NI 43-101 TECHNICAL REPORT ON THE HOPE BAY PROPERTY, NUNAVUT, CANADA

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This report entitled NI 43-101 *Technical Report on the Hope Bay Project, Nunavut, Canada,* dated *March 30, 2020 with an effective date of January 1, 2020* was prepared for TMAC Resources Inc. by Gilbert Lawson, P.Eng., David King, P.Geo., Dan Redmond, P.Geo., Brendan Barron, P.Eng. and Tommaso Roberto Raponi, P.Eng, each of whom are qualified persons as defined by NI 43-101.

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%	Percent
&	And
µm	Micrometer, one-millionth of a meter
3D	Three Dimensional (x/y/z planes)
4WD	Four-Wheel Drive
AA	Atomic Absorption
AACE	Association for the Advancement of Cost Engineering (formerly American Association of Cost Engineers)
AAS	Atomic Adsorption Spectrometry
Ag	Silver
AI	Abrasion Index
AISC	All-In Sustaining Costs
ALS	ALS Limited, analytical testing laboratory
ANFO	Ammonium Nitrate / Fuel Oil (explosive)
ARD	Acid Rock Drainage
ATD	Above the Dyke
Au	Gold
BC	British Colombia
BHP	Broken Hill Proprietary Ltd
BILR	Batch In-Line Leach Reactor
BQ	Drill size (36.5mm)
BTD	Below the Dyke
BTDEL	Ore domain block in the Doris Area
BTDELX	Ore domain block in the Doris Area
BTU	British Thermal Unit
BV	Bureau Veritas (analytical testing laboratory) or Bed Volume
°C	Celsius (temperature)
C	Continuous
CAD	Canadian Dollars
CAPEX	Capital Expenditure (estimate)
CAT	Caterpillar (mobile equipment vendor)
CCRD	Canada Centre for Remote Sensing

CCT	Combined Concentrate Transfer tank (ref. flotation, completes transfer of concentrate from continuous gravity concentration or flotation to the CTP)
CDZ	Cambridge Deformation Zone
CEE	Canadian Exploration Expenses
CIC	Carbon-in-Column
CICNAC	Crown-Indigenous Relations and Northern Affairs Canada
CIL	Carbon in Leach
CILR	Continuous In-Line Leach Reactor
CIM	Canadian Institute of Mining Metallurgy and Petroleum
CIP	Carbon in Pulp
CL	Concentrating Line. CL1 is the original, North train. Cl2 is the South train, constructed 2018. Components are secondary and tertiary crushing, surge tanks, grinding circuit, SV1350 and SB400 semi-batch gravity concentration, and flotation
cm	Centimetres
CN^-	Aqueous Free Cyanide
CNWAD	Weak Acid Dissociable Cyanide
Co	Cobalt
COG	Cut Off Grade
C_{org}	Organic Carbon content
CRF	Cemented Rock Fill
CRM	Certified Reference Material
CTP	Concentrate Treatment Plant
Cu	Copper
CV	Correlation Value or Conveyor
DCN	Doris Central Zone
DCO	Doris Connector
DDH	Diamond Drill Hole
DNO	Doris North
DR	Dimension Ratio, typically the diameter of the pipe divided by the wall thickness
DRA	DRA Americas Ltd., Toronto, Ontario
DWI	Drop Weight Index
DWT	Drop Weight Test
E	Electric
EEL	Electrical Equipment List
EEP	Engineering Execution Plan
EGL	Effective Grinding Length
EL	East Limb
Elev	Elevation

ERP	Enterprise Resource Planning
ERT	Emergency Response Team
EW	Electrowinning
FA	Fire Assay
FAR	Fresh Air Raise (intake system)
Fe	Iron
FEED	Front End Engineering and Design
FTE	Full Time Equivalent
g	Grams
G	Acceleration due to gravity, 9.8 metres per second squared (m/s^2)
G&A	General and Administration (costs)
g/h	Grams per hour
g/t	Grams per metric tonne
GCMP	Ground Control Management Plan
GN	Government of Nunavut
GoC	Government of Canada
GRG	Gravity Recovery Gold (test)
h	Hour
ha	Hectares
HBML	Hope Bay Mining Ltd.
HCL	Hydrochloric Acid
HCN	Hydrogen cyanide gas
HDPE	High Density Poly Ethylene
HP	High Pressure
HPGR	High Pressure Grinding Rolls
HQ	Drill size (63.5mm)
HR	Hydraulic Radius
ICP	Inductively Coupled Plasma (analytical method)
ICU	Intensive Cyanidation Unit
IIBA	Inuit Impact and Benefits Agreement
ILR	In-Line Leach Reactor; BILR is batch inline reactor, CILR is continuous in-line reactor
IOL	Inuit-owned Lands
IP	Induced Polarisation
IPG	Institution of Public Government
IPJ	In-line Pressure Jig
IQ	Inuit Qaujimajatuqangit (Inuit specific)
IRR	Internal Rate of Return

ISO	International Standards Organisation
ISP	In-line Spinner
JK	Julius Kruttschnitt Mineral Research Center
kg	Kilogram
kg/t	Kilogram per tonne
KIA	Kitikmeot Inuit Association
KivIA	Kivalliq Inuit Association
km	Kilometre
km^2	Square kilometers
kPa	KiloPascals
KPI	Key Performance Indicator(s)
kV	Kilovolt
kW	Kilowatt
kWh	Kilowatt-hours, ex. kW multiplied by hours.
kWh/t	Kilowatt-hour per tonne
kWhr	Kilowatt hours
LHD	Load, Haul, Dump (relating to underground mining equipment)
LME	London Metal Exchange
LOM	Life of mine
LP	Low Pressure
m	Metre
M&I	Measured and Indicated (reserves)
m^2	Square metre
m^3	Cubic metre
Ma	Million annums (years)
MCC	Motor control centre
MDZ	Madrid Deformation Zone
MEA	Mineral Exploration Agreement
MEDZ	Median Deformation Zone
MEL	Mechanical Equipment List
ML	Metal Leaching
mm	Millimetre
MMF	Micro-media filters
Moz	Million ounces (troy)
MP-AES	Microwave plasma atomic emission spectrometry
Mt	Million tonnes (metric)
MTO	Material Take Off

MW	Molecular Weight or Megawatt
MWh	Megawatt hours, ex. MW multiplied by hours.
MWHW	Naartok West Hanging Wall
NaCN	Sodium Cyanide
NaOH	Sodium Hydroxide
NDZ	Newton Deformation Zone
NFPA	National Fire Protection Association
Ni	Nickel
NI 43-101	National Instrument 43-101
NIRB	Nunavut Impact Review Board
NLCA	Nunavut Land Claims Agreement
Nm^3/h	Normal cubic metres per hour (gas)
NMS	Newmont Metallurgical Services
NN	Nearest Neighbour
NP	Neutralisation Potential
NPC	Nunavut Planning Commission
NPV	Net Present Value
NQ	Drill size (47.6mm)
NRCan	Natural Resources Canada
NSR	KIA Royalty Agreement
NSRT	Nunavut Surface Rights Tribunal
NTI	Nunavut Tunngavik Inc.
NUMR	Nunavut Mining Regulations
NW	Naartok West or North west
NWB	Nunavut Water Board
NWT	North West Territories
NYMEW	New York Metal Exchange
OG	Optimize Group - Consultant
OPEX	Operating Expenditure (estimate)
Oz	Ounce (troy)
P_{80}	Product size 80 percent passing; similarly, 95 percent passing for P_{95}, etc.
Pa	Pascal
PAG	Potential Acid Generating
PDC	Process Design Criteria
PEA	Preliminary Economic Assessment
PEP	Project Execution Plan or Procurement Execution Plan
PEpC	“Procurement-Engineering-procurement-Construction” Process

PFD	Process Flow Sheets
PFS	Pre-feasibility Study
PGP	Pale Green Pillars
pH	Power of hydrogen, a logarithmic scale used to express the acidity or alkalinity of a solution
PL	Production Leases
PPM	Parts per million
Q1	First Fiscal Quarter (January to March), subsequently Q2, Q3 and Q4 denote the other three quarters of the year
QA/QC	Quality Assurance/Quality Control
QIA	Qikiqtani Inuit Association
QP	Qualified Person
RC	Reverse Circulation (drilling method)
RCF	Resource Capital Funds
RIA	Regional Inuit Associations
RIC	Resin-in-column
RMF	Reference Material
ROM	Run-of-Mine
RPA	Mining consultant
RPM	Rotations/revolutions per minute
RQD	Rock Quality Designation
SAG	Semi Autogenous Grinding (mill)
SCADA	Supervisory control and acquisition system; process control system
SCN^-	Thiocyanate
SD	Standard Deviation
SG	Specific gravity
SGS	Société Générale de Surveillance (analytical testing laboratory)
SLR	Sub Level Retreat
SMBS	Sodium Metabisulphite
SNBS	Sodium nitrobenzene sulphonate
SO_2	Sulphur Dioxide (gas)
SRK	Mining consultant
t	Tonnes (metric)
t/d	Tonnes per day
t/h	Tonnes per hour
t/m	Tonnes per metre
TIA	Tailing Impoundment Area
TIC	Total Inorganic Carbon

TK	Traditional Knowledge (Inuit)
TLA	Territorial Lands Act
TLUR	Territorial Land Use Regulations
TMAC	100% owner of the Hope Bay project
TSL	Analytical laboratory
TSS	Total suspended solids
UCS	Ultimate Compressive Strength
ULC	Unlimited Liability Corporation
URF	Unconsolidated Rock Fill
USD	United States Dollars
V	Volt
VAT	Value Added Tax
VFD	Variable Frequency Drive
VLF	Very Low Frequency
VOIP	Voice Over Internet Protocol
VSD	Variable speed drive, used interchangeably with variable frequency drive
VSI	Vertical shaft impactor crusher
VVVF	Variable voltage variable frequency drive
WAD	Weak acid-dissociable (ref. cyanide concentration) Cyanide-complexes that are readily destroyed at moderate pH of 4.5 such as aqueous hydrogen cyanide, free cyanide, and the majority of Cu, Cd, Ni, Zn, Ag, having low dissociation constants.
WBS	Work Breakdown Structure
WL	West Limb
WOL	Whole Ore Leach
WTP	Water Treatment Plant
WVW	West Valley Wall
WWCA	Water and Wildlife Compensation Agreement
x	Dimension by dimension
XRF	X-Ray Fluorescence (analytical technique)
YE	Year End
Zn	Zinc

1.0 SUMMARY

1.1 EXECUTIVE SUMMARY

TMAC Resources Inc. (TMAC or The Company) has prepared an updated Prefeasibility Study report (PFS or the Study) of the Hope Bay Property (Hope Bay or the Property or the Project), located in Nunavut Territory, Canada. The purpose of this report is to demonstrate the economics of expanding capacity of the current mining and processing operations at Hope Bay, by building a second processing facility and related infrastructure for replacement of the currently operating Doris processing facility (Doris Plant).

TMAC is a publicly traded company involved in the exploration, evaluation, development and mining of the Hope Bay mineral property in the Kitikmeot Region of Nunavut, Canada. TMAC completed the acquisition of the Hope Bay Property from Hope Bay Mining Ltd., a subsidiary of Newmont Corporation (Newmont), on March 12, 2013. Hope Bay has been in commercial production since June 1, 2017.

Hope Bay is a fly in/fly out operation serviced from Edmonton, Alberta, Yellowknife, Northwest Territories and several Kitikmeot, Nunavut communities with supplies provided by annual sealift and regular aircraft. The nearest community and commercial airport are in Cambridge Bay, approximately 160 km by air.

This report is considered by TMAC to meet the requirements of a PFS as defined in Canadian NI 43-101 regulations. TMAC considers the PFS to be a Class 4 Study under the Association of the Advancement of Cost Engineering (AACE) guidelines with an estimation accuracy of +25% to -15%. The effective date of this NI 43-101 Technical Report is January 1, 2020.

The PFS scope includes the construction and operation of a new 4,000 t/d name plate gold processing facility (the Madrid Plant), additional supporting surface infrastructure and five underground mining operations, with a transition from the currently operated Doris Plant. Current ore mining is ongoing at the Doris deposit and a small crown pillar recovery surface operation at the Madrid North deposit and advances to the Madrid North underground operation, Madrid South, Suluk and Boston deposits will occur sequentially over the defined Life of Mine (LOM).

This report describes the Mineral Resource and Mineral Reserve estimates of Doris, Madrid North (Naartok/Suluk/Rand), Madrid South (Wolverine/Patch 14) and Boston deposits, the proposed mining methods, life of mine (LOM) plan, capital and operating costs, environmental status, and an economic analysis of the Project.

As of January 1, 2020, Proven and Probable Mineral Reserves for Hope Bay are 16.9 Mt, containing over 3.5 million ounces of gold at an average grade of 6.5 g/t gold. Mineral Resources and Mineral Reserves quoted in this PFS conform to Canadian Institute of Mining, Metallurgy and Petroleum Definition Standards for Mineral Resources and Mineral Reserves (CIM definitions).

Over the current fifteen year LOM, Hope Bay is forecast to produce over 3.1 million ounces of gold as doré, with an average of 135,800 ounces of gold per year for the first four-year period prior to the commissioning of the new processing facility, and then 253,000 ounces of gold per year for the next ten year period.

LOM total operating costs are estimated to be approximately $3.3 billion and total Capital costs are estimated at $1.3 billion.

Since discovery, Hope Bay has been the recipient of considerable exploration and development spending over the past twenty years by previous operators, including BHP Billiton Ltd. (BHP), Miramar Hope Bay Ltd. (a wholly owned subsidiary of Miramar Mining Corporation) (Miramar), and Newmont and TMAC totalling over $1.5 billion. Since the acquisition of Hope Bay, TMAC has taken the approach of starting small using the available equipment and infrastructure and growing and expanding based on exploration and mining success.

While exploration costs have not been included in the financial analysis of this report, the authors agree that exploration is recommended concurrent with construction and mining, in order to assess potential for further growth in Mineral Resources and Mineral Reserves and extension of the mine life beyond the scope contemplated in this PFS.

TMAC has overall responsibility for the preparation of this report and has worked with various consultancy firms. Other contributors to the PFS, under direction from the named Qualified Persons relative to their specific areas, are:

- Mine designs were completed by TMAC in conjunction with Optimize Group (OG).
- TMAC prepared the design and cost estimates for the processing plant in conjunction with OG.
- TMAC prepared design support pertaining to the tailings impoundment area (TIA), waste rock management, select water management components, and general site waste management aspects using previous work by SRK Consulting (Canada) Inc. (SRK).
- TMAC is responsible for environment and permitting aspects.
- Design and cost estimates for the surface infrastructure outside the Madrid Plant were completed under the direction of TMAC with support from Hatch Engineering and OG.

This Technical Report contains "forward-looking information" or "forward-looking statements" that involve several risks and uncertainties. Forward-looking information and forward-looking statements include, but are not limited to, statements with respect to the future prices of gold, the estimation of Mineral Resources and Mineral Reserves, the realisation of mineral estimates, the metallurgical performance of currently operating and future operating process plants, the timing and amount of estimated future production, costs of production, capital expenditures, costs (including capital costs and operating costs), timing and delivery to seaports of critical building supplies and equipment of the development of new infrastructure, success of exploration activities, permitting time lines, economic analysis, LOM rates of production, annual revenues, internal rate of return (IRR), NPV, currency fluctuations, requirements for funding or additional capital, government regulation of mining operations, environmental risks, unanticipated reclamation expenses, title disputes or claims, limitations on insurance coverage, and timing.

Often, but not always, forward-looking statements can be identified by the use of words such as "plans", "expects", or "does not expect", "is expected", "budget", "scheduled", "estimates", "forecasts", "intends", "anticipates", or "does not anticipate", or "believes", or variations of such words and phrases or state that certain actions, events or results "may", "could", "would", "might" or "will" be taken, occur or be achieved.

Forward-looking statements are based on the opinions, estimates and assumptions of contributors to this report. Certain key assumptions are discussed in more detail herein. Forward-looking statements involve known and unknown risks, uncertainties and other factors which may cause the actual results, performance or achievements of TMAC to be materially different from any other future results, performance or achievements expressed or implied by the forward-looking statements. Such factors include, among others: actual results of mining performance, actual results of operating and future process plants, the prediction and control

of groundwater, the actual results of further metallurgical testwork; actual results of reclamation activities; conclusions of economic evaluations; changes in project parameters as plans continue to be refined or as a result of delays; future prices of gold; possible variations in grade or recovery rates; failure of plant, equipment or processes to operate as anticipated; accidents, labour disputes and other risks of the mining industry; delays in obtaining governmental approvals or financing or in the completion of development or construction activities; shortages of labour and materials; the impact on the labour force, supply chain and other complications associated with the COVID-19 (coronavirus) pandemic; as well as those risk factors discussed or referred to in this Technical Report and in TMAC's latest annual information form under the heading "Risk Factors" and other documents filed from time to time on SEDAR and available at www.sedar.com.

There may be factors other than those identified that could cause actual actions, events or results to differ materially from those described in forward-looking statements, there may be other factors that cause actions, events or results not to be anticipated, estimated or intended. There can be no assurance that forward-looking statements will prove to be accurate, as actual results and future events could differ materially from those anticipated in such statements. Accordingly, readers are cautioned not to place undue reliance on forward-looking statements. Unless required by securities laws, the authors undertake no obligation to update the forward-looking statements if circumstances or opinions should change.

GAAP MEASURES

This Technical Report contains certain non-GAAP (Generally Accepted Accounting Principles) measures such as expected cash cost per ounce of gold and All In Sustaining Cost (AISC) per ounce of gold. Such measures have non-standardized meaning under International Financial Reporting Standards (IFRS) and may not be comparable to similar measures used by other issuers. See TMAC's latest Management's Discussion and Analysis for more information about historical non-GAAP measures reported by TMAC.

1.2 KEY STUDY CONCLUSIONS

In TMAC's opinion, the Project represents a significant opportunity for the improved development of the Hope Bay mining camp in the Canadian Arctic. The Property encompasses an area of significant exploration potential. Hope Bay's assets are well advanced and there has been significant de-risking through onsite and offsite expenditures, detailed understanding of operating costs in an Arctic environment including the construction of significant on-site infrastructure from which expansionary construction can be conducted. The development plan has been designed to build on the existing assets to generate cash flow that can sustain expansion and exploration.

TMAC has established credible relationships with Inuit residents and organizations and the Government of Nunavut. TMAC has developed trust, demonstrated results and achieved agreements that will allow development to the benefit of all stakeholders.

TMAC offers the following general conclusions for each area.

GEOLOGY AND MINERAL RESOURCES

- The Hope Bay Property is located within the Hope Bay volcanic belt which is part of a massive structural-geological complex called the Slave Structural Province.

- The Doris gold deposit is a typical Archean lode deposit which occurs within an over 3 km long, steeply dipping quartz vein system, in folded and metamorphosed pillow basaltic rocks.
- The Madrid deposit area lies within a north-south striking package of mafic volcanic rocks, comprising a sequence of Fe-Ti tholeiitics, Mg tholeiitics, komatiitic basaltic, synvolcanic to late gabbroic, and ultramafic rocks.
- The geology in the area of the Boston deposit is a bimodal assemblage of mafic and felsic volcanic rocks in contact with sedimentary rocks, all of which are complexly folded about a large-scale synformal-anticline. The core of the anticline is occupied by mafic volcanic rocks that host the Boston deposit and these are in turn overlain by sedimentary rocks.
- The drilling, sampling, sample preparation, analysis, and data verification procedures are appropriate for estimation of Mineral Resources.
- Current Mineral Resources contained within the Doris, Madrid, and Boston deposits (inclusive of Mineral Reserves, and excluding stockpiles):
    - Measured Mineral Resources are estimated at 1,570,000 t, grading 9.5 g/t Au, containing 482,000 oz Au.
    - Indicated Mineral Resources are estimated at 20,246,000 t, grading 7.2 g/t Au, containing 4,691,000 oz Au.
    - Measured plus Indicated Mineral Resources are estimated at 21,816,000 t, grading 7.4 g/t Au, containing 5,173,000 oz Au.
    - Inferred Mineral Resources are estimated at 10,917,000 t, grading 6.1 g/t Au, containing 2,127,000 oz Au.
- There is high potential to add to the current Mineral Resource base through continued exploration drilling, designed to upgrade confidence in the Inferred Mineral Resources and follow-up on significant exploration drilling results beneath and along strike of the known deposits.
    - There is good potential to add to the Mineral Resources at Doris beneath the diabase dyke with continued drilling on the BTD Extension, BTD Connector and BTD Central zones, as underground drilling platforms become available. Exploration drilling in 2019 in the Doris Valley area, has intersected Doris stratigraphy and significant mineralization approximately 325m north of the current BTD Extension zone.
    - There are high-grade exploration intercepts beneath the Madrid Suluk zone Mineral Resources, and along strike to the south in the Patch 7 area. Continued drilling to upgrade Inferred Resources and identify higher-grade trends has the potential to add to the Mineral Resources at Madrid North.
    - Exploration drilling below the current Mineral Resources at Boston has intersected high-grade mineralization as demonstrated by the 2019 exploration drilling at Boston. Historical drilling has intersected significant mineralization at the approximately 1000 m level. Continued drilling has the potential to add to the Boston Mineral Resources.
- There is good exploration potential within the Hope Bay and Elu greenstone belts. The majority of historical and recent exploration has focussed on defining and expanding the known deposits. There are over 90 exploration target areas defined by geological relationships characteristic of Archean orogenic gold deposits, surface mapping and sampling, geophysical surveying and geochemical anomalies identified to date.

MINING

- Current Mineral Reserves hosted by the Doris, Madrid, and Boston areas include:
  - Proven Reserves are estimated to be 99,000 t, grading 4.1 g/t Au, containing 13,000 oz Au.
  - Probable Reserves are estimated to be 16,782,000 t, grading 6.5 g/t Au, containing 3,502,000 oz Au.
  - Proven plus Probable Reserves are estimated to be 16,881,000 t, grading 6.5 g/t Au, containing 3,515,000 oz Au.
- The Hope Bay Project reserve base is sufficient to support production over the LOM, over a 15-year period.
- Mine designs and schedules have been completed on an annual basis.
- Production for the Doris Plant LOM period (2020-2023) is on average 1,963 t/d from two mines including Doris and Madrid North (Naartok).
- Production for the Madrid Plant LOM period (2024-2034) is up to 4,000 t/d from three mines including the Madrid North (Naartok, Suluk, Rand zones) the Madrid South (Patch 14 and Wolverine zones) and Boston.
- Mining will comprise a combination of largely longhole methods plus some cut and fill with a combination of cemented rock fill (CRF) and loose rock fill.
- Ground conditions at Doris mine have been proven to be good and are expected to be fair to good at Madrid and Boston, with minimal ground stress. Ground support systems are standard within industry and effective.
- Ground water in rock fabric has been demonstrated to be possible in the talik zones of Doris, and likely will occur for future mines at Suluk and Madrid South. Pumping systems are designed for mines in talik based on hydrogeological modeling by SRK (2017).

PROCESSING

- The Doris Plant has undergone extensive change in circuit design since initial commissioning. This technical report provides a detailed description of the current state of the circuit and performance description.
- There are further circuit improvements in the Doris Plant expected to be completed in 2020, and other improvements to be studied as outlined in this technical report.
- The Doris Plant is expected to have an average recovery of 85.1% over the next four years of its operating period.
- A new Madrid Plant design is described in this technical report and is expected to be capable of processing up to 1,460,000 t annually at an average recovery of 88.0% over its operating period.
- Further metallurgical testwork of ore samples is required to complete a Feasibility Study design of the Madrid Plant.

ENVIRONMENT, PERMITTING, AND SOCIAL ASPECTS

- The Hope Bay area is well known and has been the subject of detailed environmental baseline studies.
- Mining developments in Nunavut are subject to a robust environmental assessment and permitting process. Terms and conditions of permits and approvals are a reflection of the nature of the arctic environment and goals of minimizing environmental risks throughout the mining lifecycle.

- Elements of an Environmental Management System are already in place for the current operation and are an applicable and dependable basis for the additional activities and impacts associated with the Project as a whole.
- Maximizing the socio-economic benefits derived from the development of non-renewable resources at Hope Bay for the residents of the Kitikmeot and Nunavut requires a focus on direct employment and business opportunities that meaningfully support the economic operation of the Project. Continued engagement and compliance with the Framework Agreement and associated Inuit Impact and Benefit Agreement (IIBA) will be a support to achieving these goals.
- Key permits and approvals required to construct and operate major portions of the Project are already in place.
- The Project will require a project description and screening document to be reviewed by NIRB and an amendment application submitted to the NWB before any permits can be issued for mining and related activities beyond the scope of existing infrastructure and the extent of existing permitted infrastructure and activities at Doris, Madrid and Boston deposits.
- Any amendments to the existing permits will require ongoing design and evaluation by TMAC to ensure that the Project is acceptable from an environmental standpoint.
- The permitting and amendment timelines provided within the PFS are considered reasonable for planning purposes. TMAC has reasonable assurance that the Hope Bay Project will obtain the necessary approvals required to support the Project as presented in the PFS.

INFRASTRUCTURE

- Hope Bay has significant existing infrastructure at Roberts Bay and at the Doris Mine site, but this infrastructure is aging and as a result maintenance costs are relatively high.
- Power generation costs at Doris are higher than average for diesel powered generator plants. Building a new power plant and process plant at Madrid will result in a more cost-effective operation.
- Current mobile maintenance facilities at Hope Bay are adequate for Doris Mine but not optimal in terms of efficiency. Building a new mobile equipment maintenance facility at Madrid North will improve maintenance efficiency and result in quicker turn-around times for repairs, less maintenance persons required and lower maintenance persons turnover.
- Operating costs of new infrastructure facilities are expected to significantly improve the current ratio of General and Administration to Mining and Processing costs, resulting in more cost-effective operation.

1.3 RISKS AND UNCERTAINTIES

TMAC has assessed critical areas of the expansion Project and identified key risks associated with the technical and cost assumptions used. In all cases, the level of risk refers to a subjective assessment as to how the identified risk could affect the achievement of the Project objectives. The risks identified are in addition to general risks associated with mining projects, including, but not limited to:

- General business, social, economic, political, regulatory and competitive uncertainties.
- Changes in Project parameters as development plans are refined.
- Changes in labour costs or other costs of production.

- Adverse fluctuations in commodity prices.
- Failure to comply with laws and regulations or other regulatory requirements.
- The inability to retain key management employees and shortages of skilled personnel and contractors.

A summary of key Project related risks identified by TMAC in its review is shown in Table 1-1. The following definitions have been employed by TMAC in assigning risk factors to the various aspects and components of the Project:

- **Low Risk** - Risks that could or may have a relatively insignificant impact on the character or nature of the deposit and/or its economics. Generally, can be mitigated by normal management processes combined with minor cost adjustments or schedule allowances.
- **Moderate Risk** - Risks that are average or typical for a deposit of this nature. These risks are generally recognizable and, through good planning and technical practices, can be minimized so that the impact on the deposit or its economics is manageable.
- **High Risks** - Risks that are largely uncontrollable, unpredictable, unusual, or are considered not to be typical for a deposit of a particular type. Good technical practices and quality planning are no guarantee of successful exploitation. These risks can have a major impact on the economics of the deposit including significant disruption of schedule, significant cost increases, and degradation of physical performance.

Table 1-1. Risks and Uncertainties

TMAC RESOURCES INC. - HOPE BAY PROJECT

Project Element	Issue	Risk Level	Mitigation(s)
Geology	Resource tonnes and grade estimates	Low	There is upside potential in the grade estimates through elimination and control of dilution, continued reconciliation of short-term models to resource models
Mining	Groundwater quantity in talik ore zones	Moderate	Advanced development sequences for Doris, Suluk and Madrid South ore in talik to permit drill probing prior to scheduled need for advance, complete grouting programs to mitigate inflows, design pumping system with sufficient contingency capacity
	Ground conditions outside permafrost	Low	Host rock is typical of many greenstone hosted mines in the Canadian shield. Ground support strategies have been successful to date. Maintain focus on quality mining for dilution control.

Project Element	Issue	Risk Level	Mitigation(s)
Mining	Mining development rate	Moderate	Development rates and number of workplaces can be monitored through detailed planning and close control. Employ short interval controls to monitor poor performance and be able to react with solutions to low productivity by use of root cause analysis.
	Transition from 2,000 t/d to 4,000 t/d	Moderate	Ensure there are enough stopes through detailed planning and management/ monitoring/control of advance rates and sufficiently developed inventory.
Process (Doris)	Throughput	Moderate	Complete and commission circuit changes as outlined for 2020. Evaluate other improvement ideas as outlined. Continue to improve maintenance and operating practices. Effective training programs to facilitate quick learning of a complex circuit by operators.
	Gold recovery	Moderate	Complete and commission circuit changes as outlined for 2020. Evaluate other improvement ideas as outlined. Continue to improve operating practices.
Process (Madrid)	Throughput	Moderate	Ensure engineering designs reviewed by operations prior to approvals. Planned commissioning schedule and sign offs, ensure training completed prior to commissioning.
	Gold recovery	Moderate	Adequate testwork in place for Madrid and Boston ore types at the PFS level. Design process plant to maximize recovery using standard recovery processes. Additional testing with samples representative of current mine plan to reduce recovery and throughput risks. Organic carbon is known to occur primarily in Suluk and to lesser extents in the other Madrid and Boston deposits. The distribution and concentrations of the organic carbon are not defined. Higher concentrations of organic carbon negatively impact recovery. Review of the geological models to identify areas of organic carbon and including organic carbon assays in the block models to define areas of low recovery.
Construction Schedule	Sealift logistics to ensure delivery of materials and supplies.	Moderate	Advance engineering well ahead of time to ensure adequate lead time. Requires detailed planning and control. Goods and most equipment can be flown in if required.

Project Element	Issue	Risk Level	Mitigation(s)
Pre-production Capital Cost Estimate	See Construction Schedule	Moderate	Perform Geotechnical Investigations. Ensure engineering is complete to understand scope of work. Ensure adequate team is in place with the right skills and project controls are in place. Ensure long lead items are ordered on time.
	Execute construction plan	Moderate	
Operating Cost Estimate	Cost of key materials and supplies	Low	Close management of purchasing and logistics.
Land Tenure	Relationships with Kitikmeot	Low	Agreements in place, TMAC has built and maintains good working relationships.
Project	World Health Pandemic	Undefined	See "Current and Special Risks" discussion below

CURRENT AND SPECIAL RISKS

TMAC's operations are subject to the risk of emerging infectious diseases or the threat of outbreaks of viruses or other contagions or epidemic diseases. These infectious disease risks may not be adequately responded to locally, nationally or internationally due to lack of preparedness to detect and respond to outbreaks or respond to significant pandemic threats. As such, there are potentially significant economic and social impacts of infectious disease risks, including the inability of TMAC's mining and exploration operations to operate as intended due to shortage of skilled employees, shortages in supply chains, inability of employees to access sufficient healthcare, significant social upheavals, government or regulatory actions or inactions, decreased demand or the inability to sell precious metals or declines in the price of precious metals, capital market volatility, or other unknown but potentially significant impacts. There are potentially significant economic losses from infectious disease outbreaks that can extend far beyond the initial location of an infection disease outbreak. As such, both catastrophic outbreaks as well as regional and local outbreaks can have a significant impact on TMAC's operations. TMAC may not be able to accurately predict the quantum of such risks. In addition, TMAC's own operations are exposed to infection disease risks noted above and as such TMAC's operations may be adversely affected by such infection disease risks. Accordingly, any outbreak or threat of an outbreak of a virus or other contagions or epidemic disease could have a material adverse effect on TMAC, its business, results from operations and financial condition.

At this time, the world is experiencing a global health pandemic related to the COVID-19 virus, which is affecting the operations of multiple organizations and worldwide populations. Governments are making decisions to shut down borders and air travel and the impact on international business is not understood. How this will affect many of the assumptions regarding timelines and production assumptions in this Technical Report are unquantifiable at this time. While these effects are expected to be temporary, the duration of the business disruptions

and related financial impact cannot be reasonably estimated at this time. As a result, this Technical Report does not take into account a significant delay in carrying out critical tasks, being able to order long lead items or complete critical test work, analysis and engineering necessary to maintain the schedules presented in this report impacted by the world health pandemic. This item is a factor beyond reasonable control and estimation of a QP.

While conducting initial underground delineation diamond drilling in the Doris Central zone in the first two months of 2020, TMAC encountered groundwater of a high enough pressure and flowrate to warrant suspension of development in this zone and re-evaluation of the development strategy. Geological structural modelling indicates there are several ways water may be entering the mine, including sub-vertical faults and/or historical surface diamond drill holes from Doris Lake. The size and extent of the water bearing structures relative to the orebody is not yet known. Grouting experts have now completed a successful test grouting program and the Company will perform further probing of the Doris Central zone once the current inflow of water in this area is mitigated. As a result, development of the Doris Central zone is expected to be delayed by at least several months. TMAC had anticipated Doris Central to represent nearly 15% of its 2020 production, commencing in the second half of the year, and a significant portion of its 2021 production. There is a risk that Doris Central production in 2020 will be significantly less and that 2021 production from Doris Central may also be impacted. The Company is assessing the anticipated costs to controlling these water flows, the length of the potential delay of development, the impact of the water issues on resources and how any lost production from the Doris Central zone could be replaced with other ore within the Hope Bay project and the ultimate impact of this issue.

Since the public disclosure of this information on March 6, 2020, TMAC has re-evaluated several mine sequencing opportunities to potentially mitigate the production delay in Doris Central as a result of the disclosed water issues. Given the recent timeframe of disclosed events, these mine sequencing opportunities have not been incorporated into the LOM plan contained within the PFS and this report.

1.4 RECOMMENDATIONS

EVALUATE ALTERNATIVE DEVELOPMENT SCENARIO

- Revisit alternative design concepts for operational strategy, throughput and location of a new Process Plant to reduce construction footprint and capital infrastructure cost, prior to advancing to the Feasibility Study for the Hope Bay Project.

GEOLOGY AND MINERAL RESOURCES

- Continue underground definition drilling to facilitate mine planning and stope design.
- Near mine exploration has the potential to extend the Doris mine life. Exploration drilling is recommended to delineate the northern strike extent of the high-grade BTD Extension zone, and the relationship to the Doris Valley mineralization, intersected during the 2019 exploration program.
- Continue metallurgical testwork in advance of development of the Madrid North Suluk, Madrid South and Boston orebodies.
- Construct a geo-metallurgical model for gravity gold, sulphide and organic carbon to optimise the ore blending strategy and metallurgical recovery.
- Design and implement reconciliation processes to help refine the Mineral Resource and Mineral Reserve estimates.

- Continue exploration drilling to upgrade Inferred Mineral Resources and add to the existing Mineral Resource inventory at Doris, Madrid and Boston.

MINING AND MINERAL RESERVES

- Complete test grouting programs in 2020 at Doris Central to calibrate ability to mitigate underground water flows against the groundwater model.
- Investigate most optimal methodology for CRF placement, binder content and additives, including possible use of frozen fill in permafrost mining areas.
- Investigate further optimization of mining rates, development and stope sequencing, district mine sequences and higher cut-off grade scenarios to maximize NPV.
- Develop a comprehensive hydrogeology model for predicting water ingress for Madrid South and Suluk mines for pump design.
- Investigate the economics of using emulsion based explosive products and manufacturing explosives onsite for reducing costs, ammonia in groundwater and better blasting and dilution controls.
- Complete optimization of ventilation layouts with the goal of reducing long term energy costs.
- Investigate the use of ventilation on demand fan controls to minimize energy use for auxiliary ventilation.
- Investigate the use of remote-controlled load-haul-dump (LHD) operations to extend operating hours between shifts for productivity gains.

MINERAL PROCESSING

- Complete testwork and analyse the impact of a gravity recovery system in the new Process Plant design to maximize recovery.
- Complete all Doris Plant process improvement projects in the 2020 sustaining capital budget.
- Evaluate further Doris Plant process improvements with capital investments against short term payback targets to improve throughput and recovery.
- Complete further metallurgical testwork to support detailed Process design for the Feasibility Study.
- Conduct metallurgical testing on samples selected to define the extent of organic carbon occurrences primarily in the Suluk deposit and its impact on gold recovery.
- Investigate potential for Flotation Tails leaching for economic gold recovery.

INFRASTRUCTURE

- Perform geotechnical investigations for infrastructure buildings and facilities. Geotechnical information is limited in the areas targeted for new infrastructure. It's recommended to complete a geotechnical investigation program to confirm ground condition prior to commencing detailed design.
- Perform a business case/trade-off study to determine if a permanent cargo dock will financially benefit the operation. Currently cargo is brought to Hope Bay by ship and lightering barges. It may be financially beneficial to build a permanent dock and eliminate the need for a lightering barge and associated costs.

- Perform a scoping study for wind power. Installing wind turbines could potentially be financially beneficial in displacing diesel consumed by the diesel-powered generator-based power plant planned for Madrid.
- Perform an optimisation study for the diesel power plant planned for Madrid. The current PFS level estimate is based on a preliminary load list. An in-depth electrical load study could reduce the capital cost of the power plant as well as the operating costs by optimising the current design which consists of 4 x 7 MW gensets in an N+1 arrangement.
- Perform an optimisation study on the design of the Madrid to Boston Road. The current estimate for the road is based on a preliminary design. It is recommended that the design be finalised and concurrently optimised to potentially reduce material quantities and to minimize road maintenance during operations.
- Investigate option of running power cables or an overhead power line from Madrid Power Plant to the Doris Mine area. This could potentially reduce the overall cost of power generation at Hope Bay.
- Further investigate truck shop (surface maintenance facility) options at Madrid. The current design included in the PFS is an adaptation of another similar mine in Nunavut. Designing a truck shop from first principles in collaboration with maintenance and operations currently at the Doris Mine may potentially result in a more cost-effective surface maintenance facility.

WATER AND WASTE MANAGEMENT

- Complete a comprehensive groundwater model for all deposits to ensure sufficient treatment capacity is designed for the water treatment facilities over the long-term.
- Complete the design of a land waste fill site at Quarry 2 for long-term storage of waste products and sea cans.

ENVIRONMENT, PERMITTING, AND SOCIAL ASPECTS

- Submit a screening document, including project description, to the NIRB, and water licence amendment application package to NWB as soon as possible given some uncertainty in the timing of the regulatory process and its direct impact on the development schedule.
- Integrate engineering and permitting planning schedules and ensure that sufficient design level information will be available to support future permitting efforts.
- Undertake further studies to validate freshwater demand, the potential loss of surface water to underground workings, mine water discharges (particularly talik water), and tailings discharges to confirm that the proposed Project has acceptable environmental impacts. Completion of site-wide water balance and water quality modelling is required to support Project planning and permitting.
- Continue to engage with the local community stakeholders, maintain a constructive relationship with the KIA, and implement the requirements of the Framework Agreement.

ECONOMIC ANALYSIS

- Complete the Feasibility Study for the Project prior to a development decision on the expansion concept presented in the PFS to validate Project economics and schedule delivery.

1.5 TECHNICAL SUMMARY

LOCATION

The Hope Bay Property is located approximately 685 km northeast of Yellowknife, Northwest Territories, approximately 125 km southwest of Cambridge Bay, and east of Bathurst Inlet, in the Kitikmeot region of western Nunavut, Canada. The Hope Bay Property is approximately 160 km above the Arctic Circle, at 67º30’ N latitude and 107º W longitude, comprises an area of 1,101 km^2 and forms one large contiguous block of land that is approximately 80 km by 20 km in extent.

LAND TENURE

TMAC is the registered owner of all mineral tenure at the Project. The Hope Bay Project’s land tenure consists 78 Crown mining leases (54,132 ha); 76 Crown Claims (67,047 ha) one NTI Inuit MEA (60,361 ha) and one NTI Inuit PL (137 ha). All of the Crown mining leases for the Hope Bay Project are in good standing. Crown mining leases are issued for a 21-year period and may be renewed for additional 21-year periods as long as all required rents are paid.

Nunavut Tunngavik Inc. (NTI), the organization which coordinates and manages Inuit responsibilities set out in the Nunavut Land Claims Agreement (NLCA), holds the surface title and mineral rights to Inuit-Owned Lands (IOL) in the Kitikmeot region of Nunavut, including the surface rights over the Hope Bay Property (with the exception of certain portions, which are on Federal claims) and subsurface mineral rights over selected portions of the Property. NTI has delegated administration of surface rights in the Kitikmeot Region (subject to the exclusions previously referenced) to the Kitikmeot Inuit Association (KIA). The KIA also administers the IIBA associated with the Project. TMAC has various forms of surface tenure with the KIA: (i) the commercial lease for the Doris site that includes the entire infrastructure for the mine at Doris and the Madrid road, which was entered into effective as of March 30, 2015 for a 20-year term; (ii) advanced exploration leases required to perform advanced exploration at Boston and quarrying activities at Boston and Madrid, which have an initial term of five years effective as of March 30, 2015, with the option to renew the applicable lease for additional one year terms, up to a maximum period of 20 years; and (iii) a land use licence that provides access to non-exclusive exploration over the Inuit owned lands across the Hope Bay Property, automatically renewable on an annual basis for a 20-year term effective as of March 30, 2015.

Royalty rates for the NTI mineral rights are governed by Production Leases (PL) granted by NTI. A PL is a necessary prerequisite in order to commence production. As of March 31, 2015, TMAC had secured a 20-year MEA with an attached form of PL with NTI, which replaced the former seven Inuit exploration agreements.

HISTORY

The Hope Bay volcanic belt was first outlined in 1962 by J. A. Fraser of the Geological Survey of Canada during a reconnaissance scale mapping program. There has been continuous exploration on the property by numerous companies since 1965. During the 1960s, 1970s and the 1980s, Roberts Bay Mining and Noranda Exploration Ltd. explored portions of the Hope Bay greenstone belt for precious and base metals, respectively. In 1987, Abermin Corporation staked claims in the vicinity of Spyder (Aimaokatalok) Lake and Doris Lake and completed some reconnaissance exploration. These claims were allowed to expire. In 1991, BHP Minerals Canada Ltd. acquired a contiguous block of claims covering approximately 1,016 km^2. The staking

of additional claims then expanded this. The Boston, Madrid, and Doris deposits were discovered by BHP in 1992-1995.

In December 1999, the Hope Bay Property was purchased from BHP Minerals Canada Ltd., by the Hope Bay Joint Venture, a 50/50 joint venture between Cambiex Exploration Inc. and Miramar Hope Bay Limited, a wholly-owned subsidiary of Miramar Mining Corporation. All claims were registered in the name of Cambiex Exploration Inc., which changed its name to Hope Bay Gold Corporation Inc. in 2001. During 2001, several additional adjoining claims were staked. In May 2002, Hope Bay Gold Corporation Inc. merged with Miramar Mining Corporation. Miramar completed a number of exploration programs and engineering studies at the Project.

In late 2007, Newmont Mining B.C. Limited, an indirect wholly-owned subsidiary of Newmont, purchased Miramar Mining Corporation and formed Hope Bay Mining Ltd., which became the registered owner of all the Hope Bay Property land tenure.

From 2007 until care and maintenance in 2012, Hope Bay Mining Ltd. conducted core drilling, geological mapping, sampling, metallurgical testwork, Mineral Resource estimation, preliminary metal leaching and waste rock characterization studies, collection of environmental and social baseline data, development of a site-wide, probabilistic water balance model, groundwater monitoring programs, and preliminary mining and engineering studies.

On January 25, 2013, TMAC entered into an agreement with Hope Bay Mining Ltd. (as succeeded in interest by Newmont Mining B.C. ULC), as amended on March 12, 2013, December 5, 2014 and June 24, 2015 for the Hope Bay Acquisition. Commercial production at Doris was declared on May 15, 2017, with an effective date of June 1, 2017.

GEOLOGY AND MINERALIZATION

The Hope Bay volcanic belt is located in the northeast portion of the Slave Structural Province, a predominantly Archean granite-greenstone-metasedimentary terrane located between Great Slave Lake to the south and Coronation Gulf to the north. The Slave Province is bounded to the east by the Thelon Orogen (2,020 Ma to 1,910 Ma) and to the west by the Wopmay Orogen (1,950 Ma to 1,840 Ma.

The Hope Bay volcanic belt is dominated by mafic volcanic rocks with lesser felsic volcanic rocks and volcaniclastic products, subordinate ultramafic bodies and metasedimentary rocks. Existing U-Pb geochronology of the belt indicates felsic volcanism spanned a period of at least 53 Ma (2,716 Ma to 2,663 Ma).

Gold mineralization is found in three areas: the Doris, Madrid, and Boston areas. The deposits are typical Archean lode deposit types which occur within folded and metamorphosed mafic volcanic rocks.

The Doris Deposit is located at the north end of the north-south trending Hope Bay greenstone belt of Archean age near Cambridge Bay in Nunavut.The Doris area hosts several distinctive suites of mafic volcanic rocks which are broadly divided into Mg and Fe tholeiites. Volcanic rocks were intruded by one or two phases or late mafic dykes of gabbroic composition. A series of diabase dykes and sills clearly crosscut all of the stratigraphy. Gold mineralization is contained within predominantly sub vertical quartz veins hosted within mafic volcanic rocks.The Doris Vein system is characterized by a series of north–south striking, subvertical, gold bearing, ductile-brittle structures that commonly host wide, stylolitic, ribboned, or bull quartz veins. Gold mineralization

includes visible and disseminated gold occurring primarily with quartz veins ranging from a few centimetres to approximately 10 m in scale.

The Madrid deposit area is located in the northern area of the Hope Bay volcanic belt, south of the Doris deposit. It includes the Wolverine-Madrid corridor which is defined as the belt of rocks extending from the southern end of Wolverine Lake to the northwest end of Patch Lake. The rocks within the Madrid corridor predominantly consist of a north-south striking package of mafic volcanic rocks comprising a sequence of iron-titanium tholeiitic basalts, magnesium-tholeiitic basalts, komatiitic basalts, synvolcanic to late gabbroic and ultramafic rocks. The Madrid Deformation zone (MDZ) is a significant structural feature within the Madrid-Wolverine corridor. It runs northwest-southeast along Patch Lake and sharply swings east-west through the Madrid area, towards Windy Lake. The gold mineralization within Naartok West, Naartok East, Rand, Suluk, and Patch 7 consists of quartz-carbonate stockwork veining, which overprints dolomite-sericite-albite-pyrite altered mafic volcanic rocks of the Patch Group. The gold mineralization is characterized by multi-stage brecciation and alteration with at least two separate gold mineralization events. Gold occurs within north-northeast, east, southeast, and north-northwest trending brecciated and carbonate altered zones and is associated with disseminated pyrite which has replaced brecciated mafic fragments.

The Boston deposit is located at the south end of the Hope Bay greenstone belt, approximately 55 km south of the Doris Mine. In general, the geology of the Boston deposit constitutes an anticlinal mafic-volcanic package enclosed by a younger sequence of sedimentary rocks, dominantly metaturbidites. The Boston deposit lies immediately to the west of the belt-scale Hope Bay Break, the principal structure of the region, with significant displacement in both the Archean and Paleoproterozoic

Four significant zones of gold mineralization have been identified at Boston, which include the B2, B3, and B4/B5 zones. Gold occurs within and around structurally controlled quartz-carbonate veins, which have been developed along lithological contacts. Gold is associated with sulphide mineralization, mainly as clots of the pyrite within veins and in the wallrock.

EXPLORATION

The Hope Bay volcanic belt was first outlined in 1962. Exploration from 1965 to 1989 comprised geological mapping, prospecting, trenching and limited airborne magnetic surveys.

From 1991 to 2011, extensive exploration was conducted by BHP, Miramar, and Newmont/HBML. The 1991 to 2011 programs included geological mapping, geophysical surveys, geochemical surveys, diamond drilling, underground bulk sampling, and metallurgical testwork.

TMAC exploration from 2013 to present includes drilling, sampling, geophysical surveying, metallurgical testwork, resource estimation and regional exploration.

MINERAL RESOURCES

A summary of the Mineral Resource estimate, inclusive of Mineral Reserves, effective as of December 31, 2019, is presented in Table 1-2 The QP is not aware of any environmental, permitting, legal, title, taxation, socio-economic, marketing, political, or other relevant factors that could materially affect the Mineral Resource estimate.

Table 1-2. Summary of Mineral Resources – December 31, 2019

TMAC Resources Inc. – Hope Bay Project

	Tonnes (000 t)	Grade (g/t Au)	Ounces (000 oz)
Measured			
Doris	240	11.0	85
Madrid North	-	-	-
Suluk	-	-	-
Madrid South	-	-	-
Boston	1,330	9.3	397
Total	**1,570**	**9.5**	**481**
Indicated			
Doris	1,726	9.0	499
Madrid North	10,761	6.6	2,273
Suluk	3,670	7.2	851
Madrid South	648	14.0	292
Boston	3,441	7.0	776
Total	**20,246**	**7.2**	**4,691**
Measured and Indicated			
Doris	1,966	9.2	584
Madrid	10,761	6.6	2,273
Suluk	3,670	7.2	851
Madrid South	648	14.0	292
Boston	4,771	7.6	1,173
Total	**21,816**	**7.4**	**5,173**
Inferred			
Doris	1,750	7.1	399
Madrid North	1,113	5.3	190
Suluk	4,339	5.7	792
Madrid South	662	7.1	152
Boston	3,053	6.1	594
Total	**10,917**	**6.1**	**2,127**

Notes:

1. CIM definitions were followed for the statement of Mineral Resources.
2. Mineral Resources are inclusive of those resources converted to Mineral Reserves and are in-situ resources excluding stockpiles.
3. Mineral Resources that are not Mineral Reserves do not have demonstrated economic viability.

4. The Mineral Resources for each Individual deposit were defined utilizing a block cut-off grade of 3.5 g/t.
5. All Mineral Resources are estimated using an average long-term gold price of US$1,500 per ounce and a CAD/USD exchange rate of 1.34.
6. A 50 m crown pillar allowance was applied to Mineral Resources located below lakes where applicable.
7. A minimum intercept width of 1.5 m was applied to the Mineral Resource modelling.
8. Ore density was calculated using the geological block model density field.
9. Numbers may not add due to rounding.

MINERAL RESERVES

A summary of the Mineral Reserve estimate effective as of December 31, 2019, is presented in Table 1-3. The QP is not aware of any environmental, permitting, legal, title, taxation, socio-economic, marketing, political, or other relevant factors that could materially affect the Mineral Reserve estimate.

Table 1-3. Mineral Reserves – Year End 2019

	Tonnes (000 t)	Grade (g/t Au)	Au Ounces (000 oz)
Proven			
Stockpiles	99	4.1	13
Total	**99**	**4.1**	**13**
Probable			
Doris	1,194	8.4	321
Madrid North UG	7,525	6.1	1,466
Madrid North Pit	212	5.7	39
Madrid North Subtotal	7,737	6.1	1,505
Suluk	3,703	5.8	695
Madrid South	842	9.1	245
Boston	3,306	7.2	766
Total	**16,782**	**6.5**	**3,532**
Proven and Probable			
Stockpiles	99	4.1	13
Doris	1,194	8.4	321
Madrid North UG	7,525	6.1	1,466
Madrid North Pit	212	5.7	39
Madrid North Subtotal	7,737	6.1	1,505
Suluk	3,703	5.8	695
Madrid South	842	9.1	245
Boston	3,306	7.2	766
Total	**16,881**	**6.5**	**3,545**

Notes:

1. CIM definitions were followed for the statement of Mineral Reserves.
2. The Mineral Reserves for each Individual deposit were defined utilizing the following cut-off grades:
   a. 4.0 g/t gold for longhole stopes.
   b. 3.0 g/t gold for incremental development ore required for mining.
   c. 2.0 g/t gold for the Madrid North crown pillar surface mining.
3. All Mineral Reserve are estimated using an average long-term gold price of US$1,325 per ounce and a CAD/USD exchange rate of 1.34.
4. A 50-m crown pillar allowance was applied to Mineral Reserves located below lakes where applicable.
5. Numbers may not add due to rounding.

MINING METHOD

Mining at Hope Bay will incorporate long hole mining methods in order to address the deposit geometry and anticipated ground conditions. Mining will take place under permafrost conditions where the mineralization is located away from any water bodies and also under non-permafrost conditions in what is known as talik in the vicinity and under the lakes in the area.

Doris North will be under permafrost while the Connector and Central zones at Doris will be beneath the lake. A portion of the Madrid North deposit (part of Naartok) as well as the Madrid South deposits (Patch and Wolverine) are situated beneath the lakes and, therefore, will not be under permafrost conditions.

The deposits will be accessed, and services will be provided, by a decline from surface. The ramp will also be used for ore and waste haulage from the underground operations.

The Doris deposit is currently in production, with an existing ramp decline reaching active mining areas. Mining will continue as per current methods until depletion. Transverse and longitudinal long-hole mining is planned for Doris. Madrid North (Naartok and Suluk) and Boston will be mined using long-hole stoping methods with sub-levels placed at 20-m vertical intervals. Both longitudinal and transverse accesses are used, depending on width of the ore zones. The Madrid South (Patch and Wolverine), where ore zones are much narrower, will be mined using long-hole stope method with sub-levels placed at 16-m intervals. The majority of stopes in Madrid South will have longitudinal accesses.

Sill pillars are placed throughout the deposit to improve the mining sequence by providing additional stoping fronts. Sill pillars will be recovered at the end of the sequence using up-holes.

Stopes will be backfilled using a combination of CRF and unconsolidated rockfill (UCF). The CRF will generally contain 5% binder, except 10% in sill pillars. The CRF will be mixed on surface and trucked to the stopes.

MINERAL PROCESSING AND METALLURGICAL TESTING

The following is a summary of the proposed Doris Plant operation from 2020 to 2023. Ore will be sourced from the Doris and Madrid (Naartok) deposits. The annual tonnage of ore processed is expected to be up to 730,000 t/a.

The plant recovers gold from the ore through the Process Plant which is based on crushing, grinding, gravity concentration, flotation and cyanide leaching to achieve an overall process plant recovery of 85.1% over its operating period. The unit operations included are:

- Crushing
- Grinding
- Batch gravity concentration/intensive cyanidation
- Flotation
- Flotation tails thickening
- Concentrate regrind, thickening and leaching
- Cyanide detoxification of concentrate tails
- Gold in solution recovery via resin adsorption and gold electrowinning
- Smelting of doré bullion
- Reagent mixing, storage and distribution

The following is a summary of the process plant design and proposed operation of the Madrid Plant from 2024 to 2034. Ore will be sourced from the Madrid (Naartok, Suluk, Madrid North, Wolverine, Patch 7 and 14) and Boston deposits. The annual tonnage of ore processed is expected to be up to 1,460,000 t/a.

Gold is recovered from the ore through the Madrid Plant which is based on conventional crushing and grinding and cyanide leaching to achieve an overall process plant recovery of 88.0% over its operating period. The unit operations included are:

- Crushing
- Grinding (SABC type circuit)
- Batch gravity concentration/intensive cyanidation
- Flotation
- Flotation tails thickening
- Concentrate regrind and thickening
- Concentrate pre-aeration and carbon in leach (CIL)
- Cyanide detoxification of CIL tails
- Thickening and filtration of CIL tails
- Carbon elution and regeneration, and gold electrowinning
- Smelting of doré bullion
- Reagent mixing, storage and distribution

Over the history of the property, previous owners including BHP, Miramar and Newmont have conducted metallurgical testing. This information has been compiled and used for deriving the basis of the Madrid Plant design and metallurgical performance estimates for each deposit. Further metallurgical testwork is expected to be completed prior to finalization of the new design.

PROJECT INFRASTRUCTURE

Hope Bay has significant existing infrastructure at Roberts Bay and at the Doris Mine site, including:

- A Jetty at Roberts Bay for unloading cargo arriving by ship
- Fuel storage at Roberts Bay – installed capacity of 20.5 ML storage tanks
- Fuel storage at Doris camp – 5 x 1.5 ML storage tanks
- All-weather airstrip - 1,525 m by 40 m wide, allows for gravel-certified aircraft such as the Dash 8, Buffalo, 737-200, Hercules, ATR-72 and Avro RJ85 Avroliner
- Waste management facility including an incinerator and hazardous waste storage
- A concrete batching facility
- Sea container storage and cargo laydown areas
- Power generation plant – 8 x 1.45 MW diesel powered generators
- Process Plant – 2,000 t/d
- Mine water treatment plant and ocean discharge pipeline
- Operational Tailings impoundment area – 2.5 Mt storage and permitted for 18Mt
- Accommodation – 345-person capacity - office complex with potable water and wastewater treatment plants
- Mine dry and Doris Plant dry
- Maintenance workshops and warehouses
- Fire water tower
- Contact water ponds

- Road network connecting all infrastructure

New infrastructure planned for Hope Bay includes additional facilities at Madrid and Boston Mines, including:

- New 4000 t/d processing facility at Madrid.
- New Roads including haul roads from Madrid North to Madrid South and from Madrid North to Boston and a service road from Madrid North to the TIA.
- TIA upgrades including raising the height of the current South Dam and constructing a new West Dam wall to increase storage capacity to 18 Mt (14 million m^3).
- Mine Rock Storage Areas and contact water ponds. Mine waste rock produced from underground mining activities will be temporarily stored on the surface before being used as mine backfill. All mine waste rock will be used for back filling underground mine works. No mine waste rock will remain on the surface post mining activities.
- Bulk Fuel Storage. An additional 20 ML fuel storage capacity will be added to the tank farm at Roberts Bay that will bring the total Roberts Bay storage capacity to 45 ML. New storage tanks will be connected to existing storage tanks by a piping and valve arrangement and the existing fuel dispensing facilities at Roberts Bay will be used to fill fuel tanker trucks for transportation of fuel to various smaller fuel storage tanks located in the vicinity of facilities such as power generating plants that require fuel.
- Power Generation. A new power generation facility will be built at the Madrid North site. The new power plant at Madrid will consist of four 7 MW diesel engine powered generators in an N+1 arrangement. Low rotations per minute (RPM) fuel efficient diesel powered gensets will provide optimal fuel efficiency compared to the current units installed at Doris. Genset heat recovery systems will recover heat using a glycol-based heat exchanger. A new power plant will be installed at Boston mine site. Three 1.45 MW gensets will be relocated from Doris mine to provide power for Boston infrastructure, utilities and mining activities.
- Accommodation facility. A new camp will be built at Madrid North that will include 400 bedrooms, a kitchen and dining facility, a recreation and exercise facility, a first aid room and a housekeeping laundry room. Included in the accommodation complex is an office complex for mine management and support teams, a potable water treatment plant, a wastewater treatment plant and tanks for potable and fire water storage.
- Maintenance Facilities and Warehousing. A new maintenance facility will be built at Madrid North to service all mobile equipment at Hope Bay. The facility at Madrid North will be a pre-engineered building with 7 service bays, a wash bay, 2 overhead cranes, and a warehouse for parts storage. A smaller maintenance facility is planned for Boston which will be used for preventive maintenance and minor repairs. Equipment requiring major repairs will be towed to the main workshop at Madrid North.
- Water Treatment. In addition to the current water treatment plant at Doris an additional plant is planned to treat the increased water from mining activities at Madrid North, Madrid South and Boston and will also be located at Doris. The new water treatment plant is needed to treat water to accommodate the new Metal and Diamond Mining Effluent Regulations that come into effect in 2021.
- Waste Management Facility. No additional domestic waste management facilities are currently envisaged. All additional waste generated from Madrid and Boston will be managed using the existing waste management facility located between Doris and Roberts Bay.

- Explosives Storage and Management. No additional facilities are currently envisaged as the existing facilities at Hope Bay are adequate for explosives needed for Madrid North and Boston.

ENVIRONMENT, PERMITTING AND SOCIAL CONSIDERATIONS

The Arctic environment at Hope Bay is a mosaic of extreme climatic conditions, wildlife, vegetation, ice-rich soils, pristine water quality, and abundant aquatic life that require careful planning to manage. Completing the regulatory process, and achieving consensus on best management practices, allows development to be managed within an officially recognized framework that protects valued ecosystem components while providing a business climate that supports development in the Kitikmeot Region and Nunavut.

TMAC has the key permits and approvals currently in place for the Hope Bay Project. The existing permits and approvals provide a strong foundation and understanding of expectations for future permitting efforts required to support the full scope of the Project as described in this PFS.

Consistent with its existing operation, TMAC is committed to carefully considering cultural factors associated with Inuit way of life in the development of this Project, as well as complying fully with its obligations as a proponent under the Nunavut Agreement. The Project is envisioned such that the land and resources continue to support the cultural and economic needs of the people while providing new economic opportunities.

TMAC recognizes the significance of using land use knowledge and perspectives of local Inuit. Collaboration between the people of the Kitikmeot Region and TMAC has already built successful and sustainable partnerships that are critical to creating mutually beneficial economic opportunities and TMAC will continue to maintain and expand these as required.

With the Project, TMAC will continue with a focus on maximizing the socio-economic benefits derived from the development of non-renewable resources at the Project for the residents of the Kitikmeot Region and Nunavut. This requires a focus on direct employment and business opportunities that meaningfully support the economic operation of the Project. Other economic benefits, such as royalties paid by TMAC for mining on both Crown and Inuit-owned subsurface lands will strengthen all of Nunavut through NTI and the Nunavut Trust.

CAPITAL AND OPERATING COST ESTIMATES

Table 1-4 summarizes the LOM Project capital costs required to mine and process the defined Mineral Reserves from the effective date of this Technical Report and are estimated to be $1.29 billion over the life of mine. A further breakdown of capital cost details is provided in Table 21-2 and the annualized spend of the capital costs is outlined in Table 22-2 in Section 22.0 of this report.

On an annualized basis, 66% of the estimated $1.29 billion of capital costs will be incurred in the next four years (2020 to 2023-year end) with the remainder being incurred as mine sustaining and infrastructure capital as additional underground mines on the belt are brought into production from 2024 to 2034

Table 1-4. LOM Capital Cost Summary

Capital Cost	Costs Estimate ($ 000s)	Contingency (%)	Total Costs ($ 000s)
Expansion Capital			
Processing	152,647	20%	183,838
Site Development	76,340	18%	89,905
Infrastructure and Utilities	198,465	18%	234,415
Owners Costs	4,985	35%	6,730
Indirect Project Costs	131,501	28%	167,884
Total Expansion Capital	**563,938**	**21%**	**682,772**
Sustaining Capital			
Mining (1)	555,862	8%	602,605
Environmental Equipment	1,500	0%	1,500
Total Sustaining Capital	**557,362**	**8%**	**604,105**
Total Costs			
Total Costs	**1,121,300**	**15%**	**1,286,877**

Notes:

1. Includes $294 million in mine capital development which is included in mine production in Table 1-8.

Table 1-5 summarizes the LOM Project operating costs required to mine and process the defined Mineral Reserves from the effective date of this Technical Report and are estimated to be $3.28 billion and a life of mine unit operating cost of $194.19 per t of ore processed. A further breakdown of operating cost details is provided in Table 21-6 and the annualized spending on operating costs is outlined in Section 22.0 of this report.

Table 1-5. LOM Operating Cost Summary

Operating Category	Cost Estimate ($ 000's)	LOM Unit Costs ($/relative t)	LOM Unit Cost ($/t processed)
Underground Mining	1,647,994	117.18/t ore mined (1)	97.62
Open Pit Mining Costs	20,441	96.36/t ore mined	1.21
Surface Ore Haulage	58,677	9.96/t ore hauled	3.48
Ore Stockpile Rehandle	11,212	1.16/t ore rehandled	0.66
Processing in Current Doris Mill	160,760	56.00/t processed	9.52
Processing in New Madrid Mill	555,055	39.26/t processed	32.58
General and Administration	734,000	43.48/t processed	43.48
Environmental, Levies and Land Taxes	95,070	5.63/t processed	5.63
Total Operating Costs	**3,278,208**		**194.19**

Notes:

1. Includes $294 M in mine capital development which is included in underground mine production in Table 1-8.

ECONOMIC ANALYSIS

The Hope Bay Project economics (Project Case) were analyzed using a USD gold model as follows in Table 1-6. The basis of the Project Case gold price model is the median consensus commodity forecast from a broad list of 38 Investment Dealers consolidated on March 5, 2020 by a major Canadian bank.

Table 1-6. USD/oz Gold Price Assumption for Project Case

Year	2020	2021	2022	2023	2024-2034
USD/oz	1,500	1,500	1,475	1,474	1,400

At a discount rate of 5%, the Project Case generates an after-tax net present value (NPV) of $486 million and an internal rate of return (IRR) of 19.7%. The initial Project capital achieves payback in 7 years. The Property has a LOM All-In Sustaining Cost (AISC) of US$986/oz and a LOM Cash Cost of US$841/oz.

The test of economic extraction for the Hope Bay Project mineral reserves is demonstrated by means of a sensitivity analysis. At the Mineral Reserve gold price of US$1,325/oz, the Hope Bay Project shows positive economics with an after-tax NPV of $272 million and an IRR of 12.0%.

- All dollars are in Canadian currency unless otherwise stated.
- A CAD/USD exchange rate of 1.34 was used for the economic analysis.
- It is assumed that 100% of the payable gold is recovered and that transport and refining costs are $3.55/oz.
- The model has been prepared on a yearly life of mine basis.
- The LOM is 15 years from the start of 2020 until the depletion of Mineral Reserves in 2034.

The economic model was subjected to a sensitivity analysis to determine the effects of changing metal prices, capital and operating costs on the Project financial returns and is presented in Table 1-7.

With regard to the specific case of the potential impact of a world health pandemic affecting critical sealift deliveries in 2020 and forcing a delay of one year of the proposed LOM, it is judged by the QP that the Capital Cost +10% scenario presented in Table 1-7 would represent the maximum NAV impact of this event.

Table 1-7. Sensitivity Analysis

NPV ($ 000's) Sensitivity to Gold Price and Discount Rate						
			Discount Rate			
			0%	5%	8%	10%
Gold Price US$/Ounce	**1,225**	Pre Tax	302,341	16,236	-81,321	-126,766
	1,325	Pre Tax	703,325	288,740	140,179	67,976
	Property Case(1)	Pre Tax	1,066,221	548,964	358,867	264,587
	1,525	Pre Tax	1,505,292	833,750	583,179	457,460
	1,625	Pre Tax	1,906,276	1,106,255	804,680	652,202
NPV ($ 000's) Sensitivity to Other Variables at Property Case Gold Price and 5% Discount Rate						
			Operating Costs		**Capital Costs**	
+10%		Pre Tax	321,064		441,406	
Property Case(1)		Pre Tax	548,964		548,964	
-10%		Pre Tax	776,864		656,522	

(1) Property Case Gold Price Defined in Table 22-1

Table 1-8. Project Case Cash Flows

	Units	LOM Total	2020	2021	2022	2023	2024	2025	2026	2027
			Production Summary							
Underground Ore Mining										
Ore	kt	**16,570**	390	710	847	778	1,289	1,542	1,610	1,731
Waste	kt	**7,682**	584	461	582	529	486	463	638	805
Total	kt	**24,252**	974	1,171	1,429	1,307	1,774	2,004	2,249	2,536
Open Pit Mining										
Ore	kt	**212**	212	-	-	-	-	-	-	-
Waste	kt	**1,509**	1,509	-	-	-	-	-	-	-
Total	kt	**1,721**	1,721	-	-	-	-	-	-	-
Processing	kt	**16,881**	701	710	730	730	1,278	1,460	1,460	1,460
Gold Production	(oz)	**3,101,365**	160,000	138,997	129,212	115,136	218,279	269,154	257,572	269,230
Gold Price US$	(US$/oz)		1,500	1,500	1,475	1,474	1,400	1,400	1,400	1,400
Gross Revenue from Gold Sales	$ 000's	**5,882,626**	321,600	279,383	255,387	227,411	409,491	504,932	483,205	505,075
Total Refining and Royalty Costs	$ 000's	**217,319**	12,607	10,255	9,381	8,354	15,080	18,595	17,795	18,600
Net Revenue From Gold Sales	$ 000's	**5,665,307**	308,993	269,129	246,006	219,057	394,411	486,337	465,410	486,475
Total Direct Operating Costs	$ 000's	**3,278,209**	184,052	185,154	194,809	188,338	223,492	246,364	257,119	293,539
Total Expansion Capital	$ 000's	**682,772**	48,247	183,945	237,717	212,864	-	-	-	-
Total Sustaining Capital	$ 000's	**604,105**	41,522	38,255	49,997	37,484	41,795	38,885	51,579	75,280
Total LOM Capital Costs	$ 000's	**1,286,877**	89,769	222,199	287,715	250,348	41,795	38,885	51,579	75,280
Property Closure Costs	$ 000's	**100,000**	-	-	-	-	-	-	-	-
Corporate Taxes	$ 000's	**106,956**	4,374	3,583	2,636	-	-	-	-	434
Working Capital and Financing	$ 000's	**-66,000**	-1,228	-16,691	-9,396	5,480	21,675	-2,495	-2,931	-7,515
Property Net Free Cash Flow (Pre-Tax)	$ 000's	**1,066,221**	36,400	-121,533	-227,122	-225,108	107,449	203,583	159,643	125,171
Cum. Property Net Cash Flow (Pre Tax)	$ 000's		36,400	-85,133	-312,254	-537,363	-429,913	-226,330	-66,687	58,485
Property Net Free Cash Flow (After-Tax)	$ 000's	**959,265**	32,026	-125,116	-229,758	-225,108	107,449	203,583	159,643	124,737
Cum. Property Net Cash Flow (After Tax)	$ 000's		32,026	-93,090	-322,848	-547,956	-440,507	-236,923	-77,280	47,458

	Units	2028	2029	2030	2031	2032	2033	2034	2035	2036
		Production Summary								
Underground Ore Mining										
Ore	kt	1,563	1,302	1,449	1,414	1,118	671	158	-	-
Waste	kt	1,003	865	803	325	137	1	-	-	-
Total	kt	2,566	2,167	2,252	1,739	1,254	672	158	-	-
Processing	kt	1,460	1,460	1,460	1,460	1,460	895	158	-	-
Gold Production	(oz)	278,400	250,569	272,638	245,296	259,391	197,240	40,252	-	-
Gold Price US$	(US$/oz)	1,400	1,400	1,400	1,400	1,400	1,400	1,400	1,400	1,400
Gross Revenue from Gold Sales	$ 000's	522,278	470,068	511,468	460,176	486,617	370,021	75,513	-	-
Total Refining and Royalty Costs	$ 000's	19,233	17,311	18,835	16,946	17,920	13,626	2,781	-	-
Net Revenue From Gold Sales	$ 000's	503,045	452,757	492,632	443,229	468,697	356,395	72,733	-	-
Total Direct Operating Costs	$ 000's	304,920	274,619	274,361	253,159	218,088	137,927	42,267	-	-
Total Expansion Capital	$ 000's	-	-	-	-	-	-	-	-	-
Total Sustaining Capital	$ 000's	72,331	53,764	53,933	26,827	13,054	7,077	2,323	-	-
Total LOM Capital Costs	$ 000's	72,331	53,764	53,933	26,827	13,054	7,077	2,323	-	-
Property Closure Costs	$ 000's	-	-	-	-	-	-	50,000	50,000	-
Corporate Taxes	$ 000's	3,291	2,931	3,132	40,321	46,873	11,201	-11,821	-	-
Working Capital and Financing	$ 000's	-1,054	6,109	11	-18,711	-18,644	-13,983	-18,448	5,574	6,250
Property Net Free Cash Flow (Pre-Tax)	$ 000's	126,848	118,265	164,327	181,955	256,200	225,374	-3,408	-55,574	-6,250
Cum. Property Net Cash Flow (Pre Tax)	$ 000's	185,333	303,598	467,925	649,880	906,079	1,131,453	1,128,044	1,072,471	1,066,221
Property Net Free Cash Flow (After-Tax)	$ 000's	123,556	115,334	161,194	141,633	209,327	214,173	8,413	-55,574	-6,250
Cum. Property Net Cash Flow (After Tax)	$ 000's	171,014	286,348	447,543	589,176	798,503	1,012,675	1,021,088	965,515	959,265

Discounted Property Cash Flow (%)		Net Present Value (Pre Tax)	Net Present Value (After Tax)
5%	$ 000's	**548,964**	**485,943**
8%	$ 000's	**358,867**	**311,736**
10%	$ 000's	**264,587**	**225,297**
Property IRR (After Tax)	(%)	**19.7%**	

2.0 INTRODUCTION

TMAC's business objectives are the acquisition, exploration, development and operation of precious metal resource properties. The Company's principal asset is the Hope Bay Property, which it acquired from Newmont in March 2013. The Hope Bay Property was targeted for acquisition by the Company for positive technical and geopolitical reasons. From a technical perspective, with respect to rock type and age, the Hope Bay greenstone belt is geologically similar to gold-producing greenstone belts elsewhere in the Canadian Shield. From the date of the Company's incorporation, it has focused on the exploration, development and operation of the Hope Bay Property and the raising of equity and debt capital to fund such activities. The Doris Mine at the Hope Bay Property has been in commercial production since June 1, 2017.

This technical report, with an effective date of January 1, 2020, was prepared by TMAC and is considered by TMAC to meet the requirements of a PFS in accordance with NI 43-101. This report updates the Mineral Reserves and Mineral Resources as of December 31, 2019 and outlines a processing and mining capacity expansion plan for the Hope Bay Property. This technical report replaces the one entitled "TMAC Resources Inc. – Technical Report on The Hope Bay Project, Nunavut, Canada", dated May 28, 2015, with an effective date of March 31, 2015, prepared by RPA.

The Hope Bay Property comprises three distinct trends of known gold mineralization plus extensive exploration potential and targets. Mineral Resources are hosted in the Doris, Madrid and Boston trends. Doris is composed of Doris Connector, Doris Central and Doris BTD zones. Madrid is composed of Madrid North (including Naartok and Suluk) and Madrid South. Boston is composed of the Boston North, B2, B3 and B4 zones.

Historical work had demonstrated success in regional targeting and advanced exploration and development on near-surface targets at Doris, Madrid and Boston. Site development had been successfully advanced by certain prior owners and the property was brought into commercial production by TMAC. Canada's Arctic is geopolitically stable, and, in Nunavut, Inuit land claims have been settled for over two decades as part of the Nunavut Agreement.

TMAC believes there are opportunities for expansion of the existing established Mineral Reserve and Mineral Resource base at Doris, Madrid and Boston and the potential exists for further discoveries on the balance of the large and underexplored Hope Bay Property. All known deposit trends are open at depth and along strike.

This technical report was prepared by the following authors:

- Gilbert Lawson, P. Eng. – Lead Author, responsible for overall preparation of the report and Sections 1 to 3, 19, 20, 22, 25 and 26.
- David King, P. Geo. responsible for Sections 4, portions of 5, 6 to 12, 14 and 23.
- Tommaso Roberto Raponi, P. Eng. responsible for Sections 13 and 17.
- Dan Redmond, P. Geo. responsible for Sections 15, 16 and 21.
- Brendan Barron, P. Eng. responsible for Sections 18 and 24.

3.0 RELIANCE ON OTHER EXPERTS

The authors have relied, and believe they have a reasonable basis to rely upon the internal experts who have contributed to the royalty, taxation, environmental and land tenure information stated in this report. The authors of this report have reviewed the information provided by the internal experts and based on the authors' review of this information, believe it to be reasonable and reliable.

As operations at the Hope Bay Property are reliant upon annual sea lift delivery of critical equipment and materials, the QP's have been assured by TMAC senior executives that the procurement, and delivery of certain equipment and materials necessary to execute the 2020 and 2021 are progressing as of the filing date of this report.

4.0 PROPERTY DESCRIPTION AND LOCATION

The Hope Bay Property is located approximately 685 km northeast of Yellowknife, Northwest Territories, approximately 125 km southwest of Cambridge Bay, and east of Bathurst Inlet, in the Kitikmeot region of western Nunavut, Canada. The Hope Bay Property is approximately 160 km above the Arctic Circle, at 67º30' N latitude and 107º W longitude, comprises an area of 1,101 km^2 and forms one large contiguous block of land that is approximately 80 km by 20 km in extent.

Hope Bay mineral tenure includes Crown mineral claims, Crown mining leases, pending Crown mining leases and the land access agreements covering surface title and subsurface mineral rights to Inuit-owned lands in the Kitikmeot Region of Nunavut.

In 2013, TMAC acquired from Newmont a 100% interest in the original Elu claims, a greenstone belt to the east of the Hope Bay claims covering 31,083 hectares. The Elu greenstone belt is similar in age to the Hope Bay belt and has the potential to host both gold and base metal deposits. In June 2016, TMAC staked the extension of the Elu greenstone belt, comprising 35,964 hectares, thereby linking the Elu claims with the Hope Bay claims. The Elu claims now form a land package that comprises an area of 670 km^2 and is approximately 80 km by 10 km in extent. The majority of the Elu claims are on Inuit-owned lands that are not included in the Inuit-owned surface access rights provided through the "Framework Agreement". The Crown holds 100% of the Elu subsurface mineral rights.

The general location for the Hope Bay Property and Elu claims are shown on the map in Figure 4-1.

The Project comprises three distinct trends of known mineralization plus extensive exploration potential and targets. The three trends that host mineral resources are as follows:

- The Doris trend includes the Doris North, Doris Connector, DCNs above the diabase dyke, and the BTD East Limb, BTD Extension and BTD Connector below the diabase dyke.
- The Madrid trend includes the Naartok East and West, Rand, Suluk, Wolverine and Patch 7 and Patch 14 zones.
- The Boston trend hosts the Boston deposit, including the Boston North, B2, B3, and B4 zones.

4.1 LAND TENURE

LAND TENURE HISTORY

During the 1960s, 1970s and the 1980s, Roberts Bay Mining and Noranda Exploration Ltd. explored portions of the Hope Bay greenstone belt for precious and base metals, respectively. In 1987, Abermin Corporation staked claims in the vicinity of Spyder (Aimaokatalok) Lake and Doris Lake and completed some reconnaissance exploration. These claims were allowed to expire. In 1991, BHP Minerals Canada Ltd. acquired a contiguous block of claims covering approximately 1,016 km^2. The staking of additional claims then expanded this. The Boston, Madrid, and Doris deposits were discovered by BHP in 1992-1995.

In December 1999, the Hope Bay Property was purchased from BHP Minerals Canada Ltd., by the Hope Bay Joint Venture, a 50/50 joint venture between Cambiex Exploration Inc. and Miramar Hope Bay Limited, a wholly-owned subsidiary of Miramar Mining Corporation. All claims were registered in the name of Cambiex Exploration Inc., which changed its name to Hope Bay Gold

Corporation Inc. in 2001. During 2001, several additional adjoining claims were staked. In May 2002, Hope Bay Gold Corporation Inc. merged with Miramar Mining Corporation. Miramar completed a number of exploration programs and engineering studies at Hope Bay.

In late 2007, Newmont Mining B.C. Limited, an indirect wholly-owned subsidiary of Newmont, purchased Miramar Mining Corporation and formed Hope Bay Mining Ltd., which became the registered owner of all the Hope Bay Property land tenure. From 2007 until care and maintenance in 2012, Hope Bay Mining Ltd. conducted core drilling, geological mapping, sampling, metallurgical testwork, Mineral Resource estimation, preliminary metal leaching and waste rock characterization studies, collection of environmental and social baseline data, development of a site-wide, probabilistic water balance model, groundwater monitoring programs, and preliminary mining and engineering studies.

On January 25, 2013, TMAC entered into an agreement with Hope Bay Mining Ltd. (as succeeded in interest by Newmont Mining B.C. ULC), as amended on March 12, 2013, December 5, 2014 and June 24, 2015 for the Hope Bay Acquisition.

The Hope Bay Acquisition was completed on March 12, 2013. As consideration for the acquisition of the Hope Bay Property, the Company issued 8,000,101 Common Shares and 11,133,231 non-voting Common Shares to Newmont (which were subsequently converted to voting Common Shares). On closing of the Hope Bay Acquisition, and immediately prior to a concurrent private placement, Newmont indirectly held 82% of the total issued and outstanding Common Shares and non-voting Common Shares, with management holding the balance of the Common Shares.

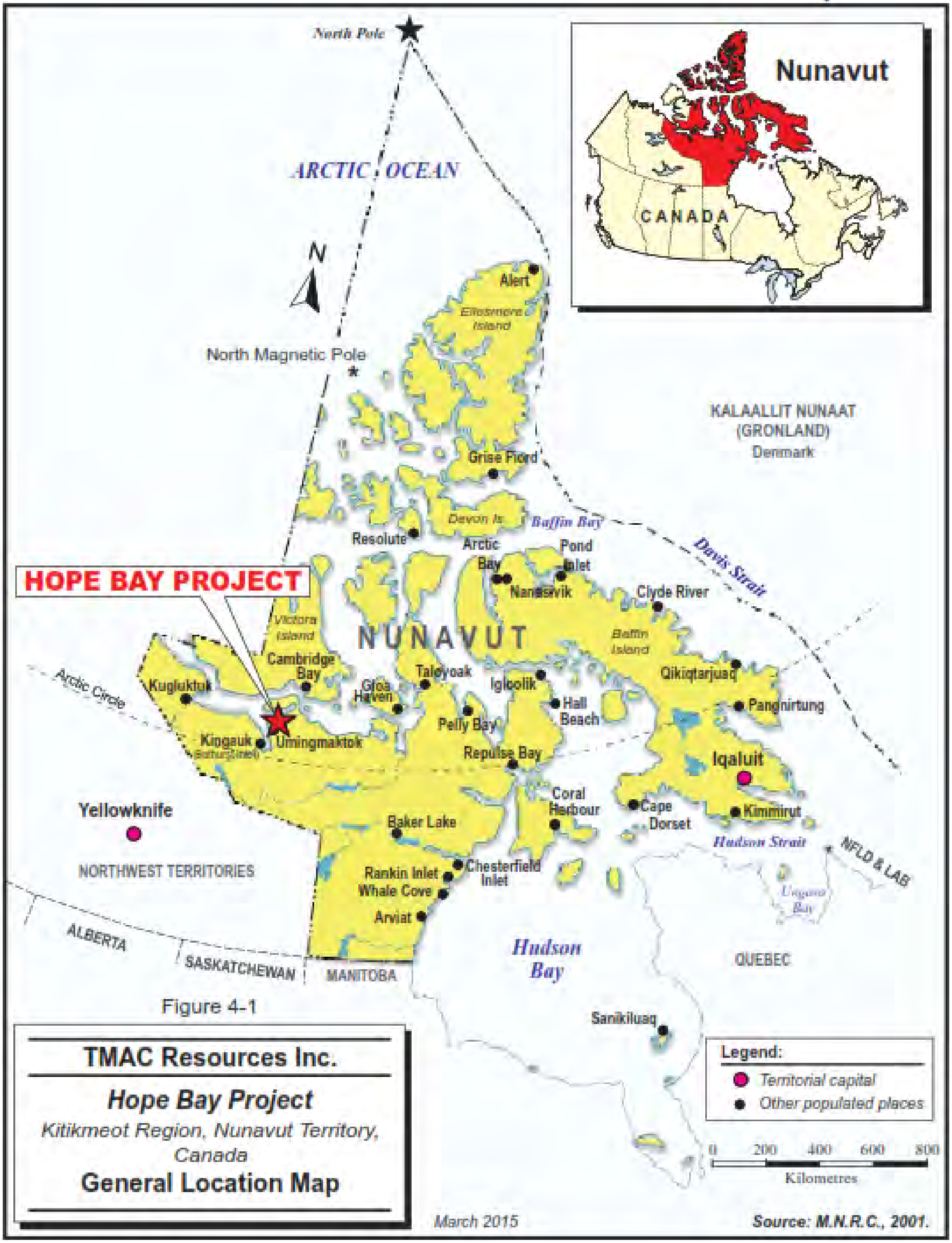


Figure 4-1. Hope Bay Project General Location Map

MINERAL TENURE IN NUNAVUT

Ownership of mineral tenure in the Hope Bay Project is split between the Crown in Right of Canada and NTI. NTI, on behalf of the Inuit of Nunavut, is the owner of subsurface mineral rights within two land parcels, designated BB-57 and BB-60, comprising the northern and middle portion of the Hope Bay greenstone belt respectively.

