5.3% for pair averages of 2 ppm or better.

11.5.2.4 Check Assays

Approximately 49,500 samples that were analysed by the site laboratory between 2000 and 2005 were reanalysed by Standard and Reference Laboratories. The reanalyses were completed for gold only. There are large discrepancies between the two laboratories' results for individual samples, but the averages are similar. As far as can be ascertained in a data set with such poor precision, there is an inconsistent, generally positive, bias.

In 2010, 167 samples plus eight SRMs were sent to Standard and Reference Laboratories for gold-assay checks. Standard and Reference Laboratories analysed the samples in duplicate. Agreement between the two laboratories was good. There is no record of any check assays for sulphur for this time period.

11.5.2.5 Observations and Interpretations

Historical QA/QC (through 2011) performance was relatively poor (see discussion in Section 12.3), and all control measures used indicate that there were problems at the mine with sample mix-ups, swaps and mislabelling of control samples, and by inference, the routine drill samples. However, in summary:

- Accuracy for this time period cannot be reliably estimated because of the erratic assays of standards;
- Contamination is low and acceptable for much of the time covered. The later months appear to have numerous sample swaps so no conclusions can be made;
- Precision appears to be adequate;
- Check assays for gold indicate that gold bias is quite small and acceptable.

The gold data suggested there was a systematic negative bias in the onsite laboratory performance for gold of the order of -5%.

The data for sulphide sulphur analysis suggests there was a systematic positive bias in the onsite laboratory performance for sulphur of the order of 15–20%. The positive bias is considered to be due to the degradation of the LabFit procedure over time such that it measured total sulphur rather than the sulphide sulphur the procedure was established for, and also the procedure used to generate the expected value of the SRMs. However, the sulphide sulphur assays are used for metallurgical characterisation and are not directly applied to Mineral Resource and Mineral Reserve estimates.

Historical QA/QC results do not suggest there is a serious bias in the performance of the onsite laboratory itself in terms of gold analysis. Therefore, whilst there are concerns over the accuracy of individual samples, this problem does not translate into a concern at a global level.

In the QP's opinion, the QA/QC data indicates the historical (prior to 2011) sample preparation, security and analytical procedures were adequate and results independently verified and as such the data are considered to be acceptable inputs for Mineral Resource estimation.

11.5.3 2012–2019 QA/QC

Batches are prepared for gold assaying with 40 primary samples and six laboratory QA/QC (three SRMs, two duplicates, one blank). Field samples are submitted with around 37 primary samples plus three geology QA/QC samples.

11.5.3.1 Grind Size

Review of grind size compliance shows a steady improvement after 2015.

11.5.3.2 Blanks

Barren flush material is used at the start of every batch or if clay build up is noticed in the pulveriser. Blank samples are inserted with the primary samples at a rate of one in 40. In addition, the laboratory uses a barren flush (not assayed) at the start of every batch, and if pulveriser bowls have residual clay in them. Flushes are prepared from ceramic pots that are broken into the bowls. During 2019 the geology blanks have generally been made up from the same ceramic pots.

Evaluation of the blank data suggests there have been 10 probable sample swaps in the 2012–2019 period, and four blank failures.

11.5.3.3 Crush Duplicates

Crush duplicate precision for gold is within corporate standards for both laboratories. The higher imprecision for NSLO is most likely due to the sample type being predominately drill core. The onsite laboratory processed more RC samples from stockpiles, which would generate more fines in the crushing process.

11.5.3.4 Pulp Duplicates

Laboratory duplicates represent two pulp packets collected from the crusher or the pulveriser, a replicate is a repeat analysis from the one pulp packet. Results from the NSLO laboratory suggest a slightly higher imprecision than the corporate standard. No pulp duplicates were collected from the onsite laboratory.

11.5.3.5 Pulp Replicates

Laboratory duplicates represent two pulp packets collected from the crusher or the pulveriser, a replicate is a repeat analysis from the one pulp packet. Pulp replicate assays are provided by the laboratory as evidence of internal QA/QC. Review of the data indicate that the NSLO laboratory has nearly double the imprecision of the onsite laboratory (8.4% vs 3.3% respectively). However, both are within the corporate standard of 10%.

11.5.3.6 Standard Reference Materials

SRMs are prepared and certified by Oreas, and are sourced from in-pit blast hole material (matrix-matched).

Evaluation of the 2012–2019 data suggests a number of sample swaps. SRMs are stored on site in sealed 30 g packets. This is only sufficient for one fire assay, so when an SRM is submitted there are two packets supplied. This may lead to sample mix-ups if two different SRMs are combined as one sample.

Monthly performance is charted by developing a "Z score" for all of the combined SRM assays in respect to individual economic and the main deleterious elements. The results are considered acceptable.

11.6 Databases

Data are stored in a SQL server database using acQuire software. Assay data and geological data are electronically loaded into acQuire and the database is replicated to Newcrest's centralised database server. The geological team on-site currently manages all data.

Data are collected from geotechnical logging, geological logging and drilling data (collar, survey) and imported/logged directly into the acQuire database. Regular reviews of data quality are conducted by site and corporate teams prior to resource estimation, in addition to external reviews.

Exclusive control over the checking and entry of analyses from the laboratory is restricted to database administrator(s) and designated geologists. Login and access permissions are limited to control access to the database and to maintain the integrity of the resource data. Data access is generally limited to project geologists and the database administrators.

The database is regularly backed up, and copies are stored in both offsite and in Newcrest facilities.

11.7 Sample Security

Sample security at the Lihir Operations has not historically been monitored. Sample collection from drill point to laboratory relies upon the fact that samples are either always attended to, or stored in the locked on-site preparation facility, or stored in a secure area prior to laboratory shipment.

Chain-of-custody procedures consist of sample submittal forms to be sent to the laboratory with sample shipments to ensure that all samples are received by the laboratory.

11.8 Sample Storage

Grade control samples submitted to the site laboratory are retained as 300 g pulps for a period of three months and then discarded.

Drill core samples are retained as half core and 300 g sample pulps at the exploration core shed. This incorporates an undercover pallet storage area as well as numerous sea containers. Some of the containers are freezer units for selective samples required for metallurgical testing.

11.9 QP Comments on "Item 11: Sample Preparation, Analyses, and Security"

In the opinion of the QP, the sample preparation, analysis, and security practices and results for the Kennecott, Lihir Gold, Rio Tinto and Newcrest programs are acceptable, meet industry-standard practice, and are adequate to support Mineral Resource and Mineral Reserve estimation and mine planning purposes, based on the following:

- Drill sampling was adequately spaced to first define, then infill, gold anomalies to produce prospect-scale and deposit-scale drill data;
- Sample preparation for core samples followed a similar procedure since Newcrest acquired the project in 2010. The preparation procedure is in line with industry-standard methods;
- Analytical methods for core samples used similar procedures for the core drill programs. The analytical procedure is in line with industry-standard methods;
- QA/QC submission rates are typical for the time of collection, and do not indicate any problems with the analytical programs, therefore the gold analyses from the core drilling are suitable for inclusion in Mineral Resource estimation;
- Newcrest used a QA/QC program comprising blank, SRM and duplicate samples. The QA/QC submission rate meets current industry-accepted standards of insertion rates;
- Data collected prior to the introduction of digital logging were subject to validation, using inbuilt program triggers that automatically checked data on upload to the database;
- Verification is performed on all digitally-collected data on upload to the main database, and includes checks on surveys, collar co-ordinates, lithology, and assay data. The checks are appropriate, and consistent with industry standards;
- Sample security relied upon the fact that the samples were always attended or locked in the on-site sample preparation facility. Chain-of-custody procedures consist of filling out sample submittal forms that are sent to the laboratory with sample shipments to make certain that all samples are received by the laboratory;
- Current sample storage procedures and storage areas are consistent with industry norms.

12 DATA VERIFICATION

12.1 Laboratory Visits

Laboratory inspections are carried out regularly, although older inspection records are no longer available. Inspection periods have varied between monthly and six-monthly intervals.

Additional measures include laboratory visits performed by the Newcrest Operations Chemist. Visits included:

- Intertek Lae: 2013;
- Intertek Perth: 2013, 2017;
- Bureau Veritas Perth: 2013.

Laboratory visits have also been undertaken on Newcrest's behalf by consultant sampling specialists such as Agoratek International.

12.2 Laboratory Checks

Round-robin programs are run by Geostats Pty Ltd, an independent third-party organisation that undertakes world-wide assay programs. Each program is run quarterly and routinely involves more than 200 laboratories each time.

The onsite laboratory and the NSLO participate in Geostats programs on a six-monthly basis, and each has performed within expected industry standards. The most recent program participation report for each laboratory was dated April 2019.

Details of each laboratory's performance are reviewed by the Newcrest Operational Chemist and improvement plans put in place if required.

12.3 Internal Data Verification

Drill hole data for the Project were collected over many years by a number of operators. Resource documentation indicates that at various times the older data were reviewed and compiled into a drill hole database. It is unlikely that original laboratory certificates are available for the older data. More recent drilling activity by Newcrest has used standard operating procedures that include data verification before data are accepted into the drill hole database.

12.3.1 Current QA/QC Reviews

12.3.1.1 Short Term Control Measures and Reporting

Weekly monitoring of key metrics including SRMs and blanks have been recorded by the sites on the corporate server since November 2011 and that process was in place as at 30 June, 2020.

A log of non-compliant laboratory batches with associated actions has been filed on the corporate server since December 2013. This monitoring continued as at 30 June, 2020.

12.3.1.2 Longer Term Control Measures and Reporting

From November 2010 to June 2017, the corporate QA/QC specialist prepared monthly consolidated assay reviews that highlighted improvements and issues needing attention. This reporting was accompanied by individual QA/QC reviews of assays used for resource modelling. These reports are filed on the corporate server and were reviewed by the QA/QC specialist to investigate any issues requiring improvement actions.

From June 2017 to July 2019, the procedure was modified such that all reporting was done by the mine site on a monthly basis. A corporate review of the monitoring was conducted in July 2019.

From July 2019 onward, monthly site-based reporting has been undertaken, and all reports are filed on the corporate server and reviewed by the corporate QA/QC specialist.

12.3.1.3 Newcrest Legacy QA/QC Reviews

2013

Newcrest staff performed a review of the available QA/QC data in 2013 (Jones, 2013).

SRMs analysed at the onsite laboratory were noted to have a negative bias for gold (approximately -5%) and a very strong positive bias for sulphur (in the range +15 to +20%). Standard and Reference Laboratories also returned a negative bias for the SRMs, leaving some doubt as to whether the SRMs were correctly certified.

The SRMs showed evidence of sample swaps and/or mislabelled SRMs, which affected as many as one in six of the SRMs. It appears likely that many of the problem results are SRMs swapped with routine samples, which suggests that there are probably also swaps of routine samples for routine samples.

Apart from sample swaps, the paired data performed acceptably well at levels of more than about 20 times the detection limit. The Standard and Reference Laboratories data agree with the onsite laboratory data, and suggest that there is not a major difference between the two laboratories.

The database contains 349 pulp samples that appear to be resubmissions, which were originally submitted between January 2002 and February 2003. The samples appear to have been selected on a grade basis and there are no samples with an original result <0.31 ppm Au. Gold showed a small positive bias (original relative to check) above about 6 ppm Au and smaller negative bias below that. The overall bias is -1%.

Sulphur showed a strong positive bias (original relative to check), particularly between sulphur grades of 3–7% and >10%. Summary population statistics indicate a precision problem with the sulphur analyses. The bias between original and resubmitted results is unlikely to be consistent, and should be considered to be a symptom of the between-job variance in the sulphur analyses, probably because the second set of analyses was undertaken over a relatively short period. Had the resubmissions been spread over a year as was the case for the original assays, it is likely the bias would have been much closer to zero.

The review also noted that the majority of the SRMs used were certified for total sulphur or not certified for any sulphur species. Sulphide sulphur assays are used for metallurgical characterisation and are not directly applied to Mineral Resource and Mineral Reserve estimates.

2014

Newcrest reviewed the 2011–2012 QA/QC data (Jones, 2014). This indicated:

- Gold data from the onsite laboratory tend to be biased by about -5%, relative to the matrix-matched SRMs. Late in the program the bias disappeared. Some samples, apparently from late in the program, were sent to NSLO for check analyses. These had a median bias of +7% relative to the mean of the onsite laboratory and NSLO values. This possibly relates to different fluxes in use at the onsite and NSLO laboratories;
- The sulphide analytical method tends to over-report sulphide above about 5% and may under-report below that figure;
- Coarse duplicates returned 5% for gold and 9% for sulphide from cleaned data. Laboratory pulp replicates had a cleaned data precision of 6% for gold, and 7% for sulphide.

12.3.2 2014 Database Validation

A database validation was performed by Newcrest personnel in November 2014. Minor errors were identified and corrected. Many of the errors are minor inconsistencies in data entry that would not have had a material impact on the current Mineral Resource estimate. Collar locations, downhole surveys, assay identifiers and data, quality control data, drill hole diameter, and drill interval gaps and overlaps were compared to original data and corrected if found to be in error.

Some logging discrepancies were not resolved; however, this was not considered to be material as spectral data and geochemistry were used to develop estimation domains.

12.3.3 Pulp Checks

Two batches of pulps from the onsite laboratory were resubmitted to the NSLO laboratory, one in May 2014, and one in September 2014. The results indicated a high degree of imprecision. The onsite laboratory had internal replicate imprecision of 3.4% and the NSLO laboratory had nearly double the imprecision of the onsite laboratory at 8.4%. However, the 24% imprecision between the laboratories is significantly higher. Potential reasons to this include the following:

- Sample swaps when the duplicate batches are prepared;
- The mean grade of the inter-laboratory checks (2.2 g/t Au) is higher than the internal onsite laboratory replicate pulp grades (1.65 g/t Au).

No similar issues were noted since 2014. The issue is not considered material to the current Mineral Resource estimate.

12.3.4 Sulphur Bias

Studies were completed in 2013 (Jones, 2013) and 2016 (Gardner, 2016).

In December 2013, a period of time where the sulphide sulphur assay data reported by the onsite laboratory were positively biased (in comparison to SRM values) was identified and documented. This bias was shown to have progressively increased over time, from +10% in 2008 to in excess of 20% at the end of 2012. The bias is most likely attributed to the degradation of the LabFit analytical instrument(s) and adherence to the analysis methodology adopted by the onsite laboratory during this time. After bias recognition, Newcrest developed a set of correction factors for the data. The majority of the 2012–2013 information affected by the bias has been subsequently mined out.

During 2016–2017, assays at NSLO showed better precision and a low bias. From 29 March 2018, assays were reported from the onsite laboratory using a newly-commissioned bank of four LECO analysers. Precision improvements have occurred since 1 September 2018, as the result of the completion of the implementation period and associated system improvements.

Sulphide sulphur assays are used for metallurgical characterisation as these determine the initial process route. If the sulphide sulphur is low, flotation is required before oxidation in the autoclave. If the sulphide sulphur values are above approximately 4% sulphide sulphur, the material can be sent directly to the autoclaves. As the biases were adjusted using correction factors, and the current methodology uses LECO instrument data, the likelihood of sending material to the wrong process route has been mitigated, and the sulphide sulphur data are considered suitable for process material classification and operational control requirements.

12.4 Resources and Reserves Steering Committee

Newcrest has implemented a steering committee, the Resources & Reserves Steering Committee to ensure appropriate governance of development and management of resource and reserve estimates, and the public release of those estimates. This is achieved by ensuring regular Resources & Reserves Steering Committee review meetings, internal competent person reviews, and independent external competent person reviews.

In particular, the Resources & Reserves Steering Committee is responsible for monitoring performance of Mineral Resource and Mineral Reserve models, ensuring governance over changes to estimation, and reporting of resources and reserves including critical input parameters of costs base assumptions, metallurgical recovery algorithms and mining dilution. The Resources & Reserves Steering Committee also monitors reconciliation of extracted metal to the resource and provides governance to resolving reconciliation variance. The committee ensures that independent external reviews of Mineral Resources and Mineral Reserve estimates for each deposit are conducted at a minimum of every three years or more frequently when a material change has occurred.

The Resources & Reserves Steering Committee comprises permanent members that represent the following areas: operations, resource management, commercial, mining and metallurgy.

The QP is a member of the Resources & Reserves Steering Committee and the current committee chair.

12.5 External Data Verification

SRK Consulting (Australasia) Pty Ltd (SRK) performed an independent review of the current resource model (Kentwall and Guibal, 2018). The review initially examined inputs to the model, including the database, QA/QC, drill type, logging, density, and exploration concept model. The second part of the review focused on the modelling, and covered modelling, domaining, compositing, declustering, top-cutting, variography, estimation and interpolation.

SRK provided Newcrest with a number of minor recommendations for future modelling efforts and concluded that there were no significant concerns or issues with the reviewed model.

12.6 QP Comments on "Item 12: Data Verification"

The process of data verification for the Project was performed by Newcrest personnel and external consultancies contracted by Newcrest.

The QP, who relies upon this work, reviewed the reports and is of the opinion that the data verification programs indicate that the data stored in the project database accurately reflect original sources and are adequate to support geological interpretations and Mineral Resource and Mineral Reserve estimation, and in mine planning.

The QP performed numerous site visits, most recently in April 2019 (refer to Section 2.4). Observations made during the visit, in conjunction with discussions with site-based technical staff, support the geological interpretations, and analytical and database quality.

The QP's role as the chair of the Resources & Reserves Steering Committee includes review of the estimation processes in place for Mineral Resource and Mineral Reserve estimation, mine planning, and the control procedures in place to ensure the process is being executed as intended.

13 MINERAL PROCESSING AND METALLURGICAL TESTING

13.1 Introduction

Laboratories and testwork facilities used during initial metallurgical evaluation included: Sherritt International Corporation (Sherritt), Metso Minerals Process Technology (Metso), Hazen Research Inc. (Hazen), Pocock Industrial (Pocock), IPRC, Lakefield, E.L. Bateman, Eimco, RESCAN, Alberta Research Council, Dorr-Oliver, Lurgi, Davy McKee, and NSR Environmental.

Metallurgical testwork supporting the original process design included comminution (crushing (impact), rod mill, ball mill, abrasion, MacPherson's semi-autogenous grind (SAG) indices.), flotation, pressure oxidation (POX), and mineralogy.

The processing facility commenced operations in 1997 at a nominal 2.8 Mt/a, treating high-grade ore with lower-grade ore stockpiled for later processing. The original process plant flow sheet consisted of grinding, whole ore oxidation in pressure autoclaves, followed by gold recovery from washed oxidised slurry using conventional carbon-in-leach (CIL) cyanidation.

In 2001, heat-exchangers were installed ahead of the autoclaves to pre-heat slurry prior to oxidation in the autoclaves in response to declining sulphide sulphur head grade. A pebble crushing circuit was installed on the then single, grinding train to increase mill throughput from a nominal 4 Mt/a to 4.6 Mt/a.

In May 2007, an additional grinding and flotation plant upgrade (FGO) was commissioned. The additional grinding train increased nominal throughput to 6 Mt/a. This was achieved without a significant change in autoclave throughput enabled by the introduction of flotation, which was primarily used to increase autoclave feed sulphide sulphur grade. This also reduced the mass flow to the autoclaves.

In early 2008, a feasibility study on a major plant expansion (the MOPU expansion) was approved by Lihir Gold, and works commenced in 2009. Following Newcrest's takeover of Lihir Gold in 2010, Newcrest completed the outstanding work of the major plant upgrade. The plant upgrade added primary jaw crushers, another grinding circuit (HGO2), another autoclave (AC4) and oxygen plant, as well as a second CIL circuit. The plant expansion was completed and commissioned in January 2013. The nominal plant capacity was 11–12 Mt/a; however, actual throughput was about 9–10 Mt/a.

Shortly after commissioning of the MOPU project Newcrest installed a second flotation circuit for the original HGO mill, to enable treatment of low-sulphur ores

In December 2014, the operating strategy for the Lihir Operations was changed to using partial pressure oxidation (minimum of 50% sulphide oxidation instead of total pressure oxidation with >98% sulphide oxidised). The switch in strategy was due to the recognition that irrespective of how gold in sulphide sulphur was presented to the autoclave or from which source (ore or flotation concentrate), only a fraction of the refractory sulphide is required to undergo oxidation to unlock the majority of the gold for subsequent recovery.

Most of the gold (generally >90%) is associated with arsenian pyrite, which is microcrystalline in nature, highly reactive, and oxidises first in the autoclaves. The other pyrite type, (blocky pyrite) is generally coarser, contains low levels of gold, and is relative unreactive in acidic conditions. The blocky pyrite requires full oxidation for gold recovery, and it is not economic to specifically target this pyrite if gold-rich arsenian pyrite is available to oxidise.

13.2 Metallurgical Testwork

13.2.1 Early Testwork

The major focus of the early metallurgical testing programs was the selection of a process for oxidation of pyrite, to make gold particles in the sulphide ore amenable to cyanidation. Investigations included roasting and pressure oxidation (POX)—both whole-ore and pyrite concentrate. Biologically assisted oxidation was also investigated. By 1988, POX was identified as the most applicable process.

Extensive testing was carried out for ore comminution (crushing and grinding) and on the flotation of a pyrite concentrate. Material handling testwork (including bulk crushed ore handling, rheology, and thickening tests) was also included. Cyanidation of oxidised products for gold recovery was used as a measure of oxidation process performance, and additional cyanidation and carbon adsorption tests were conducted to determine design and operating criteria for the CIL circuit.

Oxide ore testwork included material handling and comminution testing, agitation leach-carbon adsorption, and agglomeration and heap leach testwork. Key issues for this approach were the high clay content, high rainfall setting, and moisture content of the ores.

13.2.2 1992 Feasibility Study

The metallurgical test program in support of the 1992 design process consumed 58 t of sample (Collins et al., 2011).

The POX test program, conducted at Sherritt in Fort Saskatchewan in Canada, included more than 100 batch pressure oxidation and cyanide leach tests and nine continuous pilot plant campaigns, for a total of 889 hours of autoclave operation over a period of three years. Gold extractions >90% were achieved from all ore types in the POX and cyanide leach tests, with extractions of 94–96% being common, provided that chloride was sufficiently washed from the ore prior to autoclave processing. The extent of sulphide sulphur oxidation required to reach 94–96% gold extraction was typically in the range of 98–98.5%.

The pilot plant work was relatively extensive, and included consideration of chloride as a deleterious element in the process flowsheet. More than half of the pressure oxidation test program was directed toward defining and mitigating the effects of chloride.

13.2.3 2008–2010 MOPU

Metso was engaged to review all historical information regarding ore physical characteristics as part of the MOPU study. Depth in the ore body and the presence of key rock types such as propylitic alteration and siliceous breccia were found to be the best indicators of truly hard material.

Variability of the rock strength as measured by point load index testing was found to equate to a work index variability in the range plus 14% minus 24%.

Comminution parameters were reviewed, and are summarised by rock type (Table 13-1). These measures were used in JKSimMet evaluations of the milling circuit design and to develop relationships used to calculate that the process throughput scheduled was within the capacity envelope of the base and upgraded process.

Flotation circuit performance was modelled on the parameters in Table 13-2.

Cyanidation and CIL performance were modelled using a site process-derived regression. The formula determined the gold recovery using process historical data regression, with components linked to the residual sulphide content, cyanidation circuit performance and solution gold loss.

13.2.4 2014 Pilot Plant Pressure Oxidation

During 2014, Hazen completed pilot plant POX operations and additional laboratory experiments in support of existing plant operations.

The parameters evaluated in the POX autoclave pilot plant included retention time, temperature, O_2 overpressure, feed particle size, chloride concentration, and sulphide sulphur concentration. The pilot campaign encompassed 16 runs. Hot cure experiments were performed on 68 samples of compartment and autoclave discharge materials. A CIL program was conducted using 234 samples of raw ore and autoclave compartment and discharge material. Bench-scale batch POX experiments were requested, post shutdown, on feed material from Runs 6–9. Three kinetic samples, a feed sample, and a discharge sample were pulled from each POX run. Each set of five samples was then subjected to CIL cyanidation testing to evaluate gold extraction as a function of time.

In this testwork, the highest recovery of 95.3% was obtained on the autoclave discharge for Run 11 with the highest sulphide sulphur grade of 12.0%w/w sulphide sulphur, a temperature of 215ºC, P80 of 53 µm concentrate grind, and residence time of 51 minutes. The CIL residue grade for the recovery was 0.53 g/t Au. The high recovery for Run 11 is most likely due to a higher gold feed grade and the fact that the flotation concentrate has already rejected unliberated sulphides containing gold that achieve low gold recovery to the flotation tailings. The head grade for Run 11 was 11.1 g/t Au.