In 1994 and 1995, the then owner of the property, BHP Billiton Ltd, entered into seven 20-year term Mineral Exploration Agreements (MEAs) with NTI to acquire exploration rights within these parcels. The agreements were numbered BB57-00-01, BB57-00-02, BB57-00-03, BB57-00-04, BB60-00-01, BB60-00-02, and BB60-00-03 and comprised a total area of 49,976 ha. These agreements were among the first negotiated after the signing of the NLCA.

As described further in this section, TMAC has completed an agreement with NTI for a new MEA which has combined the seven exploration agreements into one for a 20-year term.

SURFACE RIGHTS

NTI, the organization which coordinates and manages Inuit responsibilities set out in the Nunavut Agreement, holds the surface title and subsurface mineral rights to Inuit-owned lands in the Kitikmeot Region of Nunavut, including the surface rights of the Hope Bay Property (with the exception of certain portions, which are on Federal claims) and subsurface mineral rights over selected portions of the Hope Bay Property. NTI has delegated administration of surface rights in the Kitikmeot Region to the KIA. The KIA administers the surface rights associated with the Hope Bay Property (subject to the exclusions previously referenced).

TMAC has various forms of surface tenure with the KIA:

- The commercial lease for the Doris site that includes the entire infrastructure for the mine at Doris and the Madrid road, which was entered into effective as of March 30, 2015 for a 20-year term.
- Advanced exploration leases required to perform advanced exploration at Boston and quarrying activities at Boston and Madrid, which have an initial term of five years effective as of March 30, 2015, with the option to renew the applicable lease for additional one year terms, up to a maximum period of 20 years.
- A land use licence that provides access to non-exclusive exploration over the Inuit owned lands across the Hope Bay Property, automatically renewable on an annual basis for a 20-year term effective as of March 30, 2015.

On March 30, 2015, TMAC entered into a series of landmark agreements with the KIA with respect to the Inuit-owned surface title for the lands on which the Hope Bay Property is located. These agreements comprise a 20-year comprehensive Framework Agreement, certain further agreements contemplated therein, an amended and restated Inuit-owned lands commercial lease no. KTCL313D001 (the “Commercial Lease”), an NSR agreement (the “KIA Royalty Agreement”), the Inuit Impact Benefit Agreement (the “IIBA”) and the Water and Wildlife Compensation Agreement (the “WWCA”). As consideration for the rights and benefits received under the Framework Agreement, TMAC agreed to make certain ongoing payments to the KIA, including an annual, inflation adjusted payment of $1.0 million, the one-time issuance to the KIA of 1,133,333 Common Shares and, through the KIA Royalty Agreement, a 1% NSR on production from the Hope Bay Property.

The Framework Agreement sets forth the terms under which land use licences, advanced exploration leases and commercial leases on Inuit-owned lands are granted by the KIA to TMAC. Land use licences, including the one currently held by TMAC, permit the holder to conduct non-exclusive exploration work over the applicable lands for an initial term of one year and are automatically renewed annually for a period totaling 20 years. Advanced exploration leases, including those currently held by TMAC, permit various advanced exploration and pre-production activities for an initial term of five years with the option to renew the applicable lease for additional one-year terms up to a maximum period of 20 years inclusive of renewals. Commercial leases, including the Commercial Lease, permit the development of mines and related operations for a single term of 20 years.

TMAC is subject to certain reporting and inspection obligations in favour of the KIA that require TMAC to maintain letters of credit as security, or alternative security as mutually agreed upon, for TMAC's obligations (including closure and reclamation obligations, subject to certain adjustments) under the land use licences, advanced exploration leases and commercial leases issued to or held by TMAC from time to time, including the existing land use licence, advanced exploration leases and the Commercial Lease.

TMAC has also agreed to indemnify the KIA and its directors, officers, employees and contractors for losses arising from any breach by TMAC of its covenants, obligations or representations under such surface tenure licences and leases, unless such losses arise from the gross negligence or willful misconduct of the indemnitee.

The Commercial Lease permits TMAC to develop, construct and operate one or more mines and to conduct related operations on certain lands comprising the Hope Bay Property, with the provision for including additional lands pursuant to the terms of the Commercial Lease. The term of the Commercial Lease expires at the earlier of the 20th anniversary of its effective date and the expiry or termination of the Framework Agreement. In connection with the activities contemplated by the Commercial Lease, TMAC has provided the KIA with certain environmental covenants and agreed to abide by certain environmental conditions.

Concurrently with entering into the Framework Agreement, TMAC and the KIA entered into the IIBA. The IIBA establishes various procedures through which TMAC and the KIA will communicate and maintain a working relationship and provides for certain benefits to the Inuit in the Kitikmeot region as required by the Nunavut Agreement. Among other things, the parties have established implementation and environmental advisory committees to oversee certain aspects of the IIBA and commitments thereunder. The IIBA committee meets quarterly and the environmental advisory committee meets several times per year or as required. Pursuant to the IIBA, TMAC provides certain employment, training and education opportunities to the Inuit and TMAC provides business and contracting opportunities to certain qualified businesses in connection with the Hope Bay Property. The IIBA will continue in effect for the duration of the Framework Agreement. On the 5th, 10th and 15th anniversaries of the IIBA's signing, TMAC and the KIA will review the IIBA. The review will focus on the parties' record of implementing the IIBA and meeting its objectives. During these reviews, the parties will consider if the IIBA and the Framework Agreement should be amended. Negotiations to amend the agreements may start during these reviews. If the negotiations are not complete within six months, either party may request arbitration.

Concurrent with entering into the Framework Agreement, TMAC and the KIA entered into the WWCA, which provides for certain compensatory payments to be made by TMAC to the KIA in connection with certain effects on water and wildlife in connection with the Hope Bay Property. The WWCA will continue in effect for the duration of the Framework Agreement.

SUBSURFACE RIGHTS

NTI owns approximately 50% of the subsurface mineral claims of the Hope Bay Property with the remaining 50% owned by the Crown. Mineral rights at Doris are held entirely by NTI, mineral rights at Madrid are split between NTI and the Crown, and mineral rights at Boston and further south are held entirely by the Crown. The Crown holds 100% of the Elu subsurface mineral rights.

Subsurface exploration activities on lands subject to NTI subsurface rights are governed by the MEA. Mineral production on lands subject to NTI subsurface rights, including Doris, requires a production lease issued by NTI.

The Company entered into the MEA with NTI with an effective date of January 1, 2015. On March 30, 2015, the KIA ratified the MEA and form of production lease. The MEA provides the Company with the right to explore for minerals within specified exploration areas and, subject to the terms of the agreement, obtain a production lease, the form of which was settled pursuant to the MEA and was approved by NTI and the KIA. On August 17, 2015, the Company entered into an Inuit-owned lands mineral production lease with NTI for the Doris mine.

In order to maintain its rights under the MEA, the Company must satisfy certain minimum annual exploration work requirements or pay to NTI an amount equal to a specified percentage of the value of such work, together with such other payments as may be applicable pursuant to the terms of the agreement. The MEA also sets forth the criteria pursuant to which NTI must execute and deliver to the Company one or more production leases for deposits covered by the MEA that the Company has demonstrated economic viability, which would govern the development of mines for such deposits. Under the MEA, upon commencing commercial production at the first mine on the Hope Bay Property, which was achieved at Doris effective June 1, 2017, the Company was obligated to pay $8.0 million, payable quarterly in eight equal instalments of $1.0 million commencing at the end of the third quarter of 2017, being the quarter immediately after achieving commercial production at the first mine on the Hope Bay Property. All eight quarterly payments of $1.0 million were made from September 2017 to June 2019. The initial term of the MEA was one year and can be automatically renewed annually for a period totaling 20 years, unless otherwise terminated.

SUMMARY

Hope Bay Project’s land tenure consists 78 Crown mining leases (54,132 ha); 76 Crown Claims (67,047 ha) one NTI Inuit MEA (60,361 ha) and one NTI Inuit PL (137 ha). All of the Crown mining leases for the Hope Bay Project are in good standing. Crown mining leases are issued for a 21-year period and may be renewed for additional 21-year periods as long as all required rents are paid. Tenure is summarized in Table 4-1. Table 4-2 lists mineral leases, Table 4-3 lists Crown Claims, and Table 4-4 lists the NTI Inuit MEA and PL.

Table 4-1. Mineral Tenure

TMAC Resources Inc. - Hope Bay Project

Type	Area (ha)
Crown Claims	67,047
Crown Mining Leases	54,132
Inuit Exploration Agreements	60,361
Inuit Production Leases	137

Table 4-2. Crown Mineral Leases

TMAC Resources Inc. - Hope Bay Project

Item #	Name	Number	Issue Date (MM/DD/YYYY)	Expiry Date (MM/DD/YYYY)
1	Koig 6	3544	04/17/1997	04/17/2039
2	Koig 1	3545	04/17/1997	04/17/2039
3	Wog 2	3546	04/17/1997	04/17/2039
4	Koig 2	3547	04/17/1997	04/17/2039
5	Wog 3	3548	04/17/1997	04/17/2039
6	Koig 3	3549	04/17/1997	04/17/2039
7	Koig 4	3550	04/17/1997	04/17/2039
8	Kamik 1	3923	07/24/2000	07/24/2021
9	Kamik 2	3924	07/24/2000	07/24/2021
10	Boston 6	4645	10/12/2001	10/12/2022
11	Boston 7	4646	10/12/2001	10/12/2022
12	Boston 3	4647	10/12/2001	10/12/2022
13	Madrid 1	4648	10/12/2001	10/12/2022
14	Madrid 2	4649	10/12/2001	10/12/2022
15	Boston 9	4650	12/27/2002	12/27/2023
16	Boston 8	4653	12/27/2002	12/27/2023
17	Boston 10	4654	12/27/2002	12/27/2023
18	Boston 12	4655	12/27/2002	12/27/2023
19	Boston 13	4656	12/27/2002	12/27/2023
20	Boston 1	4657	07/12/2001	07/12/2022
21	Boston 2	4658	07/12/2001	07/12/2022
22	Boston 4	4659	07/12/2001	07/12/2022
23	Boston 5	4660	07/12/2001	07/12/2022

Item #	Name	Number	Issue Date (MM/DD/YYYY)	Expiry Date (MM/DD/YYYY)
24	Havana 1	4661	10/12/2001	10/12/2022
25	Chicago 1	4785	07/15/2003	07/15/2024
26	Chicago 2	4786	07/15/2003	07/15/2024
27	Chicago 4	4787	07/15/2003	07/15/2024
28	Amarok 1	4788	07/15/2003	07/15/2024
29	Amarok 2	4789	07/15/2003	07/15/2024
30	Amarok 4	4790	07/15/2003	07/15/2024
31	Amarok 3	4791	07/15/2003	07/15/2024
32	Amarok 5	4792	07/15/2003	07/15/2024
33	Amarok 6	4793	07/15/2003	07/15/2024
34	Amarok 7	4794	07/15/2003	07/15/2024
35	Buffalo 1	4795	07/15/2003	07/15/2024
36	Buffalo 2	4796	07/15/2003	07/15/2024
37	Amarok 8	4797	07/15/2003	07/15/2024
38	Buffalo 3	4798	07/15/2003	07/15/2024
39	Buffalo 4	4799	07/15/2003	07/15/2024
40	Buffalo 5	4800	07/15/2003	07/15/2024
41	Boston 14	4801	07/15/2003	07/15/2024
42	Boston 16	4802	07/15/2003	07/15/2024
43	Quito 1	4803	07/15/2003	07/15/2024
44	Quito 2	4804	07/15/2003	07/15/2024
45	Quito 3	4805	07/15/2003	07/15/2024
46	Quito 4	4808	07/15/2003	07/15/2024
47	Amarok 10	4851	09/28/2005	09/28/2026
48	Amarok 11	4852	09/28/2005	09/28/2026
49	Amarok 9	4853	09/28/2005	09/28/2026
50	Amarok 13	4854	09/28/2005	09/28/2026
51	Amarok 12	4855	09/28/2005	09/28/2026
52	Engine 1	4856	09/28/2005	09/28/2026
53	Engine 2	4857	09/28/2005	09/28/2026
54	PJ 1	4901	11/24/2006	11/24/2027
55	PJ 2	4902	11/24/2006	11/24/2027
56	PJ 3	4903	11/24/2006	11/24/2027
57	PJ 4	4904	11/24/2006	11/24/2027
58	PJ 5	4905	11/24/2006	11/24/2027

Item #	Name	Number	Issue Date (MM/DD/YYYY)	Expiry Date (MM/DD/YYYY)
59	PJ 6	4906	11/24/2006	11/24/2027
60	PJ 7	4907	11/24/2006	11/24/2027
61	Chicago 5	4908	11/24/2006	11/24/2027
62	Engine 3	4932	05/22/2008	05/22/2029
63	Engine 4	4933	05/22/2008	05/22/2029
64	BD 1	4934	05/22/2008	05/22/2029
65	BD 2	4935	05/22/2008	05/22/2029
66	Heku 1	5717	11/03/2010	11/03/2031
67	Heku 2	5718	11/03/2010	11/03/2031
68	Heku 3	5719	11/03/2010	11/03/2031
69	Heku 4	5720	11/03/2010	11/03/2031
70	Heku 5	5297	07/06/2013	07/06/2034
71	Heku 6	6123	09/19/2013	09/19/2034
72	Heku 7	6124	09/19/2013	09/19/2034
73	Boston 18	5294	07/06/2013	07/06/2034
74	Boston 19	5295	07/06/2013	07/06/2034
75	Boston 20	5296	07/06/2013	07/06/2034
76	Quito 5	5631	08/13/2013	07/30/2034
77	Quito 6	5721	08/13/2013	07/30/2034
78	Quito 7	5722	08/13/2013	07/30/2034

Table 4-3. Crown Claims

TMAC Resources Inc. - Hope Bay Project

Item #	Claim	Number	Status	Recorded Date (MM/DD/YYYY)	Expiry Date (MM/DD/YYYY)
1	Elu 1	K15021	Active	07/11/2011	07/10/2021
2	Elu 2	K15022	Active	07/11/2011	07/10/2021
3	Elu 3	K15023	Active	07/11/2011	07/10/2021
4	Elu 4	K15024	Active	07/11/2011	07/10/2021
5	Elu 5	K15025	Active	07/11/2011	07/10/2021
6	Elu 6	K14991	Active	07/11/2011	07/10/2021
7	Elu 7	K14992	Active	07/11/2011	07/10/2021
8	Elu 8	K14993	Active	07/11/2011	07/10/2021
9	Elu 9	K14994	Active	07/11/2011	07/10/2021

Item #	Claim	Number	Status	Recorded Date (MM/DD/YYYY)	Expiry Date (MM/DD/YYYY)
10	Elu 10	K14995	Active	07/11/2011	07/10/2021
11	Elu 11	K14996	Active	07/11/2011	07/10/2021
12	Elu 12	K14997	Active	07/11/2011	07/10/2021
13	Laura	K14998	Active	07/11/2011	07/10/2021
14	Huvak 1	K14999	Active	07/11/2011	07/10/2021
15	Huvak 2	K15000	Active	07/11/2011	07/10/2021
16	Huvak 3	K15001	Active	07/11/2011	07/10/2021
17	Huvak 4	K15002	Active	07/11/2011	07/10/2021
18	Huvak 5	K15003	Active	07/11/2011	07/10/2021
19	Huvak 6	K14986	Active	07/11/2011	07/10/2021
20	Tulugaq 1	K14987	Active	07/11/2011	07/10/2021
21	Tulugaq 2	K14988	Active	07/11/2011	07/10/2021
22	Tulugaq 3	K14989	Active	07/11/2011	07/10/2021
23	Tulugaq 4	K14990	Active	07/11/2011	07/10/2021
24	Tulugaq 5	K15010	Active	07/11/2011	07/10/2021
25	Tulugaq 6	K15011	Active	07/11/2011	07/10/2021
26	Tulugaq 7	K15012	Active	07/11/2011	07/10/2021
27	Tulugaq 8	K15013	Active	07/11/2011	07/10/2021
28	Tulugaq 9	K15014	Active	07/11/2011	07/10/2021
29	Tulugaq 10	K15015	Active	07/11/2011	07/10/2021
30	Tulugaq 11	K15016	Active	07/11/2011	07/10/2021
31	Tulugaq 12	K15017	Active	07/11/2011	07/10/2021
32	Papiruq 1	K15018	Active	07/11/2011	07/10/2021
33	Papiruq 2	K15019	Active	07/11/2011	07/10/2021
34	Kent 1	K15004	Active	07/11/2011	07/10/2021
35	Kent 2	K15005	Active	07/11/2011	07/10/2021
36	Kent 3	K15007	Active	07/11/2011	07/10/2021
37	Kent 4	K15008	Active	07/11/2011	07/10/2021
38	Kent 5	K15009	Active	07/11/2011	07/10/2021
39	Kent 6	K15006	Active	07/11/2011	07/10/2021
40	Elu 14	K24001	Active	07/04/2016	07/04/2026
41	Elu 15	K24002	Active	07/04/2016	07/04/2026
42	Elu 16	K24003	Active	07/04/2016	07/04/2026
43	Elu 17	K24004	Active	07/04/2016	07/04/2026
44	Elu 18	K24005	Active	07/04/2016	07/04/2026

Item #	Claim	Number	Status	Recorded Date (MM/DD/YYYY)	Expiry Date (MM/DD/YYYY)
45	Elu 19	K24006	Active	07/04/2016	07/04/2026
46	Elu 20	K24007	Active	07/04/2016	07/04/2026
47	Elu 21	K24008	Active	07/04/2016	07/04/2026
48	Elu 23	K24010	Active	07/04/2016	07/04/2026
49	Elu 24	K24011	Active	07/04/2016	07/04/2026
50	Elu 25	K24012	Active	07/04/2016	07/04/2026
51	Elu 26	K24013	Active	07/04/2016	07/04/2026
52	Elu 27	K24014	Active	07/04/2016	07/04/2026
53	Elu 28	K24015	Active	07/04/2016	07/04/2026
54	Elu 29	K24016	Active	07/04/2016	07/04/2026
55	Elu 30	K24017	Active	07/04/2016	07/04/2026
56	Elu 31	K24018	Active	07/04/2016	07/04/2026
57	Elu 32	K24019	Active	07/04/2016	07/04/2026
58	Elu 33	K24020	Active	07/04/2016	07/04/2026
59	Elu 34	K24021	Active	07/04/2016	07/04/2026
60	Elu 35	K24022	Active	07/04/2016	07/04/2026
61	Elu 36	K24023	Active	07/04/2016	07/04/2026
62	Elu 37	K24024	Active	07/04/2016	07/04/2026
63	Elu 38	K24025	Active	07/04/2016	07/04/2026
64	Elu 39	K24026	Active	07/04/2016	07/04/2026
65	Elu 40	K24027	Active	07/04/2016	07/04/2026
66	Elu 41	K24028	Active	07/04/2016	07/04/2026
67	Elu 42	K24029	Active	07/04/2016	07/04/2026
68	Elu 43	K24030	Active	07/04/2016	07/04/2026
69	Elu 44	K24031	Active	07/04/2016	07/04/2026
70	Elu 45	K24032	Active	07/04/2016	07/04/2026
71	Elu 46	K24033	Active	07/04/2016	07/04/2026
72	Elu 47	K24034	Active	07/04/2016	07/04/2026
73	Elu 48	K24035	Active	07/04/2016	07/04/2026
74	Elu 49	K24036	Active	07/04/2016	07/04/2026
75	Elu 50	K24037	Active	07/04/2016	07/04/2026
76	Elu 52	K24039	Active	07/04/2016	07/04/2026

Table 4-4. Exploration Agreement

TMAC Resources Inc. - Hope Bay Project

Number	Expiry Date	Area (ha)
MEA (BB-57 and BB-60)	31/03/2035	60,361
PL (BB60-0002-PL)	4/11/2020	137

A Crown mineral claim can be held for up to 10 years if the holder performs representation work valued at least $5/hectare per year. Mineral leases are issued for a 21-year period and may be renewed for additional 21-year periods, as long as all required rents are paid. Production Leases are extended on 5-year terms upon application.

4.2 ROYALTIES AND ENCUMBRANCES

Production leases govern the net profits royalty payable for NTI mineral rights. A production lease must be entered into with NTI in order to develop a mine at the applicable deposit. Under the mineral production lease with NTI, TMAC pays NTI an annual 12% net profits interest royalty from any applicable production, with allowable deductions to be used in computing the net profits interest being subject to a prescribed annual limit. The Government of Canada (GoC) is entitled to royalties on net profits from production from the Crown mining leases. Crown mining leases are subject to a sliding scale net profits royalty of up to 13%. There is no prescribed annual limit on the amount of allowable deductions that may be claimed for such mining lease royalty. Crown and NTI net profits royalties are mutually exclusive.

Newmont retained a 1% NSR on commercial production from the Hope Bay Property, with TMAC having a right of first refusal on the sale of this NSR. On June 29, 2018, Newmont completed the sale of their rights to the NSR to Maverix, a non-related party. On August 14, 2019, TMAC entered into an amending agreement with Maverix which provides Maverix with an additional 1.5% NSR effective August 1, 2019 in return for a US$40 million prepayment. In addition, the amendment includes a bonus 0.25% NSR payable until the new royalty is registered on title, which is to be the earlier of June 30, 2021 or the date the Debt Facility is repaid in full. TMAC will have the option to pay the additional royalty, and the bonus royalty, in whole or in part, with Common Shares of the Company, at the then market price, until June 30, 2021. TMAC can repurchase one-third (i.e., 0.5%) of the additional NSR for US$15 million any time after June 30, 2021 or can repurchase 100% of the additional 1.5% NSR for US$50 million in the event of a change of control transaction that occurs before June 30, 2021. The additional royalty decreases to 0.75% after 3,000,000 ounces of saleable gold have been produced. Maverix has a right of first refusal on the creation of any new royalties, streams or similar transactions for a period of four years, with certain restrictions on the right.

As partial compensation for entering into the Framework Agreement, pursuant to the KIA Royalty Agreement, the Company granted the KIA a 1% net smelter return royalty on commercial production from the Hope Bay Property, which may not be transferred by the KIA other than to a “Designated Inuit Organization” which has been designated as such pursuant to the Nunavut Agreement.

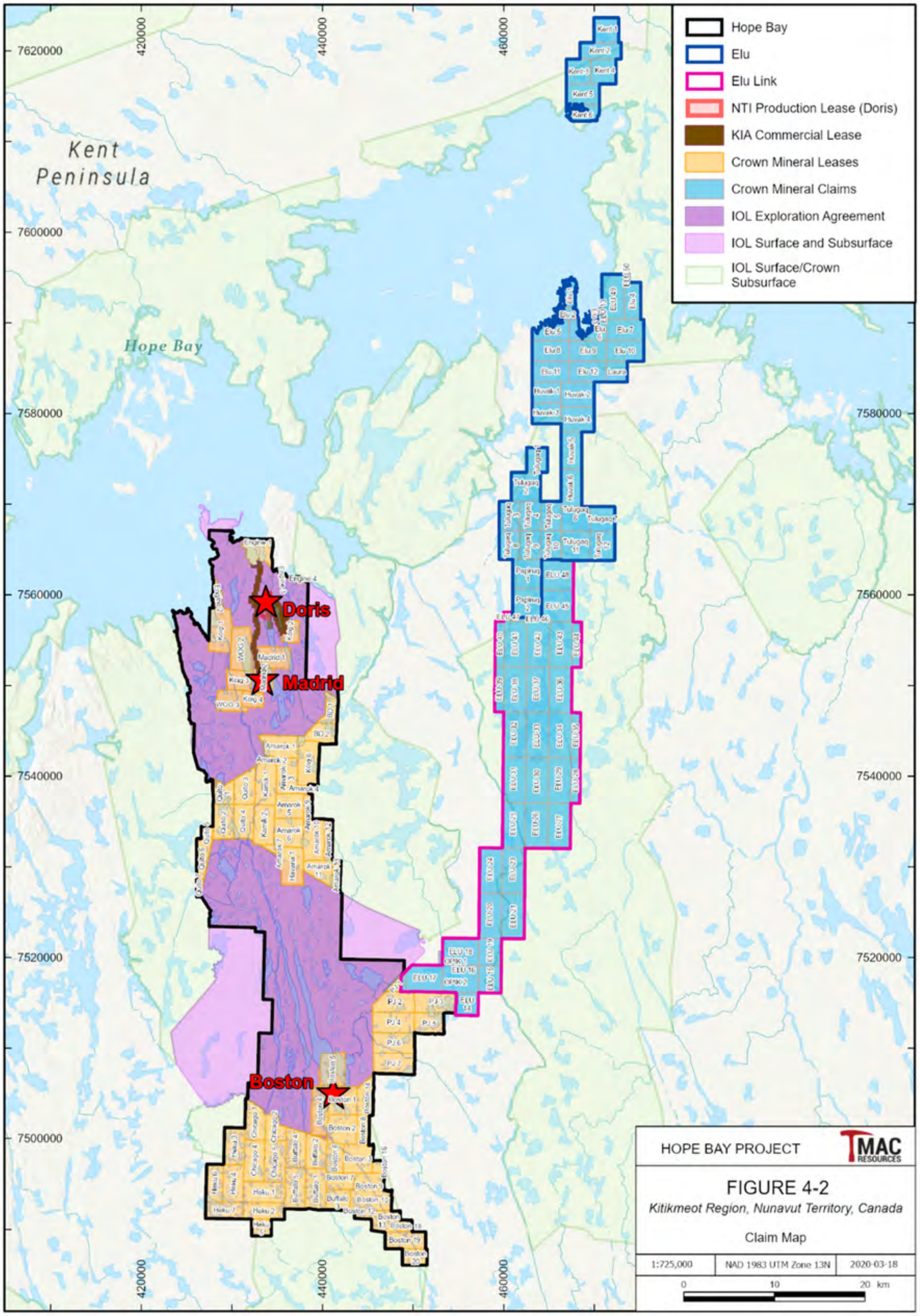


Figure 4-2. Hope Bay and Elu Mineral Tenure and Surface Rights Map

5.0 ACCESSIBILITY, CLIMATE, LOCAL RESOURCES, INFRASTRUCTURE AND PHYSIOGRAPHY

5.1 ACCESSIBILITY

Hope Bay is a fly in/fly out operation serviced from Edmonton, Alberta, Yellowknife, Northwest Territories and several Kitikmeot, Nunavut communities with supplies provided by annual sealift and regular aircraft. The nearest community and commercial airport are in Cambridge Bay, approximately 160 km by air.

The primary access route to the Hope Bay Property for bulk commodities such as diesel fuel, mining and Plant equipment and sundry supplies is via a marine route through the Arctic Ocean on the annual sealift from late July through September, when ice-free conditions allow for passage. The Dempster highway allows road access to the dock facilities of Tuktoyaktuk for use as an embarkation point to site. Goods must be transported by air during the rest of the year. Personnel are transported year-round by air to the gravel airstrip at the Doris site. Currently, the 1,525 m by 40 m wide strip allows for gravel-certified aircraft such as the Dash 8, Buffalo, 737-200, Hercules, ATR-72 and Avro RJ85 Avroliner.

5.2 CLIMATE

The climate is classified as Arctic, semi-arid. Snow accumulation and freeze-up of lakes begins in mid- to late September and remains into mid-June, with areas in the higher elevation persisting through July. Temperatures in January are often below -30°C while the mean annual precipitation is approximately 220 mm. Prevailing winds are strong and steady from the northwest.

Due to its location above the Arctic Circle, the site experiences near 24-hour sunlight in mid-summer and near 24-hour darkness in mid-winter.

5.3 LOCAL RESOURCES

All power required is currently and will need to be generated on site using diesel powered generators. There are numerous lakes in the vicinity of the mine and abundant quantities of fresh water available. Doris Lake will be the primary source of fresh make-up water.

Mining personnel mainly come from Yellowknife, Southern Canada, or Western Arctic communities, such as Cambridge Bay, Kugluktuk, and others. All personnel are flown to the site.

The TIA is approximately two km to the east of the Doris deposit. This water body has been added to Schedule 2 of the Metal Mining Effluent Regulations and is fully permitted for use as a TIA.

Temporary holding areas for waste rock are and will be located near the Mine portals. Any waste rock produced from underground is and will be utilized as fill in the underground mine stopes. Surface plans at Madrid and Boston indicate potential waste storage areas.

There are numerous sites which could be selected for the Madrid Plant. The site selected was chosen based on proximity to the planned portal location and the presence of relatively flat topography with bedrock at surface for mill and other major equipment foundations.

5.4 INFRASTRUCTURE

The Hope Bay Property is a remote project and does not rely on any territorial infrastructure. The Hope Bay Property is self-sufficient and has well-developed infrastructure. Property infrastructure is described in further detail in Section 18.0.

5.5 PHYSIOGRAPHY

The site is situated in an area of Arctic tundra with continuous permafrost. The local topography ranges from sea level at Roberts Bay to an elevation of 158 m at the summit of the Doris mesa approximately three km inland.

Vegetation consists of primary lichen, moss, dwarf willows, and birches. Outcrop forms north to northwest ridges, while tundra covers most of the flat valleys. The general overburden profile consists of saline ice-rich (10% to 30% by volume on average, but occasionally as high as 50%) marine clay and silt.

While the Project has a remote Arctic location, it is designed to operate throughout the year. Materials are transported to site from more southern locations and personnel are transported from Arctic and southern locations.

6.0 HISTORY

Historical exploration of the Hope Bay greenstone belt includes over 50 years of prospecting, diamond drilling, geophysical and geochemical surveys and mapping. The diamond drill information, when combined with drilling completed by TMAC since 2013, is used in the current Mineral Resource estimates. In general, the historical data have provided the foundation for the development of robust geological models with which to develop exploration targets at both regional and mine scales.

A summary of work completed over the Hope Bay volcanic belt from the 1960s to 2019 is listed in Table 6-1:

Table 6-1. Exploration History

TMAC RESOURCES INC. – HOPE BAY PROJECT

Company	Year	Activity
Roberts Bay Mining Co.	1965	Trenching at Roberts Lake near Doris.
Radiore Uranium Mines	1967	Trenching 10 km southwest of Madrid.
Hope Bay Mines Ltd.	1973	Mining of small silver deposit 10 km north of Doris.
Perry Nickel Mines	1976	Prospecting, sampling in belt.
Noranda Exploration Ltd.	1981	Airborne magnetics, drilling at Wombat zone near Kamik.
Roberts Bay Mining Co.	1985	Discovery of Roberts Lake Silver prospect.
Abermin Corporation	1987 - 1989	Identified Ida Bay Silver, Ida Bay Gold and Granite/Wombat prospects.
BHP Minerals Canada Ltd.	1991 - 1995	Extensive mapping, sampling, geophysical surveys, and approximately 120,000 m of drilling in 1,261 drillholes. Discovered Boston in 1992, Madrid in 1994 and Doris in 1995.
	1996 - 1998	Metallurgical testwork, underground bulk sampling (2,340 m underground development to 200 m depth), resource estimation and mining studies.
Miramar Hope Bay Limited	2000 - 2007	Geophysical surveys, till sampling, mapping and prospecting. Drilling (surface, underground, geotechnical, condemnation) approximately 382,000 m in 2,215 holes. Diamond drilling under the option agreement with Maximus Ventures Ltd. in the Eastern Contact, Twin Peaks and Chicago areas. A total of 9,536 m in 58 holes were drilled under the Maximus joint venture. Metallurgical studies, resource/reserve estimates, environmental impact statement, mining studies including a feasibility study in 2003.
Newmont	2007 - 2011	Drilling (exploration, infill, geotechnical) mapping, sampling, metallurgical testwork, resource estimation, environmental and social baseline data collection, pre-feasibility study, regional exploration.
TMAC	2013-Present	Drilling (exploration, infill, geotechnical), sampling, metallurgical testwork, resource estimation, environmental and social baseline data collection, pre-feasibility study, regional exploration.

6.1 EXPLORATION AND DEVELOPMENT HISTORY

Please refer to "RPA Technical Report on the Hope Bay Project, Nunavut, Canada – Report for N 43-101" dated March 31, 2015 for exploration and development history prior to TMAC Resources acquisition of the property in 2013.

TMAC 2013

On January 25, 2013, TMAC entered into a Transaction Agreement with Newmont for the Hope Bay Acquisition. The Hope Bay Acquisition was completed on March 12, 2013. All permits were transitioned to TMAC by June 2013. As consideration for the acquisition of the Hope Bay Property, the Company issued 8,000,101 Common Shares and 11,133,231 non-voting Common 23 Shares to Newmont (which were subsequently converted to voting Common Shares). On closing of the Hope Bay Acquisition, and immediately prior to a concurrent private placement, Newmont indirectly held 82% of the total issued and outstanding Common Shares and non-voting Common Shares, with management holding the balance of the Common Shares.

During 2013, TMAC drilled a total of 29,624 m in 67 diamond drillholes which supported the estimation of Inferred Mineral Resources at depth at both Doris North and Doris Central, demonstrating the potential to add significant gold ounces to the resource base below the dyke at Doris. Effective September 13, 2013, TMAC and the KIA agreed to a five-year renewal of Inuit owned lands commercial lease no. KTCL313D001 in respect of a portion of Doris for which TMAC was planning development of a mine. On November 19, 2013, TMAC announced the completion of a preliminary economic assessment (the "PEA Report") by RPA with respect to the Hope Bay Project, containing updated Mineral Resource estimates that were effective as of November 18, 2013.

TMAC 2014

On April 28, 2014, TMAC completed a brokered private placement of 14,647,900 Common Shares at a price of $5.25 per share and 144,666 Common Shares issued on a flow-through basis at a price of $6.00 per share, for aggregate gross proceeds of $77,769,475 (the "Second Equity Financing"). A total of 12,400,000 of such Common Shares (for proceeds of $65.1 million) were purchased by Resource Capital Funds (RCF) pursuant to the RCF 2014 Subscription Agreement, representing a 29.3% ownership of the Company at such time. The net proceeds of this offering was used by the Company to fund its 2014 work program in relation to the Hope Bay Project, including exploration, engineering, equipment, deposits for equipment, environmental permitting and compliance, the PFS, and for working capital and general corporate purposes.

The 2014 exploration program consisted of diamond drilling to infill Mineral Resources at Doris and Madrid, with two additional exploration drillholes in the southern portion of the Hope Bay Property. Drilling focused on the Wolverine, Patch 14, Naartok East and West, Doris Connector, Doris Connector BTD, and Doris North BTD sections of the property. The program targeted areas of the resource where previous drilling was widely-spaced or the down-plunge extension was not sufficiently tested. Overall, a total of 25,861 m in 61 drill holes were drilled as infill at Doris to test continuity of mineralization and extensions of existing mineralized trends. A total of 16,252 m in 41 drillholes were drilled over the Patch 14 and Wolverine deposits, focusing on increasing drillhole spacing within key sections of the existing Mineral Resources and testing the down-plunge extension of high-grade chutes. A total of 24,409 m in 48 holes (targeted Naartok East and West to determine the extent of mineralization and infill between thicker high-grade zones

and two assessment drillholes explored the mineral potential of Akungani 2 and Aimaokatuk 1. Exploration drilling targeted a similar geological environment to the setting of the Naartok East zone and a regional scale structural corridor with both holes totaling 978 m helicopter supported out of Doris. In total, the 2014 drilling program consisted of 152 diamond drillholes, for a total of 67,500 m, and was successful in the addition of 1.7 million ounces of gold to the Measured and Indicated Mineral Resources category, a significant portion of which was converted to Mineral Reserves reported in the 2015 PFS.

Further metallurgical testwork on Doris core was completed and a preliminary processing plant design completed in October 2014. Based on this design, Gekko Systems was instructed to proceed with detailed engineering in December 2014. During this time, TMAC submitted an application to the Nunavut Water Board for a new “Type B” water licence for advanced exploration, including the collection of bulk samples of 50,000-60,000 t from each of Madrid North and Madrid South. Water and waste management plans were also included in the applications submitted.

TMAC 2015

The 2015 diamond drilling program focused on three main areas: the Doris North zone; the Madrid North Naartok zone and the Madrid North Suluk zone. A total of 33,158 m, in 120 drillholes was completed in 2015. The drilling on the Doris North zone concentrated on infill drilling within the Indicated Resources, to facilitate detailed mine planning and stope design. In addition to infill drilling, four exploration holes were completed that targeted the Doris North BTD Extension. Drilling in the spring of 2015 from ice platforms focused on infill drilling on the Madrid North Suluk zone following up on high-grade intersections within the Inferred Resources, and infill drilling within the Indicated Resources to continue to refine the geological model. Drilling from land-based platforms in the second half of 2015, focused on the Madrid North Naartok zone, infill drilling within the Indicated and Inferred Resources and also followed up on high-grade, near surface intersections not accounted for in the Madrid resource base.

On March 30, 2015, TMAC entered into a MEA with an effective date of January 31, 2015, granting TMAC access to the Inuit-owned subsurface mineral rights administered by NTI. Additionally, on March 30, 2015, TMAC entered into a 20-year comprehensive framework agreement and an IIBA administered by KIA for Inuit-owned surface access rights. Both the MEA and Framework Agreement were for a 20-year period.

On April 24, 2015, TMAC announced the completion of a pre-feasibility study led by RPA, with an effective date of March 31, 2015. The PFS estimated an economically positive 20-year life of mine for the Hope Bay Project resulting in an updated Mineral Resources estimate in the PFS of 4.5 million ounces of gold in the Measured and Indicated Mineral Resources categories, including Proven and Probable Mineral Reserves of 3.5 million ounces, in support of an initial 20-year mine life at Doris, Madrid and Boston.

The 2015 sealift included the purchase and delivery to Hope Bay of mobile mine equipment capable of mining at a rate of 1,000 t per day, 15 millions liters of diesel fuel, the mill building which was designed and fabricated in 2015 and the first years worth of mining parts and supplies.

TMAC 2016

On March 18, 2016, TMAC completed a private placement of 827,206 flow-through common shares of TMAC at a price of $10.88 per Flow-Through Common Share for gross proceeds of $9.0 million. A portion of the gross proceeds from the sale of the Flow-Through Common Shares

were used for expenditures that qualify as Canadian exploration expenses (CEE) (within the meaning of the Income Tax Act (Canada)).

A total of 27,246 m in 95 diamond drillholes was completed in 2016. Underground diamond drilling on the Doris North BTD zones represented 14,589 m in 46 drillholes of the total drilling during the 2016 program. Initial underground exploration drilling below the diabase dyke demonstrated continuity of quartz veining and gold mineralization initiating additional underground development to further test Doris North BTD.

The 2016 regional exploration program, funded through flow-through Financing, was designed to advance high priority exploration targets within the northern portion of Hope Bay. Two geophysical survey programs completed during the 2016 summer season included SkyTEM Mag/EM and the CGG Helifalcon gravity gradiometry surveys. In addition, glacial gold in till sampling commenced in 2016, with 540 samples collected that season including 44 samples processed for kimberlite indicator minerals.

Construction off the Doris Plant building commenced in April 2016 with 100% of the Doris Plant enclosure constructed by September 30, 2016. The cladding for the crushed ore stockpile was completed shortly thereafter. The Doris Plant, fabricated by Gekko Systems, was successfully delivered to Hope Bay by August 30, 2016 with installation and assembly complete and commissioning started by the end of December 2016.

In June 2016, TMAC staked an additional 37,214 hectares within the extension of the Elu greenstone belt linking the Elu claims with the Hope Bay claims. The Elu claims form a land package that comprises an area of 685 km^2 and is approximately 80 km by 10 km in extent. The new Elu link claims were approved by the Nunavut mining recorder in the fourth quarter of 2016.

TMAC 2017

Commercial production was declared on May 15, 2017, with an effective date of June 1, 2017. In 2017, a total of 4,208 m of surface drilling was completed at Boston and 13,491 m of underground drilling was completed at Doris for a total of 17,699 m and 72 drillholes. Reverse Circulation (RC) drilling began in the spring, and a total of 464 m in 24 holes was completed out of Doris.

The Boston camp was opened in June 2017 and two surface rigs were active at Boston during the third quarter of 2017. Drilling at Boston finished in mid-August as TMAC's flow-through expenditure commitments were met. The camp was decommissioned, winterized and material was staged in preparation for a winter re-supply and backhaul. Diamond drilling targeted wide, high-grade trends within the current resource to allow assessment of bulk stope mining in these areas.

At Doris, underground exploration diamond drilling in 2017 focused on the first block of the BTD East Limb and BTD Extension area near the north fault. This was an area of structural complexity and where the East Limb and Extension are structurally overlapped. Drill results were issued in a Mineral Reserve and Mineral Resource statement for June 30, 2017.

Gold in till sampling during the 2016 season highlighted possible dispersal trains not associated with the known deposits and this program continued in 2017, with a total of 726 samples collected.

The NWB, in consultation with the Nunavut Impact Review Board (NIRB), renewed the new Type B Water Licence for Boston in July 2017. TMAC submitted the Madrid-Boston final environmental impact statement and two associated water licence applications to the NIRB and NWB, respectively, on December 21, 2017. This submission initiated government and public review of

the proposal for the construction, operation and closure of mines and associated infrastructure at the Madrid and Boston gold deposits prior to issuance of the necessary permits.

TMAC 2018

The 2018 diamond drilling program consisted of 35,049 m of drilling in 232 drillholes. A total of 24,287 m of underground diamond drilling in 154 drillholes was completed in 2018 at Doris that was focused on upgrading and expanding the Doris BTD Inferred Resources and on definition drilling to support production in the Doris Connector zone. A total of 9,868 m of diamond drilling in 75 drillholes was completed at Madrid. Results of the 2018 program were incorporated into an updated geological model and Mineral Reserve and Mineral Resource estimate as of December 31, 2018.

On October 3, 2018, TMAC completed an equity financing that consisted of a concurrent public offering and private placement of Common Shares and flow-through Common Shares at a blended offering price of $4.40 per share. The aggregate gross proceeds were $90.0 million with net proceeds of approximately $88.0 million. The use of proceeds was $57 million for debt repayment, $15 million for exploration to be carried out in 2019 and $16 million for capital expenditures that were mostly incurred in 2018.

TMAC 2019

Diamond drilling in 2019 consisted of surface and underground diamond drilling to support both short-term production through longer-term definition and expansion of resources at Doris, Madrid North, and Boston. In addition, a significant regional exploration drilling program was completed with a focus on established targets proximal to existing and planned infrastructure. A total of 75,738 m in 466 drillholes was completed in 2019, including 43,749 m of underground drilling at Doris and 31,989 m of surface drilling at Doris, Madrid North, Boston and Regionally.

News releases summarizing the results of the 2019 diamond drilling program were issued on: April 7, 2019 titled “Doris Drilling Continues to Define Continuity of the High Grade BTD Extension; First Quarter 2019 Exploration Update”, July 15, 2019 titled “TMAC Resources’ Second Quarter Exploration Results Include High-Grade Intercepts at Doris and Madrid North”, August 14, 2019 titled “TMAC Announces Growth of Doris BTD Extension Zone and First Results from Doris Regional Program”, October 15, 2019 titled “TMAC Continues to Intersect High-Grade at Doris BTD Extension Zone” and February 5, 2020 titled “TMAC Fourth Quarter Drilling Results Include High-Grade Gold at Boston and Regionally”.

The 2019 underground diamond drilling program had three main objectives: (i) infilling drilling within Doris Connector to support detailed mine planning, (ii) definition and expansion drilling on the high-grade zones in Doris BTD and (iii) exploration drilling testing targets near current underground infrastructure.

In 2019, a total of 10,290 m of diamond drilling was completed at Madrid North in 46 diamond drillholes. The surface program at Madrid included an infill drilling program to assist with the development and production of the near-surface mineralized Naartok East crown pillar, along with a winter ice drilling program at Suluk to assist with infill stope design and metallurgical testwork to support underground operations.

The Boston camp was opened late in the second quarter and a south belt regional drilling program was completed in the third quarter before transitioning to drilling on the Boston deposit in the fourth quarter. Five diamond drillholes were completed at Boston in 2019, totaling 3,650 m in 5

diamond drillholes. One hole was abandoned shortly after collaring due to excessive deviation. Results were reported in the February 5, 2020 news release titled “TMAC Fourth Quarter Results Include High-Grade Gold at Boston and Regionally”. Although the 2019 drilling program was limited, assay results demonstrate the significant potential to expand the Boston deposit below the current Indicated Mineral Resources and add to the current mineral resource base.

The 2019 regional exploration program was designed to focus on highly prospective targets that are in proximity to established or planned infrastructure and where successful exploration will influence TMAC’s decisions with respect to property-wide mine development. In defining targets, TMAC benefits from a significant database of historic work completed by BHP, Miramar, Newmont and TMAC, including geological mapping, sampling and airborne geophysical surveys.

6.2 HISTORICAL RESOURCE ESTIMATES

On December 31, 2006 Miramar announced an Indicated Mineral Resource estimate of 36.0 Mt grading 4.5 g/t Au, containing 5.23 Moz Au, and an Inferred Mineral Resource estimate of 46.6 Mt, grading 3.6 g/t Au, containing 5.46 Moz Au. This resource estimate is historical in nature, and should not be relied upon, and is quoted for historical purposes only.

On April 24, 2015 TMAC announced Measured and Indicated Mineral Resources of 15.2 Mt grading 9.2 g/t Au, containing 4.5 Moz Au and Inferred Mineral Resources of 6.0 Mt, grading 7.4 g/t Au, containing 1.4 Moz Au within the TMAC Pre-Feasibility Study. Please refer to “RPA Technical Report on the Hope Bay Project, Nunavut, Canada – Report for N 43-101” dated March 31, 2015.

Updated Mineral Resource estimates as of June 30, 2017 were announced on July 14, 2017 in a news release titled “TMAC Resources Provides Operation Update and Reports 2017 Mineral Reserves and Mineral Resources Estimate, Hope Bay Nunavut”. Measured and Indicated Mineral Resources Totalled 17.8 Mt, grading 8.6 g/t Au, containing 4.9 Moz Au, and Inferred Mineral Resources of 7.5 Mt, grading 7.1 g/t Au, containing 1.7 Moz Au.

On February 21, 2019 TMAC announced updated Mineral Resource estimates as of December 31, 2018 in a news release titled “TMAC Resources Reports Updated Minera Reserves and Mineral Resources Estimate, Hope Bay, Nunavut”. Measured and Indicated Mineral Resources Totalled 18.0 Mt, grading 8.3 g/t Au, containing 4.8 Moz Au, and Inferred Mineral Resources of 7.3 Mt, grading 6.9 g/t Au, containing 1.6 Moz Au.

All previous TMAC and historical Mineral Resource estimates are superseded by the estimate in Section 14.0 of this report.

6.3 PAST PRODUCTION

TMAC started mining operations on the Doris ore deposit in late 2015 and continues to mine the deposit as of December 2019. Initial production at Doris was from the Doris North zone and now includes three other zones, Doris Connector, Doris BTD, and Doris Central, in various stages of production. Two surface crown pillar ore deposits, the Doris North crown pillar and the Madrid Naartok East crown pillar have been or are in the process of being mined, to provide ore for the Doris Plant. From 2015 to 2017, ore produced by the Doris Mine was stockpiled while the first concentrator line of the Doris Plant was constructed. Construction of the first concentrator line of the Doris Plant was completed in December 2016 and commissioning completed in June 2017. The first concentrator line provided the Doris Plant with a capacity of 1,000 t/d. The Doris Plant

capacity was upgraded to 2,000 t/d when the planned second concentrator line was completed in August 2018. The Doris Plant initially consisted of two Python concentrator lines followed by a concentrate treatment plant (CTP) which produces gold dore bars for sale. The Doris Plant has been upgraded from its original design with expanded gravity recovery and leach scavenger capabilities.

The historical ore processing and gold production from the Doris Plant can be found in Table 6-2.

Table 6-2. Historical Doris Ore Processing and Gold Production

Year	Gold Produced (oz)	Ore Processed (tonnes)
2017	55,150	209,000
2018	110,970	464,200
2019	139,513	592,932

7.0 GEOLOGICAL SETTING AND MINERALIZATION

7.1 REGIONAL GEOLOGY

The Hope Bay volcanic belt is located in the northeast portion of the Slave Structural Province, a predominantly Archean granite-greenstone-metasedimentary terrane located between Great Slave Lake to the south and Coronation Gulf to the north. The Slave Province is bounded to the east by the Thelon Orogen (2,020 Ma to 1,910 Ma) and to the west by the Wopmay Orogen (1,950 Ma to 1,840 Ma) (Hoffman, 1988; Sherlock et al., 2002).

Approximately 26 granite-greenstone belts are recognized in the Slave Province. They have been classified as mafic volcanic-dominated (Yellowknife type) and felsic volcanic-dominated (Hackett River type) by Padgham (1985). Yellowknife-type belts are typically massive to pillowed tholeiitic flows interbedded with calc-alkaline felsic volcanic and volcaniclastic rocks, clastic sedimentary rocks and rare synvolcanic conglomerate and carbonate units. Hackett River-type belts are dominated by calc-alkaline felsic and intermediate rocks intercalated with turbidities.

U-Pb geochronology brackets volcanism in the Slave Province from 2,715 Ma to 2,610 Ma (Mortensen et al., 1988; Isachsen et al., 1991). The Slave volcanic belts are typically isoclinally folded and contain belt-parallel shear zones. The main greenstone belts are commonly overlain by a late (circa 2,600 Ma) “Timiskaming-type” sedimentary assemblage consisting of conglomerate and sandstone (Fyson and Helmsteadt, 1988). Villeneuve et al. (1997) subdivided the intrusive rocks into pre-deformation tonalite and diorite (2,700 Ma to 2,640 Ma), K-feldspar-megacrystic granite (2,620 Ma to 2,590 Ma), and post-deformation two-mica granite (2,600 Ma to 2,580 Ma). In general, a regional deformation event is recognized between 2,700 Ma and 2,600 Ma, and is characterized by regional compression, plutonism, and late extension (< 2,583 Ma).

As of 2016, the Slave province has produced 18.6 Moz of gold and 52.7 Moz of silver (GNWT, 2016.)

Regional geology is illustrated in Figure 7-1.

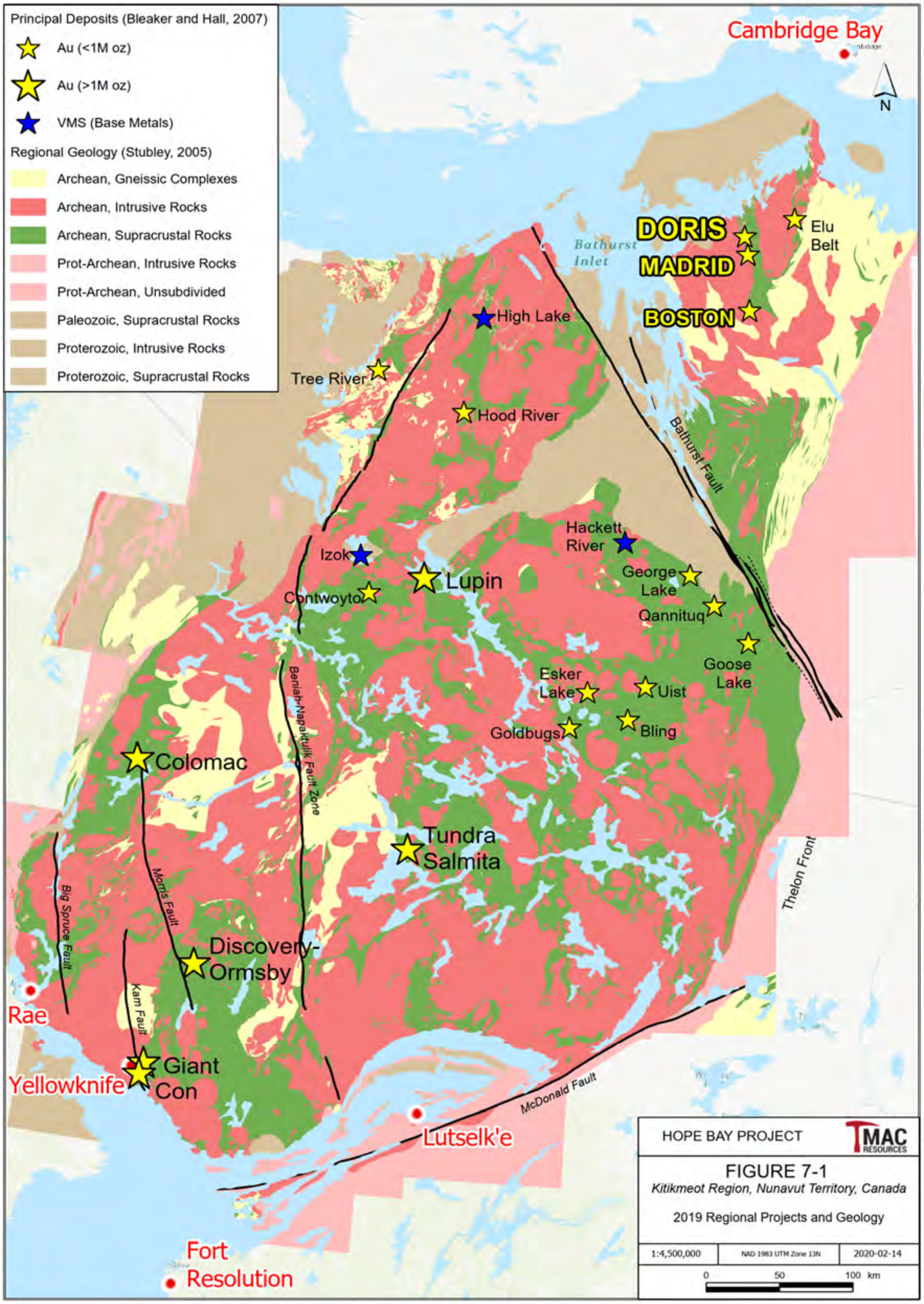


Figure 7-1. Kitikmeot Region, Nunavut Territory, Canada, 2019 Regional Projects and Geology

7.2 LOCAL GEOLOGY

The Bathurst Block refers to the section of the Slave Province northeast of Bathurst Inlet. Proterozoic cover of the Kilohigok Basin isolates it from the rest of the Slave Province (Campbell and Cecile, 1976). The Hope Bay volcanic belt lies within the northern part of the Bathurst Block. This belt was first mapped at a reconnaissance scale by Fraser (1964), and subsequently in more detail by Gibbons (1986) and Gerbet (1990; 1993) who considered the belt analogous to the Yellowknife Supergroup.

The Hope Bay volcanic belt is dominated by mafic volcanic rocks with lesser felsic volcanic rocks and volcaniclastic products, subordinate ultramafic bodies and metasedimentary rocks. Existing U-Pb geochronology of the belt indicates felsic volcanism spanned a period of at least 53 Ma (2,716 Ma to 2,663 Ma; Hebel, 1999).

The belt is composed of three major suites of mafic to felsic volcanic rocks, which comprise the Flake Lake, Windy, and Koignuk suites. Two minor suites of similar lithologies, the Square Lake and Clover suites are limited in area (Figure 7-2). These suites are separated by roughly north-south trending domain bounding structures, and are interpreted as stacked packages of volcanic rock that are thrust-repeated along the major domain bounding structures. As a result, younger suites of rock overly older suites of rock, from west to east. These include from oldest (east) to youngest (west), the Flake Lake (2,716 – 2,697 Ma), Windy (2,690 – 2,683 Ma) and Koignuk suites (~2,677 MA; Sherlock et. al., 2012.). The Windy suite hosts the Doris, Madrid and Boston deposits, although the Boston deposit is situated within a locally thickened section of the Windy suite, just to the east of the domain bounding structure between the Windy and Koignuk suites (Sherlock et. al., 2012.)

To the east, the belt is bordered by felsic intrusions that separate the Hope Bay volcanic belt from the Elu Inlet Belt. A granodiorite northeast of the Hope Bay belt gave a U-Pb zircon age of 2,672 Ma, suggesting a syn-volcanic to late volcanic age of emplacement (Bevier and Gerbert, 1991). The southeastern contact of the Hope Bay volcanic belt is a heterogeneous gneiss terrane that yielded a U-Pb zircon age of 2,649.5 Ma and a titanite age of 2,589 Ma, which may represent the age of regional metamorphism (Hebel, 1999). The Hope Bay volcanic belt is bordered to the west by plutonic rocks containing foliated mafic fragments at 2,608 Ma, placing a lower age limit on deformation and metamorphism (Bevier and Gerbert, 1991). The metamorphic grade within the interior of the belt is lower greenschist facies with amphibolite facies near the belt margins.

According to Stubley (2011), the deformation history of the Hope Bay volcanic belt can be broken into three principal tectonic events, compatible with pan-Slave relationships (e.g. Bleeker and Hall, 2007). These tectonic events include:

- D1: Inferred approximate east-west shortening resulting in local transposition of primary volcanic and sedimentary structures into an early approximate north-south trending tectonic fabric, axial planar to tight – isoclinal folds. These structures are best preserved in the Square Lake and Flake Lake suites and are largely obscured in the Koignuk and Windy suites due to overprinting by later D2 structures. The absolute timing and duration of D1 is poorly constrained for the Hope Bay volcanic belt, but is estimated to be between 2,640 and 2,630 Ma (Stubley, 2011).
- D2: Continued approximate east-west shortening resulting in the juxtaposition and / or tightening of the Koignuk and Windy suites, and development of the dominant approximate north-south trending regional foliation. The development of thrust-and-fold belt configuration in the southern Koignuk suite is also attributed to D2. Principal gold

remobilization and deposition within the belt is believed to be D2 age, bracketed between 2,610 and 2,598 Ma (Stubley, 2011).

- D3: Inferred approximate north-south shortening resulting in the gentle warping of the belt, the development of local crenulation cleavage, and development of extensional faults near the eastern margin of the belt. The absolute timing and duration of D3 is poorly constrained, but estimated between 2,575 and 2,570 Ma.

Significant post-D3 map-scale features include the emplacement of NNW-trending diabase dykes of the 1,267 Ma Mackenzie swarm, and the emplacement of shallow diabase sills and associated dykes of the 723 Ma Franklin swarm (Stubley, 2011).

The local geology, i.e., the geology of the Hope Bay volcanic belt, is illustrated in Figure 7-2.

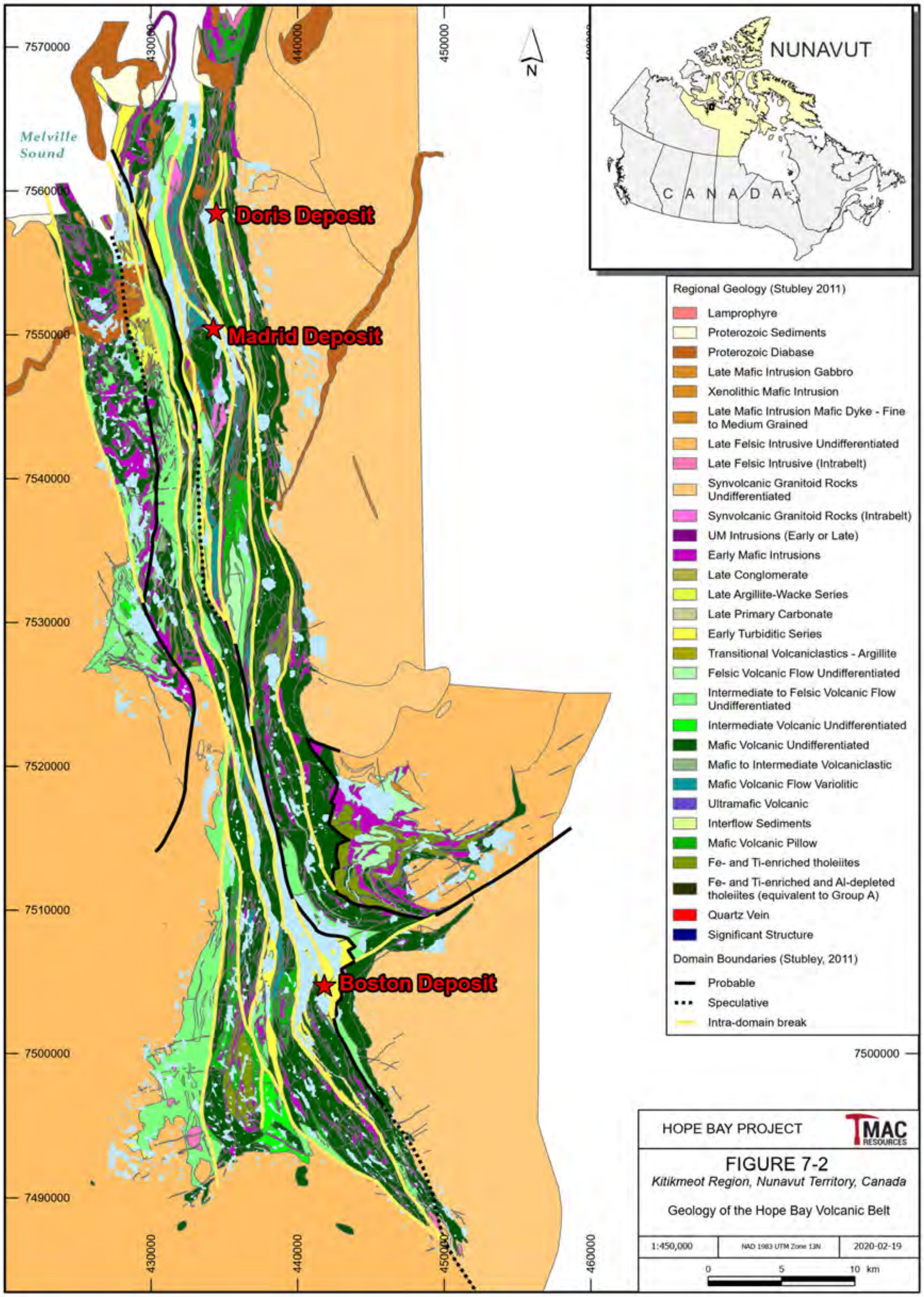


Figure 7-2. Kitikmeot Region, Nunavut Territory, Canada, Geology of the Hope Bay Volcanic Belt

7.3 PROPERTY GEOLOGY

GEOLOGICAL SETTING OF THE DORIS AREA

The Doris Deposit is located at the north end of the north-south trending Hope Bay greenstone belt of Archean age near Cambridge Bay in Nunavut. Gold mineralization is contained within predominantly sub vertical quartz veins hosted within mafic volcanic rocks. Surface mapping of the mafic volcanic stratigraphy, supported by geophysics, defines a mushroom shaped interference fold pattern interpreted as gentle, steeply-plunging D3 folds overprinting the approximately north-south trending upright, tight-isoclinal D2 folds about an approximate east-west trending axial trace. Gentle D3 folds open to the east in the Doris Mine area (Figure 7-3). The footprint of the mineralization and underground ramp development extends roughly 3 km in a similar north-northeast arcuate trend, roughly 350 m across strike, with 50% of the strike situated north of Doris Lake in permafrost ground and 50% beneath the lake.

On the north shores of Doris Lake, the veins in cross section appear folded and or faulted creating a thickened, high-grade anticlinal hinge zone close to surface called the Doris Hinge or Doris North (DNO; Figure 7-3). The Doris hinge zone plunges shallowly to the north, and locally the D2 fold limbs appear overturned to the east. The hinge zone pinches down to flanking, narrower sub vertical east and west limb components, locally transitioning into patchy stringer zones, and/or locally brecciated attenuated limb structures, with minimal vein material, but still gold bearing.

Lithogeochemical analyses routinely conducted in exploration drilling support the geometry of the Doris antiform and folded vein, by mapping the folded contact between magnesium-tholeiites in the core of the antiform and younger iron-tholeiites flanking the antiform. The mafic volcanic rocks are amygdaloidal, variolitic, variably magnetic basalts, massive and pillowed facies, characterized by narrow bleached alteration zones, ranging from 1-10 m largely in the core or footwall of the Doris antiform. The mafic volcanic rocks were intruded by one or two phases or late mafic dykes of gabbroic and basaltic composition. A series of diabase dykes and sills of the Neoproterozoic Franklin Dyke Swarm clearly crosscut all the stratigraphy. The most significant diabase body in the Doris area is approximately 50 m thick tabular sill that dips shallowly to the east-south-east. This sill crosscuts the Doris vein system at 100 m depth in the north and 300 m below surface in the south. It forms the Doris mesa at surface, a relatively flat lying hill with 150 m of topographic expression northwest of Doris Lake. This intrusion may have been injected along a flat lying structure. Below the dyke (BTD), the geology and mineralization appears to pass into a more intensely structured regime with a series of faults and/or folds down dropping the DNO roughly 150 m vertical.

The Doris hinge DNO ATD anticlinal fold axis extends south under Doris Lake marking the transition between east-facing strata on the east shore of Doris Lake and west-facing strata on the west shore of Doris Lake. Where the vein structure passes under the lake, the vein appears to lose the hinge component and is referred to as the Doris Connector (DCO) comprised of an east and west limb moving southwards, more widely spaced than the DNO. The change in the fold width formed the basis of an east-west dip slip offset interpretation. The fold axis in this area is doubly plunging and plunges shallowly to the north in the DNO and shallowly to the south about the DCO. West in the hangingwall to the DCO, the West Valley Wall veins (WVW) were intersected in the DCO access development. A further 1 km south the DCO overlaps with the DCN vein structure with another structural overlap/offset interpreted on drilling alone.

The main difference in the structural interpretation since the 2015 PFS has been the mapping and modelling of roughly 50 plus mine scale faults documented during grade control activities. These

structures logically were documented in the development areas and the main access and secondary spiral ramps, typically positioned in waste rocks.

Underground mapping in the Doris mineralization area shows a fault pattern consistent with a set of conjugates, steeply dipping northeast- and northwest-striking faults. Late brittle displacement on the northeast fault set is defined by slickensides showing dextral strike-slip movement with metre scale displacement. The northwest fault set appears to be the latest fault and clearly cuts all veins and lithologies with sinistral strike slip displacement from 5 to 20 m in the underground workings.

The conjugate fault offsets appear to dominant variably along the 3 km strike length of mineralization rotating in a clockwise direction as the overall vein structure curves to the northeast following the arcuate open folded enveloping surface and lithological units. A series of relatively shallow west dipping faults have been mapped in the development sills BTD striking roughly north-south and exhibiting metre scale reverse movement on the sub vertical east limb vein structures. The northwest sinistral fault set has been mapped cutting these thrust faults supporting their late stage brittle displacement.

A north-east trending arcuate shaped brittle-ductile structure has been mapped in the main access ramp to the south tracking the DCO and DCN with a northern extension interpreted to trace roughly parallel the axial plane of the Doris antiform hinge zone in the DNO ATD near surface within the 50 metre crown pillar.

The geology of the Doris deposit area is illustrated in Figure 7-3.

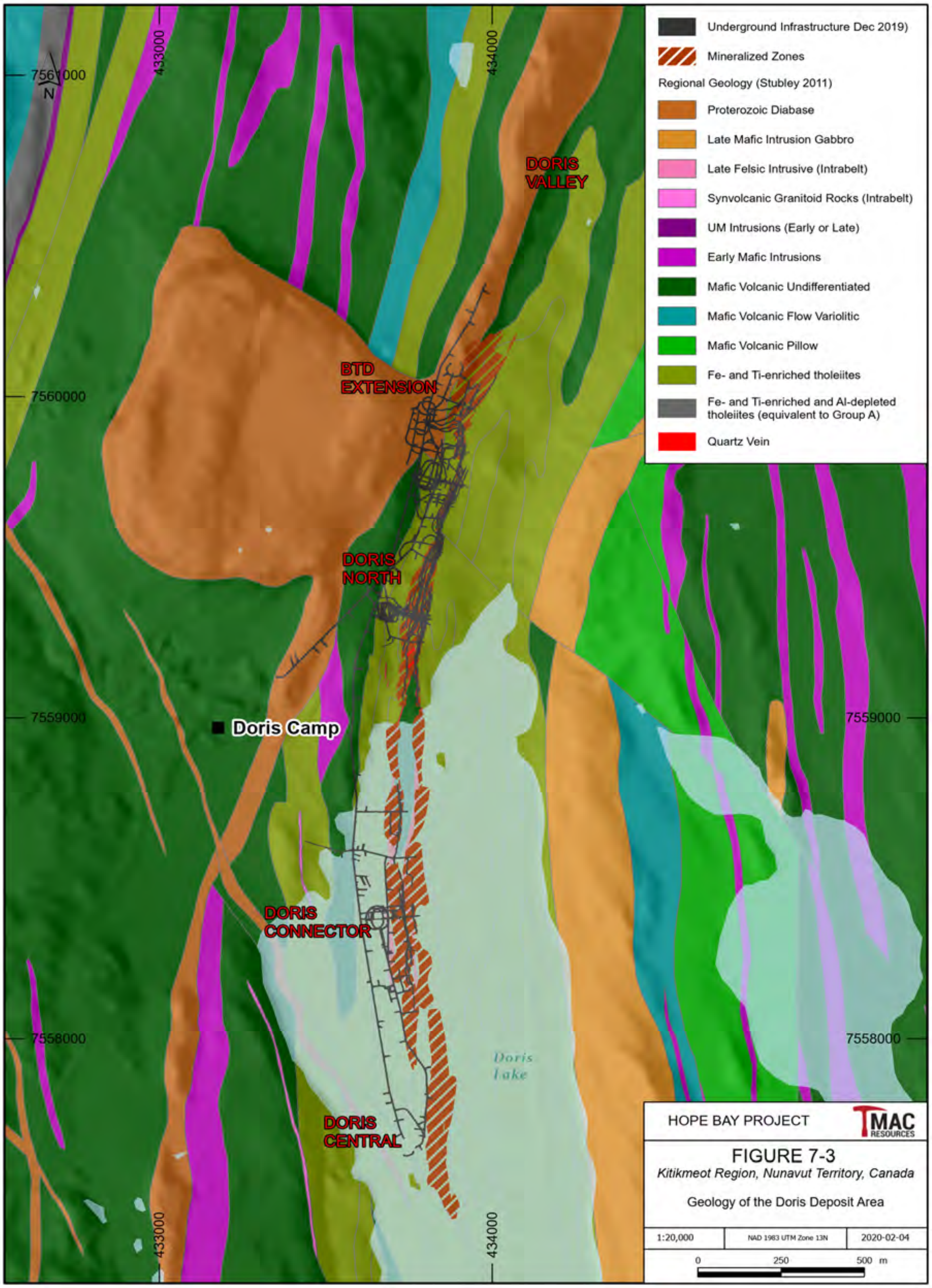


Figure 7-3. Kitikmeot Region, Nunavut Territory, Canada, Geology of the Doris Deposit Area

GEOLOGY OF THE MADRID AREA

The Madrid deposit area is located in the northern area of the Hope Bay volcanic belt, south of the Doris deposit (Figure 7-5). It includes the Wolverine-Madrid corridor which is defined as the belt of rocks extending from the southern end of Wolverine Lake to the northwest end of Patch Lake (Sherlock et al., 2002). The Madrid deposit area includes the Naartok East, Naartok West, Rand, Spur, Suluk, Wolverine and Patch 14 deposits. The Madrid trend also includes the Suluk T3, and Patch 7 prospects.

The Madrid Deformation zone is a significant structural feature within the Madrid-Wolverine corridor. It runs northwest-southeast along Patch Lake and sharply swings east-west through the Madrid area, towards Windy Lake. It is sub-vertical in its northwest-southeast orientation, but where it is oriented east-west, it dips approximately 70° to the north. The MDZ consists of a contorted quartz-mica-iron carbonate schist with white, variably sized, and disrupted vein fragments. The upper contact is distinct and is generally represented by a zone of broken core up to several m wide (Sherlock et al., 2002).

The nature and timing of the MDZ is complex. It is interpreted to have been developed initially as a pre-D2 fault system, which was subsequently reactivated at different times including syn- and post-gold mineralization (Sherlock et al., 2012). The bulk of gold mineralization at the Madrid deposit is contained within the structural hangingwall of the MDZ associated with splays off the main fault zone (Sherlock et al., 2012). These splays preferentially develop along volcanic-sediment horizons, possibly related to the large competency contrast between massive flows and argillite-volcanoclastic layers (RPA, 2013).

The rocks within the Madrid corridor predominantly consist of a north-south striking package of mafic volcanic rocks comprising a sequence of iron-titanium tholeiitic basalts, magnesium-tholeiitic basalts, komatiitic basalts, synvolcanic to late gabbroic and ultramafic rocks (RPA, 2013). A suite of dacitic to rhyodacitic rocks commonly referred to as the ‘Wolverine porphyry’ incorporates a number of texturally and compositionally different rock types. The ‘Wolverine porphyry’ had been interpreted to represent an intrusive body that crosscuts the mafic volcanic suites (J.S. Gerbert, unpub. rept., 1999; Hebel, 1999). However, Sherlock et al. (2002) suggest that the felsic rocks are in part volcaniclastic and coeval with the Wolverine basalt suite. Several intervals of felsic rocks are present in the immediate Wolverine area. Felsic fragmental rocks are distinguished by their clastic nature with numerous chloritic fragments, and coarse grained feldspar and quartz phenocrysts. Massive quartz-feldspar-phyric bodies that may represent small sub-volcanic intrusions or flows are also present within the Wolverine area. The main felsic intrusive phase is centred under Wolverine Lake. Variations in phenocryst content define individual phases of the porphyry (TMAC, 2013).

Rocks of the northern Madrid area, Naartok West to Suluk, are classified based on textural and lithogeochemical similarities. The general stratigraphy of the area is composed of three major volcanic packages: Wolverine Group (C-type rocks), Patch Group (A-type rocks), and a C-type tholeiite (Pale Green Pillows, or PGP) (Miramar Hope Bay Limited, 2005). The Naartok stratigraphy consists of a package of intercalated C-type and A-type basalts with interflow sediment, dipping to the north at Naartok West, and moderately westerly dipping in Naartok East. At Rand, stratigraphy consists of a steep northerly dipping package of C-type and A-type variolitic basalts and volcanics (Miramar Hope Bay Limited, 2005). Stratigraphy continues south to Suluk as south-southeast trending, steeply dipping, and west younging volcanic and with an increase in the proportion of interflow sediments (Miramar Hope Bay Limited, 2005).

The style of mineralization at Madrid is different from the Doris or Boston deposits and can be generally characterized by sulphidation and replacement of favourable stratigraphic units. The most favorable lithologies are Fe-rich tholeiitic mafic volcanics which have been extensively brecciated. Hydrothermal alteration at Madrid is characterized by an early assemblage of sericite micas and carbonate alteration, consisting of magnesite and ankerite with quartz-carbonate stockwork veinlets. The main gold-bearing alteration assemblage consists of secondary albite and paragonite with lesser carbonate as ankerite and quartz-ankerite stockwork veinlets. The higher gold tenor is associated with over 10% fine grained pyrite, intense albite flooding and hematite discoloration (Sherlock et al., 2012).

Both the Naartok East and Suluk zones are capped by competent bodies of variolitic pillowed flows, impeding the penetration of auriferous fluids resulting in pinch and swell mineralized zones at the contact. Mineralization tends to utilize primary breccia textures created by sediment-volcanic interactions. These permeable horizons form favourable conduits for focused strain, fluid flow and concentration of auriferous fluids. The north-south trending Naartok East and Suluk lenses are interpreted to represent high strain zones associated with S2 fabric development or secondary structural splays related to the MDZ.

The Patch 14 deposit, located at the south end of Patch Lake along the Patch Lake trend, is bounded to the east and west by steeply dipping porphyry dykes. Strongly deformed basalts between the dykes host up to three quartz veins on both the upper and lower contacts and within the central basalt. Additional veining occasionally occurs within the eastern porphyry in related structural splays off of the MDZ. Any of the three veins within the basalt may be mineralized to varying extents (Newmont, 2011). High-grade mineralization forms a narrow shoot plunging steeply to the south. Auriferous veins appear to have formed through a combination of crack-and-seal processes and replacement of carbonate-sericite altered wall-rock adjacent to the vein margins. These processes have resulted in the incorporation of numerous dolomite, sheet silicate, and/or tourmaline filled septa into mineralized quartz-carbonate veins at their margins. Visible gold tends to be most abundant within the septa rich portions of mineralized veins. Mineralization is generally sulphide poor with approximately 2% pyrite occurring within mineralized septa in gold bearing veins and within the strongly altered wall rock adjacent to vein margins (TMAC, 2013).

Wolverine mineralization occurs 500 m west of Patch 14 mineralization, but is not considered part of the main Madrid trend. The vein is associated with the eastern edge of the Wolverine Felsic body and the contact with the mafic volcanics. The mineralization is thought to be controlled by the S-C shear fabric with the vein forming parallel to S2 foliation. The Wolverine Vein is quartz dominated with minor carbonates. It often contains dark quartz with textures suggesting recrystallization and is generally sulphide poor with up to 2% pyrite, locally. The vein commonly exhibits weak, centimetre scale alteration halos extending into the wallrock (TMAC, 2013).

The geology of the Madrid deposit area is illustrated in Figure 7-4.

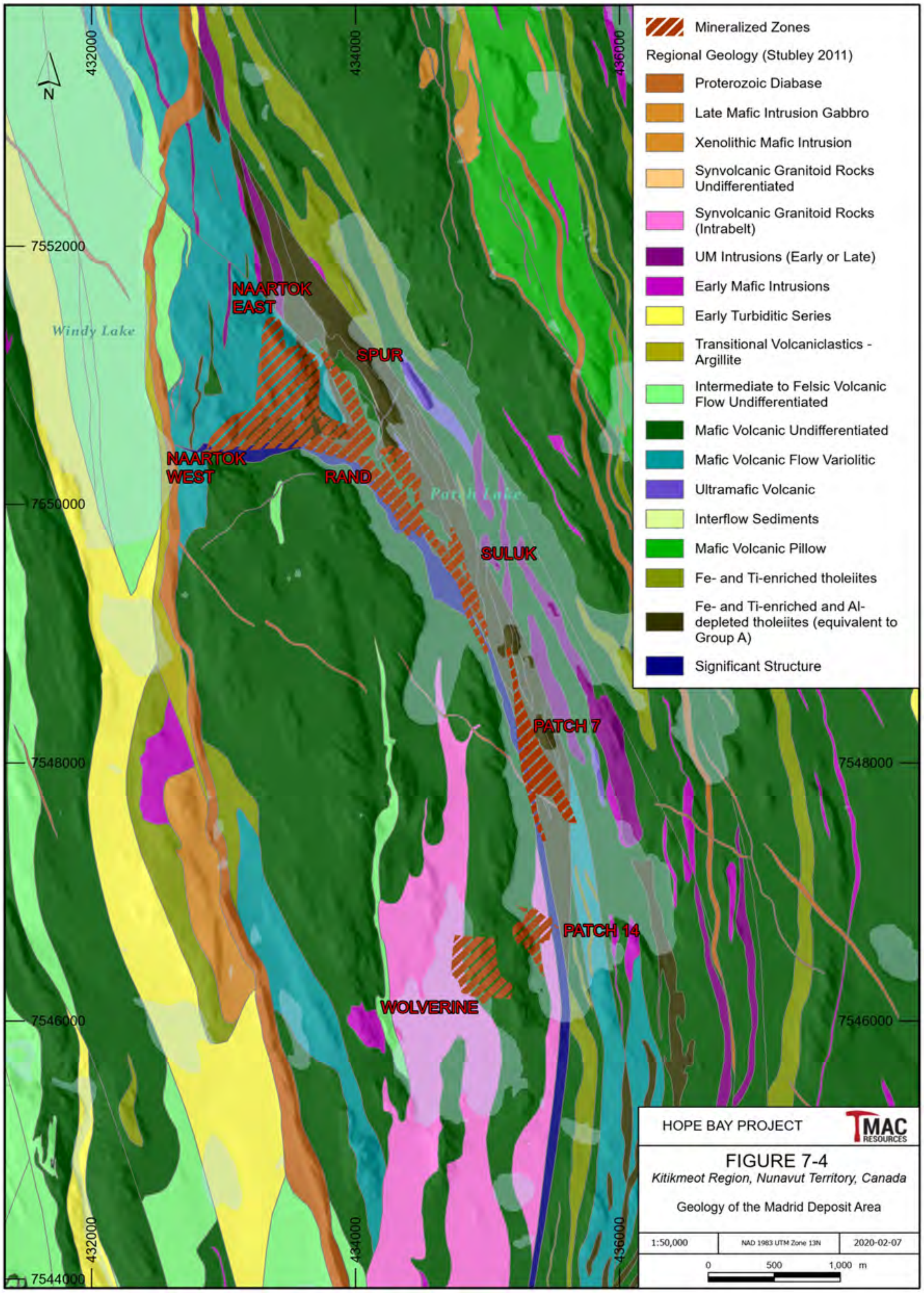


Figure 7-4. Kitikmeot Region, Nunavut Territory, Canada, Geology of the Madrid Deposit Area

GEOLOGY OF THE BOSTON AREA

The Boston deposit is located at the south end of the Hope Bay greenstone belt, approximately 55 km south of the Doris Mine. In general, the geology of the Boston deposit constitutes an anticlinal mafic-volcanic package enclosed by a younger sequence of sedimentary rocks, dominantly metaturbidites (Figure 7-6). The Boston deposit lies immediately to the west of the belt-scale Hope Bay Break, the principal structure of the region, with significant displacement in both the Archean and Paleoproterozoic (Stubley, 2017; Fingas, 2018).

The complexly folded geology of the Boston Deposit is interpreted as a large-scale synformal-anticline. This interpretation is based on facing directions recognized by graded bedding, bedding-cleavage relationships in the sedimentary rocks, and from pillow-tops indicators in the mafic volcanic rocks, all suggesting the mafic sequence youngs outward towards the metaturbidites in a broad anticlinal structure (Stubley, 2017). The tight fold geometry is well constrained by geological contacts mapped on surface and underground, and documented in drill core (Fingas, 2018).

A brief summary of the Boston mineralization will be presented below to accompany the geological descriptions in this section; for more details on Boston mineralization, please refer to "Gold Mineralization at the Boston Area". Boston mineralization has been subdivided into the B2, B3, B4, and B5 zones. Within this scheme, "B2" is the westernmost and most prominent zone, sitting roughly along the western contact between sediments and the volcanic package which hosts the Boston deposit (Fingas, 2018). The "B3" zone occupies the core of the volcanic package, and "B4" zone is a relatively small zone hosted on the eastern contact of the volcanic core. The "B5" zone comprises several mineralized horizons located south of the Newton Deformation Zone (Fingas, 2018).

In terms of the Boston deposit-scale geology, Fingas (2018) has identified 7 major rock types that can be broken into 13 distinct units based on texture and composition. Although most of the rocks in the Boston area are penetratively foliated, metamorphosed, and deformed, the prefix 'meta' is omitted from the following descriptions for brevity. The rock types are presented in order of oldest-to-youngest, based on stratigraphy, cross-cutting relationships, and overprinting relationships with the dominant fabric:

- A suite of dominantly fine-grained, variably coloured, mafic volcanic rocks, which make up the older core of the anticline, include:
    - Banded variolite: makes up the footwall to the B2 deposit and is typically characterized by a chaotic, tightly or broadly banded appearance. Varioles typically occupy dark bands and occur as mm- to cm-scale light-green ovals.
    - Coarse variolite: less common than the banded variolite, the coarse variolite was intersected north of main B2 area and seems more restricted in range. A typical interval of coarse variolite consists of broad (decimetre- to metre-scale), diffuse bands of dark green and grey green, and cm-wide varioles.
    - Finely pillowed mafic flow: texturally monotonous unit with decimetre-scale bands that represent flattened pillow selvedges.
    - Crackle breccia: best documented on the northeast edge of the anticline, just west of the Boston fault. The unit has a coherent groundmass that is overprinted by mm to cm-scale seams of black argillite and/or aphanitic siliceous material. These seams frequently show a characteristic 'jagged/jigsaw' form, and locally have a 'folded' appearance on a core scale. Sherlock et al (2012) suggest that this texture is the result of mixing basaltic flow and unconsolidated sediments.

- Mafic and sedimentary transition breccia: an interval of variably reworked, mafic dominated, epiclastic rocks marks the transition from the mafic volcanic rocks to the sequence of sedimentary rocks. The key characteristic of the transition breccia is a significant component of interstitial and/or matrix argillite, typically as bands. The distinction between mafic and sedimentary transition breccia is based on basis of clast support. A predominantly clast-supported breccia would be defined as a mafic transition breccia, whereas a matrix-supported breccia would qualify as a sedimentary transition breccia. The transition breccias at Boston host the bulk of B2 Zone mineralization as well as some of the B3 and B4 resources. Transition breccias appear to make an excellent host for mineralization (Sherlock et al., 2012; Fingas, 2018).
- Enclosing the volcanic package is a younger sequence of siliciclastic sedimentary rocks, which youngs outward from the core of the anticline, include:
  - Argillite: the distal sedimentary endmember of the Boston volcanoclastic mixing series, argillite is soft, fine-grained, and black. Many of the argillite beds contain a significant fraction of mafic fragments.
  - Turbiditic wacke-siltstone: the most proximal sedimentary unit at Boston. Wacke consists of a thick sequence of metre- to decimetre-scale graded and/or alternating beds of light (sand-sized) and dark (silt-sized) sedimentary fractions. No significant mineralization is known to be hosted within the wacke.
- Picrite: a fine-medium grained, equigranular, mafic / ultramafic intrusive unit that is commonly strongly fuchsite altered. The unit is the main host to B3 mineralization, and is currently described as a 'picrite', based on the strong fuchsite alteration and equigranular texture. However, it remains the most controversial and poorly understood unit at the Boston Deposit.
- South gabbro: a medium-grained, moderate to strongly magnetic gabbro, found to the south of the Newton Deformation Zone.
- Late felsic dykes: Also formerly known as the "Quartz-Carbonate Dyke", the late felsic dykes are non-foliated (locally flow-banded), fine-grained, and contain sharp contacts that cross-cut mineralization and foliation.
- Diabase: Late diabase dikes are evident at Boston as sharp linear magnetic anomalies. Drilling west of the Boston deposit has intercepted thick intercepts of diabase; diabase has not yet been found internally to the Boston anticline.

Stubley (2017) also documented a suite of mafic volcaniclastic rocks in the Boston area, with the distinctive feature of localized accumulations of fine quartz crystals, typically to 1 to 2 mm. The quartz clasts typically form resistant crystals on weathered surfaces but are commonly undetectable on fresh surfaces. Fine euhedral magnetite crystals are concentrated locally in some horizons. The suite is typically expressed as semi-massive fine- to medium grained variably chloritic rocks that have been mapped as "gabbro" previously.

In the Boston area, a single sub-vertical foliation is evident in most outcrops of the mafic sequence and is everywhere associated with a moderate to steep south-plunging lineation. The linear fabric is commonly of similar or greater intensity than the planar fabric (L-S tectonite). From regional considerations, this prominent foliation and lineation are ascribed to the pan-Slave D2 event; remnants of D1 are not identified in the mafic sequence but are likely evident in the turbidite. D3 elements, include steeply plunging minor folds of the dominant foliation and a crenulation cleavage is sporadically encountered in localized zones throughout the mafic rocks (Stubley, 2017).

At the Boston deposit scale, at least 5 major shear zones and 12 significant faults have been documented by surface and underground mapping and intercepts in drill core (Fingas, 2018).

These structures can be grouped into four distinct structural styles including: 1) ductile shear zones, 2) Brittle pre- to syn-mineralization faults, 3) Post-mineralization reverse faults, and 4) Post-mineralization strike-slip faults; as described below.

- Ductile shear zones:
  - Ductile shear zones of variable thicknesses defined by steeply-dipping, penetrative ductile fabrics play a significant role in channeling ore-forming fluids within the Boston deposit. Boston shear zones identified to date consist of 'northeast-striking' and 'south-southeast-striking' shear zones. The northeast-striking shear zones are roughly parallel to the Newton Deformation Zone and are characterized by geological contact offsets, truncation of mineralized zones, and by the presence of transition volcanics, which are commonly dragged into the shear zone (Fingas, 2018). Examples include the Newton Deformation Zone, Median Deformation Zone (MEDZ), "DDZ", and "TDZ".
  - As for the south-southeast-striking shear zones, the only example identified to date is the Cambridge Deformation Zone (CDZ). The CDZ represents a major shear and alteration corridor that wraps along the western transitional margin of the Boston anticline, and bounds both B2 mineralization as well as the Boston Deposit area as a whole.
- Brittle pre- to syn-mineralization faults:
  - Faults of this generation are commonly recognized in the margins of the Boston anticline, and are typically lined with argillite-rich fault gouge. These faults are pre- to syn-mineralization generation since they often host veins and mineralization, including instances of high-grade in graphitic gouge. Evidence for post-mineralization re-activation is also present, as evidenced by quartz vein fragment cataclasite. It seems likely that these structures are long-lived, multiply reactivated planes of weakness, and in some cases, syn-mineralization faults have subsequently been intruded by late felsic dikes (Fingas, 2018).
- Post-mineralization reverse faults:
  - This generation of fault is commonly documented in drill core as vein cataclasite, and mapped underground as roughly foliation-parallel reverse faults that offset mineralization and veins. Gerbert (1999) documents a variable amount of displacement along reverse faults, up to 30 to 40 m, west side up. The effect of this fault generation is to displace blocks, sometimes thickening the horizon, sometimes causing the horizon to disappear. Movement indicators are expressed by veins being dragged into the fault. The fault surfaces are often accompanied by 1 to 3 cm-thick zones of fault gouge, and sub-parallel, 1 cm-thick creamy-white quartz veins (Gerbert, 1999). Reverse faults are inferred to be post-mineralization based on a fault-fill phase of creamy-white quartz vein, which crosscuts mineralization.
- Post-mineralization strike-slip faults:
  - This generation of fault is defined by underground mapping in the B2 area and shows a fault pattern consistent with the development of a set of conjugate, steeply dipping, northeast- and northwest-striking faults. Such faults are documented to offset mineralized vein, which are described by Gerbert (1999) as the latest generation of faults that cleanly cuts all veins and rock types. Slickensides show dextral strike-slip movement with displacement of approximately 7 to 10 m. These faults appear to be quite extensive (traced for at least 200 m vertically) and are parallel to the northeast structures easily visible on the belt-scale aeromagnetic

map (Gerbert, 1999). This conjugate fault pattern is strikingly similar to the orientation of late faults at the Doris Mine (Fingas, 2018).

The geology of the Boston deposit area is illustrated in Figure 7-5.

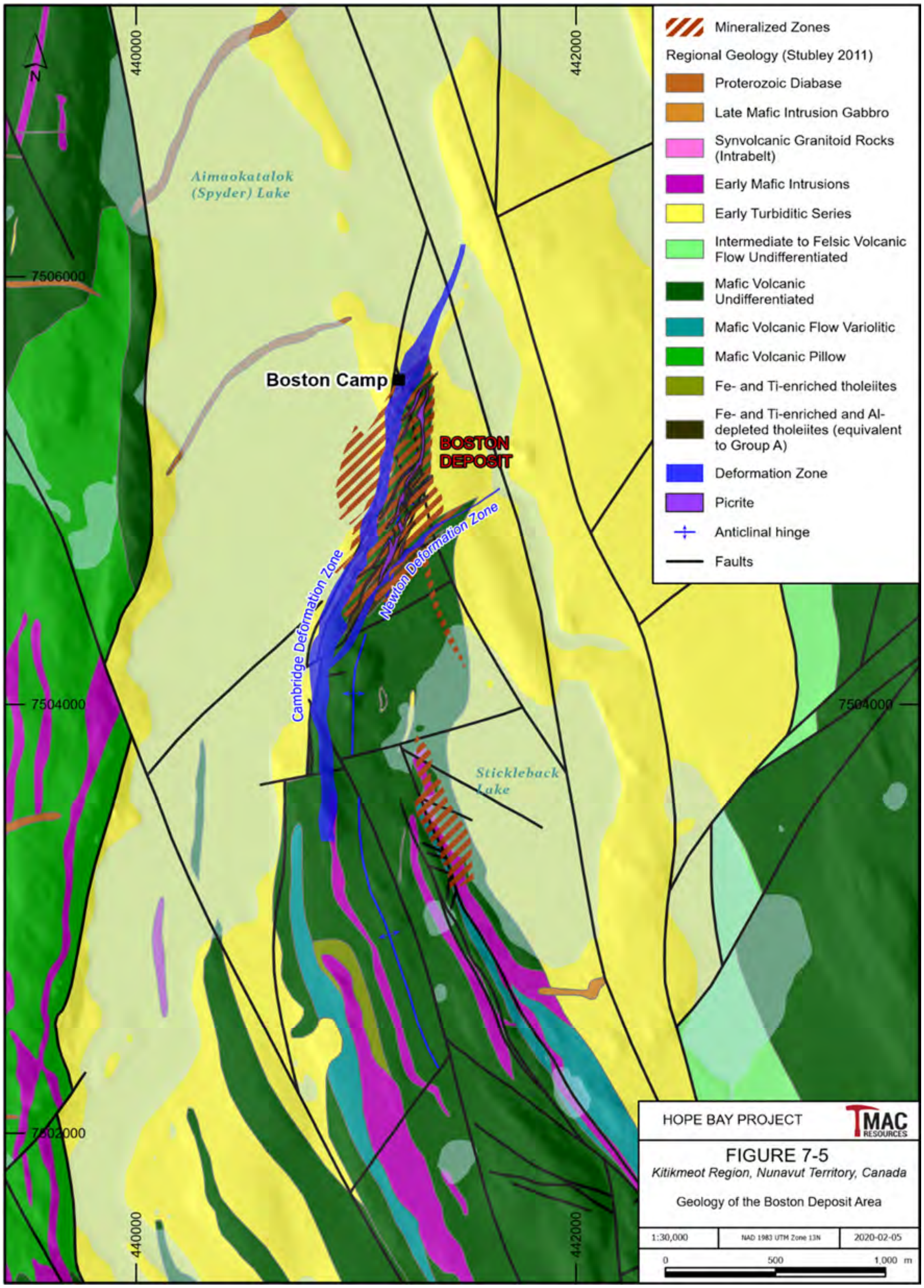


Figure 7-5. Kitikmeot Region, Nunavut Territory, Canada, Geology of the Boston Deposit Area

7.4 MINERALIZATION

GOLD MINERALIZATION AT THE DORIS AREA

The Doris Vein system is characterized by a series of north–south striking, sub vertical, gold-bearing, brittle-ductile structures that commonly host wide, stylolitic, ribboned, or bull quartz veins.

Within the veins, gold is commonly associated with narrow tourmaline chlorite septa oriented parallel to and along the vein margins. Veins are not consistently mineralized along strike. Gold is distributed throughout vein structure but is usually concentrated near the footwall side of the vein, where visible gold is relatively common. Gold mineralization includes visible and disseminated gold occurring primarily with quartz veins ranging from a few centimetres to approximately 10 m in scale. Visible gold includes coarse leafy free milling grains located along vein margins, tourmaline septa, and wallrock fragments which are commonly associated with pyrite. Gold is also associated with disseminated sulphides at the margins of the quartz veins, or with sulphide clusters within the vein. Occasionally, gold is present within brecciated zones adjacent to the quartz veins. Sulphide mineralization consists of trace to 2% pyrite, trace chalcopyrite, rare sphalerite, and pyrrhotite.

Since the 2015 PFS, individual historic vein nomenclature has been replaced by a composite hinge, east and west limb mineralization model grouped into six spatial sectors three ATD and three below. Exploration drilling and in the case of the DNO BTD development has outlined the vertical continuation of the three mineralization styles below the diabase dyke to a vertical depth of 600 m. Limited surface BTD drilling has failed to resolve any reliable marker horizons for a detailed displacement reconstruction.

The DNO is situated between surface to 100 m depth above the dyke (ATD) between 7559050N and 7559850N, while below the dyke (BTD) the East Limb (EL) and BTD Extension (BTD ext) continue northwards to 7560200 N with a major vertical down drop, below the dyke from 200-300 m vertical depth in the BTD EL down 100 m vertical to 300-400 m depth north in the BTD extension north of 7559950N (Figure 7-6). At Doris North ATD, the antiformal vein structure is comprised of a relatively consistent north-northeast trending, gently north plunging hinge. This high-grade vein structure continues for roughly 850 m in length from 7559050N to 7559850N, ranging from 40 m wide in the south to 10 m wide in the north horizontally across the hinge. The true thickness of the vein structure ranges from over 10 m to less than one metre horizontal thickness and averages between four to five m, thickest in the hinge and pinching down to its narrowest vertically below the hinge, and at its northern extent. On a true-thickness basis a large proportion of the veins at EL and BTD extension are below 1.5 m. A minority of the veins at both zones could be considered wide (>3 m.) The BTD Extension zone has returned high-grade intersections throughout the 2018-2019 exploration and infill programs and has now been defined over more than 300 m along strike. An unusually high proportion of diamond drillhole vein intercepts and development rounds have visible gold noted.

The DCO vein system is exposed immediately underneath Doris Lake ATD between 200-300 m vertical, between 7558000N to 7559000N (Figure 7-6). DCO EL and WL vein structures are subdivided into a north, central and south zones roughly along the interpreted fault block bounding east west structures, often denoted in the sill development by dog legs in the vein structure supporting the original drill indicated structural interpretation. The EL and WL veins often exhibit splay structures in the structural FW, a bifurcation in vertical section and plan creating a braided or weakly developed skeined morphology, incorporating altered wallrock inclusions but merging back into the singular vein structure in an almost pinch and swell type pattern. Where there is a

bend in the vein structure grade seems to be concentrated. Although the DCO vein structures average roughly 3 m in horizontal width, they locally exceed seven m, despite gold mineralization usually concentrated along narrow contact zones, preferentially on the west wall contact but not exclusively. Although grades are modest in comparison to the DNO, tonnes are relatively significant and grades appear to increase vertically, approaching the 50 m crown pillar beneath the lake.

The DCN overlaps with the DCO at 7558000N and is truncated by the Alpha fault on the southern boundary at roughly 7557500N ATD between surface and 300 metre vertical (Figure 7-6). The morphology of the Central Zone is intensely skeined with a relatively narrower structure in the EL position and highly variable shear hosted singular vein transitioning to a stringer zone that generally exceeds 20 m in thickness in the WL projection. The WL projection, although a relatively wide zone has a narrow high-grade structure along the west contact with reasonable continuity plunging to the south coincident in the widest intervals of mineralization. Veining consists of numerous metre scale veins with wallrock inclusions over a three metre to five metre interval but can exceed 15 m in width in some intervals. Grade appears to be best developed where skeined structures are most intensely developed and vein orientation is dramatically altered.

The BTD DCO and DCN resources are limited by sporadic drilling from surface intersecting mineralization down to 650 m vertical in two resource groupings centered at 7557600N in the DCN and 7558900N in the DCO (Figure 7-6). Other isolated unclassified intercepts BTD require additional follow-up deep drilling from surface or development of underground drill platforms stepped back west from the main access ramps to provide reasonable intersection angles.

The mineralization of the Doris deposit is illustrated in Figure 7-6.

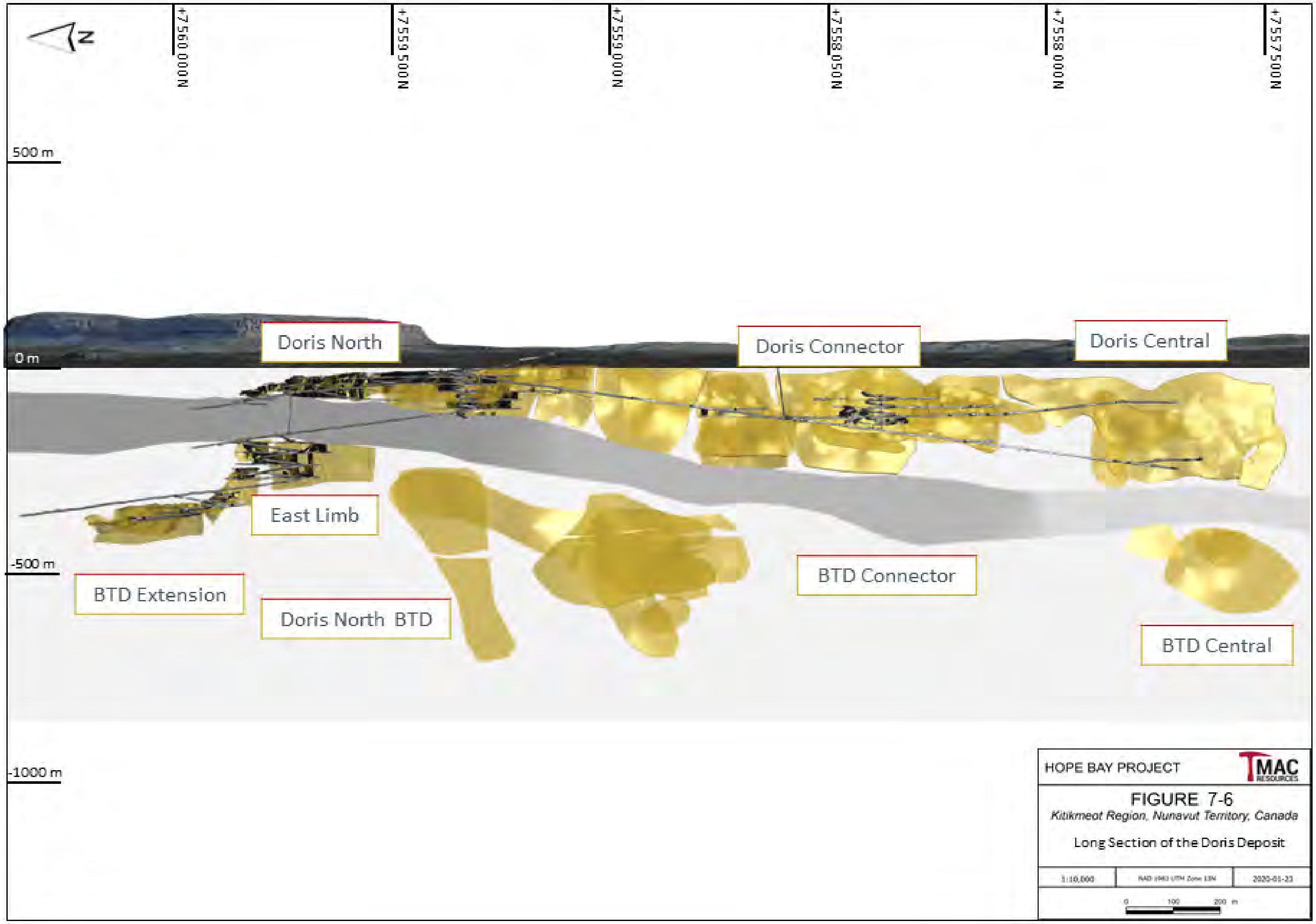


Figure 7-6. Kitikmeot Region, Nunavut Territory, Canada, Long Section of the Doris Deposit

GOLD MINERALIZATION AT MADRID AREA

The following description of gold mineralization at Madrid is updated from the RPA (2015), reflecting additional drilling in 2014-2019.

The gold mineralization within Naartok West, Naartok East, Rand, Suluk, and Patch 7 consists of quartz-carbonate stockwork veining, which overprints dolomite-sericite-albite-pyrite altered mafic volcanic rocks of the Patch Group. The gold mineralization is characterized by multi-stage brecciation and alteration with at least two separate gold mineralization events. Gold occurs within north-northeast, east, southeast, and north-northwest trending brecciated and carbonate altered zones and is associated with disseminated pyrite which has replaced brecciated mafic fragments.

NAARTOK WEST ZONE

The Naartok West zone consists of two main mineralized lenses (Figure 7-7). These two mineralized zones have been labelled the Naartok West (NW) and Naartok West Hanging Wall (NWHW) zones. The NW zone comprises the lower structural/stratigraphic lens which sits in the immediate hangingwall of the MDZ with a strike length of approximately 600 m and dips 70° to the north (Figure 7-8). It consists of lenses a primary main zone (lens 10) which is between 10 and 25 m thick. It is in the immediate hangingwall of the MDZ and reaches its maximum thickness as it comes to surface. Additional mineralized lenses (zones 27, 12, 13, 11) splay off the main zone below -200 metre elevation, are between 2 and 5 m thick with variable strike lengths.

The NW zone lithology is very distinctive in the core as it exhibits a cryptocrystalline texture resulting from strong silicification and albitization. The NW lens is translucent grey to brown to white in colour and has a “dirty looking” appearance likely due to fine grained disseminated sulphides and gold. Gold bearing quartz ± carbonate veins at or near the hangingwall contact with the MDZ are commonly associated with the lens.

The NWHW lens is located within the hangingwall of the NW zone and consists of two low-grade lenses (28 and 30) with localized high-grade shoots within them. They trend northeast from the western extent of the NW zone for 400-450 m. Zone 30 has an average thickness of 10-12 m, while zone 28 broadens up to 50 m and encompasses several shoots of high-grade. With a near vertical sense of dip, the NWHW terminates against the north dipping NW zone at approximately 100-200 m depth (west to east). In general, the NWHW lenses are less continuous and associated with a weaker tenor of mineralization. The NWHW lenses are characterized by strong sericite-paragonite and iron carbonate alteration with millimetre to centimetre scale quartz veins. Overprinting these veins are secondary quartz-dolomite veins that form a “crackle breccia” texture. Visible gold is commonly observed within the narrow quartz-dolomite veinlets and within an earlier veining phase. Pyrite content is variable and is commonly observed as fine grained disseminations within the basalt, to subhedral and medium grained within the quartz veining, and is positively correlated with gold mineralization. Larger (less than 1 metre) gold bearing white quartz veins are also associated with the NWHW lens.

NAARTOK EAST ZONE

The Naartok East zone has a north-northeast strike with a moderate northwest dip (Figure 7-9). It consists of zones 1-9. The main orebody, zone 1, has a SSW-NNE orientation with strike length of approximately 500 m and a concave west curvature. Zone 1 extends to a depth of at least -600 m elevation, with thicknesses ranging from 5-20 m, generally thickening towards the surface. Zones 2-9 are splays off of zone 1 and are sub-parallel with an average thickness of 5 to 15 m.

The most significant splay, Zone 2 splays off of Zone 1 at the mid-point of its strike length and trends NNW with a similar western concavity. This zone broadens to 15 m near surface. All Naartok mineralized zone are capped by a competent body of variolitic pillowed flows that impede the penetration of auriferous fluids, resulting in pinch and swell mineralized zones at the contact. North-northwest trending structures intersect the permeable horizon forming flow conduits which localize the development of the mineralization horizons. Mineralization lenses thicken adjacent to undulations within the capping variolitic pillowed flows. These structures are possibly related to the development of a strong axial planar foliation or secondary shear zones. Narrow intersections of gold grades at depth suggest a steepening of the mineralized system parallel to the structural fabric. Mineralization is hosted within a noticeable stratigraphic horizon of mafic volcanics with intercalated sediments utilizing primary breccia textures created by sediment-volcanic interactions. Mineralized zones occur within distinctive zones of strong sericite, silica alteration, brecciation, localized hematite alteration and strongly disseminated sulphidization.

RAND ZONE

The Rand zone (Figure 7-7, Figure 7-10) is roughly west striking and north dipping and occurs east of the Naartok East zone. Rand zone mineralization is hosted within A-type volcanic, gabbroic, and graphitic argillic rocks, which are weakly to strongly brecciated. The Rand zone is similar to the Naartok East A1 lens with respect to its moderate to intense sericite/dolomite ± albite ± silica alteration and pyrite content. Like the Naartok East zone, the Rand zone is typically terminated at a strongly siliceous and locally graphitic argillaceous unit.

SULUK ZONE

The following description of Suluk Mineralization is modified from RPA (2015) and RPA (2017).

The Suluk zone is located southeast of the Rand zone (Figure 7-7). The Suluk Deposit consists of 32 anastomosing mineralized lenses which are divided into three distinct zones (Figure 7-11). The Suluk Central zone (primary orebody,) the satellite deposits in the Suluk East zone and the Suluk South zone. The Suluk Central zone consists of mineralization immediately adjacent to or within the Madrid Deformation Zone. The Suluk East T2-HW or West lens consists of the pyrite mineralization associated with dolomite/silica/sericite alteration with local wormy sub-centimetre occasionally hematite bearing veins. Visible gold may be observed within these veins.

The main mineralized lens is the Suluk Central zone. This lens is brecciated and consists of a silica/sericite/dolomite-flooded mafic volcanic mixed volcanoclastic zone, with the host rocks replaced by locally up to 40% very fine grained pyrite. This flow is bounded by black argillite interflow/intraflow sediments to the west and a visually distinct spilitized flow to the east. The Suluk East lens is very similar in character to the Suluk Central lenses but is more poorly developed and less explored. Similarly, the Suluk South zone is located 300-400 m south of the Suluk Main zone and also consists of mineralization immediately adjacent to the Madrid Deformation Zone

Within the 32 lenses, four types of mineralization styles are present at Suluk:

- Structurally controlled disseminated mineralization in and adjacent to anastomosing brittle faults. Mineralization of this type typically crosscuts bedding at low angles, with brittle, frequently graphite-lined faults apparently acting as conduits for mineralization. Coherent gold-bearing quartz-carbonate veins up to several metres in thickness may be developed adjacent to the faults often associated with intense hematite alteration. The bulk of the mineralization however, occurred as disseminated to (rarely) semi-massive sulphides with several generations of associated quartz stringers and strong alteration (quartz flooding,

hematite, and sericite). This disseminated zone may be up to 20 m wide (more typically 5-10 m), with grades typically decreasing away from the controlling fault. The best grades are usually associated with the strongest alteration and highest sulphide contents, and the presence of ghostly grey to brown quartz-veining. Host lithology strongly influences the thickness and grade of these zones, with the highest grades developed within transitional mafic-sedimentary "breccia" units. Where faults cut through other lithologies (PGP, variolitic volcanics, etc.) grades and thicknesses are typically much diminished. Examples include zones 1001, 2001, 2002, 6001, and 7003. This is best displayed in Suluk Central.

- On the margins of ductile shear zones, with grade typically occurring outside of, but adjacent to, sheared material. Mineralization is typically fairly weak, and occurs as disseminations, stringer zones, and occasionally coherent veins developed next to sheared wall rock. These zones are frequently associated with brittle faulting and graphitic gouge, and some of this mineralization may have formed when late faults propagated along the weak interface between sheared and unsheared rock. An example would be zone 3001. This style is most prominent in zones adjacent to the MDZ.
- Foliation-discordant "ladder vein" sets forming pipes of mineralization with relatively competent blocks of rock sandwiched between them. These pipes generally consist of swarms of irregular white quartz veinlets at various orientations; these may follow or crosscut foliation, are typically less than 10cm wide, and may achieve densities of 20 veinlets/m or more in core. These brittle zones are usually tightly bounded by sheared and intensively sericitized wall rock. In spite of abundant veining, grades are tightly bounded by sheared an intensely sericitized wall rock. In spite of abundant veining, grades are typically fairly low, but some pod-like sections are relatively wide (up to 15 m) and may be amenable to bulk mining. This style of mineralization has so far only been recognized in the Suluk Central Zone. An example would be zone 4002.
- Two minor zones which could not be clearly characterized but seem to follow stratigraphic contacts (both closely parallel the PGP and may relate to shear/fault propagation and veining along weak stratigraphic layers. These zones are 5001 and 5002.

A generalized section of the mineralization at Suluk is illustrated in Figure 7-11.

PATCH 7 ZONE

Patch 7 zone is located adjacent to the MDZ approximately four km south of the Suluk. Gold mineralization style is similar to Suluk and is spatially associated with the main strand of the MDZ, smaller splaying shear zones, faults and sedimentary/volcanic contacts. The main distinction is that south of Suluk, the Patch Volcanics have a much higher proportion of intercalated sediments (argillites, greywackes). Brittle strain has been concentrated at the sedimentary/volcanic contacts and resulted in broad zones of sericite alteration and disseminated sulphides.

Four distinct horizons have been identified at Patch East and Patch West. Patch West is a single zone located directly in the hanging wall of the MDZ contained in a broad zone tectonically brecciated mafic volcanic unit. The zone is characterized by pervasive sericite alteration and stockwork quartz veining, locally up to 1m thick. The Patch East zone consists of a main lens of mineralization and two smaller splay zones. The main zone, furthest east, is located on the eastern margin of a package of sediments intercalated with lesser volcanics. Mineralization is associated with brittle faults and strong pyrite mineralization. Veining is on the 0.5 to 2m scale and is observed as both large coherent quartz veins and quartz filled breccia zones. Both smaller splay zones at Patch East are at the contact of a major splays of the MDZ and characterized by pervasive sericite altered volcanics, abundant stockwork quartz veining and disseminated pyrite mineralization. Despite the Patch Zones being continuous over large strike lengths (up to 1.5km),

south-plunging ore-grade shoots are restricted to intersections of mineralized structures and areas of complex strain partitioning.

PATCH 14 ZONE

Patch 14 is located adjacent to the MDZ approximately four km south of the Suluk zone (Figure 7-7 to Figure 7-12). Gold mineralization is hosted within a zone of moderately to strongly carbonate-sericite altered mafic volcanic rocks and narrow intermediate porphyry dykes (Wolverine porphyry dykes). This moderately to intensely strained zone is wedged between two wider (±20 m), thick dykes of porphyry. Mineralization occurs as visible gold and disseminated pyrite hosted within massive bull quartz and quartz-carbonate veins. At least three sub-parallel veins have been identified which exhibit a north-south strike and steep (80°) dip to the west.

The West Vein is the most significant structure at Patch 14 and has been traced discontinuously along strike for 400 m; however, the mineralized portion has only about a 100 m of strike extent. The East Vein extends for approximately 80 m along strike and closely resemble Suluk style mineralization, being closely associated with graphite layers and intercalated sediments. Mineralization of both veins is open down a steep southerly plunge (about 70°) and along strike at the depth. Drilling to a depth of 400 m level below the bottom of Patch Lake has intersected multiple veins and gold mineralization. The main quartz lenses appear to be steep, southerly plunging bodies that appear to be open at depth.

A generalized section of the mineralization at Patch 14 is illustrated in Figure 7-11.

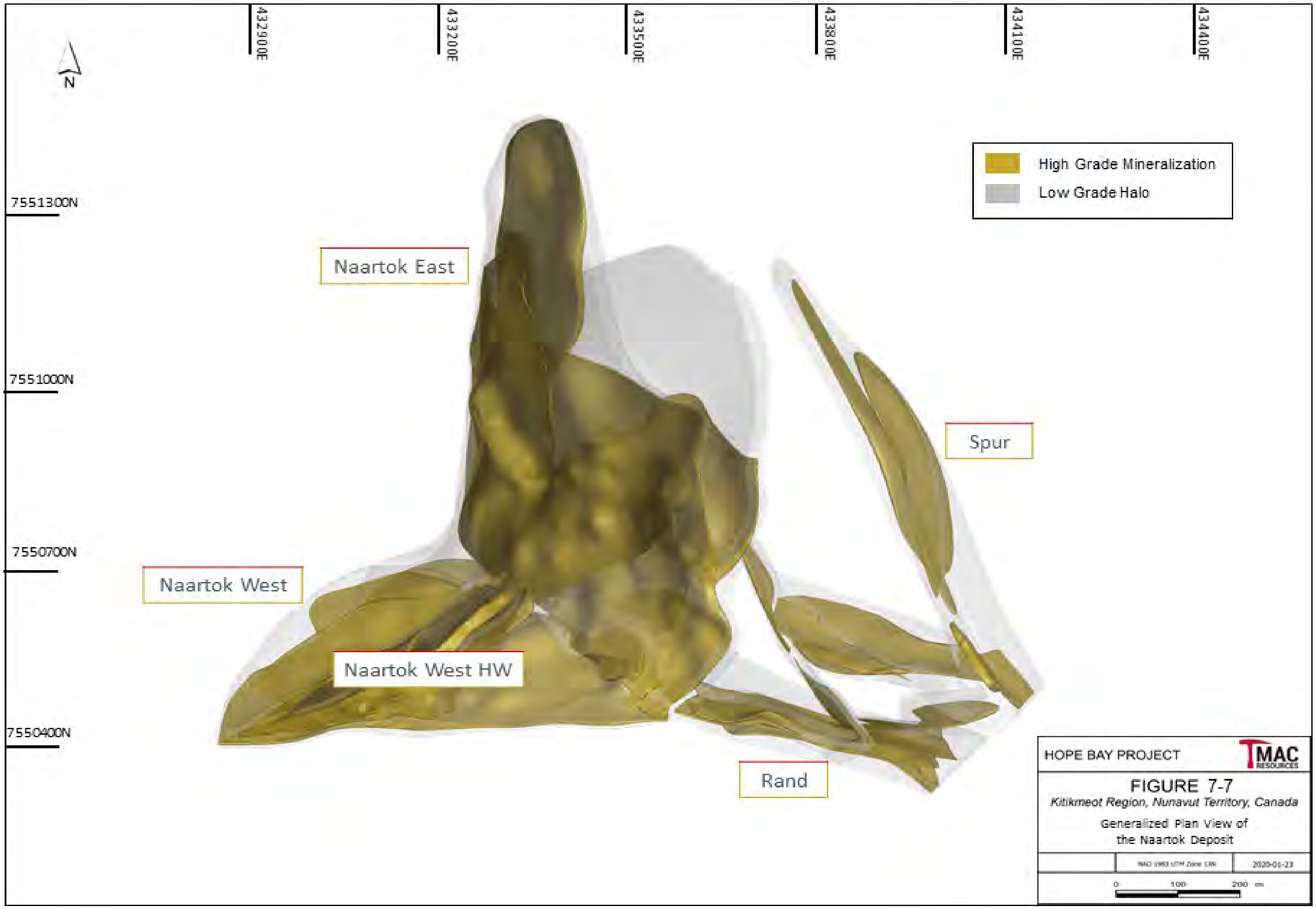


Figure 7-7. Kitikmeot Region, Nunavut Territory, Canada, Generalized Plan View of the Naartok Deposit

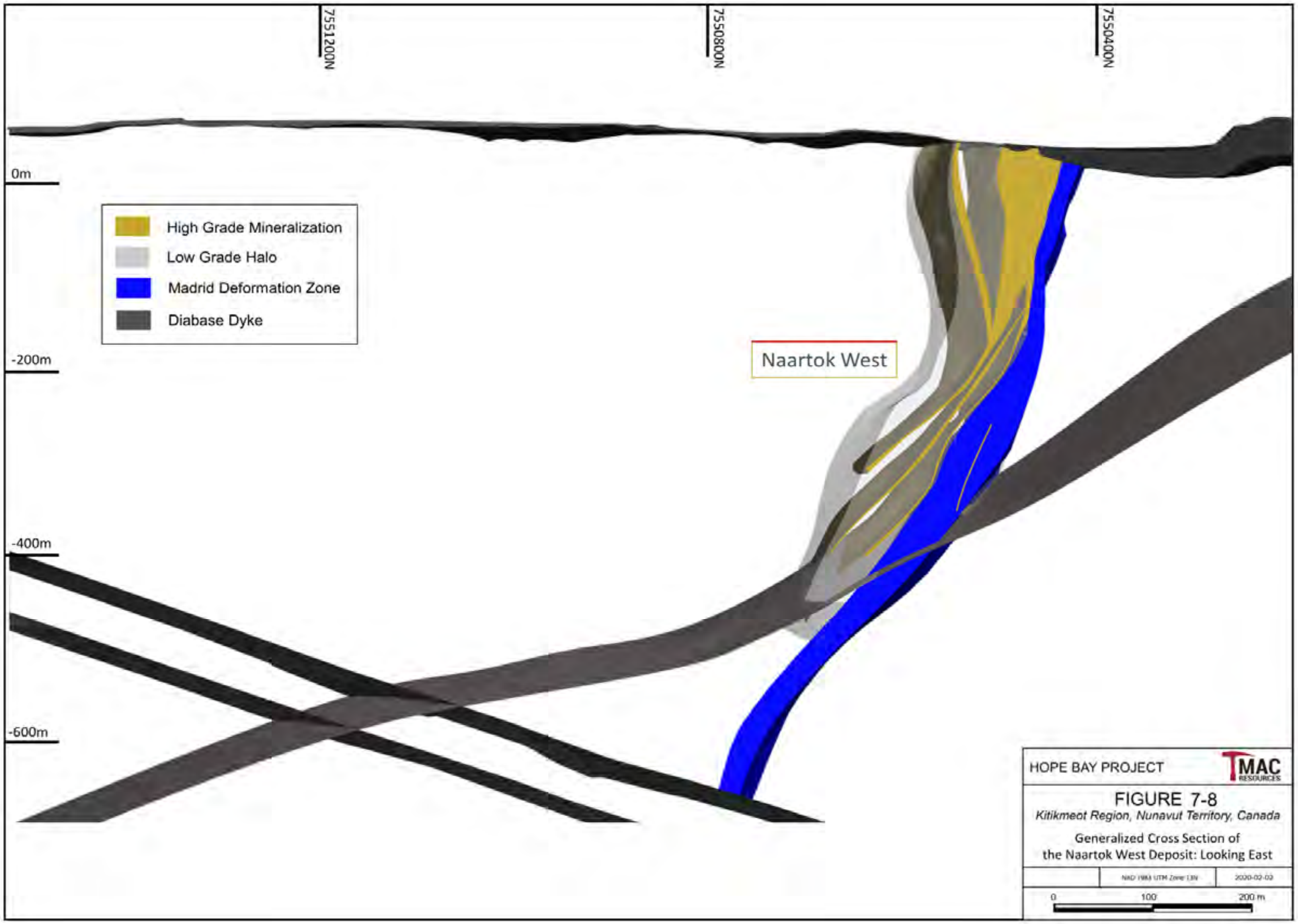


Figure 7-8. Kitikmeot Region, Nunavut Territory, Canada, Generalized Cross Section of the Naartok West Deposit: Looking East

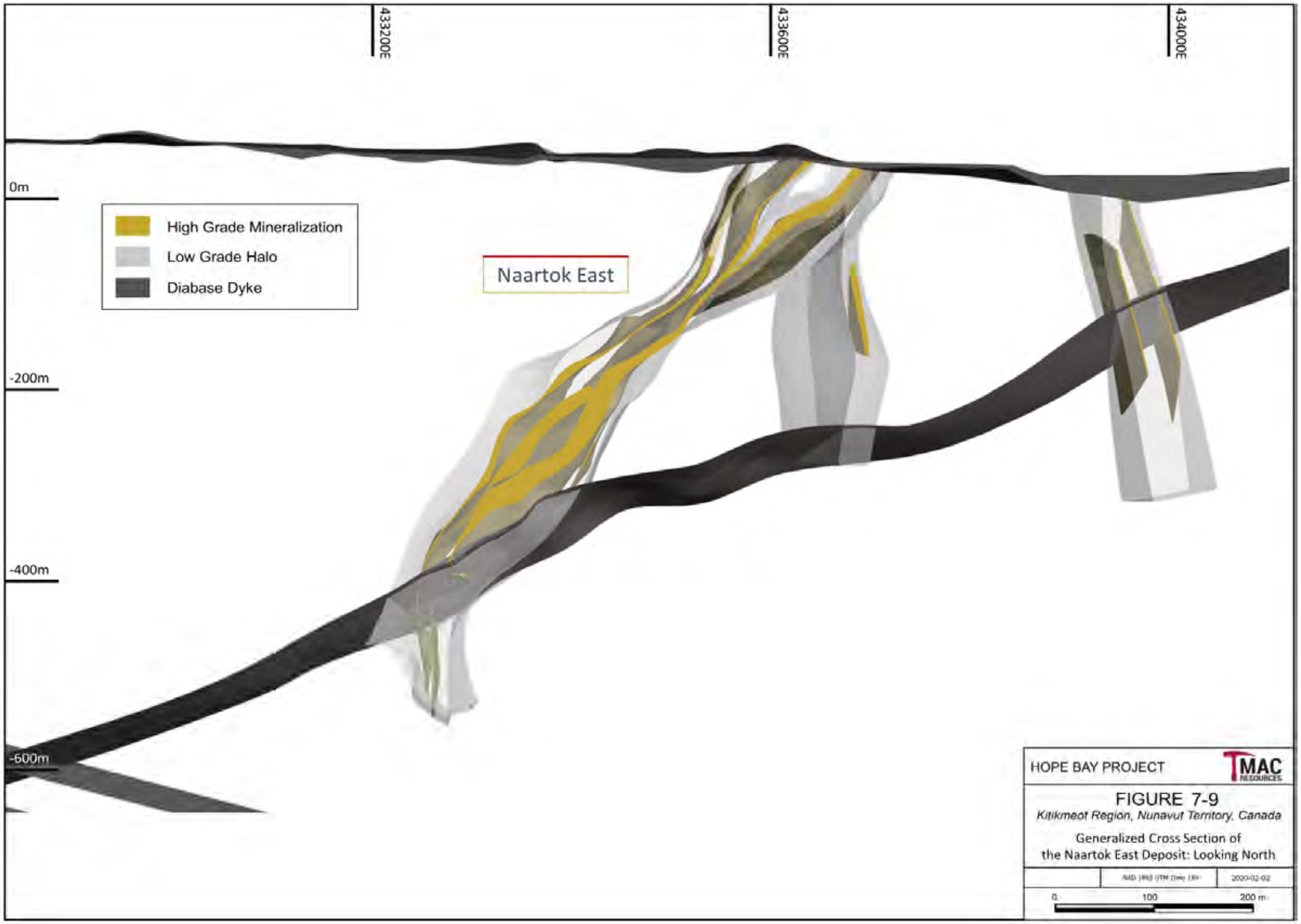


Figure 7-9. Kitikmeot Region, Nunavut Territory, Canada, Generalized Cross Section of the Naartok East Deposit, Looking North

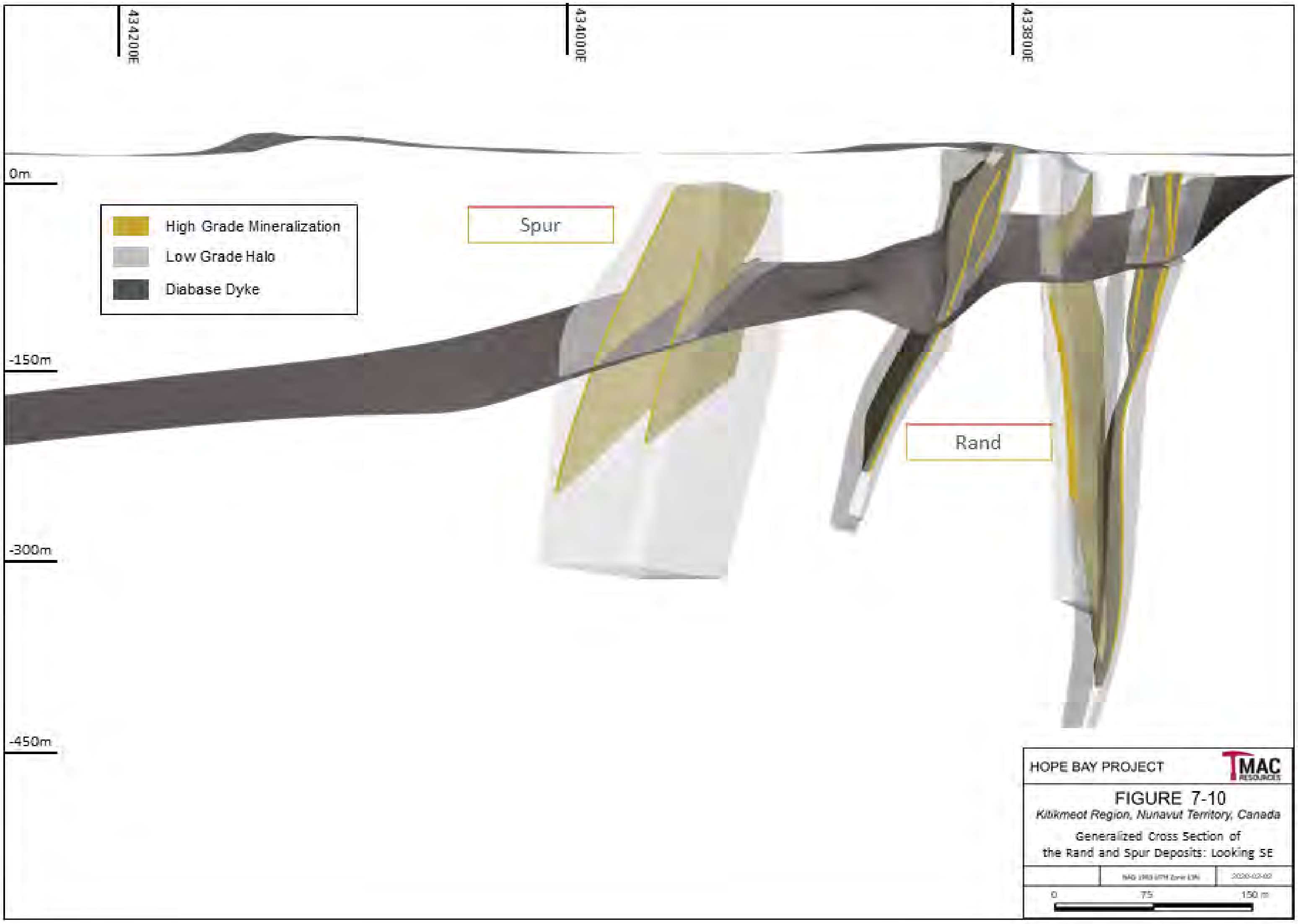


Figure 7-10. Kitikmeot Region, Nunavut Territory, Canada, Generalized Cross Section of the Rand and Spur Deposits: Looking SE

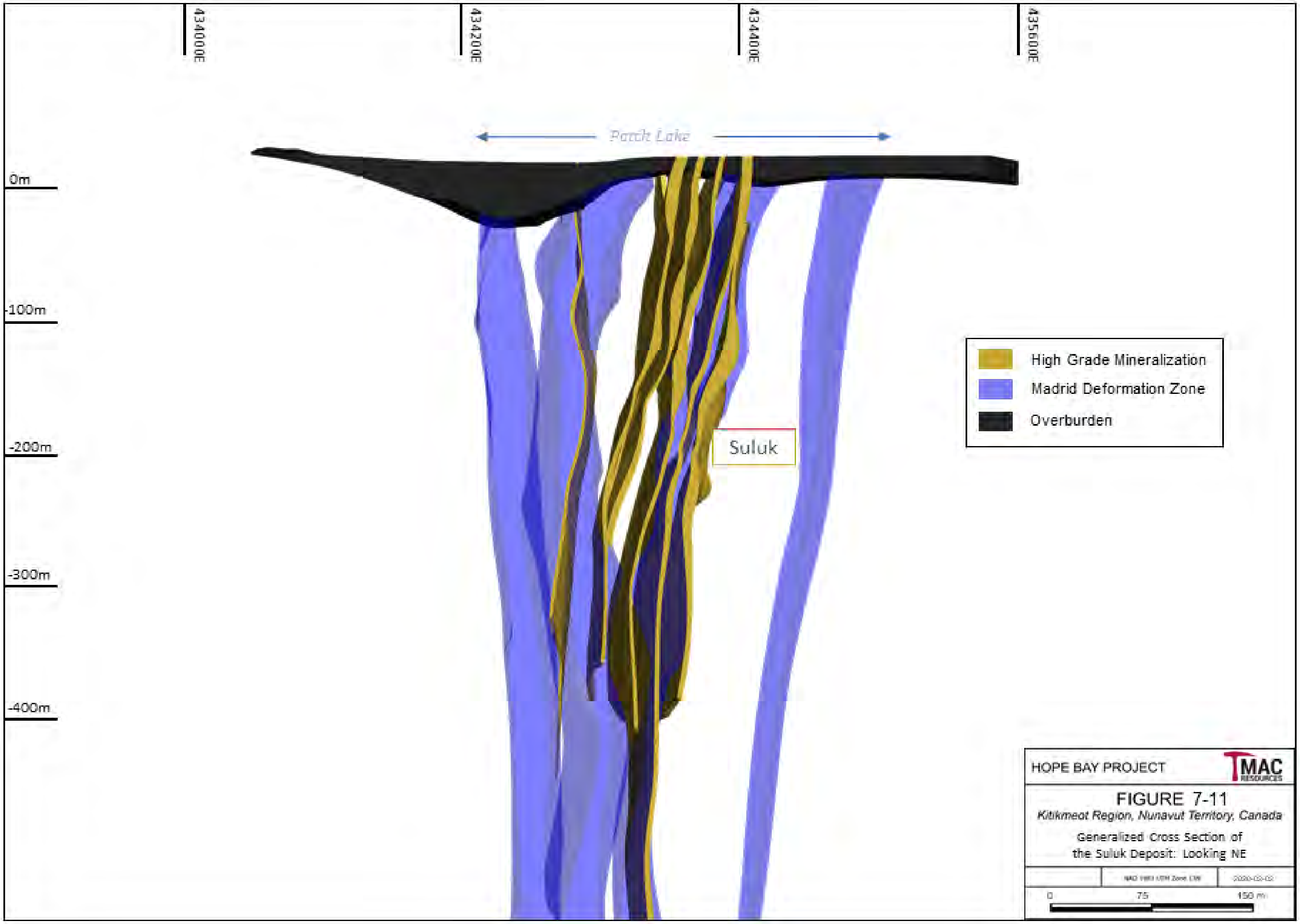


Figure 7-11. Kitikmeot Region, Nunavut Territory, Canada, Generalized Cross Section of the Suluk Deposit: Looking NE

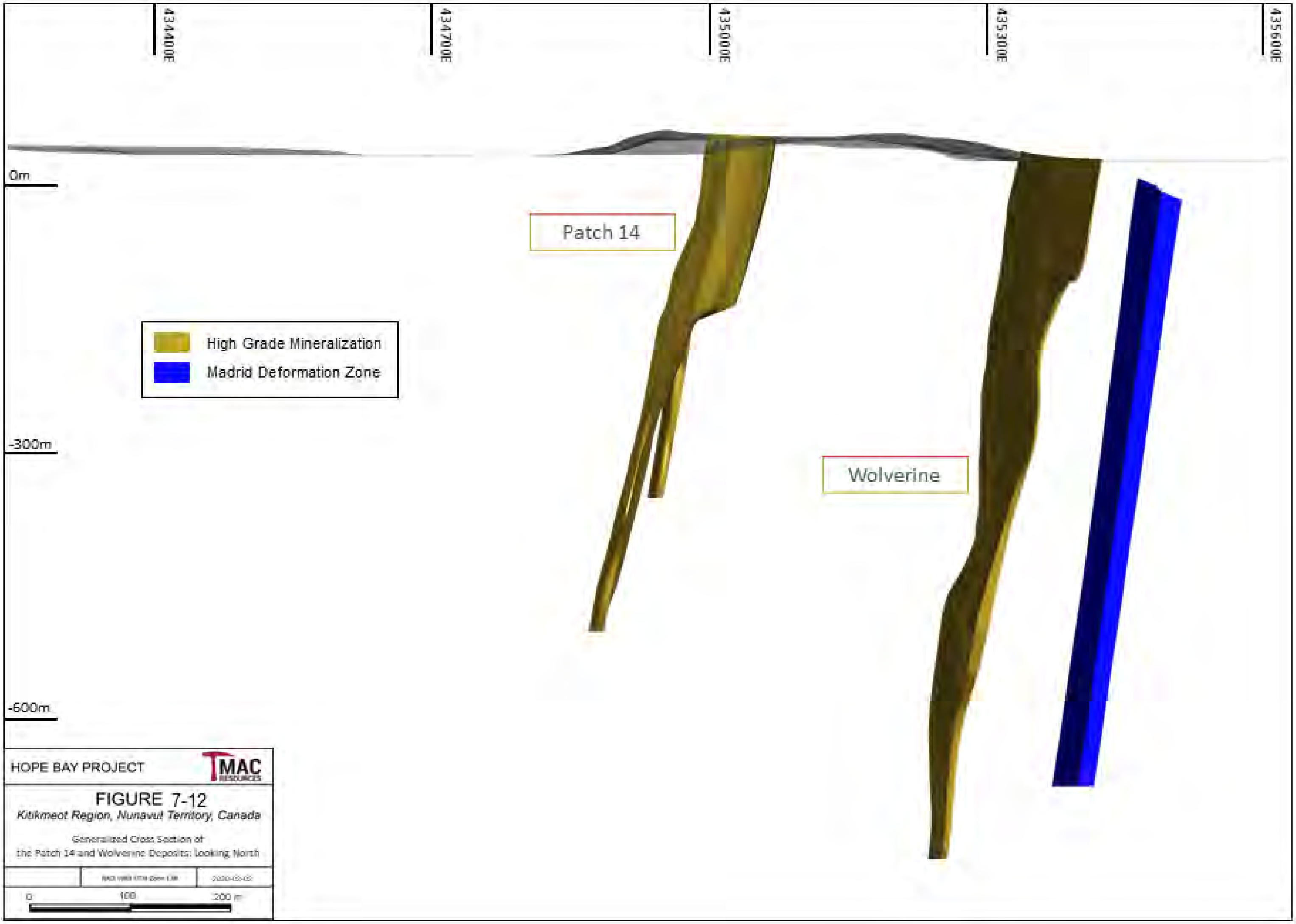


Figure 7-12. Kitikmeot Region, Nunavut Territory, Canada, Generalized Cross Section of the Patch 14 and Wolverine Deposits: Looking North

7.5 GOLD MINERALIZATION AT THE BOSTON AREA

Four significant zones of gold mineralization have been identified at Boston, which include the B2, B3, and B4/B5 zones. This purpose of this section is to discuss these mineralized zones in more detail, and then describe the styles of mineralization within the Boston deposit.

B2 ZONE

The strongest mineralization in the Boston deposit is found within the B2 zone, particularly the section investigated by the underground workings. The B2 zone contains 885,000 ounces of Measured and Indicated gold, 81% of the Boston Mineral Resources, and a further 202,000 ounces of Inferred gold. The B2 zone has been intersected to a depth of 1,000 m, with the highest grades located in the central part of the zone. Fingas (2018) compiled the following list of possible structural and geological controls to help explain why the B2 zone is so favourably mineralized compared to the rest of the zones:

- The B2 zone occurs directly adjacent to the Cambridge Deformation Zone a major, long-lived ductile shear and alteration zone that likely provided the significant deep fluid source; and over time, produce the prolific B2 zone.
- The B2 zone also lies within a geologically complex package of host rocks, including transitional breccias, argillite and relatively coherent mafic volcanics. This geological complexity provides an area with significant competency and chemical contrasts, favourable for trapping gold dissolved in ascending hydrothermal fluids.
- Steeply south-dipping ore shoots observed in the B2 zone are primarily related to the F2/F3 intersection lineation and dilation developed along these structural intercepts. F2 fold hinge measurements indicate that hinge-parallel shoots would likely be flatter than most ore shoots developed in the B2 zone, however, these may be a secondary control.

The B2 zone has been sub-divided into five sub-zones, or lenses: 200, 210, 220, 240, and 260. These lenses extend 50 m to 70 m along strike and have been traced for approximately 300 m vertically.

B3 ZONE

Compared with the B2 zone, mineralization in the B3 zone is less continuous and lower grade. The B3 zone contains 153,000 oz of Measured and Indicated gold, approximately 14% of the Boston Mineral Resources, and 46% of Inferred Resources, totaling 241,000 oz Au. Controls on mineralization within the B3 Zone is significantly different to those in the B2 zone, and include:

- Most B3 mineralization is hosted within or adjacent to the picrite unit within contact-parallel veins and shear zones, as well as in internal breccias.
- B3 mineralization is strongest parallel to northeast-striking shear zones. Ore shoots within picrite, mineralization parallel intercepts with the northeast shears, with strong shoots developed on both contacts of the Median Deformation Zone. Mineralization also forms in shear margins, where it occurs as heavily sericitized sulphide rich shear bands.

B4 / B5 ZONES

The B4 and B5 zones are the smallest of the three main Boston ore zones, hosting less than 5% of Measured and Indicated resources. The B4 zone is a relatively small zone hosted on the

eastern contact of the volcanic core, while the B5 zone comprises several mineralized horizons located south of the Newton Deformation Zone. Controls on B4 mineralization include:

- The most continuous B4 domain is hosted directly within Boston Fault, with the thickest mineralization developed at the intersection of the Boston Fault with the CDZ, in the northern tip of the Boston Deposit. Some B4 mineralization is hosted within F2 axial planar brittle faults. Intersections of F2-parallel faults with other structures are known to localize ore shoots within the B4 domain.
- B4 mineralization is also hosted within northeast-striking faults and shears, including along the north contact of the Newton Deformation Zone, along the south MEDZ contact, and mineralization hosted in brittle northeast faults. Most B4 ore shoots are narrow, steeply dipping rods, at the intersections of northeast-trending structures and F2 axial planar faults.

Control features on B5 mineralization have seen little investigation, although they are suspected to be similar to controls within the main deposit area. Zones documented to date are hosted in brittle faults, along the south margin of the NDZ, or else associated with the south gabbro (Fingas, 2018).

With the mineralized zones now defined, the following section will provide descriptions of the styles of mineralization found within the Boston Deposit. Fingas (2018) recognizes at least 6 styles of mineralization in the Boston deposit, which include:

- VEIN STRINGER SETS HOSTED IN TRANSITION BRECCIA

  This is the most important mineralization style in the B2 zone and has been exposed in underground drifts. Mineralization consists of sulphide-bearing quartz-carbonate veins, typically hosted in both volcanic- and sediment-dominated transition breccia. Zones are typically planar, from 2 to 10 metre wide, with ore shoots plunging steeply to the southwest (e.g. ore shoots within the B2 zone with an apparent plunge of 77° to 225°). As documented underground, domains are generally a chaotic mixture of veins (typically making up 25 to 50% of the domain) and altered wallrock. Veins commonly occur as discontinuous and irregular sheeted sets subparallel to the dominant bedding/foliation plane. However, vein geometries are complex and includes irregular, warped, branching, folded, brecciated and blown-out forms. Veins mapped underground show strong evidence of having formed during progressive deformation, with strong influence by a later northeast-directed event. Wallrock within these domains is strongly carbonate-sericite altered, with up to 10% pyrite. Both veins and wallrock material carry gold within these zones, with statistical analyses indicating that the sediment-dominated transition breccia is a particularly consistent host rock (Fingas, 2018).

- DISCRETE VEINS AT GEOLOGICAL CONTACTS

  Mapping in the Boston underground workings indicates that larger, more continuous vein domains are frequently developed along geological contacts. In contrast to the discontinuous veining developed in stringer zones, contact-parallel veins are thicker (0.5 metre to 3 metre) and continuous for tens of metres along strike and down-dip. Veins appear to wrap tightly along contacts, including simultaneous folding of veins and the associated contact. The upper and lower contacts between transition units and more competent rock types, are particularly favourable locations for mineralization. In the B3 zone, the development of veins occur along picrite contacts; as discussed further below.

Most contacts at Boston show strong evidence of being tectonized, leading to confusion between contact-hosted and fault-hosted veins (Fingas, 2018).

- FAULT-HOSTED VEINS

  Examination of drill core shows many vein intercepts to be shouldered by rubble and/or fault gouge; this gouge is frequently argillaceous or chloritic in composition. Fault-hosted vein domains have been documented across the Boston deposit, in a variety of orientations. Continuous F2 axial planar vein domains, associated with argillite bands, bound the east and west contacts of the Boston anticline (B4 and B2 zones respectively). A distinct style of northeast-trending fault veins is documented cross-cutting geological contacts throughout the B2, B3 and B4 zones (Fingas, 2018).

- SHEAR-HOSTED MINERALIZATION

  The majority of mineralization at Boston is directly related to quartz-carbonate veins, either hosted directly within veins or else hosted in wallrock adjacent to veining. However, occasional zones in the B3 area were found to lack substantial veins in drill core, with gold instead being hosted in altered shear zones. The host rock for such zones is typically transitional breccia; however, such zones are not necessarily shear foliation-parallel, as transition material may be transposed into the shear zones. Shear zones typically have a banded appearance, with high sulphide content (including both pyrite and rare arsenopyrite), and strong sericite-ankerite alteration. Quartz-carbonate stringers may also occur, but are typically a relatively minor component (less than 10%; Fingas, 2018).

- VEIN DOMAINS AT PICRITE CONTACTS

  Picrite is the predominant host of mineralization in the central B3 zone. The most consistent mineralization associated with the picrite bodies is continuous, well-developed vein domains along the margins of bodies. These domains differ in several ways from the contact-hosted veins domains seen elsewhere. Volumetrically, these domains frequently are thick and quartz-carbonate rich, often with large intervals of bull-quartz and solid veins of Fe-carbonate. The vein style is more brittle than that observed elsewhere, dominated by breccia features and relatively little evidence of shearing. Where shearing is present (e.g. where transition material abuts picrite), sheared intervals may carry significant grade. Sulphide content and wallrock interaction also seem lower overall, although locally strong alteration and abundant pyrite-arsenopyrite mineralization is observed. Relatively coarse visible gold has been observed in these marginal quartz-carbonate breccias. However, dead intercepts are also common, and overall these zones show lower grade and a substantially higher nugget effect than B2-style mineralization (Fingas, 2018).

- INTERNAL PICRITE-HOSTED MINERALIZATION

  While a large percentage of picrite-hosted mineralization occurs along the margins of the picrite bodies, breccia mineralization is also hosted internally to the picrite in some areas. The exact controls on internal breccia mineralization remain uncertain. Picrite-hosted mineralization takes a variety of forms, including ladder-vein sets at varying orientations, irregular breccia veins, and diffuse irregular veins grading into zones of siliceous flooding. Zones of siliceous flooding are often accompanied by pyrite and arsenopyrite mineralization, up to 10%, and mineralized veins may contain sulphides. Bright green fuchsite is common within the picrite, however bright green intervals are frequently not mineralized, and fuchsite may be a product of local alteration that is not closely related with gold mineralizing processes. While intercepts of mineralized picrite can occasionally

be significantly high (e.g., 11SBD414A, which intercepted 24.1 g/t Au over 26 m at 600 m depth), lateral continuity of these zones tends to be poor (Fingas, 2018).

- OTHER MINERALIZATION

  Other mineralization styles include a number of unusual quartz-actinolite veins, logged in the B3 area; these are from 10-30 cm in thickness, are consistently grade-bearing, and are not associated with geological contacts, or well defined shears or faults. Another style of mineralization documented south of the NDZ, and is similar to B3 mineralization, but associated with a competent gabbroic body on the west shore of Stickleback Lake (Fingas, 2018).

A generalized section of the mineralization at Boston is illustrated in Figure 7-13.

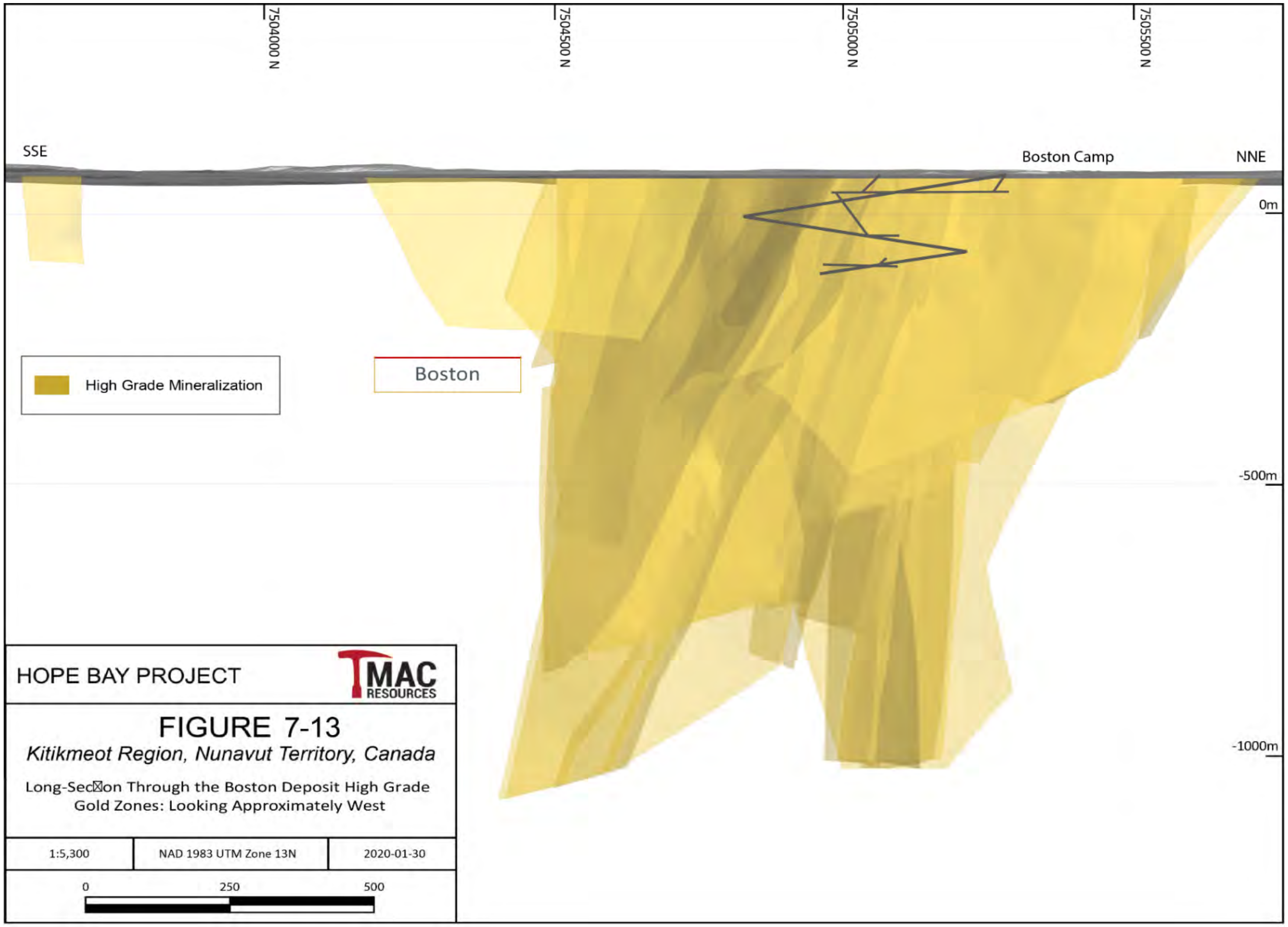


Figure 7-13. Kitikmeot Region, Nunavut Territory, Canada, Long Section Through the Boston Deposit High-grade Gold Zones: Looking Approximately West

8.0 DEPOSIT TYPES

This section on "Deposit Types" is summarized from Technical Report: Hope Bay Project, an in-house report for Newmont (Hope Bay Mining Ltd., 2012), and the summary paper on greenstone-hosted quartz-carbonate vein deposits by Dubé and Gosselin (2007).

The Hope Bay deposits (Doris, Madrid, and Boston), as well as a large number of other prospects, are considered to be typical of orogenic-type mesothermal lode gold deposits, greenstone-hosted quartz carbonate vein deposits. In Canada, orogenic deposits represent the main source of gold and are typically located in the Archean greenstone belts of the Superior and Slave provinces.

Orogenic gold deposits are structurally-controlled and typically occur along major compressional to transtensional crustal-scale fault zones in deformed greenstones terranes, commonly marking convergent margins between major lithological boundaries, such as volcano-plutonic and sedimentary domains. Deposits typically occur in deformed greenstone belts of all ages, especially those with variolitic tholeiitic basalts and ultramafic komatiitic flows intruded by intermediate to felsic porphyry intrusions, and sometimes with swarms of albite or lamprophyre dykes. The deposits are hosted by greenschist to locally amphibolite-facies metamorphic rocks of dominantly mafic composition, and typically form at intermediate depths of 5 to 10 km. The mineralization is syn- to late-deformation and typically post-peak greenschist -facies or syn-peak amphibolite- facies.

Deposits are typically located in second- or third-order structures, most commonly near crustal- to regional-scale deformation zones, in brittle, brittle-ductile, and ductile deformational environments. The structures hosting the gold deposits (shear zones, faults, extensional veins, breccias) are typically discordant with respect to the stratigraphic layering of the host rocks, but in some cases they can be parallel to bedding planes and fold hinges or intrusive contacts.

Deposits consist of simple to complex networks of gold-bearing, laminated quartz–carbonate fault-fill veins that are commonly hosted by moderately to steeply dipping, compressional brittle-ductile shear zones and faults. Veins are dominated by quartz with subsidiary carbonate and sulphide minerals, and less abundant, albite, chlorite, white mica (fuchsite in ultramafic host rocks), tourmaline, and scheelite. Carbonate minerals consist of calcite, dolomite, and ankerite.

Gold is typically hosted in the quartz-carbonate vein network but may also be present in significant amounts within iron-rich sulphidized wallrock selvages, or within silicified and arsenopyrite-rich replacement zones. Gold mineralization can be in the form of native gold, as free gold grains in gangue and sulphides, and in fractures developed in gangue and sulphides. In some deposits, gold may occur as either sub-microscopic inclusions in, or in the lattice of, pyrite or arsenopyrite.

There is general consensus that orogenic gold deposits are related to metamorphic fluids from accretionary processes and generated by prograde metamorphism and thermal re-equilibration of sub-ducted volcano-sedimentary terranes. The deep-seated, Au transporting metamorphic fluids are channeled to higher crustal levels through major crustal faults and deformation zones. Along the pathway, the hydrothermal fluid dissolves various components, notably gold, from the host volcano-sedimentary packages, including a potential gold-rich precursor. Such precursors include differentiated melts, where diffusive gold in the melt may concentrate within the magmatic volatile phase, provided an adequate component of sulphur or halogens are present (Vigneresse, 2019). The fluid then precipitates as vein material or wall-rock replacement in second and third order structures, at higher crustal levels, through fluid-pressure cycling processes and temperature, pH and other physico-chemical variations.

9.0 EXPLORATION

9.1 GRIDS AND SURVEYS

Bathymetric data was collected for Doris Lake, Patch Lake, and Spyder Lake during 1994–1995. Bathymetry surveys were conducted by Frontier Geoscience on behalf of BHP. Data was collected for Doris and Spyder Lakes in 1997 and Patch and Windy Lakes in 2002. In 1996, a bathymetric survey was also conducted from Bathurst Inlet to Roberts Bay.

During 2008, Newmont had all Project data translated and stored as truncated UTM coordinates. Prior to the 2016 SkyTEM survey and subsequent digital elevation model (DEM), topographic data utilized was from 2007 orthophoto data, generated by Aero Geometrics. The contour interval accuracy is approximately 0.5 m for Doris, Madrid and Boston.

9.2 GEOLOGICAL MAPPING

BHP completed 1:10,000 scale regional mapping over the Boston 18 and 19 claims, subsequently extending this to cover the entire Project holdings by the end of 1998. Detailed mapping at 1:100 scale was performed in the Boston underground mine.

Miramar undertook 1:5,000 scale geological mapping over the Project area.

From 2007-2011, Newmont completed the following mapping programs:

- 1:25,000 scale structural, stratigraphic, metamorphic and metallogenic mapping over the entire Project area.
- 1:10,000 scale regional structural, metamorphic, and geological mapping of selected geological targets.
- 1:5,000 scale structural and prospect mapping of selected geochemical and geophysical targets.
- 1:2,000 scale structural and prospect mapping of selected prospects.
- 1:1,000 scale prospect mapping.
- 1:50 scale detailed mapping.

In 2009, a multi-year (2009- 2011) collaborative project between the Geological Survey of Canada under Geo-Mapping for Energy and Minerals (GEM 1) and the University of New Brunswick studied the mineral district of the Elu belt under Newmont ownership.

From 2013 to 2019, TMAC has completed various scale mapping programs and reconnaissance on the Hope Bay belt and Elu claims. Geological mapping was conducted in two-person teams for safety and supplemented with and without the assistance of various contractors and district geologists from the Canada Nunavut Geoscience Office (CNGO). The Geological Survey of Canada and Canada-Nunavut Geoscience Office conducted a short mapping project in 2015 and 2016 that concentrated on the Proterozoic metasedimentary rocks. During the 2019 field season, mapping included the use of the DJI Phantom 3 drone for aerial surveys and photography over the Boston Peninsula along with regional targets Domani and Too. A short reconnaissance mapping program was completed over Elu-Link in 2019. Underground mapping at Boston was digitized in 2018.

9.3 GEOCHEMICAL SAMPLING

BHP collected approximately 24,000 samples of glacial till during the period 1991 to 1998. In addition, during 1994, a study of the variability of the soil geochemistry was undertaken.

From 2000 to 2008, Miramar collected 15,300 rock and till samples in the Doris, North Madrid, and Daiwa areas. Samples in the North Madrid area indicated potential for additional mineralization based on gold grain morphology and assumed travel distance of the grains.

In 2008, Newmont compiled the existing geochemical data. In addition to the compilation, Newmont collected 7,149 rock and tillite samples. Data collated included whole rock, inductively-coupled plasma (ICP) analyses, and gold assay data.

Sample locations from the Newmont work programs, and where known, earlier sampling programs collected by third-parties, are indicated in the 2015 RPA Technical Report.

Since 2013, TMAC collected 222 grab samples for geochemical processing across the Project. 134 samples were taken across the Hope Bay belt along various prospects at Doris, mid-belt and Boston, 82 samples on Elu-Link during a helicopter sampling reconnaissance program in 2019 and 6 samples at Elu in 2018, following up on base metal trends. Surface outcrop channel samples were cut and sampled in 2019 at regional target Too, which is located south of Boston.

In 2016, TMAC commenced a gold in glacial till program which has totalled 3,388 till samples (including duplicates) across the Hope Bay belt, Elu and Elu-Link. Till sampling programs run seasonally from June-August, weather dependant. From 2016-2019, till sampling has been a key variable in target generation and target vectoring across the belt. Within the Hope Bay belt, 540 and 725 samples were collected in 2016 and 2017 respectively, with 809 collected in 2018; 26 of which collected during a limited till sampling campaign within the northern portion of the Elu property; these numbers include duplicate samples. In addition, kimberlite indicator minerals were picked in 46 of the 540 samples collected in 2016. In 2019, 1,267 till samples (including 40 duplicates) were collected strategically across the belt with an additional 46 samples (including 2 duplicates) were taken at the southern portion of Elu-Link for a total of 1,313 samples. Till sampling programs were designed following a review and subsequent target generation utilizing the 2018 VTEM geophysical results for Elu-Link. Samples were analyzed for grain count (total VGG) and morphology characterization as well as ICP multi-element. As required, anomalous results were re-sampled in subsequent seasons.

LAKE SEDIMENT SAMPLING

In February 2019, TMAC conducted a lake sediment sampling survey totaling 119 sample stations; 98 on Doris Lake and 21 on Patch Lake. 79 samples were collected on Doris Lake and 18 samples collected on Patch Lake over the Patch 14 mineralized zone. Samples were retrieved from the lake bottom using a torpedo-style sediment sampler with a minimum of 50 grams of material recovered at each station. 22 samples were unrecoverable due to shallow areas, the lake bottom was frozen and/or no material was recovered. Samples were analyzed for ICP multi-element testing the geochemical response.

Geochemical sample locations acquired under TMAC Resources Inc. ownership is presented in Figure 9-1 through Figure 9-6 for the Hope Bay (North, Central, and South), Elu and Elu-Link volcanic belts.