Predictive modelling was used to establish the pilot plant operating conditions. Modelling was also used to verify the mass balances arising from the pilot plant. The predictive modelling was adequate for providing mass balance data to define each run. This was confirmed with the good agreement of the Run 6 tracer test to the predicted residence time from a SysCAD model. The original Sherritt pilot plant results together with historical operating data were used to provide the sulphide oxidation profiles and estimates of iron and acid concentrations. Iron hydrolysis chemistry was constrained to jarosite, basic iron sulphate and hematite. This was sufficient for all of the predictive modelling as well as the majority of the verification modelling.

Mineralogy was completed on autoclave profile and autoclave discharge samples to support the verification modelling work.

Evaluation of chloride concentrations in the autoclave feed liquor indicated that higher chloride concentrations have a negative impact on gold recovery.

Table 13-1: Comminution Parameters

Ore Type Code	Code Descriptor	Grouping	S.G	CWi	RMWi	BBWi	UCS
AA	Advanced argillic	Free dig	2.25	4.2	7.7	7.7	17
A	Argillic	Soft blast	2.25	5.2	9.4	9.4	17
AOPBZ	Argillic boiling zone	Medium blast	2.40	8.5	15.5	15.5	44
BZ	Boiling zone	Boiling zone med-hard	2.50	9.3	17.0	17.0	133
AS	Anhydrite seal	Hard blast	2.50	9.3	17.0	17.0	133
Ore Type Code	**Code Descriptor**	**Grouping**	**A*b**	**A**	**b**	**ta**	
AA	Advanced argillic	Free dig	190	62	3.06	1.17	
A	Argillic	Soft blast	190	62	3.06	1.17	
AOPBZ	Argillic boiling zone	Medium blast	109	66	1.65	0.74	
BZ	Boiling zone	Boiling zone med-hard	58	71	0.81	0.47	
AS	Anhydrite seal	Hard blast	58	71	0.81	0.47	

Note: SG = specific gravity; CWi = crusher work index; RMWi = rod mill work index; BBWi = Bond ball mill work index; UCS = unconfined compressive strength; A, b, and ta are JK drop weight test parameters.

Table 13-2: Flotation Performance Parameters by Blast Type

Flotation Feed Stream	Au Rec%	S Rec %	Mass Rec%
Stockpile	75.8	86.3	34.8
FeedType1 – Free dig	85.3	91.1	29.5
FeedType2 - Soft blast	85.3	91.1	29.5
FeedType3 - Medium blast	84.8	92.4 2	9.1
FeedType4 - Hard blast	93.3	93.7	29.7

The data for all the various runs conducted at 100 ppm chlorides were compared to identify trends for sulphide grade, grind size, redox, calculated residence times on sulphide oxidation and CIL gold recovery. Results showed that the greater the quantity of concentrate blended in the autoclave feed, the higher the overall recovery.

There was strong relationship of high redox potentials achieving high sulphide oxidation and subsequent high CIL recoveries. This was particularly evident when the redox was >550 mV, and resulted in a high sulphide oxidation of +98%.

It was inconclusive to whether there was an improvement in gold recovery from the hot cure. No increase in gold recovery was expected when investigating the hot cure chemistry, only a reduction in reagent consumption.

There were improved sulphide oxidation kinetics with a finer primary grind, and the CIL residue grade appeared to also increase with the finer concentrate. The whole ore regrind P80 of 115 µm to 88 µm was comparable to regrinding concentrate from P80 of 85 µm to 38 µm.

Settling rates achieved for autoclave feed and discharge slurries were comparable with or higher than the then plant operating settling rates.

To further investigate gold recoveries versus sulphide oxidation, four batch tests were run with constrained oxygen to obtain a degree of sulphide oxidation completely independent of time. For the limited testwork completed, the batch testwork achieved slightly higher gold recoveries than the equivalent continuous pilot plant results.

13.2.5 Mineralogy

Microscopic examination identified pyrite as the dominant opaque mineral, with accessory marcasite. Minor amounts of chalcopyrite, pyrrhotite, sphalerite, galena, covellite and arsenopyrite were also identified, along with the major gangue minerals potassium feldspar, biotite and white mica, and clay. Minor gangue minerals identified include silica, anhydrite and calcite. Minute gold particles were only occasionally observed, ranging in size from the sub-micrometre detection level to 4 µm.

Investigation of pyrite-hosted gold was conducted by Rio Tinto in 2004–2005. The deposit was found to contain different pyrite types, including blocky, fractured/porous, framboidal and disseminated, and the gold tenor differed with each of these pyrite types. Each pyrite type was estimated to exist in the feed materials (hard, medium and soft blast composites) in similar proportions; however, given the variation in gold grade within the pyrite types, it was estimated that approximately 60% of the pyrite contained 90% of the gold.

A combination of optical microscopy, scanning electron microscopy and secondary-ion mass spectrometry established that most of the gold occurs as a nearly atomic dispersion in the pyrite. It was estimated that at least 80% of the gold present in the pyrite grains was <5 nm in diameter. During 2016, a LA-ICP-MS study identified two separate pyrite morphologies, micro-crystalline versus blocky pyrite. These morphologies had varying reactivities due to the changing abundance of elemental impurities, in addition to different gold contents.

13.2.6 Metallurgical Types

Lithological, alteration and “oretype” models were developed during the exploration and feasibility stages. Thirteen principal ore types were distinguished on the basis of hardness, alteration, vein intensity and degree of brecciation: alluvium; oxide (oxide, white rock and white clay); transition; advanced argillic (referred to as advanced argillic condensate when not at near-surface location); argillic; clay silica; silica clay; siliceous breccia; quartz stockwork; boiling zone; argillic overprinted boiling zone (AOPBZ); anhydrite sealed; and propylitic. The oretype model was selected as the base model for the geostatistical, metallurgical and geotechnical evaluation of the deposit.

Initial metallurgical testing was carried out on samples that consisted of multiple drill hole intervals of the same oretype, as well as a lesser number of oretype combination blends, the proportions of which were derived from the mine plan at the time.

During the initial years of the operation, there was no official change to the oretype model; however, the model became oversimplified to accommodate perceived operational requirements. Previously-identified and modelled material types, such as the siliceous breccia and quartz stockwork units, were grouped into a unit referred to as "leach soaked", together with silica–clay and clay–silica material types. In some areas of the operation the advanced argillic oretype was no longer referred to, and was assumed to be a subset of the argillic oretype.

By 2009, after continued simplification of the original deposit model, the deposit was represented by five ore types. These were further simplified for mining purposes to "hard blast", "medium blast", "soft blast" or "free dig", and for processing as either "hard ore" or "soft ore", both of which were known to impact the processing plant.

The first alteration domain model of the deposit was generated in 2014 based on the results of >17,000 m of Corescan data from 70 drill holes across the deposit. In 2015, the model was further enhanced with the inclusion of 20 additional drill holes with Corescan data and 250 drill holes with multi-element chemistry. The results from the metallurgical testwork campaign were analysed against both the oretype material designation and the new alteration domain model. The alteration domain model provided improved processing response prediction, particularly for flotation and crushing. The ore characterisation and testwork conducted on stockpile material identified that variable degrees of in-situ oxidation were occurring within the stockpiles, providing further evidence of the variation in pyrite chemistry, and its impact on reactivity of the ore material. Since the generation of the 'alteration domain' model, which is based on mineralogical variations observed in the deposit, a number of mining and processing operational changes have occurred.

An ore characterisation program that commenced in 2012 determined that gold in the fine fraction of the flotation tailings was largely cyanide-soluble. This led to the staged introduction of float tails leach, where a portion of the flotation tailings are directed to the existing CIL circuit to recover cyanide-soluble gold without pressure oxidation. In the first stage of implementation in December 2015, an un-sized split of the HGO flotation tailings stream was directed to the CIL circuit, via CCD, up to the maximum available CCD/CIL circuit capacity. A second stage implementation consisted of a cyclone circuit which recovered the fine, higher cyanide recoverable tailings from both flotation circuits to CIL, thereby increasing the quantity of flotation tails that can be treated.

13.3 Recovery Estimates

13.3.1 Comminution Response

Drop weight and Bond ball test indices are converted into Mia and Mib (kWh/t) parameters that are used in a Morrell Power model for forecasting purposes. Empirical relationships were internally developed to relate Axb or DWi values to Mia, and from BWI to Mib. The ore hardness (BWi/Mib) and competence (Axb/Mia) parameters conform to expectations in terms of the argillic materials being softer and less competent, with silica breccia material displaying the hardest and most competent parameters.

There is a correlation between SG and Mia, while there is no significant correlation between Mib and SG. A multiple linear regression model was fitted between the comminution parameters and selected input variables. For Mia, the input parameters were the categorical alteration domain of each sample as well as the SG; for the Mib regression, only the categorical alteration domain was used.

The Mia and Mib values were applied to a power model. Figure 13-1 shows specific power (kWh/t) per alteration type as a function of grinding circuit product size (P80) using the Morrell power model. These outputs assume that pebble crushing is used. The values represent a P75 value.

13.3.2 Basis of Forecast

Future recovery projections for Lihir are based on laboratory testwork data as well as past actual plant performance combined with the laboratory response of future ores.

This has been found to be sufficiently accurate for the purposes of projecting recovery and hence gold production from Lihir ores.

The future Kapit orebody has been metallurgically tested and these data were incorporated into future recovery projections.

Future flotation and neutralisation, cyanidation and adsorption (NCA) recoveries are estimated by multi-parameter statistical correlation of historical plant performance (using data from January 2016 to March 2019) as well as future Kapit ore testwork data.

A description of gold recovery modelling for flotation and NCA is provided in the following sub-sections.

13.3.3 Flotation Recovery

For both the FGO and HGO flotation the key input parameters are:

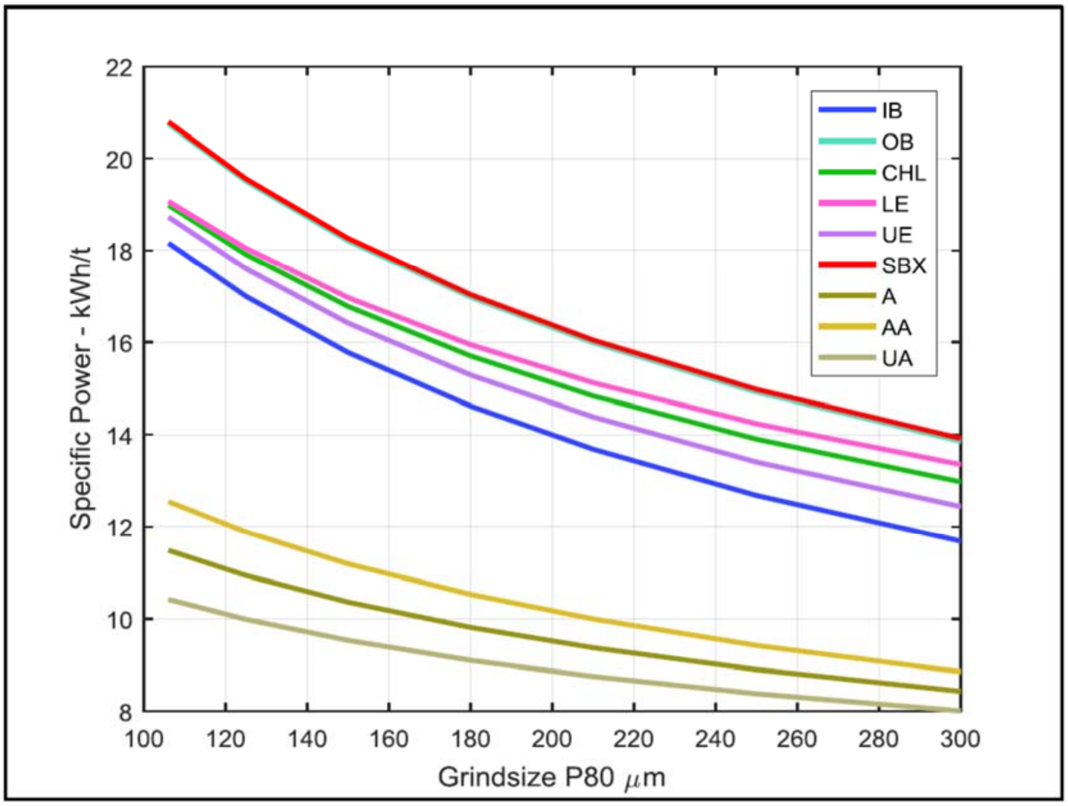
- The stockpile ore blend to flotation (as a % of total feed); this incorporates stockpile ageing;
- Feed sulphide sulphur and gold grades;
- Dry solids mass throughput (tonnes/day basis);
- Feed S:Ca ratio;
- Feed grind size (µm);
- Flotation mass recovery to concentrate.

Generally, plant and testwork data is used directly however simple transformations like logarithms are also commonly used. To further improve the accuracy of the recovery estimate more advanced statistical data transformation techniques are also used.

For example, the S:Ca ratio in FGO flotation uses a Yeo–Johnson transformation:

$$\psi(\lambda, y) = \begin{cases} ((y+1)^{\lambda} - 1)/\lambda & \text{if } \lambda \neq 0, y \geq 0 \\ \log(y+1) & \text{if } \lambda = 0, y \geq 0 \\ -[(-y+1)^{2-\lambda} - 1)]/(2-\lambda) & \text{if } \lambda \neq 2, y < 0 \\ -\log(-y+1) & \text{if } \lambda = 2, y < 0 \end{cases}$$

Figure 13-1: Specific Power (kWh/T) by Alteration Domain



Note: Figure prepared by Seaman and Gardner, 2017. Alteration domain nomenclature: IB = inner biotite; OB = outer biotite; CHL = chlorite; LE = lower epithermal; UE = upper epithermal; SBX = silica breccia; AC = argillic; AA = advanced argillic; UA= upper argillic.

For the S:Ca ratio in HGO flotation a Box–Cox approach is used (see Equation 1):

$$x'_\lambda = \frac{x^\lambda - 1}{\lambda}, \quad \text{(Equation 1)}$$

13.3.4 NCA Recovery

For NCA recovery the following key input parameters were used:

- Autoclave oxidation (as measured via feed and discharge sulphur assays);
- Mill particle grind size;
- NCA feed sulphide sulphur assay;
- The proportion of flotation tailings leach solids in NCA feed;
- NCA feed throughput (tonnes dry solids/day);
- NCA gold feed grade (g/t).

13.3.5 Final Recoveries

The average metallurgical recovery for gold over the LOM plan is predicted to be 80.7%. The period where open pit and stockpile material is treated is projected to be about 80.9%. The period at when stockpile material only will be treated is anticipated to have a recovery of approximately 78%. Daily and monthly recovery varies, based on ore grade, the fraction of milled ore sent to flotation, and the amount of stockpiled ore being treated. These values include recovery uplift from projects of 1.2% from the current base.

Naturally fine-grained ores (mostly argillic material) and clays (from fresh or stockpile ore) can impact on both plant throughput and metallurgical recovery. For the crushing and materials handling areas, wet and sticky ores are managed through blending and on-going mechanical modifications to conveyors and chutes etc. Once in slurry form, these ores can display high and variable non-Newtonian shear-thinning behaviour, which can impact the milling, flotation, POX and CIL circuits. However, dilution with fresh or sea water has been found effective in controlling slurry rheology to date.

The maximum proportion of fines and clays (mainly from argillic ores) that can be treated within the plant is not known with certainty. There are several types of clay minerals with varying impact on plant performance. There is some risk that high proportions of such ore types in plant feed may lead to both lower recovery and throughput, until an adjustment to the mine plan and/or additional plant modifications can be implemented.

13.4 Metallurgical Variability

During 2012 Newcrest conducted an ore variability characterisation program to improve the level of orebody knowledge. This involved a combination of re-interpretation of old geology logs, re-logging of existing drill holes where required, and an extensive program of Corescan hyperspectral imaging and multi-element geochemical analysis across typical sections through the deposit. To complement this deposit-scale exercise, bulk samples of material were collected from both in-situ locations and stockpiles.

Samples were subjected to optical, mineral liberation analysis, and X-ray diffraction mineralogy, hyperspectral imaging, multi-element geochemical analysis, comminution testing, diagnostic leach and flotation tests.

Laser ablation inductively-coupled plasma mass spectrometry (LA-ICP-MS) analysis of pyrite particles was completed on selected samples to revisit the work started by Rio Tinto. By the end of three phases of LA-ICP-MS work, over two million data points detailing pyrite chemistry were collected, covering the full range of material types and grade variations observed within the deposit.

Overall, samples selected for metallurgical testing during feasibility, development and expansion studies were representative of the various styles of mineralisation within the different mineralised zones. Samples were selected from a range of locations within the deposit zones. Sufficient samples were taken, and tests were performed, using sufficient sample mass for the respective tests undertaken.

13.5 Deleterious Elements

There are no penalty elements that affect doré sales.

Deleterious components in the ore that may affect aspects of plant operation are typically localised, and to date, have had only short-term effects.

These can include:

- Copper: elevated copper levels in the plant may cause instances of higher cyanide usage;
- Chloride: chloride management in the POX plant requires the use of fresh water to maintain set chloride limits in autoclave discharge;
- Clays: can cause isolated or localised effects on the crushing, grinding, POX and CIL circuits; this is generally managed using water dilution;
- Carbonate: can cause excessive venting and oxygen loss in the autoclaves; this is typically managed using blending and flotation.

13.6 QP Comments on "Item 13: Mineral Processing and Metallurgical Testwork"

The QP notes:

- The testwork undertaken is of an adequate level to ensure an appropriate representation of metallurgical characterisation and the derivation of corresponding metallurgical recovery factors. Initial metallurgical assumptions are supported by 22 years of production data;
- The average metallurgical recovery for gold over the LOM plan is predicted to be 80.7%. The period where open pit and stockpile material is treated is projected to be about 80.9%. The period at when stockpile material only will be treated is anticipated to have a recovery of approximately 78%. Daily and monthly recovery varies, based on ore grade, the fraction of milled ore sent to flotation, and the amount of stockpiled ore being treated. These values include recovery uplift from projects of 1.2% from the current base;
- Naturally fine-grained ores (mostly argillic material) and clays (from fresh or stockpile ore) can impact on both plant throughput and metallurgical recovery. For the crushing and materials handling areas, wet and sticky ores are managed through blending and on-going mechanical modifications to conveyors and chutes etc. Once in slurry form, these ores can display high and variable non-Newtonian shear-thinning behaviour, which can impact the milling, flotation, POX and CIL circuits;
- The maximum proportion of fines and clays (mainly from argillic ores) that can be treated within the plant is not known with certainty; however, studies are underway. There is some risk that high proportions of such ore types in plant feed may lead to both lower recovery and throughput, until an adjustment to the mine plan and/or additional plant modifications can be implemented;
- There are no penalty elements that affect doré sales;

- Deleterious components in the ore that may affect aspects of plant operation are typically localised, and to date have had short-term effects.

14 MINERAL RESOURCE ESTIMATES

14.1 Introduction

The database close-out date for the Mineral Resource estimate is 25 November, 2016.

Vulcan 10.0.4/10.0.5, Isatis 2016.2/2017.0, Leapfrog 3.1.1/4.0 and Supervisor 8.6/8.7 were the modelling and geostatistical software systems used in modelling and estimation.

Geological interpretation is supported by core, RC (blast hole), rotary drilling, in-pit mapping, and grade control sampling data. Core drilling can include drill holes completed for geotechnical, geothermal, resource definition, and metallurgical purposes, if there are assay data for the drill holes. Not all core holes, if completed for purposes other than resource definition, have analytical data.

Only core holes support grade estimation.

14.2 Modelling Approach

Ore control data were used to verify or help define domain boundaries. The blasthole database was flagged into three sub-horizontal layers (argillic, epithermal and porphyry).

Lateral domains were identified within the ore control data set using statistical methods. The alteration model was used as the underlying geological model because alteration (based on mineralogy and chemistry) was found to characterise key processing parameters better than other geological parameters. Calcium was identified as a suitable proxy for flotation performance and calcium grades were estimated using the alteration domains.

Five structural domains and three alteration domains were used in estimation.

14.3 Exploratory Data Analysis

The blast hole data are closely spaced (averaging 5 x 5 m) and provide a substantial dataset for ground truth modelling and data bias analysis. Potential biases between the core and blast hole data were tested by pairing each blast hole with the nearest 12 m RD composite and examining the statistics. The pair tolerance is <5 m and both datasets were capped for outliers. The statistics suggest no material bias between the two data types.

Contact plots for all the elements that were estimated were generated for the alteration domain contacts. Contacts were defined as either soft, firm, or hard.

The mineralisation mean and variance statistics are very sensitive to the declustering approach and the cell size. Vulcan cell declustering was used, with 12 grid offsets to eliminate origin bias.

14.4 Composites

All core data are composited 12 m downhole; this composite length corresponds to the mining bench height.

To accommodate sulphide sulphur and minor element estimation, where there can be a lack of contiguous sampling, a Vulcan option was used where all final composites, regardless of length, are retained together with the final composite lengths. The composite lengths are used as an additional weighting variable in statistical analysis and estimation.

14.5 Grade Capping/Outlier Restrictions

Geostatistical evaluations indicate that gold and sulphur are not highly skewed populations. Gold distributions have outliers that required examination and adjustment. Newcrest's internal guidelines for porphyry-style deposits is that the top one percentile of the sample population should not contain more than 5% of the metal (per domain). For epithermal deposits, the internal Newcrest guideline allows that this can be extended to no more than 10–15%. Outliers are capped such that the tail of the distribution is reasonably contiguous; this is also important for fitting Hermitian polynomials for uniform conditioning.

Domain cap limits vary by domain and range from 5–30 g/t Au.

No capping was applied to sulphide sulphur composites.

14.6 Density Assignment

Block density data were estimated via ordinary kriging (OK), based on alteration domains. Density values <1.5 and >3.5 were discarded and not used for analysis and estimation.

14.7 Variography

Variography was performed in Supervisor. All data were capped and final declustering weights were used. Variograms were calculated for gold, sulphide sulphur, arsenic, silver, calcium, carbonate, copper, and molybdenum.

Gold variograms in real space were unobtainable; hence, Gaussian transforms were used for calculations and modelling. The Gaussian variogram models were back-transformed to real space for panel kriging and uniform conditioning (UC). The argillic domains generally had the lowest nuggets (5%, 17%, 15%), while the porphyries had the highest nuggets (23%, 40%, 31%).

Sulphide sulphur variograms were calculated and modelled in real space.

Density variogram calculation and modelling were performed in real space, and declustering weights were not used.

14.8 Estimation/Interpolation Methods

14.8.1 Kriging Neighbourhood Analysis

Kriging neighbourhood analysis was performed for all uniform conditioning (UC) domains (gold and sulphide sulphur) in Supervisor, using the following:

- Establish optimum panel size by maximising the kriging efficiency and slope of regression;
- Select the minimum and maximum sample limits by maximising slope of regression while at the same time ensuring that the percentage of negative kriging weights is approximately <2%;
- Maximise the search ellipse ensuring that the previously-established slope of regression and negative kriging weight thresholds are not violated.

The analysis was not performed for the minor elements (silver, copper, arsenic, carbonate, calcium, and molybdenum), as the number of samples available was usually insufficient.

14.8.2 Stationarity

Stationarity is challenging as there is a complex interplay of mineralisation styles, and that are only evaluated for gold and sulphide sulphur. Newcrest uses the following guidelines for testing assumptions of constant mean and variance:

- From the domain being tested, randomly draw a number of samples (at least 5% for unbiased statistics), and calculate the mean and variance of this set;
- Repeat the exercise above for another number of "simulations" (generally 100 is an accepted number);
- Plot the mean, variance and coefficient of variation (CV) of each of the simulations as a relative percentage of the domain global mean, variance and CV;
- If the simulation mean, variance and CV are within, say 20% of the global mean and variance on a 90% confidence interval, then a plausible working hypothesis of the stationarity of the mean and stationarity of the variance can be assumed respectively.

For gold, the assumption of a constant mean and variance is a relatively weak stationarity hypothesis. For sulphide sulphur, however, simulation means, and variances are generally within the internal Newcrest ±20% tolerance guideline on a 90% confidence interval. Hence, the assumption of a constant mean and variance is a relatively stronger stationarity hypothesis than for gold.

14.8.3 Gold and Sulphide Sulphur Grade Estimation

Gold and sulphide sulphur were estimated with the non-linear UC method into large 100 x 100 x 12 m panels in their respective domains. The panel UC grade–tonnage curve was subdivided into 20 x 20 x 12 m selective mining unit (SMU) blocks for the final output model.