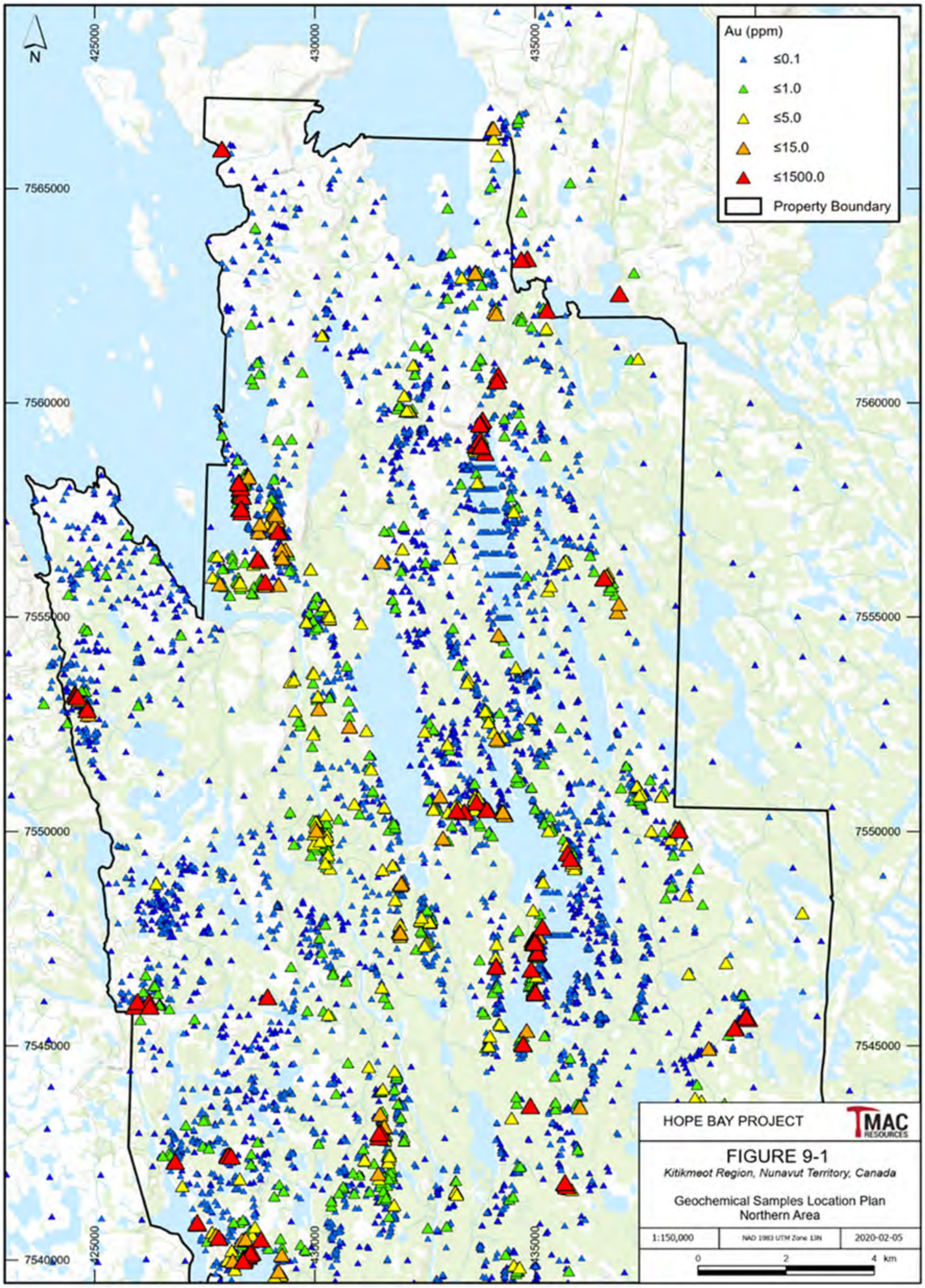


Figure 9-1. Kitikmeot Region, Nunavut Territory, Canada, Geochemical Samples Location Plan Northern Area

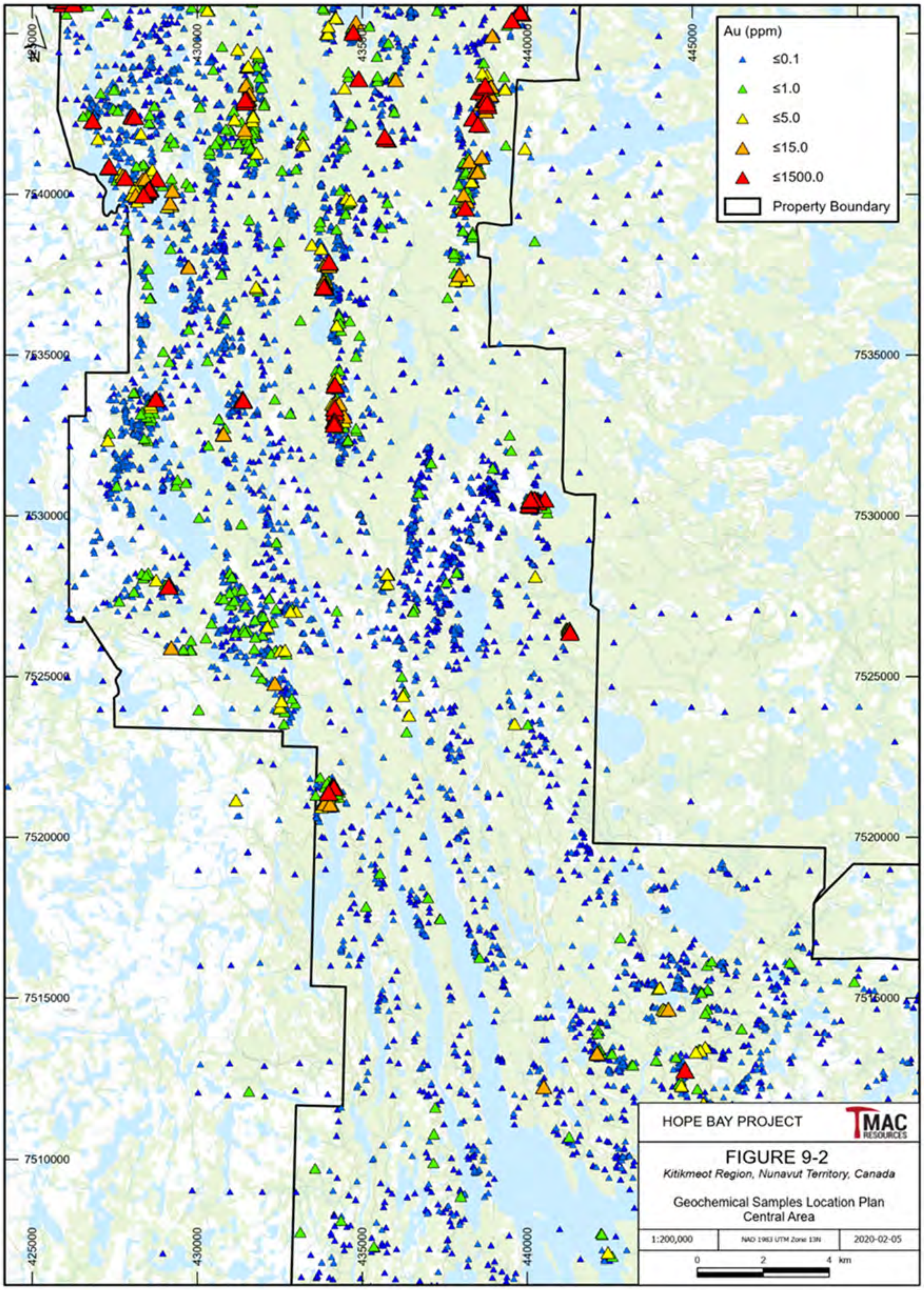


Figure 9-2. Kitikmeot Region, Nunavut Territory, Canada, Geochemical Samples Location Plan Central Area

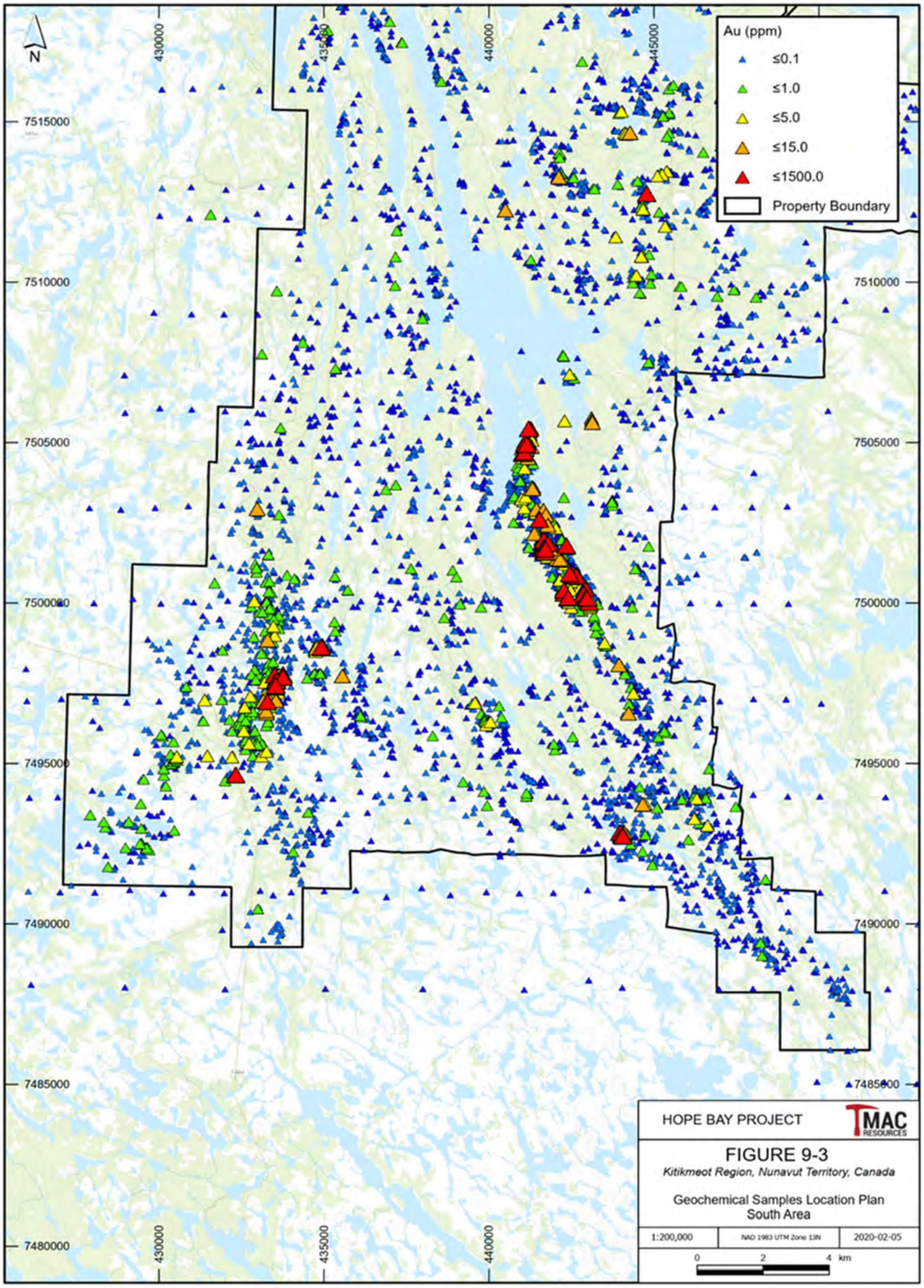


Figure 9-3. Kitikmeot Region, Nunavut Territory, Canada, Geochemical Samples Location Plan South Area

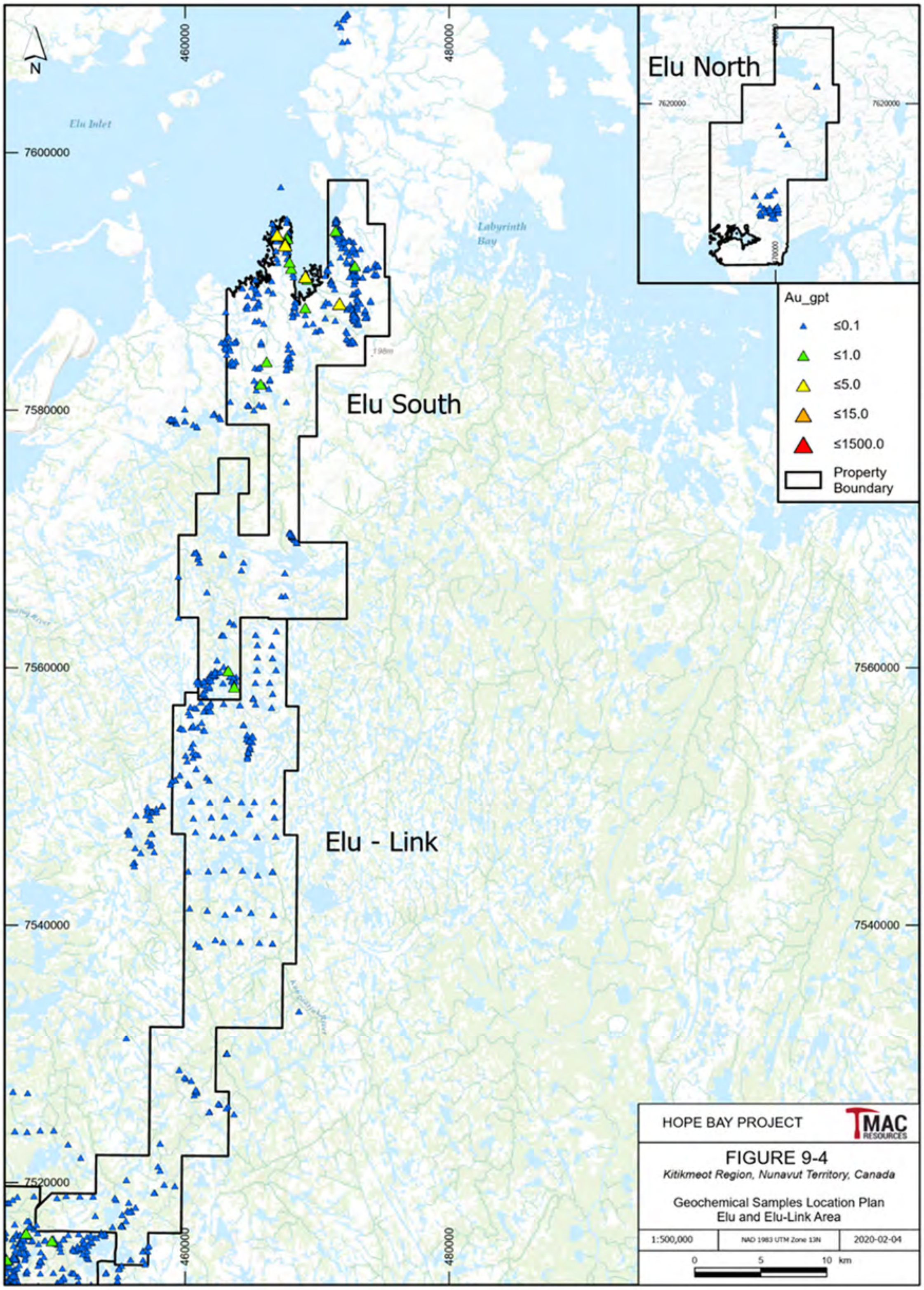


Figure 9-4. Kitikmeot Region, Nunavut Territory, Canada, Geochemical Samples Location Plan Elu and Elu-Link Area

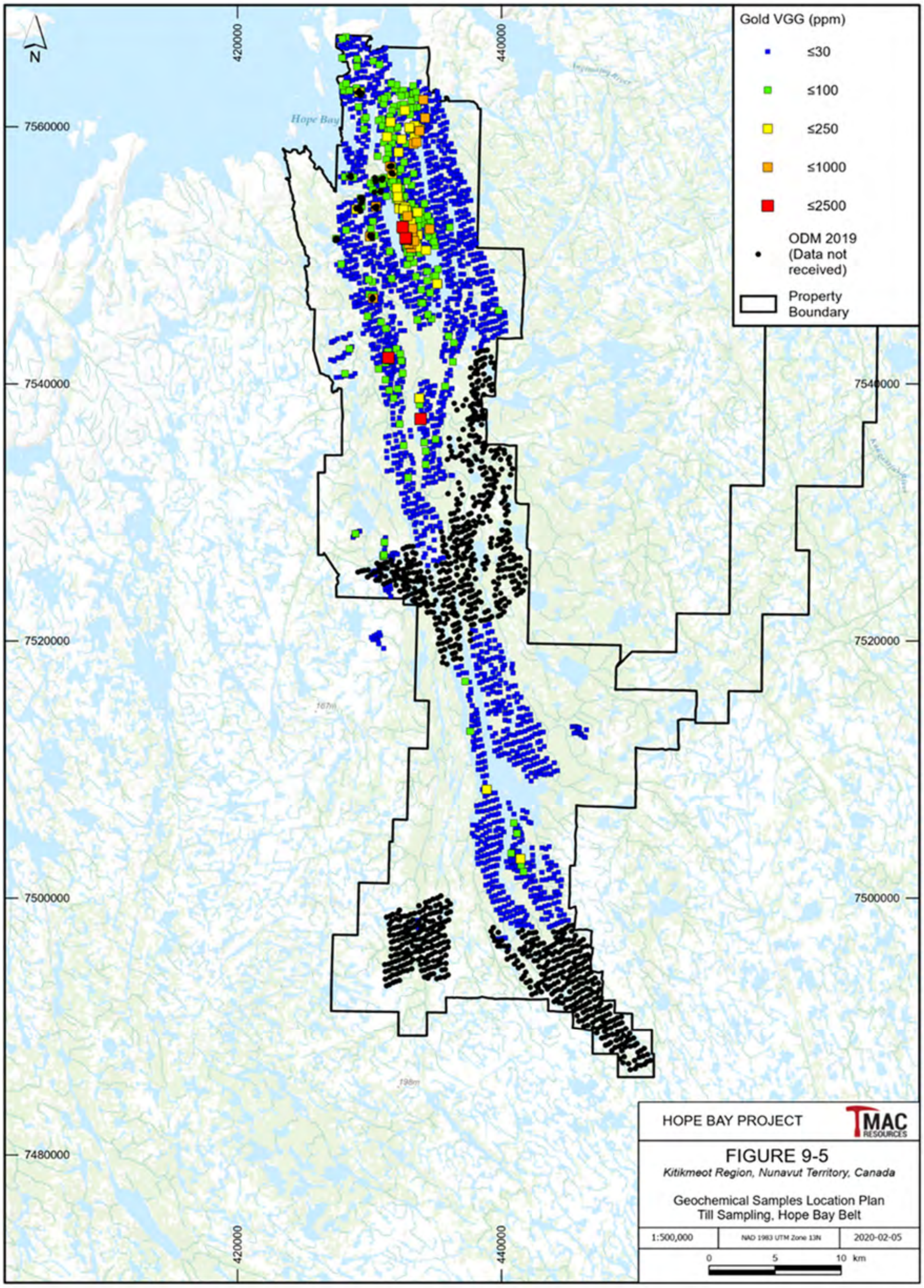


Figure 9-5. Kitikmeot Region, Nunavut Territory, Canada, Geochemical Samples Location Plan Till Sampling, Hope Bay Belt

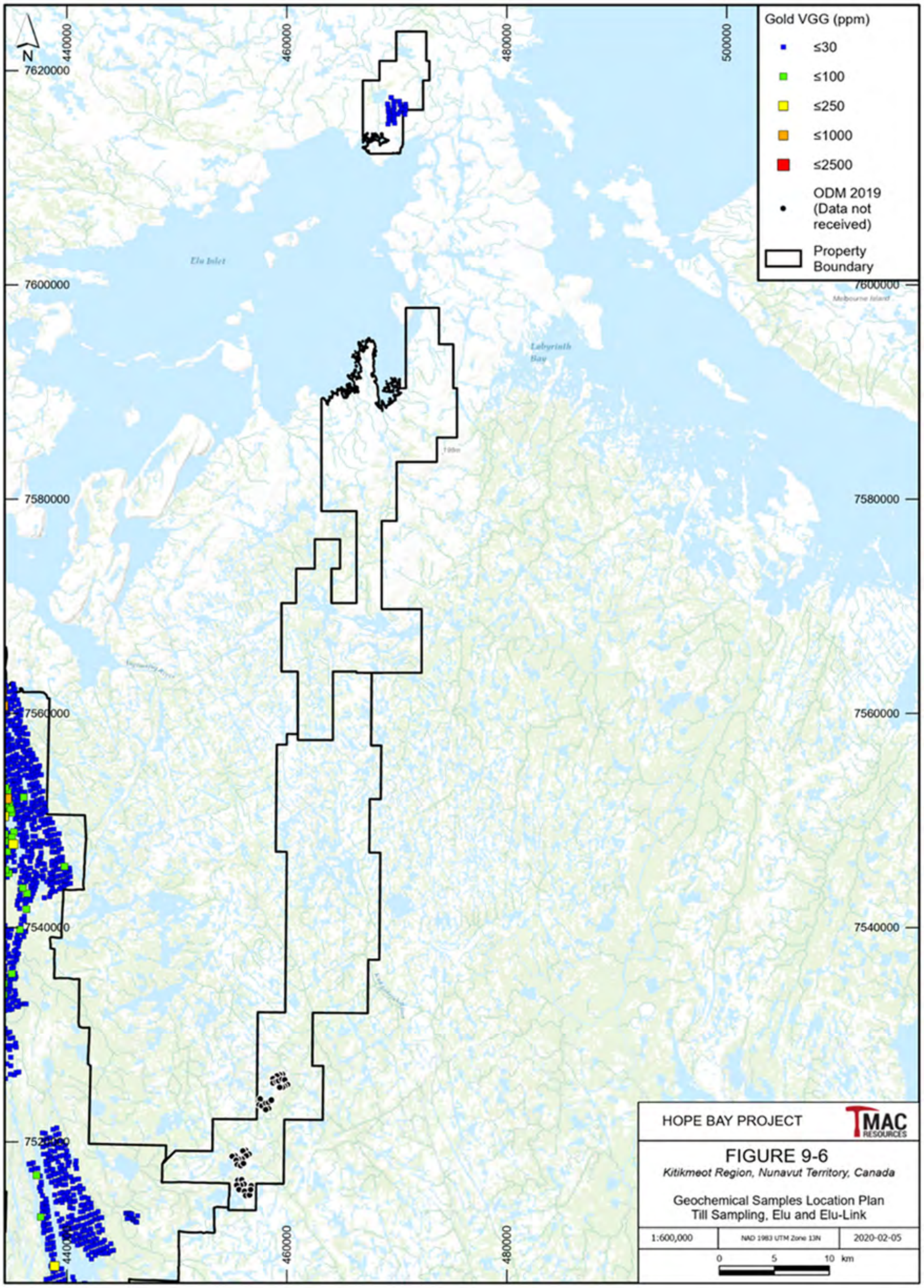


Figure 9-6. Kitikmeot Region, Nunavut Territory, Canada, Geochemical Samples Location Plan Till Sampling, Elu and Elu-Link

9.4 GEOPHYSICS

The Hope Bay volcanic belt has been fully covered by aeromagnetic, gravity, and Dighem (conductivity/resistivity) data. Radiometric and ground magnetic data cover approximately one quarter and one third of the belt, respectively. Approximately 200 km of induced polarization (IP)/resistivity (gradient, dipole-dipole, pole-dipole, and TITAN), seismic surveys have been completed on several prospects. Newmont collated the data from these earlier programs, and in many cases, re-processed the airborne magnetic and ground magnetic data. Full Remote sensing (hyperspectral) surveys are available for the Hope Bay greenstone belt which was a cooperative project involving NRCan's GSC, NRCan's Canada Centre for Remote Sensing (CCRD) and the CNGO along with WORMS inversion by Intrepid Geophysics. Geophysical surveys are used as vectors for exploration programs and provide drill targets that were followed-up with geological mapping, reconnaissance and tested using RC and diamond drilling on various drill campaigns.

Since 2015, TMAC has completed high-resolution airborne magnetic, electromagnetic and gravity surveys across the entire property including the Hope Bay, Elu and Elu-Link volcanic belts using various methods including; CGG HeliFALCON Gravity Gradiometry, Sander AirGRAV, Airborne Mag/EM (SkyTEM) and VTEM. No recent Very Low Frequency (VLF), IP or seismic refraction surveys have been completed under current ownership. Since 2019, Pole-Dipole IP (Titan-24) data for Boston and Madrid have been inverted with Quantec Geoscience and magnetic inversion models for Doris through a private consultant.

Geophysical survey methods which have taken place on the Hope Bay, Elu and Elu-Link volcanic belts are summarized in Table 9-1.

Geophysical surveys completed under TMAC Resources Inc. ownership are presented in Figure 9-7 through Figure 9-10 for the Hope Bay and Elu, Elu-Link volcanic belts.

Table 9-1. Geophysical Survey Summary

TMAC RESOURCES INC. – HOPE BAY PROJECT

Year	Survey Type	Survey Details	Contractor	Location
1993	GMAG	552 line-km, 20 km^2 variable 25 m and 50 m line spacing, 2 m sensor height	Contractor not specified	Boston, Patch, Fickleduck
1993	AMAG, DIGHEM, VLF, ARAD	2,657 line-km, 263 km^2 100 m line spacing, 40 m sensor height	Geoterrex	Boston, Mid-belt Corridor, QSP
1993	AMAG, DIGHEM, VLF	925 line-km, 168 km^2 variable 100 m and 200 m line spacing, 40 m sensor height	Geoterrex	QSP, Chicago, Barney
1994	GMAG, VLF	82 line-km, 4.0 km^2 50 m line spacing, 2 m sensor height	Geoterrex	Kamik, South-West Patch
1994	AMAG, DIGHEM, VLF	3,328 line-km, 329 km^2, 100 m line spacing, 40 m sensor height	Geoterrex	Patch, Boston, North and Central Corridor
1995	GMAG, VLF	182 line-km, 8.8 km^2, 50 m line spacing, 2 m sensor height	Contractor not specified	Doris, Discovery, Boston
1995	AMAG, DIGHEM, VLF	4,700 line-km, 466 km^2, 100 m line spacing, 40 m sensor height	Geoterrex	Boston Region, North Doris

Year	Survey Type	Survey Details	Contractor	Location
1995	AMAG, DIGHEM	477 line-km, 47 km², 100 m line spacing, 40 m sensor height	Geoterrex	Flake Lake
1996	GMAG, VLF	287 line-km, 15.7 km², 50 m line spacing, 2 m sensor height	Contractor not specified	North and South Patch, Wolverine
1996	GMAG	1,235 line-km, 81 km², 50m line spacing, 2m sensor height	Clearview Geophysics	Boston, Chicago, Daiwa, Discovery, Doris
1996	GMAG	157 line-km, 7.7 km² 50 m line spacing, 2 m sensor height	Contractor not specified	Kamik
1997	AMAG	880 line-km, 43.5 km² 50 m line spacing, 40 m sensor height	High Sense Geophysics	Madrid Corridor
1997	GMAG, VLF	19.6 line-km, 1.3 km² 100 m line spacing, 2 m sensor height	Contractor not specified	South Doris, North Patch
1997	GMAG	130 line-km, 10 km², 75 m line spacing, 2 m sensor height	Contractor not specified	North-West Boston
1997	Seismic Refraction	5.2 line-km, 7.5 m data spacing	Frontier Geoscience	Various locations in the Mid-belt
1997	Seismic Reflection	43 line-km, 7.5 m data spacing	Frontier Geoscience	Doris/Spyder Lake
1998	AMAG	3776 line-km, 188 km², 50 m line spacing, 40 m sensor height	Geoterrex	Boston, Flake Lake, Gas Cache,
1998	Seismic Refraction	2.5 line-km, 7.5 m data spacing	Frontier Geoscience	Boston Camp
2002	Seismic Refraction	11.6 line-km, 7.5 m data spacing	Frontier Geoscience	Nexus Area
2002	Seismic Reflection	56 line-km, 7.5 m data spacing	Frontier Geoscience	Windy/Patch Lake
2003	GMAG	30 line-km, 1.3 km², 50 m line spacing, 2 m sensor height	Aurora Geoscience	Inge
2003	Seismic Refraction	10.3 line-km, 7.5 m data spacing	Frontier Geoscience	Gas Cache
2005	Pole-Dipole IP	14.8 line-km, 100 m dipole spacing	Aurora Geoscience	Nexus, Naartok, Kink
2006	Pole-Dipole IP	31 line-km, 100 m dipole spacing	Aurora Geoscience	Havana, Patch, Peanut, Twin Peaks, Kink, Koig
2007	GMAG	3733 line-km, 91 km², 50 m line spacing, 2 m sensor height	Clearview Geophysics	Boston, Flying Squirrel, Windy Corridor
2008	Pole-Dipole IP (Titan-24)	12.5 line-km variable dipole spacing	Quantec Geoscience	Madrid/Boston
2008	Pole-Dipole IP (Conventional)	20 line-km, variable dipole spacing	Clearview Geophysics	Ak1, Ak3, Amarok

Year	Survey Type	Survey Details	Contractor	Location
2009	Pole-Dipole IP	29 line-km, 100 m dipole spacing	Clearview Geophysics	Gas Cache, Kamik, Windy Lake, Kink
2009	Airborne assisted Ground Gravity	1,800 data points, 1,700 km^2, 1 km data spacing	Newmont Geophysics	Entire Hope Bay Belt
2011	Seismic Refraction	17 line-km, 7.5 m data spacing	Frontier Geoscience	Kink, Ogama, Main, Omayuk, Havana.
2011	Pole-Dipole IP	5.5 line-km, 50 m dipole spacing	Aurora Geoscience	Omayuk, Peanut, QSP, North Tail.
2011	Gradient IP	7 km^2,100 m line spacing, 50 m dipole spacing	Aurora Geoscience	Omayuk, Peanut, QSP, Kink, North Tail.
2011	AMAG/ARAD	2,865 line-km, 228 km^2, 100 m line spacing sensor height 40 m	Newmont Geophysics	6 blocks along the Belt margins
2015	Airborne Mag/EM (SkyTEM) Survey with Sander AirGRAV	2,139 line-km, 100 m line spacing	SkyTEM Canada Inc.	Elu South
2016	Airborne Mag/EM (SkyTEM) Survey with Sander AirGRAV	1,587 line-km, 100 m line spacing	SkyTEM Canada Inc.	Elu South
2016	Airborne Mag/EM (SkyTEM) Survey with Sander AirGRAV	197 line-km, 100 m line spacing	SkyTEM Canada Inc.	Elu North
2016	CGG HeliFALCON Gravity Gradiometry	12,676.4 line-km, 100 m line spacing	CGG Canada Services	Hope Bay Belt
2016	Airborne Mag/EM (SkyTEM)	3,500 line-km, 100 m line spacing	Geotech Ltd.	Hope Bay Belt
2018	Airborne Mag/EM (VTEM) Survey	2,645 line-km, 150 m line spacing	Geotech Ltd.	Elu Link
2019	Pole-Dipole IP (Titan-24) Inversions	Re-processing of 2008 survey data	Quantec Geoscience	Madrid/Boston

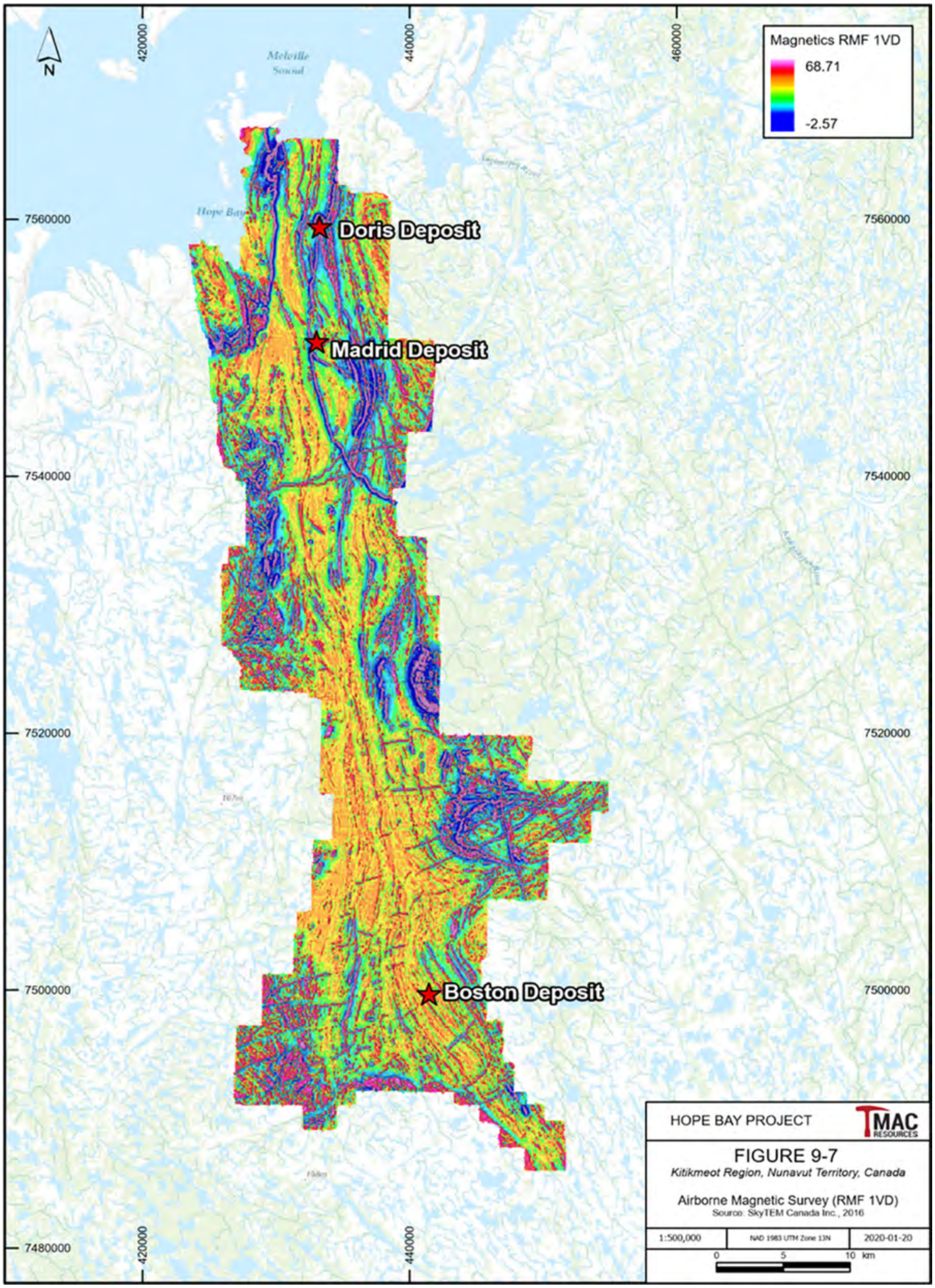


Figure 9-7. Kitikmeot Region, Nunavut Territory, Canada, Airborne Magnetic Survey (RMF 1VD)

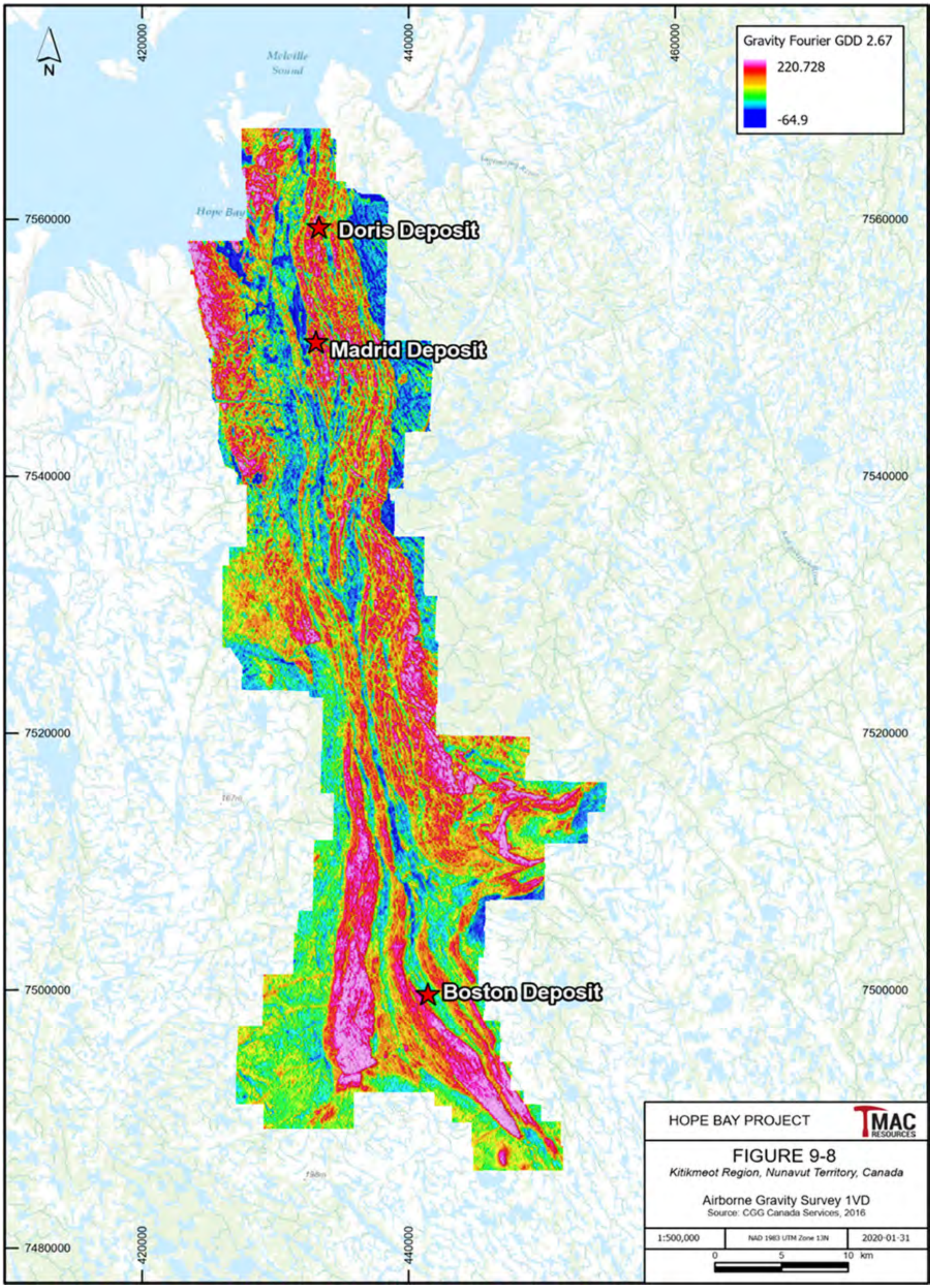


Figure 9-8. Kitikmeot Region, Nunavut Territory, Canada, Airborne Gravity Survey 1VD

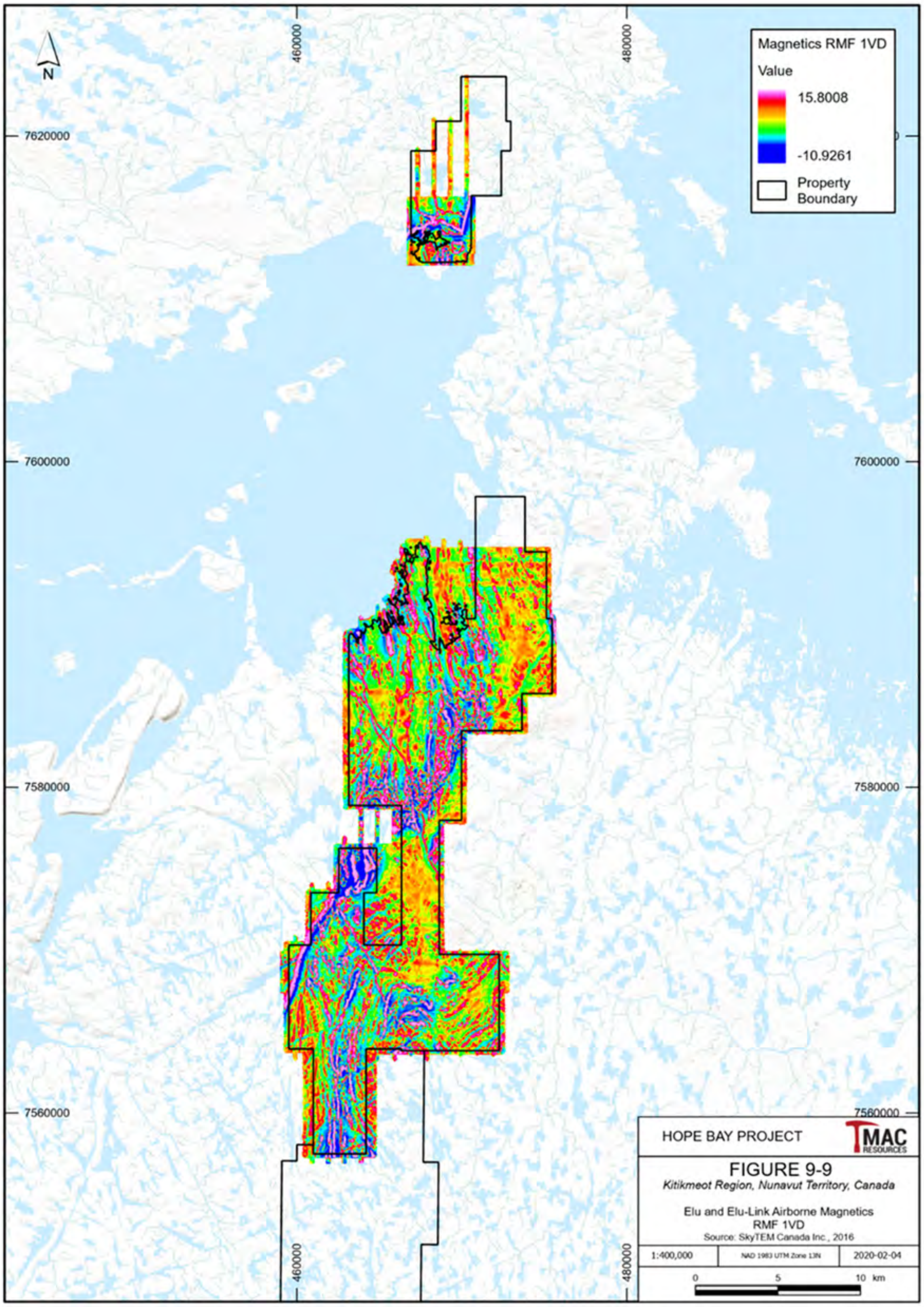


Figure 9-9. Kitikmeot Region, Nunavut Territory, Canada, Elu and Elu-Link Airborne Magnetics RMF 1VD

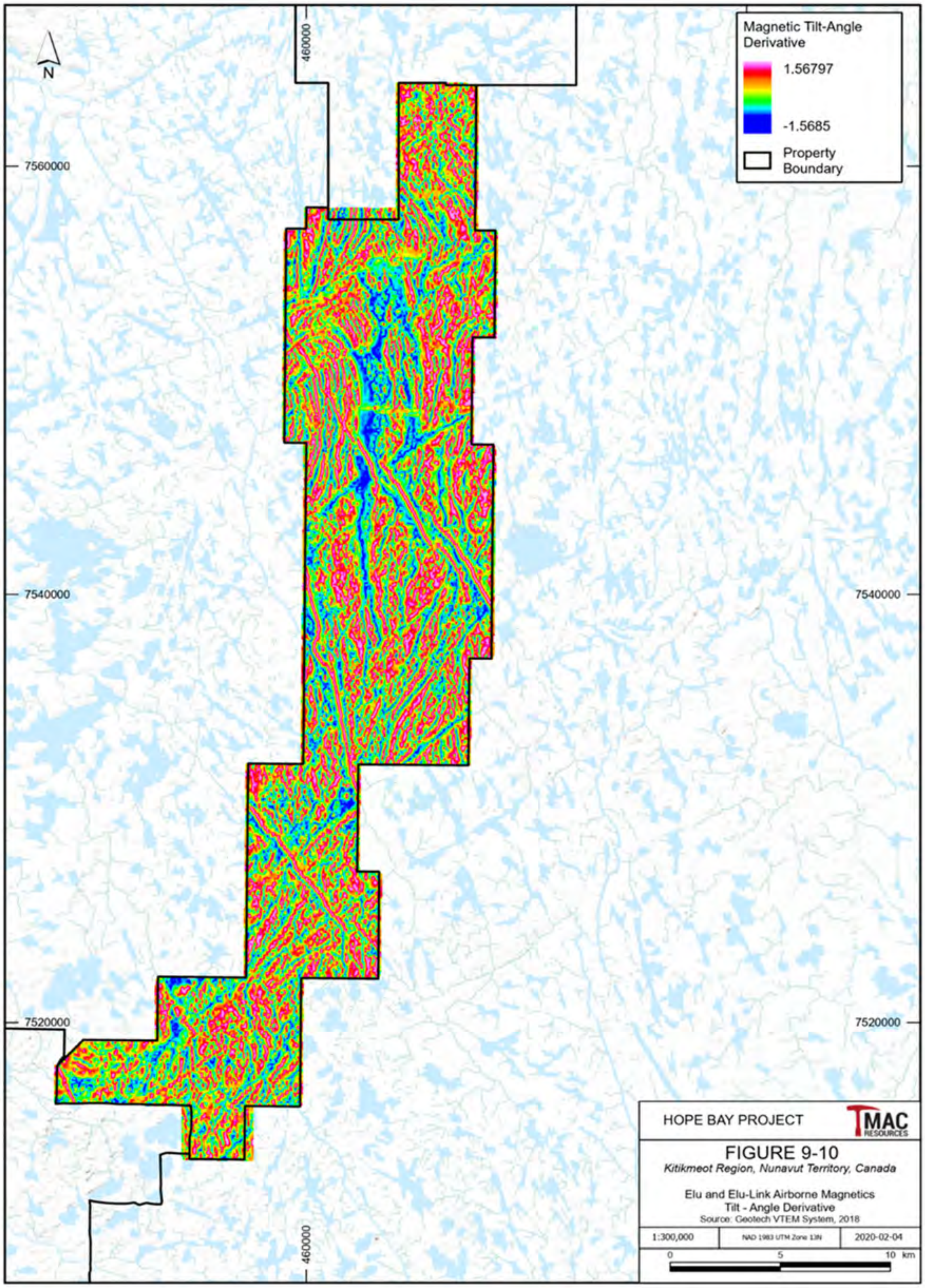


Figure 9-10. Kitikmeot Region, Nunavut Territory, Canada, Elu and Elu-Link Airborne Magnetics Tilt-Angle Derivative

9.5 UNDERGROUND SAMPLING

HISTORICAL

BHP conducted an underground exploration and bulk sampling program on the Boston deposit between 1996 and 1997. The deposit was accessed via a portal and decline. Five separate crosscuts were established from the decline, at various levels, to give access to drifts on the B2 and the B3 mineralization. Once the desired mineralized system was intersected in the crosscuts, drifts were then established to follow the veins along strike. In addition to the drifts, five raises were developed in an attempt to follow the vein system vertically.

Each round for all of the drifts, raises, and crosscuts were stockpiled separately on the surface pad. Each round was treated separately for sampling and crushing purposes. After each round had been processed through the on-site crusher and sampling tower, the rounds were then piled separately and were surveyed.

Approximately 27,000 t of B2 and B3 mineralized material and 105,000 t of waste were brought to surface and almost all of it was crushed to 1.5 cm to 2.0 cm size. A sampling tower was set up to collect representative samples of mineralization (approximately 1:1,000 sample reduction).

In 1996, 9.4 t of this material was sent to the BHP Reno Laboratory and in 1997 an additional 11.7 t was sent to Lakefield Laboratories (now SGS Lakefield) for detailed analysis of grade, recovery, and metallurgical characteristics.

MUCK SAMPLING

TMAC initiated a mucking sampling program for Doris underground in February 2019. This program was implemented to assist mining operations in maintaining accurate grade control and allow for more accurate grade calls. Muck samples are taken from a scoop bucket when ore is removed from an active face and/or stope. A representative sample is taken from both sides of the scoop bucket and includes a range of material sizes and composition. Samples are taken every 6th bucket in longhole stopes and every 4th bucket in ore development, regardless of scoop size. Samples are assayed at the on-site SGS lab at Doris.

CHIP/CHANNEL SAMPLING

TMAC initiated a chip sampling program for Doris underground and the regional exploration program.

For underground the program was implemented to assist with ore control of underground development to ensure grade quality of veins. Chip sampling was used to rectify grades of significant features within given rounds within the resource block model. Once marked up and distances measured, the development face was sampled left to right, breaking along significant veining or alteration. Samples were limited to less than 1.5 m across the face and require approximately 2 kilograms of representative rock. All production rounds were sampled. Target veins were sampled with minimal shoulders and wall-rock sampled separately.

Channel samples were taken at the Too showing during the 2019 regional exploration program. Channels were marked-up perpendicular to veins and cut approximately 1.5 inches into clean outcrop. Samples were taken honoring lithology, alteration and mineralization with start and end points of each channel surveyed with a Trimble Differential GPS.

For both underground chip and regional channel samples, QA/QC standards were inserted every 25th sample, blanks every 20th sample and duplicates taken in large veins or areas of interest. Chip and channel samples were entered into the Fusion Database. For underground samples, assaying was completed at the on-site SGS lab at Doris and for regional samples, assays were completed at the off-site ALS lab.

9.6 PETROLOGY, MINERALOGY, AND RESEARCH STUDIES

A number of studies have been completed on the Project. These include:

- Petrography and Mineralogy
- Fluid Inclusion Studies
- Lithogeochemistry
- Soil Gas Sampling
- Satellite Data
- Theses:
- Clark D. B., 1996: The Geology of the Boston Deposit, Hope Bay volcanic belt, Northwest Territories, Canada: unpubished MSc Thesis, Queens University, Ontario, 94 p.
- Hebel, M.U., 1999: U-Pb Geochronology and Lithogeochemistry of the Hope Bay greenstone belt, Slave Structural Province, Northwest Territories, Canada: unpublished M.Sc. thesis, University of British Columbia, 96 p.
- Stemler, J. U., 2000: A Fluid Inclusion and Stable Isotopic Examination of the Boston greenstone belt Hosted Archean Lode-Gold Deposit, Hope Bay volcanic belt, Nunavut, Canada: unpubished MSc Thesis, University of Alberta, Edmonton, 212 p.
- Shannon, A.J., 2008: Volcanic Framework and Geochemical Evolution of the Archean Hope Bay greenstone belt, Nunavut, Canada: unpublished M.Sc. thesis, University of British Columbia, 211 p.

GEOTECHNICAL

SRK performed a rock mass assessment for Doris North in 2009. Conclusions of that study were:

- Most portions of the Doris North deposit host fair to good rock mass conditions.
- Although a number of fault structures are observed to pass through the area of major infrastructure, these are not expected to be too difficult to traverse using conventional mining and support practices, which may include the application of shotcrete. These fault structures are likely to have a localized influence on stability.
- Disturbance zones of less than one metre are noted for major structures in the Doris North area.

Existing data for the Doris area portal was reviewed by SRK in 2010. Geotechnical surface mapping and drilling was performed to determine support requirements for the planned portal face. Recommendations from the review included removing the rock rubble along the face of the portal and placing rock fall catchments and screening on either side of the portal. For the area immediately around the portal, screening and extra bolting was recommended.

HYDROGEOLOGICAL

The current hydrogeological understanding of property is based on information from field investigations completed by SRK in 2004, 2008, 2010 and 2011. A summary of hydrogeological and geotechnical work completed by SRK includes:

- SRK 2005: Thermistor data are available from two test holes completed in 2004 near Doris North; one along the southern extent of the Doris North deposit in deep permafrost, the other to the west of the Doris North deposit in shallow permafrost. Data for the two wells have been collected since 2004.
- SRK 2009b: SRK issued a Stage 2 geotechnical and hydrogeological assessment for the Doris North Open Pit and Doris Central Underground. The assessments were based on field studies completed by SRK in 2008 that included detailed structural review, hydrogeological investigations, and geotechnical assessments (including additional thermistor drill holes). No hydrogeological data were available for the Doris Central area prior to the 2008 program.
- SRK 2011a: SRK conducted a field program in 2010 involving the installation of several Westbay multi-level monitoring wells for the purpose of characterizing groundwater quality at Doris North, Doris Central, and Boston. Hydraulic tests were also completed during drilling. One of these wells is within the Doris Lake talik; groundwater quality was characterized for each of the sampled zones to a depth of 490 m below lake elevation.
- SRK 2011b: SRK provided a memo summarizing results of updated estimates for inflow rates and water quality for Doris Central and Connector, including provision for flow contributions from open exploration drill holes. The updated assessments used data from the 2010 field program (SRK 2011a).
- SRK 2012: SRK provided a report summarizing results of groundwater quality sampling and analyses from the three existing Westbay wells (Doris North, Doris Central, and Boston).
- SRK 2014: SRK provided a report that reviewed all the historical data as well as the additional field work conducted in 2011 at the Project, and updated the characterization of the geotechnical and hydrogeological conditions. This document provided information for use in mine and infrastructure design, and to support an internal Stage 2 (pre-feasibility) study for the 2015 PFS.
- SRK 2015: SRK provided a report that presented a hydrogeological model for the proposed Doris North Mine which estimated the potential quantity and quality of groundwater flow into the talik zones of the Doris Mine.

Based on available data, the hydrogeological system for the entire Hope Bay volcanic belt can be generally considered as a low flux, lake-dominated flow system (SRK 2011b). Regional flow is primarily controlled by the presence or absence of permafrost, which is widespread and deep away from lakes and considered to be essentially impermeable. Away from lakes, permafrost may exist to depths of 400 m below ground surface. Unfrozen zones under lakes (taliks) can provide connection between surface water and groundwater.

Doris Lake represents a significant source of water that could have an influence on inflows. Inflows to the mining areas within the talik are likely to come from three sources:

- Fractures in bedrock: Hydraulic testing data suggests that shallow bedrock and/or the mineralized zone and surrounding altered zones may have relatively high hydraulic conductivities compared to greater depths and other lithologies. The diabase sill underlying the area of development appears to have significantly lower hydraulic

conductivity, which may reduce the inflows to Doris Lower, at depths of 300 m to 750 m below the lake.

- Geological structures: The likelihood of intersecting such structures is considered high, though uncertainty exists regarding specifically where or if they will act as conduits. However, as diamond drilling and mining progress, structures are being modelled and projected in Seequent's Leapfrog: 3D Geologic modelling software by TMAC geologists
- Exploration drilling: there is uncertainty as to if and how these drillholes were sealed upon completion. However, utilization of the historical diamond drill database has allowed planning through historical drilling and as mining has progressed, historical drillholes were plugged and grouted as required in order to eliminate risk to production rates.

10.0 DRILLING

Since 1991, approximately 1,113,489 m have been drilled in 6,075 core and RC drill holes on the Hope Bay greenstone belt. Details of the various drilling programs are summarized in Table 10-1. Since 2013, TMAC has drilled 1204 diamond drill holes for a total of 286,016 meters and 24 reverse-circulation drill holes for a total of 464 meters. Figure 10-1 to Figure 10-4 present the location of all historical and TMAC drill collars for the Doris, Madrid and Boston deposits respectively.

A total of 187 core holes have been drilled for geotechnical, hydrological, and condemnation purposes. An additional 137 drill holes were completed for metallurgical purposes. Drilling across the Hope Bay belt has been executed through various campaigns including: underground; and surface via helicopter, crane, ice portage and winter ice supported drilling.

Core drilling has primarily been completed at HQ (63.5 mm) and NQ/NQ2 (47.6 mm) core sizes. Core size BQ (36.5 mm) core was drilled in the Boston underground program and for underground production drilling at Doris. A gopher diamond rig was used in the 1990s for regional exploration purposes. This rig delivered ADBGM-size (30.09 mm) core.

Current drill inventory on the Hope Bay belt includes: three surface Zinex A5 units, two surface Hydracore 2000 units, one underground Zinex U5, an underground Hydracore 2000, and an underground Hydracore 1000 Gopher.

TMAC 2013

The 2013 program by TMAC consisted of drilling which supported the estimation of Inferred Mineral Resources at depth at both Doris North and Doris Central, demonstrating the potential to add significant ounces of gold to the resource base below the dyke at Doris. A total of 29,622 m in 67 diamond drillholes was completed during the 2013 exploration program; this included a regional exploration program.

TMAC 2014

The 2014 program totalled 67,500 m of drilling in 152 diamond drillholes. The program consisted of diamond drilling to infill Mineral Resources at Doris and Madrid with two additional assessment drillholes in the south of the Hope Bay Property. Drilling focused on the Wolverine, Patch 14, Naartok East and West, Doris Connector, Doris BTD Connector, and Doris North BTD sections of the property. This program targeted areas of the resource where the previous drilling was widely spaced or the down-plunge extension was not sufficiently tested.

Overall, at the Doris deposit a total of 61 drillholes (25,861 m) were drilled as infill to test continuity of mineralization and extensions of existing mineralized trends. A total of 41 drillholes (16,252 m) were drilled over the Patch 14 and Wolverine deposits, focusing on increasing drillhole spacing within key sections of the existing Mineral Resources and testing the down-plunge extension of high-grade chutes. A total of 48 holes (24,409 m) targeted Naartok East and West to determine the extent of mineralization and infill between thicker high-grade zones.

Two drillholes explored the mineral potential of Akungani 2 and Aimaokatuk 1. The exploration drilling targeted a similar geological environment to the setting of the Naartok East zone and a regional scale structural corridor. Both drillholes were helicopter supported out of Doris camp and resulted in a total of 978 m of drilling.

TMAC 2015

The 2015 diamond drilling program was focused on three main areas: the Doris North zone; the Madrid North Naartok zone and the Madrid North Suluk zone. A total of 33,158 m, in 120 drillholes was completed in 2015.

The drilling on the Doris North zone concentrated on infill drilling within the Indicated resources, to facilitate detailed mine planning, and stope design. In addition to infill drill, four exploration holes were completed to target the Doris North BTD Extension, north of the current mine plan and beneath the diabase dyke. Drilling in the spring of 2015 from ice platforms focused on infill drilling on the Madrid North Suluk zone following up on high-grade intersections within the inferred resources, and infill drilling within the Indicated resources to continue to refine the geological model and provide material for metallurgical testwork. Drilling from land-based platforms in the second half of 2015 focused on the Madrid North Naartok zone, infill drilling within the Indicated and Inferred resource and also following up on high-grade, near surface intersections not currently accounted for in the Madrid resource base.

TMAC 2016

The primary objective of the 2016 exploration diamond drilling program was to support the advancement of Hope Bay through continued geological modelling, diamond drilling and metallurgical testwork and resource definition at both Doris and Madrid. The 2016 exploration drilling program comprised of both surface and underground diamond drilling targeted both near-term (one to three year) production areas and longer-term expansion of resources at Doris and Madrid.

A total of 27,246 m in 95 diamond drillholes was completed in 2016. Underground diamond drilling on the Doris North BTD zones represented 14,589 m in 46 drillholes of the total drilling during the 2016 program. Initial underground exploration drilling below the diabase dyke demonstrated continuity of quartz veining and gold mineralization thereby providing TMAC the confidence to initiate additional underground development to further test Doris North BTD.

TMAC 2017

In 2017, a total of 4,208 m of surface drilling was completed at Boston and 13,491 m of underground drilling was completed at Doris for a total of 17,699 m and 72 drillholes. Diamond drilling at Boston targeted wide, high-grade trends within the known Indicated Resource to assess continuity of grade and thickness. Underground drilling at Doris was focused on production related definition drilling within the Doris Connector zone and infill drilling to upgrade Inferred Mineral Resources within the Doris BTD East Limb and southern portion of the Doris BTD Extension zones. Regional RC drilling consisted of 24 holes totaling 464 m.

TMAC 2018

The 2018 diamond drilling program consisted of 35,049 m of drilling in 232 drillholes.

A total of 24,287 m of underground diamond drillling in 154 drillholes was completed at Doris, focused on definition and expansion drilling on the high-grade Doris BTD Extension zone, and infill drilling within the Doris Connector zone to support detailed mine planning. Diamond drilling at Madrid North consisted of 9,868 metrs of surface drilling in 75 drillholes, targeted to define the continuity of the wide, high-grade core of the Naartok West zone and Naartok East zones, near

surface at depths less than 150 m. Regional diamond drilling consisted of 895 m in 3 drillholes, completed approximately 1.5 km and 2.5 km north of the Madrid North Naartok zone, designed to define the geological stratigraphy beneath a wide, covered valley along strike of the Naartok East zone. One drillhole was abandoned prior to reaching the target depth. No drilling was conducted at Boston in 2018.

TMAC 2019

Diamond drilling in 2019 consisted of surface and underground diamond drilling to support both short-term production through longer-term definition and expansion of resources at Doris, Madrid North, and Boston. In addition, a significant regional exploration drilling program was completed with a focus on established targets proximal to existing and planned infrastructure. A total of 75,738 m in 466 drillholes was completed in 2019, including 43,749 m of underground drilling at Doris and 31,989 m of surface drilling at Doris, Madrid North, Boston and Regionally.

The 2019 underground diamond drilling program had three main objectives: (i) infilling drilling within Doris Connector to support detailed mine planning, (ii) definition and expansion drilling on the high-grade zones in Doris BTD and (iii) exploration drilling testing targets near current underground infrastructure.

In 2019, a total of 10,290 m of diamond drilling was completed at Madrid North in 46 diamond drillholes. The surface program at Madrid included an infill drilling program to assist with the development and production of the near-surface mineralized Naartok East crown pillar, along with a winter ice drilling program at Suluk to assist with infill stope design and metallurgical testwork to support underground operations.

The Boston camp was opened late in the second quarter and a south belt regional drilling program was completed in the third quarter before transitioning to drilling on the Boston deposit in the fourth quarter. Five diamond drillholes were completed at Boston in 2019, totaling 3,650 m in 5 diamond drillholes. One hole was abandoned shortly after collaring due to excessive deviation.

The 2019 regional exploration program was designed to focus on highly prospective targets that are in proximity to established or planned infrastructure. The regional exploration program was split into two programs: (i) a northern regional program based out of the Doris camp, which commenced during the second quarter, and (ii) a southern regional program based out of the Boston camp, which commenced in the third quarter. Approximately 15,852 m of Regional exploration drilling was completed in 2019, in 37 diamond drillholes, targeting seven exploration areas. 2019 exploration drilling targets included Qaiqtuq, Naartok North and Patch 7, in the north portion of the Hope Bay belt, Pogey and Kamik in the midbelt area, and the Too showing and Domani trend in the south portion of the belt.

TMAC drill collars and historical drill collars for the Hope Bay belt are illustrated in Figure 10-1 through Figure 10-4. Regional targets for 2019 are presented in Figure 10-5.

Table 10-1. Drilling Summary

TMAC RESOURCES INC. – HOPE BAY PROJECT

Company	Years	No. of Core Holes	Metres Drilled	No. of RC Holes	Metres Drilled
BHP	Pre 1999	933	195,269	328	6,111
Miramar/Cambiex JV	1999-2002	730	110,293	587	13,389
Hope Bay Maximus JV	2001-2009	58	9,536	-	-
Miramar	2003-2007	847	258,116	383	6,774
Newmont	2008 to date	873	212,617	108	15,081
TMAC	2013-Present*	1204	286,016	24	464
Total		**4,645**	**1,071,847**	**1,430**	**41,819**

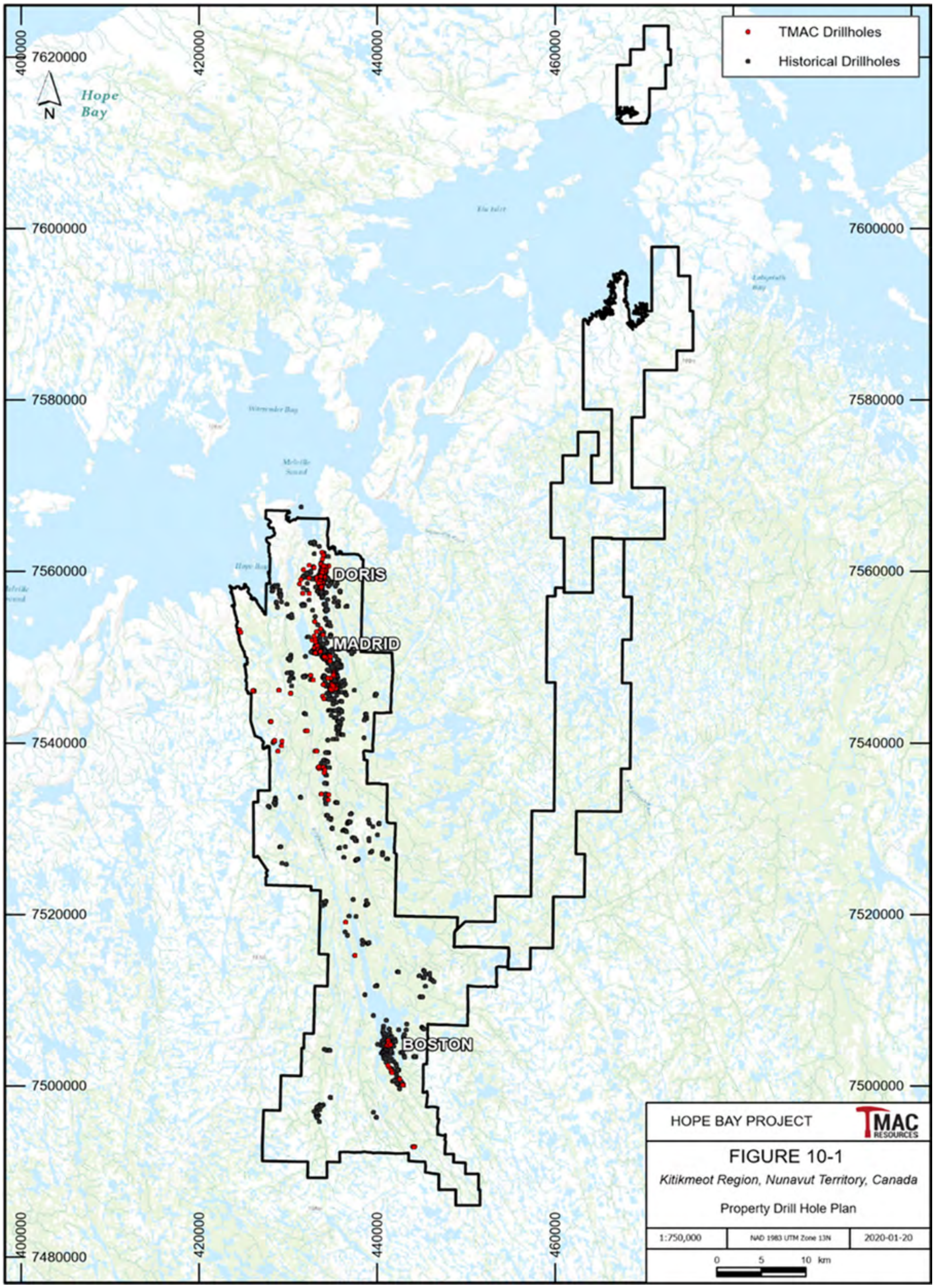


Figure 10-1. Kitikmeot Region, Nunavut Territory, Canada, Property Drill Hole Plan

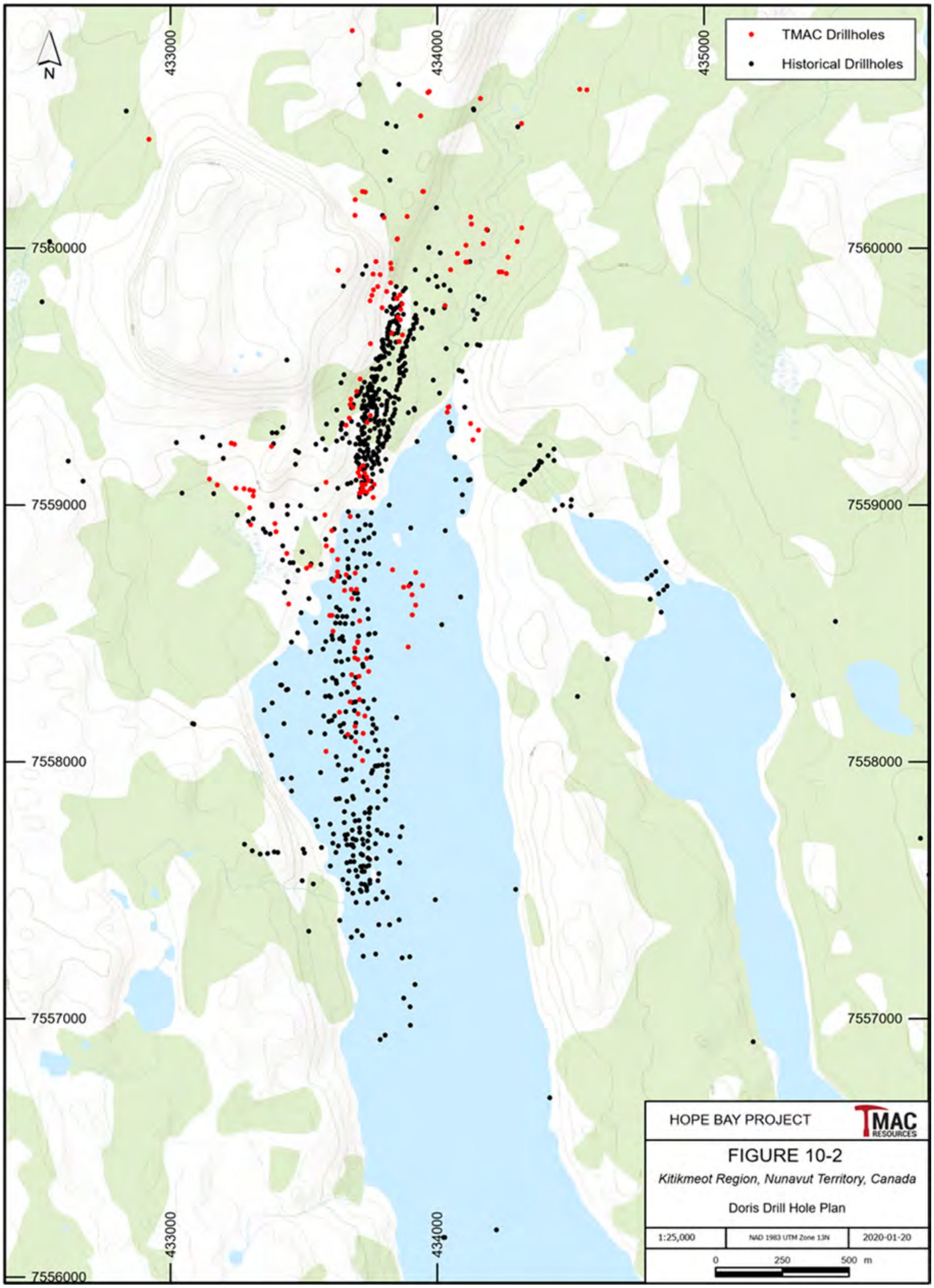


Figure 10-2. Kitikmeot Region, Nunavut Territory, Canada, Doris Drill Hole Plan

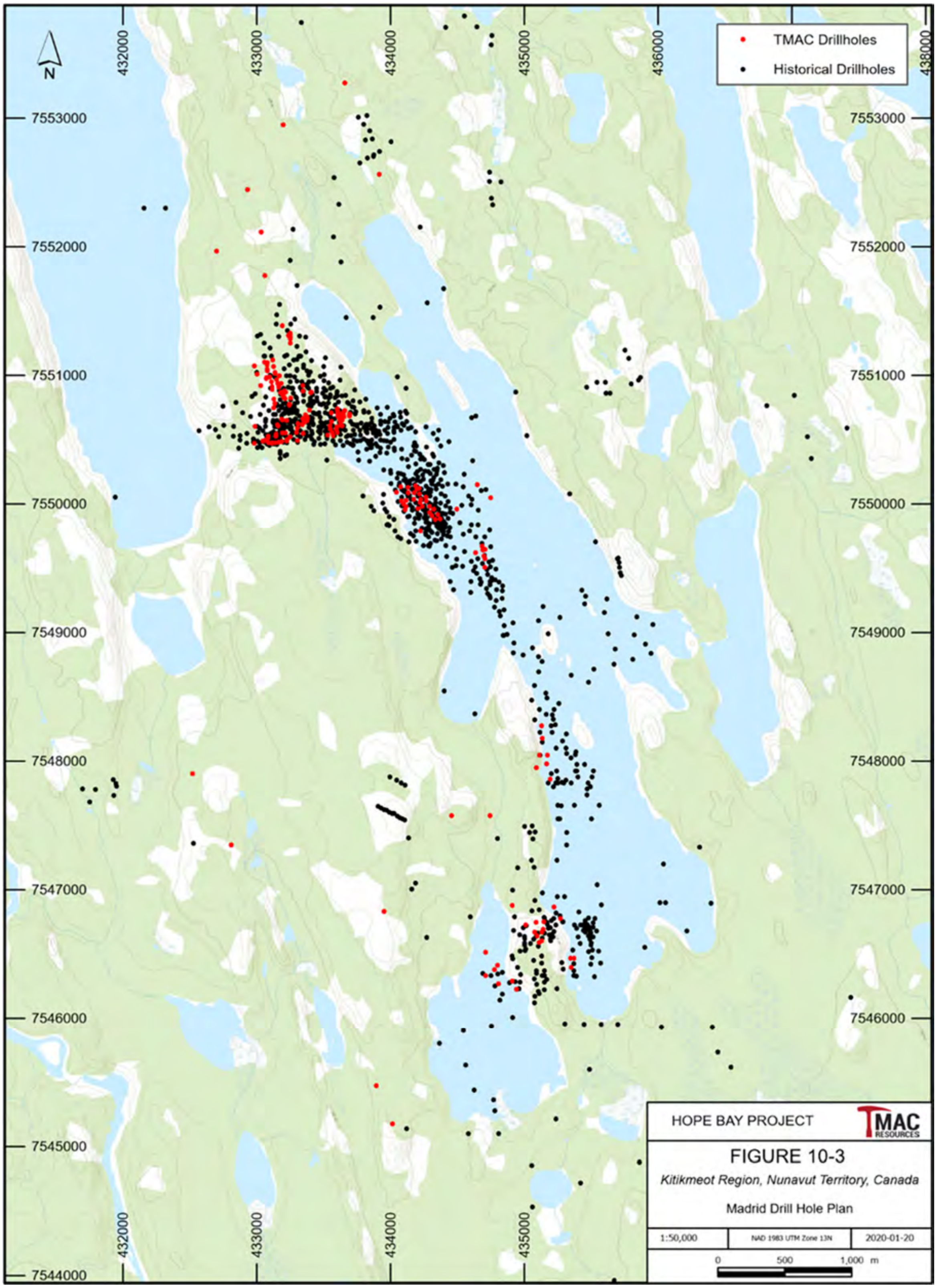


Figure 10-3. Kitikmeot Region, Nunavut Territory, Canada, Madrid Drill Hole Plan

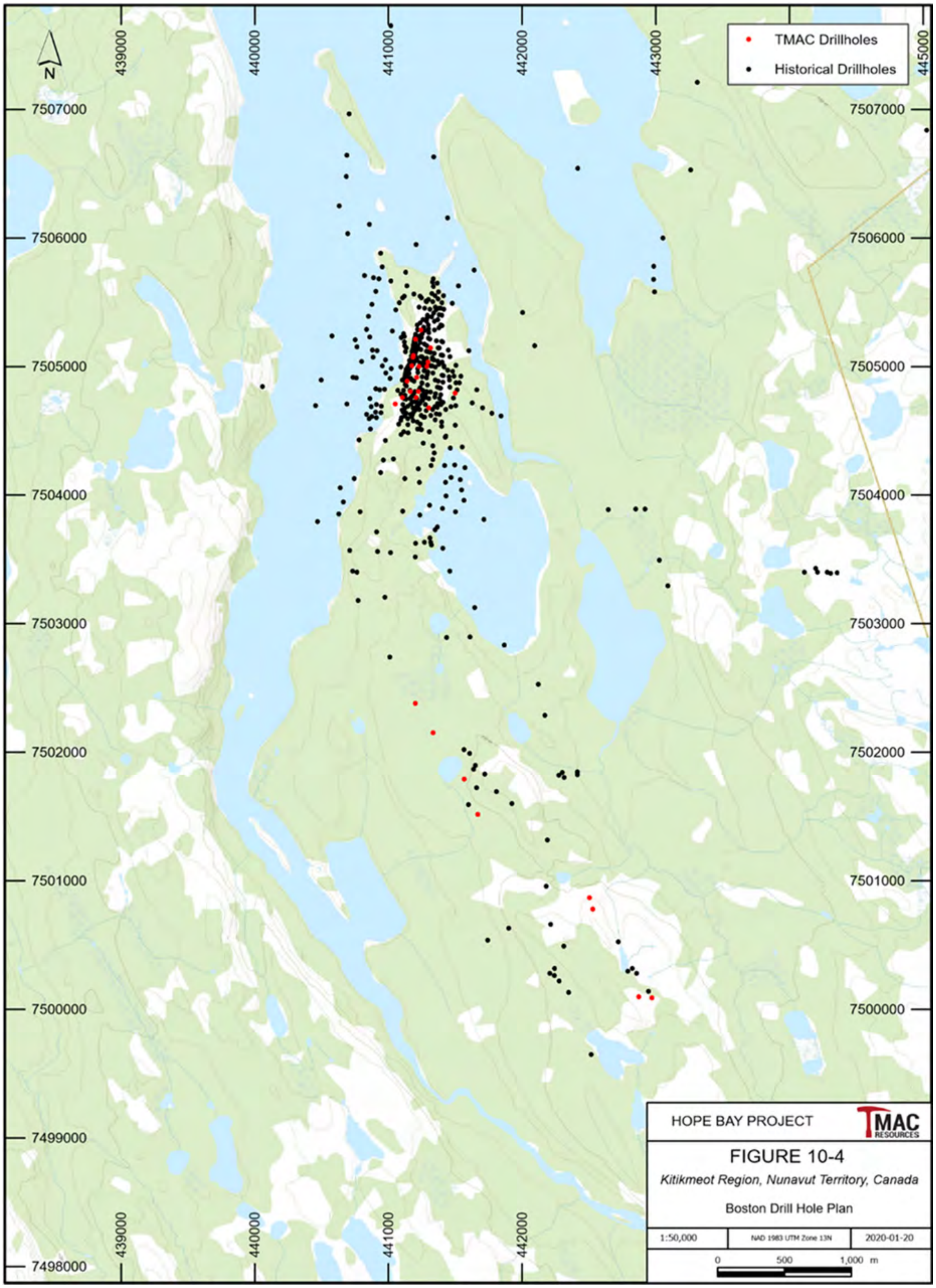


Figure 10-4. Kitikmeot Region, Nunavut Territory, Canada, Boston Drill Hole Plan

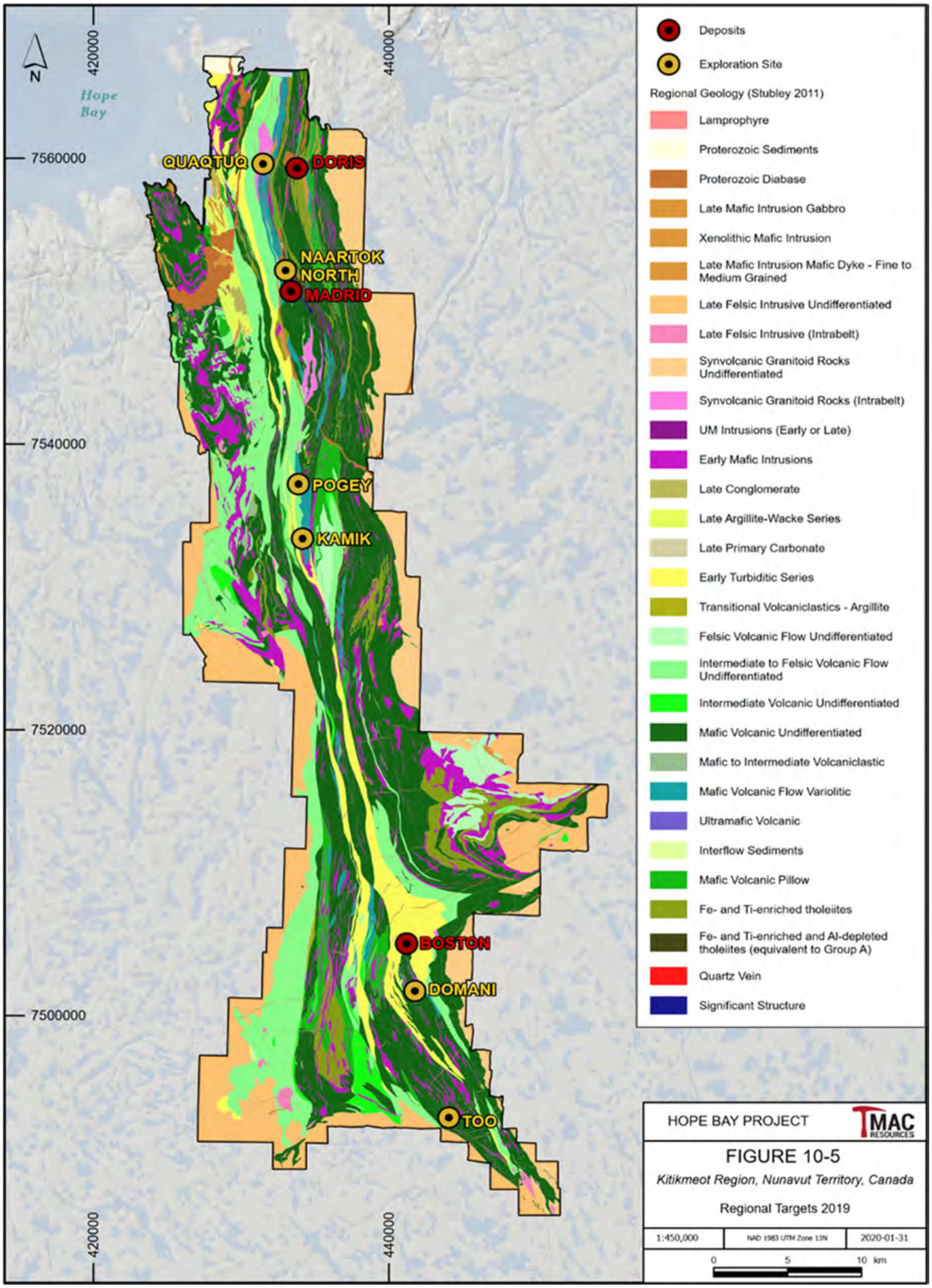


Figure 10-5. Kitikmeot Region, Nunavut Territory, Canada, Regional Targets 2019

10.1 GEOLOGICAL LOGGING

BHP PROGRAMS

RC HOLES

The RC samples were placed in ten-foot intervals on a board to allow visual comparison throughout the hole. Tills were logged by colour, clay, and sand content, percentages of various identifiable lithologies, and alteration. Alteration was particularly important, with a rudimentary clast lithology count serving as the predominant qualitative indicator.

Bedrock chips were classified according to the previously established logging codes for the core drilling projects (see next sub-section). Particular attention was paid to the weaker types of alteration (i.e., chlorite–calcite) as they form the largest haloes around the gold deposits.

CORE HOLES

BHP staff completed both geological and geotechnical logging. Geological logs were based on a set of pick-lists developed for the Project. Data recorded included lithology, quartz–pyrite, sericite, dolomite, and fuchsite alteration and intensity, graphite content, presence of sulphide mineralization, and structure.

Geotechnical logs comprised recording joint conditions and joint fill, number of natural and mechanical breaks per interval, rock quality designation (RQD), an estimation of the approximate ranges of compressive strength per interval, and discontinuity depth, type, direction, and fill.

MIRAMAR PROGRAMS

Geotechnical and geological logging data were recorded on Palm Pilots and laptops. Core was laid out and metre-marks noted on the core. RQD length, RQD%, and magnetic susceptibility were measured. Samples of five cm to seven cm length were selected from hangingwall, mineralized, and footwall zones for measurement of specific gravity, using the “weighing in air, weighing in water" method without wax immersion.

Logging focused on the collection of lithological, structural, and mineralogical parameters, as well as veining relationships and alteration intensity, which have a suspected or demonstrated relationship to gold mineralization. Data was entered into an Access database, with parameters described using pick-lists developed for each deposit or zone and with free-form descriptions as appropriate.

Following the logging, core was photographed. If requested by the logging geologist, uniaxial compressive rock strength (UCS) and joint sets were measured/logged for geotechnical data.

NEWMONT PROGRAMS

Core logging for the Newmont drill programs was based on the company manual, which required the following steps:

- Core was laid out, cleaned and core blocks were inspected.
- Metre marks were drawn on the core with permanent marker and core recovery was recorded.
- Measurements of the RQD were taken.

- Measurements of the magnetic susceptibility were taken.
- Measurements of the rock density were taken for hangingwall, mineralized, and footwall zones on 5 cm to 7 cm representative lengths of the core using the water displacement method (weighing core in air and water without wax immersion).
- Where graphite was present, a multimeter was used to measure conductivity.
- Where requested, the geologist drew cutting lines on the core with permanent marker, to ensure representative core splitting.
- Each core box was labelled and geologically logged.
- Core was photographed and subsequently sampled.
- The data from the core logging was uploaded to the Project server.
- Where requested by the geologist, internal rock strength core points were measured and different joint sets were described using information outlined in the company geotechnical manual.