Vulcan and Isatis versions of UC were compared, and checked against Newcrest's internal UC code. These tests indicated that Isatis was the preferred software and was used for all UC estimates. Isatis does not allow soft-boundary conditions; hence, all gold and sulphide sulphur boundaries were hard. Isatis version 2016.2 was used for gold, while the upgraded Isatis version 2017.0 was used for sulphide sulphur.

Local uniform conditioning (LUC) post-processing from the UC panels was performed in Isatis using a proportional panel method.

14.8.4 Minor Element Estimation

Minor elements (silver, copper, arsenic, carbonate, calcium, and molybdenum) were estimated directly into the SMU blocks using OK. All estimations were done in Vulcan 10.1, and hard boundary conditions were used between the argillic, epithermal and porphyry domains.

14.9 Block Model Validation

The block model and composites were examined in plan and section views to ensure no obvious errors. No major errors were detected.

Means of the declustered composites were compared with the means of the models by domain. The means were found to be acceptably similar. A nearest neighbour (NN) declustering was performed in a 10 x 10 x 12 m size grid. The NN, panel, and LUC models were restricted to a common volume, and means compared. The means of the panels, blocks and NN declustered comps were comparable.

A review of swath plots indicated no major biases.

Grade–tonnage curves for all models were compared with grade–tonnage curves generated from the theoretical discrete Gaussian model change of support. No material flaws were noted.

The direct block simulation methodology available in Isatis 2016.2 was used to generate 100 realisations of the gold grade using the gold domains as per the resource model. The direct block simulations were validated through comparison with actual historical production, and the simulations compared well to the production data.

14.10 Reconciliation

Newcrest has a robust mine reconciliation process to capture most of the required information needed to support reconciliation studies, but historical material movement reconciliations and surveys were inconsistent and the existence of large stockpiles (now comparable in size to annual pit ore production) make the traditional mine reconciliation process challenging as pit production is reconciled to the metallurgical balance and changes in stockpiles.

Reconciliation based on blasthole sampling is considered to be acceptable, and the results are adequate to provide validation support for the Mineral Resource estimate.

14.11 Classification of Mineral Resources

Mineral Resources were classified as either Indicated or Inferred Mineral Resources, based on a combination of the estimation slope of regression and the variogram-weighted distance.

A slope of regression ≥ 0.70 is considered well estimated for the Lihir deposit. For Indicated Mineral Resources, a lower distance of 75 m was selected as the variogram-weighted distance.

A slope of regression value of 0.65 is taken as the estimation limit for Inferred Mineral Resources, and the upper limit of the scatter plot as the distance limit, which, in this case, was 160 m.

Mineral Resources contained within stockpiles are classified as Measured as they are derived from grade control models.

14.12 Reasonable Prospects of Eventual Economic Extraction

Mineral Resources are reported within a conceptual open pit shell that used the parameters summarised in Table 14-1.

Cost inputs for pit optimisation purposes were based on the cost model developed for the FY19 LOM plan base case scenario. This cost model was derived from the FY19 budget cost model adjusted for LOM plan scheduled activity levels and updated long term economic parameters.

Mineral Resources are reported using a marginal cut-off grade, determined using the parameters in Table 14-2.

Cost inputs for marginal cut-off grade purposes were based on the cost model developed for the FY20 LOM plan Reserve case scenario. This cost model was derived from the FY20 budget cost model adjusted for LOM plan scheduled activity levels and updated long-term economic parameters. Adjustments were made to reduce general and administrative (G&A), sustaining capital and other overhead costs at the end of the mining period (stockpile feed only period). The costs from the stockpile feed-only period are used to support the marginal cut-off grade.

The mineralization and resource model extents continue offshore. A seaward limit was imposed on the resource shell optimisation based on an alignment of a conceptual deep water coffer dam to constrain the Mineral Resource shell on the eastern extent. The coffer dam alignment lies to the east of the original shoreline and represents the maximum seaward extent of reasonable mining scenarios for open pit mining.

14.13 Mineral Resource Statement

Mineral Resources are reported with an effective date of 30 June, 2020, and are reported inclusive of those Mineral Resources converted to Mineral Reserves. Mineral Resources that are not Mineral Reserves do not have demonstrated economic viability. The Qualified Person for the estimate is Mr. Kevin Gleeson, FAusIMM, whose job title with Newcrest is Head of Mineral Resource Management. Mr. Gleeson is a Newcrest employee. Mineral Resources are tabulated in Table 14-3 and Table 14-4.

Table 14-1: Mineral Resource Constraining Pit Shell Input Parameters

Mining Cost	US$/t ex-pit (average)
Total mining costs	4.31
Processing Cost	**US$/t milled (average)**
Average processing unit cost	25.57
Sustaining capital	5.02
G&A	9.87
Total	***40.46***
Other Parameters	**Value**
Slope angles	10–55°
Whittle calculated metallurgical recoveries	83.8%

Table 14-2: Marginal Cut-off Grade Calculation for Mineral Resources

FY20 LOM Plan		Assumption
Gold price	US$/oz	1,300
Gold price	US$/g	41.80
Royalty	%	2
Mining levy	%	0.5
Treatment charges/refining charges	US$/oz	2.12
Effective price	US$/g	40.7
Processing Cost		**US$/t Milled**
Average processing unit cost		24.82
Sustaining capital	US$/t milled	3.97
G&A	US$/t milled	4.64
Total	US$/t milled	8.61
Total	***US$/t milled***	***33.43***
Modelled recovery	%	78
Marginal cut-off	g/t Au	1.00

Table 14-3: Measured and Indicated Mineral Resource Statement

Confidence Category	Tonnage (Mt)	Grade (g/t Au	Contained Metal (Moz Au)
Measured	81	1.9	5.0
Indicated	520	2.3	39
Total Measured and Indicated	***600***	***2.2***	***44***

Table 14-4: Inferred Mineral Resource Statement

Confidence Category	Tonnage (Mt)	Grade (g/t Au	Contained Metal (Moz Au)
Inferred	67	2.3	4.9

Notes to accompany Mineral Resource tables:

1. Mineral Resources are reported with an effective date of 30 June, 2020, using the 2014 CIM Definition Standards. The Qualified Person responsible for the estimate is Mr. Kevin Gleeson, FAusIMM, whose job title at Newcrest is Head of Mineral Resource Management, and who is a Newcrest employee.
2. Mineral Resources are reported inclusive of those Mineral Resources converted to Mineral Reserves. Mineral Resources that are not Mineral Reserves do not have demonstrated economic viability.
3. The Mineral Resource estimate is reported within a conceptual open pit shell that is based on the following assumptions: gold price of US$1,300/oz, variable pit slope angles that range from 10–55°; metallurgical recovery from Whittle optimisation of 83.8%; mining costs of US$4.31/t, and processing and general and administrative (G&A) costs of $40.46/t.
4. Tonnages are metric tonnes. Gold ounces are estimates of metal contained in tonnages and do not include allowances for processing losses.
5. Rounding as required by reporting guidelines may result in apparent differences between tonnes, grade and contained metal content. Rounding is to two significant figures.

14.14 Factors That May Affect the Mineral Resource Estimate

Areas of uncertainty that may materially impact the Mineral Resource estimates include:

- The lack of stationarity in gold domains;
- Changes to long-term gold price assumptions;
- Changes in local interpretations of mineralisation geometry and continuity of mineralised zones;
- Changes to geological shape and continuity assumptions;
- Changes to metallurgical recovery assumptions;
- Changes to the operating cut-off assumptions for open pit mining methods;
- Changes to the input assumptions used to derive the pit shell used to constrain the estimate;
- Changes to the marginal cut-off grade assumptions used to constrain the estimate;
- Variations in geotechnical, hydrogeological and mining assumptions;

- Changes to environmental, permitting and social license assumptions.

14.15 QP Comments on "Item 14: Mineral Resource Estimates"

The QP is of the opinion that Mineral Resources were performed using industry-accepted practices and conform to the 2014 CIM Definition Standards. Mineral Resources are based on open pit mining assumptions.

There are no other environmental, legal, title, taxation, socioeconomic, marketing, political or other relevant factors known to the QP that would materially affect the estimation of Mineral Resources that are not discussed in this Report.

15 MINERAL RESERVE ESTIMATES

15.1 Introduction

Mineral Reserves are reported using open pit mining assumptions.

Indicated Mineral Resources were converted to Probable Mineral Reserves. Inferred Mineral Resources within the mine plan are set to waste.

15.2 Pit Optimisation

15.2.1 Inputs

Key inputs for open pit optimisations are as follows:

- A marginal cut-off grade of 1.0 g/t Au;
- Gold price of US$1,200/oz;
- Treatment charges/refining charges of US$2.12/oz;
- 2% royalty and mining levy of 0.5%;
- Mining costs of US$4.31/t ex-pit, which include the following cost areas:
  - Dewatering;
  - Depressurisation;
  - Cold water injection;
  - Hot ground definition;
  - Drill & blast;
  - Load;
  - Haul;
  - Barge;
  - Ancillary;
  - Mine overhead;
  - Sheeting (note that sheeting is a term used for competent material rehandled back into the pit to use for providing a trafficable running surface for heavy equipment on soft or uneven ground. An average sheeting percentage of 8% has been assumed for optimisation costing;
- Processing cost assumptions total US$25.57/t milled, consisting of allocations for:
  - Stockpile reclaim;
  - Crush;

- Grind;
- Float;
- Autoclaves;
- CIL/elution;
- Unallocated power;
- Plant overheads;
- Plant maintenance;
- Power overheads;

All blocks are assigned a small cost for waste barge disposal. During the optimisation process, blocks that are determined to be ore are credited with this cost and this credit is allocated to the processing costs.

Average LOM sustaining capital costs of US$5.02/t milled and general and administrative (G&A) costs of US$9.87/t milled were included in the optimisation. The metallurgical recovery from the Whittle optimisation was 83.8%.

Geotechnical assumptions are provided in Section 16.2. Pit slope angles range from approximately 10–55°.

Cost inputs for pit optimisation purposes were based on the cost model developed for the FY19 LOM plan base case scenario. This cost model was derived from the FY19 budget cost model adjusted for LOM plan scheduled activity levels and updated long term economic parameters. Adjustments were made to reduce general and administrative (G&A), sustaining capital and other overhead costs at the end of the mining period (stockpile feed only period).

Mining costs included unit operating costs for drill and blast, load and haul, waste disposal by barge, ancillary equipment, pit cooling and a mine overheads component.

Processing unit costs were broken down by plant activity to allow a choice of two processing routes (direct to autoclave, or via flotation).

Fixed costs per period for G&A, plant maintenance, plant overheads, and power were divided by the nominal mill throughput to provide a unit cost per tonne processed for optimisation purposes.

Sustaining capital costs for fleet replacement, plant maintenance and capital for other sustaining capital projects were also divided by the nominal mill throughput to provide a unit cost per tonne processed for optimisation purposes.

It was assumed that cold water injection will sufficiently cool rock temperatures above 150°C to allow mining.

15.2.2 Pit Optimisation Considerations

Pit optimisation using Whittle software was performed to produce optimised shells on which to base the final reserves design and intermediate cutbacks. The final reserves design was based on the revenue factor = 1 (RF1.0) optimum shell.

A sequence of seven cutbacks was used to develop the remainder of the reserves ultimate pit (Figure 15-1). Cutbacks to develop the Kapit area were created in a lateral sequence from south to north to facilitate pit cooling and drainage, to allow time for overlying stockpile reclaim and processing, and for completion of the Kapit seepage barrier between Luise Harbour and the pit crest. Cutback shells were chosen with a sufficient size to allow practical mining and ramp access.

The value of geothermal power and associated infrastructure within the Kapit area was taken into account when generating the lateral development sequence shells during the optimisation. This was achieved by loading model blocks associated with the infrastructure with capital hurdles that reflect the LOM value that the cheaper geothermal power contributes.

Cutback designs conform to open pit design procedures established for the Lihir deposit, which include use of approved slope parameters, 28 m wide ramps at 10% gradient, and a minimum mining width of 40 m. Each cutback has independent ramp access, with secondary egress through the opposite end of the pit for some of the development time.

The final pit design incorporates provision for diversion drainage around the pit crest to the north and south, to manage run-off from the caldera slopes.

The planned final dimensions of the pit are approximately 2,000 m by 1,400 m, with a final depth of approximately 300 m below sea level.

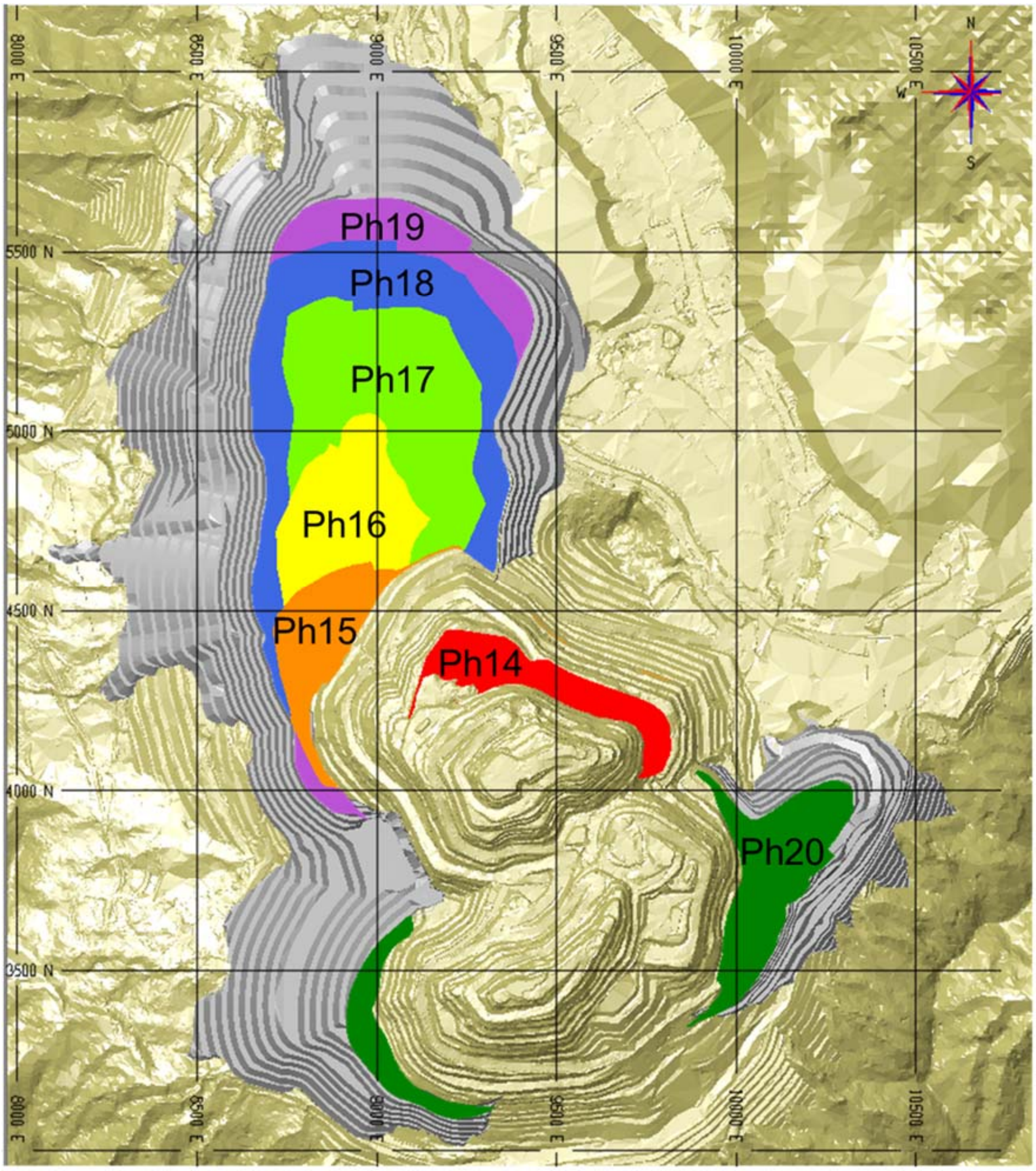
15.2.3 Stockpiling

As the Lihir Operations are constrained by the ore tonnes that can be processed by the mill, only the higher-grade fraction of ore is processed through the mill while the lower grade fraction is stored in long-term stockpiles. As a result, a period of low-grade stockpile processing is expected at the end of the mine life when mining operations were completed (see also discussion in Section 16.5).

15.3 Dilution and Ore Loss

The Mineral Reserve estimate assumes 100% mining recovery with no dilution or ore loss. Due to the approach adopted in the resource model, no additional mining dilution or recovery factors are applied in the planning model. This assumption is supported by the actual reconciliation between resource model and mill performance at the Lihir Operations to date being within an acceptable uncertainty range.

Figure 15-1: LOM Pit Phase Plan



Note: Figure prepared by Newcrest, 2020.

15.4 Mineral Reserves Statement

Mineral Reserves are reported with an effective date of 30 June, 2020 in Table 15-1.

The Qualified Person for the estimate is Mr. Steven Butt, FAusIMM, whose job title at Group Manager – Mining Technical Services. Mr. Butt is a Newcrest employee.

The Mineral Reserves are forward-looking information and actual results may vary.

15.5 Factors that May Affect the Mineral Reserves

Areas of uncertainty that may materially impact the Mineral Reserve estimates include:

- Changes to long-term gold price assumptions;
- Changes to exchange rate assumptions;
- Changes to the resource model or changes in the model reconciliation performance including operational mining losses;
- Changes to geometallurgical recovery and throughput assumptions;
- Changes to the input assumptions used to generate the open pit design;
- Changes to operating, and capital assumptions used, including changes to input cost assumptions such as consumables, labour costs, royalty and taxation rates;
- Variations in geotechnical and mining assumptions; including changes to designs, schedules, and costs, as a result of changes to geotechnical, hydrogeological, geothermal and engineering data used;
- Changes to assumptions as to pit cooling and seepage barrier development and operation;
- Ability to source sufficient quality water supplies to support process plant operations;
- Changes to the assumed permitting and regulatory environment under which the mine plan was developed;
- Continued ability to use sub-sea waste and tailings disposal methods;
- Ability to maintain mining permits and/or surface rights;
- Ability to maintain social and environmental license to operate.

Table 15-1: Mineral Reserves Statement

Confidence Category	Tonnage (Mt)	Grade (g/t Au)	Contained Metal (Moz Au)
Proven	81	1.9	5.0
Probable	230	2.4	18
Total Proven and Probable	***310***	***2.3***	***23***

Notes to accompany Mineral Reserves table:

1. Mineral Reserves are reported using the 2014 CIM Definition Standards, and have an effective date of 30 June, 2020. The Qualified Person for the estimate is Mr. Steven Butt FAusIMM, whose job title at Newcrest is Group Manager – Mining Technical Services, and who is a Newcrest employee.
2. The Mineral Reserve estimate is reported based on the following assumptions: open pit mining method; gold price of US$1,200/oz, open pit mining method, 2% royalty, 0.5% mining levy, treatment and refining charges of US$2.12/oz; variable pit slope angles (inter-ramp) that range from 10º to 55º; metallurgical recovery applied in Whittle optimisation of 83.8%, and output life-of-mine average modelled metallurgical recovery of 80.7%; dilution and mining recovery of 0% and 100% respectively; average stripping ratio of 1.9:1 (waste:ore); mining costs of US$4.31/t mined; processing costs of US$25.57/t milled, sustaining capital costs of US$5.02/t milled, and general and administrative costs of US$9.87/t milled.
3. Tonnages are metric tonnes. Gold ounces are estimates of metal contained in tonnages and do not include allowances for processing losses.
4. Rounding as required by reporting guidelines may result in apparent differences between tonnes, grade and contained metal content. Rounding is to two significant figures.

Newcrest is currently undertaking a range of studies (collectively referred to internally by Newcrest as the “Lihir mine optimisation study”) that are reviewing mining rates, waste disposal options, stockpile feed sequences, processing assumptions including material blend constraints, and the relationship to the planned ex-pit mining sequence. This could include an upper mill feed limit or additional penalties on argillic and or stockpile feed that may impact on mine schedule and or recovery assumptions. The current Mineral Reserve estimate does not include a mill feed constraint on proportions of argillic and or stockpile feed.

As with all forward study work there is risk that the future outcomes of these studies could result in changes to costs, schedule, mining rate, equipment requirements, reclassification of the confidence category assigned to some or all of the stockpiled material, and ultimately the Mineral Reserve estimate. The studies are partly dependent on the outcomes of the major studies projects listed in Section 21.

15.6 QP Comments on “Item 15: Mineral Reserve Estimates”

The QP is of the opinion that Mineral Reserves were estimated using industry-accepted practices, and conform to the 2014 CIM Definition Standards. Mineral Reserves are based on open pit mining assumptions.

The Mineral Reserves are acceptable to support mine planning.

There are no other known environmental, legal, title, taxation, socioeconomic, marketing, political or other relevant factors known to the QP that would materially affect the estimation of Mineral Reserves that are not discussed in this Report.

16 MINING METHODS

16.1 Overview

Production mining is conducted by Newcrest using Owner-operated equipment fleet and an Owner workforce. A separate mining contractor operation using a smaller pioneering fleet is used to develop new working areas on the steep caldera slopes.

Production mining is by conventional open pit method, using a fleet of 500 t class (operating weight) hydraulic face shovels loading into 135 t capacity rear-dump haul trucks, with a recently demonstrated mining rate of 33 Mt/a ex-pit. Ore and waste are drilled and blasted on 12 m benches and mined in a single pass. Where practicable, walls are drilled with a pre-split to assure stable wall rock conditions. The ground is frequently too hot for conventional explosives, requiring high-temperature blasting products and specialised blasting procedures for mining in hot ground.

A majority of ex-pit ore is allocated by gold and sulphur grade into a blend plan agreed with process plant staff along with existing stockpiled ore. Mill feed is based on the blend plan and can be comprised of reclaimed ore from the ROM stockpiles, direct ex-pit ore and existing stockpile ore.

Waste rock from the mine is either placed into 1,500 t capacity barges for off-shore submarine disposal or stockpiled for use as road base, bench sheeting, stemming or construction fill. Submarine waste disposal is carefully planned and controlled to achieve a continuous rill along the steeply-sloping sea floor and minimise the potential for uncontrolled slumping.

16.2 Geotechnical Considerations

Pit slope designs were developed in conjunction with recommendations from external consultants. Slope performance is continuously monitored and reviewed, with local adjustments to slope designs made where necessary.

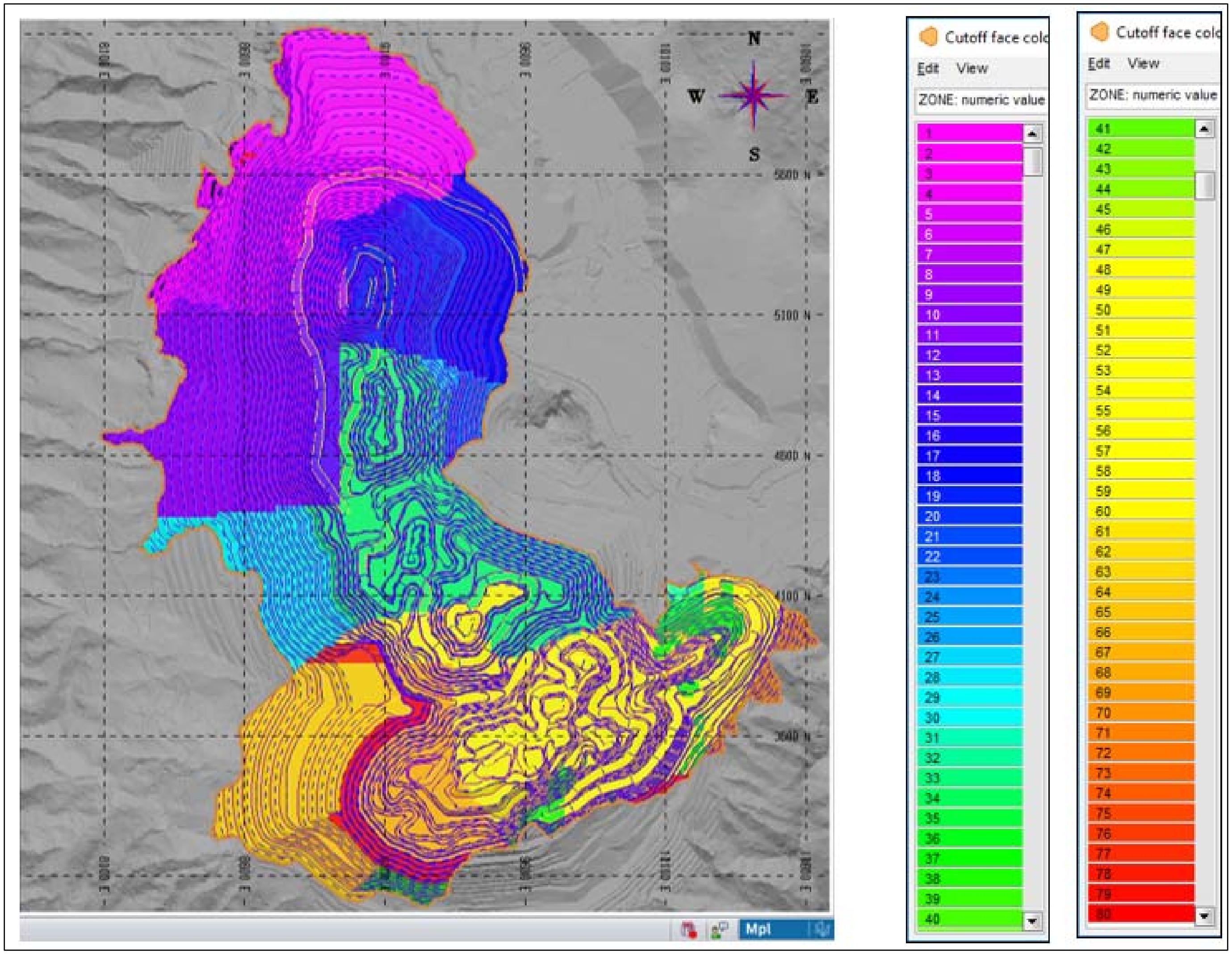
Slope parameters are a combination of two inputs;

- Geotechnical slope domains that are defined 3D spatial solids representing zones of common slope criteria;
- Slope profiles that are relevant to each specified slope domain.

Slope parameters are incorporated into a set of 80 contiguous slope domain solids which cover the extents of the resource model framework. Each domain solid is assigned an appropriate inter-ramp angle (IRA) and batter and berm configurations for pit design work. IRA angles varied from 10–55° with batter angles varying from 25–70º.

An example of the geotechnical domain distributions at the end of the pit life is provided Figure 16-1.

Figure 16-1: Pit Slope Design Domains



Note: Figure prepared by Newcrest, 2020.

Horizontal pit wall holes are drilled to allow dewatering and controlled venting of steam to depressurise pit walls. Extensive prism, pit face radar and geotechnical monitoring of pit slopes and seismic monitoring is also undertaken.

Earthquake, tsunami and landslide events have been recorded at the site. Slope failures have occurred historically, including a major failure of the caldera wall in the Kapit area in 2005.

16.3 Hydrogeological Considerations

The Lihir Operations receive on average 4.4 m annual rainfall, and have extensive groundwater volumes, both of which are managed through a pit dewatering program and surface water management facilities incorporated into pit designs.

Surface runoff from the caldera slopes is intercepted by the main pit diversion drains, which are installed around the perimeter of the pit crest, and is diverted around the mining operation to flow by gravity into the Luise Harbour. Remaining surface runoff, groundwater seepage, and rainfall is collected by drainage berms and ramps incorporated in the pit designs and directed into sumps.

A fleet of diesel-powered pit dewatering pumps, each of 250 L/s capacity, and 400 mm discharge lines are used to discharge sumps into gravity drains at the pit crest. These also drain into Luise harbour. In-pit water is acidic from contact with sulphide rocks and is treated with lime prior to discharge to help neutralise pH.

16.4 Geothermal Considerations

The Luise Caldera is still geothermally active, with temperature modelling indicating current rock temperatures in some areas within the ultimate pit design exceeding 100°C. The active zone is extensive within the Kapit area. Areas with rock temperatures greater than 100°C can cause groundwater to instantaneously flash to steam when confining pressure is released by mining, with the potential for rock outburst events to occur. Potential geothermal outburst areas are managed using the following methods.

16.4.1 Geothermal Depressurisation and Pit Cooling

Geothermal depressurisation for Kapit area has been underway since 2004, using a program of steam relief and horizontal drain holes. Monitoring systems are in place to check the effectiveness of these systems. Temperature modelling and pressure trends to date indicate that depressurisation alone will ultimately be insufficient in some locations to allow mining to proceed in accordance with current life-of-mine plans.

From 2017–2019, progressive trials and studies were completed to test the practicality and effectiveness of cold-water injection as a means of actively reducing rock temperatures in targeted areas in advance of mining. The work to date demonstrated the practicalities of construction, measured the rate of cooling, and estimated the costs associated with cold water injection to a pre-feasibility level of study. This work supports that the cold-water injection project can cool mining areas to below 150ºC as required in the mine plan as input to the Mineral Reserve estimate.

16.4.2 Hot Ground Mining Methods

Current operational technology allows mining of hot ground to ground temperatures of up to 130ºC, after which the bulk explosive formulation required for production blasting becomes a constraint. The potential for geysering from blastholes, or for geothermal outburst areas is identified through a combination of historical domain performance, blast-hole or probe-hole monitoring, and daily dig-face temperature measurement.

A procedure is used to control all mining activities in areas identified as containing potential geothermal outburst areas. This includes specific training, demarcation, minimum distances between working shovels and other equipment or personnel, surface drainage, explosives loading, quarantining of ground after blasting, bullet-proof glass in dig equipment, and other hot ground management practices. In some cases, hot ground must be exposed and left to cool before mining.

Additional projects and trials to mitigate the risk to mining activities in hot ground, and to extend successful blasting and mining of ground with temperatures of 130–150ºC are under evaluation.

16.5 Operational Considerations

Development of the Kapit area of the open pit will require the following:

- The proximity of the Kapit zone to the shoreline requires the construction of a seepage barrier or cut-off wall, just off the original Kapit shoreline in the shallows of Luise Harbour. The seepage barrier will be a significant structure, and will be engineered to cope with earthquake and tsunami events. A 100 m-wide buffer zone between the toe of the structure and crest of the pit will be included in the design. The final design is being completed by a specialist engineering firm and will be independently reviewed;
- Concurrent processing and/or relocation of the Kapit Flat low-grade stockpile, currently situated on top of the Kapit sector of the deposit;
- Pre-stripping/development of >200 Mt of overlying argillic clay waste rock;
- Construction of a perimeter drainage channel around Kapit to divert rainfall run-off from the caldera slopes around the pit footprint;
- Geothermal cooling and depressurisation of the Kapit zone to a temperature at which mining can be safely undertaken.

16.5.1 Consideration of Marginal Cut-off Grades

Material above the marginal cut-off grade of 1 g/t Au is stored in long-term stockpiles for processing after the end of mine life. The marginal cut-off grade assumes a reduction in sustaining capital and G&A costs at the end of mine life, allowing marginal material to be economically processed (Table 16-1).

The marginal cut-off is ultimately determined by running a series of scenarios at incremental marginal cut-off grades to determining the cut-off that supports the maximum project value. This process supports the 1 g/t Au marginal cut-off.

Table 16-1: Mineral Reserve Marginal Cut-off Grade Input Assumptions

FY20 LOM Plan		Assumption
Gold price	US$/oz	1,200
Gold price	US$/g	38.6
Royalty	%	2
Mining levy	%	0.5
Treatment charges/refining charges	US$/oz	2.12
Effective price	US$/g	37.6
Processing Cost		**US$/t Milled**
Average processing unit cost	US$/t milled	24.82
Sustaining capital	US$/t milled	3.97
G&A	US$/t milled	4.64
Total	***US$/t milled***	***33.43***
Modelled recovery	%	78
Marginal cut-off	g/t Au	1.00

16.5.2 Operational Cut-off Grades

An elevated cut-off strategy is employed, where only high- and medium-grade material is fed to the mill, while the lower-grade fraction is stockpiled for later processing. An average of approximately 30% of ore mined is sent to long-term low-grade stockpiles. High-grade ore (typically >3 g/t Au) is always fed to the plant first, while medium-grade ore (2–3 g/t Au) is blended in ROM stockpiles to achieve the required feed properties of ore type and sulphur grade. The planned cut-off between medium-grade and low-grade material can be adjusted if needed, depending on ore supply and phase development.

Over the life of the mine, it is expected that about 80–90 Mt of low-grade material will be stockpiled, to be fed to the plant progressively over the LOM. Only 40–50 Mt stockpiling capacity is available outside the ultimate pit footprint at the Kapit North stockpile. In-pit stockpiling is used to accommodate the balance, and will be reclaimed during development of the final cutback.

16.5.3 Grade Control and Production Monitoring

All blastholes in ore zones are sampled and assayed to allow grade control mark-up and to update the grade control model. Dig block inventory is reconciled against the grade control and resource models on a monthly basis to assess resource model performance. When longer-term trends are identified, corrections are undertaken to the resource model if required.

16.6 Production Schedule

Newcrest is currently undertaking the Lihir mine optimisation study, a range of studies that are reviewing mining rate, waste disposal options, stockpile feed sequence, processing assumptions including material blend constraints and the relationship to the planned ex-pit mining sequence. This could include an upper mill feed limit or additional penalties on argillic and or stockpile feed that may impact on mine schedule and or recovery assumptions. The current mine schedule does not include a mill feed constraint on proportions of argillic and or stockpile feed. As with all forward study work there is risk that the future outcomes of these studies could result in changes to the production schedule.

The LOM scheduled mining rate is also partly determined by the lead time on construction of the Kapit seepage barrier. Other factors include the removal and concurrent feeding of the existing Kapit Flat low-grade stockpiles, the effectiveness of pit cooling and hot ground mining techniques, and the throughput capacity of the process plant.

The mining schedule minimises the size of cutbacks required to access higher-grade ore in the Kapit area. The forecast completion date for the mining operation is FY38, and the forecast completion date for the processing operation is FY41, giving a mine life of 18 years, and a process life of 21 years, with the last year a partial year.

Phase 14 and Phase 15 are currently being mined, with mill feed coming from active mining phases and stockpile reclaim. On average, approximately 40 Mt/a of material is planned for mining ex-pit, with approximately 20–25 Mt/a additional movement required for stockpile reclaim, ore blending for mill feed purposes, and rehandle movements. The remaining ex-pit LOM strip ratio is approximately 1.9:1 (waste:ore).

Figure 16-2 is the projected production ex-pit; Figure 16-3 is the production plan including stockpiles. Note that the years shown are financial years (FY), which run 1 July–30 June.

16.7 Blasting and Explosives

A dedicated on-site bulk explosives manufacturing facility is operated and maintained by a contract explosives company. Two mobile manufacturing units are used to deliver product to the pit on a daily basis. Due to potentially hot ground conditions, explosives are currently not slept in the ground for more than 12 hours, so blasting is usually undertaken on a daily basis. Blasts are initiated remotely by radio control after pit clearance.

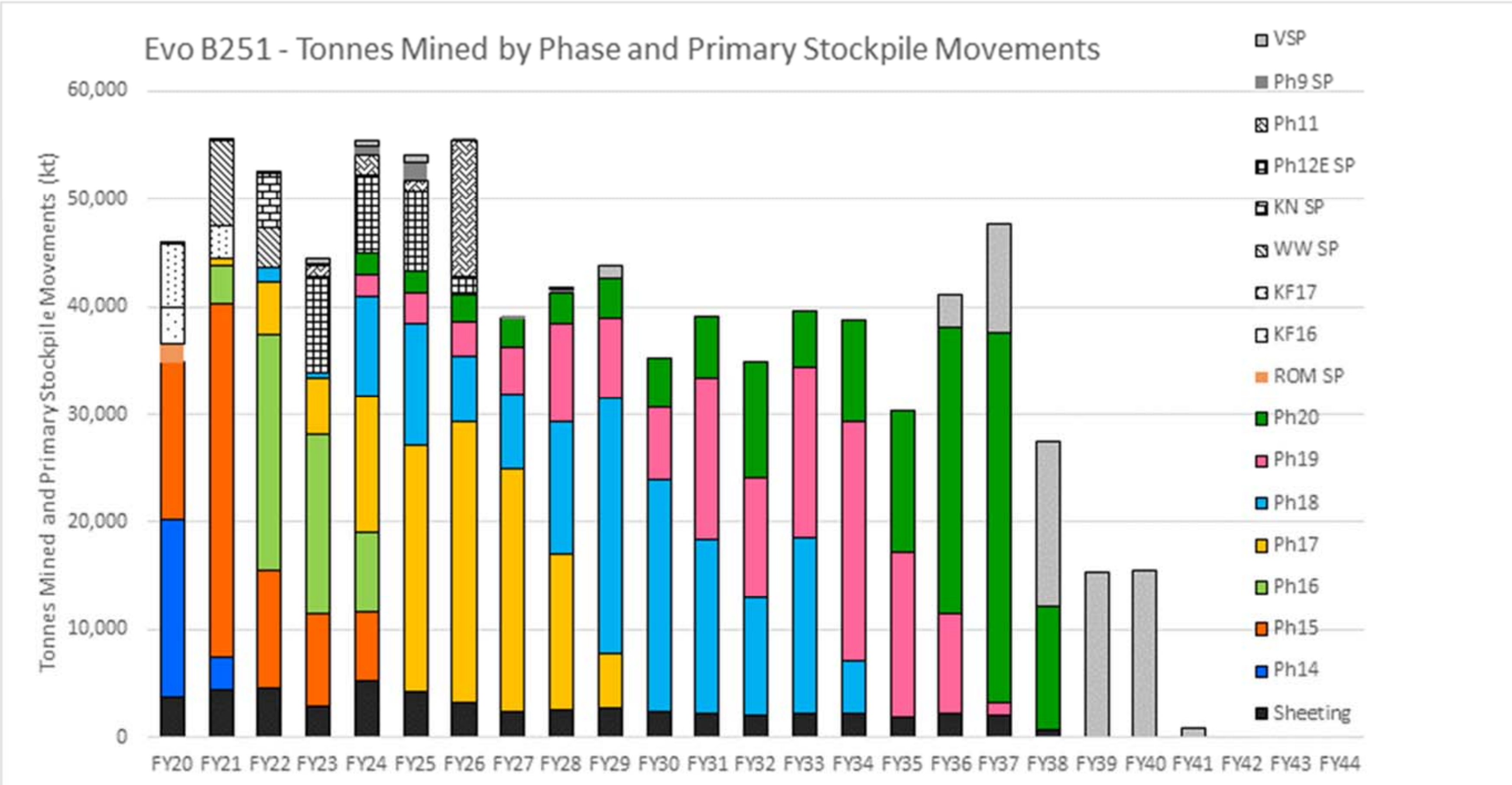
Newcrest is currently evaluating alternative specialised explosives products to cater for the increased ground temperatures expected in Kapit.

16.8 Mining Equipment

The current mining fleet is listed in Table 16-2 and a contractor fleet of ancillary equipment is also used for road maintenance and drainage, mobile crushing services, pioneering work, and other minor project work where required. The number of Cat 785 trucks is planned to increase to 39. There are no other material changes to the equipment fleet that are currently planned.

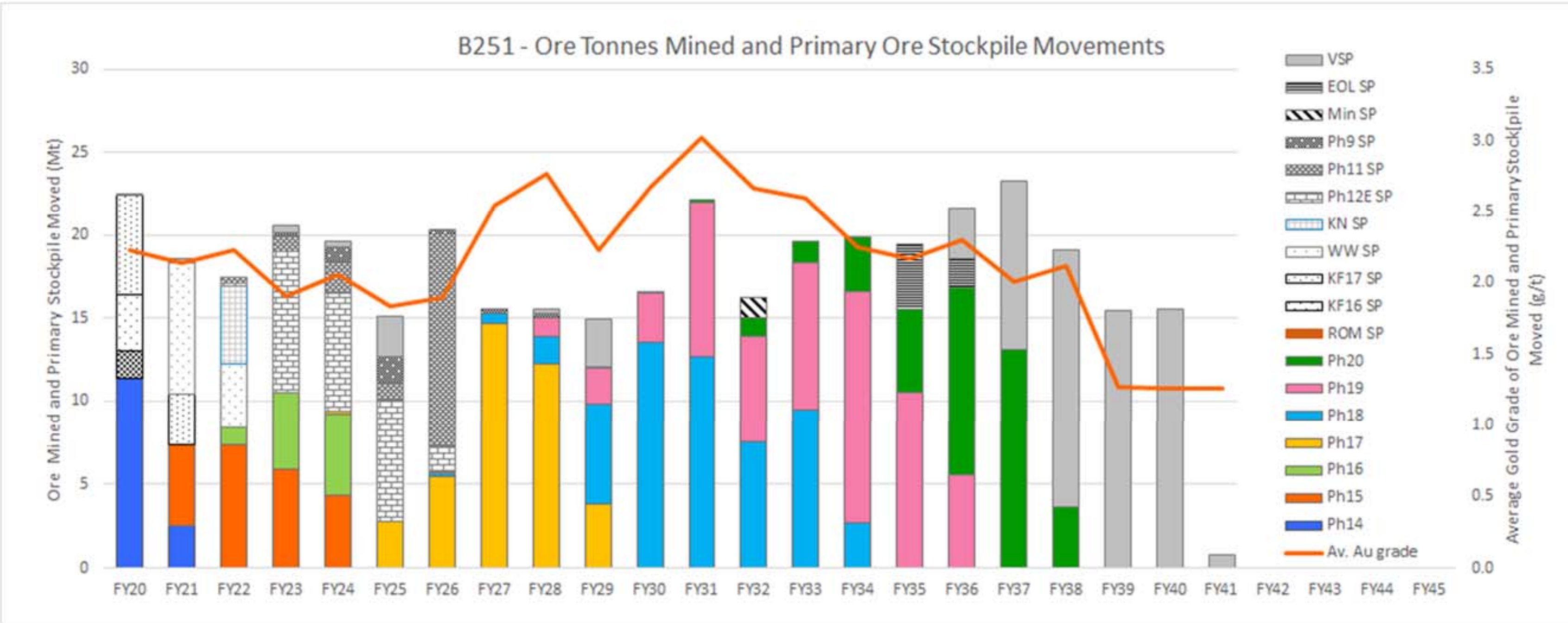
Newcrest is currently reviewing mining rates, waste disposal options, stockpile feed sequences, processing assumptions including material blend constraints, and the relationship to the planned ex-pit mining sequence. Outcomes from these reviews could lead to changes in mining rate and/or equipment requirements in the future.

Figure 16-2: LOM Plan Production Plan (Ex-Pit + Stockpile)



Note: Figure prepared by Newcrest, 2020. VSP = stockpiles created by mining and stockpiling low grade in the future (virtual stockpiles). SP = stockpile. Newcrest is currently undertaking studies that are reviewing mining rate, stockpile feed sequence, processing blend constraints, and the relationship to the planned in-pit mining sequence. The studies are partly dependent on the outcomes of the major studies projects discussed in Section 21.2.3. Information in this figure includes ex-pit mining tonnes, sheeting tonnes, and some of the primary stockpile movements. The figure is not intended for, or to be used as, forward-looking guidance.

Figure 16-3: LOM Production Plan (including stockpiles)



Note: Figure prepared by Newcrest, 2020. VSP = stockpiles created by mining and stockpiling low-grade in the future (virtual stockpiles). SP = stockpile. Newcrest is currently undertaking studies that are reviewing mining rate, stockpile feed sequence, processing blend constraints, and the relationship to the planned in-pit mining sequence. The studies are partly dependent on the outcomes of the major studies projects discussed in Section 21.2.3. Information in this figure cannot be used to back-calculate mill feed grades as the figure includes high-grade and medium-grade to the mill feed, low-grade ex-pit ore to long-term stockpile, and some of the stockpile movements. The figure is not intended for, or to be used as, forward looking guidance of mill feed.

Table 16-2: Mine Production Fleet

Equipment Type	Number
RH 200 shovel	4
EX 2600 excavator (ROM pad)	2
EX 1200 excavator (K1200)	2
Cat 992 loader (mill)	3
Cat 993 loader (ROM pad)	2
Cat 936 loader (mine – waste)	2
Cat 785 truck	35
Marine barge	3
D55 drill	4
D45 drill	1
Atlas drill	2
Cat D10 dozer (batter and bench)	8
Cat 834 wheeled dozer	2
Cat 16 grader	3
Cat 336 excavator (rock breaker)	3
Cat 385 excavator	2
Cat 773 service truck	2
Cat 777 service/water truck	4
420 pump	15
180 pump	6

16.9 QP Comments on "Item 16: Mining Methods"

The QP notes:

- The mining operations use conventional open pit methods, and conventional equipment;
- The mining method being used is appropriate for the deposit being mined;
- Mining operations are below sea-level, and sea surges can pose a risk to operations;
- Mining methods have to accommodate the deposit geothermal setting, which requires consideration of the potential for blasthole geysering, geothermal outburst areas, and use of careful blast management practices;
- The planned Kapit sector mining will require a seepage barrier, processing and/or removal of the low-grade stockpile, significant waste stripping, and a strategy to deal with hot ground;

- Operations use Owner-operated equipment fleet and an Owner workforce. A contractor fleet of ancillary equipment is used for road maintenance and drainage, mobile crushing services, pioneering work, and other minor project work where required;
- The forecast completion date for the mining operation is FY38, and the forecast completion date for the processing operation is FY41, giving a mine life of 18 years, and a process life of 21 years, with the last year a partial year;
- The mining plan includes an ex-pit mining rate ramp up from the recently-demonstrated 33 Mt/a to approximately 40 Mt/a. Environmental and difficult operational conditions in soft argillic mining domains can impact mining rates, and there is a risk that the mining rates may not be achieved as planned;
- Newcrest is currently undertaking a range of studies that are reviewing mining rate, waste disposal options, stockpile feed sequence, processing assumptions including material blend constraints, and the relationship to the planned ex-pit mining sequence. As with all forward study work, there is a risk that the future outcomes of these studies could result in changes to the production schedule, mining rate, and/or equipment requirements.

17 RECOVERY METHODS

17.1 Introduction

As the gold mineralisation is refractory, the plant consists of crushing and grinding followed by partial flotation, pressure oxidation, and then recovery of gold from washed oxidised slurry using conventional cyanidation.

The plant currently has a nameplate capacity of 15 Mt/a.

The plant was first commissioned in 1997 and has undergone a number of alterations and expansions (refer to discussion in Section 13.1). The testwork discussed in Section 13, in conjunction with operational results, were used to refine plant operations.

17.2 Process Flow Sheet

The process flowsheet is provided in Figure 17-1 and Figure 17-2. A list of the key equipment is provided in Table 17-1.

The Lihir Operations have changed from a “full oxidation” treatment plant to a partial oxidation plant. The current operating strategy, termed the “Lihir operating strategy” or LOS, was developed to exploit the benefits of partial oxidation to maximise gold production rates.

The LOS is a self-correcting system. If a feed is presented to the autoclave that is too low in sulphide sulphur, then the autoclaves will slow down to maintain front-end temperatures; hence, forcing more ore to flotation, which then increases sulphur grade, allowing increased throughput reaching a new operating equilibrium.

The LOS maximises and optimises the gold production rate at all times irrespective of equipment downtime or ore type (within reason), and reflects a flowsheet with a wide operating window. In normal operation there is significantly more milling capacity than autoclave capacity, therefore a substantial amount of ore is typically sent to flotation to match autoclave throughput.