The logging form contained fields for hole number, project name, date, geologist, azimuth, inclination, and total depth at the top of each page. Geological logging was conducted utilizing a standardized set of pull-down fields in each column for structure, lithology (formation and rock type), metallurgical type, intensity codes for metallurgy and alteration, and geotechnical parameters such as RQD and number of fractures per foot. Comments could be added in the far right column of the drill log at the geologist's discretion. Geology logs were directly uploaded from Newmont's in-house Visual Logger software to Newmont's standardized Global Exploration Database (GED) software interface, eliminating the data entry step and possible errors associated with traditional paper logs. A hard copy was printed out and archived.

TMAC PROGRAMS

RC CORES

RC samples were logged for lithology, alteration, texture, structure, mineralization, magnetic susceptibility. Samples were taken at intervals between 0.2-2.0 m and assayed for multi-element geochemistry, hyperspectral and gold and gold grain count in till.

CORE LOGGING AND SAMPLING

Core logging was completed digitally using CAE Mining's DHLogger software and managed in CAE Mining's Fusion database software. Following each shift, each core box was measured, labelled, geotechnical and geologically logged. Logging recorded lithology, alteration (including degree of intensity), texture, strain, veining, structure, structural measurements, magnetic susceptibility (every 3 m for exploration drill holes), mineralization (including percentage) and sample intervals. Items in the collar tab included; property, location, project area, hole size, casing, core storage, start and end dates, final log dates, core logger, purpose of drill hole, target description, final depth and comments. Limitations to core logging were present including (but not limited to): major units no less than 2 m in length unless a vein at greater than 0.3 m; lithological boundaries honored with regards to alteration, mineralization, and texture. Once major units were logged, written descriptions and summaries were recorded in the Datamine's DHLogger software. In 2018, a non-destructive analytical portable x-ray fluorescence spectrometer was implemented into the core logging process for real-time geochemical data processing and analysis.

Once logged, samples were selected. Exploration holes were sampled full column while production cores were sampled in the ore zones with shoulder samples before and after zones of interest at a minimum of 1 metre. Sample lengths for exploration and production cores range from

0.3-1.5 m and 0.3-1.3 m respectively. In the event visible gold is observed, a request for screen assay is recorded in DHLogger and forwarded to ALS. Screen assays were performed solely on exploration cores, not inclusive of production. Following sampling, cores were photographed dry and wet. In 2019, production cores were whole rock sampled while all exploration cores half split for assay with a diamond blade saw. Following split or whole rock sampling, QA/QC standards and blanks were inserted every 20 samples and samples prepped for off-site shipment. Production cores were sent to ALS for analysis with the odd hole sent to the on-site SGS lab at TMAC's Doris site. All exploration core was forwarded to ALS for prep and analysis, in Yellowknife and Vancouver respectively. For more information on sample preparation, analysis and security, please refer to Section 11.0.

GEOTECHNICAL LOGGING

Core oriented geotechnical logging commenced in 2013. This does not include production diamond drilling for underground resource infill following 2019. Core orientation was implemented through the use of the Reflex ACT III tool which displays accelerometer data collected via time stamping technology, including depth values, (when entered at each orientation), inclination, roll, gravity and temperature. This tool allowed orientation lines to be drawn on clean core which was used to take structural measurements with variable levels of confidence from QD0 to QD3. Rock quality designations (RQD) were measured for exploration cores. The amount of natural and mechanical fractures were recorded. In 2019, RQD was not measured for production core.

RECOVERY

Recovery is calculated for the entire drillhole for all surface exploration drilling and 15 m above and below the ore zone for underground drillholes at Doris on diamond drill holes logged earlier than 2019. No areas of very poor ground were noted. Typical recoveries across the belt ranged between 60% and 100%.

COLLAR SURVEYS

Pre-2013

- All the drillhole collars completed at Boston by BHP were surveyed using a theodolite to accurately position the drill hole collar location and drillhole azimuth with respect to the local Boston coordinate system.
- All core drillhole collars during the Miramar campaigns, including the Hope Bay Joint Venture, were established by total station surveying carried out by a Miramar contract surveyor. RC drill collars were laid out and surveyed post-drilling using a differential GPS system.
- All Newmont drill hole collar surveys were performed by surveyors utilizing a series of control points. All collars were established by total station and differential GPS. Established control points are situated throughout the Hope Bay belt.

Post-2013

- Planned TMAC collars were staked using a Trimble Differential GPS. When drills are situated in winter shacks, collars were off-set from planned by a fixed distance. On surface, azimuth is calculated using front- and back-sight stakes. While underground, azimuth was assigned using a DeviAligner instrument. Drillhole dips were lined up using an inclinometer. For surface drilling, once casing is set, downhole directional surveys were completed to ensure accurate direction of hole prior to production. All final collars on surface were surveyed using a Trimble Differential GPS and underground collars surveyed

with a Leica total station. DHLogger tracks planned collar locations and final survey locations.

DOWNHOLE SURVEYS

Pre-2013

- Most of the BHP surface drill holes were inclined. The direction of diamond holes drilled during the 1992 and 1993 field season were monitored using a Roto-Dip and/or Sperry-Sun single-shot survey taken while drilling. Upon drillhole completion, each drill hole was surveyed using a Sperry-Sun multi-shot survey tool. From 1994, BHP core holes were downhole surveyed using a Light-log instrument. Readings were taken at 42 second time intervals from approximately 10 feet depth to the end of hole.
- For some of the holes completed by Miramar in 2000, downhole surveys were performed by J. L. Corriveau and Associates Ltd., but for the majority, downhole surveys were conducted by International Directional Services of Sudbury, Ontario, using a photo-gyro unit. No downhole surveying was completed during the Miramar campaigns to determine true dips of vertical RC holes; an inclinometer was utilized on angled RC holes to estimate drillhole inclination.
- All Newmont core holes were downhole surveyed using Light Lo, Maxibor, or photo-gyro survey instruments. No downhole surveying was completed to determine true dips of vertical RC holes; an inclinometer was utilized on angled RC holes to estimate drillhole inclination.

Post-2013

- In 2013, TMAC completed downhole directional surveys on 30 metre to 60 metre intervals with the Reflex Ez-trac instrument. This is a magnetic azimuth based system. Additional readings were taken in areas were the azimuth reading was suspect. Anomalous azimuth readings were flagged as “Dip-only” in the Fusion database. From 2014 to 2017, a Reflex Gyro non-magnetic survey tool was used and in 2018 tools were converted to the Champ Gyro north seeking solid state gyro system. From April 2019 onwards, underground surveys were performed with the Devico DeviFlex instrument. Surveys completed by the contract diamond drillers underground with check surveys done roughly 1 in 25 surveys by a Geologist or Geotechnician using a Champ Gyro tool. In 2020, downhole directional surveys for surface drill holes will be tested with the non-magnetic DeviGyro instrument. All downhole surveys are reviewed with QA/QC measures through both in/out surveys with check surveys completed on underground diamond drill holes by a Geologist or Geotechnician every 1 in 25 surveys.

11.0 SAMPLE PREPARATION, ANALYSES AND SECURITY

11.1 SAMPLE PREPARATION AND ANALYSIS (PRE 2006)

All samples submitted between 2000 and 2006 were sent to TSL Laboratories Inc. (TSL) in Saskatoon, Saskatchewan. TSL has attained ISO/IEC 17025 accreditation, which verifies that TSL are technically competent to produce calibration and testing results.

Drill core samples are prepared as follows:

- Primary crush entire sample using a jaw crusher;
- Secondary crush using a rolls crush to 95% passing 1.7mm (-10 mesh);
- Riffle-split 1,000 grams;
- Pulverize 1,000 gram to 95% passing 106 µm (-150 mesh).

An assay ton (58.4 grams) of the prepared pulp is analysed for gold using lead fire assay with a gravimetric finish. For assays with gold greater than 20 g/t the remaining prepared pulp is further analysed by metallic screen fire assay. If samples were identified as containing visible gold they were sent directly for metallic screen fire assay.

A selection of pulps were sent to ALS Minerals (ALS) in North Vancouver for check assaying. ALS is ISO/IEC 17025 and ISO 9001:2000 accredited.

11.2 SAMPLE PREPARATION AND ANALYSIS (2006-2012)

All samples submitted between 2006 and 2012 were prepared and analysed by ALS. Between 2008 and 2012, some samples were submitted to ACME Analytical Labs (ACME) in Vancouver. ACME is ISO/IEC 17025 and ISO 9001 accredited. Check assays were sent to TSL Laboratories in Saskatoon.

Drill core samples are prepared as follows:

- Primary crush entire sample using a jaw crusher;
- Secondary crush using a rolls crusher to 95% passing 1.7mm (-10 mesh);
- Riffle-split 1,000 grams;
- Pulverize 1,000 gram to 95% passing 106 µm (-150 mesh).

An assay ton (58.4 grams) of the prepared pulp is analysed for gold using lead fire assay with a gravimetric finish. For assays with gold greater than 20 g/t the remaining prepared pulp is further analysed by metallic screen fire assay. If samples were identified as containing visible gold they were sent directly for metallic screen fire assay.

A selection of pulps were sent to TSL in Saskatoon for check assaying.

11.3 SAMPLE PREPARATION AND ANALYSIS (2013-2014)

All drill core samples submitted in 2013 and 2014 were prepared at ALS Minerals in Yellowknife, NWT and analysed for gold at ALS Minerals, Vancouver, BC.

Drill core samples are prepared as follows:

- Primary crush entire sample using a jaw crusher.

- Secondary crush using a rolls crusher to 95% passing 1.7mm (-10 mesh).
- Rotary-split 1,200 grams.
- Pulverize 1,200 gram to 95% passing 106 µm (-150 mesh).

A 30 gram aliquot of the prepared pulp was analysed for gold using lead fire assay with an atomic absorption finish (AAS) (Method code AA23). For assays with gold greater than 0.25 g/t, a 50 gram aliquot of the sample was re-analysed for gold using lead fire assay with AAS finish (Method code AA26). For assays with gold greater than 10 g/t the remaining prepared pulp was further analysed by metallic screen fire assay. If samples were identified as containing visible gold they were sent directly for metallic screen fire assay. In 2014, the 30 g fire assay for samples with visible gold was discontinued and when samples were analyzed by metallic screen fire assay, a sample from an interval on either side was also sent for metallic screen fire assay.

The priority order in the assay database is established as the metallic screen assay when available, followed by the 50 gram fire assay and then the 30 gram fire assay. Table 11-1 summarizes the analytical methods and detection limits for each of the assay procedures.

Table 11-1. Gold Detection Limits

TMAC Resources Inc. – Hope Bay Project

Procedure	Sample Weight (g)	Lower Limit (g/t)	Upper Limit (g/t)
Au_AA23	30	0.005	10.0
Au-AA26	50	0.01	100.0
Au-GRA22	up to 50	0.05	10,000
Au-SCR24g	up to 1,000	0.05	1,000

11.4 SAMPLE PREPARATION AND ANALYSIS (2015-2019)

All drill core and production chip samples submitted between 2015 and 2019 were prepared at ALS Minerals in Yellowknife, NWT and analysed for gold at ALS Minerals, Vancouver, BC. Beginning in 2017, production chip samples were prepared and analysed at the TMAC on-site laboratory operated by SGS Minerals.

Drill core samples submitted to ALS are prepared as follows:

- Crush entire sample to >95% passing 2mm
- Rotary-split 1,200 grams
- Pulverize 1,200 gram to 95% passing 106 µm (-150 mesh)

In 2018, the sample procedure at ALS was updated to pulverize 1,000 grams to 85% passing 75 µm for sample preparation efficiency and cost savings at the on-site laboratory.

For samples submitted to ALS, a 50 gram aliquot of the prepared pulp was analysed for gold using lead fire assay with an atomic absorption finish (AAS) (Method code AA26). For assays with gold greater than 100 g/t, another 50 gram aliquot was analysed for gold using lead fire assay with a gravimetric finish (GRA22). Samples that were identified as containing visible gold were sent directly for metallic screen fire assay (SCR24) and bypassed the AA-26 method.

Drill core and production samples submitted to the on-site laboratory are prepared as follows:

- Crush entire sample to >95% passing 2mm
- Rotary-split 300 grams for production and 500 grams for drill core
- Pulverize the split to 90% passing 75 µm (-200 mesh)

For metallic screen fire assay at the on-site laboratory, 750 to 1,000 grams of sample is pulverized to 95% passing 106 microns (140 mesh). The coarse fraction is assayed to extinction and two 30 gram assays are taken of the fine fraction.

For core samples submitted to the on-site laboratory, a 50 gram aliquot of the prepared pulp was analysed for gold using lead fire assay with AAS finish (GCFAA35V). For assays with gold greater than 100 g/t and samples identified as containing visible gold, the prepared pulp is assayed by metallic screen fire assay. The chip and muck samples are assayed using a 30 gram aliquot.

The priority order in the assay database is established as the screen fire assay when available, followed by the 50 gram fire assay with a gravimetric finish and then the 30 gram fire assay. Table 11-2 summarizes the analytical methods and detection limits for each of the assay procedures.

Table 11-2. Gold Detection Limits

TMAC Resources Inc. – Hope Bay Project

Procedure	Sample Weight (g)	Lower Limit (g/t)	Upper Limit (g/t)
Au-AA26	50	0.01	100
Au-GRA22	up to 50	0.05	10,000
Au-SCR24g	up to 1,000	0.05	1,000
Au-FAA35V	Up to 1,000	0.01	100

11.5 SAMPLE SECURITY

The Hope Bay Project has security protocols in place to ensure the security of its core samples and the analytical data derived from them. Among these are:

- Individual plastic sample bags are securely sealed with non-reusable zap straps prior to being placed in larger rice bags for shipment off site in charter aircraft.
- Neither drill hole numbers nor sample intervals are written on the sample tags included with the samples shipped, so the laboratory cannot identify the locations of the samples.
- Assay results are restricted to a small number of project personnel and only a limited number of personnel can relate the sample numbers and assays to the drill hole from which they came.

11.6 OPINION

In the opinion of the Q.P., the sample preparation, security, and analytical procedures at the Hope Bay Project meet or exceed industry standards.

See Section 12.0 for further information on QA/QC.

12.0 DATA VERIFICATION

Quality assurance (QA) consists of evidence to demonstrate that the assay data has precision and accuracy within generally accepted limits for the sampling and analytical method(s) used in order to have confidence in a resource estimate. Quality control (QC) consists of procedures used to ensure that an adequate level of quality is maintained in the process of collecting, preparing, and assaying the exploration drilling samples. In general, quality assurance/quality control (QA/QC) programs are designed to prevent or detect contamination and allow assaying (analytical), precision (repeatability), and accuracy to be quantified. In addition, a QA/QC program can disclose the overall sampling-assaying variability of the mineralization itself. The QA/QC and data verification programs undertaken to date at the Project are summarized below.

12.1 BHP PROGRAMS

No information is available on any data verification programs undertaken by BHP.

12.2 MIRAMAR PROGRAMS

In April 2000, RPA carried out a review to provide an independent opinion of the work practices, including drill core logging and sampling procedures, as well as sample preparation and assay procedures at TSL in Saskatoon. No significant issues were noted from the review.

SRK performed a review of the Project data in 2002, in support of mineral resource estimates at Doris North, and in preparation of a technical report. SRK stated that the quality of the analytical data is reliable and that the sample preparation, analysis, and security were carried out in accordance with best practices and industry standards.

RPA reviewed Project data again in 2003 during the preparation of an updated technical report. RPA commented that no significant issues were noted from the review.

In 2006, Watts, Griffis, and McOuat (WGM) undertook a site visit during which a selection of current and historic drill core for the Madrid, Doris, and Boston deposit areas was reviewed. WGM also inspected the core logging and sawing facilities and reviewed core logging and sawing protocols, and QA/QC and security procedures. No significant issues were noted during the site visit.

12.3 NEWMONT PROGRAMS

Newmont used the following protocols during data upload to the Project database:

- Validation by the Database Analyst on uploading logging forms to the database.
- Validation using routines in GEMS software.
- Assay results were received from assay laboratories as digital Microsoft Excel files via email, to a restricted list of email addresses compiled by the Technical Services Manager and the Exploration Manager and macros were used to automate the import process in order to minimize the possibility for error.
- Fire assays and screen metallic assays were maintained in separate database tables.
- When the signed hard copy certificates arrived, approximately 20% were manually checked against the compilation database tables to verify the veracity of the digital data.

2008 DATA REVIEW

Database verification was carried out in early 2008 by matching the hardcopy library files to the queried Gemcom database. Every result on the list greater than the cut-off was verified by physically looking at all the assay certificates in the library to verify both the accuracy and completeness of the database. Any discrepancies were noted and summarized in accompanying Excel spreadsheets. The database itself was not updated.

2009 DATA REVIEW

In January 2009, Newmont undertook a review of the existing databases for the Doris, Madrid, and Boston areas. The review comprised:

- Validation of 100% of drill hole collars;
- Validation of 100% of downhole azimuths and dips;
- Validation of 10% of gold assays;
- Validation of the local grid to UTM transformation process.

A total of 668, 1,264, and 1,306 drill holes for Doris, Boston, and Madrid respectively were checked.

Newmont concluded from this work that:

- Hope Bay collar locations were accurate. The error rate, defined as the number of collars with an error in easting, northing, or elevation as a percentage of collars audited was about 5% across all datasets.
- Hope Bay downhole survey data was good. The error rate for Boston and Madrid was less than 1%. The error rate for Doris was 17% and could be reduced by re-importing corrupted and missing survey records.
- Assay data quality was very good. The error rate was less than 2% across all projects. The assay methodology was fire assay throughout – no aqua regia assays existed in the database.
- Recommendations for future action included:
- Assess whether any other data were available on site, including original collar and downhole survey data and sample tags.
- Compile a list of collar survey methods, quantify the method accuracy, and flag drill holes as surveyed or estimated.
- Compile a list of downhole survey methods, quantify the dip accuracy, quantify the dip and azimuth accuracy, and flag drill holes as surveyed or estimated.

As part of this comprehensive and ongoing QA/QC program for gold analyses, blank and standard samples were routinely inserted into the sample stream. Screen metallic fire assays were performed on samples returning higher than 20 g/t Au on fire assay with a gravimetric finish, and approximately 4% of the samples were re-assayed by an external laboratory throughout the duration of the drilling program. In accordance with the QA/QC procedures, data collected were reviewed, and if necessary, re-analyzed.

RPA reviewed the reports generated from these QA/QC programs and is of the opinion that the data verification programs undertaken on the data collected from the Project adequately support the geological interpretations, the analytical and database quality, and the use of the data in Mineral Resource estimation.

12.4 TMAC PROGRAMS

AUDIT OF DRILL HOLE DATABASE (2015)

In 2015, RPA compared 100% of the 2013 and 2014 sample databases to assay certificates from ALS. No major discrepancies were found, however, RPA noted the following:

- Nine samples (<1%) differed by more than 0.05 g/t Au from the drill hole database. Of these, eight appear to be screen metallic results not incorporated into the final drill hole database.
- 113 samples (1%) differed by more than 0.05 g/t Au from the drill hole database. Of these, eight use a different assay result than expected, 70 samples use a default value where an actual value exists, and 32 samples use an incorrect default value.

RPA was of the opinion that these inconsistencies were minor and that the drill hole database is acceptable for use in a Mineral Resource estimate.

AUDIT OF DRILL HOLE DATABASE (2019)

In 2019, TMAC performed an audit of 5% of the assay information (comparing assay certificates with the assay data) and 100% of the drill hole information (collar, survey, lithology and sample interval data). No discrepancies were found in the assay certificate check. No major discrepancies were found in the drill hole audit, however, the following was noted:

- There was one instance (<1%) where the maximum depth of the survey exceeded the recorded drill hole length. However, this error was in a hole that did not reach target and was redrilled.
- There was one instance (<1%) where a sample interval was entered incorrectly. This error was at the beginning of the hole before the target was reached.

No significant errors were found in the drill hole database. In the opinion of the author, the database is suitable to support the estimation of Mineral Resources and Mineral Reserves.

12.5 QUALITY CONTROL PROGRAMS (PRE TMAC)

No information is available to describe the quality control program used by BHP at the Hope Bay Project before 1999.

The data produced by Miramar, between 2003 and 2007, was reviewed extensively by multiple independent consultants. The reviews include: RPA in April 2000, SRK in 2002, RPA in 2003, Watts, Griffs and McOuat in 2006. No significant issues were identified and additional details are available in the technical report prepared by RPA dated May 28, 2015.

RPA reviewed the Newmont data for the years 2008 to 2012 and associated quality control programs. The Newmont quality control program consisted of the routine insertion of blank materials and reference materials. Metallic screen fire assays were done on assays with greater than 20 g/t gold. Approximately 4% of the samples were submitted for check assaying. The quality control procedures assured that the quality control data were reviewed, and repeat assays completed if necessary. RPA concluded that the data are suitable for Mineral Resource estimation. (Clow 2015)

12.6 QUALITY CONTROL PROGRAMS (TMAC 2013-2014)

As part of the Technical Report published on May 28, 2015, RPA reviewed the quality control data inserted in 2013 and 2014. Reference materials were submitted with an overall insertion rate of 3% and blank materials, 2% insertion rate. A certified reference material was said to have failed if the results were outside three standard deviations or two consecutive reference materials are outside two standard deviations. RPA concluded that the certified reference materials performed well and no biases were present. TMAC performed timely and ongoing monitoring of mislabels and failures. (Clow 2015) The blank material being inserted was diabase core obtained from Newmont historical drilling. A blank material was said to have failed if the gold results was more than ten times the detection limit. Only one failure was identified for blanks.

Quarter core duplicates were taken at a rate of 1 per 45 samples. The data were plotted and RPA concluded that no bias was present but there was considerable scatter of the assays for the half core to quarter core duplicates. RPA concluded that the reproducibility of the core duplicates was as expected for the deposit type.

The results of check assays were not available at the time of the writing of the 2015 report so conclusions were not made.

12.7 QUALITY CONTROL PROGRAMS (ALS MINERALS) (TMAC 2015-2019)

TMAC Resources engaged Analytical Solutions Ltd. in December 2019 to prepare an independent report related to the performance of the quality control program for results returned between April 1, 2015 and June 30, 2019. The following information draws from this report.

Approximately 85,000 drill core and chip samples (including quality control samples) were collected and assayed from the various deposits that make up the Hope Bay Project.

The TMAC quality control program consists of the routine insertion of certified reference materials and blank materials as well as the submission of pulps to a secondary laboratory for check assaying. Reference materials are inserted at a rate of 1 in 40 samples and blank materials are inserted at a rate of 1 in 50 samples.

BLANKS

Barren coarse material is submitted with samples for crushing and pulverizing to determine if there has been sample cross-contamination in preparation and may also indicate sources of contamination in the fire assay procedure, in the analytical procedure or as sample solutions carry-over during instrumental finish.

TMAC utilizes Franklyn diabase core from historical drilling on the Hope Bay property as blank material. The diabase has been previously tested to confirm that it does not contain gold.

A total of 2,027 blanks were submitted to ALS with samples. The maximum allowed value for gold in the blank material is 0.1 g/t. One and a half percent of the inserted blanks reported gold values above 0.1 g/t. This is considered acceptable for the project and no systematic contamination has been identified.

REFERENCE MATERIALS

TMAC inserted a total of ten certified reference materials between 2015 and 2019. The materials are commercial reference materials prepared by CDN Labs (CDN) and Ore Research and Exploration (ORE). The reference material names and expected values can be found in Table 12-1. The expected values and standard deviations were taken from the certificates provided by the supplier.

Table 12-1. List of Inserted Reference Materials and Expected Values

Reference Material	Element	Expected Value (g/t)	1 SD
CDN-GS-22	Au	22.94	0.560
OREAS 200	Au	0.34	0.012
OREAS 202	Au	0.752	0.026
OREAS 206	Au	2.197	0.081
OREAS 207	Au	3.472	0.130
OREAS 208	Au	9.248	0.438
OREAS 215	Au	3.54	0.097
OREAS 217	Au	0.338	0.010
OREAS 228b	Au	8.57	0.199
OREAS 239	Au	3.55	0.086

Reference materials are submitted with samples to identify if there were assay problems with specific batches and possible long-term biases in the overall dataset. The failure criteria were set as cases where the results were outside three times the standard deviation.

A total of 2,279 certified reference materials were inserted with samples and analysed for gold. The average gold values reported for the certified reference materials are compared against the expected values in Table 12-2. Control charts were prepared for all of the CRMs and no biases are evident.

Table 12-2. Summary of Reference Material Performance for Gold

RM	N	Outliers Excluded	Failures Excluded	Accepted Au g/t		Observed Au g/t		% of Accepted
				Accepted	Std. Dev.	Avg.	Std. Dev.	
OREAS 217	501	3	7	0.338	0.010	0.337	0.010	100%
OREAS 200	439	1	2	0.340	0.012	0.341	0.010	100%
OREAS 202	50	-	-	0.752	0.026	0.758	0.023	101%
OREAS 206	77	-	-	2.197	0.081	2.209	0.058	101%

RM	N	Outliers Excluded	Failures Excluded	Accepted Au g/t		Observed Au g/t		% of Accepted
				Accepted	Std. Dev.	Avg.	Std. Dev.	
OREAS 207	383	2	1	3.472	0.130	3.504	0.088	101%
OREAS 215	369	-	2	3.540	0.097	3.531	0.079	100%
OREAS 239	38	2	-	3.550	0.086	3.544	0.084	100%
OREAS 228b	36	-	3	8.570	0.199	8.582	0.221	100%
OREAS 208	281	1	-	9.248	0.438	9.404	0.275	102%
CDN-GS-22	77	1	3	22.94	0.560	23.14	0.756	101%
Total	2,251	10	18	Weighted Average				100%

A total of twenty-eight quality control failures where identified. Four failures are suspected sample switches or mis-labels. Based on a total of 2,279 gold determinations and twenty-eight QC failures, this is a low failure rate of 1.2% and is acceptable.

The average accepted values reported for each reference material are calculated and compared to the Accepted Value. The calculated Percent of Accepted value should range between 98 to 102%.

The percent of Accepted values for gold in all ten certified reference materials fall within 100-102% and demonstrate good accuracy with respect to the Accepted Values. There are no noticeable biases present in the reference material data.

REPRODUCIBILITY OF LABORATORY PREPARATION AND PULP DUPLICATES

Commercial laboratories routinely assay a second aliquot of the sample pulp at a frequency of approximately one in ten samples. For preparation duplicates, the frequency is one in fifty samples. The data are used by the laboratory for the internal quality control monitoring.

Results for pulp and preparation duplicates were reviewed and fall within expected ranges for gold assays. Only the duplicate pairs above ten times the lower detection limit are considered significant and are included in calculations.

A total of 1,457 pulp duplicate pairs out of a total 4,275 reported above 0.05 g/t gold. Eighty-seven percent of the duplicate pairs above ten times the detection limit reported within ±25%.

A total of 393 preparation duplicates pairs out of a total 1,116 reported above 0.05 g/t gold. Seventy-four percent of the duplicate pairs above ten time the detection limit reported within ±25%.

The results are consistent with expectations for the deposit type. The pulp and coarse reject duplicate data further indicate assays are suitable for use in mineral resource estimation.

METALLIC SCREEN FIRE ASSAY

A total of 2,830 samples were assayed by metallic screen fire assay. Of these samples, 108 were first assayed by FA-AAS. The data are compared in Figure 12-1. There is generally good agreement between the FA-AAS and metallic Screen Fire.

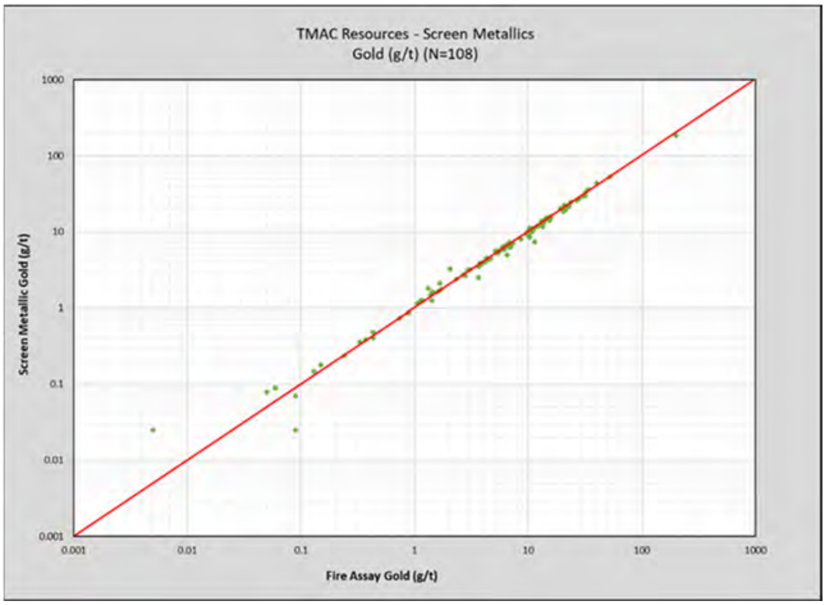


Figure 12-1. Comparison of FA-AAS and Metallic Screen Fire

To support the recommendation and on-going analysis of gold by metallic screen fire the percentage of gold reporting to the coarse fraction of the metallic screen fire, is plotted against the calculated gold grade in Figure 12-2.

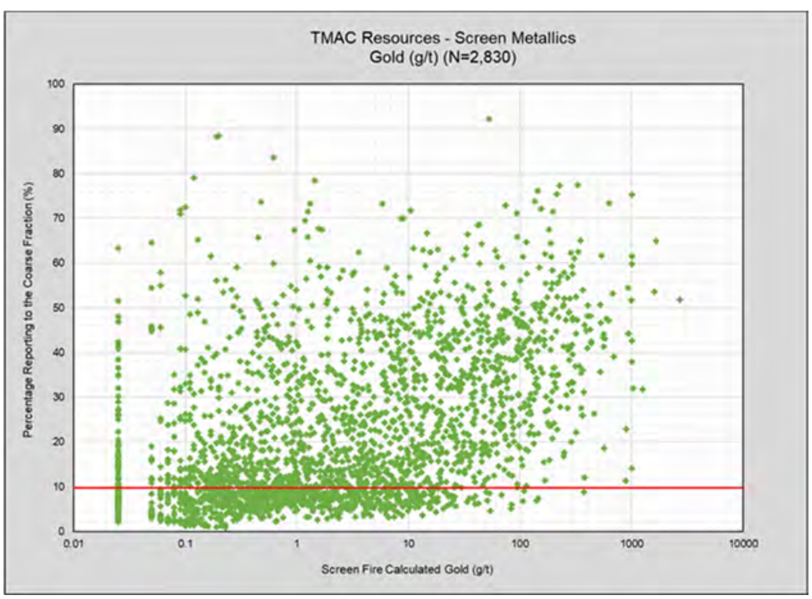


Figure 12-2. Percentage of Gold Reporting to the Coarse Fraction for Metallic Screen Fire

Samples are screened to 106 µm. For 40% of the samples, the percentage of gold reporting to the coarse fraction is less than 10%. However, the majority of the samples have greater than 10% of the gold reporting to the coarse fraction which is usually an indication that assay sub-samples will be prone to poor reproducibility. This indicates that metallic screen fire assays are recommended.

CHECK ASSAYS

Check assays consist of submitting the pulp that was assayed originally to a different laboratory for the same analytical procedures to augment the assessment of bias, in addition to reference materials submitted to the original laboratory.

A total of 1,521 sample pulps, selected from 2017 to 2019 samples, were submitted to Bureau Veritas (BV), Vancouver for check assaying. Bureau Veritas is a well-established laboratory that is certified to ISO 17025 standards for gold analyses.

There is good agreement between ALS and BV gold assays and no bias is evident. Over 85 percent of the check assay results for gold above ten times the detection limits are within ±25 percent of the two sets of laboratory results which is considered acceptable. This is comparable to the results for the pulp duplicates reported in the previous section. See Figure 12-3.

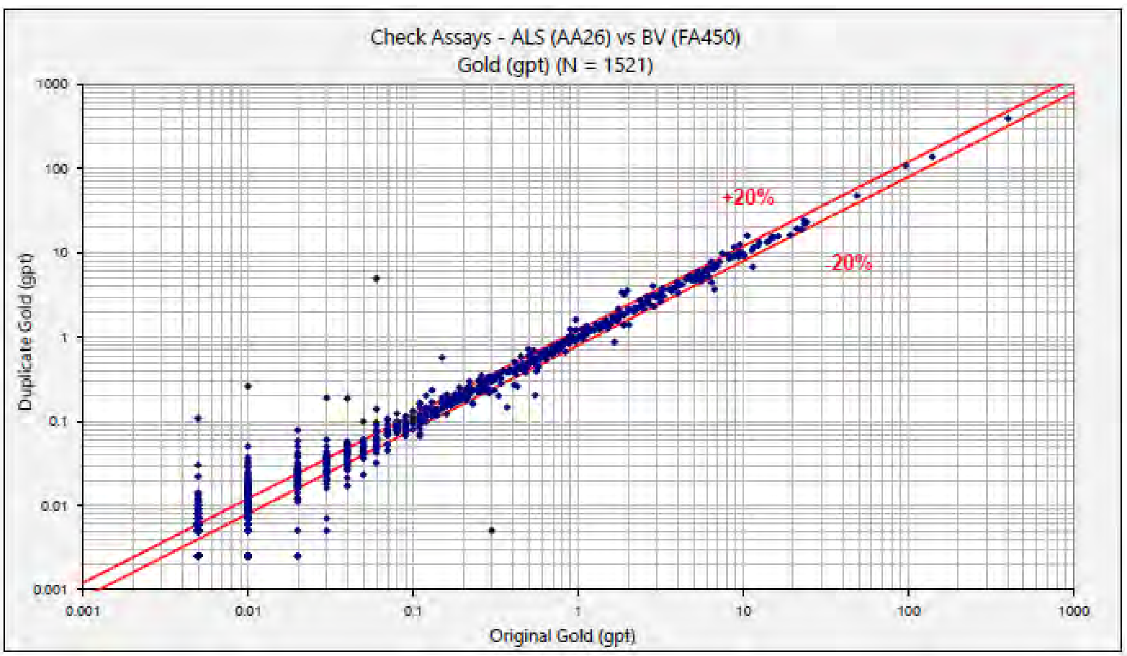


Figure 12-3. Check Assays for Gold - ALS vs BV

12.8 QUALITY CONTROL PROGRAMS (ON-SITE LABORATORY) (TMAC 2017-2019)

The TMAC quality control program at the on-site laboratory consists of the routine insertion of certified reference materials and blank materials as well as the submission of pulps to a secondary laboratory for check assaying. Reference materials are inserted at a rate of 1 in 40 samples and blank materials are inserted at a rate of 1 in 50 samples.

BLANKS

Barren coarse material is submitted with samples for crushing and pulverizing to determine if there has been sample cross-contamination in preparation and may also indicate sources of contamination in the fire assay procedure, in the analytical procedure or as sample solutions carry-over during instrumental finish.

TMAC utilizes Franklyn diabase core from historical drilling on the Hope Bay property as blank material. The diabase has been previously tested to confirm that it does not contain gold.

A total of 191 blanks were submitted to the on-site laboratory with samples. The maximum allowed value for gold in the blank material is 0.1 g/t. Nine percent of the inserted blanks reported gold values above 0.1 g/t. Two samples are possible mis-labels. The contamination is isolated to samples analyzed in March 2019. This is considered acceptable for the project and no systematic contamination has been identified.

REFERENCE MATERIALS

TMAC inserted a total of eight certified reference materials between 2017 and 2019. The materials are commercial reference materials prepared by CDN Labs (CDN) and Ore Research and Exploration (ORE). The reference material names and expected values can be found in Table 12-3. The expected values and standard deviations were taken from the certificates provided by the supplier.

Table 12-3. List of Inserted Reference Materials and Expected Values

Reference Material	Element	Expected Value (g/t)	1 SD
CDN-GS-22	Au	22.94	0.560
OREAS 208	Au	9.248	0.438
OREAS 228b	Au	8.57	0.199
OREAS 239	Au	3.55	0.086
OREAS 215	Au	3.54	0.097
OREAS 207	Au	3.472	0.130
OREAS 200	Au	0.34	0.012
OREAS 217	Au	0.338	0.010

Reference materials are submitted with samples to identify if there were assay problems with specific batches and possible long-term biases in the overall dataset. The failure criteria were set as cases where the results were outside three times the standard deviation.

A total of 388 certified reference materials were inserted with samples and analysed for gold. The average gold values reported for the certified reference materials are compared against the expected values in Table 12-4 Control charts were prepared for all of the CRMs.

Table 12-4. Summary of Reference Material Performance for Gold

RM	N	Outliers Excluded	Failures Excluded	Accepted Au g/t		Observed Au g/t		Percent of Accepted
				Accepted	Std. Dev.	Average	Std. Dev.	
CDN-GS-22	46	2	3	22.94	0.560	22.32	0.713	97%
OREAS 208	66	1	1	9.25	0.438	9.11	0.396	99%
OREAS 228b	41	-	4	8.57	0.199	8.45	0.225	99%
OREAS 239	18	-	-	3.55	0.086	3.47	0.077	98%
OREAS 215	92	-	3	3.54	0.097	3.44	0.090	97%
OREAS 207	2	-	2	3.47	0.130	3.29	0.141	95%
OREAS 200	2	2	-	0.34	0.012	0.35	0.028	103%
OREAS 217	95	2	6	0.34	0.010	0.34	0.012	99%
Total	362	7	19	Weighted Average				98%

A total of twenty-six quality control failures where identified. Based on a total of 388 gold determinations and 26 quality control failures, this is a high failure rate of 7%.

The average accepted values reported for each reference material are calculated and compared to the Accepted Value. The calculated Percent of Accepted value should range between 98 to 102%.

The percent of Accepted values for gold in all eight certified reference materials fall within 95-103% and demonstrate acceptable accuracy with respect to the Accepted Values. There are no significant biases present but it should be noted that the Percent of Accepted for seven of the eight reference materials are below the Accepted Value.

REPRODUCIBILITY OF LABORATORY PREPARATION AND PULP DUPLICATES

The TMAC on-site laboratory operated by SGS Minerals routinely assay a second aliquot of the sample pulp at a frequency of approximately one in ten samples. For preparation duplicates, the frequency is approximately one in fifty samples. The data are used by the laboratory for monitoring the internal quality control procedures.

Results for pulp and preparation duplicates were reviewed and fall within expected ranges for gold assays. Only the duplicate pairs above ten times the lower detection limit are considered significant and are included in calculations.

A total of 573 pulp duplicate pairs out of a total 711 reported above 0.05 g/t gold. Eighty-two percent of the duplicate pairs above ten times the detection limit reported within ±25%.

A total of 196 preparation duplicates pairs out of a total 220 reported above 0.05 g/t gold. Seventy-five percent of the duplicate pairs above ten time the detection limit reported within ±25%.

The results are consistent with expectations for the deposit type. The pulp and coarse reject duplicate data further indicate assays are suitable for use in mineral resource estimation.

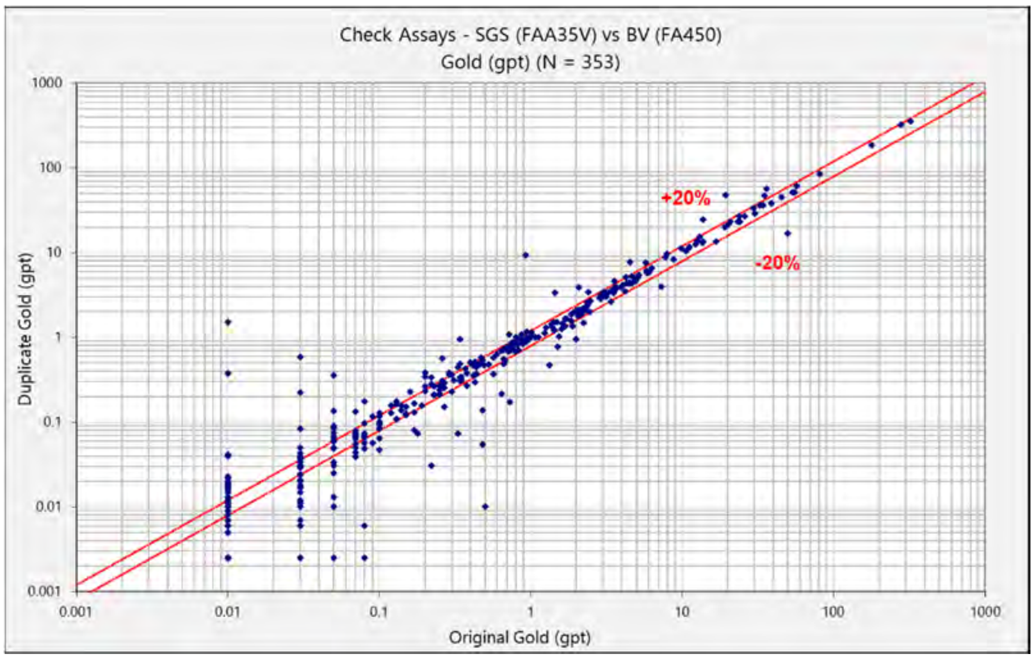
CHECK ASSAYS

Check assays consist of submitting the pulp that was assayed originally to a different laboratory for the same analytical procedures to augment the assessment of bias, in addition to reference materials submitted to the original laboratory.

A total of 353 sample pulps, selected from 2017 to 2019 samples, were submitted to BV, Vancouver for check assaying.

There is good agreement between the on-site laboratory and BV gold assays and no bias is evident. Over 70 percent of the check assay results for gold above ten times the detection limits are within ±25 percent of the two sets of laboratory results which is considered acceptable. This is comparable to the results for the pulp duplicates reported in the previous section. See Figure 12-4.

Figure 12-4. Check Assays for Gold - SGS vs BV



12.9 COMMENTS

It is the opinion of the Q.P. that the sample preparation, security, analytical procedures and quality control practices meet or exceed industry standards and are, therefore, acceptable.

13.0 MINERAL PROCESSING AND METALLURGICAL TESTING

13.1 DORIS TESTWORK AND PROCESS RECOVERIES

Testwork used to support the design of the current Doris Process Plant is detailed in the March 31, 2015 Technical Report on The Hope Bay Project, Nunavut, Canada. The subject of this report is on Madrid and Boston from the Hope Bay Property that will be processed through a new plant.

13.2 MADRID PROCESS RECOVERIES

The following overall plant recoveries for the various deposits are being used in the PFS, based on the available historical testwork. Table 13-1 shows the testwork and PFS assumed recoveries. In the production plan, recoveries have been applied by deposit. The overall LOM average recovery is 88.0%.

Table 13-1. Hope Bay Deposit Recoveries

TMAC RESOURCES INC. – HOPE BAY PROJECT

Deposit	Recovery (%)		
	2012[1] Newmont	2015 PFS Report	2020 PFS Report
Madrid South	93	93	89
Naartok	89	90	90
Suluk	84	84	77
Boston	95	95	94

13.3 MADRID TESTWORK

INTRODUCTION

Metallurgical testing of Madrid area samples was conducted previously by Miramar and Newmont. The programs are shown in Table 13-2 and Table 13-3. No further metallurgical testing has been performed since 2012.

Table 13-2. Miramar Metallurgical Testing Programs

1	PRA Project No. 0406908 November 12, 2004 Cyanidation Tests on Samples from the Naartok Project.
2	PRA Project No. 0406908 June 16, 2005 The Naartook Project Phase II Progress Report.
3	PRA Project No. 0406908 January 18, 2006 The Naartook Project - Hope Bay Phase III Progress Report.
4	PRA Project No. 0406908 January 10, 2008 The Naartook Project Phase III Progress Report.

Table 13-3. Newmont Metallurgical Testing Programs

1	Hope Bay Metallurgical Studies, August 13, 2008.
2	Hope Bay Metallurgical Studies, October 21, 2008.
3	Hope Bay Carbon Mitigation Testwork January 6, 2009.
4	Grind vs. Recovery Testing of Madrid Samples February 3, 2009.
5	Pocock Industrial Solids Liquid Separation Testing February 2009,
6	Hope Bay Madrid Pilot Plant Flotation Testwork May 15, 2009.
7	Hope Bay Carbon Mitigation Testwork January 11, 2010.
8	2009 Gravity and Flotation Testwork Patch 14, Patch 7 and South Suluk June 12, 2010.
9	Addendum to Metallurgical Testing of Patch 14, Wolverine and Patch 14 Extension Variability Composites March 27, 2012.
10	Hope Bay 2012 Metallurgical Testing Naartok Variability Samples April 4, 2012.

Not included in the data are two samples tested by Gekko to assess recovery of Naartok samples through the Doris Mill. The testing was specific to unit operations in the Doris Mill flowsheet and are not representative of the flowsheet developed for this study.

The Madrid deposit consists of seven zones: Naartok East, Naartok West, Suluk, Suluk South, Patch 7, Patch 14 and Wolverine. Work on the Madrid deposit dates to 2001 with metallurgical studies performed by Miramar and later by Newmont. The Newmont testing concluded in 2012.

The PRA test programs utilized drill core samples selected from the Naartok and Suluk deposits. The test programs included gravity, flotation and cyanidation. The Suluk deposit has interbanded graphite (carbon) mineralization in areas. Tests were included to examine the preg-robbing characteristics of the graphite.

The latter programs examined metallurgical testing of Naartok ore, splitting the testwork into three phases. In phase one, nine composites were subjected to direct cyanidation while four composites were subjected to CIL. In phases two and three, three Naartok composites were prepared from 114 individual drill core samples obtained from 2005 drill holes. These were stage ground and subjected to some grindability and work index testing in addition to metallurgical testwork. Samples were near surface and higher in organic carbon, sulphide and arsenic than previously tested material. The objective was to adapt the previously developed flowsheet to achieve higher gold recovery at coarser primary grinds with better rejection of the gangue using a combined gravity, flotation and concentrate leach process.

The Newmont testing commenced in 2008 at Newmont Metallurgical Services (NMS) in Denver. The Newmont testing utilized the gravity/flotation/concentrate leach test for almost all tests. The programs included over 100 samples from Naartok East, Naartok West and Suluk. In addition to flowsheet recovery tests, comminution testing was performed including HPGR testing in Germany. The HPGR products were returned and used for a full flowsheet pilot plant. The pilot sample contained grades below what would be mined in an underground mine and are not relevant to this study.

Additional variability samples from Patch 7, Patch 14 and Suluk South were tested with the gravity/flotation/concentrate leach flowsheet. Some whole ore CIL tests were completed on highly preg robbing Suluk samples, including limited tests with masking agents.

The Newmont samples were selected on the basis that the Madrid deposits would be mined by open pit methods, with sample head grades as low as 1 g/t Au. The underground mining methods proposed for this study required that only samples with grades >4 g/t Au were included in any analyses.

MINERALIZATION AND LIBERATION

Gold mineralization at the Madrid area is hosted by sericitic and iron-carbonate altered iron and titanium rich basaltic rocks, and less commonly by gabbro, ultramafic rocks and interlayered argillaceous sedimentary rocks. Alteration minerals are albite, dolomite and quartz. Gold occurs within north-northeast, east, southeast and north-northwest trending brecciated and carbonate altered zones, and is associated with disseminated pyrite.

Naartok mineralization is characterized by multiple generations of alteration, silicification, quartz veins and veinlets, and breccia. At the deepest scale, it is an east-west trending, steeply north-dipping zone of vein and fracture stockwork / breccia hosting disseminated gold-pyrite mineralization. The mineralization is found within a much larger envelope of dolomite-sericite silica alteration within mafic volcanic and subdivided gabbroic rocks. The best mineralization is developed in highly brecciated volcanic flows, which are easily identified due to the preservation of variolitic textures. An important style of mineralization at Naartok is gold associated with disseminated pyrite. This is best exemplified nearest the DEFZ (Deformation Zone) contact where silicified breccia fragments contain from 2% to 5% on average evenly disseminated, fine to medium grained pyrite.

The presence of organic carbon in Madrid ores led Newmont to evaluate the potential for preg-robbing during cyanidation. Results found that Naartok East, Naartok West, Suluk and Patch 7 exhibited a potential for preg-robbing. Patch 14 and Suluk South exhibited a very low potential for preg-robbing. In addition, arsenic content in all six deposits tested averaged 490 g/t ranging between 217 g/t (Patch 14) and 717 g/t (Naartok West).

Liberation studies were completed on Naartok samples by PRA in 2005 for both gravity/leach and flotation/concentrate leach processing. With the gravity/leach flowsheet, recovery increased with increasing fineness of grind, with the finest grind tested at 80% passing 74 µm. With the flotation/concentrate leach flowsheet, the optimal flotation feed grind size was 80% passing 150 µm. This grind size was included in the process design criteria. Flotation concentrate regrind testing recovery increased with increasing fineness of grind, with the finest grind tested at 80% passing 25 µm. For subsequent testing, Newmont used a concentrate regrind size of 80% passing 37 µm. This grind is included in the process design criteria.

SAMPLE SELECTION

Naartok metallurgical testing performed by PRA (2004, 2005 & 2006b) was carried out on composite samples representing the various types of mineralization in the Naartok deposit. Initial testing was conducted on upper level mineralization composites 1C, 2A and 2C from the X, Y and Z lenses and later testing focused on down-dip extension composite samples A, B and C compiled from drill core samples from deeper Naartok lens A, B and C. It should be noted that composite 2A was a near-surface composite from the NE “X” lens and was higher in sulphide and arsenic content. In a 2006 study, Fluor commented that the representativeness of the samples used by PRA may not be representative of the mineralization that would be mined.

Testwork carried out by NMS for Naartok West, Naartok East, Suluk, Suluk South, Patch 14 and Patch 7 was performed on variability and master composite samples made up of diamond drill core sample extracted by Miramar and later Newmont.

The metallurgical testing included in this study is limited to historical testing. Madrid testing, particularly testing completed by Newmont, was based on samples representative of open pit mining, with sample grades down to 1 g/t Au. For this study, results for samples that were from drill holes that intercepted mineralized resources and had minimum grades of 4 g/t Au were included. The number of drill holes that intersected Madrid deposits includes:

- Naartok, 12 drill holes.
- Patch, 1 drill hole.
- Suluk, 36 drill holes.
- Wolverine, no drill holes.
- Suluk South, no drill holes.

The major Madrid deposits are Naartok and Suluk. There are enough drill holes in each deposit to provide representative sample coverage. Patch and Wolverine are minor deposits are not material to Madrid resource. Suluk South has similar geology and mineralization to Suluk and the same recovery will be applied to both.

COMMINUTION TESTS

Newmont commissioned comminution tests in 2008 on 35 samples from Naartok and Suluk. The tests included Bond ball mill work index, Bond abrasion index and SMC drop weight tests (DWT). The results are shown in Table 13-4. The program also included testing for HPGR crushing (LABWAL and ATWAL tests). The current flowsheet includes conventional semi-autogenous and ball mill grinding so the HPGR tests are not relevant and not included.

Table 13-4. 2008 Comminution Test Results

Sample	Bond Ball Mill Work Index (kWh/t)			Bond Abrasion Index (g)			Drop Weight Index (kWh/m^3)		
	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.
Naartok East	15.7	18.7	17.7	0.17	0.48	0.38	8.3	11.1	9.55
Naartok West	16.4	18.7	17.7	0.12	0.42	0.30	8.8	10.6	9.54
Suluk	14.8	20.4	16.9	0.05	0.64	0.27	6.0	9.7	8.18
Average	15.6	19.3	17.4	0.11	0.51	0.31	7.7	10.47	9.09

The results show that Naartok and Suluk samples exhibit hard competency and are also abrasive.

GRAVITY CONCENTRATION TESTING

Gravity concentration testing was completed on ground samples using lab scale Knelson concentrators (centrifugal concentrator) with panning of the concentrate to reduce the concentrate mass and estimate recovery. The protocol used resulted in mass recoveries that are very high and not representative of plant scale operations. There are few results which have mass recoveries around 0.05% that would be achieved in plant scale operation. For the Madrid deposits, a gravity recovery of 13.7% Au is included in the process design criteria.

FLOTATION TESTING

Flotation testing was completed by PRA in 2005 and 2006 on Naartok gravity tailings (separately for Knelson concentrator and pan tailings) samples. The high mass pull gravity testing combined with flotation produced results with overall mass recoveries >22% and gold recoveries around 98%. This approach is not suitable for process design and the results were not used.

The PRA flotation conditions were used for subsequent testing by Newmont. These include:

- Flotation feed grind of 80% passing 150 µm.
- Flotation reagents potassium amyl xanthate (collector), A209 (promotor) and AF65 (frother).
- Total flotation time of 22 minutes with 4 concentrates collected.

Newmont completed a series of flotation optimization tests on three Suluk master composite samples. The tests evaluated a series of grinds, various flotation reagent combinations. No improvements were made over the base conditions. The results showed concentrate mass recoveries from 9% to 14% with combined gravity/flotation recoveries from 92% to 96% Au.

Newmont also evaluated several reagents to depress organic carbon to mitigate preg robbing issues. For clarity, preg-robbing occurs when a gold cyanide complex is removed from the pregnant (gold rich) solution by some component of the ore. The preg-robbing component can be carbonaceous in nature, such as organic carbon or other impurities which will adsorb the gold resulting in decreased recovery. Suluk variability samples with >0.2% organic carbon content were selected. The results did not show significant suppression with acceptable gold losses to flotation tailings and this approach was not carried forward.

Flotation tests were completed on Naartok East and West master composite samples mainly to evaluate grinds and some reagent changes over base conditions. No changes were made to the base conditions. The results showed concentrate mass recoveries from 13% to 21% with combined gravity/flotation recoveries from 94% to 98% Au for the three Naartok East master composites. Similarly, for the Naartok West master composites, concentrate mass recoveries from 10% to 12% with combined gravity/flotation recoveries from 90% to 95% Au were obtained.

WHOLE ORE LEACH TESTS

Miramar conducted a series of whole ore leach (WOL) tests on Naartok and Suluk composite samples to compare recoveries with the flotation/concentrate leach flowsheet. There was no clear advantage of one flowsheet over the other on all samples. CIL tests were also conducted on Suluk samples with preg robbing organic carbon. CIL resulted in higher recoveries over WOL for the samples tested although for samples with severe preg robbing, CIL recoveries were not at an acceptable level.

Newmont conducted comparative WOL/CIL tests on the Naartok East and West and the Suluk master composite samples. The samples were ground to 80% - 75 µm, with 48 hours of leaching. The results are shown in Table 13-5.

Table 13-5. Results of comparative WOL/CIL test on Naartok East and West and Suluk Master Composite Samples

Sample	Recovery (% Au)	
	Whole Ore Leach	Carbon in Leach
Suluk		
MC 1	31.2	80.0
MC 2	47.7	76.9
MC 3	26.3	76.3
Average	35.1	77.7
Naartok West		
MC 1	55.9	83.3
MC 2	60.4	82.5
Average	58.2	82.9
Naartok East		
MC 1	74.3	82.9
MC 3	86.4	87.3
MC 4	71.2	82.0
Average	77.3	84.1

All samples appear to be preg robbing. This was not previously observed in earlier flotation tests. Severely preg robbing samples will also adsorb flotation reagents but this effect was not evident in this instance. All recoveries are less than acceptable for these samples.

CONCENTRATE CARBON IN LEACH

Newmont conducted a series of flotation/concentrate leach on a large number of variability samples from Suluk, Naartook East and Naartok West. A summary of the results is shown in Table 13-6. The flowsheet included the standard flotation conditions, flotation concentrate regrind to 80% -25 µm, and 48 hour CIL.

Table 13-6. Flotation/concentrate leach test results from Suluk, Naartok East, and Naartok West

Deposit	Number of Samples	Head Grades			Gravity Recovery (% Au)	Flotation Mass Recovery			Grav./ Flotation Recovery (% Au)	CIL Recovery (% Au)	Total Recovery (% Au)
		(g/t Au)	S (%)	C_{org} (%)		Min. (%)	Avg. (%)	Max. (%)			
Suluk	54	4.27	1.82	0.11	10.0	9.8	15.3	23.7	94.6	84.5	81.6
Naartok East	30	3.22	1.62	0.12	11.6	9.7	15.4	28.2	97.0	90.5	88.6
Naartok West	48	4.34	1.20	0.22	18.5	7.0	14.3	25.7	95.8	92.4	89.6
Madrid South	16	11.8	-	0.10	9.7	-	10.9	-	94.4	90.4	89.8

The Suluk samples have the lowest average recovery. The average Suluk organic carbon content (C_{org}) is close to preg robbing levels and may contribute to the low recovery. Suluk has known areas with high organic carbon concentrations not reflected in the tests shown in Table 13-6. The distribution and concentrations of organic carbon throughout Suluk are not established.

The high average head grade for Madrid South was largely from two Patch 14 samples with head grades >300 g/t Au.

The average sample grades are not representative of underground mining, the results overall provide guidance for recovery estimates as recovery is relatively insensitive to head grade as shown in Figure 13-1 and Figure 13-2 for Naartok East and West and Madrid South.

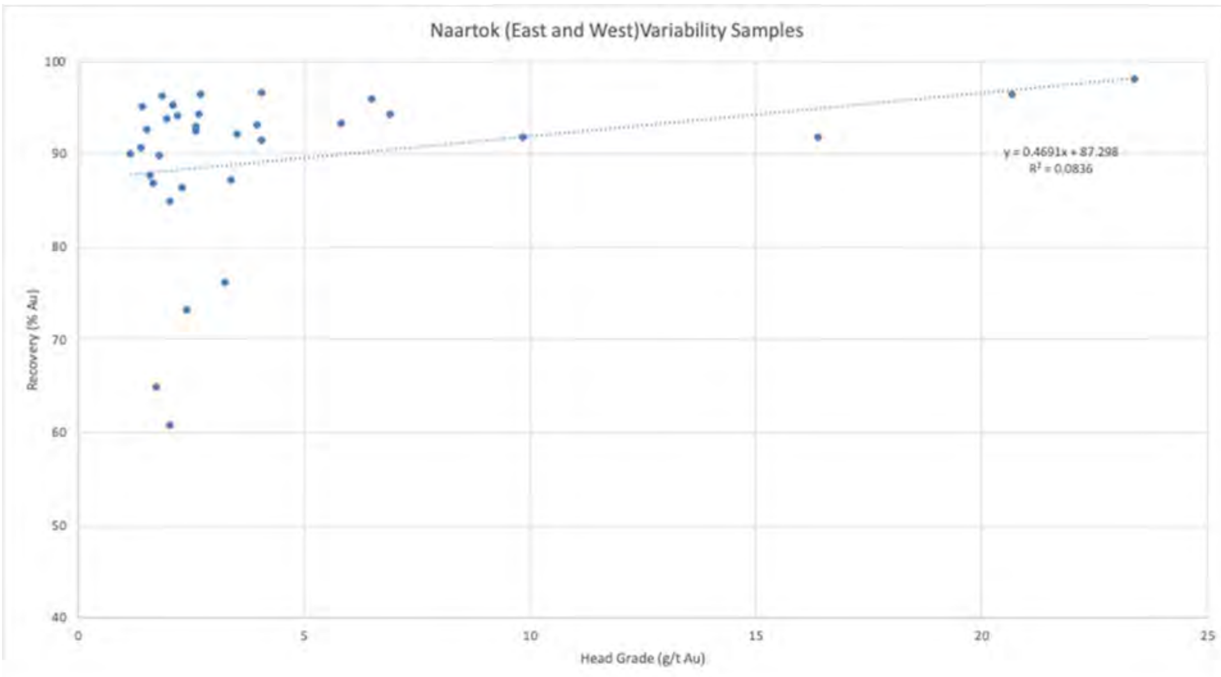


Figure 13-1. Naartok (East and West) Variability Samples Recovery as a Function of Head Grade

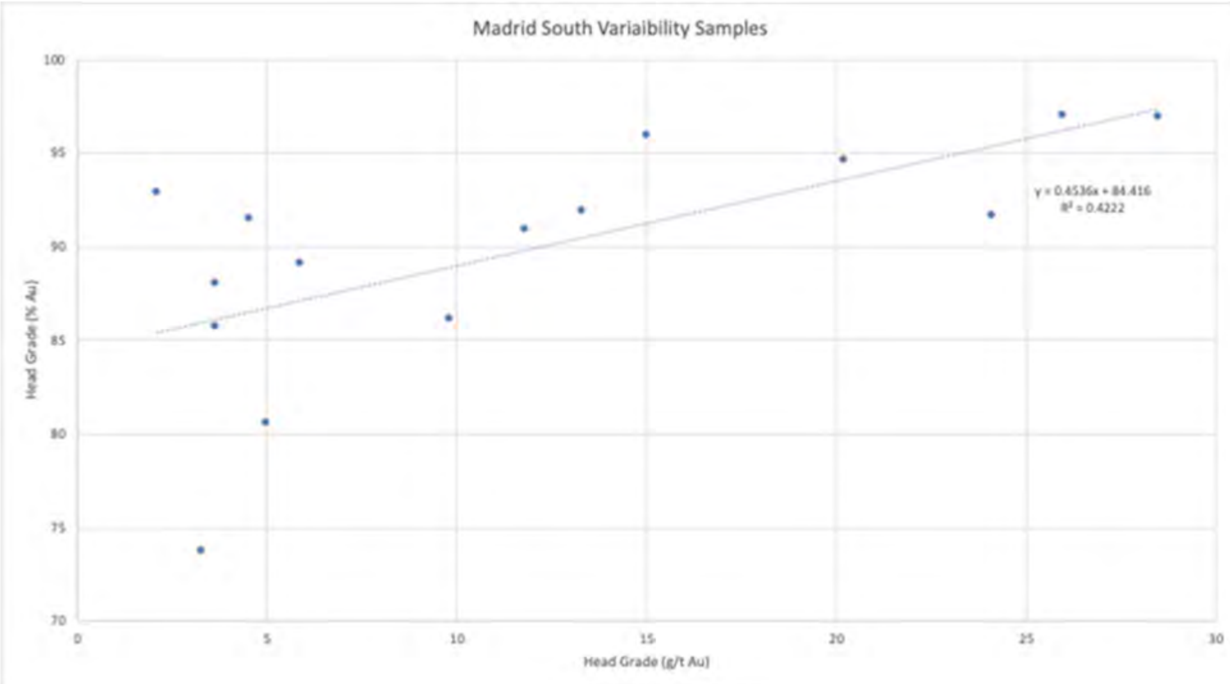


Figure 13-2. Madrid South Variability Samples Recovery as a Function of Head Grade

Using LOM average head grades, Naartok will have an average recovery of 90.2% Au at a head grade of 6.09 g/t Au while Madrid South will have an average recovery of 89.4% Au at an average head grade of 10.9 g/t Au.

SULUK RECOVERY

Both Miramar and Newmont metallurgical reports note the occurrence of preg robbing organic carbon in the Madrid area and Boston deposits. The drill hole data base only includes total carbon assays which does not permit or allow the understanding of the occurrence and/or distribution of organic carbon and the potential impact on gold recovery.

Newmont in 2008 identified in testing Naartok and Suluk samples the impact of organic carbon on recovery. The results showed a strong correlation between increasing organic carbon content resulting in decreasing recovery.

Newmont selected 2,184 samples from 83 drill holes in Naartok and Suluk in 2008. From this data set, 54 holes intersect the Suluk deposit with 43 samples intercepting stopes in the current Suluk mine plan. While this is a limited data set, some insight is provided into the relationship between organic carbon content and recovery. A summary of the results is shown in Table 13-7. The test flowsheet was identical to the variability samples tested with the results in Table 13-6.

Table 13-7. Average Assays of Newmont Suluk Samples

Head Grade (g/t Au)	Sulphur Grade (% $S^=$)	Organic Carbon Grade (% CAI)	Flotation Mass Recovery (%)	Gravity/ Flotation Recovery (% Au)	Overall Recovery (% Au)
3.55	1.57	0.19	14.95	94.4	81.75

The overall recovery is similar to the average recovery from the variability tests but the results show a strong correlation between recovery and organic carbon content as shown in Figure 13-3.

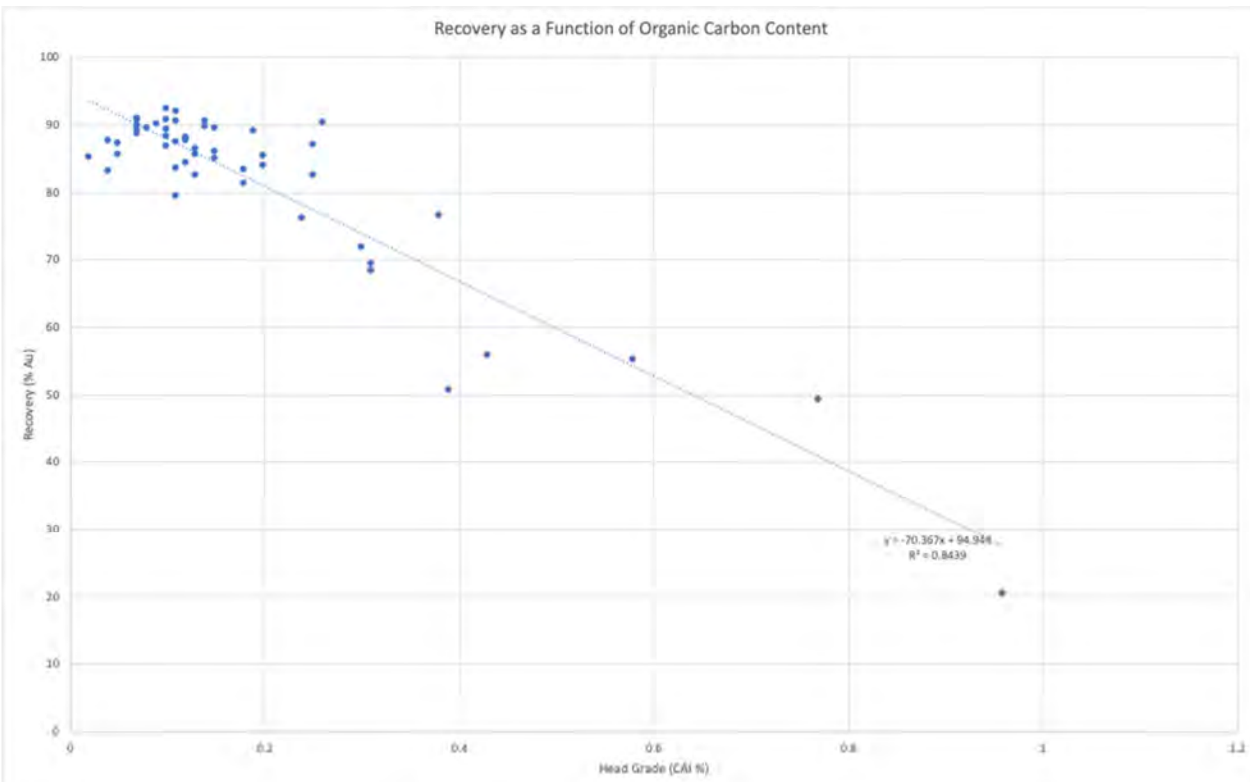


Figure 13-3. Suluk Recovery as a Function of Organic Carbon Content.

The global average organic carbon assay of the assays in the resource is 0.25%. Using the curve developed and shown in Figure 13-3, the recovery is estimated at 77% Au, including plant losses. This assumes that all the mineralization in question can be blended to feed the Mill at 0.25% C_{org}. This may not be that straightforward. There are a few Diamond Drill Holes (DDH) that would be difficult to blend with C_{org} grades up to 1.3%.

RECOVERY MODELING

Recovery distributions for each of the deposits is derived from the Newmont variability samples testing and summarized in Table 13-8.

Table 13-8. Summary of Recovery Distributions from Variability Samples Testing

Deposit	Gravity Recovery (% Au)	Flotation Recovery (%)		CIL Extraction (%)	Total Recovery (%)
		Mass	Au		
Naartok	23	15	73	67	90
Madrid South	10	15	85	79	89
Suluk	14	15	85	64	77

SOLID LIQUID SEPARATION TESTING

A range of solid-liquids separation tests were completed at Pocock Industrial under Newmont's direction. Relevant samples tested included flotation tailings from Naartok East, Naartok West, Suluk and Boston. The results from dynamic thickener tests were used for selection of the flotation tailings thickener size. A summary of the relevant results is shown in Table 13-9.

Table 13-9. Pocock High Rate Thickener Test Results

Sample	pH	Feed Solids Conc. (%)	Flocculant Dose (g/t)	Flocculant Conc. (g/L)	Design U/F Solids Conc. (%)	Max. Design Net Feed Loading Rate ($m^3/m^2/h$)
Boston Flotation Tail	8.0	15 – 20	25 – 30	0.1 - 0.2	65 – 69	4.5 – 5.5
Naartok East Flotation Tail	8.4	15 – 20	20 – 25	0.1 - 0.2	67 – 71	4.5 – 5.5
Naartok West Flotation Tail	8.3	15 – 20	20 – 30	0.1 - 0.2	65 – 69	4.5 – 5.5

There was no testing done on Madrid area flotation concentrates by Pocock. Results from Boston samples were used for Madrid flotation concentrate thickener selection.

13.4 BOSTON TESTWORK

INTRODUCTION

Metallurgical testing of the Boston deposit samples was conducted previously by BHP and Newmont. The programs are shown in Table 13-10 and Table 13-11. No further metallurgical has been performed since 2012.

Table 13-10. BHP Metallurgical Testing Programs

1	1992 BHP bench scale tests
2	1996 BHP bulk sample tests at CMT.
3	1997 Lakefield Research program on sub-sample of 1996 bulk sample.

Table 13-11. Newmont Metallurgical Testing Programs

1	PRA Project No. 0704305 September 2008 The Naartok Project Phase III Progress Report.
2	Lakefield Research Project No.11609-002 November 2007
3	Lakefield Research Project No.11609-003 May 2009
4	Pocock Industrial Solids Liquid Separation Testing February 2009
5	Standard Metallurgical Testing of Eight Boston Hope Bay Variability Composites, March 23, 2011.

MINERALIZATION AND LIBERATION

Gold mineralization in the Boston deposit is present in vertical horizons of hydrothermal alteration in an iron rich carbonate shear zone. Gold occurs in structurally controlled quartz-carbonate veins. Gold is associated with pyrite within both veins and the wall rock. There are three major zones of gold mineralization in the Boston deposit: B2, B3 and B4. B2 and B3 are the highest-grade zones. The B2 Zone also contains organic carbon that has been shown to be preg robbing in testing.

Liberation studies have shown fairly coarse liberation sizes in the range of 120 µm to 80 µm. These sizes correlate broadly with liberation sizes in the Madrid samples tested.

SAMPLE SELECTION

BHP obtained samples from the Boston deposit through mining via underground declines mineralized zones B-2 and B-3 in two 1996-1997 bulk sampling campaigns. Samples at a depth of 50 m were collected and three composite samples prepared and tested at CMT, while samples at depths of 130 m and 185 m were collected and tested at Lakefield Research. Testwork carried out by Newmont in 2011 was performed on variability and master composite samples made up of diamond drill core sample extracted by Newmont.

Representative samples of the Boston gold mineralization were used in the preparation of:

- CMT 1997 B-2 and B-3 Flotation and Cyanidation Testing
- Lakefield Research Project No. LR-97 B-2 and B-3 Metallurgical Testing
- PRA Project No. 0704305 and SGS Lakefield Project No. 11609-002 and 11609-003
- Newmont Metallurgical Services Standard Metallurgical Testing of Eight Boston Hope Bay Variability Composites, March 23, 2011.

COMMINUTION TESTS

Comminution tests were completed at SGS in 2007 and included a broad range of tests. A summary of the results is shown in Table 13-12. The results show the Boston samples to be medium competency (DWT parameters) with above average ball mill grinding energy input and moderate abrasiveness.

Table 13-12. Summary of Boston Sample Comminution Test Results

Sample Name	S.G.	DWT Parameters		18" SAG Mill		Autogenous Work Index	Rod Mill Work Index	Bond Ball Mill Work Index (kWh/t)		AI
	(g/cm^3)	A x b	DWI	(kg/h)	(kWh/t)	(kWh/t)	(kWh/t)	210 µm	149 µm	(g)
Boston OA Comp	2.84	52.7	5.4	11.3	7.3	13.6	-	-	-	-
Level Comp. B4.0-3.9	2.89	59.2	4.9	-	-	-	13.8	14.4	-	-
Level Comp. B3.9-3.8	2.88	62.2	4.6	-	-	-	14.1	15	-	-
Level Comp. B3.8-3.7	2.79	52.4	5.3	-	-	-	13.9	15.1	-	-
Level Comp. B3.7-3.6	2.93	52	5.6	-	-	-	13.9	14.9	-	0.304
Level Comp. B3.6-3.5	2.85	52.9	5.3	-	-	-	14.5	13.4	-	-

Metso conducted concentrate regrind jar tests in 2008. The results showed that 8 kW/t was required to reduce the flotation concentrate to 80% - 24 µm.

GRAVITY CONCENTRATION TESTING

No gravity testing was conducted by BHP. One set of tests was conducted by Met-Solve laboratories in 2007 under Newmont's direction. The results were not comparable to gravity recoverable gold (GRG) tests which better predict plant gravity recoveries with very low mass recoveries. The results showed 39.7% Au recovery at a high mass pull of 2.1%. At more typical mass pulls of 0.05%, recoveries are likely low enough to not merit gravity concentration in the process flowsheet.

FLOTATION TESTING

BHP conducted flotation tests at their CMT on the B2 and B3 bulk samples that evaluated recovery as a function of grind. The B2 samples showed increasing recovery with decreasing grind size while B3 samples recoveries were insensitive to grind sizes. Additional testing by Lakefield Research on the same B2 and B3 bulk samples showed the same trends as the CMT tests. Concentrate mass recoveries ranged from 11% to 23% while gold recoveries ranged from 92.5% Au to 96.6% Au.

Newmont conducted a metallurgical test program on eight Boston variability samples using the same flowsheet as used for Suluk, Naartok East and West and Madrid South samples. Combined gravity and flotation recoveries ranged from 89.0% Au to 98.7% Au with mass recoveries ranging from 4.8% to 11.2%. The average head grade of the variability samples was 3.57 g/t Au with only two samples with head grades that would align with underground mining.

WHOLE ORE LEACHING

BHP conducted whole ore leach and CIL tests on the Boston bulk samples over a range of grind sizes. In general, recovery increases with fineness of grind. Recoveries ranged from 8.5% Au at the coarsest grind of 80% -200 µm to 95.7% Au at an intermediate grind of 80% -100 µm. The results show that whole ore leaching or CIL is a viable flowsheet for Boston samples.

CONCENTRATE CARBON IN LEACH

Lakefield Research also conducted testing to evaluate potential gold recoveries for a gravity/flotation/cyanidation circuit with the B2 and B3 bulk samples. Testing was carried out at a primary grind 80% -120 µm and a concentrate regrind 80% -30 µm. Results are summarized in Table 13-13.

Table 13-13. Gravity/Flotation/Cyanidation Results for Boston Bulk Samples

Composite ID	Head Grade (Au g/t)	Gravity Concentration		Flotation Recovery (%)		Leach Extraction (%)	Total Recovery (%)
		Au (g/t)	Rec. (%)	Mass	Au		
B-2 Avg.	8.85	7017	3.6	15	93.8	97.4	94.9
B-2 Low	6.82	3129	2.1	15	95.9	95.8	93.9
B-3	5.9	1553	1.5	18	97.4	97.2	96.1

The results show that this flowsheet is viable for the Boston samples tested providing high recoveries. The gravity recoveries shown are not representative of plant scale conditions due to the high mass pulls.

The Newmont variability samples testing showed a wider range of overall recoveries ranging from 69.2% Au to 95.4% Au. The lowest recovery was from a sample that had very good gravity and flotation recovery, 96.1% Au, but very poor CIL extraction. This is likely from preg robbing but additional testing was not conducted to determine the cause.

The results confirm that Boston ore can be processed through the proposed Hope Bay process plant with the gravity/flotation/concentrate CIL flowsheet. There are five Boston samples tested with head grades representative of underground mining; the three bulk samples and two Newmont variability samples. The averages from the test results of these samples result in this recovery distribution:

- Gravity Recovery = 10.2% Au
- Flotation Recovery = 87.8% Au
- CIL Recovery = 84.1% Au
- Overall Recovery = 94.3% Au

CYANIDE DESTRUCTION TESTING

In 2009, Lakefield Research performed cyanide destruction batch testing on Carbon in Pulp (CIP) pulp and CIP barren solution using the SO_2/air process. Results from the study found that CIP pulp and CIP barren solution could both be successfully treated to target 20 mg/L residual cyanide. The use of ferric sulphate was tested on filtered cyanide destruct product, successfully reducing the arsenic level from 4.5 mg/L to 0.28 mg/L. A further reduction in arsenic level to 0.019 mg/L was achieved using the process of reverse osmosis.

Continuous SO_2/air cyanide destruct testing on washed CIP pulp indicated that a residual cyanide level of 20 mg/L could be attained by treating the washed CIP pulp with a retention time of 1 hour using 1.9 g SO_2 and 0.44 g of hydrated lime per gram of CN_{WAD} in the feed. A further decrease to below 11 mg/L was attained by increasing the SO_2 addition to 2.8 g per gram of Weak Acid Dissociable Cyanide (CN_{WAD}). The SO_2 addition rates would be more in the typical range of 5:1 with unwashed pulps.

SOLID LIQUID SEPARATION TESTS

A range of solid-liquid separation tests were completed at Pocock Industrial under Newmont's direction. Relevant samples tested were Boston CIL tailings and Boston CIL tailings after cyanide detoxification. The results from dynamic thickener tests were used for selection of the flotation concentrate thickener size and CIL tailings thickener. Pressure filtration test results were used for the selection of the CIL tailings filters. A summary of the relevant high rate thickener results is shown in Table 13-14. Pressure filtration test results are shown in Table 13-15. In the absence of Madrid Area samples pressure filtration tests, the Boston sample results were used in the process design criteria for pressure filter selection.

Table 13-14. Pocock High Rate Thickener Test Results

Sample	pH	Feed Solids Conc. (%)	Flocculant Dose (g/t)	Flocculant Conc. (g/L)	Design U/F Solids Conc. (%)	Max. Design Net Feed Loading Rate (m^3/m^2 /h)
Boston CIL Residue	10.2	15 – 20	30 – 35	0.1 - 0.2	57 – 61	4.0 – 5.0
Boston CIL Residue After Detox	8.5	15 – 20	30 – 40	0.1 - 0.2	53 – 57	4.0 – 5.0

Table 13-15. Pocock Boston CIL Residue Pressure Filtration Test Results

Material	Dry Bulk Cake Density (kg/m^3)	Sizing Basis (m^3/t) dry solids	Filter Feed Solids (%)	Filter Wash Ratio (N)	Dry Time/Filter Cake Moist. (min / %)	Filter Cycle Time (min)
Boston CND Tail	1,687.2	0.741	61.3	None	3 / 18.5	11.1
				2.0		41.3
			42.1	None	3 / 18.5	19.4
				2.0		49.6

14.0 MINERAL RESOURCE ESTIMATE

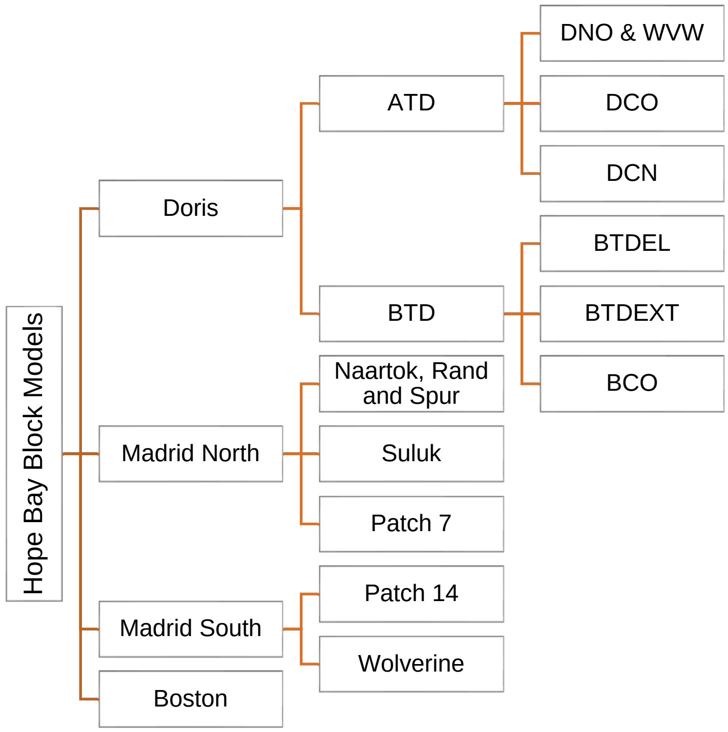
The 2019 year-end (YE) Hope Bay Property (Hope Bay or the Property) Mineral Resource estimates were completed by Sean Horan, P.Geo. and John Makin, MAIG , of Roscoe Postle and Associates (RPA) and have been adopted by Mr. David King, P.Geo. of TMAC Resources Inc. (TMAC), the Qualified Person (QP) taking responsibility for this section. The Mineral Resources presented represent yearly updates to the Mineral Resource estimates since the 2015 Prefeasibility Study (PFS) completed by RPA and reflect changes as a result of additional drilling and mining on the Property.

The Mineral Resource areas are subdivided into Doris, Madrid North, Madrid South, and Boston. Figure 14-1 shows the break down of resources into different zones across the Property. Table 14-1 describes each block model and supporting information.

Table 14-1. Summary of Hope Bay Block Models

TMAC Resources Inc. – Hope Bay Project

Area	Domain	Model Name	Last Updated	Database Cutoff	Status
Doris	DNO	dno_md_depleted13122019	2017	2016-04-18	Mining
Doris	DCO	dco_md_depleted13122019	2019-10	2019-10-03	Mining
Doris	DCN	dce_md04122018	2019-12	2018-11-06	Mining 2020
Doris	BTDEL	btd_el_md_depleted13122019	2018-12	2018-11-28	Mining
Doris	BTDEXT	btd_ext_md_depleted13122019	2019-10	2019-10-07	Mining
Doris	BCO	btdcc_final	2016	2016-08-19	Reserve
Madrid North	Naartok, Rand, and Spur	ntk_md_depleted20122019	2019-05	2019-04-02	Mining (small open pit)
Madrid North	Suluk	suluk_final	2017	2016-07-13	Reserve
Madrid North	Patch 7	RPA Patch 7 model	2020-02	2019-10-09	Resource
Madrid South	Patch 14	pch_class2301	2015	2014-08-17	Reserve
Madrid South	Wolverine	wv_class2301.dm	2015	2014-08-17	Reserve
Boston	B2, B3, B4	boston_final.dm	2018-06	2017-08-03	Reserve



Acronyms	Description
ATD	Above the Diabase
DNO & WVW	Doris North Above the Diabase and West Valley Wall
DCO	Doris Above the Diabase Connector
DCN	Doris Above the Diabase Central
BCO	Doris Connector Below the Diabase
BTD	Doris Below the Diabase
BTDEL	Doris Below the Diabase East Limb
BTDEXT	Doris Below the Diabase Extension

Figure 14-1. Breakdown of the Block Models for Each Mineral Resource Area at Hope Bay

RPA used a conventional block modeling approach with wireframes generated in Leapfrog Geo and block models completed in Datamine Studio 3, Datamine Studio RM, and Leapfrog Edge. The general workflow adopted involved capping of raw assay grades, compositing, interpolation using Inverse Distance (ID) and classification of blocks a Measured, Indicated and Inferred using distance based criterion. Canadian Institute of Mining, Metallurgy and Petroleum (CIM) Definition Standards for Mineral Resources and Mineral Reserves (CIM (2014) definitions) were used for Mineral Resource classification. Models were depleted to November 30, 2019. Material within the

mine plan for December 2019 was removed from Mineral Resource statement to account for mining during December.

The estimates were validated using industry standard techniques and were peer reviewed prior to finalization.

A summary of the Mineral Resource estimate, inclusive of Mineral Reserves, effective as of December 31, 2019 is presented in Table 14-2. The QP is not aware of any environmental, permitting, legal, title, taxation, socio-economic, marketing, political, or other relevant factors that could materially affect the Mineral Resource estimate.

Table 14-2. Summary of Mineral Resources – December 31, 2019

TMAC Resources Inc. – Hope Bay Project

	Tonnes (000 t)	Grade (g/t Au)	Ounces (000 oz)
Measured			
Doris	240	11.0	85
Madrid North	-	-	-
Suluk	-	-	-
Madrid South	-	-	-
Boston	1,330	9.3	397
Total	**1,570**	**9.5**	**481**
Indicated			
Doris	1,726	9.0	499
Madrid North	10,761	6.6	2,273
Suluk	3,670	7.2	851
Madrid South	648	14.0	292
Boston	3,441	7.0	776
Total	**20,246**	**7.2**	**4,691**
Measured and Indicated			
Doris	1,966	9.2	584
Madrid North	10,761	6.6	2,273
Suluk	3,670	7.2	851
Madrid South	648	14.0	292
Boston	4,771	7.6	1,173
Total	**21,816**	**7.4**	**5,173**

	Tonnes (000 t)	Grade (g/t Au)	Ounces (000 oz)
Inferred			
Doris	1,750	7.1	399
Madrid North	1,113	5.3	190
Suluk	4,339	5.7	792
Madrid South	662	7.1	152
Boston	3,053	6.1	594
Total	**10,917**	**6.1**	**2,127**

Notes:

1. CIM definitions were followed for the statement of Mineral Resources.
2. Mineral Resources are inclusive of those resources converted to Mineral Reserves and are in-situ resources excluding stockpiles.
3. Mineral Resources that are not Mineral Reserves do not have demonstrated economic viability.
4. The Mineral Resources for each Individual deposit were defined utilizing a block cut-off grade of 3.5 g/t.
5. All Mineral Resources are estimated using an average long-term gold price of US$1,500 per ounce and a CAD/USD exchange rate of 1.34.
6. A 50-metre crown pillar allowance was applied to Mineral Resources located below lakes where applicable.
7. A minimum intercept width of 1.5 m was applied to the Mineral Resource modelling.
8. Ore density was calculated using the geological block model density field.
9. Numbers may not add due to rounding.

14.1 COMPARISON WITH 2018 MINERAL RESOURCE ESTIMATE

Since the 2018 YE Mineral Resources and Mineral Reserves estimate, there has been a 21% increase in tonnes, 11% decrease in grade, and 8% increase in ounces of Measured and Indicated Resources, and a 49% increase in tonnes, 12% decrease in grade and 31% increase in ounces of Inferred Resources The primary factors contributing to these changes, in order of significance, are:

- Decrease in the Mineral Resource cut-off grade (COG) across the Property due to a higher gold price and higher recoveries for the larger plant.
- The initial estimation of the Madrid North Patch 7 Zone.
- Mining activities at Doris during 2019
- Additional drilling and sampling during 2019
- Re-modelling and some re-interpretation based on new information and experience gained during mining

A summary of the changes to the Mineral Resource is presented in Table 14-3 and waterfall charts showing the changes are given in Figure 14-2 to Figure 14-5.

Table 14-3. Comparison with Previous Estimate

TMAC Resources Inc. – Hope Bay Project

Zone	2018			2019			Difference		
	Tonnes (000 t)	Grade (g/t Au)	Ounces (000 oz)	Tonnes (000 t)	Grade (g/t Au)	Ounces (000 oz)	Tonnes (000 t)	Grade (g/t Au)	Ounces (000 oz)
Measured and Indicated									
DNO	151	20.0	97	78	8.1	20	-48%	-59%	-79%
Doris Connector/Central	1,413	9.1	411	1,576	8.2	416	12%	-9%	1%
Connector/Central BTD	141	8.4	38	157	7.9	40	12%	-6%	5%
BTD EL and EXT	190	20.4	125	156	21.5	107	-18%	5%	-14%
Doris Total	**1,894**	**11.0**	**671**	**1,966**	**9.2**	**583**	**4%**	**-16%**	**-13%**
Suluk + Patch 7	3,195	7.7	794	3,669	7.2	851	15%	-7%	7%
Rand + Spur	826	6.0	160	1,054	5.6	188	28%	-8%	18%
Naartok	7,962	7.4	1,882	9,707	6.7	2,084	22%	-9%	11%
Madrid Total	11,983	7.4	2,835	14,431	6.7	3,123	20%	-9%	10%
Patch 14	384	16.8	208	417	15.8	212	9%	-6%	2%
Wolverine	221	11.2	79	232	10.8	81	5%	-3%	2%
Madrid South Total	**605**	**14.8**	**287**	**648**	**14.0**	**292**	**7%**	**-5%**	**2%**
Boston B2	2,798	9.3	839	3,507	8.3	930	25%	-12%	11%
Boston B3	606	6.6	129	1,017	5.6	182	68%	-16%	41%
Boston B4/B5	141	10.7	48	247	7.8	62	76%	-27%	28%
Boston Total	**3,545**	**8.9**	**1,017**	**4,771**	**7.7**	**1,173**	**35%**	**-14%**	**15%**
Total	**18,027**	**8.3**	**4,809**	**21,816**	**7.4**	**5,172**	**21%**	**-11%**	**8%**

Inferred									
DNO	62	6.9	14	69	6.6	15	12%	-5%	7%
Doris Connector/Central	391	6.2	77	432	5.8	81	10%	-6%	4%
Connector/Central BTD	1,055	7.5	254	1,208	7.0	272	14%	-6%	7%
BTD EL and EXT	59	14.0	26	41	24.2	32	-30%	73%	20%
Doris Total	**1,566**	**7.4**	**371**	**1,750**	**7.1**	**399**	**12%**	**-4%**	**8%**

Zone	2018			2019			Difference		
	Tonnes (000 t)	Grade (g/t Au)	Ounces (000 oz)	Tonnes (000 t)	Grade (g/t Au)	Ounces (000 oz)	Tonnes (000 t)	Grade (g/t Au)	Ounces (000 oz)
Suluk + Patch 7	2,583	6.6	524	3,302	5.7	610	28%	-13%	16%
Rand + Spur	323	6.1	58	457	5.3	74	42%	-12%	28%
Naartok	453	6.1	89	655	5.5	116	45%	-10%	30%
Madrid Total	**3,359**	**6.2**	**671**	**5,451**	**5.6**	**982**	**62%**	**-10%**	**46%**
Patch 14	249	6.1	49	365	5.4	63	47%	-13%	28%
Wolverine	241	10.6	82	297	9.3	89	23%	-12%	8%
Madrid South Total	**490**	**8.3**	**131**	**662**	**7.1**	**152**	**35%**	**-15%**	**16%**
Boston B2	700	7.6	172	1,103	6.3	224	58%	-17%	30%
Boston B3	955	7.0	216	1,393	6.1	272	46%	-14%	26%
Boston B4/B5	279	6.7	60	556	5.5	98	99%	-18%	63%
Boston Total	**1,934**	**7.2**	**448**	**3,053**	**6.1**	**594**	**58%**	**-16%**	**32%**
Total	**7,349**	**6.9**	**1,621**	**10,916**	**6.1**	**2,126**	**49%**	**-12%**	**31%**

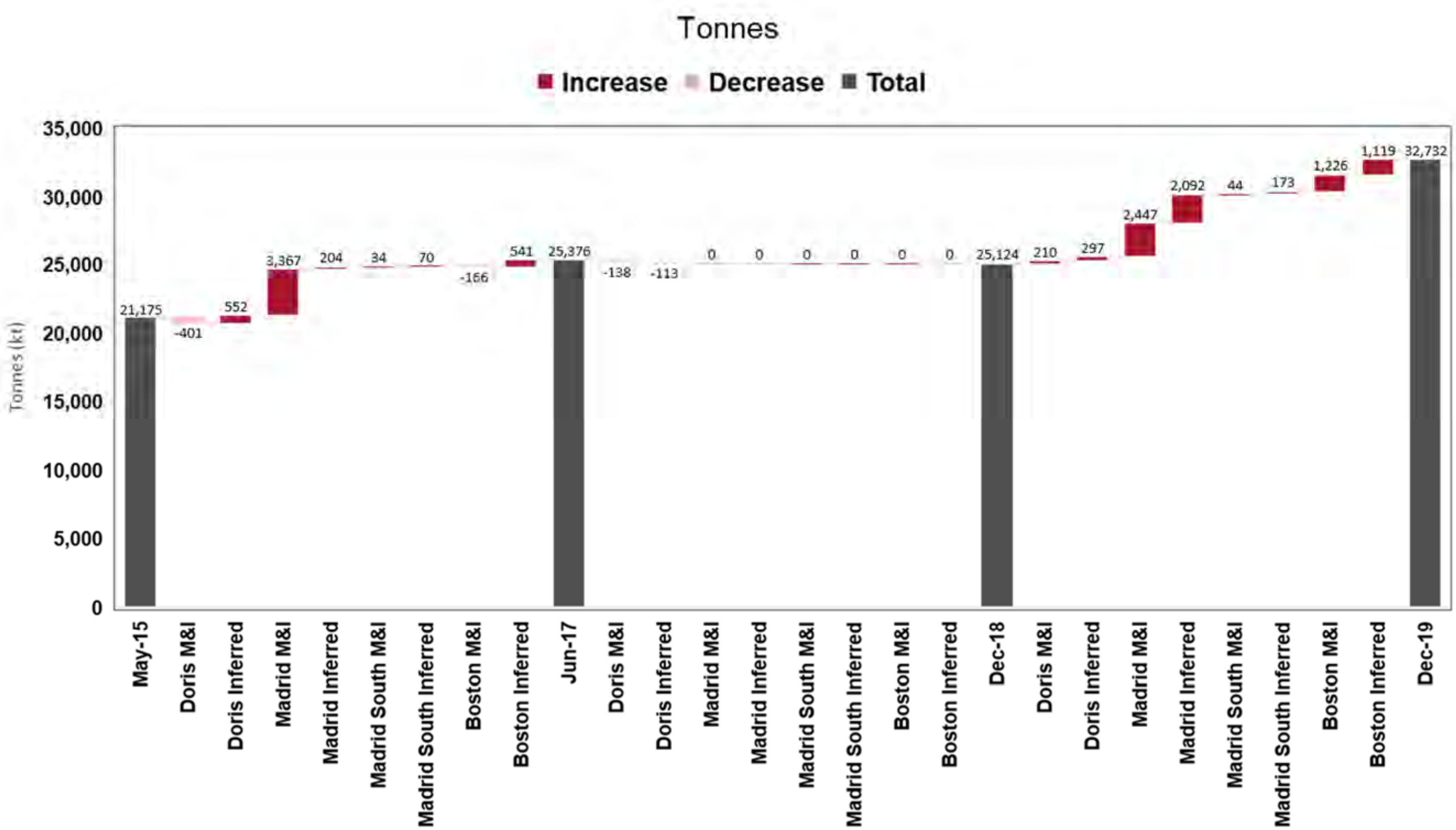


Figure 14-2. Tonnes Waterfall Chart by Area

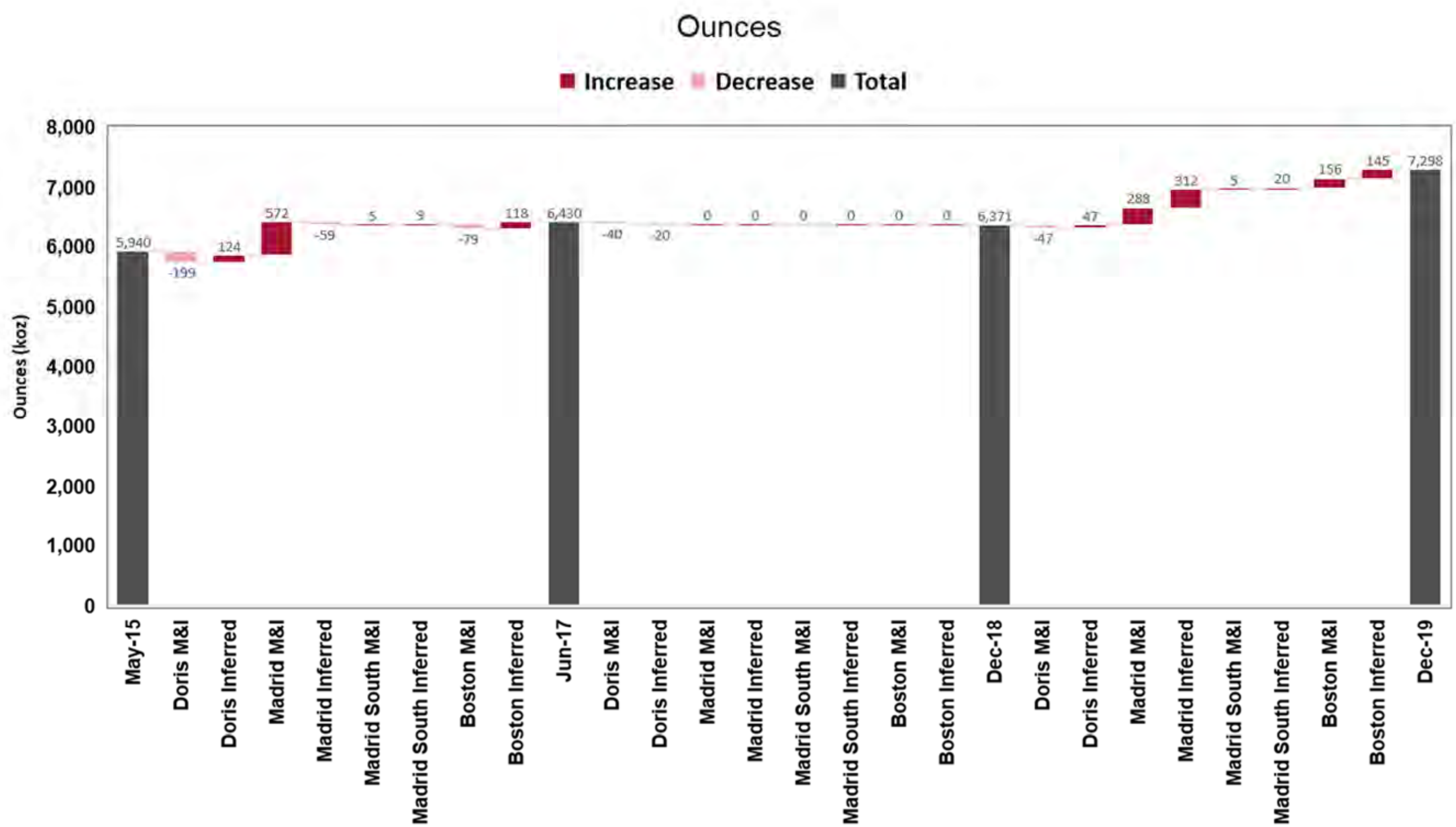


Figure 14-3. Ounces Waterfall Chart by Area

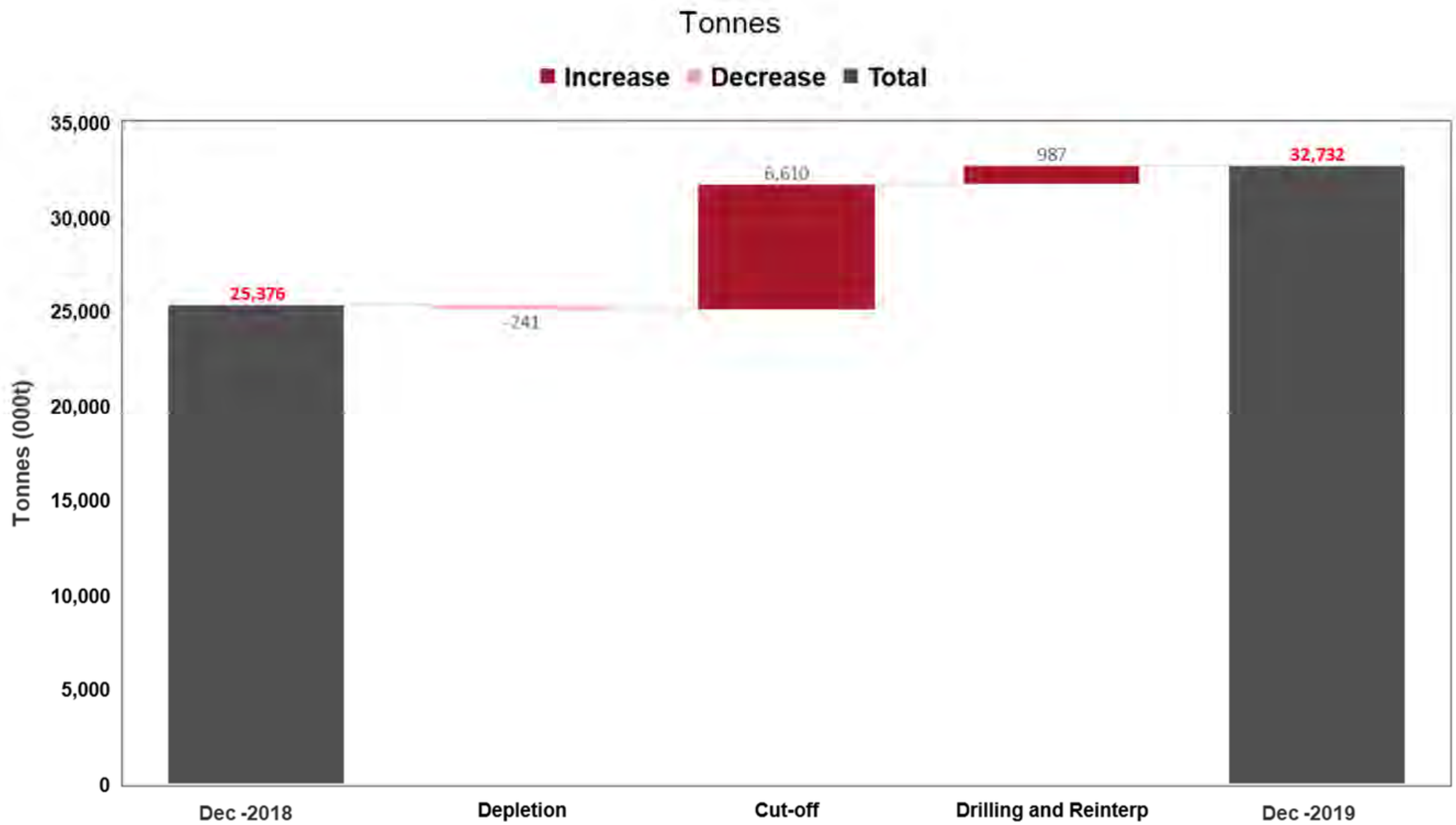


Figure 14-4. Tonnes Waterfall Chart by Change Category

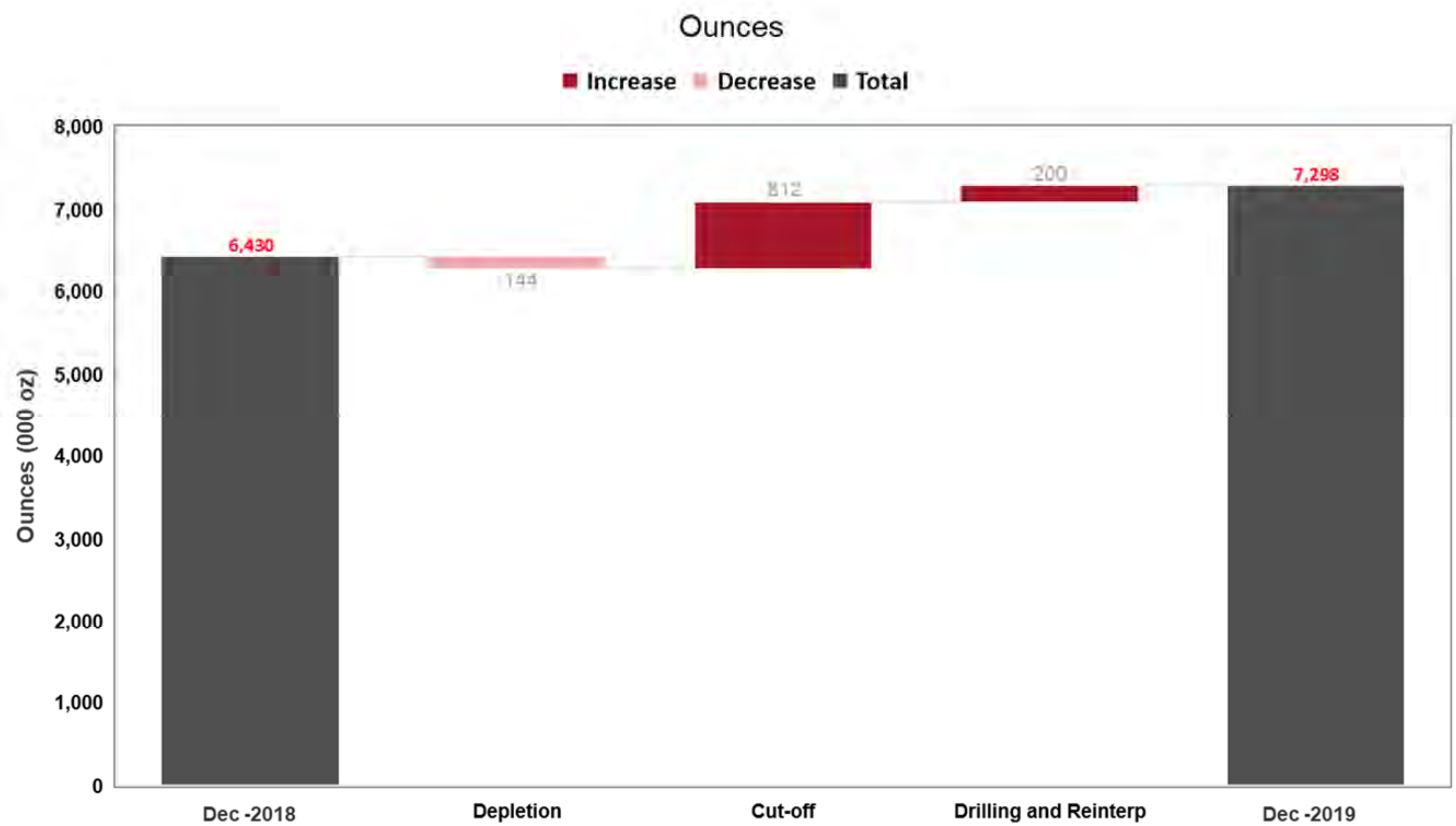


Figure 14-5. Ounces Waterfall Chart by Change Category

14.2 MINERAL RESOURCE CUT-OFF GRADES

Mineral Resource COGs have been calculated based on cut and fill and long-hole stoping mining methods. The full operating costs including mining, processing and General & Administration (G&A) have been included in the calculations. Capital costs, including sustaining capital have been excluded.

Metal prices used for Mineral Resource estimation are slightly higher than those for Mineral Reserves, as metal prices used for Mineral Reserve estimation are based on consensus, long term forecasts from banks, financial institutions, and other sources.

Recoveries used are based on actual recoveries from the Doris Plant for the areas currently in production and have been calculated based on testwork for the scenario involving the Madrid Plant.

Mineral Resources are stated at a cut-off grade of 3.5 g/t Au, and are estimated using a long-term gold price of US$1500 per ounce, and a CAD/USD exchange rate of 1.34.

14.3 DORIS

Doris represents approximately 9% and 11% of the total Hope Bay Measured and Indicated tonnes and ounces, in addition to 16% and 19% of the total Hope Bay Inferred tonnes and ounces, respectively. Various areas in Doris are currently being mined including DNO, BTDEL, BTDEXT, and DCO. Mining in DCN is scheduled to commence in 2020.

The Doris Mineral Resources are presented in Table 14-4.

Table 14-4. Summary of Doris Mineral Resources – December 31, 2019

TMAC Resources Inc. – Hope Bay Project

Domain	Tonnes (000 t)	Grade (g/t Au)	Ounces (000 oz)
Measured			
DNO	15	12.8	6
DCO	177	7.2	41
DCN	0	0.0	0
BCO	0	0.0	0
BTDEL and BTEXT	48	24.5	38
Total	**240**	**11.0**	**85**
Indicated			
DNO	63	7.0	14
DCO	323	7.7	80
DCN	1,076	8.5	295
BCO	157	7.9	40
BTDEL and BTEXT	107	20.1	69
Total	**1,726**	**9.0**	**499**
Measured and Indicated			
DNO	78	8.1	20
DCO	499	7.5	121
DCN	1,076	8.5	295
BCO	157	7.9	40
BTDEL and BTEXT	156	21.5	107
Total	**1,966**	**9.2**	**583**
Inferred			
DNO	69	6.6	15
DCO	255	6.4	53
DCN	177	4.9	28
BCO	1,208	7.0	272
BTDEL and BTEXT	41	24.2	32
Total	**1,750**	**7.1**	**399**

Notes:

1. CIM definitions were followed for the statement of Mineral Resources.
2. Mineral Resources are inclusive of those resources converted to Mineral Reserves and are in-situ resources excluding stockpiles.

3. Mineral Resources that are not Mineral Reserves do not have demonstrated economic viability.
4. The Mineral Resources for each Individual deposit were defined utilizing a block cut-off grade of 3.5 g/t.
5. All Mineral Resources are estimated using an average long-term gold price of US$1,500 per ounce and a CAD/USD exchange rate of 1.34.
6. A 50-metre crown pillar allowance was applied to Mineral Resources located below lakes where applicable.
7. A minimum intercept width of 1.5 m was applied to the Mineral Resource modelling.
8. Ore density was calculated using the geological block model density field.
9. Numbers may not add due to rounding.

RESOURCE DATABASE

The Doris Mineral Resource estimate consists of 355,394 m of surface and underground drilling, and 26,571 m of underground channel samples and surface blast holes.

A summary of Doris' drill hole database is provided in Table 14-5. The data presented in the table reflects the last database export supplied to RPA. The last drill hole was entered into the dataset in October 2019.

Table 14-5. Doris Mineral Resource Database

TMAC Resources Inc. – Hope Bay Project

Year	Historic Surface and Underground DDH		Underground Chips		Surface Blast Holes		TMAC Surface DDH		TMAC Underground DDH		Grand Total	
	No. of Holes	Length (m)	No. of Holes	Length (m)	No. of Holes	Length (m)	No. of Holes	Length (m)	No. of Holes	Length (m)	Total No. of Holes	Length (m)
1995	73	16,122	-	-	-	-	-	-	-	-	73	16,122
1996	58	15,979	-	-	-	-	-	-	-	-	58	15,979
1997	52	16,929	-	-	-	-	-	-	-	-	52	16,929
1998	110	12,954	-	-	-	-	-	-	-	-	110	12,954
2000	142	23,461	-	-	-	-	-	-	-	-	142	23,461
2001	31	2,151	-	-	-	-	-	-	-	-	31	2,151
2002	156	13,851	-	-	-	-	-	-	-	-	156	13,851
2003	9	478	-	-	-	-	-	-	-	-	9	478
2004	9	2,176	-	-	-	-	-	-	-	-	9	2,176
2005	31	7,212	-	-	-	-	-	-	-	-	31	7,212
2006	25	3,513	-	-	-	-	-	-	-	-	25	3,513
2007	23	782	-	-	-	-	-	-	-	-	23	782
2008	17	3,174	-	-	-	-	-	-	-	-	17	3,174
2009	73	18,751	-	-	-	-	-	-	-	-	73	18,751
2010	88	38,695	-	-	-	-	-	-	-	-	88	38,695
2011	269	37,480	82	341	-	-	-	-	-	-	351	37,821
2013	2	1,286	-	-	-	-	27	13,515	-	-	29	14,801
2014	1	240	-	-	-	-	60	25,621	-	-	61	25,861
2015	3	222	99	354	-	-	50	7,393	-	-	152	7,969

Year	Historic Surface and Underground DDH		Underground Chips		Surface Blast Holes		TMAC Surface DDH		TMAC Underground DDH		Grand Total	
	No. of Holes	Length (m)	No. of Holes	Length (m)	No. of Holes	Length (m)	No. of Holes	Length (m)	No. of Holes	Length (m)	Total No. of Holes	Length (m)
2016	2	267	956	4,401	-	-	22	6,634	47	13,632	1,027	24,934
2017	30	781	529	2,352	-	-	-	-	62	13,273	621	16,406
2018	23	296	888	3,932	2,080	12,061	1	155	156	24,743	3,148	41,186
2019	6	309	710	3,130	-	-	11	3,449	261	29,874	988	36,762
Grand Total	1,233	217,105	3,264	14,510	2,080	12,061	171	56,767	526	81,521	7,274	381,965

GEOLOGICAL INTERPRETATION

Mineralization and lithology wireframes were completed using Leapfrog Geo (various versions). The mineralization wireframes, used to constrain grade interpolation, were guided by a number controls:

- The Doris veins formed preferentially along a contact between B-type and C-type basalts. RPA used Al/Ti ratios from XRF data and geochemical data to confirm the location of the vein along the contact. The contact is tightly folded with some parasitic folding evident in areas (e.g. BTDEXT).
- The Doris veins were cross-cut by thin late mafic dikes striking sub-parallel to the vein dipping moderately to steeply towards the west.
- Late cross-cutting strike and dip slip normal faults forming conjugate fault sets with an overall sinistral lateral movement, with down dropping towards the north in the DNO, BTDEL and BTDEXT areas and possibly down dropping towards south in the DCO and DCN with offsets ranging from metre scale to tens of metres offsets.
- The Doris veins, mafic dikes and cross-cutting faults are truncated by a large diabase dike which is predominant over the entire strike length of the deposit.
- In some areas, the hinge or the limbs of the folded vein are truncated up against the overburden-bedrock contact. During 2018 and 2019 a small open pit was mined near Doris Lake where the hinge outcropped at surface.

For DNO, BTDEL, and BTDEXT the mineralization is generally a discrete narrow structure with thicker massive quartz carbonate veining on the east limb and narrow stringer veining on the west limb. The west limb is generally higher grade than the east limb.

For DCO, DCN, and BCO, mineralization is hosted within a mixture of massive quartz vein and vein zones with higher grade mineralization occurring preferentially along one of the vein zone-basalt contacts.

The location of the different wireframes at Doris are shown in Figure 14-6, while isometric views of the wireframes are presented in Figure 14-7 to Figure 14-11.

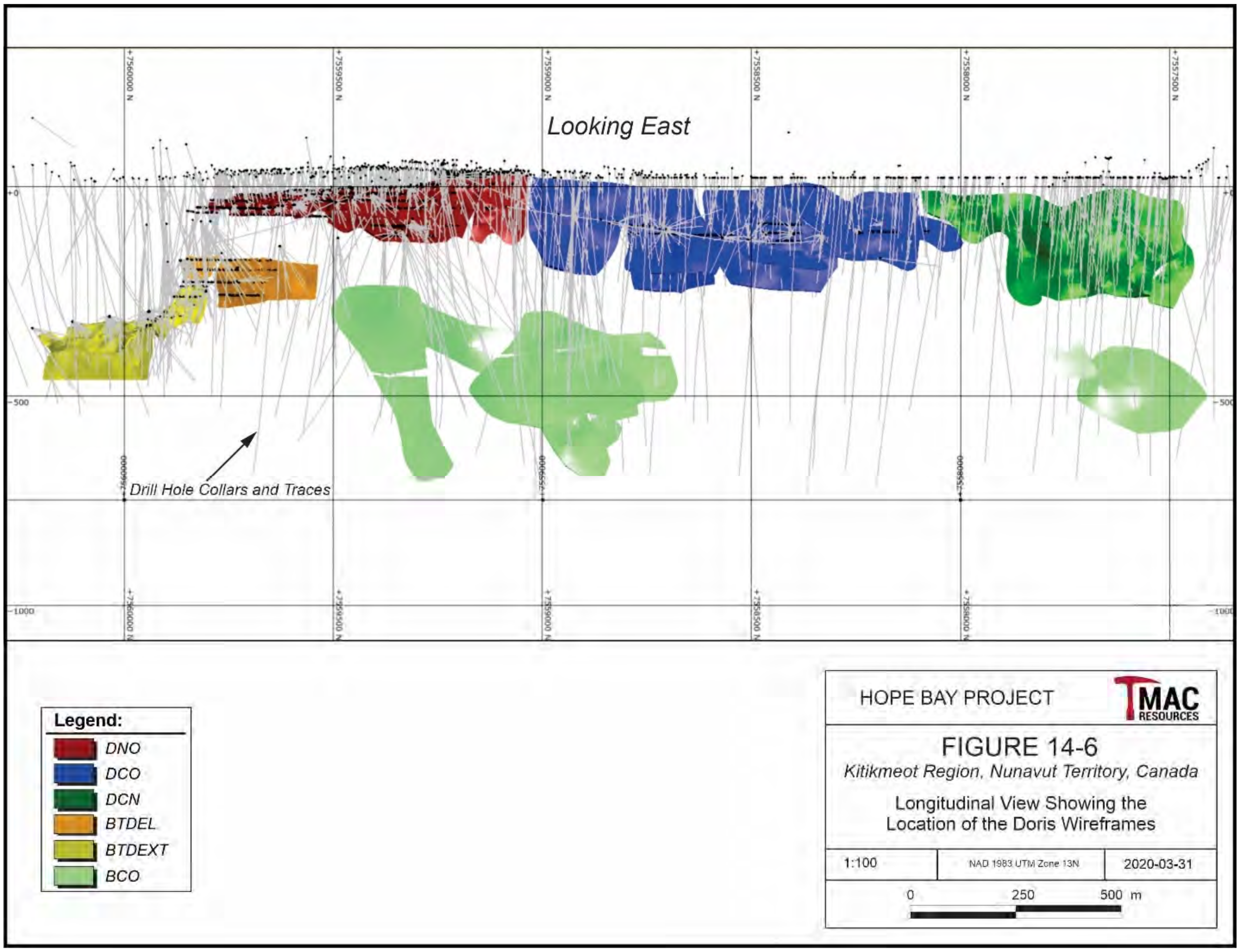


Figure 14-6. Plan View Showing the Location of the Doris Wireframes

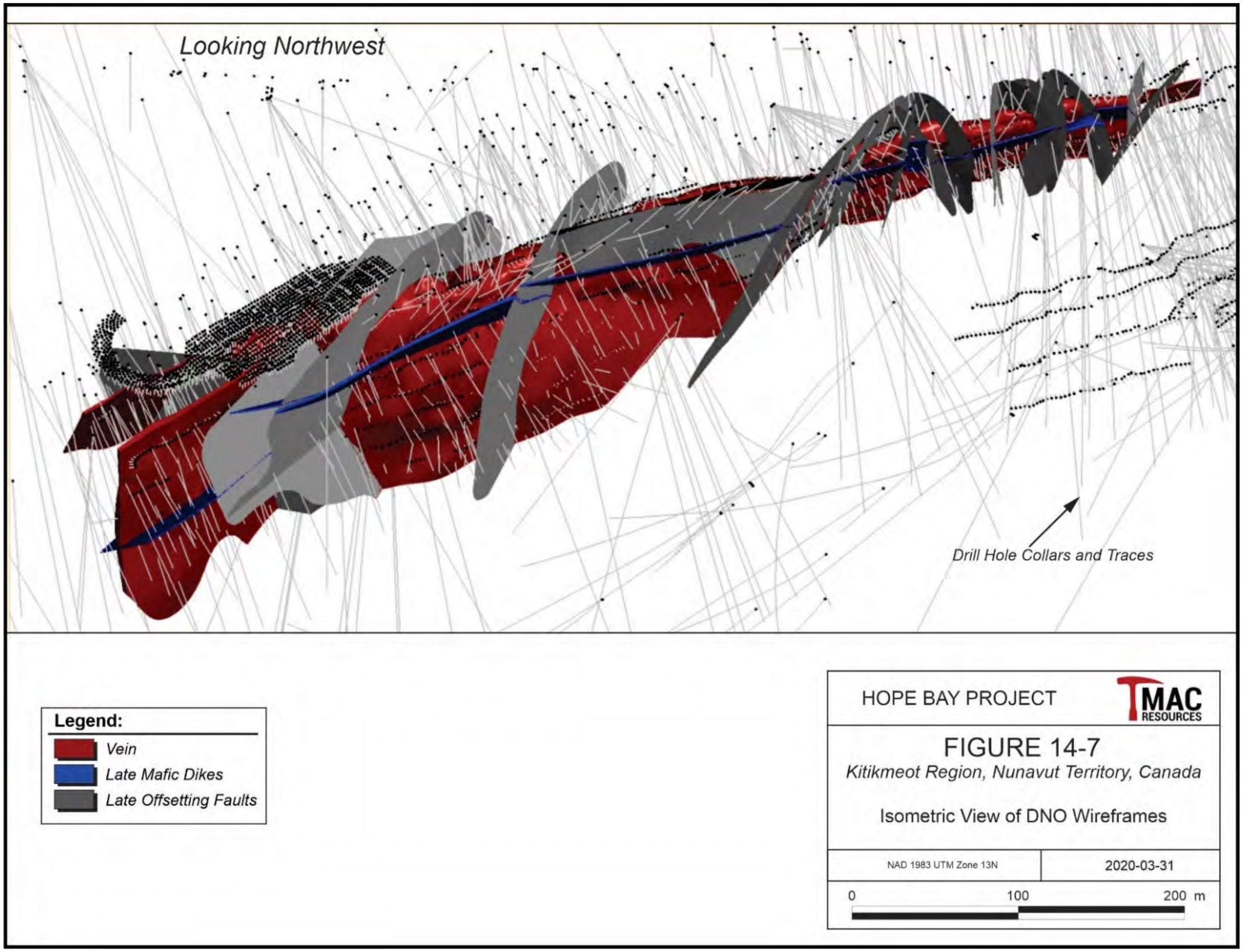


Figure 14-7. Isometric View of DNO Wireframes

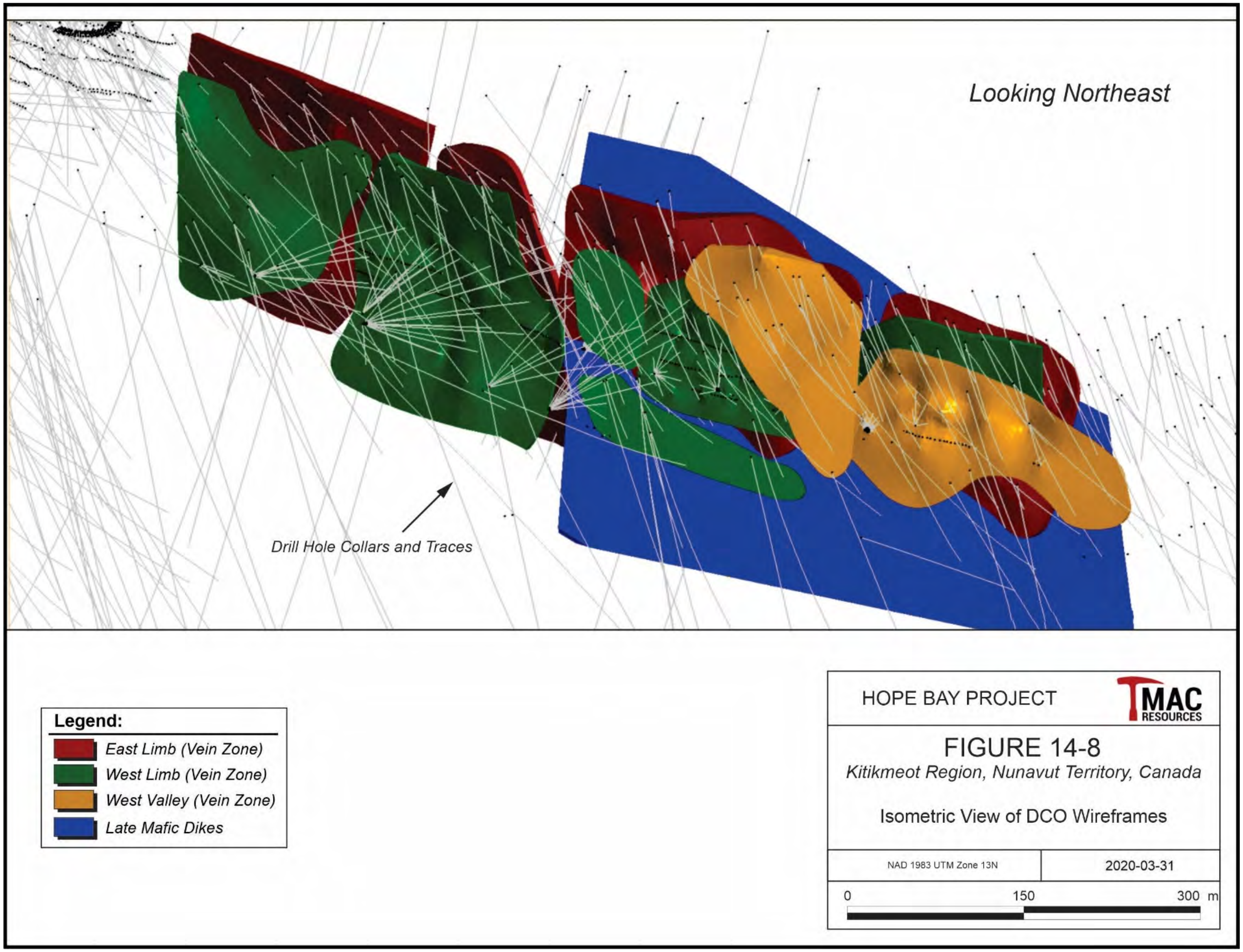


Figure 14-8. Isometric View of DCO Wireframes

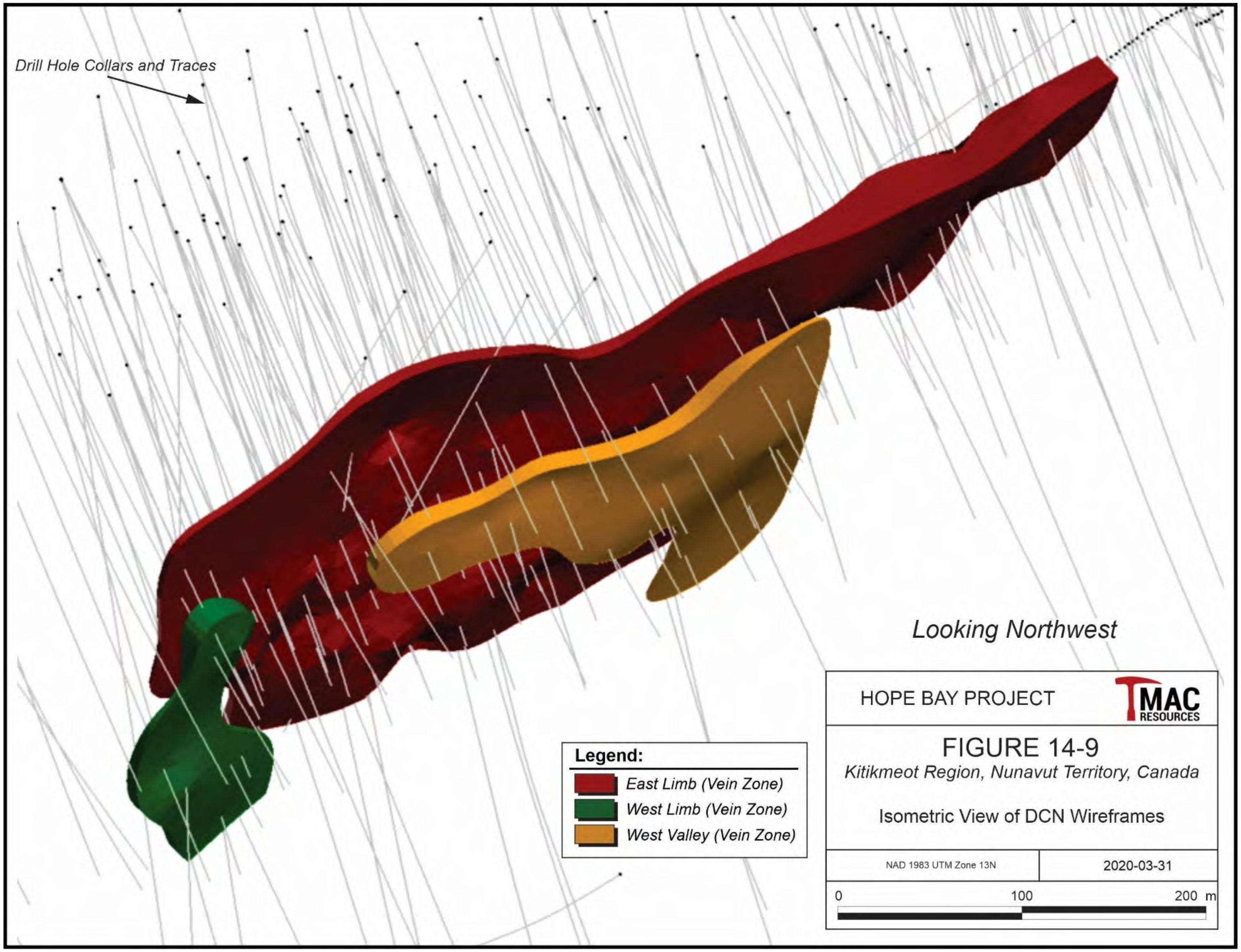


Figure 14-9. Isometric View of DCN Wireframes

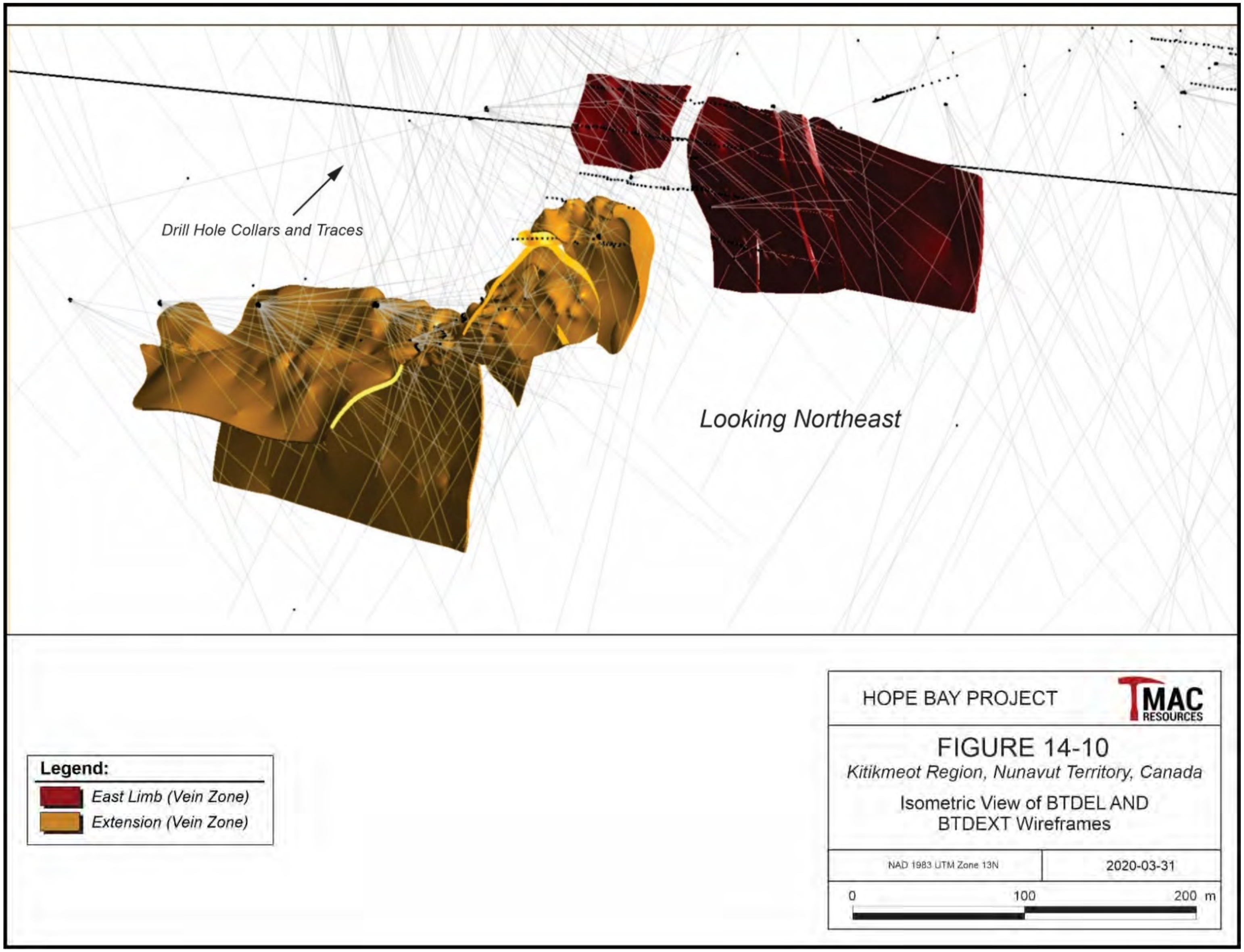


Figure 14-10. Isometric View of BTDEL and BTDEXT Wireframes

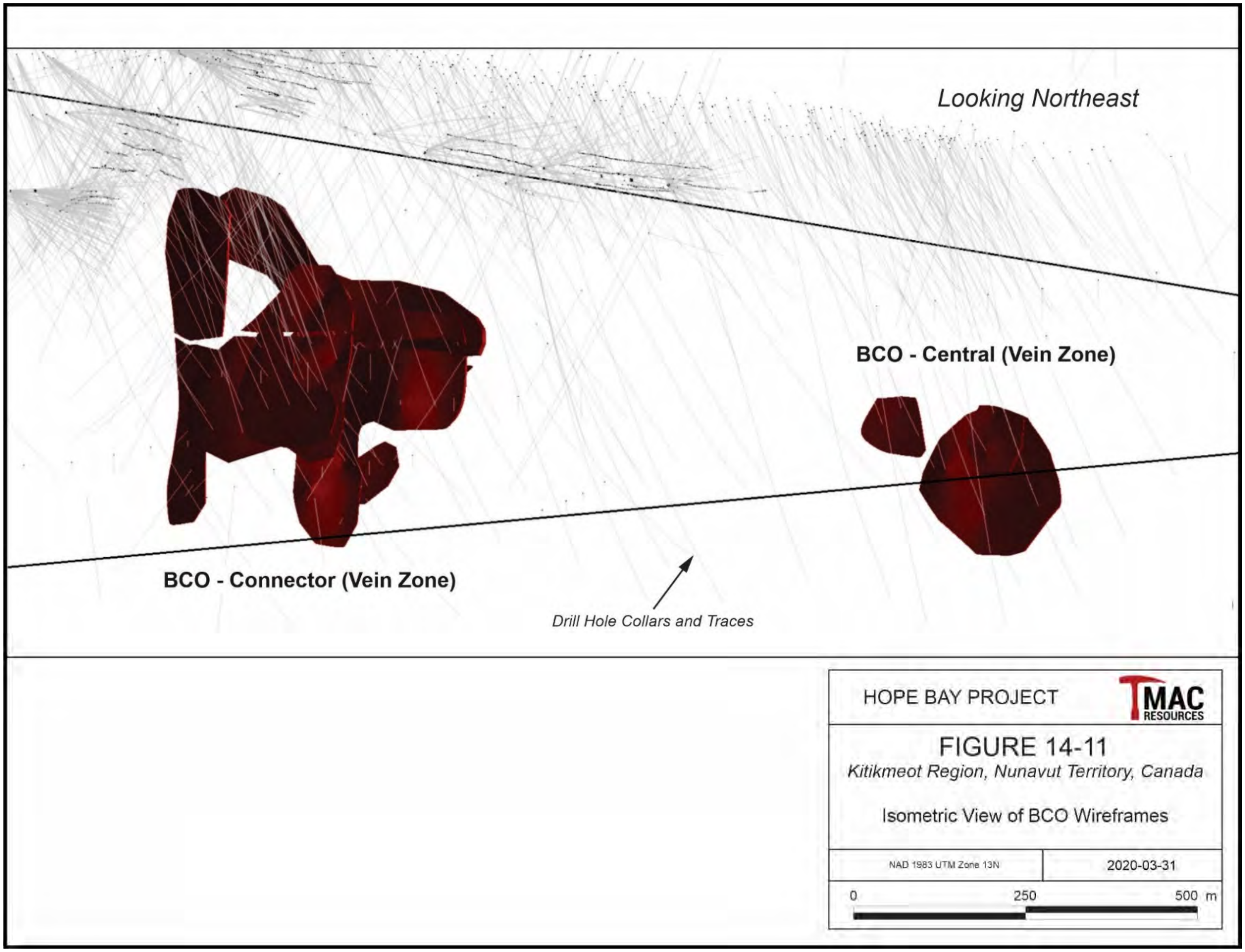


Figure 14-11. Isometric View of BCO Wireframes

TREATMENT OF HIGH-GRADE ASSAYS

Assay intervals were capped at various levels depending on their univariate and spatial distributions. Capping analysis involved the inspection of the spatial location of high-grades, log probability plots, histograms, decile analyses, and disintegration analysis. For distributions where capping, as implied by the decile analysis, resulted in excessive metal loss, a two-tier capping approach was adopted whereby an initial higher cap was applied within a specified distance. Beyond the specified distance a lower cap was used.

For DNO, BTDEL, and BTDEXT, high-grade domains within the vein shape were identified. Separate capping grades were then applied to the high and low-grade portions although soft boundaries were used between the high and low-grade domains.

A summary of the Doris uncapped and capped statistics is provided in Figure 14-7.

Table 14-6. Doris Uncapped and Capped Assay Statistics

TMAC Resources Inc. – Hope Bay Project

Domain	No. of Assays	Uncapped				Capped Assays				Restricted Capping Level		
		Min (g/t Au	Max (g/t Au)	Average (g/t Au)	CV	Capping Level	Average (g/t Au)	CV	Metal Loss (%)	Capping Level	Average (g/t Au)	CV
DNO												
BASALT	13,931	0.00	746.80	1.63	11.43	7	0.38	3.12	77			
VEIN_HG	5,177	0.00	5,777.00	31.74	3.91	250	24.48	2.11	23			
VEIN_LG	2,411	0.00	599.00	5.45	4.35	50	3.89	2.32	29			
WVW												
1	280	0.00	561.70	11.39	4.76	35	4.28	2.10	62	100.00	6.80	2.86
2	872	0.00	25.50	0.13	5.48	10	0.12	4.41	5	25.50	0.13	5.48
BTDEL												
HG	234	-0.01	1,000.00	73.00	2.01	250	53.90	1.52	26			
MG	420	0.01	134.50	5.01	2.34	40	4.47	1.83	11			
BTDEXT												
V1	499	-0.01	278.00	7.86	3.29							
V1_fault	23	0.09	262.00	30.42	2.01							
V2	270	-0.01	2,710.00	24.92	6.88	Composites within high-grade zone capped to 160 g/t Au, composites within low-grade zone capped to 35 g/t Au						
V2A	135	-0.01	1,255.00	12.64	8.49							
V3	299	-0.01	965.00	29.21	3.44							
DCO												
EL1	584	0.00	194.61	3.06	4.37	75	2.64	3.33	14			
EL2	2,027	0.00	103.00	2.08	2.78	75	2.06	2.70	1			
EL3	552	0.00	109.00	2.33	3.01	75	2.26	2.72	3			

Domain	No. of Assays	Uncapped				Capped Assays				Restricted Capping Level		
		Min (g/t Au	Max (g/t Au)	Average (g/t Au)	CV	Capping Level	Average (g/t Au)	CV	Metal Loss (%)	Capping Level	Average (g/t Au)	CV
EL4	283	0.00	427.10	3.30	7.78	75	2.05	3.18	38			
EL5	199	0.00	22.10	0.59	3.08	22.1	0.59	3.08	0			
WL1	77	0.00	48.70	2.16	2.71	48.7	2.16	2.71	0			
WL10	42	0.00	335.21	14.79	3.87	80	6.08	2.78	59			
WL2	1,146	0.00	159.72	3.98	2.60	80	3.83	2.26	4			
WL3	1,654	0.00	1,005.00	7.15	4.74	100	5.79	2.37	19			
WL6	516	0.00	169.00	7.49	2.21	80	7.12	1.98	5			
WL7	529	0.00	116.10	4.33	2.84	80	4.20	2.69	3			
WL8	30	0.00	12.01	3.42	1.02	12.01	3.42	1.02	0			
WL9	360	0.00	27.00	1.18	2.23	27	1.18	2.23	0			
WV1	399	0.00	52.40	2.33	2.22	40	2.29	2.14	1			
WV2	122	0.00	115.30	4.96	3.11	40	3.56	2.04	28			
DCN												
VCE	2,306	0.00	1,357.00	6.06	5.70	100	4.85	2.62	20	40.00	4.06	2.02
VCE2	148	0.00	605.49	5.10	9.70	10	0.90	2.28	82	10.00	0.90	2.28
VEV	119	0.00	60.45	4.00	2.14	10	2.78	1.12	31	10.00	2.78	1.12
BCO												
0	4,070	0.00	201.00	0.11	14.77	10	0.09	4.42	14			
1	129	0.00	46.19	3.78	2.24	30	3.56	2.15	6			
2	17	0.02	26.20	7.69	0.93	26.2	7.69	0.93	0			
3	139	0.01	70.80	3.73	2.61	20	2.71	1.89	27			
4	15	0.02	57.75	4.32	2.68	30	3.21	2.32	26			
5	20	0.01	30.36	3.41	1.78	20	3.11	1.60	9			
6	114	0.00	248.00	6.89	2.43	50	6.14	1.40	11			

Domain	No. of Assays	Uncapped				Capped Assays				Restricted Capping Level		
		Min (g/t Au	Max (g/t Au)	Average (g/t Au)	CV	Capping Level	Average (g/t Au)	CV	Metal Loss (%)	Capping Level	Average (g/t Au)	CV
7	31	0.00	25.50	3.32	1.74	20	3.13	1.64	6			
8	40	0.02	80.72	7.61	2.23	30	5.19	1.62	32			
9	12	0.24	14.46	4.12	0.96	14.46	4.12	0.96	0			

COMPOSITING

A composite length was selected for each domain considering the dominant sampling length, block size domain variability, thickness, and structural complexity. Full width composites were used exclusively at BTDEL as the domain vein is narrow, massive, and discrete, and drill hole intercepts intersected the wireframes at reasonable angles. While DNO and BTDEXT are both narrow and discrete, given that the vein is folded some drill holes intercepted at sub-optimal angles which do not warrant full-width compositing. For DCO, DCN, and BCO, the vein does not contain mineralization of economic interest across the width of the vein and selectivity within the vein is of interest. RPA is of the opinion that fixed length composites are appropriate for these domains.

The Doris compositing strategy is presented in Table 14-7 and the composite statistics is given in Table 14-8.

Table 14-7. Doris Compositing Strategy

TMAC Resources Inc. – Hope Bay Project

Domain	Composite Length (m)
DNO	1.0
DNO WVW	Full width
DCO	3.0
DCN	2.0
BTDEL	Full width
BTDEXT	1.5
BTD DCO	Full width

Table 14-8. Doris Capped Composite Statistics
TMAC Resources Inc. – Hope Bay Project

Domain	No. of Composites	Min (g/t Au)	Max (g/t Au)	Mean (g/t Au)	CV
DNO					
BASALT	15,973	0.0	10.0	0.4	3.4
VEIN_HG	2,124	0.0	50.0	3.3	2.0
VEIN_LG	5,140	0.0	250.0	23.5	2.0
WVW					
1	60	0.0	20.4	4.3	1.2
2	806	0.0	3.8	0.1	3.2
BTDEL					
ALL	267	0.0	250.0	20.5	1.9
BTDEXT					
V1	501	0.0	35.0	4.8	2.0
V2	801	0.0	160.0	12.5	2.5
V2A	102	0.0	26.6	4.2	1.5
V3	369	0.0	160.0	12.1	2.6
DCO					
EL1	132	0.0	25.0	2.1	1.7
EL2	578	0.0	18.8	1.9	1.4
EL3	150	0.0	19.5	2.1	1.7
EL4	76	0.0	13.9	1.9	1.4
EL5	55	0.0	5.1	0.7	1.5
WL1	17	0.1	15.4	2.9	1.2
WL10	11	0.3	32.1	5.9	1.5
WL2	281	0.0	40.5	3.9	1.4
WL3	437	0.0	41.7	5.4	1.4
WL6	125	0.0	41.8	8.8	1.1
WL7	95	0.0	44.9	3.9	2.1
WL8	8	1.7	7.3	3.8	0.4
WL9	104	0.0	9.7	1.2	1.5
WV1	121	0.0	25.4	3.6	1.4
WV2	33	0.0	14.0	3.4	1.0

Domain	No. of Composites	Min (g/t Au)	Max (g/t Au)	Mean (g/t Au)	CV
			DCN		
VCE	1,004	0.0	81.5	4.1	1.9
VCE2	54	0.0	7.4	0.8	1.6
VEV	61	0.0	8.7	2.4	0.9
			BCO		
0	5,099	0.0	6.7	0.1	3.7
1	15	0.0	11.2	3.6	1.0
2	4	2.7	17.8	7.7	0.7
3	20	0.0	12.5	2.7	1.0
4	3	0.4	6.5	3.2	0.8
5	4	2.8	3.9	3.1	0.1
6	25	0.0	19.9	6.1	0.8
7	8	0.0	7.6	3.1	0.8
8	8	0.0	18.0	5.2	1.1
9	2	3.3	5.0	4.1	0.2

TREND ANALYSIS

Analysis of grade trends was performed on mineralization using three dimensional (3D) grade shell contouring in Leapfrog Geo and variography. Variogram models were interpreted from experimental variograms and used to inform search parameters, classification decisions, and for validation purposes.

A summary of the Doris variogram models is provided in Table 14-9.

Table 14-9. Doris Variogram Models

TMAC Resources Inc. – Hope Bay Project

Domain	DNO North	DNO South	BTDEL	BTDEXT	DCO West Limb	DCO East Limb	DCN Main
Angle1	105	105	105	-175	90	90	-90
Angle2	95	95	80	160	90	90	85
Angle3	-155	160	140	70	150	170	30
Axis1	Z	Z	Z	Z	Z	Z	Z
Axis2	X	X	X	X	X	X	X
Axis3	Z	Z	Z	Z	Z	Z	Z
Nugget	0.3	0.25	0.596	0.41	0.45	0.34	0.429
Sill(st1)	0.6	0.48	0.128	0.52	0.12	0.46	0.408

Domain	DNO North	DNO South	BTDEL	BTDEXT	DCO West Limb	DCO East Limb	DCN Main
Range1(st1)	5	4	9	8	27	13	83
Range2(st1)	4	3	9	8	27	13	28
Range3(st1)	5	3	10	5	5	9	25
Type(st1)	Spherical	Spherical	Spherical	Exponential	Spherical	Exponential	Exponential
Sill(st2)	0.1	0.27	0.277	0.07	0.43	0.21	0.163
Range1(st2)	80	80	66	152	81	255	92
Range2(st2)	40	23	66	20	41	46	40
Range3(st2)	10	18	10	10	10	17	25
Type(st2)	Spherical	Spherical	Spherical	Spherical	Spherical	Spherical	Spherical

BULK DENSITY

Bulk density values were assigned based on rock type and mineralization zones. A summary of the bulk densities assigned to blocks is provided in Table 14-10.

Table 14-10. Doris Bulk Density Assignment

TMAC Resources Inc. – Hope Bay Project

Domain	Bulk Density (t/m^3)
DNO Vein	2.74
DNO Basalt	2.84
BTDEL	2.75
BTDEXT	2.75
DCO	2.80
DCN	2.80
BCO Min	2.82
BCO Waste	2.84

BLOCK MODELS

Block model dimensions and setups have been selected based on the proposed scale of mining, considering the available data and complexity of the mineralization wireframes. Parent blocks were split into sub-cells at wireframe boundaries, with the minimum sub-cell size set to a reasonable size with intention of minimizing the difference between wireframe and block volumes while still maintaining a manageable block model file size.

The Doris block model prototypes are given in Table 14-11:

Table 14-11. Doris Block Model Prototypes

TMAC Resources Inc. – Hope Bay Project

Domain	Model Name	XINC	YINC	ZINC	XMORIG	YMORIG	ZMORIG	NX	NY	NZ
DNO	dno_md_depleted13122019	2	2	2	433,700	7,559,030	-140	115	390	88
WVW	wvw_final	2	2	2	433600	7559230	-120	160	190	92
DCO	dco_md_depleted13122019	2.5	2.5	2.5	433,660	7,557,970	-273	72	430	124
DCN	dce_md04122018	2	5	5	433,790	7,557,440	-310	57	132	66
BTD East Limb	btd_el_md_depleted13122019	2	2	2	433,820	7,559,520	-314	67	183	82
BTD Extension	btd_ext_md_depleted13122019	1	1	1	433,860	7,559,800	-460	213	404	228
DCO BTD	btdcc_final	2	2	2	433,440	7,557,280	-740	217	1,152	279

SEARCH STRATEGY AND GRADE INTERPOLATION PARAMETERS

A multi-pass search strategy was implemented using unique dynamic anisotropy angles for each block, except for BTDEL which used a fixed rotation search ellipse. Block grades were interpolated using Inverse Distance Squared (ID^2) and Inverse Distance Cubed (ID^3) while a Nearest Neighbour (NN) estimate was run for validation purposes.

A summary of the search strategy and interpolation parameters is provided in Table 14-12.

Table 14-12. Doris Search Strategy and Interpolation Parameters

TMAC Resources Inc. – Hope Bay Project

Domain	Pass	Interpolation Method	Major (m)	Semi-Major (m)	Minor (m)	Min	Max	Max Per hole	Weight
DNO HG	1	ID^3	15	15	4	3	12	2	
	2	ID^3	30	30	8	3	12	2	
	3	ID^3	45	45	12	1	12	2	
DNO LG	1	ID^3	15	15	4	4	12	3	
	2	ID^3	30	30	8	4	12	3	
	3	ID^3	60	60	16	1	12	3	
DNO BASALT	1	ID^3	30	30	4	3	12	2	
	2	ID^3	60	60	8	3	12	2	
	3	ID^3	90	90	12	1	12	2	
WVW	1	ID^3	40	20	8	3	8	2	Length
	2	ID^3	80	40	16	3	8	2	Length
	3	ID^3	160	80	32	1	4	2	Length

Domain	Pass	Interpolation Method	Major (m)	Semi-Major (m)	Minor (m)	Min	Max	Max Per hole	Weight
BTDEL[1]	1	ID^2	40	10	20	4	12		Length
	2	D^2	120	30	30	1	12		Length
BTDEXT	1	ID^3	25	10	5	4	8	3	
	2	ID^3	50	20	10	1	8	3	
DCO	1	ID^3	60	30	15	4	12	3	
	2	ID^3	120	60	15	1	6		
DCN	1	ID^3	60	30	4	3	8	2	
	2	ID^3	120	80	8	3	8	2	
	3	ID^3	300	150	20	1	4	2	
BCO	1	D^2	30	15	6	3	8	2	Length
	2	D^2	60	30	12	3	8	2	Length
	3	D^2	120	60	24	1	4	2	Length

Notes:

1. All domains used dynamic anisotropy except for BTDEL. The following rotation was used for BTDEL: dip, dip-azimuth, pitch rotation 77°/100°/145°

CLASSIFICATION

Definitions for resource categories used in this report are consistent with those defined by CIM (2014) and adopted by NI 43-101. In the CIM classification, a Mineral Resource is defined as “a concentration or occurrence of solid material of economic interest in or on the Earth’s crust in such form, grade or quality and quantity that there are reasonable prospects for eventual economic extraction”. Mineral Resources are classified into Measured, Indicated, and Inferred categories. A Mineral Reserve is defined as the “economically mineable part of a Measured and/or Indicated Mineral Resource” demonstrated by studies at Pre-Feasibility or Feasibility level as appropriate. Mineral Reserves are classified into Proven and Probable categories.

Blocks were classified as Measured, Indicated and Inferred using a distance based criterion with consideration for the continuity of grade above the cut-off and complexity of the geological model. While the classification was adjusted for each domain, the maximum classification criteria at Hope Bay is as follows:

- Inferred Mineral Resources are defined by 3D continuity of grade located in areas where drill spacing does not exceed 100 m.
- Indicated Mineral Resources require continuity of grade above the cut-off in reasonably contiguous areas where the drill spacing does not exceed 40 m.
- Measured Mineral Resources are defined after the grid defining the Indicated material has been infilled and the blocks are within close proximity to excavations.

The classification assigned to each domain is presented in Table 14-13 and is shown in Figure 14-12 to Figure 14-16.

Table 14-13. Doris Classification by Domain

TMAC Resources Inc. – Hope Bay Project

DDH spacing for 90% of the Tonnes			
Domain	**Measured**	**Indicated**	**Inferred**
DNO	<5m	<15m	-
DCO	<5m	<20m	<45m
DCE	-	<25m	<40m
BTDEL	<10m	<45m	<45m
BTDEXT	<5m	<20m	<40m
BCO	-	<45m	<75m

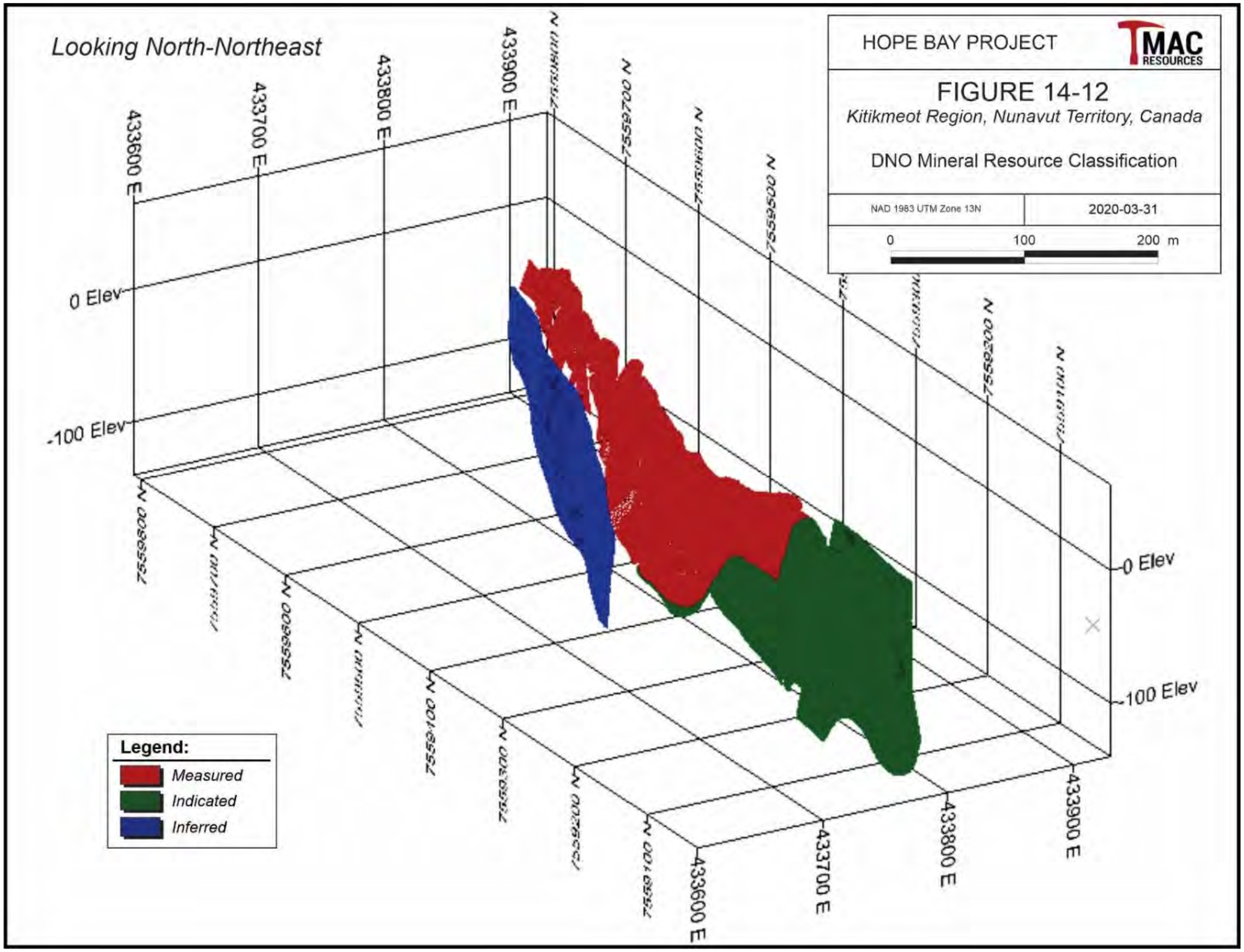


Figure 14-12. DNO Mineral Resource Classification

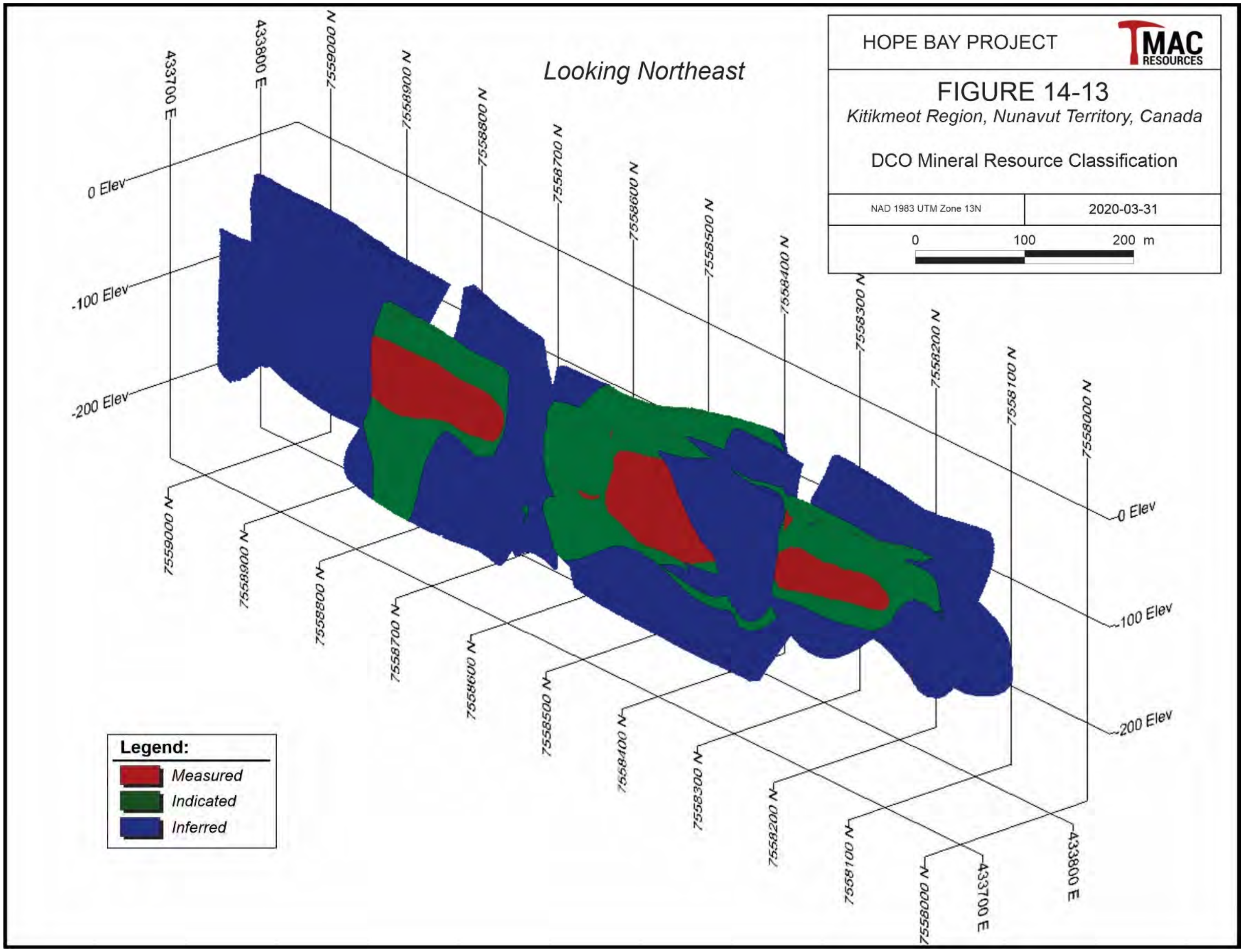


Figure 14-13. DCO Mineral Resource Classification

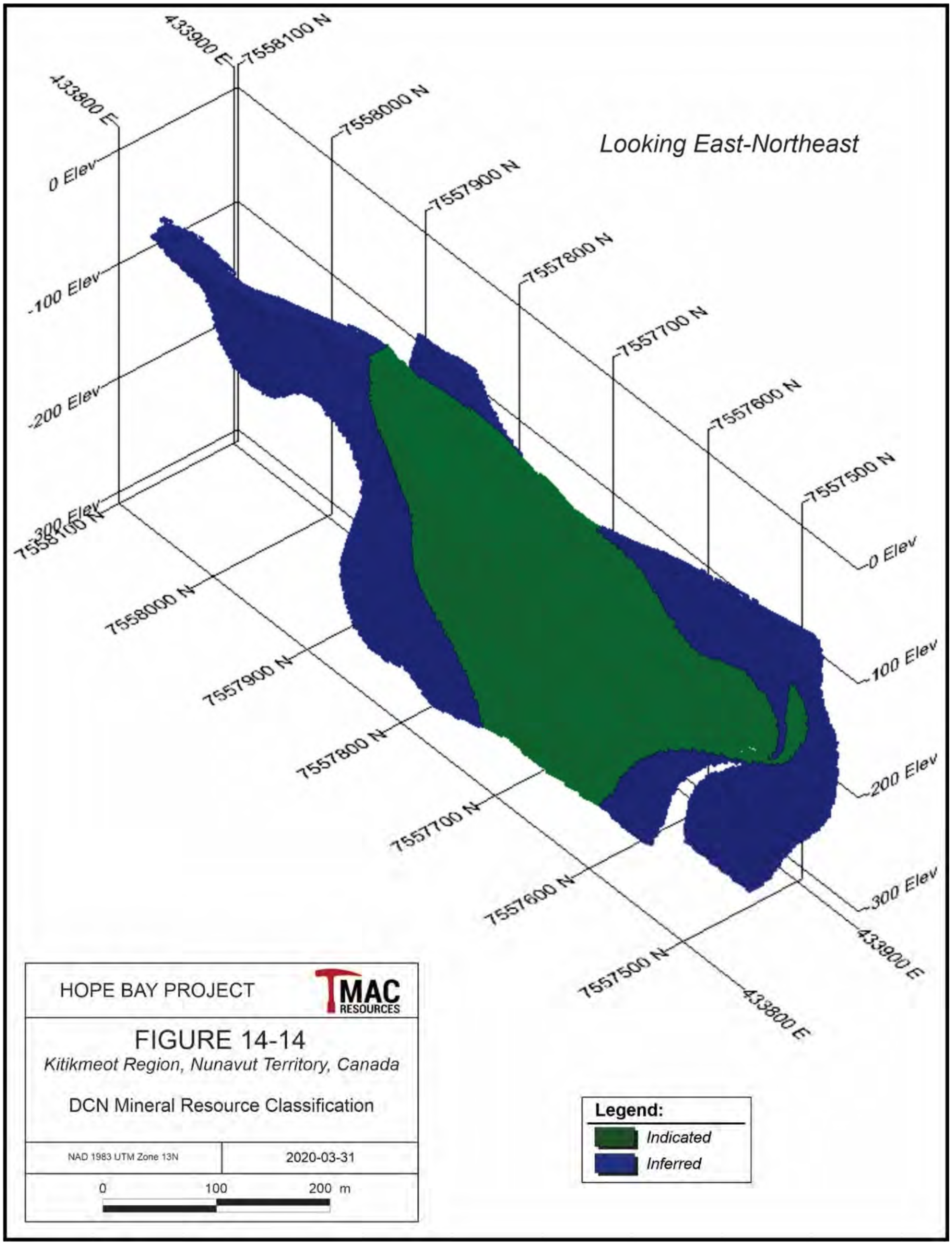


Figure 14-14. DCN Mineral Resource Classification

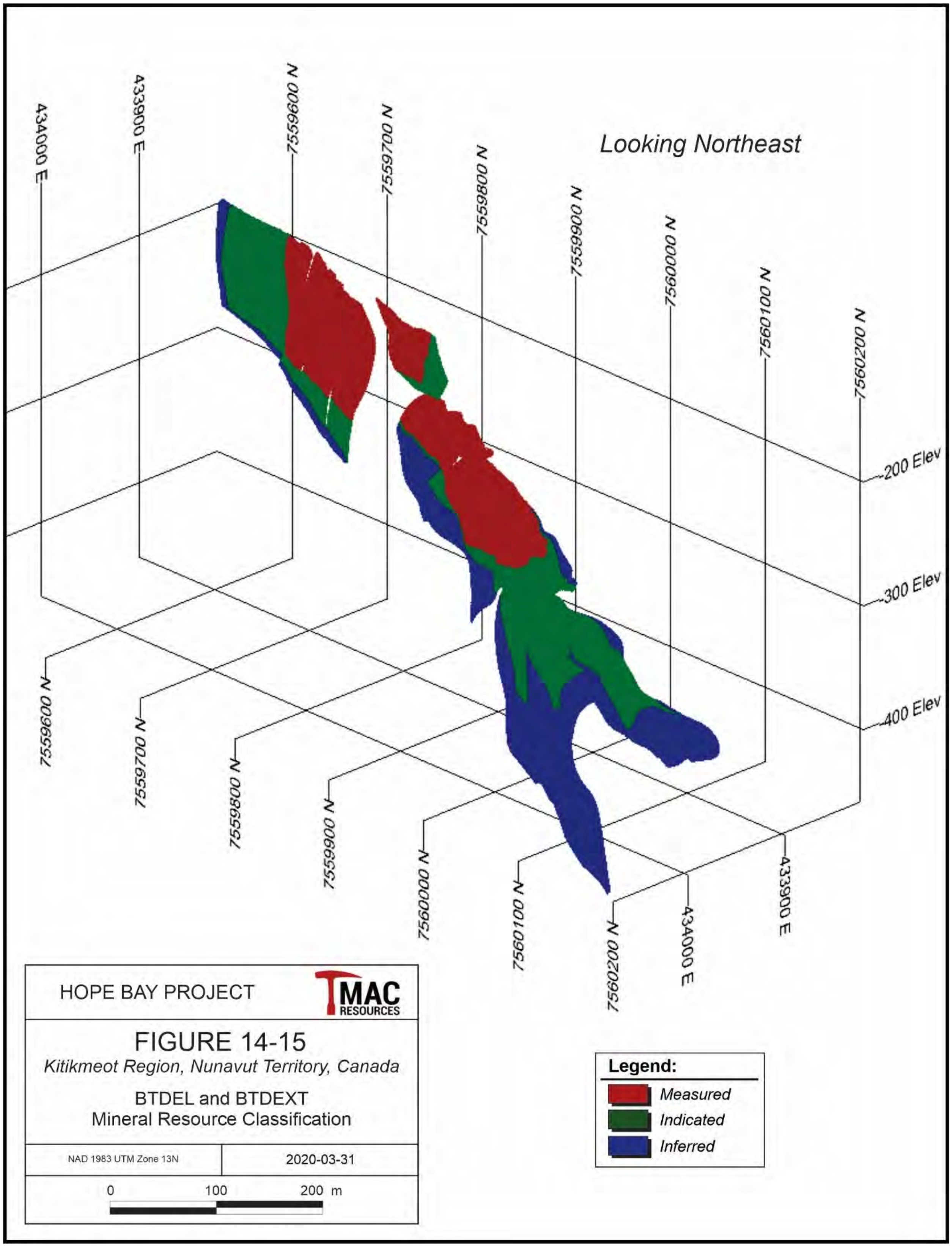


Figure 14-15. BTDEL and BTDEXT Mineral Resource Classification

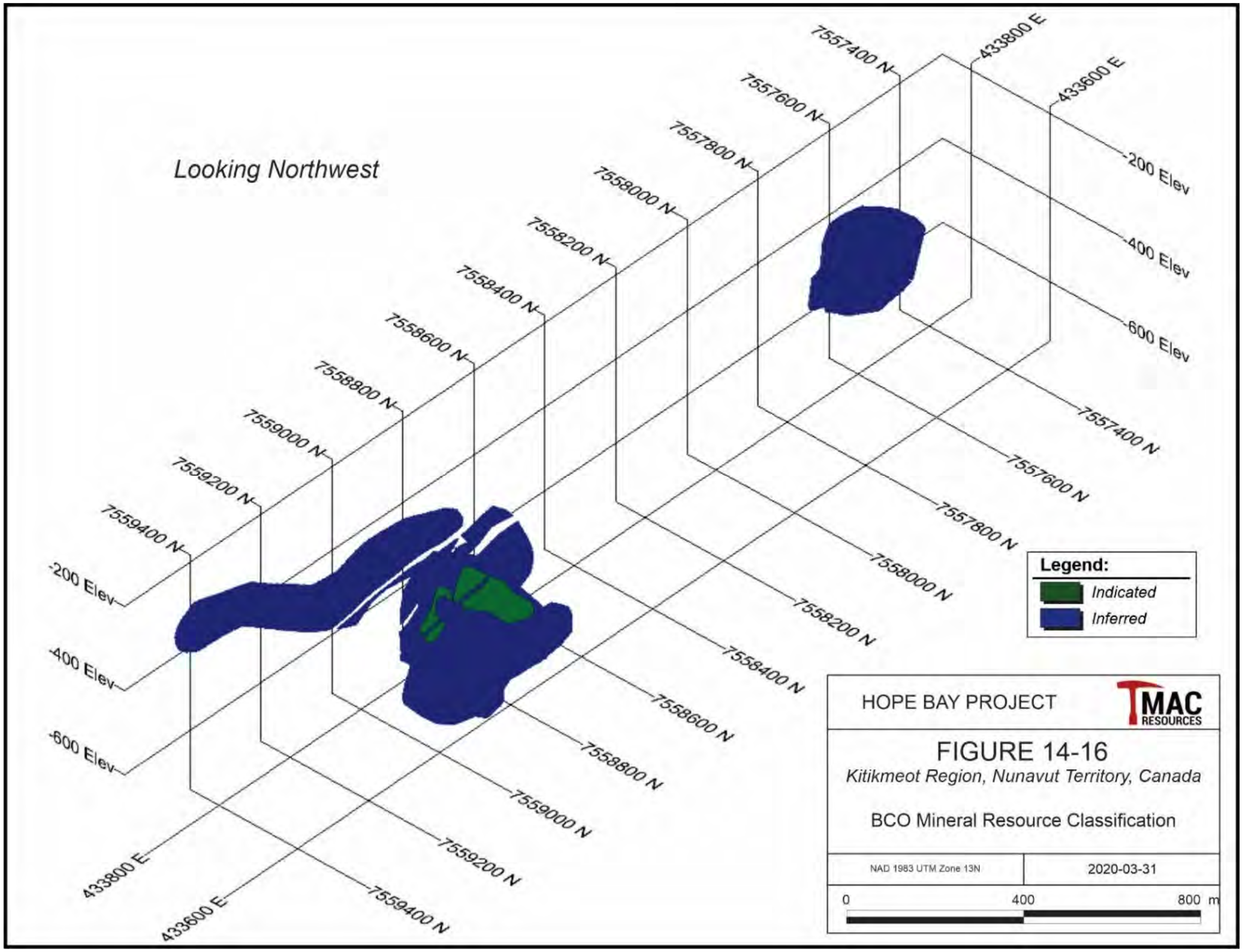


Figure 14-16. BCO Mineral Resource Classification

BLOCK MODEL VALIDATION

Blocks were validated using industry standard techniques including:

- Visual inspection of composite versus block grades (Figure 14-7 to Figure 14-22).
- Comparison between ID, NN, and composite means (Figure 14-23).
- Swath plots (Figure 14-24 to Figure 14-29).