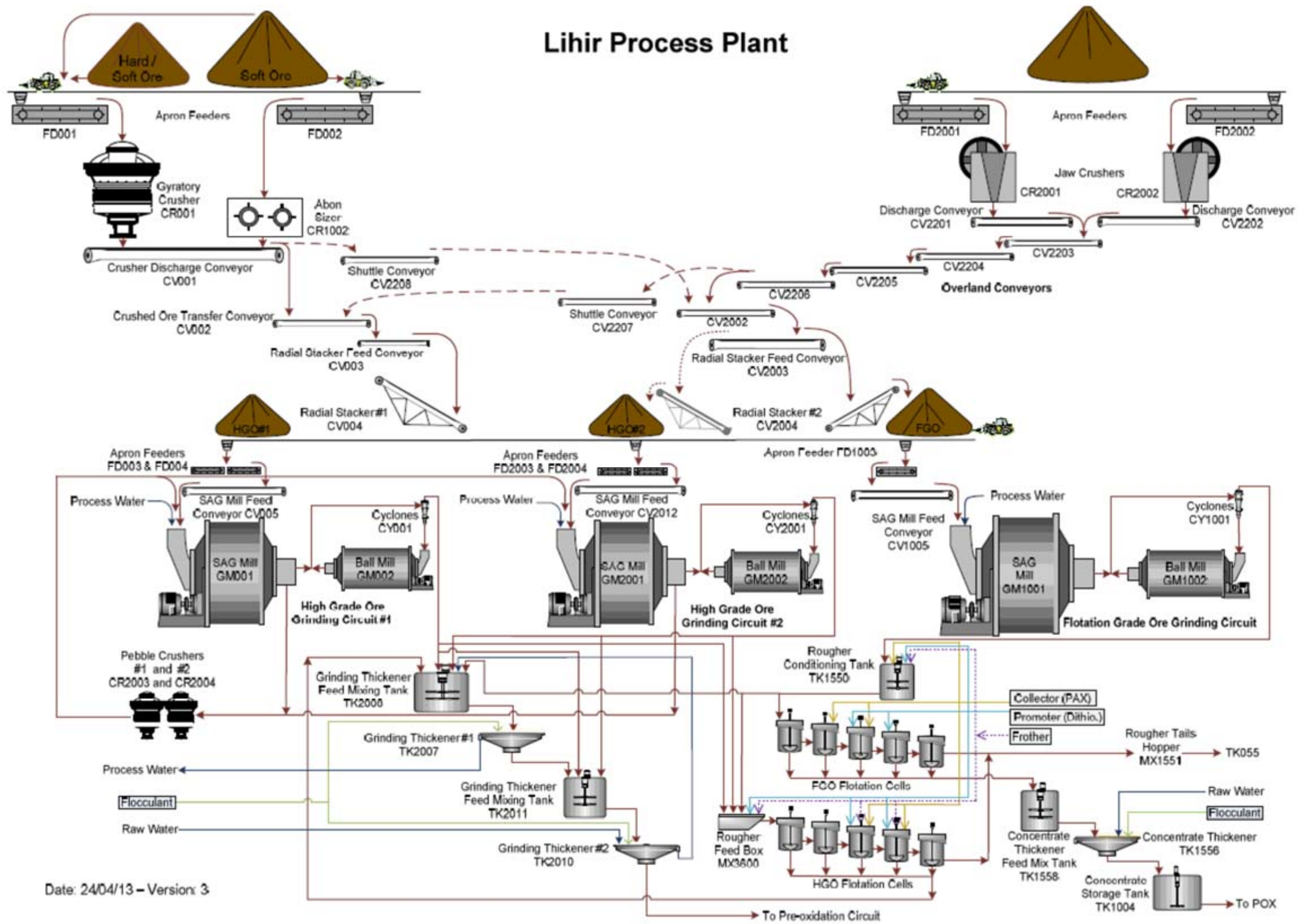
The LOS uses levels in the autoclave feed slurry storage tanks (pre-oxidation tanks) to control the amount of ore going to the autoclaves that is either direct feed or concentrate feed. The switch from directing ore to the autoclave or to flotation is done manually:

- As slurry storage tank levels increase, excess milled ore above autoclave capacity is directed to flotation;
- As slurry storage tank levels decrease, more ore is directly fed to the autoclaves.

17.2.1 Crushing and Milling

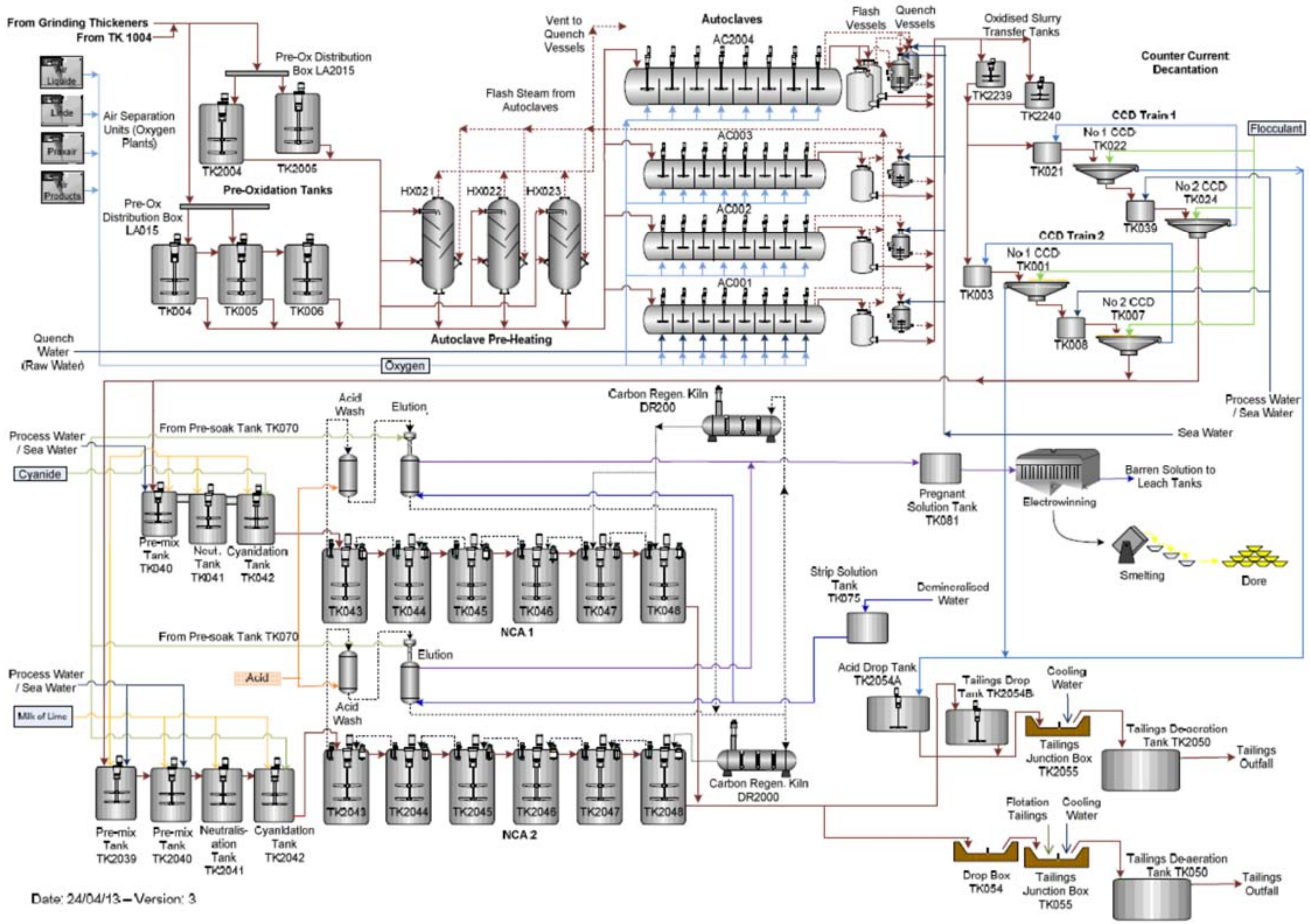
Ore is crushed in two primary crushing circuits. The first circuit consists of a 42–65” gyratory crusher and second an MMD toothed rolls crusher. Competent ore is crushed in the gyratory crusher and softer ore types in the MMD crusher. Both crushers discharge on to an overland conveyor and then to a radial stacker for stockpiling ahead of the grinding circuits.

Figure 17-1: Simplified Process Flow Sheet (Part A)



Note: Figure prepared by Newcrest, 2020.

Figure 17-2: Simplified Process Flow Sheet (Part B)



Note: Figure prepared by Newcrest, 2020.

Table 17-1: Key Process Equipment

Area	Asset	Manufacturer/Supplier	Specifications	Quantity
Crushing	Gyratory crusher	Fuller Traylor	Model 1067 x 1778 TCB OSS 125–200 mm	1
	MMD sizer crusher	MMD	MMD sizer 1150, 300 kW	1
	Jaw crushers	Thyssen Krupp	Model: EB 16-12 /N, Single toggle. Mouth: 1,600 x 1,200 mm	2
	HGO SAG mills	FLSmidth	5.5 MW, 8.53 m inside diameter (28 ft), 4.1m long (flange to flange), grate discharge, design ball charge of 15%, current target 15%	2
	HGO ball mills	FLSmidth	5.5 MW, 5.5 m inside diameter (18 ft), 9.75 m long (flange to flange), 13.46 rpm, overflow discharge	2
	FGO SAG mill	Outokumpu/Outotec	4.3 MW, 7.3 m inside diameter (24 ft), 5.1 m long (flange to flange). 9.5 to 12.7 rpm range, grate discharge, design ball charge of 12%, current target 15%	1
	FGO ball mill	Outokumpu/Outotec	4.3 MW, 5.5 m inside diameter (18 ft), 8.53 m long (flange to flange), 13.8 rpm, overflow discharge	1
	Pebble crushers	Norberg	Norberg HP4	2
Flotation	FGO flotation cells	Outotec	OK150	5
	HGO flotation cells	Outotec	OK300	5
Autoclave feed slurry thickening & storage	Grinding thickeners	FLSmidth	48 m FLS thickeners, dual E-duct system, max 1,500 t/h (nominal 1,000 t/h), feed flow range 2,500–7,340 m^3/hr	2
	Autoclave feed slurry storage tank	Sun Engineering	Dimensions: 16.5 x 17.3 m tank; capacity: 3,500m^3; duty: sulphide flotation concentration storage tank. Operating levels: low: 0.5 m, normal: variable between limits; high: 16.8 m, freeboard: 0.5 m. Operating pressure: atmospheric Carbon steel/rubber lined; corrosion allowance 1.6 mm	1
	Autoclave feed slurry storage tank	CBI Constructors (PNG) Pty Ltd	Dimensions: 16.5 x 17.3 m; capacity: 3,527 m^3; freeboard: 0.81 m Operating pressure: atmospheric Baffled, open top, mild steel, rubber-lined	5
Pressure oxidation	Autoclave feed pre-heaters	Hatch Engineering design	Dimensions: 5.36 m (ID) x 12.656 m; 5 sets segmented splash baffle plates.	3

Area	Asset	Manufacturer/Supplier	Specifications	Quantity
			Design internal pressure: 200 kpa@150ºC; normal operating: 13 kPa@103ºC; max operating: 180 kPa@134ºC Fluid volume >> operating: 64.2 m^3, full: 340 m^3	
	Autoclave feed pumps, autoclaves 1, 2 &3	Envirotech/Geho	Positive displacement slurry pumps; variable frequency drive; duty Flow (m^3/h) >> min: 85, normal: 165, rated: 270 Discharge pressure (kPa.a) >> Normal: 2,750, Rated: 3,100 NPSHA (kPa.a): >200; slurry temperature: 40–95ºC; Motor rating/speed: 315 KW/1500	6
	Autoclaves	Sherritt Gordon	4.5 mID x 31.23 mL, 0.36 m spherical head; operating temperature range: 200–210ºC; pressure > nominal: 2580 kPa, max: 2800 kPa; nominal O_2 overpressure: 867 kPa (32% O_2 overpressure control philosophy)	3
	Flash vessels, autoclaves 1, 2 & 3	Evans Deakin Engineering Ltd	5.5 m (I.S) x 6.9 m (tangent to tangent or T–T), 25 mm thick vessel. Carbon steel with bromo-butyl rubber lining and acid brick lining. Design pressure: 200 kPa, design temperature > max: 150ºC, min: 90ºC	3
	Quench vessels, autoclaves 1, 2 & 3		Vertical, 3.5 m dia (I.S) x 5 m T–T with SE heads, carbon steel membrane and acid brick lined. Design exit temperature: 80ºC	3
	Vent scrubber, autoclaves 1, 2 & 3		Venturi type with cyclonic separator; inlet vol: 5240 Am3/h @ 85ºC, outlet vol: 5565 Am3/h @ 65ºC; scrubber differential pressure: 10 kPa; cooling water rate: 3.8 L/sec @ 110 kPa	3
	Autoclave feed pumps, autoclave 4	Weir Minerals	Type: TZPM 1200; max flow: 475 m^3/h, max discharge pressure: 3100 kPa, max stroke rate: 50 spm, power: 449 kW	3
	Autoclave 4		5.600 m dia IS x 44.820 L T–T; operating volume = 865 m^3; operating temperature range: 200–210ºC; pressure > nominal: 2580 kPa, max: 2800 kPa; nominal O_2 overpressure: 867 kPa (32% O_2 overpressure control philosophy)	1
	Flash vessels autoclave 4		5.5 m (I.S) x 7 m (T–T), 25 mm thick vessel. Carbon steel with bromo-butyl rubber lining and acid brick lining. Design pressure: 200 kPa, design temperature > max: 150ºC, total vol: 197 m^3	2
	Quench vessels autoclave 4		Vertical, 3.6 m (I.S) x 5 m (T–T) with SE heads, carbon steel membrane and acid brick lined; operating temperature: 90ºC, design temp: 150ºC; total vol: 62 m^3	2
	Vent scrubber, autoclave 4		Units: SVS Size 27/60; inlet gas vol: 20,000 m^3/h @ 80ºC; outlet gas vol: 19,783 m^3/h @ 30ºC; cooling water rate: 4.5 L/sec @ 80kPa per nozzle, 3 nozzles	2

Area	Asset	Manufacturer/Supplier	Specifications	Quantity
	Oxidised slurry transfer tanks	Walz Construction	Diameter x height: 11.0 m inside x 6.0 m; material SAF2507; sacrificial plate, seal welded; acidic slurry @ 100ºC	2
Oxygen plant	Air products oxygen plant	Air Products	27,929 kW/day; 1,700 t/d GOX capacity	1
	Linde oxygen plant	Linde CyroPlants	23,000 kW/day; 1,400 t/d GOX capacity	1
	Air Liquide oxygen plant	Air Liquide	5,000 kW/day; 240 t/d GOX capacity	1
Flotation tailings gold recovery	Flotation tailings thickener	Supaflo Technologies Pty Ltd	Supaflo 26 m dia, high rate thickener, design feed flowrate: 1,556 m^3/h, solid flux: 0.167 $m^2/t/d$,	1
Autoclave discharge slurry washing	CCD thickeners	Supaflo Technologies Pty Ltd	Tank diameter: 35.5 m; tank sidewall height: 6.2 m; Freeboard to liquid level, 0.6 m; 35.5 m dia x 6.2 m side wall height thickener, rubber-lined steel, flat bottom, HDPE floor	4
Neutralisation, cyanidation and adsorption (NCA)	NCA 1 neutralisation tank		Diameter x height: 13.7 m inside x 18.0 m; operating temp: 36.8ºC; operating & design pressure: ATM; corrosion allowance: 1. 6 mm; rubber-lined; shell AS3679 GR250 & GR350	1
	NCA 1 leach tank		Diameter x height: 13.7 m inside x 18.0 m; operating temp: 36.8ºC; operating & design pressure: ATM; corrosion allowance: 1.6 mm; rubber-lined; shell AS3679 GR250	1
	NCA 1 CIL tanks		Diameter x height: 13.7 m inside x 15.0 m; operating temp: 36.8ºC; operating & design pressure: ATM; corrosion allowance: 1.6 mm; rubber-lined; shell AS3679 GR250	6
	NCA 2 neutralisation Tank		Diameter x height: 14.2 m inside x 18.5 m; operating temp: 35ºC; operating & design pressure: ATM; corrosion allowance: 1.0 mm; shell ASTM A36; rubber-lined	1
	NCA 2 leach tank		Diameter x height: 14.2 m inside x 18.5 m; operating temp: 35ºC; operating & design pressure: ATM; corrosion allowance: 1.0 mm; shell ASTM A36; rubber-lined.	1
	NCA 2 CIL tanks		Diameter x height: 14.2 m inside x 18.5 m; operating temp: 35ºC; operating & design pressure: atmospheric; corrosion allowance: 1.0 mm; shell ASTM A36; rubber-lined	6
Carbon elution and regeneration	NCA 1 acid wash pressure vessel	Morton Engineering Co Pty Ltd	Diameter x height mm: 1,620 x 11,900; mat: AS3678-250 plate; hydrotest pressure- 550 kPa; rubber lined – 6 mm; S135 paint spec	2

Area	Asset	Manufacturer/Supplier	Specifications	Quantity
	NCA 1 carbon elution column	Pinnacle Engineering/Wacol, Brisbane	Diameter (m) x height (m): 1,320 ID x 12,150 L; design pressure, kPa (g) / design temperature: °C 350 / 120; carbon elution column, 6 mm 316l SS, with two 316 SS wedge wire bayonet screens, insulation support rings, one wire-reinforced EPDM elastomer flanged chamber	1
	NCA 2 acid wash pressure vessel	Not applicable	Not applicable	2
	NCA 2 carbon elution column	Pinnacle Engineering/Wacol, Brisbane	Diameter (m) x height (m): 1,320 ID x 12,150 L; design pressure, kPa (g) / design temperature: °C 350 / 120; carbon elution column, 6 mm 316l SS, with two 316 ss wedge wire bayonet screens, insulation support rings, one wire-reinforced EPDM elastomer flanged chamber.	1
	NCA 2 carbon reactivation kiln	Metso	Size: length x diameter – 16,121 x 2,781 x 4,417 mm; required motor voltage: 415 volts	1
	NCA 1 carbon reactivation kiln	Nutec Bickley	Type: indirect fired (diesel fuel) rotary; model: RK850X8000; L x W x H (mm): 13,000 x 3,000 x 8,200; live operating capacity: 12 hrs (12 tons @ 1000 kg/hr); 20 years design life	1
Gold room	Electrowinning cells		Knitted 430 SS; sludge removal type. 3.5 m^3; 2 line of 2 cells, with rectifiers	4
	Furnace, melting gold room		Melting: tilting induction type, 30 L crucible capacity	1
Tailings	Tailings de-aeration tank		Size: length x diameter = 9.6 x 10 m; segmented; corrosion allowance: 4.0 mm; 12 mm bromo-butyl rubber lining; shell A3678-250	1
Lime production	Lime slaking plant LS100	Newell Dunford	Size: length x diameter – 2.3 x 2.2 m; required motor voltage: 132 kw; capacity 200 t/d dry lime, max 265 t/d	1
	Lime slaking plant LS1100	Bradken	Vertical stirred mill slaker, SM6018, 90 kW 1400 L capacity	1
	Lime slaking plant LS2100	Lime Systems	Size: length x diameter - 4 m diameter x 2.0 m ball mill; rubber-lined; double drive 150kW and 90 kW; mill speed 22.68 rpm; 8 dt/h capacity	1

The second primary crushing circuit, installed during the 2010–2012 MOPU plant expansion, consists of two jaw crushers operating in parallel. Separate overland conveyors are used.

The operating window for the LOS is largely set by limits on the autoclave operations as follows:

- Minimum feed sulphide sulphur of 5.5% w/w;
- Maximum feed sulphide sulphur of 10% w/w;
- Minimum sulphide sulphur oxidation of 50%;
- Minimum oxidation–reduction potential (ORP) of 350 mV (ref Ag–AgCl in flash tank discharge);
- “Front end” temperature limitations.

There are three grinding circuits. One circuit (HGO2) generally treats high grade ore that is fed direct to the downstream oxidising autoclaves. The second and third circuits (FGO circuit and HGO circuit) are generally directed to the flotation plants. However, all three circuits can be directed to flotation as necessary, and all three circuits can go “direct” to the autoclaves as necessary.

All three grinding circuits have a primary semi-autogenous grind (SAG) mill followed by a secondary ball mill in closed circuit with classifying hydro-cyclones. Pebbles from the HGO and HGO2 circuits are combined and directed to two cone pebble crushers. Crushed pebbles are directed back to the HGO mills.

The current capacity of the HGO, FGO and HGO2 mills is approximately 6.5, 5.0 and 6.5 Mt/a respectively. Ground ore is thickened and washed in a one or two stage grinding thickener counter-current decant (CCD) washing circuit with raw water to minimise chloride concentration in the autoclave feed.

17.2.2 Flotation

Two rougher flotation circuits are installed. No concentrate cleaning is practiced.

In the first, older, flotation circuit, ground ore from the FGO circuit mill is subjected to simple bulk rougher flotation in a single roughing stage consisting of a bank of five 150 m^3 flotation tank cells (2007 installation).

In the second, newer, (2013 installation) circuit ground flotation ore from the HGO and/or HGO2 circuit mill is processed by five 300 m^3 flotation tank cells. The mass recovery (pull) to flotation concentrate is high at approximately 30–40%.

Flotation concentrate is directed to the grinding thickeners, and a portion of the flotation tails are directed to cyclones for partial recovery of mainly cyanide-soluble gold.

17.2.3 Flotation Tailings Gold Recovery

Partial recovery of gold from flotation tailings is practiced. Following earlier partial recovery of gold in flotation tailings in 2015, a dedicated flotation tailings treatment system was commissioned in 2017.

In this circuit flotation tailings are directed to two separate hydro-cyclone clusters (one for FGO floats and one for HGO floats) where a separation based on size is completed. Gold in recovered fines can be recovered by direct cyanidation at 60–75% recovery. A flowsheet showing the process is provided in Figure 17-3.

The fines are recovered at a cut-size of 40 μm and sent to a re-purposed thickener. After thickening to about 30–40% solids, the fines are then pumped to the autoclave discharge tanks, thereby effectively by-passing the autoclaves.

Hydro-cyclone underflow coarse solids are directed to tailings for disposal.

17.2.4 Pressure Oxidation

Thickened ore slurry is pumped to four parallel autoclave circuits via six slurry storage tanks. The buffer between the milling and autoclave circuits helps stabilise autoclave operations.

Conventional gold processing Sherritt autoclave technology at a temperature of 215°C and a total pressure of 2,650 kPag is used. Feed slurry can be first preheated in the heat recovery vessels, before being pumped under pressure to each of the eight agitator horizontal autoclave vessels. If sulphide sulphur grades are high enough, operation without pre-heating is possible and is often practiced.

Pure oxygen (approximately 98% v/v) from three operating cryogenic oxygen plants is injected into the autoclaves to oxidise approximately 50–90% of the sulphide minerals (predominantly pyrite).

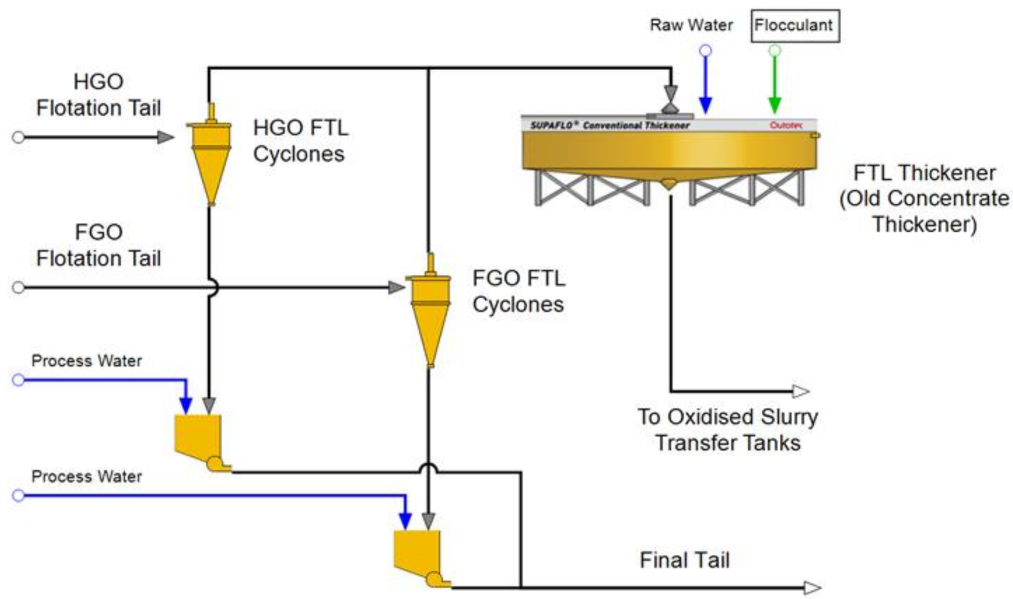
Each autoclave has a single stage of slurry temperature and pressure let-down by steam flashing. For the original, smaller, autoclaves 1, 2 and 3, flashed steam can be used in the direct contact pre-heater vessel. Flash steam from the newer autoclave 4 is not recovered for the purposes of slurry pre-heating.

17.2.5 Counter-Current Decant Washing, Neutralisation and Gold Recovery

Oxidised slurry passes through two trains of a two-stage CCD circuit, where gold containing solids are washed with process water and seawater as required, reducing slurry acidity. The washed slurry is neutralised with lime slurry prepared by slaking imported quicklime. Gold is recovered from the neutralised slurry by cyanide leaching using conventional CIL technology and a series of agitated tanks. The slurry is conditioned with lime in the first tank and cyanide is added to the second tank. The slurry is then agitated with granulated carbon in the absorption tanks and passes through the tanks while the carbon is retained by screens.

Loaded carbon from the CIL circuit is stripped of gold in an elution system. The gold is eluted from carbon using hot caustic/cyanide solution and the carbon is then rinsed with water. The resulting gold solution is circulated through electro-winning cells where gold is recovered through electrowinning to form a gold sludge. The sludge is dried and smelted to produce doré bars, which are shipped to a refinery. Barren carbon is regenerated in two rotary kilns.

Figure 17-3: Flotation Tailings Gold Recovery



Note: Figure prepared by Newcrest, 2020.

17.2.6 Residue Tailings

The CIL leach residue tailings are detoxified by formation of strong metal complexes such as ferrocyanide, and through dilution with seawater (oxygen plant cooling water return).

Under these conditions weakly acid-dissociable cyanide (CN_{WAD}) converts to stable ferrocyanide.

The tailings gravitate to a common disposal system which also collects the flotation tailings; remaining CCD wash water as well as oxygen plant and power plant cooling water return streams. The tailings disposal method is by deep sea tailings placement (DSTP). The combined stream flow discharges through a de-aeration tank to the ocean via a pipeline outfall at a depth of approximately 125 m below sea level. The depth of the outfall discharge is below the surface mixed layer of the ocean. Being denser than the receiving seawater, the tailings gravitate down the steep submarine slope.

17.3 Blending Strategy

Limited ore blending is practiced prior to crushing. This assists in managing the significant variability that exists in the mineralization being mined. This variability manifests itself in several number of ways, including:

- Gold and sulphide sulphur grade;
- Split of barren (unreactive) and arsenian (reactive) pyrite;

- Total carbonates;
- Mineralogical variability particularly in terms of clay proportions and speciation;
- Copper and other base metal impurities;
- Lithology;
- Hardness and abrasiveness;
- Moisture;
- Chlorides;
- Sulphates and oxidised ores in general;
- "As-blasted" ROM ore particle size.

17.4 Energy, Water, and Process Materials Requirements

17.4.1 Energy

The average power demand from the process plant is 126 MW/a. This is met from a combination of heavy fuel oil (HFO) and geothermal sources.

17.4.2 Water

The processing plant uses a combination of seawater, untreated fresh water and various treated water streams.

Seawater is used for cooling the oxygen production plants and power station, quenching and scrubbing in the pressure oxidation areas, and in the post-oxidation CCD circuit. Seawater is drawn from a screened intake chamber in the small boat harbor. The plant currently uses about 21,000 m^3/hr of seawater.

Untreated fresh water is mainly used in the milling circuits and in the grinding thickeners for washing the ground ore and control of ore chloride concentrations. Some fresh water is provided from rainfall collection on site. Most of the fresh water is drawn from a small weir on the Londolovit River, situated approximately 8.4 km north of the process plant, and pumped via pipeline to the plant raw water storage tank and the thickener circuit.

The maximum permitted extraction rate from the Londolovit River is 3,168,000 m^3 per month or 38,016,000 m^3 annually (in accordance with the existing Environment Permit WEL3(143) and the Lower Londolovit River Management Plan). During 2020 the average water demand for ore processing is approximately 2,600,000 m^3 per month.

Processing can be affected by prolonged drought periods (see Section 20.9). Newcrest has developed and implemented a water conservation strategy to support operations during low rainfall periods. This includes recovery of fresh water from some flotation tailings, minimising non-essential usage, maximising use of seawater throughout the process plant and maintaining a minimum base flow in the Londolovit River. About 13.8 ML of the process water (23%) was reused in 2018 (excluding seawater).

17.4.3 Process Materials

Key processing reagents are oxygen (generated on site), lime and cyanide. Quick lime is imported in dedicated shipping containers. Cyanide is imported as sodium cyanide briquettes in 1 t bags and then dissolved in water for distribution to the cyanidation circuit. Other minor reagents are for flotation (collector and frother) and flocculent for thickening. Grinding balls are imported in sea containers and stored in bunkers.

17.5 QP Comment on "Item 17: Recovery Methods"

The QP notes:

- The process plant is designed to treat refractory gold mineralisation;
- The plant has undergone a number of modifications and expansions and can currently treat a nameplate 15 Mt/a;
- The Lihir Operations have changed from a "full oxidation" treatment plant to a partial oxidation plant. Feed to the autoclaves is a mixture of whole ore and flotation concentrate;
- In normal operation there is significantly more milling capacity than autoclave capacity, therefore a substantial amount of ore is typically sent to flotation to match autoclave throughput;
- If a feed is presented to the autoclave that is too low in sulphide sulphur, then the autoclaves will slow down to maintain front-end temperatures, hence forcing more ore to flotation, which increases sulphur grade, allowing increased throughput reaching a new equilibrium;
- The average power demand from the process plant is 126 MW/a;
- The processing plant uses a combination of seawater, untreated fresh water and various treated water streams. Processing can be affected by prolonged drought periods (see Section 20.9). Newcrest has developed and implemented a water conservation strategy to support operations during low rainfall periods.

18 PROJECT INFRASTRUCTURE

18.1 Introduction

The majority of surface infrastructure to support operations is in place, and includes:

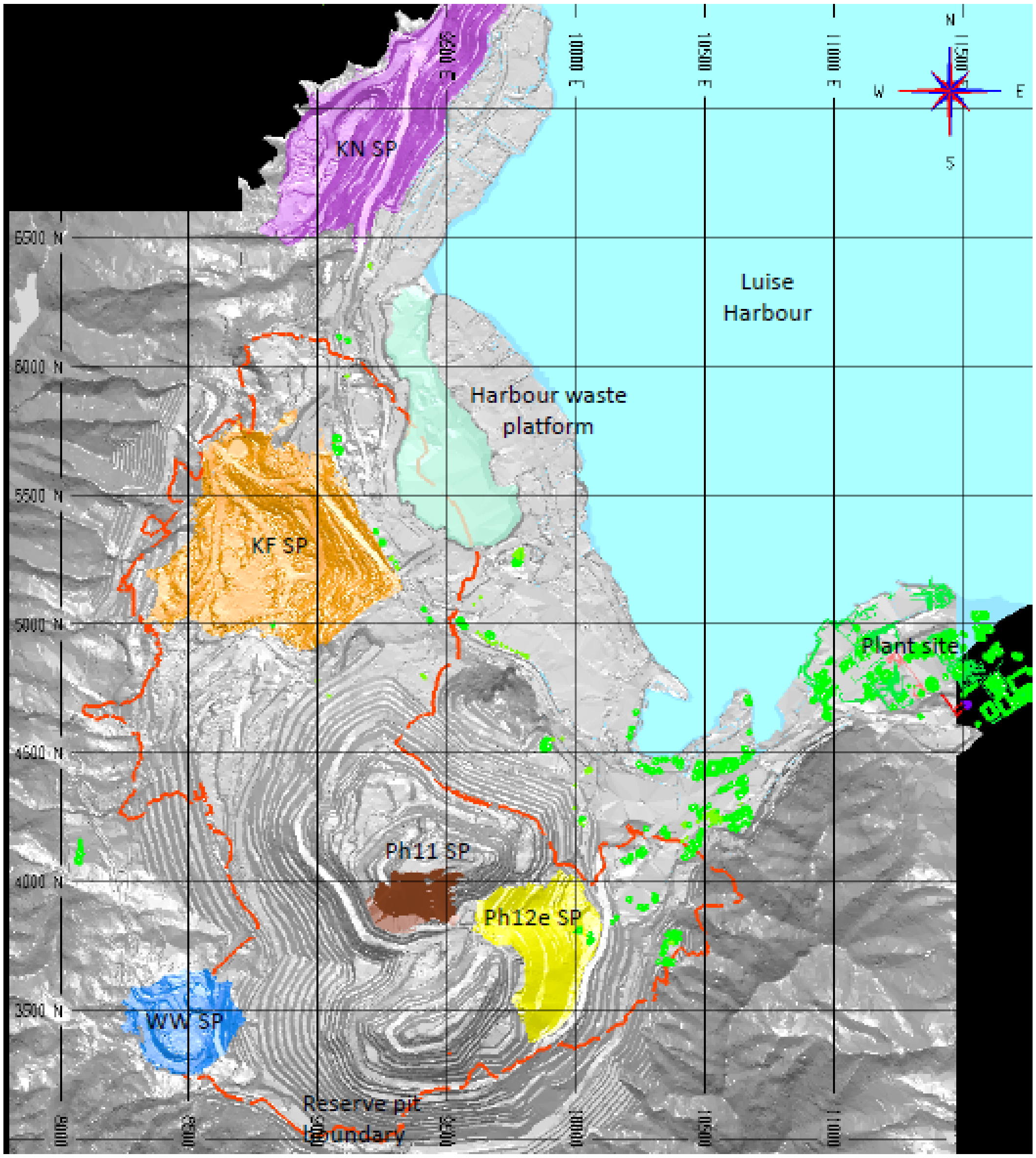
- One open pit;
- Mine facilities: ROM stockpiles, low-grade stockpile, crushing facilities, explosives magazine and mine support facilities;
- Processing facilities: main office, laboratory, training building, warehouse and bond store, plant workshop, and an emergency and security services building;
- Materials handling for processing: fuels, reagents, and consumables required by the processing plant.
- Port facilities: servicing oil tankers, general cargo ships, passenger ferries and work boats;
- Put Put wharf;
- Inner harbour for small boats;
- Waste rock disposal barges and associated loading and disposal infrastructure;
- Tailings pipeline and pipeline outfall;
- Water management facilities: stormwater and water storage dams, diversions, culverts;
- Landfill facility;
- Power generation facilities;
- Fuel storage facilities;
- Airstrip and terminal facilities.

Infrastructure layout plans are included as Figure 18-1 and Figure 18-2.

Additional infrastructure that will be required to support the LOM plan is the Kapit seepage barrier, discussed in Section 16.5, and also shown in Figure 18-2.

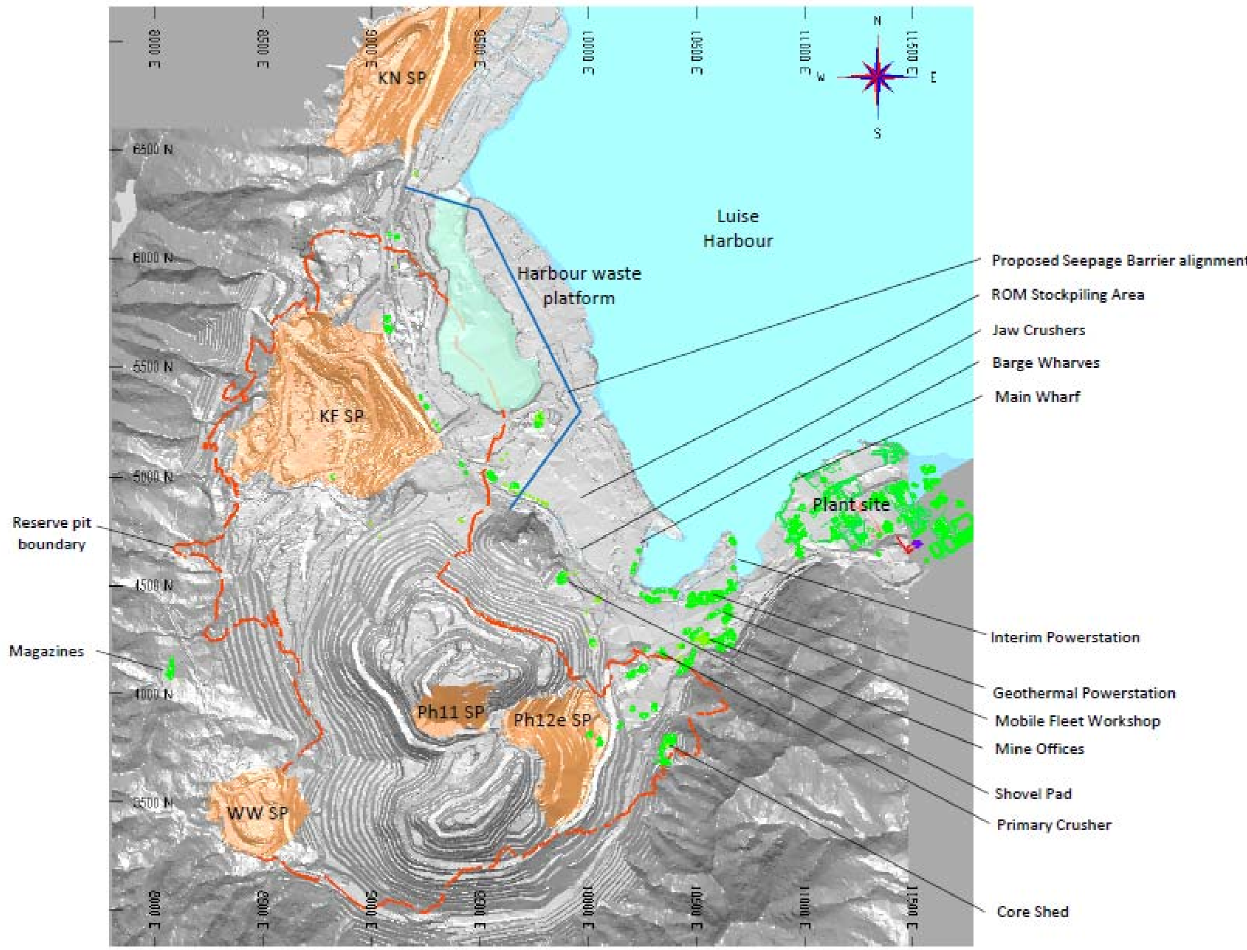
Infrastructure for the workforce includes housing and camp accommodation, and related community facilities such as a school, medical centre, supermarkets, an open market and a police station, as well as associated messing and recreation facilities, and plants for water and sewerage treatment.

Figure 18-1: Infrastructure Layout Plan



Note: Figure prepared by Newcrest, 2020. KNSP = Kapit North stockpile; KFSP = Kapit Flat stockpile; Ph11 SP = pit phase 11 stockpile; Ph12e SP = pit phase 12 east stockpile; WWSP = western wall stockpile.

Figure 18-2: Infrastructure Layout Plan



Note: Figure prepared by Newcrest, 2020. KNSP = Kapit North stockpile; KFSP = Kapit Flat stockpile; Ph11 SP = pit phase 11 stockpile; Ph12e SP = pit phase 12 east stockpile; WWSP = western wall stockpile.

18.2 Road and Logistics

A public road was constructed from the village of Put Put to the accommodation centre at the Londolovit plantation, and from there to the airstrip at Kunaye.

Haul roads run between the crushing facilities and ROM stockpiles at Ladolam, the barge loading dock in Luise Harbour, and the low-grade ore stockpiles.

A wharf was constructed at Put Put for general cargo ships and tankers.

An airstrip and terminal facilities were constructed on the northern portion of the island. The airstrip was certified with the PNG Civil Aviation Authority in 2007 and the airport operates both domestic flights, and international flights to Cairns.

18.3 Stockpiles

Stockpiles are discussed in Section 20.4.

18.4 Waste Storage Facilities

Waste rock from the mine is either used for construction purposes or transported in barges for off-shore submarine disposal. Additional information on waste rock storage is provided in Section 20.5.

18.5 Tailings Disposal

Due to the heavy rainfall typically experienced on Aniolam Island, the lack of suitable area for a tailings storage facility, and the high seismicity of the region, DSTP was selected as the preferred tailings placement method for the Lihir Operations. Additional information is provided in Section 20.6.

18.6 Built Infrastructure

Mine facilities, including ROM stockpiles, crushing facilities, and mine support facilities, are located in the Ladolam Creek valley, immediately to the east of the ultimate pit boundary.

The processing plant is on the northwestern side of Put Put Point on relatively flat land adjacent to the shoreline and on the gentler lower slopes of the eastern end of the Luise Caldera.

Support buildings include a main office, laboratory, training building, warehouses, plant workshop, and an emergency and security services building. An environmental laboratory was built, and field and laboratory equipment provided for air and water sampling, steam gauging, sediment sampling, fish sampling, weather monitoring, oceanographic monitoring and industrial hygiene measurements.

Facilities for handling and transport of the various fuels, reagents, and consumables required by the processing plant are located near the general ship berth and the processing plant.

Port facilities are installed to service oil tankers, general cargo ships, passenger ferries and work boats. The Put Put wharf can berth general cargo ships of 13,000 dead weight tonnes (DWT) capacity, and oil tankers of 12,000 DWT, with draughts to 10 m.

Small boats with a draught up to 2 m can berth in the small boat harbour excavated in the coral platform within SML6. Several small boats are moored at this location and provide a ferry service to Namatanai, pilot boats for the primary port and vessels for environmental monitoring. Several small boats service the western side of Aniolam Island and the outlying islands of Mahur, Masahet and Mali. Permanent marine facilities were constructed at these locations for passenger loading and unloading.

The Kunaye airstrip has a 1,200 m long runway, and is suitable for use by a variety of small to medium size passenger aircraft. The airstrip includes a taxiway and aircraft parking area for three aircraft. A terminal building next to the aircraft parking area contains arrival and departure facilities and baggage-handling equipment.

18.7 Camp and Accommodation

The Londolovit accommodation centres provide housing for senior staff living on site and a number of government employees. Single persons' quarters are provided for commuting personnel.

18.8 Power and Electrical

Power is produced at site by a combination of heavy fuel oil (HFO) reciprocating engines and geothermal steam turbines. The existing total mine site power demand is around 115–126 MW is when all equipment is at full capacity (peak usage). Geothermal power provides an average of 13 MW, and the balance is from the HFO-fired generators.

The HFO power supply consists of twelve 6.3 MW units, and ten 8.8 MW units.

The geothermal power supply consists of five turbines with maximum design capacity of 10 MW each. Geothermal power system is current generating 12–15 MW from 10 production wells. The system is constrained by suitable steam availability. Geothermal power is forecast to decline in the medium term as a result of mining impacting producing wells, seepage barrier construction and the gradual depletion of the heat reservoir. The mine plan allows capital for replacement of geothermal power with HFO-generated power aligned with the forecast ramp down.

The site has small backup generators that use light fuel oil.

18.9 Fuel

Fuel handling facilities include provision for handling of HFO and diesel fuel (distillate). HFO discharges from oil tankers to two bulk storage tanks using the supplying tanker's pumps. These HFO tanks have a total capacity of 26,500 t. An estimate of average HFO consumption is 205 t/d.

Using the supplying tanker's pumps, diesel discharges to two bulk storage tanks that have a total capacity of 6,000 t. Average diesel consumption is estimated at 70 t/d.

18.10 Communications

Communications at the site, across the island and within the PNG mainland and overseas are provided through the national telephone network carrier. Internet access for the operation is provided via a dedicated satellite link. Marine and aeronautical radio systems are installed.

18.11 Water Supply

Water supply is discussed in Section 20.8.

18.12 QP Comments on "Item 18: Project Infrastructure"

The QP notes:

- The majority of the infrastructure required for the Lihir Operations has been constructed and is operational;
- A seepage barrier will be required to be constructed to support mining of the Kapit sector of the open pit;
- The geothermal power generation system is constrained by suitable steam availability. Geothermal power is forecast to decline in the medium term and be replaced with HFO-generated power. There is a minor risk to the power assumptions within the mine plan, and therefore to the Mineral Reserves, if there is a faster decline of geothermal steam than forecast that could not be off-set by construction of replacement power infrastructure.

19 MARKET STUDIES AND CONTRACTS

19.1 Market Studies

No market studies have been conducted. Gold is a freely-traded commodity with spot pricing readily available.

The Lihir Operations consist of an operating mine with refining contracts in place. The Lihir Operations produce gold doré containing 91–97% gold, 2.2–8.24% silver and 0.5–3% base metals, which is securely transported from the mine to a refinery.

Within the Asia–Pacific region, there are a number of London Bullion Market Association-accredited refineries that have the capacity to refine doré, including the West Australian Mint refinery (WAM) in Perth, WA, the ABC Refinery in Sydney, NSW, Metalor Technologies in Singapore, W.C Heraeus–Precious Metals in Hong Kong, Logam Mulia in Indonesia, and new refineries in India as well as a number of established refineries in Europe and the Middle East. Currently WAM is the preferred refinery.

19.2 Commodity Price Projections

Metal price assumptions are provided by Newcrest management. Newcrest considers analyst and broker price predictions, and price projections used by peers as inputs when preparing the management pricing forecasts.

Metal price assumptions used for the 30 June 2020 Mineral Resource and Mineral Reserve estimates are as follows:

- Mineral Resource estimates:
  - Gold: US$1,300/oz;
- Mineral Reserve estimates:
  - Gold: US$1,200/oz;
  - Long term exchange rate A$:US$: 0.75.

19.3 Contracts

There are currently eight major contracts in place to support the Lihir Operations. These contracts cover items such as refining, security transport, data management and invoicing, mining contracts, sea freight, catering and accommodations support, air transport, and labour hire.

Contracts are negotiated and renewed as needed. Contract terms are in line with industry norms, and typical of similar contracts in Papua New Guinea that Newcrest is familiar with.

19.4 QP Comments on “Item 19: Market Studies and Contracts”

The QP notes:

- The Lihir Operations consist of an operating mine with doré sales contracts in place;

- The terms contained within the refining agreement and sales contracts are typical of and consistent with Australian standard industry practice, and are similar to contracts for the supply of doré that Newcrest is familiar with in Australia;
- Contracts are currently in place in support of Project operations. These contracts are negotiated and renewed as needed. Contract terms are to be within industry norms, and typical of similar contracts in PNG that Newcrest is familiar with;
- Metal price assumptions are provided by Newcrest management. Newcrest considers analyst and broker price predictions, and price projections used by peers as inputs when preparing the management pricing forecasts.

The QP is of the opinion that the marketing and commodity price information is suitable to be used in cash flow analyses to support the Mineral Reserve estimates.

20 ENVIRONMENTAL STUDIES, PERMITTING, AND SOCIAL OR COMMUNITY IMPACT

20.1 Introduction

Mine development and operations (i.e. processing) at the Lihir Operations commenced in 1997 in accordance with the agreed development plans stipulated in the approved Proposal for Development, which forms the basis of the Mining Development Contract (MDC) and the subsequently issued Special Mining Lease (SML6). The original Environmental Plan associated with mine development was completed in 1995 (NSR, 1995) and approved by the PNG Minister of Environment.

An Environmental Impact Statement (EIS) was prepared under the *Environment Act 2000* for the Production Improvement Program, which facilitated the subsequent incorporation of the existing Water Use Permits into two new Level 3 Environment Permits (Lihir Gold, 2005). The EIS was subsequently approved by the PNG Department of Environment and Conservation (DEC) in 2008, with new environmental permits issued for waste discharge and water abstraction in October 2008 (DEC, 2008a; 2008b).

Newcrest completed a major plant upgrade in 2013, which did not require any change to the current rate of mining or to the extent of the pit footprint. Instead, additional ore processing was made possible by increasing the rate of processing for stockpiled low-grade ore and increases to tailing disposal, as part of the MOPU project. An EIS for the expansion was submitted to the PNG DEC (Coffey, 2009) and was approved by the PNG Environment Council in February 2011. The existing waste discharge and water extraction permits were amended in March 2012 and November 2014, respectively.

A regulatory-approved Environmental Management and Monitoring Plan (EMMP) is used to manage and monitor the predicted environmental impacts associated with the Project. The EMMP is updated every four years for review and endorsement by the PNG Conservation and Environment Protection Authority (CEPA; formerly DEC). In addition, an annual environmental report is prepared and submitted to CEPA as well as other national, provincial and local level government bodies. Newcrest has an operating environmental management system (EMS).

20.2 Baseline and Supporting Studies

Baseline studies were completed in support of permitting and operations in the period 1988–1992. Additional studies were conducted during the MOPU expansion from 2009–2013. Completed studies included the following major discipline areas:

- Vegetation;
- Fauna and avifauna (including megapodes);
- Freshwater and coastal fish;
- Marine biological habitat;
- Fringing coral reefs;
- Bathymetry;

- Upper ocean characteristics (e.g. water temperature, salinity, density, dissolved oxygen, light penetration);
- Meteorology and hydrology;
- Oceanic currents;
- Land use;
- Marine resources use;
- Riparian resources use;
- Archaeology and material culture.