The QP is of the opinion that the Doris Mineral Resource estimates validate well and are appropriate for the public disclosure of Mineral Resources and the estimation of Mineral Reserves.

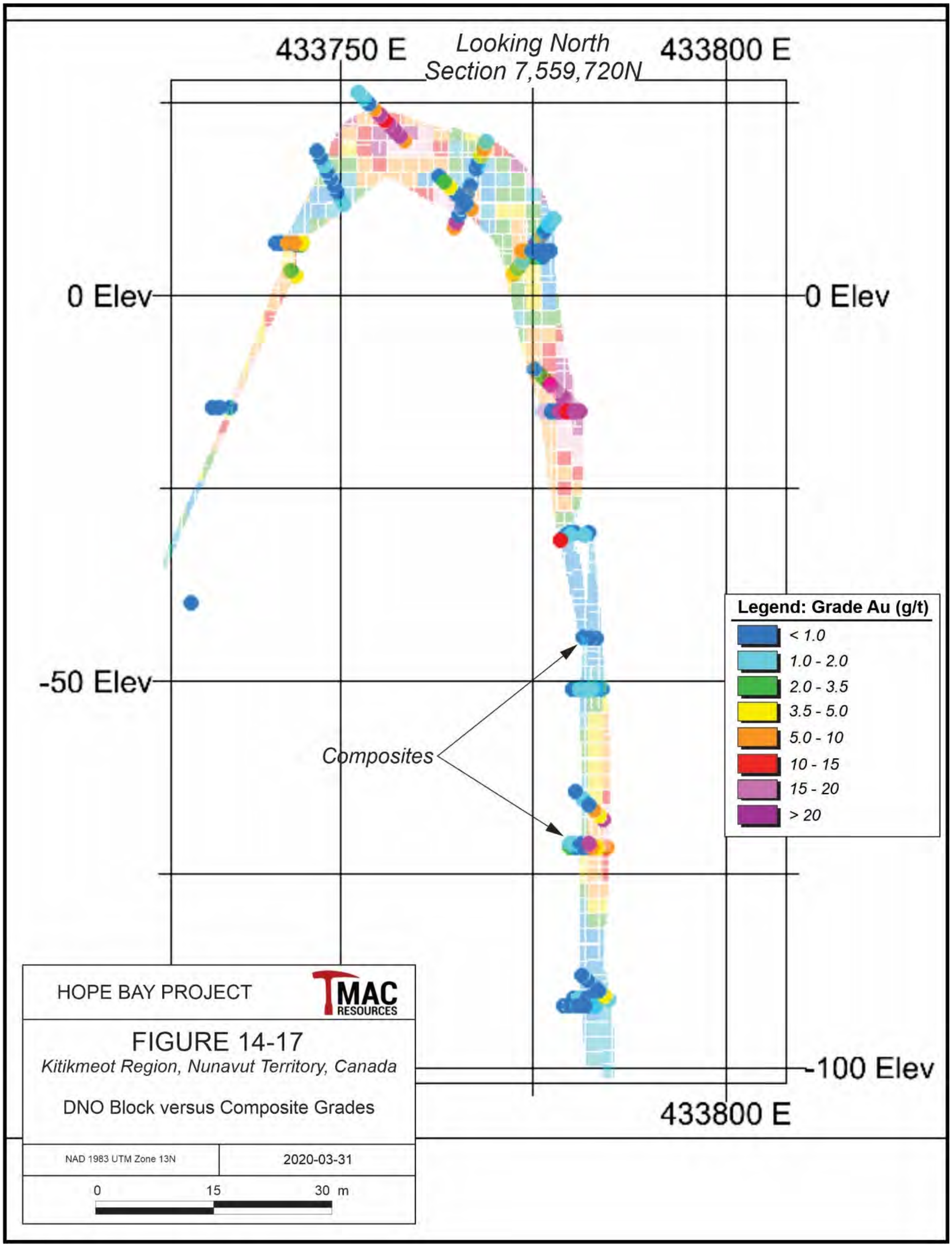


Figure 14-17. DNO Block versus Composite Grades

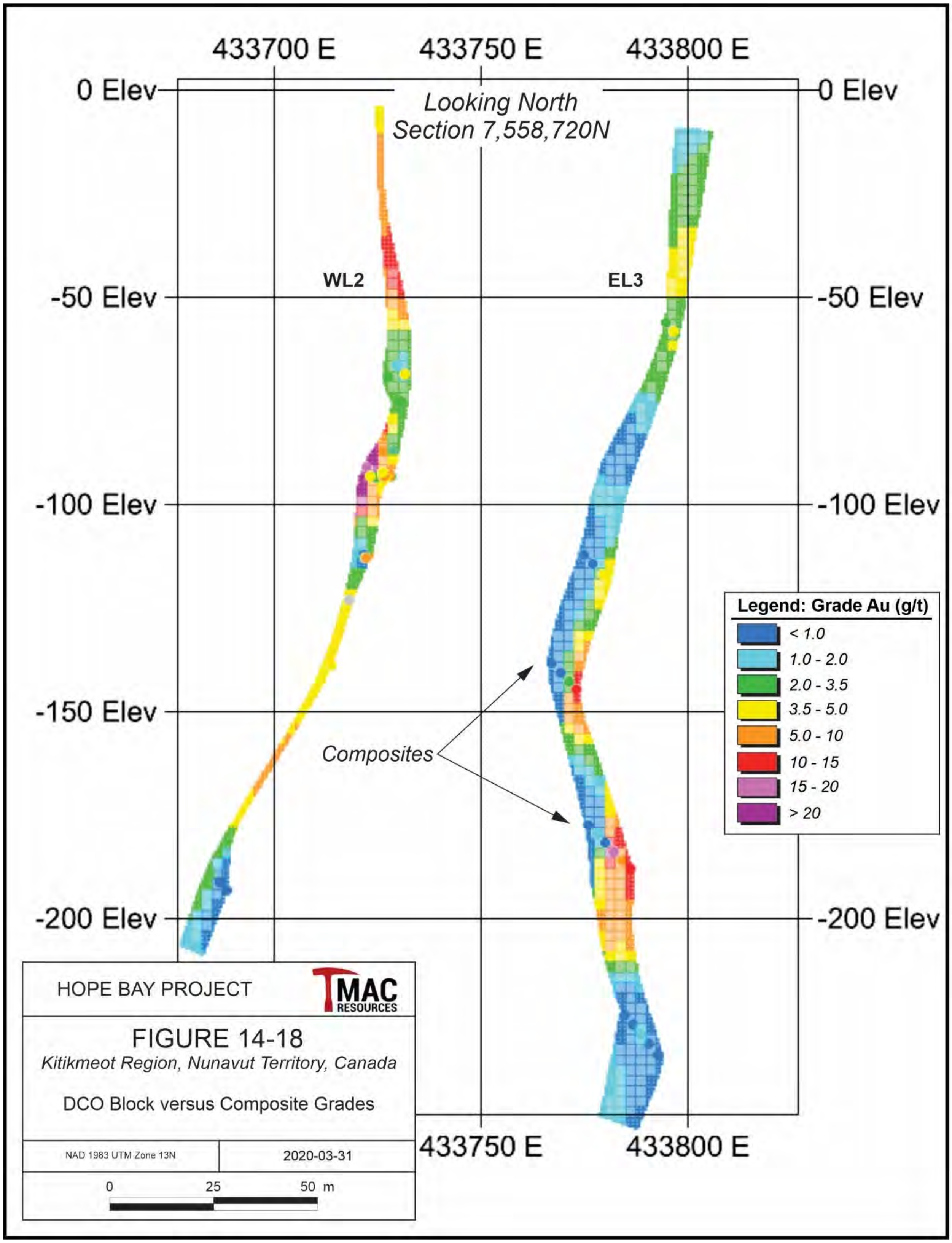


Figure 14-18. DCO Block versus Composite Grades

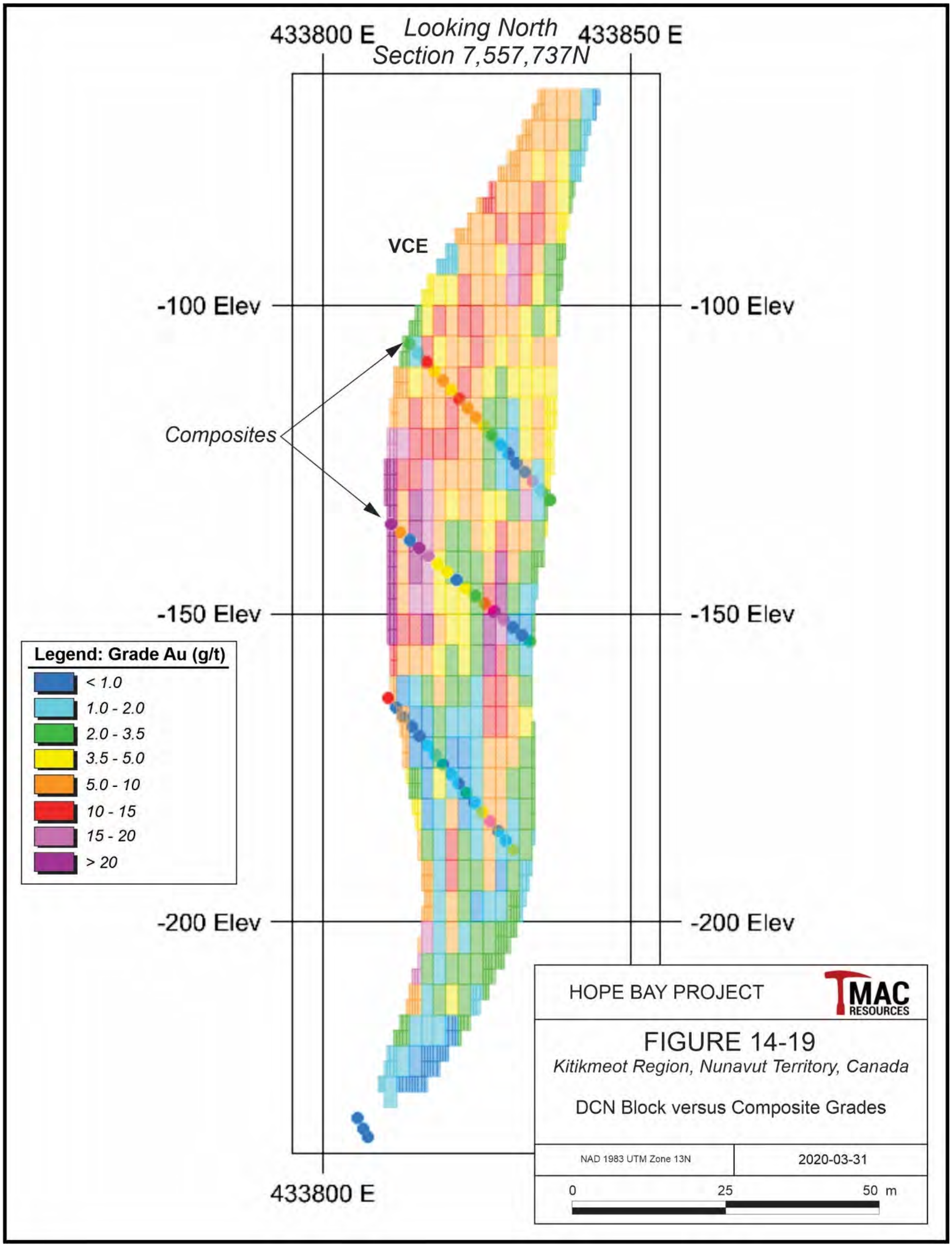


Figure 14-19. DCN Block versus Composite Grades

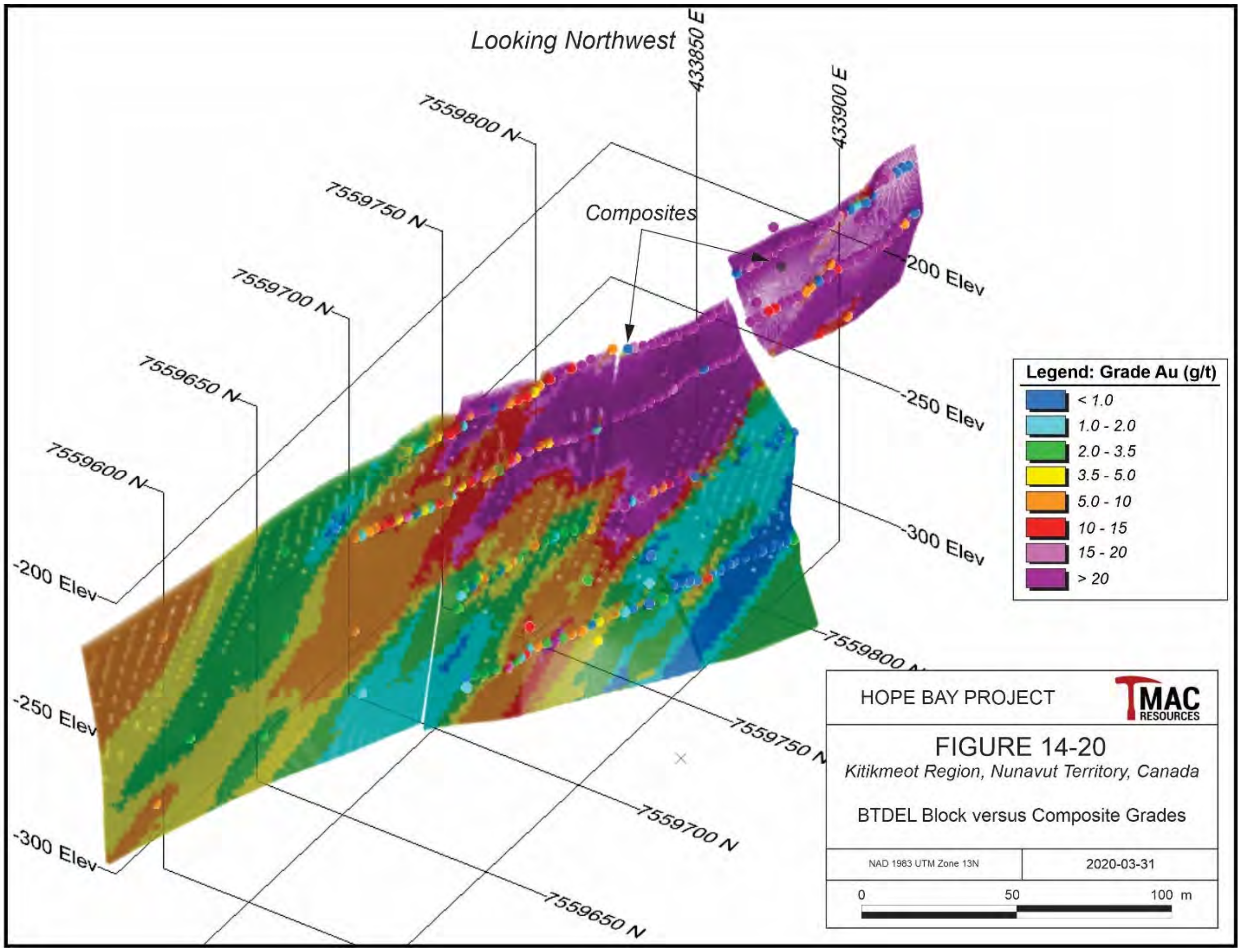


Figure 14-20. BTDEL Block versus Composite Grades

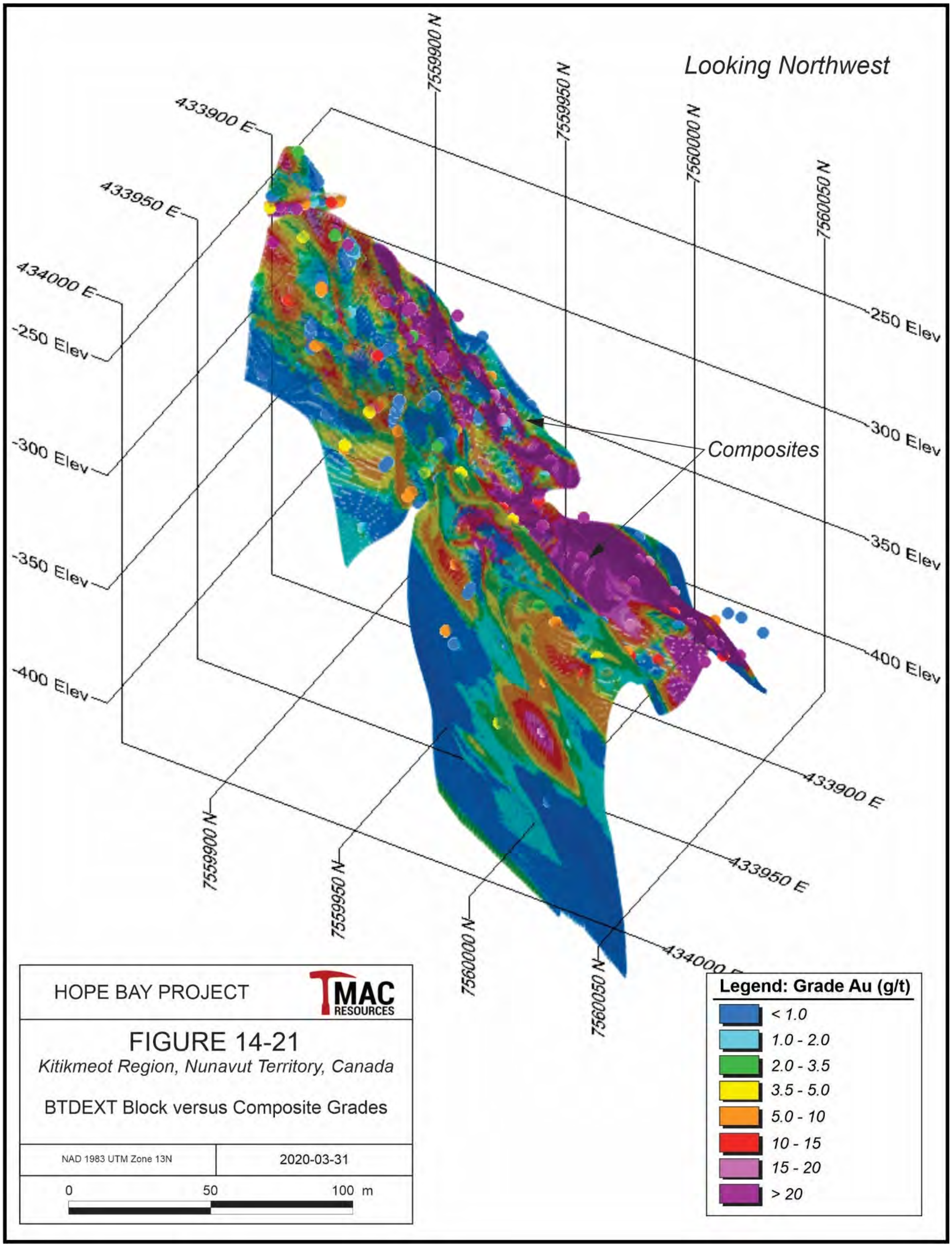


Figure 14-21. BTDEXT Block vs. Composite Grades

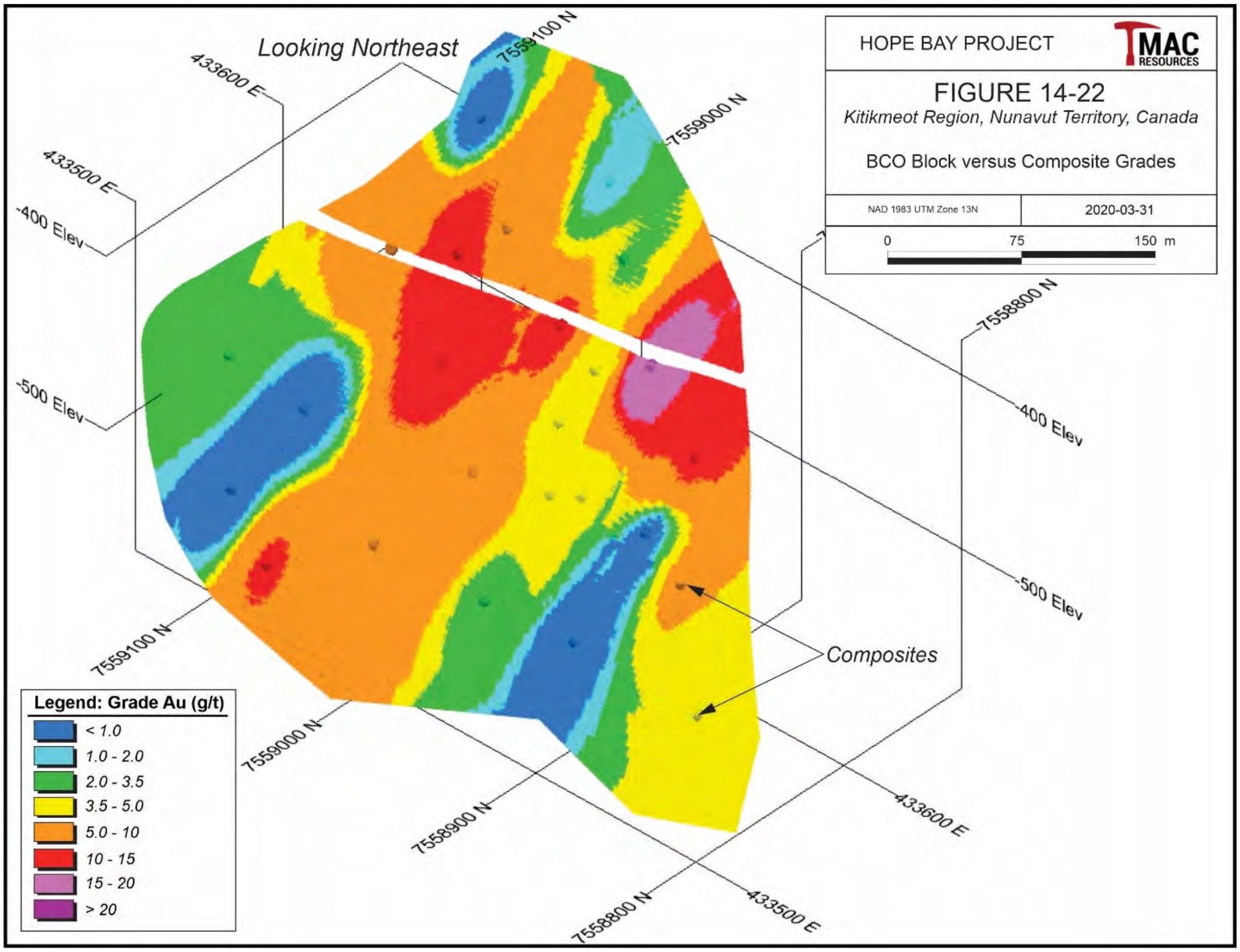


Figure 14-22. BCO Block vs. Composite Grades

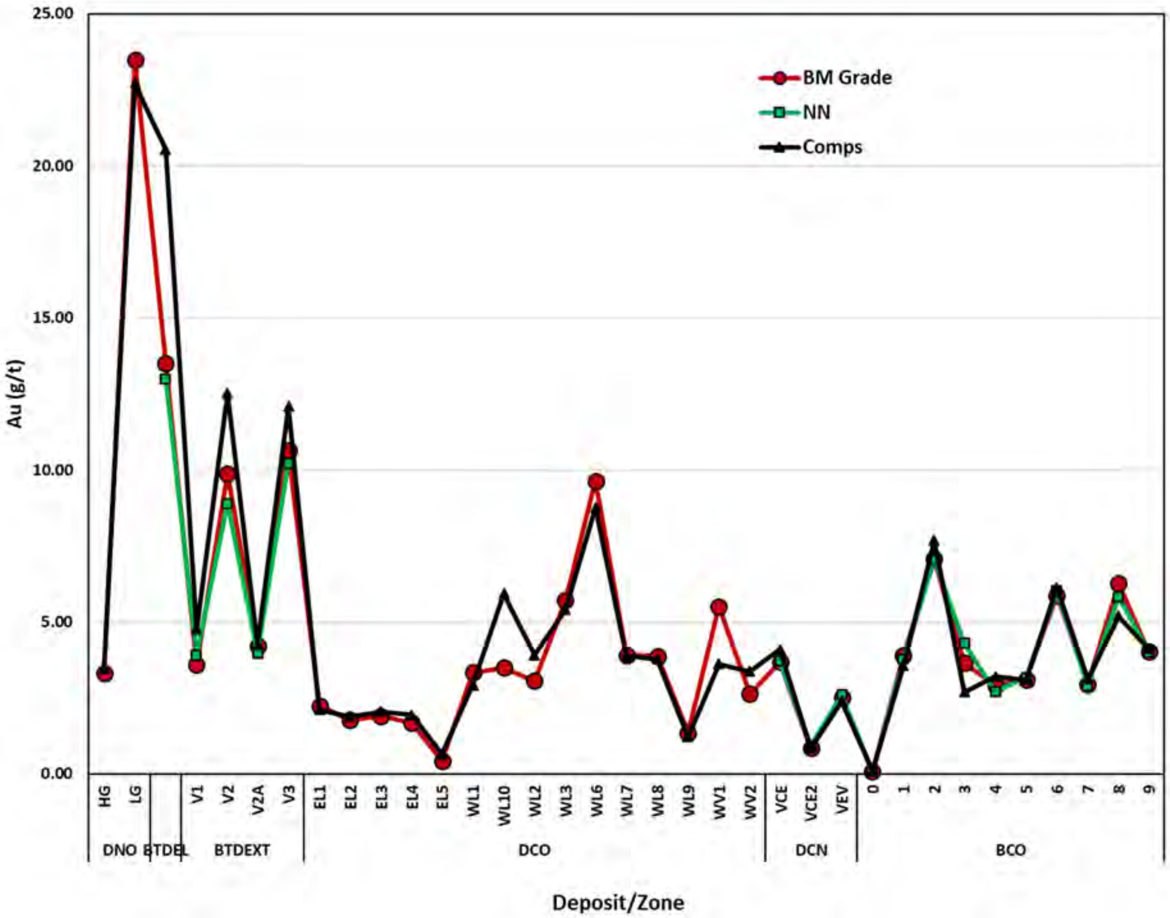


Figure 14-23. Doris Comparison Between Means

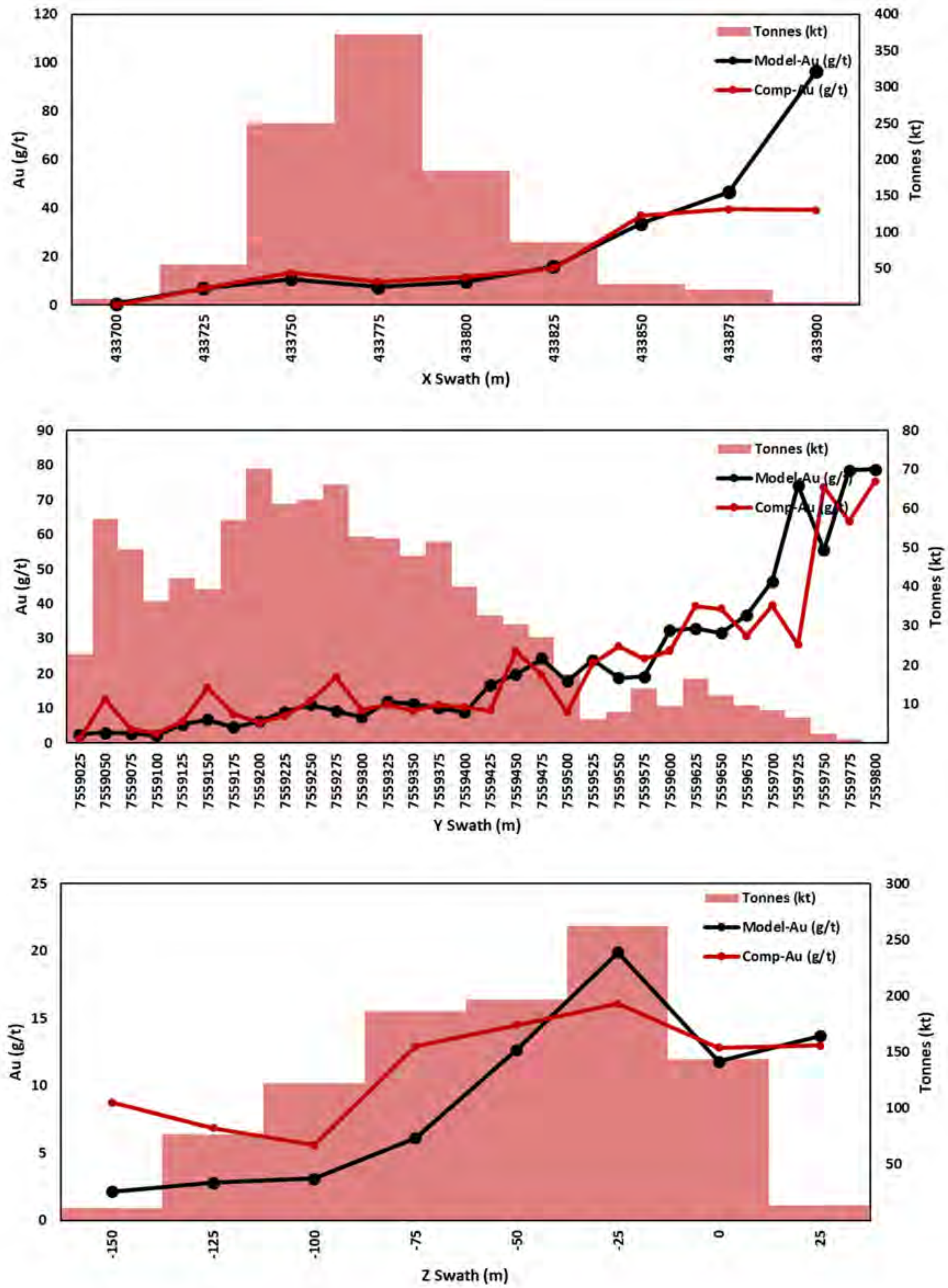


Figure 14-24. DNO Swath Plots

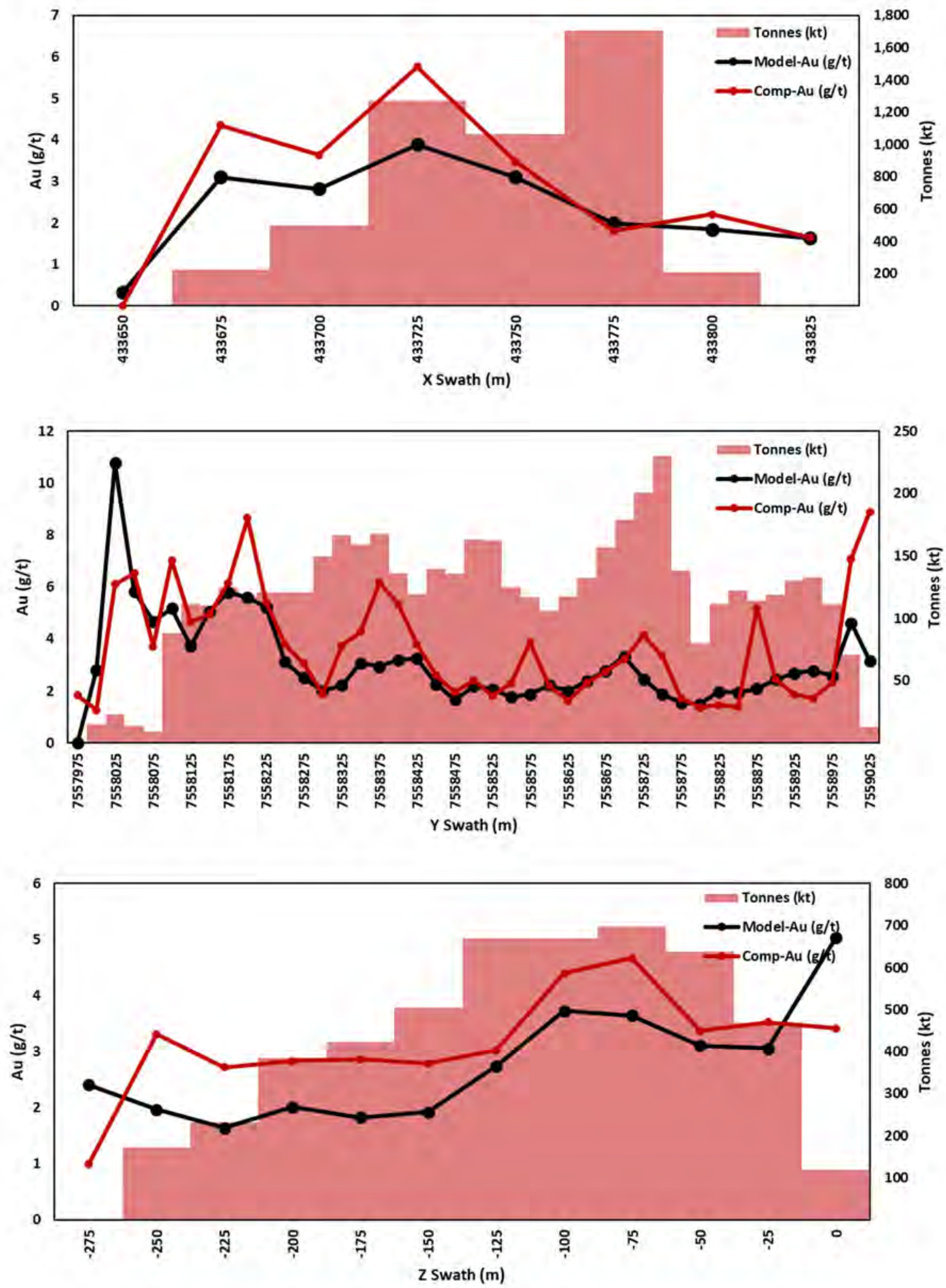


Figure 14-25. DCO Swath Plots

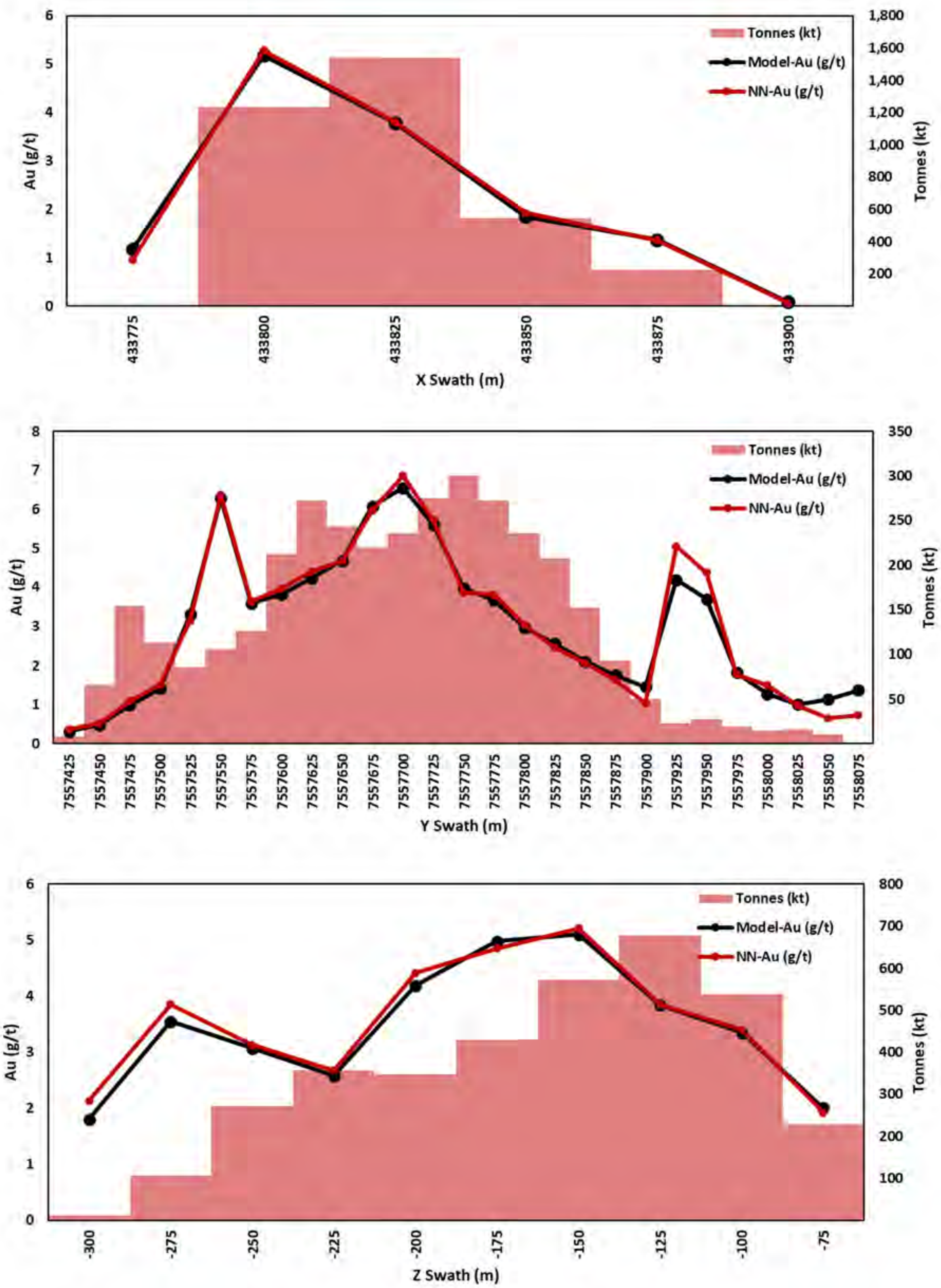


Figure 14-26. DCN Swath Plots

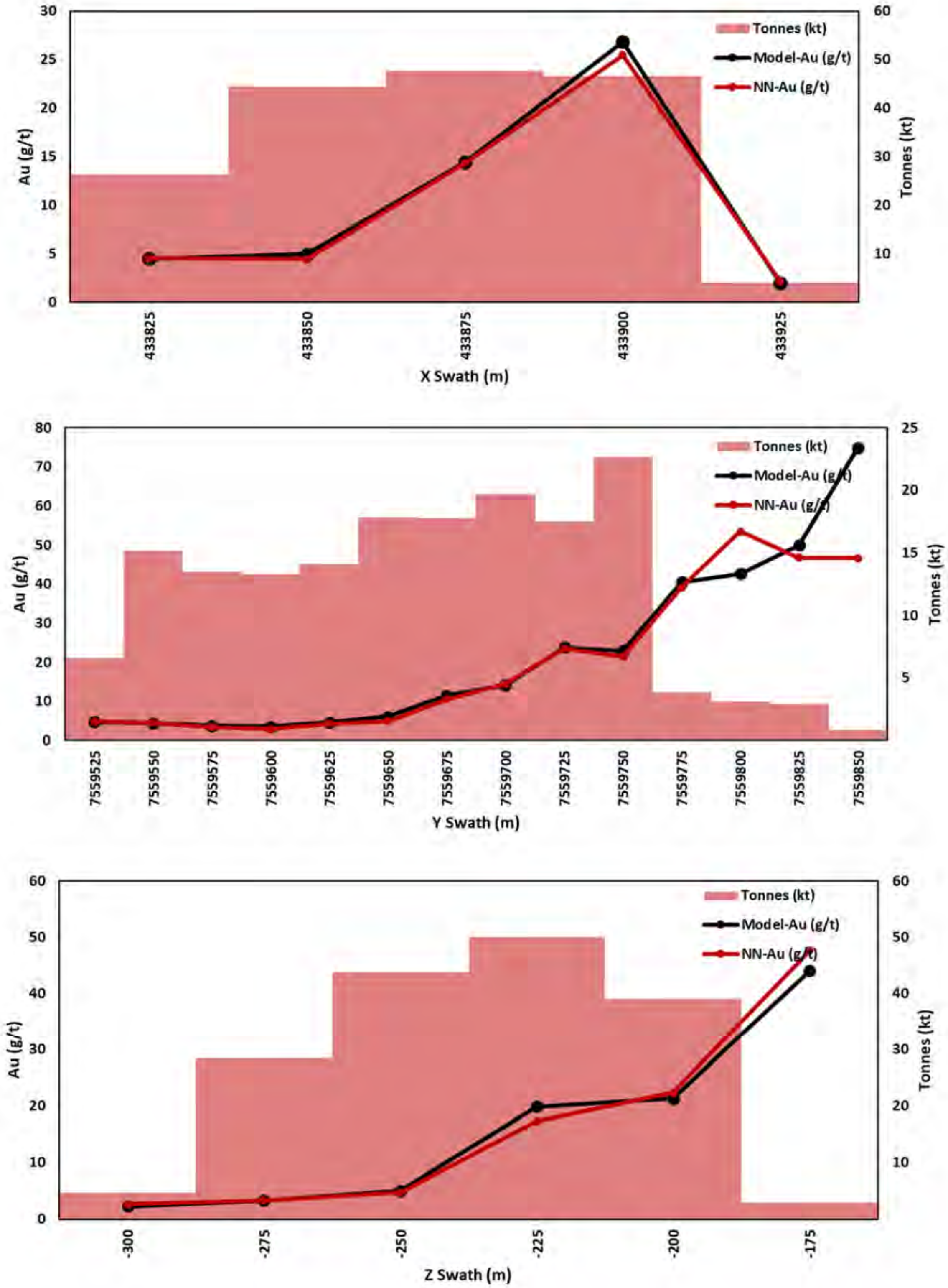


Figure 14-27. BTDEL Swath Plots

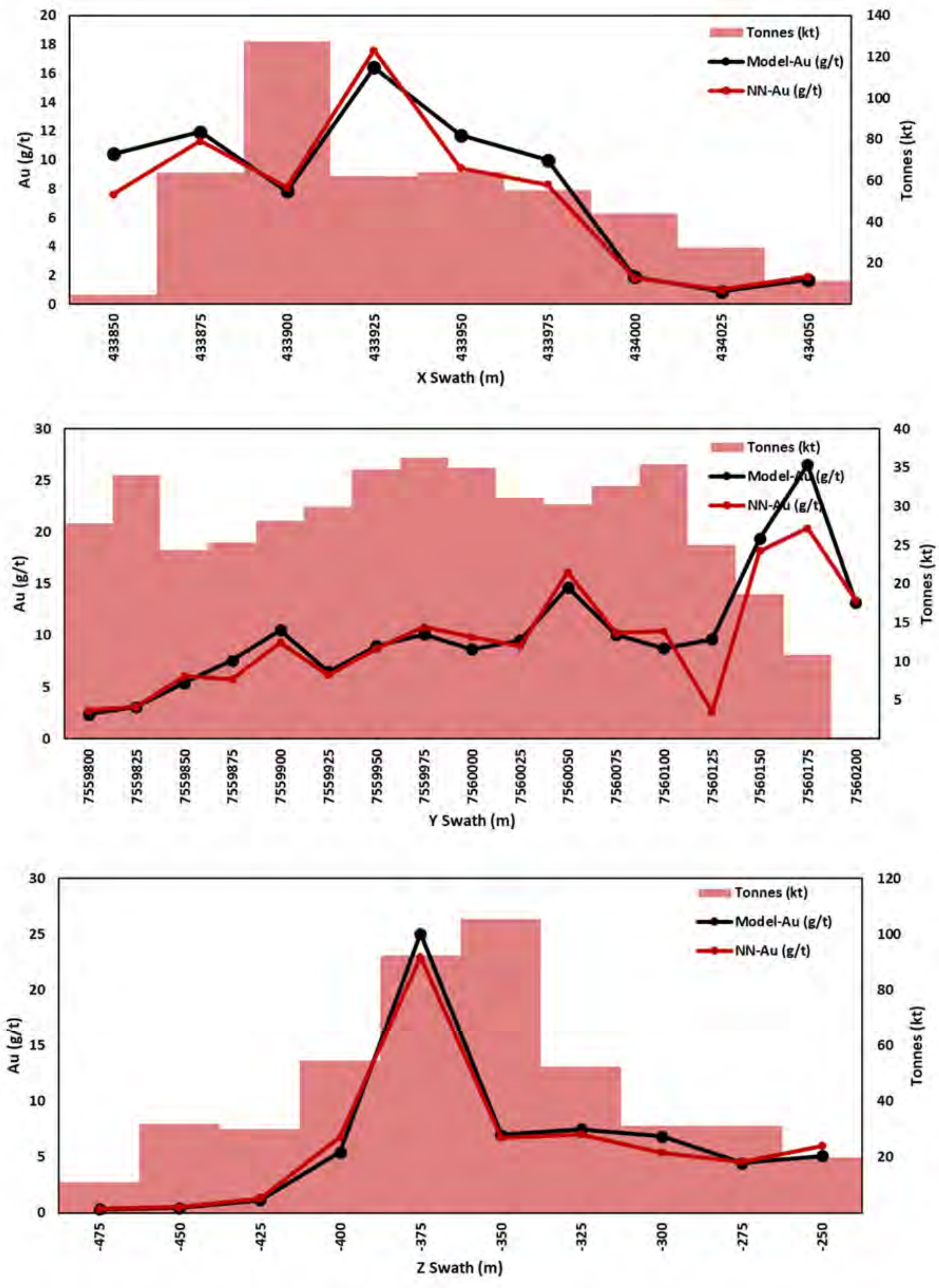


Figure 14-28. BTDEXT Swath Plots

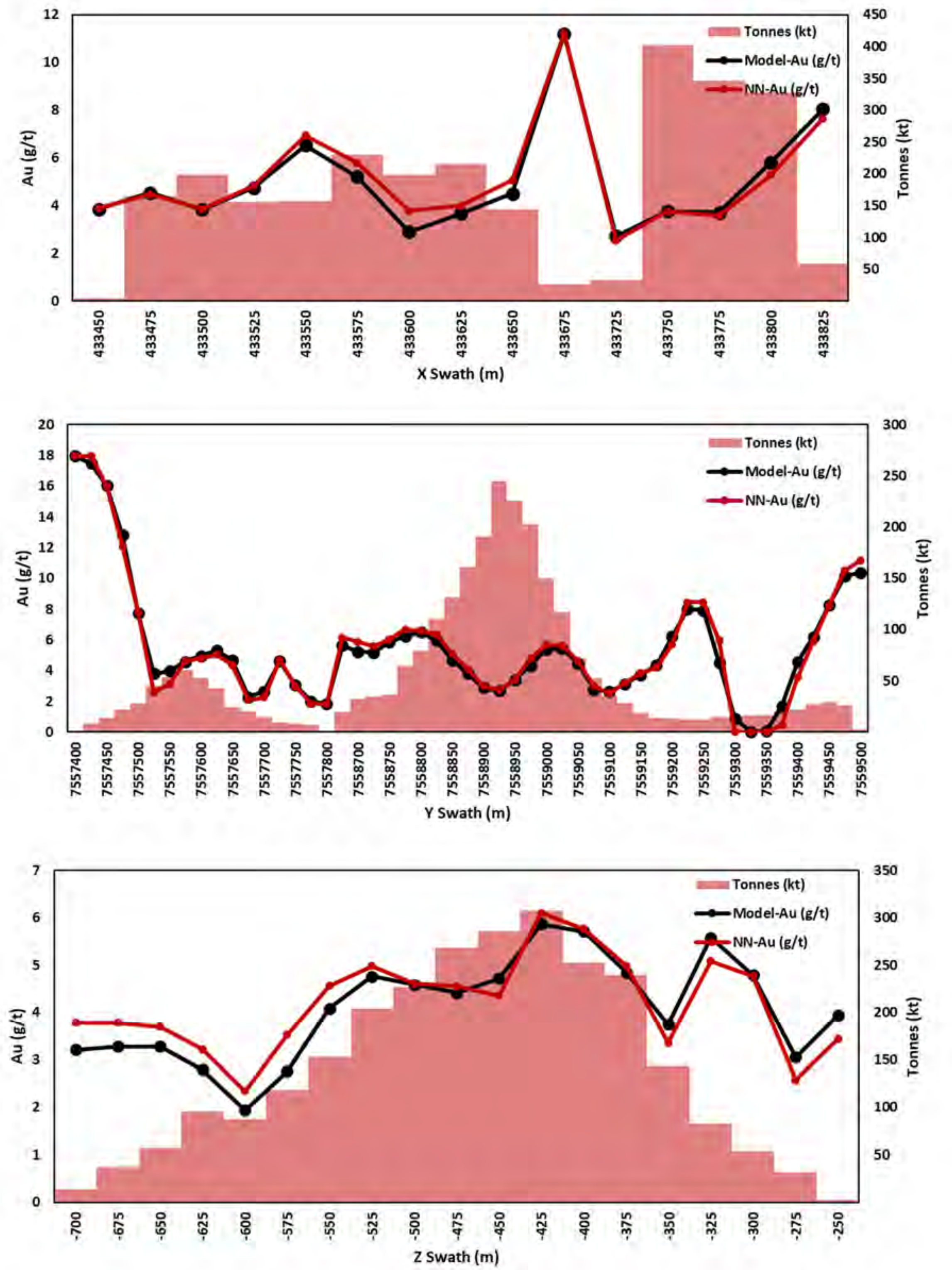


Figure 14-29. BCO Swath Plots

MADRID NORTH

Madrid North represents approximately 66% and 60% of the total Hope Bay Measured and Indicated tonnes and ounces, in addition to 50% and 46% of the total Hope Bay Inferred tonnes and ounces, respectively. A small open pit is currently being mined on the Naartok East Limb.

In early 2020, initial modeling of the Patch 7 mineralization was completed and incorporated into the December 31, 2019 Mineral Resources.

The Madrid Mineral Resources are presented in Table 14-14.

Table 14-14. Summary of Madrid North Mineral Resources - December 31, 2019

TMAC Resources Inc. – Hope Bay Project

Domain	Tonnes (000 t)	Grade (g/t Au)	Ounces (000 oz)
Indicated			
Suluk South	312	8.0	80
Suluk East	197	5.4	34
Suluk West	3,160	7.2	736
Patch 7	0	0.0	0
Spur	0	0.0	0
Rand	1,054	5.6	188
Naartok	9,707	6.7	2,084
Total Indicated	**14,431**	**6.7**	**3,123**
Inferred			
Suluk South	892	5.4	156
Suluk East	455	5.2	77
Suluk West	1,954	6.0	378
Patch 7	1,037	5.5	182
Spur	244	4.8	38
Rand	213	5.3	37
Naartok	655	5.5	116
Total Inferred	**5,451**	**5.6**	**982**

Notes:

1. CIM definitions were followed for the statement of Mineral Resources.
2. Mineral Resources are inclusive of those resources converted to Mineral Reserves and are in-situ resources excluding stockpiles.
3. Mineral Resources that are not Mineral Reserves do not have demonstrated economic viability.
4. The Mineral Resources for each Individual deposit were defined utilizing a block cut-off grade of 3.5 g/t.

5. All Mineral Resources are estimated using an average long-term gold price of US$1,500 per ounce and a CAD/USD exchange rate of 1.34.
6. A 50-metre crown pillar allowance was applied to Mineral Resources located below lakes where applicable.
7. A minimum intercept width of 1.5 m was applied to the Mineral Resource modelling.
8. Ore density was calculated using the geological block model density field.
9. Numbers may not add due to rounding.

RESOURCE DATABASE

The Madrid North Mineral Resource estimate consists of 451,090 m of surface drilling.

A summary of Madrid North's drill hole database is provided Table 14-15. The data presented in the table reflects the last database export supplied to RPA. The last drill hole was entered into the dataset in October 2019.

Table 14-15. Madrid North Mineral Resource Database

TMAC Resources Inc. – Hope Bay Project

Year	Historic DDH		TMAC Surface DDH		Grand Total	
	No. of Holes	Length (m)	No. of Holes	Length (m)	Total No. of Holes	Total Length (m)
<1994	6	50	-	-	6	50
1994	3	584	-	-	3	584
1995	11	1,092	-	-	11	1,092
1996	47	7,768	-	-	47	7,768
1997	91	19,587	-	-	91	19,587
1998	121	13,541	-	-	121	13,541
2000	12	2,168	-	-	12	2,168
2001	142	24,925	-	-	142	24,925
2002	58	9,432	-	-	58	9,432
2003	100	30,906	-	-	100	30,906
2004	82	21,742	-	-	82	21,742
2005	110	27,293	-	-	110	27,293
2006	149	50,723	-	-	149	50,723
2007	190	45,065	-	-	190	45,065
2008	56	12,984	-	-	56	12,984
2009	104	27,077	-	-	104	27,077
2010	72	14,408	-	-	72	14,408
2011	103	35,383	-	-	103	35,383
2013			20	8,263	20	8,263
2014	-	-	89	40,661	89	40,661

Year	Historic DDH		TMAC Surface DDH		Grand Total	
	No. of Holes	Length (m)	No. of Holes	Length (m)	Total No. of Holes	Total Length (m)
2015	-	-	69	25,645	69	25,645
2016	-	-	22	5,980	22	5,980
2018	-	-	77	10,297	77	10,297
2019	-	-	56	15,517	56	15,517
Grand Total	1,457	344,728	333	106,362	1,790	451,090

GEOLOGICAL INTERPRETATION

Mineralization and lithology wireframes were completed using Leapfrog Geo (various versions). The mineralization wireframes, used to constrain grade interpolation, were informed by detailed lithology models. Two detailed lithology models were generated by RPA, a model to the north, covering Naartok, Rand, and Spur, and model to south, covering Suluk. The lithology models were used to guide the mineralization models. TMAC provided a lithology and mineralization model for Patch 7. These were modified by RPA and used for block modeling.

For the Naartok domain, the main controls on mineralization used as guides included:

- Detailed relogging of the core with specific emphasis on alteration and brecciation. A strong relationship exists between the occurrence of gold grades and these two features.
- In Naartok West and Rand, mineralization occurs in planar lenses parallel and sub-parallel to the contact of brecciated, sericite altered volcanics and the Madrid Deformation Zone. These zones are associated with intense silicification and stockwork veining
- For Naartok East, mineralization is predominantly associated with dilatant zones of stratigraphic origin. The alteration and mineralized trends follow the contacts between the mafic pillow breccias and intercalated sediment horizons. The zone steepens at depth where it intersects a diabase dike.
- Spur structures to the east follow a north-northwest trend along mineralized faults which can be traced north from Madrid South. Spur is separated from Rand by non-permeable pillow basalts striking toward north-northwest.

For the Suluk domain, the main controls on mineralization used as guides included:

- Detailed relogging of the core with emphasis on refining the structural model at Suluk. South of Madrid North, the MDZ swiftly bends to a north-northwest to south-southeast orientation and a more complex structural domain with significant partitioning of strain into many splay structures.
- The strong relationship between gold grades, ductile shears associated with the MDZ, including it's many splays, and cross-cutting brittle structures.
- Most Suluk mineralization is associated with zones of strong hematite + sericite alteration and disseminated sulphide zones (five m to 20 m wide) adjacent to anastomosing brittle faults sub-parallel to much broader shear zones (MDZ).
- Discordant ladder vein sets in between the anastomosing brittle faults described above. These pipes of mineralization consist of zones of high density quartz veinlets (<10 cm)

adjoining brittle structures. These are typically lower grade and are bound tightly to non-grading wallrock.
- Minor zones of mineralization also follow the outer contacts of two distinct pillowed basalt units which resisted gold-bearing fluid permeation.

For the Patch 7 domain, the main controls on mineralization used as guides included:

- A total of seven new 2019 DDHs which were logged in detail to match the current understanding of mineralization at Naartok and Suluk. Additionally, detailed relogging of existing core photos with emphasis on extending the geological model south from Suluk to the Patch 7 domain.
- The strong relationship between gold grades the MDZ, including it’s many splays, and the proportion of intercalated sediments. Brittle controls on Patch 7 mineralization are likely but still remain unclear with reliable structural data only available for seven DDHs.
- Mineralization in the Patch 7 West zone is located in the footwall of the main strand of the MDZ and is associated with a broad zone of sericite and hematite alteration, with 1 m -3 m quartz veins.
- Mineralization in the Patch 7 East zone is located in the hanging wall of a portion increased intercalated sediments in the lower part of the Path Volcanic group. Disseminated pyrite mineralization, approximately one metre quartz veins, and breccia zones are common. Evidence of late-brittle structures is evident in core photos.
- Mineralization in the Patch 7 East splay zone is associated with a felsic splay of the MDZ and truncated against the Patch 7 East zone and is accompanied by strong sericite alteration and disseminated pyrite.

The location of the different wireframes at Madrid North are shown in Figure 14-30, while isometric views of the wireframes are presented in Figure 14-31 to Figure 14-33.

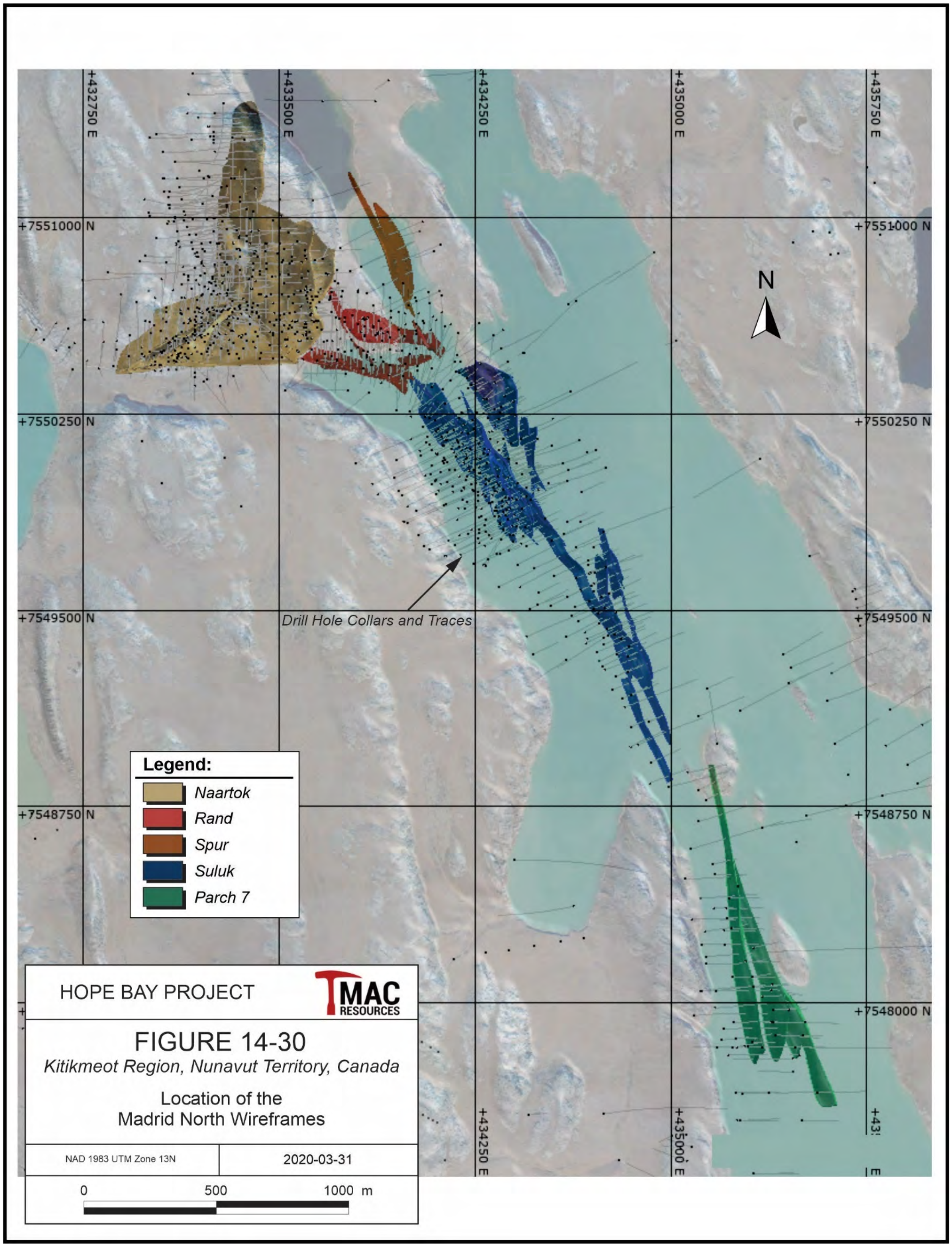


Figure 14-30. Location of the Madrid North Wireframes

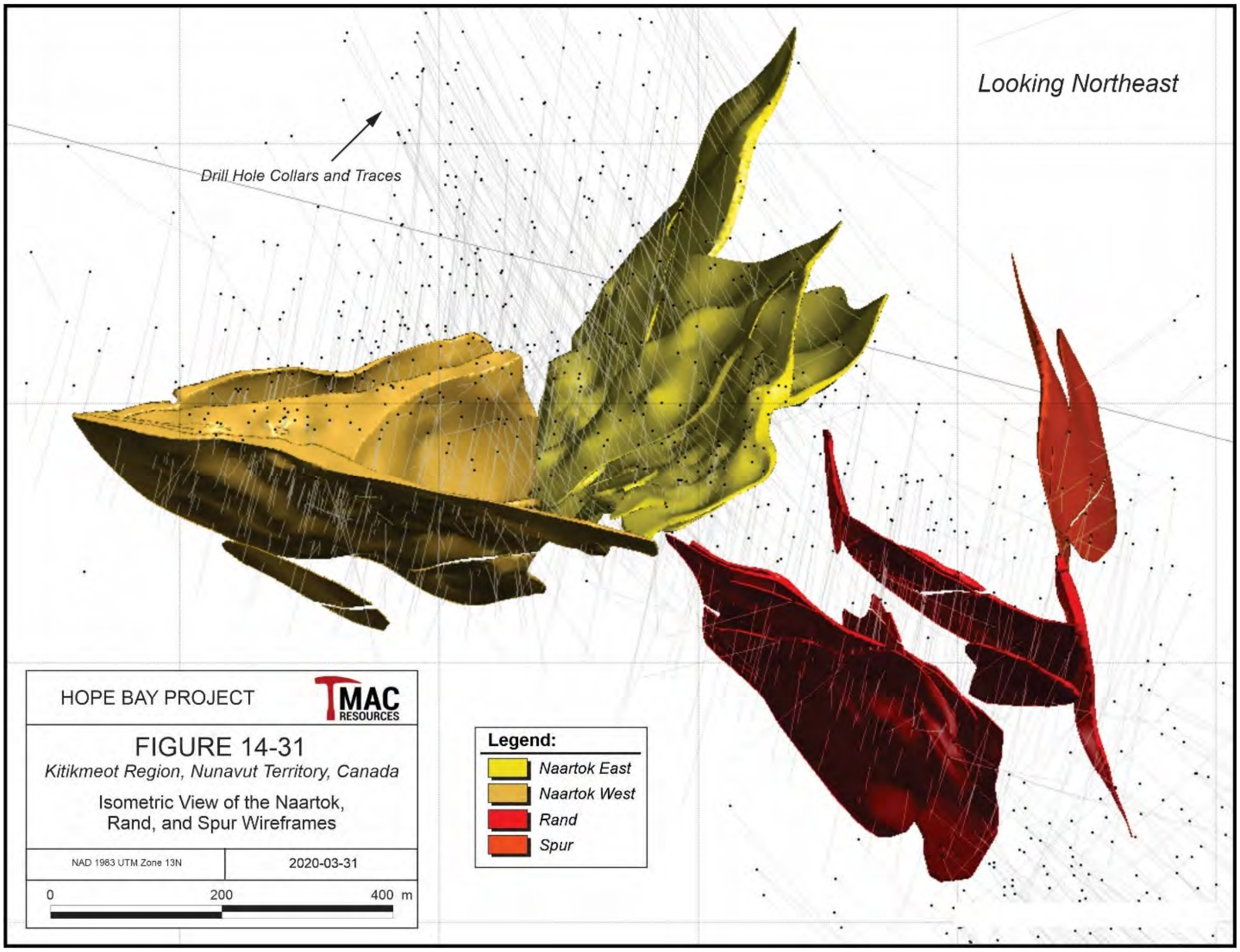


Figure 14-31. Isometric View of the Naartok, Rand, And Spur Wireframes

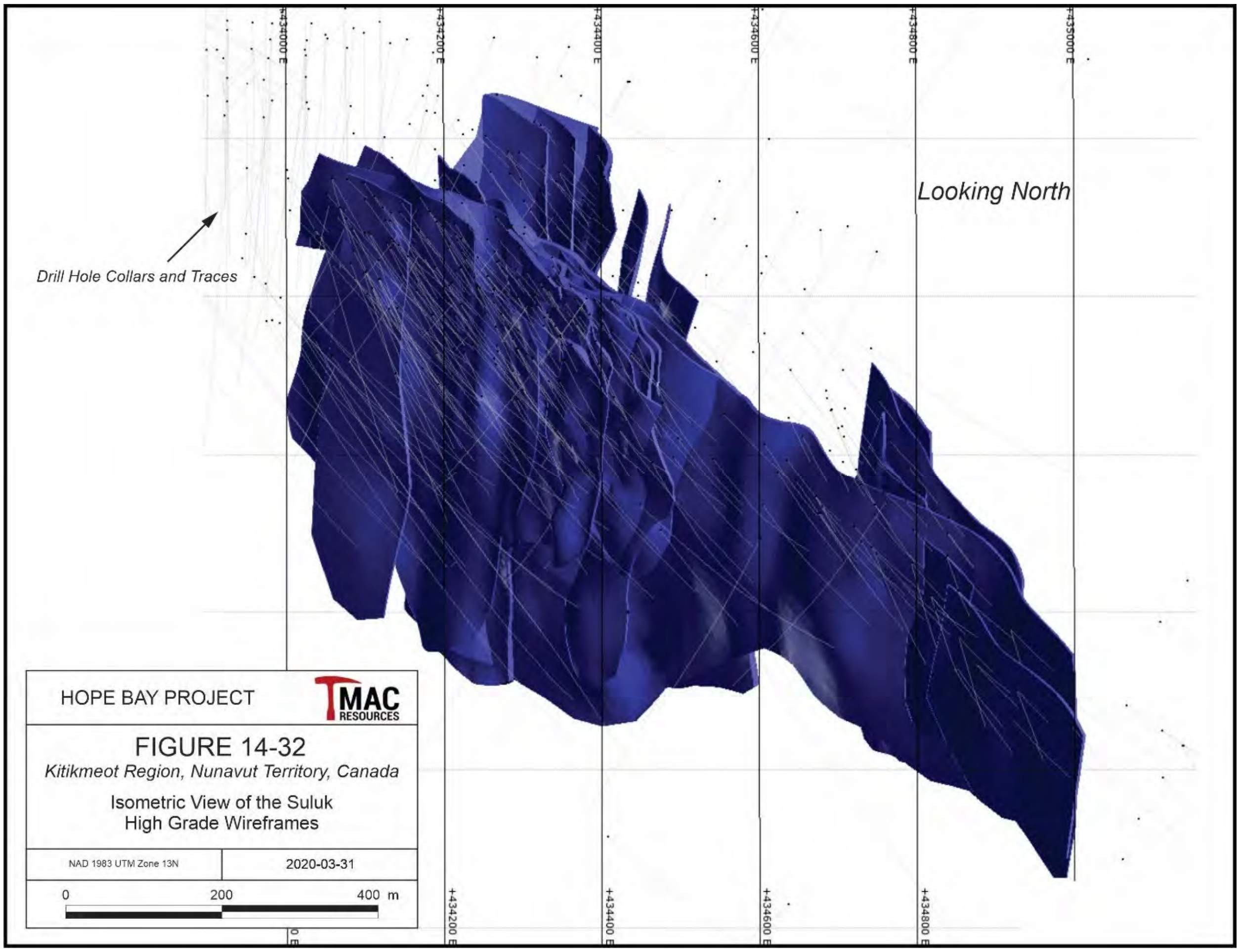


Figure 14-32. Isometric View of the High-grade Suluk Wireframes

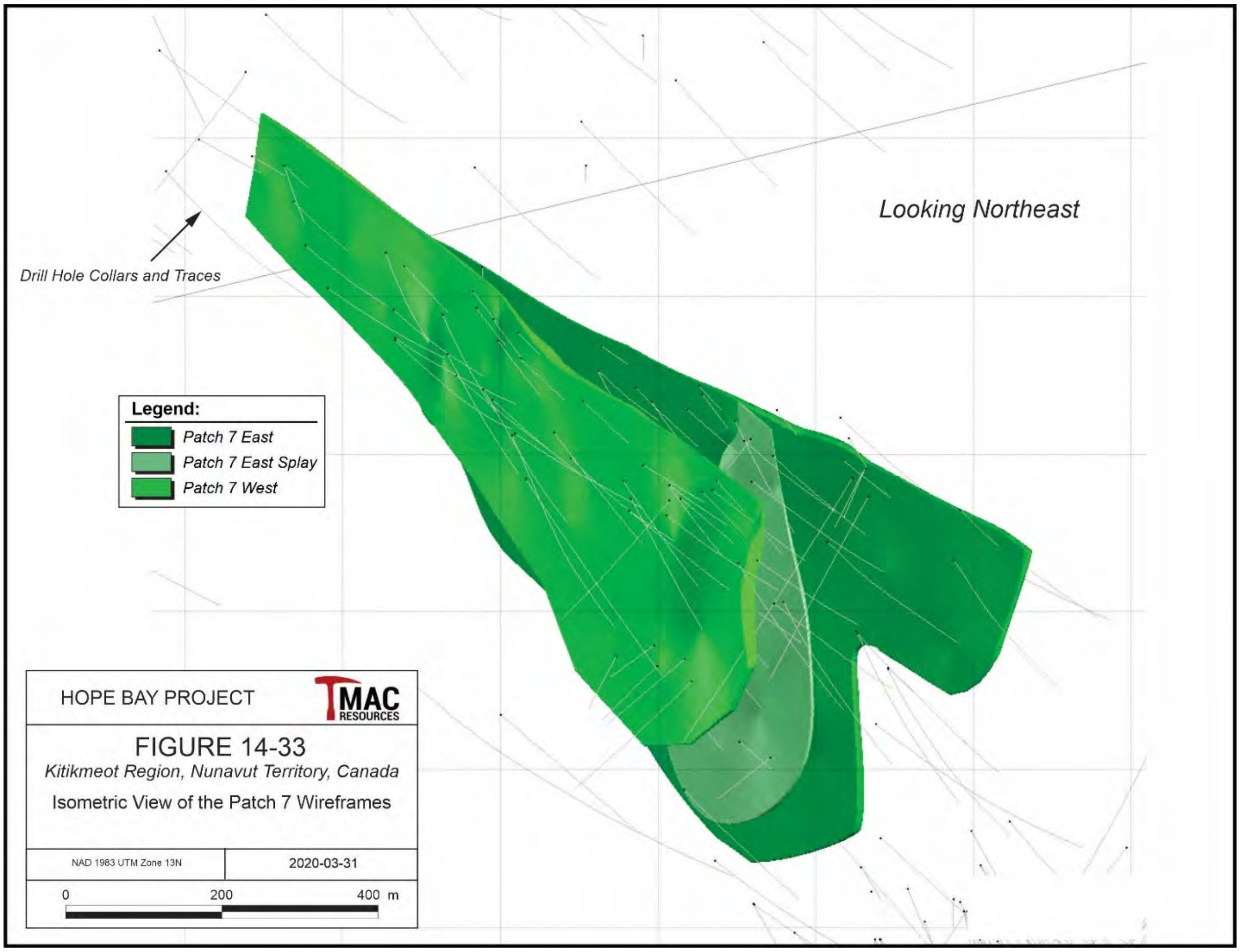


Figure 14-33. Isometric View of the Patch 7 Wireframes

TREATMENT OF HIGH-GRADE ASSAYS

Assay intervals were capped at various levels depending on their univariate and spatial distributions. Capping analysis involved the inspection of the spatial location of high-grades, log probability plots, histograms, decile analyses, and disintegration analysis.

For the Naartok domain, blocks within a15 m radius of composites exceeding 15 g/t Au, assays were capped to 60 g/t Au. Beyond a 15 m radius, the assays were capped to the levels given in Table 14-16.

A summary of the Madrid North uncapped and capped statistics is provided in Table 14-16.