Additional surveys, evaluations, and models included:

- Waste rock characterisation;
- Submarine tailings hydraulics and dissolution, tailings dispersal;
- Trial waste dumping, plume modelling;

20.3 Environmental Considerations/Monitoring Programs

The onsite Environment Department uses and references a number of records, documentation and information management systems to store assess and review data:

- Environmental data monitoring (EQuIS) database: water quality criteria and monitoring results; water run-off volumes and quality, stream flows and suspended sediment flux;
- Hydrometeorology: water level, pH, water temperature, and weather information, fresh-water management model for the Londolovit River;
- Meteorology: rainfall, evaporation, relative humidity, solar radiation, air temperature, prevailing winds;
- Air quality and noise monitoring;
- Groundwater monitoring;
- Vegetation and soil monitoring;
- Megapode monitoring;
- Aquatic biomonitoring: fish, shellfish and seagrass;
- Waste rock disposal and submerged waste stockpile dimensions;
- DSTP tailings discharge volumes, chemistry;
- Ocean physio-chemical monitoring, near shore sedimentation rates and turbidity, water quality;
- Land management model: land disturbance and progressive rehabilitation statistics;

- Laboratory information management: sample collection, registration, and chain of custody and reporting;

Newcrest maintains a central compliance system for all sites, including the Lihir Operations, to report environmental incidents, notifications, investigations, tracking of actions, reporting, inspections and track action completion.

Newcrest conducts additional reviews, research and monitoring in-house or with external specialists and consultants and independent experts to examine company activities that have a potential risk of impacting the environment. Newcrest's applied research and management plans aim to develop a better understanding of the surrounding environment in which the mine operates and to provide plans to manage and mitigate potential impacts associated with mining activities.

20.4 Stockpiles

Figure 18-1 showed the major existing stockpile locations as at 30 June 2020. All stockpiles, except Kapit North and Wild West, are within the planned final pit boundary, and will need to be consumed or relocated to allow final pit development. All major existing stockpiles are scheduled to be reclaimed over the next eight years.

It is planned to use the Phase 9 pit void for low-grade stockpiling to meet LOM plan requirements. The design complies with Newcrest's standard stockpile design parameters, including 10 m berms, 24 m face height, 28 m ramps, batter angle of 35º, and inter-ramp angle of 28º. The stockpile will have a total capacity of about 42 Mt up to the 968 mRL.

Acid and metalliferous drainage (AMD) will be generated from medium-term storage of ore stockpiles prior to processing. This requires management of runoff and drainage to ensure discharges comply with the requirements of the site's Environment Permits. Regular monitoring is undertaken of water quality for regulatory reporting. Newcrest is currently conducting studies to assess appropriate means of treating, mitigating and/or managing AMD as the basis for an amendment to the Environment Permit for Waste Discharge.

20.5 Waste Rock Disposal

Waste rock from the mine is either transferred into 1,500 t capacity barges for off-shore submarine disposal within the boundaries of the Special Mining Lease, or stockpiled for use as road base, bench sheeting, stemming or construction fill. Submarine waste disposal is carefully planned and controlled to achieve a continuous rill along the steeply-sloping sea floor and minimise the potential for uncontrolled slumping.

Alternate deposition strategies are under review.

20.6 Tailings Disposal

Tailings are disposed using DSTP. This disposal process was selected as the preferred tailings management option from an environmental and social point of view because the Lihir Operations have limited space for terrestrial tailings storage and the mine is situated in a seismically active region. Baseline studies were undertaken prior to the approval by PNG environmental authorities and commencement of the DSTP.

Tailings are discharged from a pipeline that extends from the de-aeration tank through a directionally-drilled hole in the shoreline at Put Put Point to a discharge point beneath the productive euphotic (sunlight-penetrating) zone at a depth of approximately 125 m below the surface.

The process tailings comprise a dilute mixture of treated mill feed material and seawater from the cooling water systems and discharged through the DSTP system at a depth of approximately 125 m within the boundaries of the Special Mining Lease. Given that the waste rock and tailing materials contain sulphide minerals (including pyrite), submerging these materials prevents oxidation and potential AMD generation.

Ongoing monitoring of DSTP is conducted under a government-approved EMMP. Detailed seabed and tailings footprint surveys are regularly conducted as per EMMP requirements. These surveys include seabed bathymetry, ocean water quality, seabed physio-chemical characterisation, and abundance of deep-sea marine fauna.

Newcrest has conducted numerous studies to investigate the performance of the DSTP system including potential impacts from mine-derived sediment, waste rock and tailing disposal (CSIRO, 2009). The PNG Government has also conducted studies on the DSTP system independently of Newcrest (SAMS, 2008). The studies have found that the system performs according to approved environmental permits and regulatory monitoring requirements.

In addition, periodic independent technical reviews (e.g. Scottish Association of Marine Science) have been undertaken to assess whether the DSTP system is functioning as designed, and to develop ongoing research projects.

There have been no significant operational, compliance, environmental or social issues related to the operation of the DSTP system since Newcrest's acquisition of the Lihir Operations in 2010.

20.7 Water Management

Pit perimeter diversion drains are installed on a 50 m wide drainage berm sloping at 3% to intercept as much surface runoff as possible from the Luise Caldera, which is diverted around the mining operation and into the ocean.

Remaining surface runoff, groundwater seepage and rainfall is collected by 16 m wide drainage berms incorporated into pit designs and directed into sumps. Water is then pumped by in-pit dewatering pumps to external holding dams before ocean discharge.

20.8 Seepage Barrier

Optimisation studies on the mine plan have indicated that inner harbour infill, in combination with a cut-off wall, could provide a dual seepage barrier to reduce seepage into the Lihir open pit and provide protection to the planned Kapit pit phase from inflow during earthquake and/or tsunami events. Other advantages of this proposed approach include that the infill of the inner harbour will use appropriate available mine waste material rather than requiring external sourcing, and that the inner harbour would provide a temporary stockpile location for material that would otherwise have needed to be stockpiled elsewhere.

The soil bentonite or plastic concrete mix design will be uniquely tailored to the Lihir Operations environment (i.e. geothermal heat, seawater and heavy metals in the argillic clays) and will require testing to ensure the appropriate design is used.

20.9 Water Supply

20.9.1 Overview

The rugged topography, steep stream gradients and high earthquake risk on Aniolam Island mean that there are few locations suitable for cost effective construction of large volume water storages. Furthermore, those locations most amenable to large dam construction are also those most suitable for human habitation, and have the greatest population density and resource value to the local community. As a consequence, development of water supply yield on the island is necessarily focused on run-of-river and/or groundwater resources.

The nearest available source of water in sufficient quantity is the Londolovit River where a 3–4 m high, broad diversion causeway weir scheme and associated pumping station were constructed. Four large turbine pumps supply the process plant via a pipeline from the weir that discharges to both the plant raw water storage tank and the thickener circuit.

Water can also be sourced from a natural fresh-water spring within the caldera. A water treatment plant serves to improve water quality.

The operations water demand is currently met by a combination of Londolovit raw water from the weir, caldera extraction via the Kapit spring and seawater supplement. Fresh water from pit diversion can also be substituted into the plant supply.

The catchment area is very small, (12 km length and surface catchment area of about 26.1 km^2) and flow in the Londolovit River is dependent on rainfall, with the system draining within 3–5 days of rainfall events. Over the record since 1999, the system has delivered 80–85% reliability for supply at licensed extraction rates.

Prolonged drought conditions are a risk to continued plant operations due to the lack of water. Sea water substitution measures can be implemented in the plant under major drought conditions and can mitigate a portion, but not all, of the drought-related effects on production.

Based on the Aqueduct Water Risk Atlas, which assesses water risk on a five-tiered scale against a series of indicators (including physical quantity, quality, and regulatory and reputational risk) at Newcrest sites, the water risk range rating for the Lihir Operations is “high”, the second-highest risk rating assigned under the scale.

20.9.2 Water Extraction Permits

Extraction from the Londolovit River is governed by PNG government permit under the PNG *Environment Act 2000*, under permit number WE-L3(143). Two uses are permitted from the Londolovit surface water system by WE-L3 (143):

- #3: Extraction from the Londolovit weir for use at the Londolovit township & camp(s) at 1,250,000 m^3/year or 145 m^3/hour;

- #5: Extraction from the Londolovit weir for operations use for ore processing at 38,016,000 m^3/year, or 4,400 m^3/hour.

A key condition of the permit is the specification for maintenance of environment flow as a mandatory requirement for extraction at Londolovit Weir. Environmental flow is set at 200 L/second, or 720 m^3/hour, which is to be maintained below the extraction point and weir at all times during the extraction of water. Environmental flow is required as a minimum requirement to protect downstream aquatic water quality and ecosystems along the lower reaches of Londolovit River.

20.10 Closure Considerations

In compliance with regulatory requirements, Newcrest commissioned a conceptual mine closure plan in 1995, which was submitted to the PNG government, and which has been updated and refined in accordance with the Newcrest closure standard, including in FY20. A detailed Mine Rehabilitation and Mine Closure Plan is required to be submitted to the regulator a minimum of two years prior to the cessation of operations.

Planned closure is divided into three stages:

- Open pit mine closure;
- End of milling operations;
- Post-closure monitoring.

Site rehabilitation and closure will involve dismantling and demolition of infrastructure not intended for subsequent community use, removal of residual materials and remediation of disturbed areas. Community requirements and long-term land use objectives will also be taken into account.

A mine closure risk assessment to guide future updates to the closure plan was completed in 2018. The closure cost estimates are currently being updated following a review of the closure options and update of the Lihir Operations closure plan.

There are currently no known requirements to post performance or reclamation bonds. However, new closure policy documentation that is being drafted by the State may introduce bonding requirements. A bond of PGK111,000 was posted prior to the Lihir Operations commencing in 1997.

A 2016 conceptual closure cost assumption of approximately US$89 M was used in the cash flow analysis that supports the 30 June 2020 Mineral Reserve estimate. Newcrest expects that as a result of the 2019 introduction of the Mining Project Rehabilitation and Closure Guidelines, a review of bonding and financial assurance payable will be undertaken to determine what Newcrest's financial assurance will be to cover the existing and proposed disturbances. It is expected that the revised provision will be higher than current assumptions; however, due to the nature and end of life timing of this cost, it is not considered material to the Mineral Reserve estimate.

20.11 Permitting

Newcrest currently holds the key applicable permits required to support current operations. Permit renewals are applied for where required.

Additional permits will be required as follows:

- Seepage barrier: currently approved with existing approvals but requires sign off by the Chief Inspector of Mines (MRA) pursuant to the *Mining (Safety) Act 1977*. The construction of this barrier was previously approved as part of the 2005 Production Improvement Programme Environmental Impact Statement;
- HFO power generation infrastructure to replace geothermal ramp down: this will require permitting through CEPA and MRA. This process has commenced;
- Installation of any additional processing tertiary grinding and flotation capacity.

Subject to outcomes of current study work additional permits may be required as follows:

- Changes to the AMD management strategy to treat, mitigate and manage AMD at the source, pathway and receptor;
- Investigation into alternatives for future waste rock disposal.

The Lihir Operations are conducted in accordance with the development plans stipulated in the MDC and the accompanying Approved Proposal for Development (APFD) signed between the State and Lihir Gold in 1995. The MDC and APFD represent the principal agreement/contract between the State and Lihir Gold in accordance with that described in the *Mining Act 1992* Part IV. The MDC and APFD provide details of the conditions and implementation of the Project's approved environmental, financial, business, training/localisation, land-owner agreements and infrastructure plans.

The Project's approved Environmental Plan (NSR, 1992) was prepared in accordance with the *Environmental Planning Act 1978*, the *Water Resources Act 1982*, and the *Environmental Contaminants Act 1978*.

The *Environment Act 2000*, which came into effect in January 2004, allows for existing approvals, permits and licences issued under the now repealed Environmental Planning, Water Resources and Environmental Contaminant acts to continue to be valid and in force for existing projects such as the Lihir Operations.

The operations EMMP provides details of the environmental monitoring requirements and reporting commitments to CEPA, MRA, New Island Provincial Government Nimamar Local Level Government, and community representatives such as the Lihir Mine Area Landholders Association. The EMMP lists the various monitoring requirements, which arose from the identification of key environmental issues documented in the Project's Environmental Plan (NSR, 1992) and subsequent EISs. The EMMP includes statutory monitoring associated with the water extraction permit for the Lihir Operations, which regulates the volume of water extracted from rivers and the ocean to operate the mine, and the waste discharge permit, which limits the volume and concentration of discharged waste streams.

20.12 Considerations of Social and Community Impacts

Newcrest's ongoing commitment to sustainable development on Aniolam Island is encapsulated in its 2019 Community and Environment Policy.

Commitments to the local community around compensation and community development are embodied in an Integrated Benefits Package Revised Agreement, which incorporates the Lihir Sustainable Development Plan, signed in 2007 with the Lihir Mining Area Landowners Association and the Nimamar Rural Local-Level Government. The Integrated Benefits Package Revised Agreement sets out the heritage and compensation arrangements for the local landowners, with the main objectives of ensuring that development on Aniolam Island occurs in parallel with mining, is balanced across the island, is sustainable, and is stable. Commitments to the local community around compensation and community development are embodied in an Integrated Benefits Package Revised Agreement signed in 2007, which incorporates the Lihir Sustainable Development Plan. As at 31 August 2020, the terms of the suite of agreements that are to replace the 2007 Integrated Benefits Package Revised Agreement have been agreed and the final draft agreements have been reviewed by the affected landholder groups and submitted to the Mineral Resources Authority for confirmation of regulatory compliance. On receipt of confirmation of regulatory compliance, the agreements will be executed and form the basis of future compensation and community development activities.

The Lihir Sustainable Development Plan is the overall implementation plan and provides a framework for future development initiatives to be aligned and focused over the life of the operations. Through these actions, Newcrest has made a strong commitment to support the local population and to prepare the community for a post mining environment.

Newcrest has a Social Impact Monitoring Program (Lihir Gold, 2009) in place via which the company monitors social issues related to the mine and uses the reports to develop mitigation strategies in consultation with the local community. The overall approach to social and community-related issues on Aniolam Island align well with the requirements of the International Council for Mining and Metals (ICMM) performance standards and Equator Principles (EPFI, 2009).

A Cultural Heritage Management Plan was developed during 2018 and adopted by Newcrest in 2019.

Newcrest has established generally good working relationships with local communities and although occasional disputes do occur, they are relatively minor in nature. The last disputes that resulted in brief disruptions to operations occurred in 2014–2015.

20.13 QP Comments on "Item 20: Environmental Studies, Permitting, and Social or Community Impacts"

The QP notes:

- Mine development and operations (i.e. processing) commenced in 1997 in accordance with the MDC;
- A regulatory-approved EMMP is in place;
- Newcrest has an operating EMS;
- AMD is generated from storage of ore stockpiles prior to processing;

- Waste rock is either sent to off-shore submarine disposal or stockpiled for use as road base, bench sheeting, stemming or construction fill;
- Submarine disposal of waste rock is carefully planned and controlled to achieve a continuous rill slope along the steeply-dipping sea floor and to minimise the potential for uncontrolled slumping;
- Tailings are disposed using a DSTP methodology.
- Water sources include a weir, spring, seawater supplement, and can include pit diversion run-off. Prolonged drought conditions are a risk to continued plant operations due to the lack of water. Sea water substitution measures can be implemented in the plant under major drought conditions, and can mitigate a portion, but not all, of the drought-related effects on production;
- A conceptual mine closure plan was prepared in 1995 and has been periodically updated. A detailed Mine Rehabilitation and Mine Closure Plan is required to be submitted to the regulator two years prior to the cessation of operations;
- Newcrest currently holds the key permits required to support current operations. Permit renewals are applied for where required;
- Additional permits will be required for the seepage barrier (requires sign off by the Chief Inspector of Mines pursuant to the *Mining (Safety) Act 1977*), the HFO power generation infrastructure to replace geothermal ramp down (permitting through CEPA and MRA), and installation of any additional processing tertiary grinding and flotation capacity;
- As at 31 August 2020, the terms of the suite of agreements that are to replace the 2007 Integrated Benefits Package Revised Agreement have been agreed and the final draft agreements have been reviewed by the affected landholder groups and submitted to the Mineral Resources Authority for confirmation of regulatory compliance. On receipt of confirmation of regulatory compliance, the agreements will be executed and form the basis of future compensation and community development activities;
- Newcrest has established generally good working relationships with local communities and although occasional disputes do occur, they are relatively minor in nature.

21 CAPITAL AND OPERATING COSTS

21.1 Introduction

Cost estimates were prepared as part of the Lihir Operations FY20 LOM plan base case. This LOM plan is underpinned by the mining and processing of the existing Mineral Reserves.

The LOM plan assumes Owner-operated ex-pit mining activities supported by specialist contractors primarily in pioneering and blasting. Ex-pit mining continues partway through FY38, after which there is a transition to processing only low-grade stockpile material through to FY41.

The majority of costs are based current-period budget level detailed forecasts, adjusted for Newcrest's long-term economic parameters, inclusive of key consumables price forecasts. Cost estimates for major projects required to mine the Mineral Reserves include costs based on the latest study outcomes for these projects.

Newcrest's internal study guidelines require project scope definition for a feasibility study to have an accuracy level of ±15%. Pre-feasibility studies must have a project scope definition accuracy level of ±25%. The capital and operating cost estimates that support the Mineral Reserves are at a minimum at pre-feasibility accuracy levels (±25%).

21.2 Capital Cost Estimates

21.2.1 Introduction

As the Lihir Operations are a steady-state operation, sustaining capital costs largely consist of site infrastructure upkeep and mobile equipment replacement costs. An allowance for miscellaneous equipment, small projects, and other minor capital costs was included for mining, processing, and site general. The sustaining capital cost estimate is based current budget level costs, combined with recent average sustaining capital spend.

The non-sustaining capital cost estimate for the major projects included in the Mineral Reserves estimate was developed in accordance with the following Newcrest standards and guidelines:

- IM GL-04 Feasibility Study Guideline;
- IM GL-03 Pre-Feasibility Study Guideline;
- PRJ-340-05-A Preparation and Review of Estimates;
- PRJ-340-05-B Preparing a Project Estimate Guide;
- PRJ-340-05-C Estimating Standards and Guidelines.

The major projects included in the Mineral Reserves estimate include:

- Seepage barrier;
- Pit cooling;

- Front-end recovery;
- Power generation;
- High voltage upgrade.

21.2.2 Labour Assumptions

Labour estimates for capital work were calculated using project operating schedules consistent with site experience in execution of similar activities and using industry-standard practices.

Operator and maintenance labour rates were taken from Lihir Operations standard pay scales. Internal and external labour costs required for execution of the capital projects are estimated in the capital costs.

Labour estimates for construction activities were calculated using detailed project construction estimates. Labour rates were based on historical and current site project rates.

21.2.3 Contingency

As the capital costs are based on actual recent prices, an allowance for contingency has not been included in the sustaining capital estimate. Contingency/risk was included for non-sustaining capital projects as per the outcomes of the latest supporting study. Contingency was intended to produce an estimate with equal chance of under-run/over-run.

21.2.4 Mine Capital Costs

Mine capital costs were based on modelling, using mine plans and schedules, material quantities, equipment data, consumable estimates and labour schedules.

Mining sustaining capital costs are based on the continuation of Owner-operator mining model. Mine sustaining capital estimates were built up from the current detailed budget combined with project to date actual spend, and adjusted using forward production plans and schedules, engineering designs, and equipment strategies.

Mining sustaining capital costs were estimated to average $28 M/a, for a total of $530 M over the remaining LOM.

Newcrest has made allowances for non-sustaining capital to pursue a variety of interrelated and inter-dependent studies, that include, but are not limited to, the seepage barrier, pit cooling, front-end plant recovery, alternative power generation and miscellaneous studies aimed at optimising production outputs. Mining-related non-sustaining capital costs were estimated at $871 M over the remaining LOM.

Pre-stripping costs are capitalised when they are directly related to the open pit mining activity, as per Newcrest's standards for production stripping. This includes costs relating to the movement of waste and ore, and excludes any costs associated with other surface movements, underground mining, milling, and processing operations. Direct administration costs for the Mining Department are included in these capitalised costs. A proportion of the indirect site administrative costs are capitalised as a proportion of direct mining costs to total direct costs. Pre-stripping expenditure associated with the stripping that is above the strip ratio (i.e. the balance capitalised) is reported as capital expenditure for management reporting, and as investing cash flow for statutory reporting. The capital expenditure is recognised monthly, and is consistent with the balance that is recognised each month as an addition to the asset.

21.2.5 Process Capital Costs

Process plant sustaining capital estimates were built up from the current detailed budget combined with project-to-date actual expenditure. These are adjusted using forward production plans and schedules, engineering designs and equipment strategies.

Process plant non-sustaining capital expenditure, primarily the front-end recovery project and supporting infrastructure capital, were based on equipment lists and material take-offs from engineering drawings.

Process plant sustaining capital costs were estimated to average $42 M/a, for a total of $877 M over the remaining LOM.

Processing-related non-sustaining capital costs were estimated at $200 M over the remaining LOM.

21.2.6 General and Administrative Capital Costs

Site G&A sustaining capital estimates were built up from the current detailed budget combined with project-to-date actual expenditure and adjusted using forward production plans and schedules, and engineering designs. These costs include major maintenance activities to maintain airport, port, site access roads, camps and accommodation.

These costs were estimated to average $9 M/a, for a total of $191 M over the remaining LOM.

21.2.7 Infrastructure Capital Costs

The site power and utilities sustaining capital estimates were built up from the current detailed budget combined with project-to-date actual spend and adjusted using forward production plans and schedules, engineering designs and equipment strategies.

The site power and utilities, inclusive of the projects and engineering areas, sustaining capital costs were estimated to average $11 M/a, for a total of $237 M over the remaining LOM.

Power and utilities-related non-sustaining capital costs were estimated at $100 M over the remaining LOM.

21.2.8 Capital Cost Summary

Sustaining capital costs are summarised in Table 21-1. Sustaining and non-sustaining capital costs will total US$3,006 M over the anticipated LOM.

Table 21-1: Sustaining Capital Cost Estimate

Sustaining Capital Description	Average Sustaining Capital Cost (US$M/a)	Sustaining Capital Cost (US$M)	% of Estimate
Mining	28	530	29
Processing	42	877	48
Infrastructure (power and utilities)	11	237	13
General and administrative	9	191	10
Totals	***90***	***1,834***	***100***

21.3 Operating Cost Estimates

21.3.1 Basis of Estimate

The operating costs used in the financial model were derived from a variety of sources. The mining costs were derived from a purpose-built, activity-based cost model, while ore treatment and G&A costs were based on budgeted numbers adjusted for Newcrest's long-term consumable price forecasts.

For mining and milling rates greater than the 15 Mt/a base case, costs were factored accorded to estimated fixed/variable components for existing assets and a bottom-up build for new infrastructure or activities.

All operating costs are presented in US$, and reflect 2019 market terms. Inputs in currencies other than US$ were converted at exchange rates as per Newcrest's economic parameters.

21.3.2 Mine Operating Costs

Mining operating costs are forecast to average $2.96/t of material moved or $9.76/t ore milled, for a total of $3,143 M over the remaining life of mine. These costs are based on an ex-pit mining rate mining of up to 40 Mt/a and total material movement rate of up to 70 Mt/a. Included in the costs are provision for load and haul, barging, drill and blast, ancillary costs and overheads. The mine operating cost also includes the forward operational costs defined by the pit cooling pre-feasibility study. Stockpile and re-handle costs are included with the mining costs.

21.3.3 Process Operating Costs

Process operating costs are forecast to average $23.48/t milled, for a total of $7,563 M at a throughput rate of 15.5 Mt/a over the remaining LOM. Process costs include provision for crushing and grinding, flotation, autoclave, neutralisation, cyanidation and adsorption, unallocated power, overheads, pit cooling and ancillary costs.

21.3.4 Infrastructure Operating Costs

Infrastructure and other distributable costs (power and utilities) are included in the mining and processing operating costs.

21.3.5 General and Administrative Operating Costs

General and administrative operating costs are forecast to average $9.59/t milled, for a total of $3,088 M over the remaining LOM.

21.3.6 Operating Cost Summary

The projected LOM plan operating costs are summarised in Table 21-2, and are anticipated to total US$42.83/t milled.

21.4 QP Comments on "Item 21: Capital and Operating Costs"

The QP notes:

- Capital costs are estimated to total US$3,006 M over the anticipated LOM, consisting of US$90 Mt/a or US$1,834 M over the LOM in sustaining capital costs and an additional US$1,172 M in non-sustaining capital costs;
- The projected LOM plan operating costs include provision for US$9.76/t milled mining costs, US$23.48/t milled process costs, and US$9.59/t milled of G&A costs, for a total LOM estimate of US$42.83/t milled;
- Any changes to the production plan as a result of the studies discussed in Section 16.6 may result in changes to the forecast operating costs outlined in Section 21.3;
- Outcomes of the major studies projects listed in Section 21.2.1 may also have an effect on the forecast operating costs.

Table 21-2: Operating Cost Estimate

Cost Area	Units	Value
Mining cost	US$/t ore milled	9.76
Ore treatment	US$/t ore milled	23.48
G&A	US$/t ore milled	9.59
Site costs	***US$/t ore milled***	***42.83***

22 ECONOMIC ANALYSIS

22.1 Cash Flow Analysis

Newcrest is using the provision for producing issuers, whereby producing issuers may exclude the information required under Item 22 for technical reports on properties currently in production and where no material production expansion is planned.

Mineral Reserve declaration for the Lihir Operations is supported by a positive cash flow.

22.2 Comments on Section 22

An economic analysis was performed in support of estimation of Mineral Reserves; this indicated a positive cash flow using the assumptions and parameters detailed in this Report.

23 ADJACENT PROPERTIES

This section is not relevant to this Report.

24 OTHER RELEVANT DATA AND INFORMATION

This section is not relevant to this Report.

25 INTERPRETATION AND CONCLUSIONS

25.1 Introduction

The QPs note the following interpretations and conclusions in their respective areas of expertise, based on the review of data available for this Report.

25.2 Mineral Tenure, Surface Rights, Water Rights, Royalties and Agreements

Information from legal experts and Newcrest's in-house experts support that the tenure held is valid and sufficient to support a declaration of Mineral Resources and Mineral Reserves.

The Lihir Project is 100% owned by Newcrest's wholly-owned subsidiary, Lihir Gold.

Newcrest holds a granted Special Mining Lease which encompasses all of the area where Mineral Reserves are estimated. There are some areas of the lease where agreements are not yet in place with local landowners or the community where Mineral Resources are estimated.

The Project area is situated on land held variously under customary, State and private ownership, including under State lease. Newcrest has been granted rights to undertake mining and processing of gold and related activities, through negotiations with the State and local government, and landowners in the area.

An Environment Permit for Water Extraction is in place to support Project operations.

The Project is subject to a 2% mining royalty and a 0.5% production levy.

Environmental liabilities for the Project are typical of those that would be expected to be associated with an active mining operation in an active geothermal setting in a high rainfall tropical area, and include mining, earthworks, ore pads, roads, settling ponds, camps and associated support infrastructure.

To the extent known to the QP, there are no other significant factors and risks known to Newcrest that may affect access, title, or the right or ability to perform work on the Project that are not discussed in this Report.

25.3 Geology and Mineralisation

The Lihir deposit is considered to be an example of an epithermal gold deposit.

The understanding of the Lihir deposit settings, lithologies, and geological, structural, and alteration controls on mineralisation is sufficient to support estimation of Mineral Resources and Mineral Reserves.

The mineralisation style and setting are well understood and can support declaration of Mineral Resources and Mineral Reserves.

There is some remaining exploration potential in the Project area, with a number of prospects that may warrant additional investigation.

25.4 Exploration, Drilling and Analytical Data Collection in Support of Mineral Resource Estimation

The exploration programs completed to date are appropriate for the style of the deposits in the Project area.

Sampling methods are acceptable for Mineral Resource estimation.

Sample preparation, analysis and security are generally performed in accordance with exploration best practices and industry standards.

The quantity and quality of the logged geological data, collar, and downhole survey data collected in the exploration and infill drill programs conducted by Kennecott, Lihir Gold, Rio Tinto and Newcrest are sufficient to support Mineral Resource and Mineral Reserve estimation and mine planning.

No material factors were identified with the data collection from the drill programs that could significantly affect Mineral Resource or Mineral Reserve estimation.

The collected sample data adequately reflect deposit dimensions, true widths of mineralisation, and the deposit style. Sampling is representative of the gold grades, reflecting areas of higher and lower grades.

The sample preparation, analysis, and security practices and results for the Kennecott, Lihir Gold, Rio Tinto and Newcrest programs are acceptable, meet industry-standard practice, and are adequate to support Mineral Resource and Mineral Reserve estimation and mine planning purposes.

There is a known legacy sulphur bias from 2012–2013, which is most likely attributed to the degradation of the Labfit analytical instrument(s) and adherence to the analysis methodology adopted by the site laboratory during this time. The majority of the 2012–2013 information affected by the bias has been subsequently mined out. Sulphide sulphur assays are used for metallurgical characterisation as these determine the initial process route. If the sulphide sulphur is low, flotation is required for oxidation in the autoclave. If the sulphide sulphur values are above approximately 4% sulphide sulphur, the material can be sent directly to the autoclaves. As the biases have been adjusted using correction factors, and the current methodology uses LECO instrument data, the likelihood of sending material to the wrong process route has been mitigated, and the sulphide sulphur data are considered suitable for process material classification and operational control requirements.

The data verification programs concluded that the data collected from the Project adequately support the geological interpretations and constitute a database of sufficient quality to support the use of the data in Mineral Resource and Mineral Reserve estimation, and in mine planning.

25.5 Metallurgical Testwork

Metallurgical testwork and associated analytical procedures were appropriate to the mineralisation type, appropriate to establish the optimal processing routes, and were performed using samples that are typical of the mineralisation styles found within the Lihir deposit.

Samples selected for testing were representative of the various types and styles of mineralisation. Samples were selected from a range of depths within the deposits. Sufficient samples were taken so that tests were performed on sufficient sample mass.

Recovery factors estimated are based on appropriate metallurgical testwork, and are appropriate to the mineralisation types and the selected process routes.

Initial metallurgical assumptions are supported by 22 years of production data.

The average metallurgical recovery for gold over the LOM plan is predicted to be 80.7%. The period where open pit and stockpile material is treated is projected to be about 80.9%. The period at when stockpile material only will be treated is anticipated to have a recovery of approximately 78%. Daily and monthly recovery varies, based on ore grade, the fraction of milled ore sent to flotation, and the amount of stockpiled ore being treated. These values include recovery uplift from projects of 1.2% from the current base.

Naturally fine-grained ores (mostly argillic material) and clays (from fresh or stockpile ore) can impact on both plant throughput and metallurgical recovery. For the crushing and materials handling areas, wet and sticky ores are managed through blending and on-going mechanical modifications to conveyors and chutes etc. Once in slurry form, these ores can display high and variable non-Newtonian shear-thinning behaviour, which can impact milling, flotation, POX and CIL circuits. However, dilution with fresh or sea water has been found to be effective in controlling slurry rheology to date.

The maximum proportion of fines and clays (mainly from argillic ores) that can be treated within the plant is not known with certainty. There are several types of clay minerals with varying impact on plant performance. There is some risk that high proportions of such ore types in plant feed may lead to both lower recovery and throughput, until an adjustment to the mine plan and/or additional plant modifications can be implemented.

There are no penalty elements that affect doré sales. Deleterious components in the ore such as clay, chloride, copper and carbonate content of mill feed materials can affect aspects of plant operation, are typically localised, and to date, have had only short-term effects.

25.6 Mineral Resource Estimates

The Mineral Resource estimation for the Project conforms to industry-accepted practices, and is reported using the 2014 CIM Definition Standards.

Areas of uncertainty that may materially impact the Mineral Resource estimates include: the lack of stationarity in gold domains; changes to long-term gold price assumptions; changes in local interpretations of mineralisation geometry and continuity of mineralised zones; changes to geological shape and continuity assumptions; changes to metallurgical recovery assumptions; changes to the operating cut-off assumptions for open pit mining methods; changes to the input assumptions used to derive the pit shell used to constrain the estimate; changes to the marginal cut-off grade assumptions used to constrain the estimate; variations in geotechnical, geothermal, hydrogeological and mining assumptions; and changes to environmental, permitting and social license assumptions.

There is upside potential for the estimates if mineralisation that is currently classified as Inferred can be upgraded to higher-confidence Mineral Resource categories.

25.7 Mineral Reserve Estimates

The Mineral Reserve estimation for the Project incorporates industry-accepted practices and meets the requirements of the 2014 CIM Definition Standards.

The Mineral Reserves are forward-looking information and actual results may vary. The risks regarding Mineral Reserves are summarised in Section 15.5 and in this sub-section. The assumptions used in the Mineral Reserve estimates are summarised in the footnotes of the Mineral Reserves table, and in Sections 15 and 16 of the Report.

Mineral Reserves amenable to open pit mining methods were estimated assuming the use of conventional open pit methods and conventional equipment. However, estimation and mine planning have to accommodate mining operations below sea-level and the active geothermal setting, which are non-conventional constraints.

Areas of uncertainty that may materially impact the Mineral Reserve estimates include: changes to long-term gold price assumptions; changes to exchange rate assumptions; changes to the resource model or changes in the model reconciliation performance including operational mining losses; changes to geometallurgical recovery and throughput assumptions; changes to the input assumptions used to generate the open pit design; changes to operating, and capital assumptions used, including changes to input cost assumptions such as consumables, labour costs, royalty and taxation rates; variations in geotechnical and mining assumptions; including changes to designs, schedules, and costs, as a result of changes to geotechnical, hydrogeological, geothermal and engineering data used; changes to assumptions as to pit cooling and seepage barrier development and operation; ability to source sufficient quality water supplies to support process plant operations; changes to the assumed permitting and regulatory environment under which the mine plan was developed; continued ability to use sub-sea waste and tailings disposal methods; ability to maintain mining permits and/or surface rights; ability to maintain social and environmental license to operate.

Newcrest is currently undertaking a range of studies that are reviewing the mining rate, waste disposal options, stockpile feed sequence, processing assumptions including material blend constraints and the relationship to the planned ex-pit mining sequence. This could include an upper mill feed limit or additional penalties on argillic and or stockpile feed that may impact on mine schedule and or recovery assumptions. The current Mineral Reserve estimate does not include a mill feed constraint on proportions of argillic and or stockpile feed. As with all forward study work there is risk that the future outcomes of these studies could result in changes to costs, schedule, mining rate, equipment requirements, reclassification of the confidence category assigned to some or all of the stockpiled material, and ultimately the Mineral Reserve estimate. The studies are partly dependent on the outcomes of the major studies projects listed in Section 21.1.1.

25.8 Mine Plan

Mining operations are conducted year-round. Operations are Owner-conducted, except for when a smaller, contractor-operated, pioneering fleet is used to develop new working areas on the steep caldera slopes.

The open pit mine plans are appropriately developed to maximise mining efficiencies, based on the current knowledge of geotechnical, hydrological, mining and processing information on the Project.

Production mining is by a conventional open pit method, using a conventional mining fleet. Mining is being carried out at elevations below sea level. Sea surge inundation is a risk to operations.

The mining plan includes an ex-pit mining rate ramp-up from the recently-demonstrated 33 Mt/a capability to approximately 40 Mt/a. Environmental and difficult operational conditions in soft argillic mining domains can impact mining rates, and there is a risk that the mining rates may not be achieved as planned.

The Luise caldera is still geothermally active, with temperature modelling indicating current rock temperatures in some areas within the ultimate pit design exceeding 100°C. Areas with rock temperatures greater than 100°C can cause groundwater to instantaneously flash to steam when containing pressure is released by mining, with the potential for rock outburst events to occur.

Current operational technology allows mining of hot ground up to 130ºC, after which the bulk explosive formulation required for production blasting becomes a constraint. A procedure is used to control all mining activities in areas identified as containing potential geothermal outburst areas. Additional feasibility study-level projects and trials to mitigate the risk to mining activities in hot ground, and to allow the successful blasting and mining of ground with temperatures of 130–150ºC are under evaluation.

Development of the Kapit area of the open pit will require construction of a seepage barrier prior to mining. The seepage barrier will be a significant structure, and will be engineered to cope with earthquake and tsunami events. The Kapit Flat low-grade stockpile must be moved from its current location on top of the mineralisation and pre-stripping/development of >200 Mt of overlying argillic clay waste rock is required. In addition, geothermal cooling and depressurisation of the Kapit zone must be undertaken such that mining can be safely undertaken.

An elevated cut-off strategy is employed where only high- and medium-grade material is fed to the mill, while the lower-grade fraction (1 g/t Au) is stockpiled for later processing. The stockpiling strategy in place due to mill throughput rate constraints results in a period of low-grade stockpile processing at the end of the mine life when mining operations have been completed.

The forecast completion date for the mining operation is FY38, and the forecast completion date for the processing operation is FY41, giving a mine life of 18 years, and a process life of 21 years, with the last year a partial year.

As part of day-to-day operations, Newcrest may perform reviews of the mine plan and consider alternatives to, and variations within, the plan. Alternative scenarios and reviews may be based on ongoing or future mining considerations, evaluation of different potential input factors and assumptions, and corporate directives.

25.9 Recovery Plan

The plant currently has a nameplate capacity of 15 Mt/a, and since commissioning in 1997 has undergone a number of alterations and expansions.

The process plant flowsheet design was based on testwork results, previous study designs and industry-standard practices.

As the gold mineralisation is refractory, the plant consists of crushing and grinding followed by partial flotation, pressure oxidation, and then recovery of gold from washed oxidised slurry using conventional cyanidation.

The process methods are conventional CIL and pressure oxidation methods. The comminution and recovery processes used in the plant have no significant elements of technological innovation.

The Lihir Operations have recently changed from a “full oxidation” treatment plant to a partial oxidation plant. The LOS maximises and optimises the gold production rate at all times irrespective of equipment downtime or ore type (within reason), and reflects a flowsheet with a wide operating window. In normal operation there is significantly more milling capacity than autoclave capacity; hence, a substantial amount of ore is typically sent to flotation to match autoclave throughput. If a feed is presented to the autoclave that is too low in sulphide sulphur, then the autoclaves will slow down to maintain front-end temperatures hence forcing more ore to flotation which then increases sulphur grade allowing increased throughput reaching a new operating equilibrium.

The process plant will produce variations in recovery due to the day-to-day changes in ore type or combinations of ore type being processed. These variations are expected to trend to the forecast recovery value for monthly or longer reporting periods.

25.10 Infrastructure

The majority of infrastructure required for operations is constructed and operational. A seepage barrier must be constructed to support the mining of the Kapit sector within the LOM plan.

Power is produced at site by a combination of HFO reciprocating engines and geothermal steam turbines. The geothermal power-generating system is constrained by suitable steam availability. Geothermal power is forecast to decline in the medium term as a result of mining impacting producing wells, seepage barrier construction and the gradual depletion of the heat reservoir. The mine plan allows capital for replacement of geothermal power with HFO-generated power aligned with the forecast ramp down.

There is a minor risk to the power assumptions within the mine plan, and therefore to the Mineral Reserves, if there is a faster decline of geothermal steam than forecast that could not be off-set by construction of replacement power infrastructure.

The existing infrastructure, staff availability, existing power, water, and communications facilities, and the methods whereby goods are transported to the mine are all in place and well-established, and can support the estimation of Mineral Resources and Mineral Reserves.

25.11 Environmental, Permitting and Social Considerations

Baseline studies were completed in support of mine permitting. Environmental and social management plans were developed in support of operations.

Mine development and operations commenced in 1997 in accordance with the MDC.

A regulatory-approved EMMP is in place.

Waste rock is either sent to off-shore submarine disposal within the boundaries of the Special Mining Lease, or stockpiled for use as road base, bench sheeting, stemming or construction fill. Submarine disposal of waste rock is carefully planned and controlled to achieve a continuous rill slope along the steeply-dipping sea floor and to minimise the potential for uncontrolled slumping.

Tailings are disposed using a DSTP methodology.

Water sources include a weir, spring, seawater supplement, and can include pit diversion run-off. Prolonged drought conditions are a risk to continued plant operations due to the lack of water. Sea water substitution measures can be implemented in the plant under major drought conditions, and can mitigate a portion, but not all, of the drought-related effects on production.

A conceptual mine closure plan was initially prepared in 1995 and has been regularly updated during the life of the operation, including during FY20. A detailed Mine Rehabilitation and Mine Closure Plan is required to be submitted to the regulator two years prior to the cessation of operations.

Newcrest currently holds the key permits required to support the current operations. Permit renewals are applied for where required.

Additional permits will be required for the seepage barrier (requires sign off by the Chief Inspector of Mines pursuant to the *Mining (Safety) Act 1977*), the HFO power generation infrastructure to replace geothermal ramp down (permitting through CEPA and MRA), and installation of any additional processing tertiary grinding and flotation capacity.

Newcrest's ongoing commitment to sustainable development on Aniolam Island is encapsulated in its 2019 Community and Environment Policy. As at 31 August 2020, the terms of the suite of agreements that are to replace the 2007 Integrated Benefits Package Revised Agreement have been agreed and the final draft agreements have been reviewed by the affected landholder groups and submitted to the Mineral Resources Authority for confirmation of regulatory compliance. On receipt of confirmation of regulatory compliance, the agreements will be executed and form the basis of future compensation and community development activities.

Newcrest has established generally good working relationships with local communities and although occasional disputes do occur, they are relatively minor in nature. The last disputes that resulted in brief disruptions to operations occurred in 2014–2015.

25.12 Markets and Contracts

The Lihir Operations consist of an operating mine with doré sales contracts in place. The terms contained within the refining agreement and sales contracts are typical of and consistent with Australian standard industry practice, and are similar to contracts for the supply of doré that Newcrest is familiar with in Australia.

Contracts are currently in place in support of Project operations. These contracts are negotiated and renewed as needed. Contract terms are to be within industry norms, and typical of similar contracts in PNG that Newcrest is familiar with.

Metal price assumptions are provided by Newcrest management. Newcrest considers analyst and broker price predictions, and price projections used by peers as inputs when preparing the management pricing forecasts.

25.13 Capital Cost Estimates

Capital and operating costs have a minimum pre-feasibility study level of accuracy (±25%).

Capital costs will total US$3,006 M over the anticipated LOM, consisting of US$90 Mt/a or US$1,834 M over the LOM in sustaining capital costs, and an additional US$1,172 M in non-sustaining capital costs.

25.14 Operating Cost Estimates

The projected LOM plan operating costs include provision for US$9.76/t milled mining costs, US$23.48/t milled process costs, and US$9.59/t milled of G&A costs, for a total LOM estimate of US$42.83/t milled.

25.15 Economic Analysis

Newcrest is using the provision for producing issuers, whereby producing issuers may exclude the information required under Item 22 for technical reports on properties currently in production and where no material production expansion is planned.

Mineral Reserve declaration for the Lihir Operations is supported by a positive cash flow.

25.16 Risks and Opportunities

25.16.1 Project

The Lihir Operations are located in a volcanic amphitheatre, in a seismically-active area, and mining is conducted at elevations below sea level. Earthquake, tsunami and landslide events have been recorded at the site. Slope failures have occurred historically, including a major failure of the caldera wall in the Kapit area in 2005. There is a risk to the operations should the area be subject to a large magnitude earthquake. Sea surges can also pose a risk to operations.

The Luise Caldera is still geothermally active. Areas with rock temperatures greater than 100°C can cause groundwater to instantaneously flash to steam when containing pressure is released by mining, with the potential for rock outburst events to occur. Mining methods have to accommodate the potential for blast hole geysering, geothermal outburst areas, and use of careful blast management practices.

The planned Kapit sector mining will require a seepage barrier, removal of the low-grade stockpile, significant waste stripping, and a strategy to deal with hot ground. There is a risk to the mine plan if depressurisation and geothermal cooling measures are not sufficient in some locations to allow mining as forecast. There is also a risk to the LOM plan if the seepage barrier cannot be permitted as envisaged.

The mining plan includes an ex-pit mining rate ramp-up from the recently-demonstrated 33 Mt/a capability to approximately 40 Mt/a. Environmental and difficult operational conditions in soft argillic mining domains can impact mining rates, and there is a risk that the mining rates may not be achieved as planned.

Newcrest is currently undertaking a range of studies that are reviewing the mining rate, waste disposal options, stockpile feed sequence, processing assumptions including material blend constraints and the relationship to the planned ex-pit mining sequence. This could include an upper mill feed limit or additional penalties on argillic and or stockpile feed that may impact on mine schedule and or recovery assumptions. The current Mineral Reserve estimate does not include a mill feed constraint on proportions of argillic and or stockpile feed. As with all forward study work there is risk that the future outcomes of these studies could result in changes to costs, schedule, mining rate, equipment requirements, reclassification of the confidence category assigned to some or all of the stockpiled material, and ultimately the Mineral Reserve estimate. The studies are partly dependent on the outcomes of the major studies projects listed in Section 21.1.1.

Naturally fine-grained ores (mostly argillic material) and clays (from fresh or stockpile ore) can impact on both plant throughput and metallurgical recovery. For the crushing and materials handling areas, wet and sticky ores are managed through blending and on-going mechanical modifications to conveyors and chutes etc. Once in slurry form, these ores can display high and variable non-Newtonian shear-thinning behaviour, which can impact the milling, flotation, POX and CIL circuits. However, dilution with fresh or sea water has been found effective in controlling slurry rheology to date.

The maximum proportion of fines and clays (mainly from argillic ores) that can be treated within the plant is not known with certainty. There are several types of clay minerals with varying impact on plant performance. There is some risk that high proportions of such ore types in plant feed may lead to both lower recovery and throughput, until an adjustment to the mine plan and/or additional plant modifications can be implemented.

Prolonged drought conditions are a risk to continued plant operations due to the lack of water. Sea water substitution measures can be implemented in the plant under major drought conditions and can mitigate a portion, but not all, of the drought-related effects on production. Water security remains a risk to operations.

The Lihir Operations dispose of waste and tailings using sub-sea disposal methods. There is no ready alternative to DSTP, due to the heavy rainfall typically experienced on Aniolam Island, the lack of suitable area for a tailings storage facility, and the high seismicity of the region.

Equipment and infrastructure mechanical failures and fires are operational risks.

Although the mine maintains good stakeholder relations, social unrest is a risk to continued operations.

These risks are managed on a day to day basis by the Lihir Operations with regular reviews and audits to ensure compliance to the process as well as to ensure risks that have diminished are removed and new and emerging risks are placed onto the register.

25.16.2 In-Country

Mining and exploration tenure are subject to renewal. There can be no certainty that renewals will be granted, including in a timely manner. Similarly, there can be no assurance that Newcrest will be able to successfully convert exploration tenure into mining tenure to support future mining operations. The failure to secure renewal of mining and/or exploration tenure, or to successfully convert exploration tenure into mining tenure, could have an adverse impact on Newcrest's ability to successfully maintain its exploration and mining interests and deliver development projects. Although Newcrest to date has been able to negotiate commercially reasonable and acceptable arrangements with native title claimants or land owners where it operates, there can be no assurance that claims will not be lodged in the future, including upon expiry of current mining leases, which may impact Newcrest's ability to effectively operate in relevant geographic areas.

Disagreements between national and regional governments in Papua New Guinea have historically created an uncertain business environment for Newcrest and may increase its costs of business. Papua New Guinea has a system of provincial level governments, most of which are funded almost entirely by direct grants from the national government. In the past, there have been disagreements between the national government and the provincial level governments of Papua New Guinea, primarily in relation to power sharing and revenue arrangements, and such disagreements may resurface in the future. These inter-government disputes could adversely affect Newcrest's operations in Papua New Guinea.

The State is undertaking a broad review of mining laws, with potential reforms extending the level of local equity participation in projects; more stringent requirements for local participation in mining-related businesses, local mineral smelting and processing; and implementing broader changes to the regulatory regime for mining and related activities. There is also continuing focus on the transfer of benefits from resources (both oil and gas and minerals) to customary landowners. More broadly, mineral ownership under the *Papua New Guinea Mining Act 1992* remains a high profile social and political issue in PNG. There can be no certainty as to what changes, if any, will be made to the *Papua New Guinea Mining Act 1992* under the current or future governments. Material changes to the *Papua New Guinea Mining Act 1992* may have a material adverse impact on Newcrest's ability to own or operate its respective properties and to conduct its business in PNG.

The State is also working on a set of new policies concerning geothermal energy, mine closure, sustainability, biodiversity offsets, carbon offsets, offshore mining and resettlement. Policies under consideration that, if adopted, may adversely affect Newcrest's PNG operations include introduction of royalty payments for geothermal energy, increasing the State's entitlement to acquire equity in new mines, restriction on FIFO operations, a limit on the number of exploration licenses that can be held by one party, local smelting and processing requirements, mine closure planning and funding obligations, and other changes to the regulatory regime for mining and related activities.

25.17 Conclusions

Under the assumptions in this Report, the Project shows a positive cash flow over the life-of-mine and support Mineral Reserves. The mine plan is achievable under the set of assumptions and parameters used.

26 RECOMMENDATIONS

Lihir is operating, and has a long operational history. Major engineering studies and exploration programs have largely concluded. As a result, the QPs are not able to provide meaningful recommendations.

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