Table 14-16. Madrid North Uncapped and Capped Assay Statistics

TMAC Resources Inc. – Hope Bay Project

Domain	No. of Assays	Uncapped				Capped			
		Min (g/t Au)	Max (g/t Au)	Average (g/t Au)	CV	Capping Level (g/t Au)	Average (g/t Au)	CV	Metal Loss (%)
Naartok, Rand and Spur									
0	32367	0.00	197.50	0.36	4.50	15.00	0.34	2.72	6
1	2892	0.00	951.50	4.58	3.61	45.00	4.20	1.30	8
2	426	0.00	26.60	2.76	1.24		2.76	1.24	0
3	373	0.00	98.10	2.76	1.73	45.00	2.72	1.53	1
4	899	0.00	918.00	6.00	3.93	45.00	4.83	1.64	20
5	206	0.00	93.84	6.22	2.09	45.00	5.38	1.61	13
6	100	0.00	127.60	4.85	2.69	45.00	4.02	1.46	17
7	48	0.17	177.20	4.63	3.74	45.00	3.31	1.42	29
8	43	0.02	40.80	2.95	2.16		2.95	2.16	0
9	55	0.00	129.11	4.86	2.46	45.00	4.13	1.23	15
10	2202	0.00	586.40	5.86	3.09	60.00	5.14	1.59	12
11	378	0.01	460.00	6.64	3.62	60.00	5.14	1.64	23
12	300	0.00	197.00	6.29	3.17	60.00	4.99	2.00	21
13	127	0.00	383.00	4.48	4.71	60.00	3.44	1.94	23
14	409	0.00	53.70	4.00	1.29	30.00	3.93	1.20	2
15	238	0.00	88.54	2.54	2.31	30.00	2.34	1.55	8
16	44	0.03	17.72	4.13	0.79		4.13	0.79	0
17	252	0.00	121.10	4.24	2.28	30.00	3.65	1.59	14
18	105	0.02	18.32	2.59	1.25		2.59	1.25	0
19	127	0.00	32.95	3.52	1.17	30.00	3.51	1.15	0
20	133	0.00	22.08	3.86	1.03		3.86	1.03	0
21	98	0.00	63.75	3.70	2.23	30.00	3.27	1.74	12
22	90	0.00	24.12	2.95	1.08		2.95	1.08	0
23	52	0.00	11.76	2.07	1.05		2.07	1.05	0
24	83	0.02	14.50	2.07	1.39		2.07	1.39	0
25	199	0.00	33.81	3.35	1.15	20.00	3.31	1.08	1
26	39	0.02	7.15	1.62	1.09		1.62	1.09	0
27	19	0.01	85.10	5.13	3.28	60.00	4.32	3.12	16
28	6930	-0.03	296.00	0.91	5.58	15.00	0.72	2.51	20
30	1354	-0.03	97.51	0.80	5.07	15.00	0.63	2.83	21
33	227	0.03	21.30	3.04	0.80		3.04	0.80	0

Domain	No. of Assays	Uncapped				Capped			
		Min (g/t Au)	Max (g/t Au)	Average (g/t Au)	CV	Capping Level (g/t Au)	Average (g/t Au)	CV	Metal Loss (%)
Suluk									
1001	1100	0.00	250.40	6.45	1.91	60.00	6.13	1.39	5
1002	373	0.00	49.50	1.65	2.38	12.00	1.42	1.49	14
2001	817	0.00	61.80	3.23	1.43	24.00	3.14	1.26	3
2002	403	0.00	490.80	8.54	2.13	60.00	7.91	1.12	7
2003	426	0.02	159.60	5.59	2.20	38.00	4.85	1.44	13
2004	78	0.01	10.25	2.13	1.10	10.25	2.13	1.10	0
2005	163	0.02	129.40	4.33	1.99	24.00	3.81	1.42	12
2006	93	0.01	15.96	1.82	1.55	15.96	1.82	1.55	0
2007	39	0.02	10.85	2.83	0.96	10.85	2.83	0.96	0
3001	231	0.01	92.49	4.34	1.75	24.00	3.94	1.11	9
3002	66	0.02	24.90	3.24	1.00	24.00	3.22	0.98	0
3003	124	0.02	42.20	3.00	1.66	24.00	2.86	1.41	5
4001	127	0.02	17.59	2.54	1.27	17.59	2.54	1.27	0
4002	140	0.02	12.14	2.35	1.00	12.14	2.35	1.00	0
4003	216	0.02	61.12	3.45	2.03	24.00	3.00	1.40	13
4004	59	0.16	326.80	9.10	4.32	38.00	4.69	1.25	48
4005	99	0.00	30.19	2.85	1.31	24.00	2.79	1.19	2
5001	29	0.02	31.62	2.45	1.63	24.00	2.32	1.35	5
5002	78	0.01	25.68	5.52	1.00	24.00	5.49	0.99	1
6001	175	0.00	84.57	5.46	1.89	38.00	4.97	1.54	9
6002	51	0.02	19.15	3.39	0.99	19.15	3.39	0.99	0
6003	35	0.03	201.10	6.40	3.50	24.00	3.34	1.58	48
6004	83	0.00	19.70	1.50	1.94	12.00	1.37	1.59	9
6005	51	0.00	306.00	5.77	5.19	24.00	2.67	2.04	54
6006	22	0.00	196.50	5.98	3.91	24.00	3.44	1.77	42
7001	84	0.00	19.59	3.05	1.06	19.59	3.05	1.06	0
7002	108	0.02	54.70	1.62	2.26	12.00	1.49	1.56	8
7003	144	0.01	65.21	4.42	1.81	24.00	3.85	1.32	13
7004	56	0.01	10.35	1.86	1.25	10.35	1.86	1.25	0
7005	35	0.00	104.64	6.70	2.65	24.00	3.78	1.85	43
8001	105	0.00	21.44	2.95	1.16	21.44	2.95	1.16	0
8002	31	0.01	15.44	3.38	1.32	15.44	3.38	1.32	0
9000	19067	0.00	84.57	0.26	2.44	12.00	0.26	2.37	0

Domain	No. of Assays	Uncapped				Capped			
		Min (g/t Au)	Max (g/t Au)	Average (g/t Au)	CV	Capping Level (g/t Au)	Average (g/t Au)	CV	Metal Loss (%)
Patch 7									
Patch East	371	0.00	54.6	2.75	2.33	40.00	2.65	2.14	3.64
Patch East Splay	69	0.00	61.1	3.94	1.92	40.00	3.72	1.64	5.58
Patch West	413	0.00	126.7	2.41	2.49	40.00	2.32	2.14	3.73

COMPOSITING

A composite length was selected for each domain considering the dominant sampling length, block size domain variability, thickness, and structural complexity. The Madrid North compositing strategy is presented in Table 14-17, with composite statistics in Table 14-18.

Table 14-17. Madrid North Compositing Strategy

TMAC Resources Inc. – Hope Bay Project

Domain	Composite Length (m)
Naartok, Rand and Spur	1.5
Suluk	1.5
Patch 7	3.0

Table 14-18. Madrid North Capped Composite Statistics

TMAC Resources Inc. – Hope Bay Project

Domain	No. of Composites	Min (g/t Au)	Max (g/t Au)	Mean (g/t Au)	CV
Naartok, Rand and Spur					
0	28,685	0.00	15.00	0.34	2.32
1	2,210	0.00	45.00	4.27	1.17
2	373	0.00	21.45	2.95	1.09
3	298	0.01	28.92	2.72	1.31
4	635	0.00	45.00	4.69	1.41
5	155	0.00	45.00	5.38	1.55
6	81	0.00	39.10	4.27	1.29
7	34	0.17	16.89	3.27	0.94
8	30	0.24	22.61	2.61	1.45
9	27	0.90	8.45	3.58	0.56

Domain	No. of Composites	Min (g/t Au)	Max (g/t Au)	Mean (g/t Au)	CV
10	1,575	0.00	60.00	5.11	1.32
11	252	0.01	55.66	5.27	1.40
12	232	0.01	60.00	5.11	1.67
13	73	0.00	25.98	3.54	1.34
14	224	0.02	29.51	3.91	1.02
15	109	0.00	21.72	2.30	1.28
16	22	0.96	10.94	4.22	0.59
17	148	0.00	30.00	3.62	1.40
18	71	0.02	18.30	2.67	1.14
19	73	0.00	14.35	3.58	0.90
20	53	0.33	18.78	3.84	0.86
21	55	0.00	26.52	3.29	1.43
22	45	0.00	12.44	2.87	0.90
23	27	0.02	5.48	2.05	0.79
24	55	0.02	10.74	2.10	1.19
25	102	0.02	16.50	3.31	0.95
26	22	0.07	5.87	1.53	0.86
27	8	0.01	12.03	2.76	1.45
28	5,952	0.00	15.00	0.73	2.17
30	1,044	0.00	15.00	0.57	2.56
33	173	0.00	21.28	2.91	0.82
Suluk					
1001	764	0.00	60.00	6.12	1.24
1002	258	0.00	11.99	1.42	1.32
2001	570	0.00	21.78	3.15	1.10
2002	273	0.01	53.85	7.93	0.96
2003	288	0.02	38.00	4.90	1.23
2004	50	0.02	9.01	2.11	1.02
2005	104	0.02	22.84	3.74	1.22
2006	64	0.01	13.46	1.78	1.37
2007	25	0.02	7.84	2.66	0.83
3001	154	0.01	24.00	3.93	0.98
3002	47	0.19	17.01	3.21	0.84
3003	86	0.02	22.42	2.80	1.32
4001	87	0.02	16.37	2.52	1.20
4002	99	0.02	12.14	2.36	0.95

Domain	No. of Composites	Min (g/t Au)	Max (g/t Au)	Mean (g/t Au)	CV
4003	147	0.02	24.00	2.92	1.31
4004	44	0.55	26.19	4.56	0.96
4005	68	0.01	16.69	2.79	1.07
5001	15	0.61	6.46	2.44	0.66
5002	55	0.02	22.38	5.48	0.90
6001	119	0.00	38.00	5.04	1.20
6002	35	0.02	11.47	3.39	0.71
6003	19	0.20	14.35	3.44	0.97
6004	56	0.00	11.22	1.36	1.36
6005	34	0.00	19.16	2.59	1.58
6006	13	0.00	19.33	3.64	1.39
7001	60	0.02	10.40	3.03	0.81
7002	70	0.02	11.31	1.45	1.41
7003	91	0.01	24.00	3.96	1.09
7004	37	0.01	8.97	1.89	1.07
7005	15	0.01	16.00	3.91	1.29
8001	68	0.00	14.70	3.04	1.01
8002	17	0.02	15.44	3.31	1.34
9000	15,269	0.00	11.49	0.26	2.13
Patch 7					
Patch East	467	0.00	22.76	2.65	1.524
Patch East Splay	85	0.00	15.32	3.72	1.10
Patch West	521	0.00	17.87	2.32	1.32

TREND ANALYSIS

Analysis of grade trends was performed on mineralization using 3D grade shell contouring in Leapfrog Geo and variography. Variogram models were interpreted from experimental variograms and used to inform search parameters, classification decisions, and for validation purposes.

A summary of the Madrid North variogram models is provided in Table 14-19.

Table 14-19. Madrid North Variogram Models

TMAC Resources Inc. – Hope Bay Project

Domain	Naartok					Suluk						
	Naartok East	Naartok West	Rand	Spur	Naartok West HW	1001, 1002	2003, 2001, 2002, 2005, 2007, 2006, 2004	3002, 3001, 3003	4003, 4001, 4005, 4002, 4004	6001, 6003, 6004, 6005, 6006, 6002	7003, 7005, 7001, 7004, 7002	9000
Angle1	-95	-5	20	70	135	-120	-130	-125	60	75	60	-125
Angle2	55	65	100	85	90	80	85	80	90	75	110	75
Angle3	-50	-70	120	90	-125	-90	65	-105	80	-120	90	-135
Axis1	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
Axis2	X	X	X	X	X	X	X	X	X	X	X	X
Axis3	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
Nugget	0.27	0.37	0.25	0.29	0.25	0.30	0.30	0.30	0.50	0.40	0.29	0.10
Sill(st1)	0.70	0.52	0.58	0.42	0.67	0.48	0.52	0.51	0.17	0.40	0.60	0.80
Range1(st1)	21	60	60	4	57	28	52	35	29	10	20	42
Range2(st1)	20	40	20	4	30	37	25	35	29	10	20	33
Range3(st1)	12	25	5	5	30	5	11	6	6	5	4	26
Type(st1)	Exponential	Exponential	Exponential	Spherical	Exponential	Exponential	Exponential	Spherical	Spherical	Spherical	Spherical	Exponential
Sill(st2)	0.03	0.12	0.17	0.29	0.08	0.22	0.18	0.19	0.33	0.20	0.11	0.10
Range1(st2)	110	229	200	20	250	120	110	172	73	109	50	171
Range2(st2)	50	100	50	20	110	50	66	172	73	109	50	150
Range3(st2)	36	25	10	10	110	10	26	10	15	10	10	30
Type(st2)	Spherical	Spherical	Spherical	Spherical	Spherical	Spherical	Spherical	Spherical	Spherical	Spherical	Spherical	Spherical

BULK DENSITY

Bulk density values were assigned based on rock type and mineralization zones. A summary of the bulk densities assigned to blocks is provided in Table 14-20.

Table 14-20. Madrid North Bulk Density Assignment

TMAC Resources Inc. – Hope Bay Project

Domain	Bulk Density (t/m^3)
Naartok	
Basalt	2.86
Diabase	2.99
Gabbro	2.87
Deformation Zone	2.87
Overburden	1.6
Pillowed Basalt	2.85
Strong Breccia	2.87
Weak Breccia	2.86
Variolitic Basalt	2.86
Suluk	
Basalt	2.87
Pillowed Basalt	2.87
Deformation Zone	2.85
Overburden	1.6
Porphyry	2.75
Mineralized Zone	2.89
Patch 7	
Overburden	1.6
Diabase	2.99
Deformation Zone	2.85
Mineralized Zone	2.89
Basalt	2.87

BLOCK MODELS

Block model dimensions and setups have been selected based on the proposed scale of mining, with consideration given to the available data and complexity of the mineralization wireframes. Parent blocks were split into sub-cells at wireframe boundaries, with the minimum sub-cell size set to a reasonable size with the intention of minimizing the variance between wireframe and block volumes while maintaining a manageable block model file size.

The Madrid North block model prototypes are presented in Table 14-21.

Table 14-21. Madrid North Block Model Prototypes

TMAC Resources Inc. – Hope Bay Project

Domain	Model Name	XINC	YINC	ZINC	XMORIG	YMORIG	ZMORIG	NX	NY	NZ
Naartok, Rand and Spur1	ntk_md_depleted20122019.dm	2.5	2.5	2.5	432,500.00	7,550,100.00	-610.00	688	544	280
Suluk	suluk_final	3	3	3	433,988.43	7,548,828.61	-679.13	347	547	240
Patch 7	RPA Patch 7 Model	3	3	3	435130.00	7547590.00	-613	175	441	211

Notes:

1. A 5 m by 5 m by 5 m block size was used in the low-grade portions of Naartok, Rand and Spur

SEARCH STRATEGY AND GRADE INTERPOLATION PARAMETERS

A multi-pass search strategy was implemented using unique dynamic anisotropy angles for each block. Block grades were interpolated using ID3 while a NN estimate was run for validation purposes. A summary of the search strategy and interpolation parameters is provided in Table 14-22.

Table 14-22. Madrid North Search Strategy and Interpolation Parameters

TMAC Resources Inc. – Hope Bay Project

Domain	Pass	Interpolation Method	Major (m)	Semi-Major (m)	Minor (m)	Min	Max	Max Per Hole
Naartok								
HG	1	ID^3	60	40	6	3	8	2
	2	ID^3	100	66	10	3	8	2
	3	ID^3	240	160	24	1	4	2
LG	1	ID^3	60	60	10	6	20	5
	2	ID^3	100	100	16	6	20	5
	3	ID^3	240	240	40	1	5	5
Suluk								
5001, 6002-6006	1	ID^3	50	50	5	3	8	4
	2	ID^3	80	80	8	3	8	4
	3	ID^3	150	150	15	1	4	4
7002	1	ID^3	60	20	6	3	8	4
	2	ID^3	110	27	11	3	8	4
	3	ID^3	220	73	22	1	4	4
2001, 6001, 7001, 7003-7005, 8001, 8002	1	ID^3	60	30	6	3	8	4
	2	ID^3	100	50	10	3	8	4
	3	ID^3	180	90	18	1	4	4
1001, 1002, 2002-2007, 3001-3003, 4001-4005, 5002, Suluk Dilution	1	ID^3	60	40	6	3	8	4
	2	ID^3	96	64	9.6	3	8	4
	3	ID^3	180	120	18	1	4	4
Patch 7								
All Zones	1	ID^3	200	110	15	3	6	2
	2	ID^3	300	175	50	3	6	2

CLASSIFICATION

Definitions for resource categories used in this report are consistent with those defined by CIM (2014) and adopted by NI 43-101. See the Doris Classification subsection for further details.

The classification assigned to each domain is presented in Table 14-23 and is shown in Figure 14-34 to Figure 14-36.

Table 14-23. Madrid North Classification by Domain

TMAC Resources Inc. – Hope Bay Project

DDH spacing for 90% of the Tonnes			
Domain	**Measured**	**Indicated**	**Inferred**
Naartok	-	<20m	<45m
Suluk	-	<30m	<80m
Patch 7	-	-	<100m

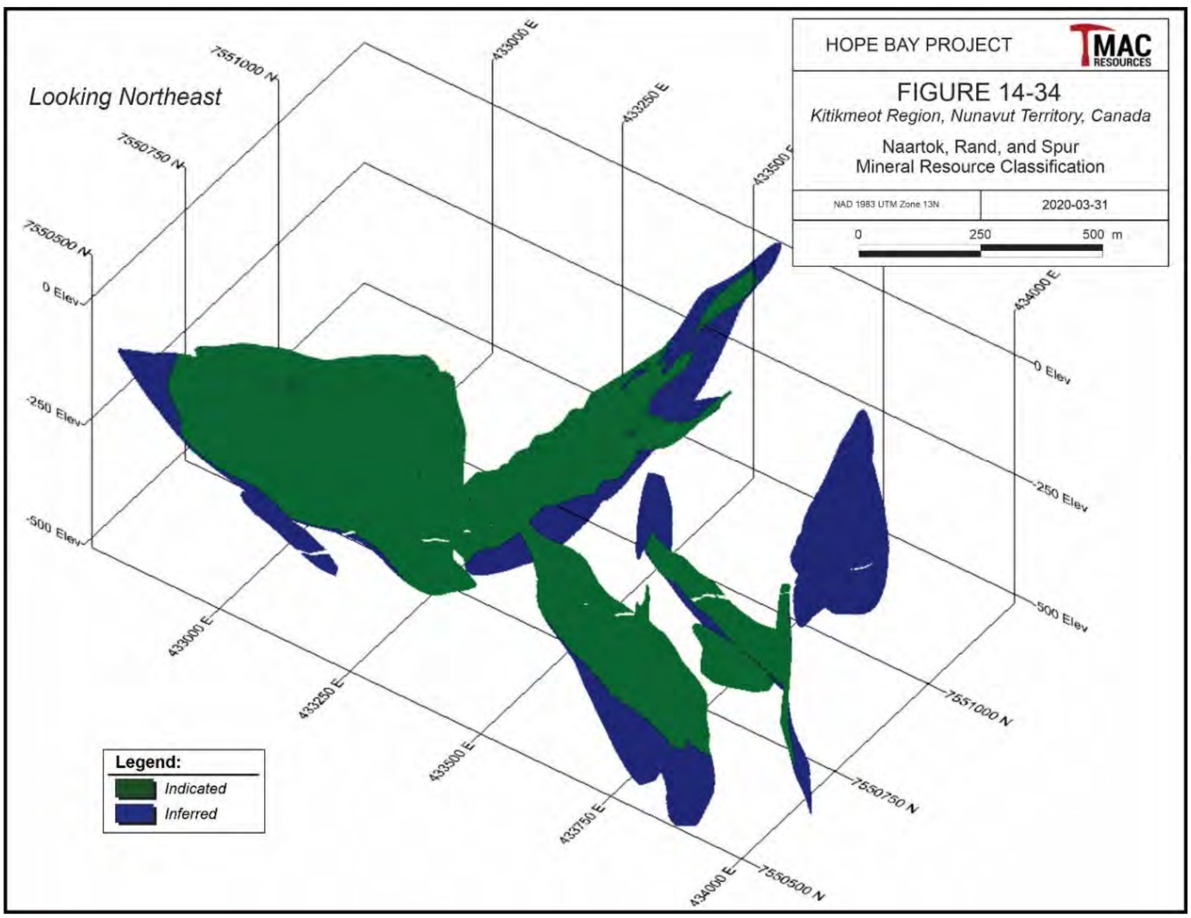


Figure 14-34. Naartok, Rand, and Spur Mineral Resource Classification

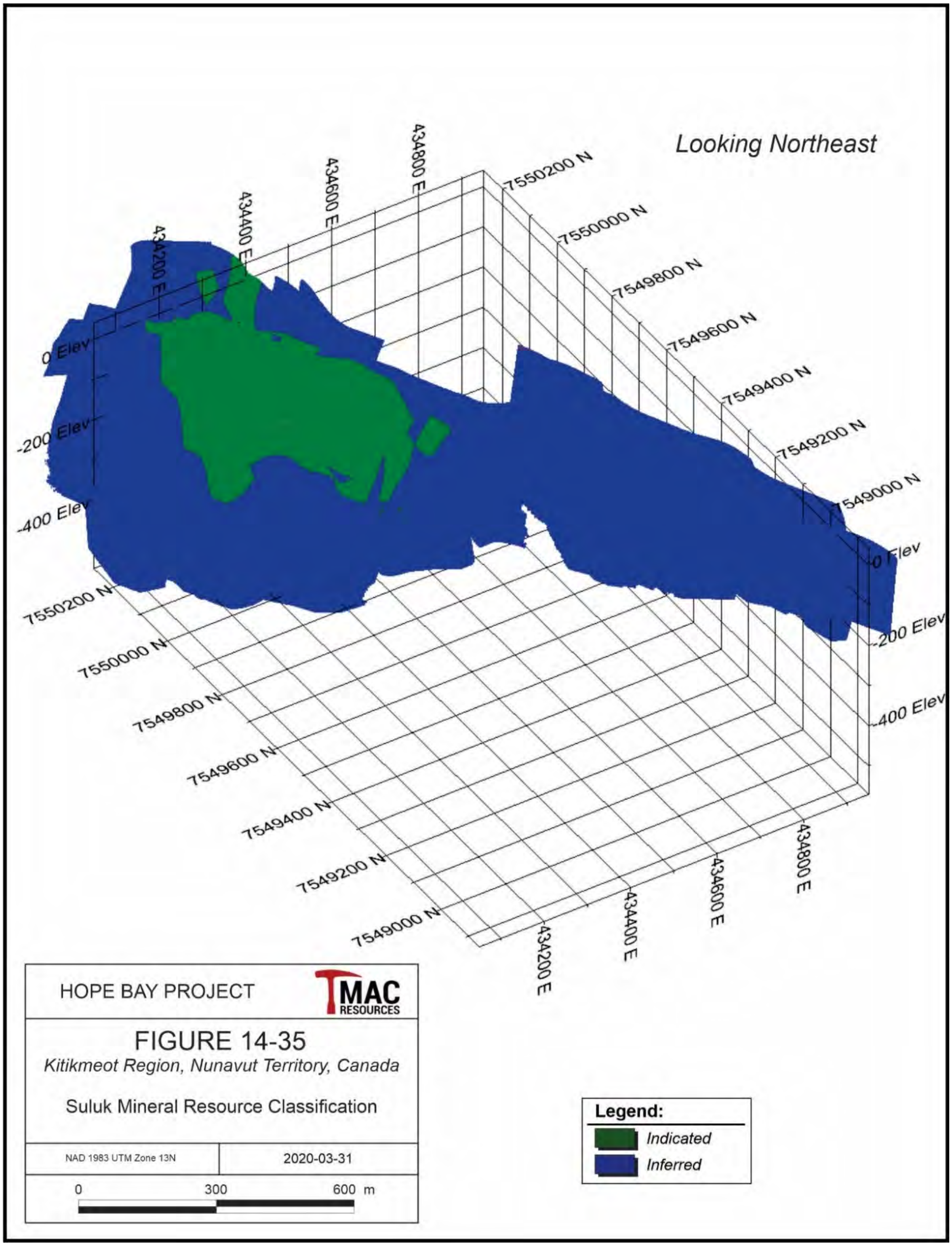


Figure 14-35. Suluk Mineral Resource Classification

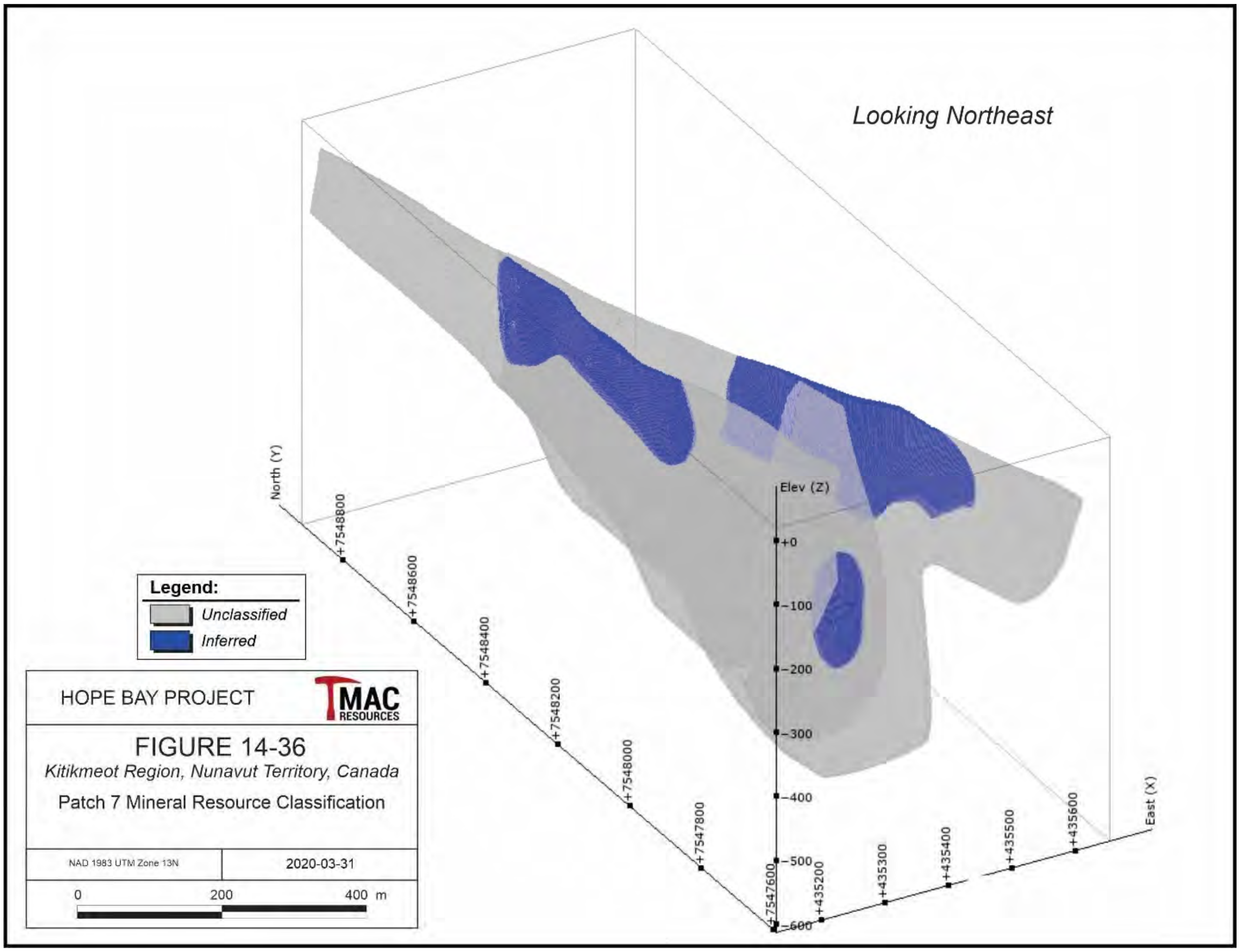


Figure 14-36. Patch 7 Mineral Resource Classification

BLOCK MODEL VALIDATION

Blocks were validated using industry standard techniques including:

- Visual inspection of composite versus block grades (Figure 14-37 to Figure 14-39)
- Comparison between ID, NN and composite means (Figure 14-40)
- Swath plots (**Figure** 14-41 to Figure 14-43)

The QP is of the opinion that the Madrid North Mineral Resource estimates validate well and are appropriate for the public disclosure of Mineral Resources and the estimation of Mineral Reserves.

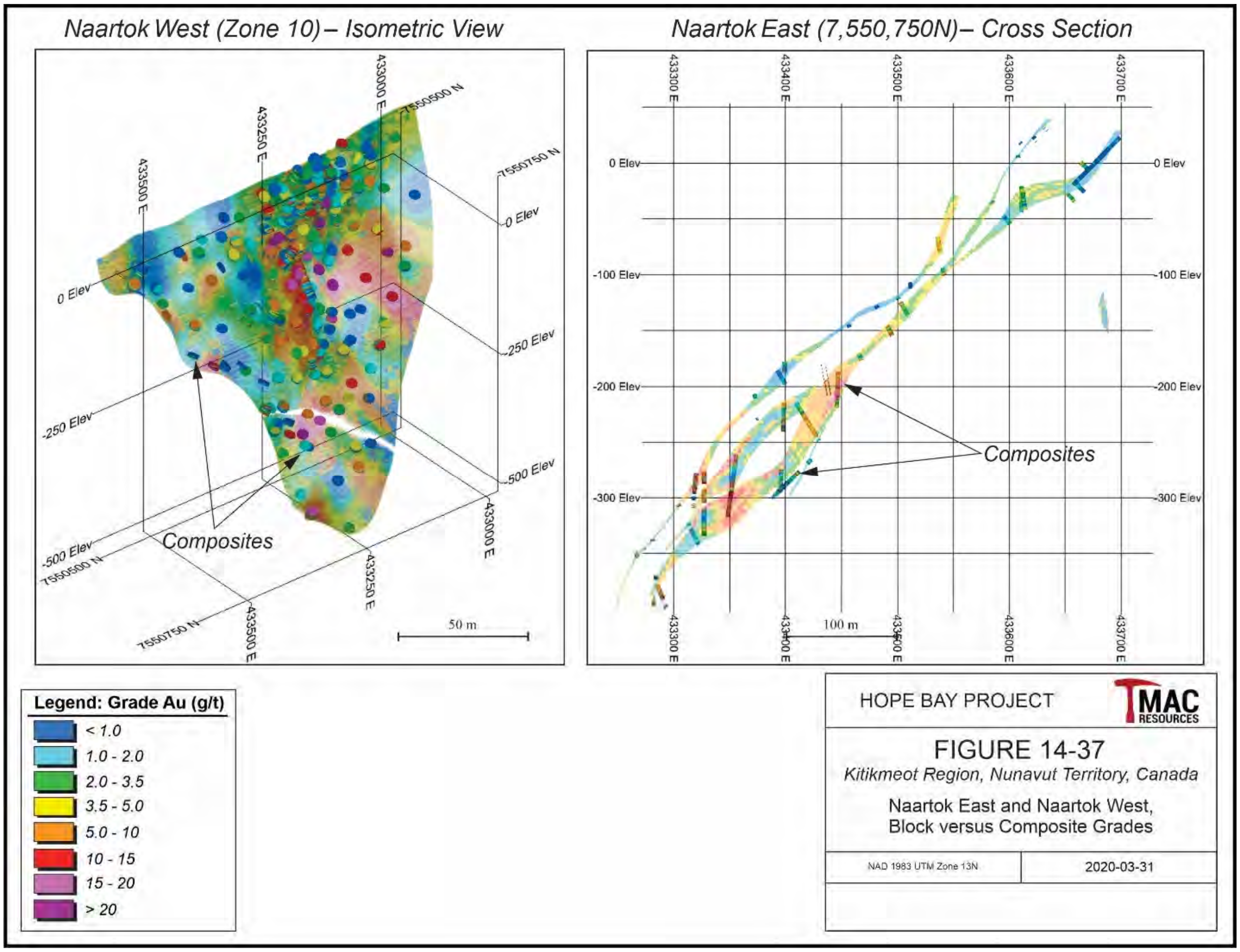


Figure 14-37. Naartok East and Naartok West, Block Versus Composite Grades

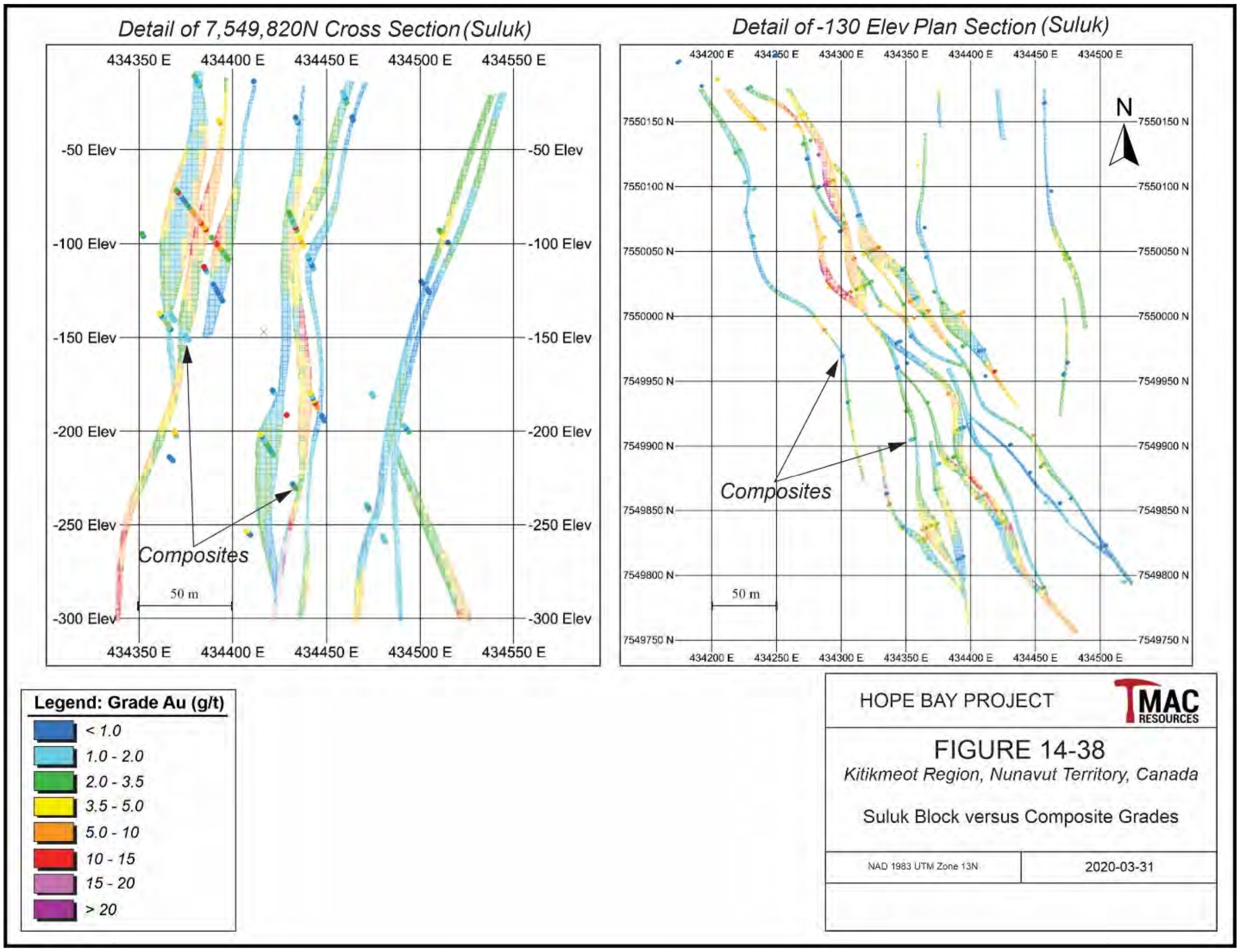


Figure 14-38. Suluk Block Versus Composite Grades

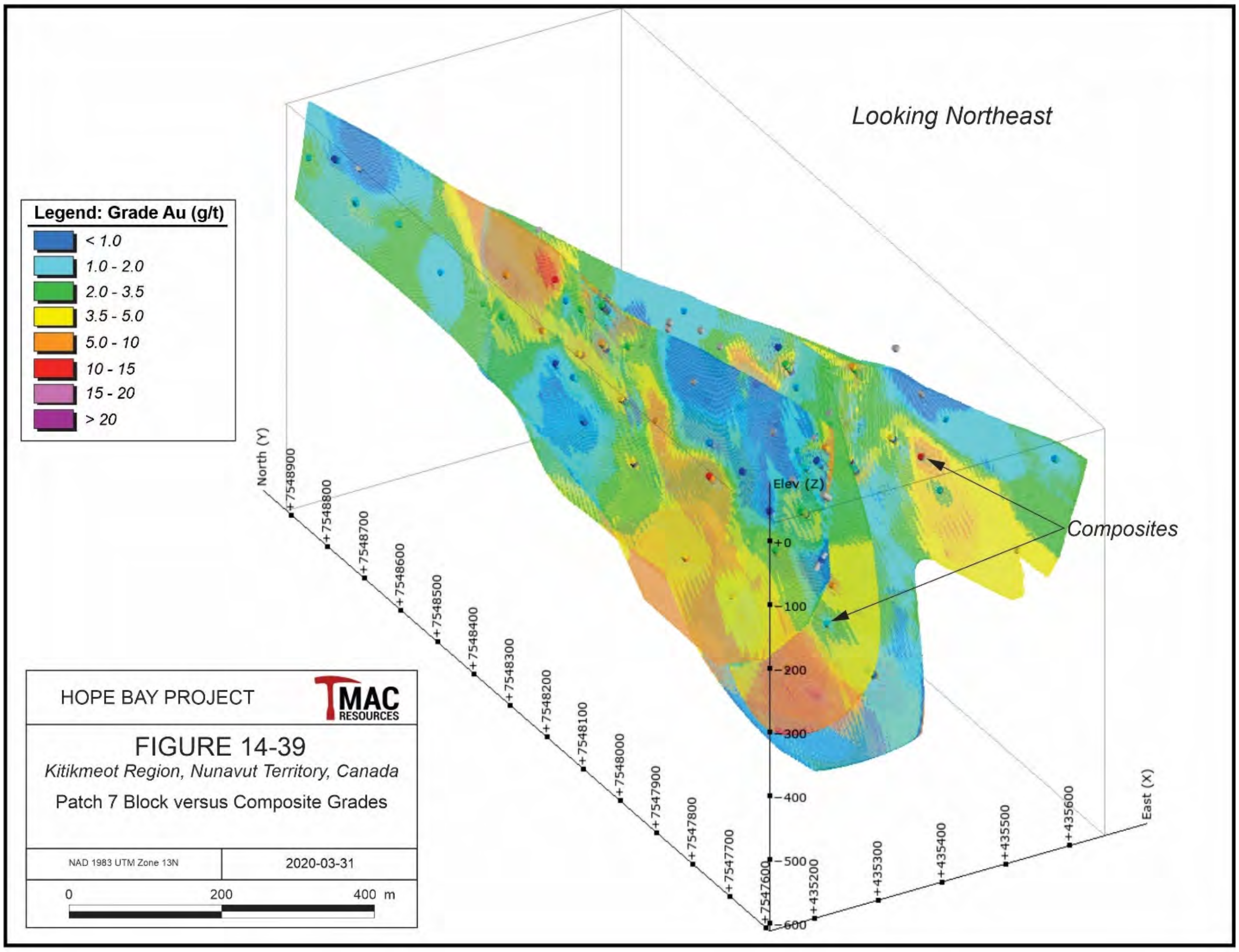


Figure 14-39. Patch 7 Block Versus Composite Grades

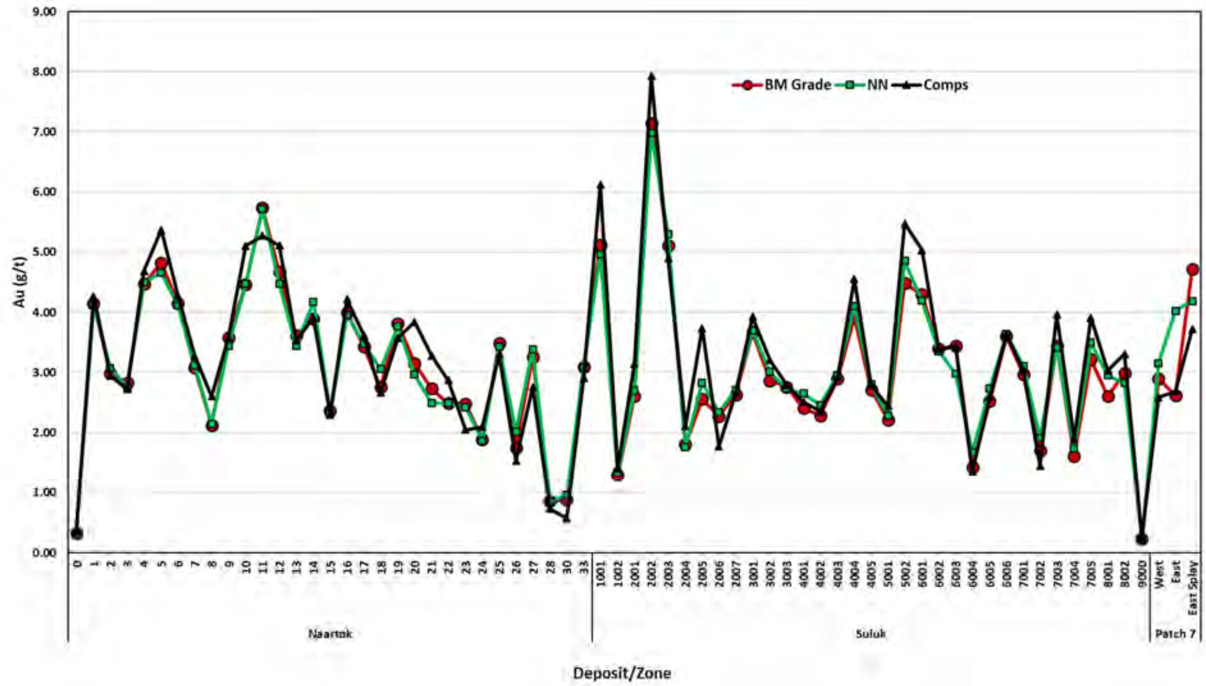


Figure 14-40. Madrid North Comparison Between Means

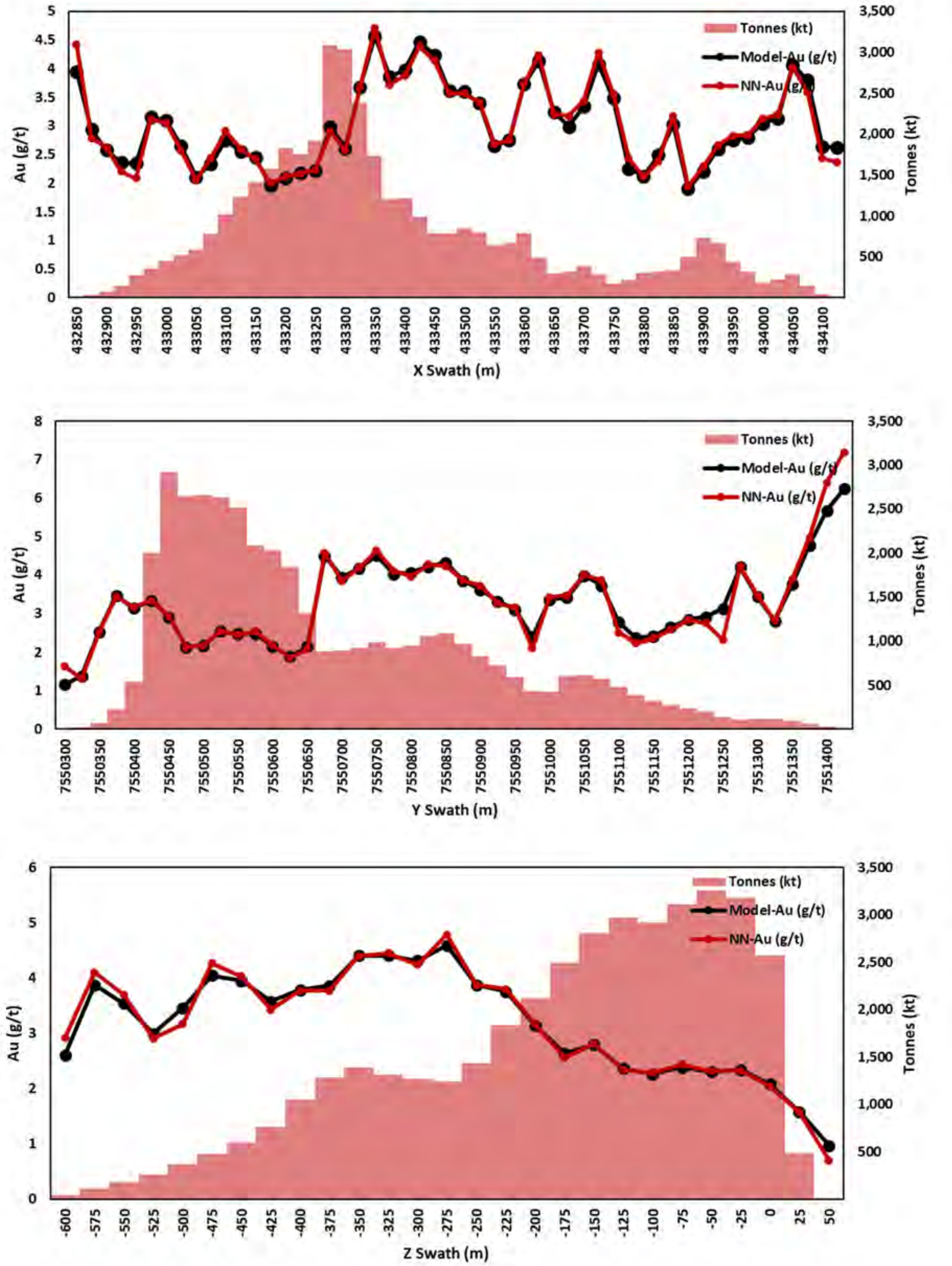


Figure 14-41. Naartok, Rand, and Spur Swath Plots

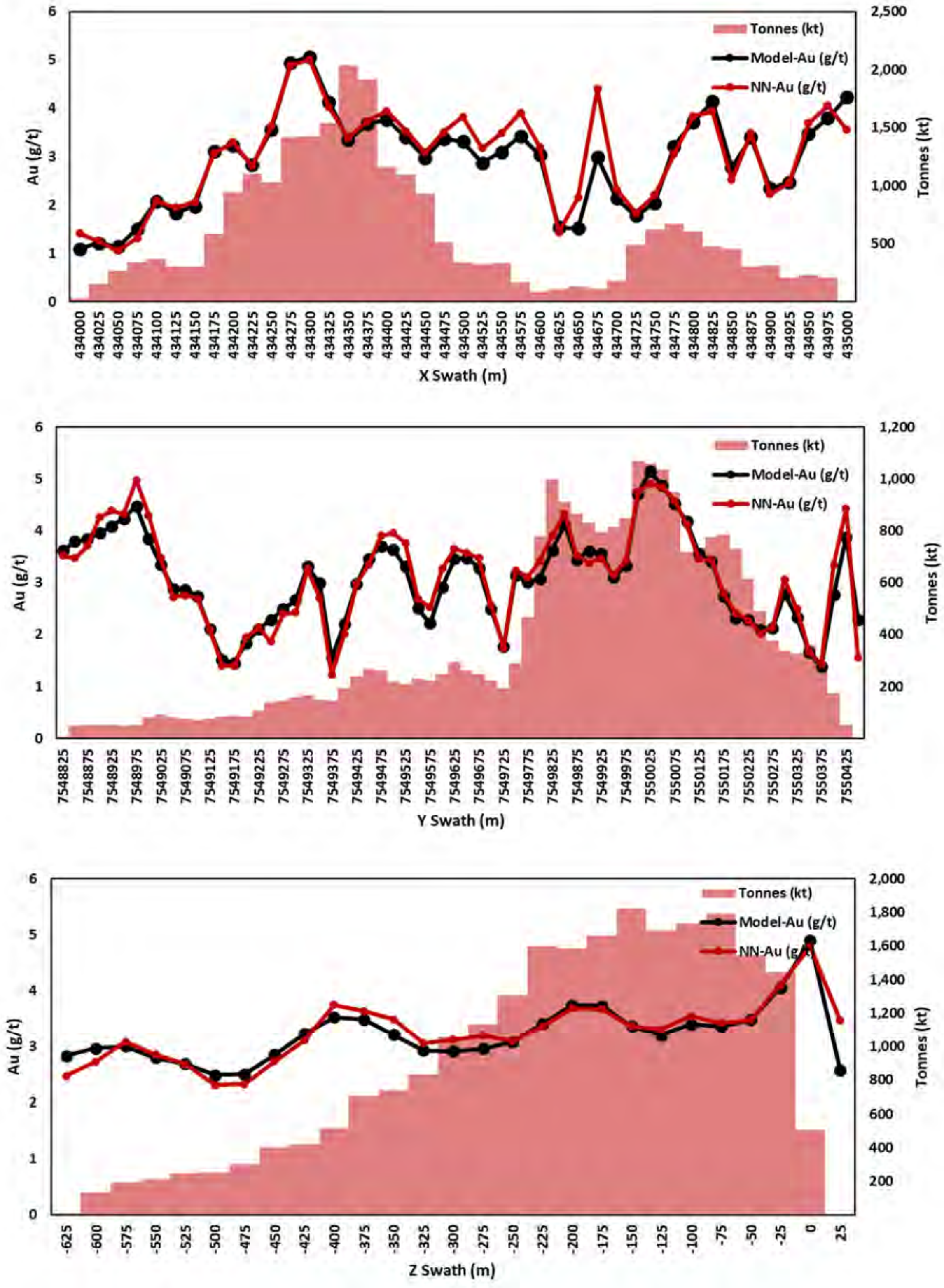


Figure 14-42. Suluk Swath Plots

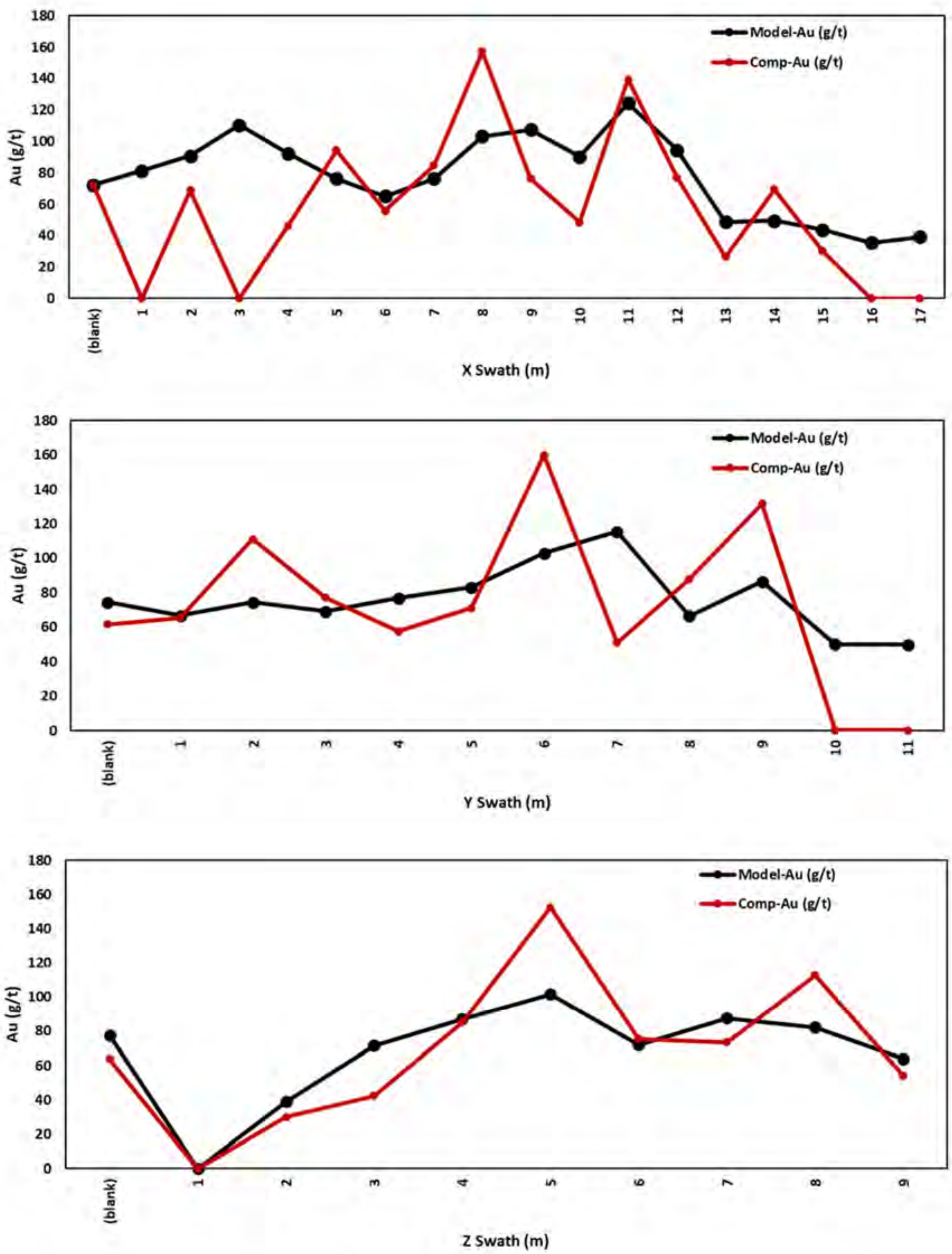


Figure 14-43. Patch 7 Swath Plots

MADRID SOUTH

Madrid South represents approximately 3% and 6% of the total Hope Bay Measured and Indicated tonnes and ounces, and 6% and 7% of the total Hope Bay Inferred tonnes and ounces, respectively.

The Madrid South Mineral Resources are presented in Table 14-24.

Table 14-24. Summary of Madrid South Mineral Resources – December 31, 2019

TMAC Resources Inc. – Hope Bay Project

Domain	Tonnes (000 t)	Grade (g/t Au)	Ounces (000 oz)
Indicated			
Patch 14	417	15.8	212
Wolverine	232	10.8	81
Total Indicated	**648**	**14.0**	**292**
Inferred			
Patch 14	365	5.3	63
Wolverine	297	9.3	89
Total Inferred	**662**	**7.1**	**152**

Notes:

1. CIM definitions were followed for the statement of Mineral Resources.
2. Mineral Resources are inclusive of those resources converted to Mineral Reserves and are in-situ resources excluding stockpiles.
3. Mineral Resources that are not Mineral Reserves do not have demonstrated economic viability.
4. The Mineral Resources for each Individual deposit were defined utilizing a block cut-off grade of 3.5 g/t.
5. All Mineral Resources are estimated using an average long-term gold price of US$1,500 per ounce and a CAD/USD exchange rate of 1.34.
6. A 50-metre crown pillar allowance was applied to Mineral Resources located below lakes where applicable.
7. A minimum intercept width of 1.5 m was applied to the Mineral Resource modelling.
8. Ore density was calculated using the geological block model density field.
9. Numbers may not add due to rounding.

RESOURCE DATABASE

The Madrid South Mineral Resource estimate consists of 374,255 m of surface drilling. RPA notes that the Madrid South database, as per TMAC's central storage protocol, includes Madrid North drilling.

A summary of Madrid South drill hole database is provided in Table 14-25. The data presented in the table reflects the last database export supplied to RPA. The last drill hole was entered into the dataset in August 2014.

Table 14-25. Madrid South Mineral Resource Database

TMAC Resources Inc. – Hope Bay Project

Year	Historic DDH		TMAC Surface DDH		Grand Total	
	No. of Holes	Length (m)	No. of Holes	Length (m)	Total No. of Holes	Total Length (m)
<1994	6	50	-	-	6	50
1994	3	584	-	-	3	584
1995	11	1,092	-	-	11	1,092
1996	47	7,768	-	-	47	7,768
1997	91	19,587	-	-	91	19,587
1998	121	13,541	-	-	121	13,541
2000	12	2,168	-	-	12	2,168
2001	142	24,925	-	-	142	24,925
2002	58	9,432	-	-	58	9,432
2003	100	30,906	-	-	100	30,906
2004	82	21,742	-	-	82	21,742
2005	110	27,293	-	-	110	27,293
2006	149	50,723	-	-	149	50,723
2007	190	45,065	-	-	190	45,065
2008	56	12,984	-	-	56	12,984
2009	104	27,077	-	-	104	27,077
2010	72	14,408	-	-	72	14,408
2011	103	35,383	-	-	103	35,383
2013	-	-	20	8,263	20	8,263
2014	-	-	51	21,264	51	21,264
Grand Total	1,457	344,728	71	29,526	1,528	374,255

GEOLOGICAL INTERPRETATION

RPA notes that Wolverine and Patch 14 wireframes have not been updated since the 2015 PFS report. The mineralization wireframes, used to constrain grade interpolation, were guided by a number controls:

- For Patch 14, narrow high-grade intercepts were selected at a nominal 3 g/t Au COG and were used to generate wireframe solids in Leapfrog using the vein system tool.

- Patch 14 veins were interpreted to bifurcate and truncate one another. A very strong rake of assays above 15 g/t Au is observed towards the southeast which is truncated by a lineation towards the northwest at depth (also a high-grade shoot).
- A polyline was digitized on the longitudinal section and extruded in and out of the section to encapsulate the high-grade shoot observed so as to separate out the assay distributions.

In general, the Patch 14 mineralization is narrow with the majority of the horizontal thicknesses less than the minimum mining thickness of 1.5 m. The horizontal thicknesses were extracted from each triangle of the wireframes and were interpolated into blocks for reporting purposes.

Traditional section interpretation was used for Wolverine, which included digitizing polylines on vertical sections, snapped to drill hole intercepts. Wolverine was interpreted to be two separate and discrete zones, less sinuous than the Patch 14 veins. A rake to the northwest was interpreted for Wolverine. A polyline was digitized in longitudinal section and extruded around higher grades and was used to separate out the population during exploratory data analysis and as a hard boundary during block modelling.

The Madrid South wireframes are shown in Figure 14-44.

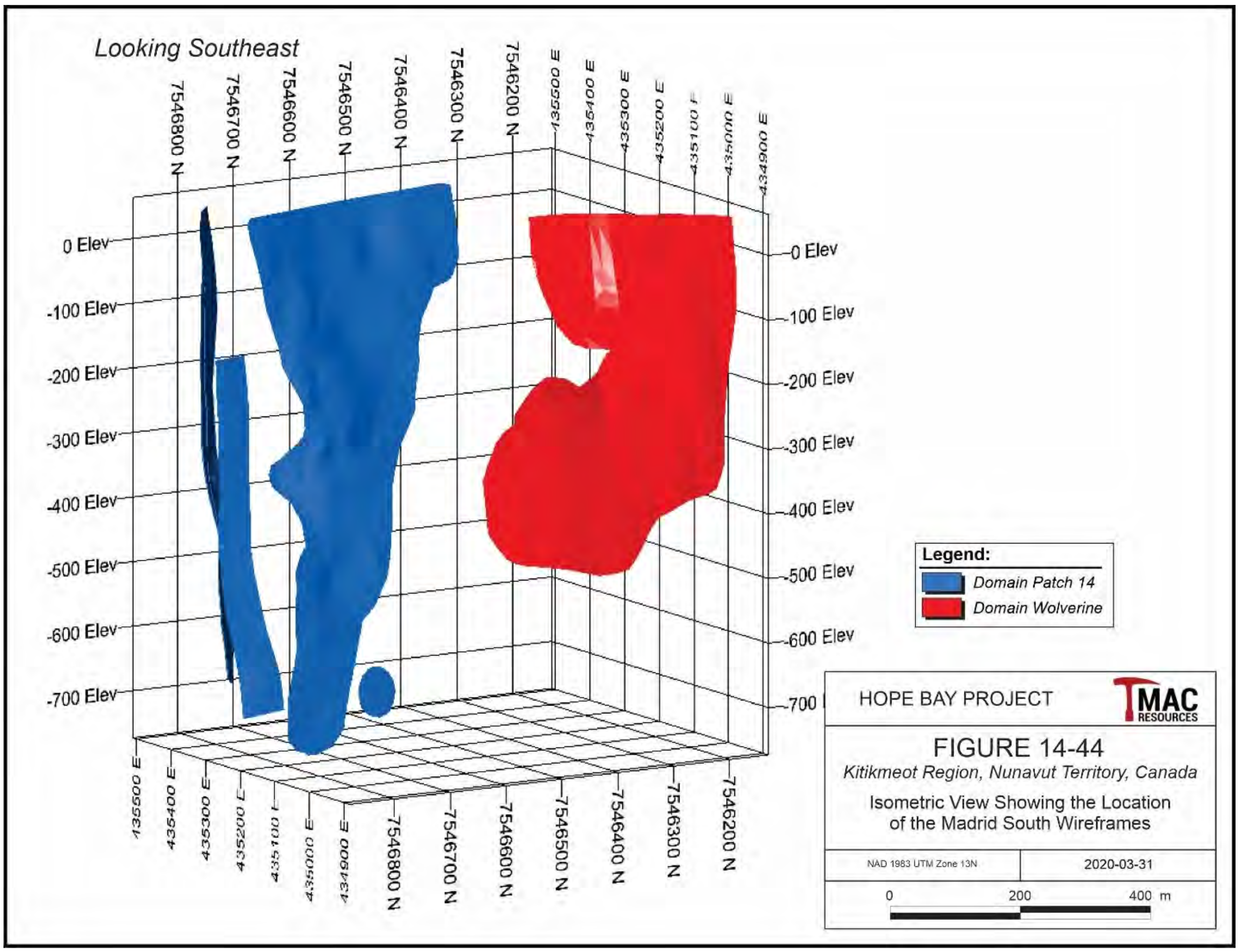


Figure 14-44. Isometric View Showing the Location of the Madrid South Wireframes

TREATMENT OF HIGH-GRADE ASSAYS

Assay intervals were capped at various levels depending on their univariate and spatial distributions. Capping analysis involved the inspection of the spatial location of high-grades, log probability plots, histograms, and decile analyses. For both Patch and Wolverine, RPA identified a high-grade shoot and applied unique capping grades to these areas.

A summary of the Madrid South uncapped and capped statistics is provided in Table 14-26.

Table 14-26. Madrid South Uncapped and Capped Assay Statistics

TMAC Resources Inc. – Hope Bay Project

Domain	No. of Assays	Uncapped				Capped			
		Min (g/t Au)	Max (g/t Au)	Mean (g/t Au)	CV	Mean (g/t Au)	CV	Capping Level	Metal Loss (%)
Waste	1764	0	25.7	0.3	2.78	0.3	2.5	10	2
Patch Domain 1	77	0.02	980.6	20.87	6.16	4.33	1.42	30	79
Patch Domain 2	26	0.02	6.02	1.05	1.45	1.05	1.45	-	0
Patch Domain 4	10	0.45	68.5	10.17	1.87	7.17	1.36	30	30
Patch Domain 5	1	10.65	10.65	10.65	-	10.65	-	-	0
Patch Domain 6	30	0	12.35	4.08	0.93	4.08	0.93	-	0
Patch Domain 7	28	0.5	66.7	5.65	1.99	4.54	1.13	30	20
Patch Domain 8	19	0	5.25	2.42	0.67	2.42	0.67	-	0
Patch Domain 1 High Grade Shoot	175	0.02	725.94	26.68	2.24	23.3	1.58	150	13
Patch Domain 2 High Grade Shoot	56	0.01	105.5	10.98	1.91	10.98	1.91	-	0
Patch Domain 3 High Grade Shoot	47	0.01	69.1	4.85	2.32	4.85	2.32	-	0
Wolverine Domain 10 (High Grade Shoot)	101	0.03	199.2	13.89	1.97	10.98	1.31	50	21
Wolverine Domain 11	6	1.43	47.8	14.61	1.47	14.61	1.47	-	0
Wolverine Domain 12	49	0.01	21.2	2.57	10.69	2.57	10.69	-	0

COMPOSITING

A composite length was selected for each domain considering the dominant sampling length, block size domain variability, thickness, and structural complexity. For both Patch and Wolverine, full-width composites were used.

The Madrid South composite statistics are presented in Table 14-27:

Table 14-27. Madrid South Capped Composite Statistics

TMAC Resources Inc. – Hope Bay Project

Domain	No. of Composites	Min (g/t Au)	Max (g/t Au	Mean (g/t Au	CV	Composite Length (m)
Patch 14 Waste	976	0.00	8.94	0.49	1.62	1
Wolverine Waste	885	0.00	5.37	0.08	3.99	1
Patch 14 Domain 1	27	0.02	17.17	4.33	0.86	Full Length
Patch 14 Domain 2	7	0.02	3.81	1.05	0.80	Full Length
Patch 14 Domain 4	3	5.50	30.00	7.17	0.81	Full Length
Patch 14 Domain 5	1	10.65	10.65	10.65	-	Full Length
Patch 14 Domain 6	6	0.61	9.06	4.08	0.35	Full Length
Patch 14 Domain 7	9	1.89	10.40	4.54	0.57	Full Length
Patch 14 Domain 8	6	0.00	3.42	2.42	0.43	Full Length
Patch 14 Domain 1 High Grade Shoot	38	0.02	90.45	23.30	0.80	Full Length
Patch 14 Domain 2 High Grade Shoot	23	0.01	43.60	10.98	1.20	Full Length
Patch 14 Domain 3 High Grade Shoot	17	0.01	18.28	4.85	0.62	Full Length

TREND ANALYSIS

Analysis of grade trends was performed on mineralization by inspecting grade trends in the block model and variography. Variogram models were interpreted from the experimental variograms and used to inform search parameters, classification decisions, and for validation purposes.

A summary of the Madrid South variogram models is provided in Table 14-28.

Table 14-28. Madrid South Variogram Models

TMAC Resources Inc. – Hope Bay Project

Domain	Rotations				Structure 1				Structure 2			
	Z	X	Z	Nugget	Major	Semi-Major	Minor	Variance	Major	Semi-Major	Minor	Variance
Patch 14	-95	85	80	0.2	43	43	0	0.04	102	102	1	0.76

BULK DENSITY

Bulk density values were assigned based on rock type and mineralization zones. A summary of the bulk densities assigned to blocks is provided in Table 14-29.

Table 14-29. Madrid South Bulk Density Assignment

TMAC Resources Inc. – Hope Bay Project

Domain	Waste (t/m^3)	High Grade (t/m^3)
Patch 14	2.88	2.79
Wolverine	2.84	2.79

BLOCK MODELS

Block model dimensions and setups have been selected based on the proposed scale of mining, with consideration given to the available data and complexity of the mineralization wireframes. Parent blocks were split into sub-cells at wireframe boundaries, with the minimum sub-cell size set to a reasonable size with the intention of minimizing the variance between wireframe and block volumes while maintaining a manageable block model file size.

The Madrid South block model prototypes are presented in Table 14-30.

Table 14-30. Madrid South Block Model Prototypes

TMAC Resources Inc. – Hope Bay Project

Domain	Model Name	Rotation	XINC	YINC	ZINC	XMORIG	YMORIG	ZMORIG	NX	NY	NZ
Patch 14	pch_class2301.dm	-8	1.5	3	3	435,276	7,546,273	-782	200	117	140
Wolverine	wv_class2301.dm	0	1.6	6	6	434,859	7,546,115	-513	156	86	104

SEARCH STRATEGY AND GRADE INTERPOLATION PARAMETERS

A multi-pass search strategy was implemented using unique dynamic anisotropy angles for each block. Block grades were interpolated using ID3 while a NN estimate was run for validation purposes. Estimates were length weighted to account for the variable composite length. The horizontal thickness was extracted from each triangle of the mineralization wireframes and was interpolated into blocks. The thicknesses were used for reporting resources to minimum thickness criteria of 1.5m.

A summary of the search strategy and interpolation parameters is provided in Table 14-31.

Table 14-31. Madrid South Search Strategy and Interpolation Parameters

TMAC Resources Inc. – Hope Bay Project

Domain	Pass	Interpolation Method	Major (m)	Semi-Major (m)	Minor (m)	Min	Max	Weight
Patch 14	1	ID^3	80	30	30	3	8	Length
	2	ID^3	160	60	60	3	8	Length
	3	ID^3	320	120	120	1	5	Length
Wolverine	1	ID^3	60	20	30	3	8	Length
	2	ID^3	120	40	60	3	8	Length
	3	ID^3	240	80	120	1	5	Length

CLASSIFICATION

Definitions for resource categories used in this report are consistent with those defined by CIM (2014) and adopted by NI 43-101. See the Doris Classification subsection for further details.

Blocks were classified as Measured, Indicated and Inferred based using distance based criterion with consideration for the continuity of grade above the cut-off and complexity of the geological model. While the classification is adjusted for each domain is, the maximum classification criteria at Hope Bay is as follows:

- Inferred Mineral Resources are defined by three-dimensional continuity of grade located in areas where the drill spacing does not exceed 100m.
- Indicated Mineral Resources require continuity of grade above the cut-off in reasonably contiguous areas where the drill spacing does not exceed 40m.
- Measured Mineral Resources are defined after the grid defining the Indicated material has been infilled and the blocks are within reasonable proximity to excavations.

The classification assigned to each domain is shown in Figure 14-45 to Figure 14-46.

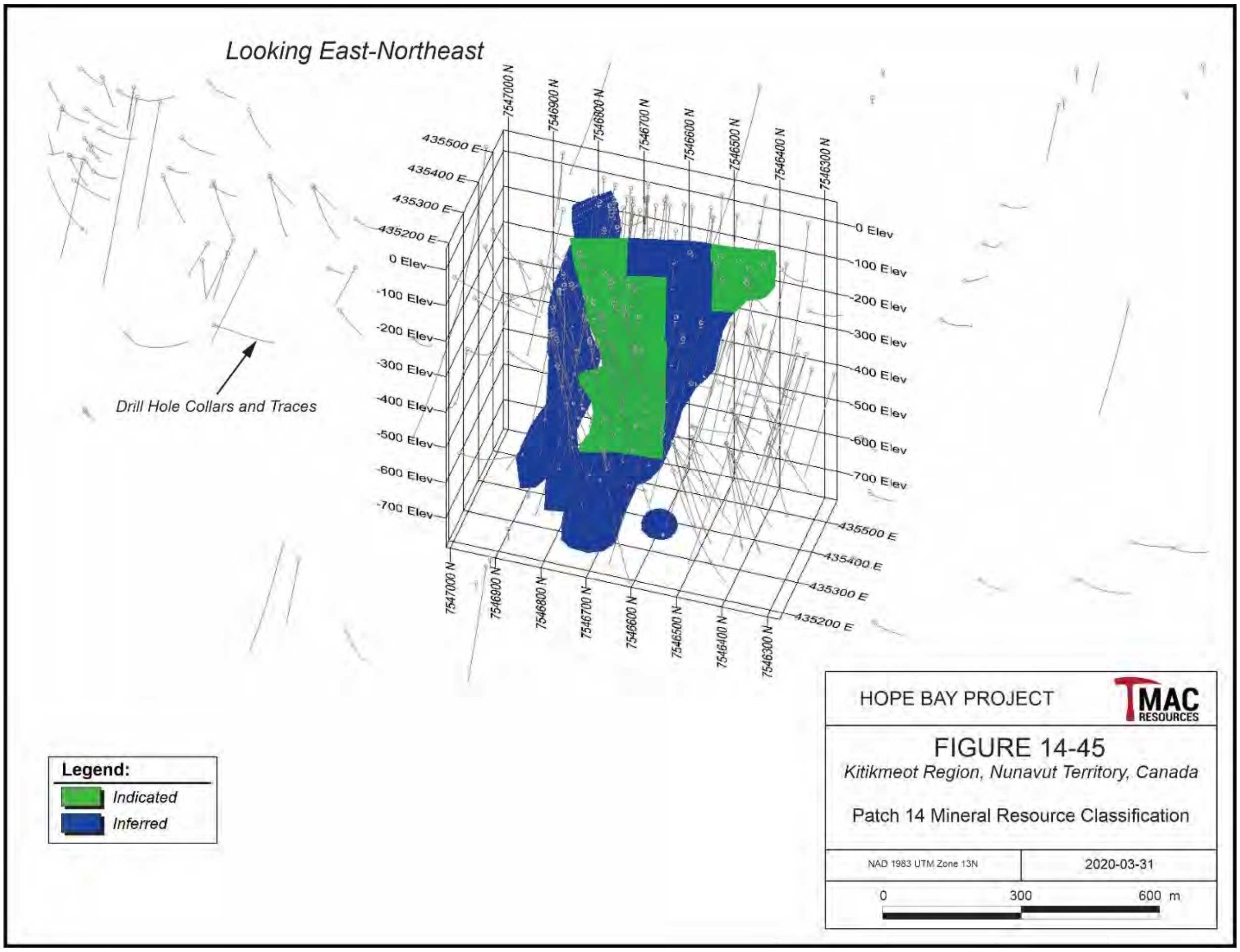


Figure 14-45. Patch 14 Mineral Resource Classification

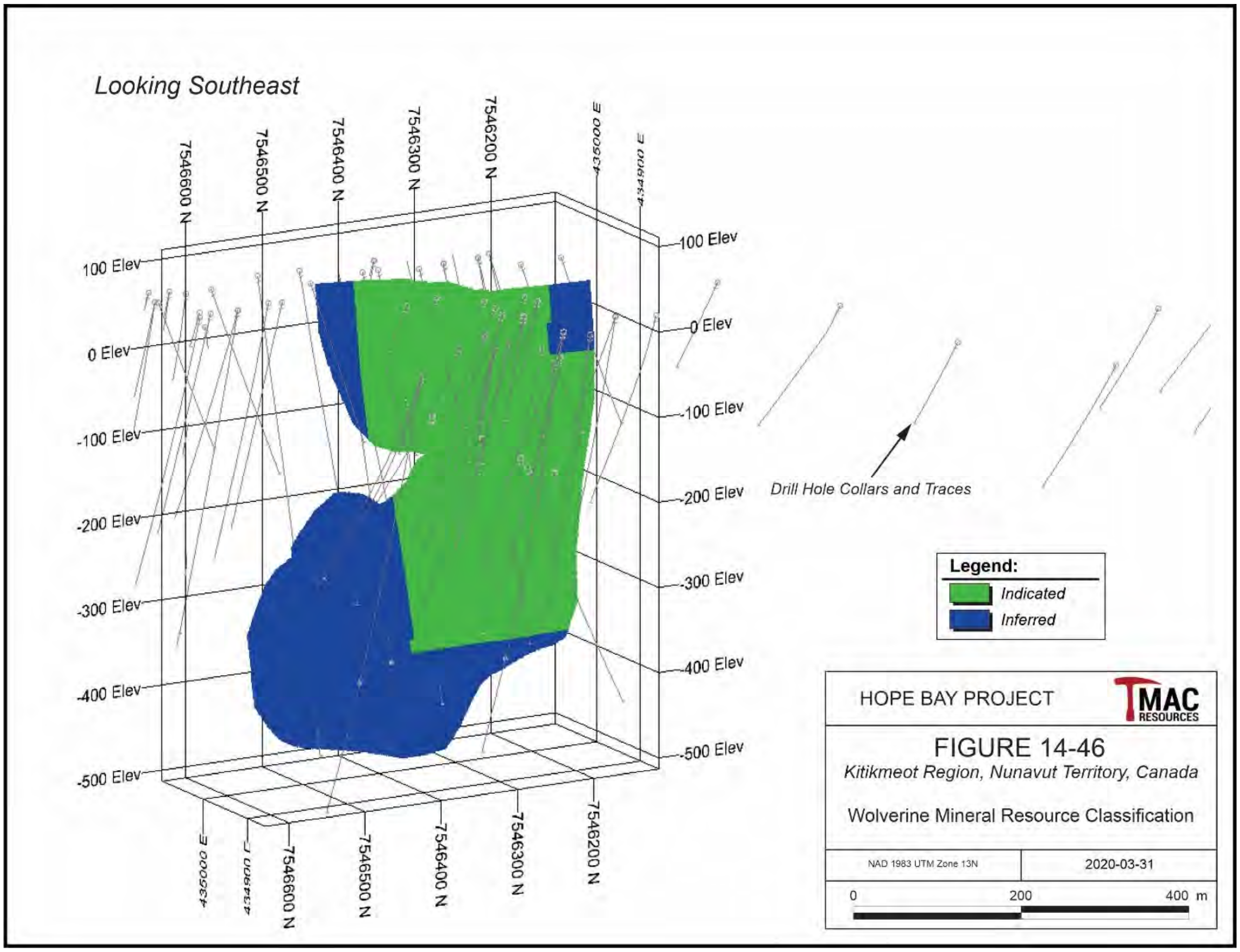


Figure 14-46. Wolverine Mineral Resource Classification

BLOCK MODEL VALIDATION

Blocks were validated using industry standard techniques including:

- Visual inspection of composite versus block grades (Figure 14-47 to Figure 14-48)
- Comparison between ID, NN and composite means (Figure 14-49)
- Swath plots (Figure 14-50 to Figure 14-51)

The QP is of the opinion that the Madrid South Mineral Resource estimates validate well and are appropriate for the public disclosure of Mineral Resources and the estimation of Mineral Reserves.

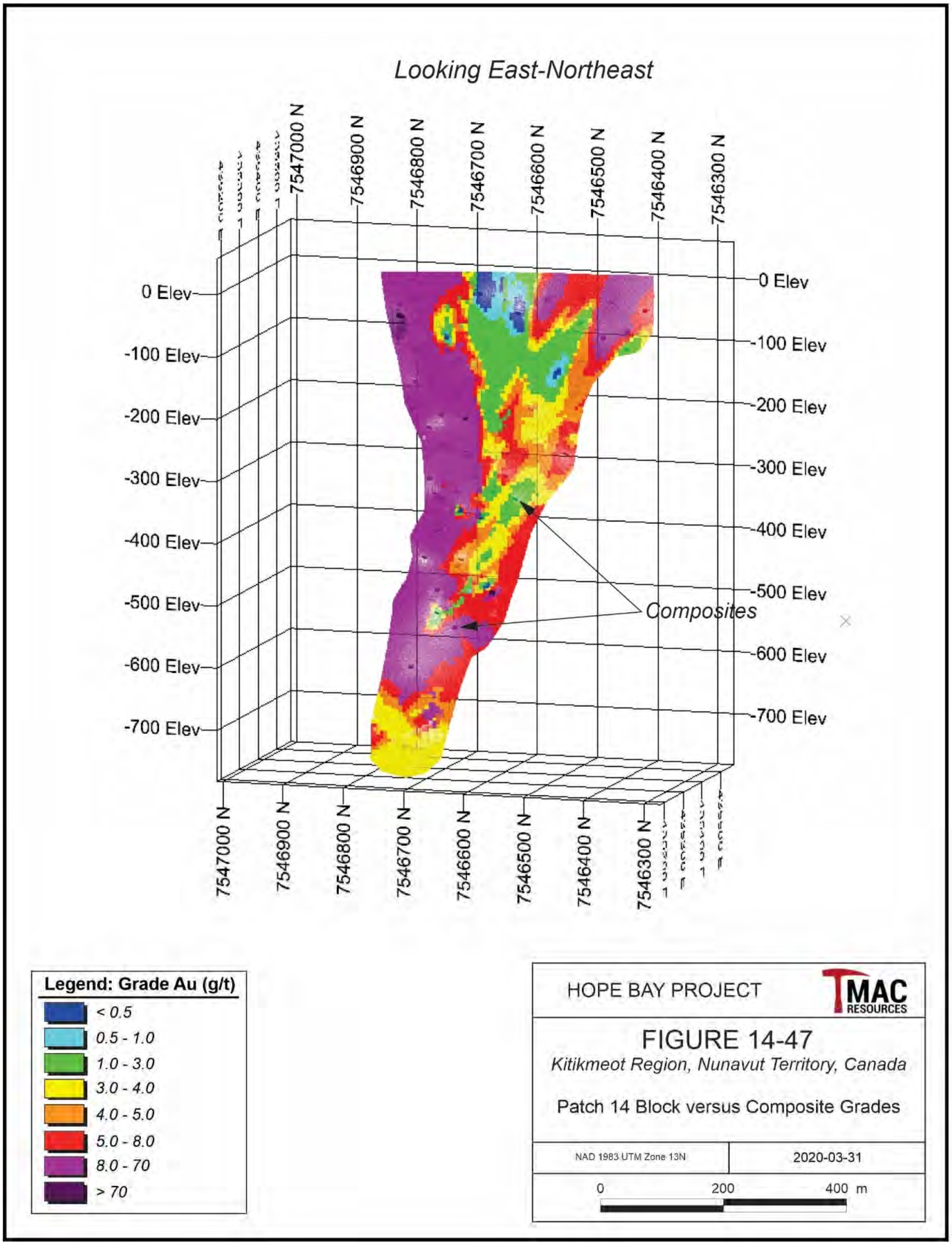


Figure 14-47. Patch 14 Block Versus Composite Grades

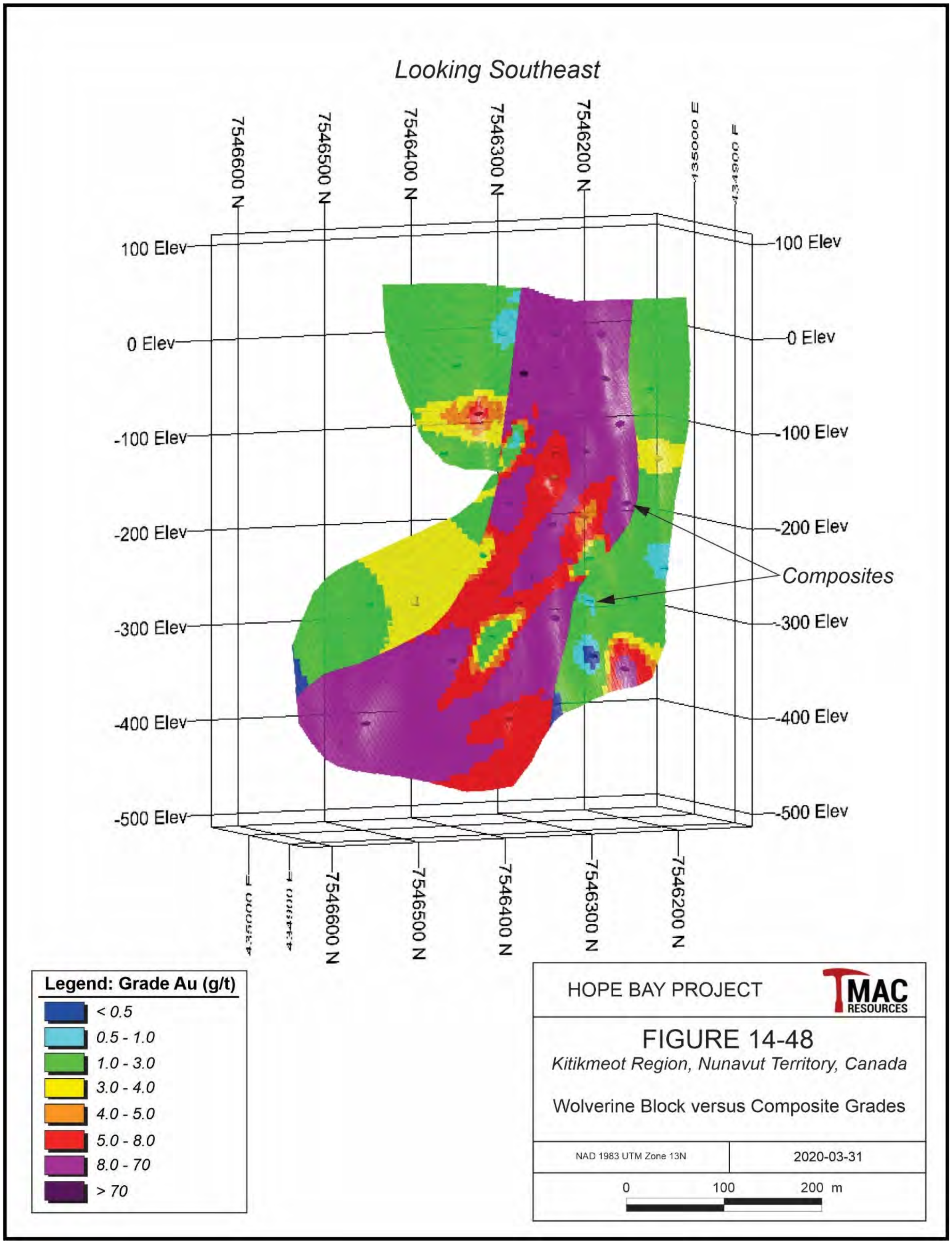


Figure 14-48. Wolverine Block Versus Composite Grades

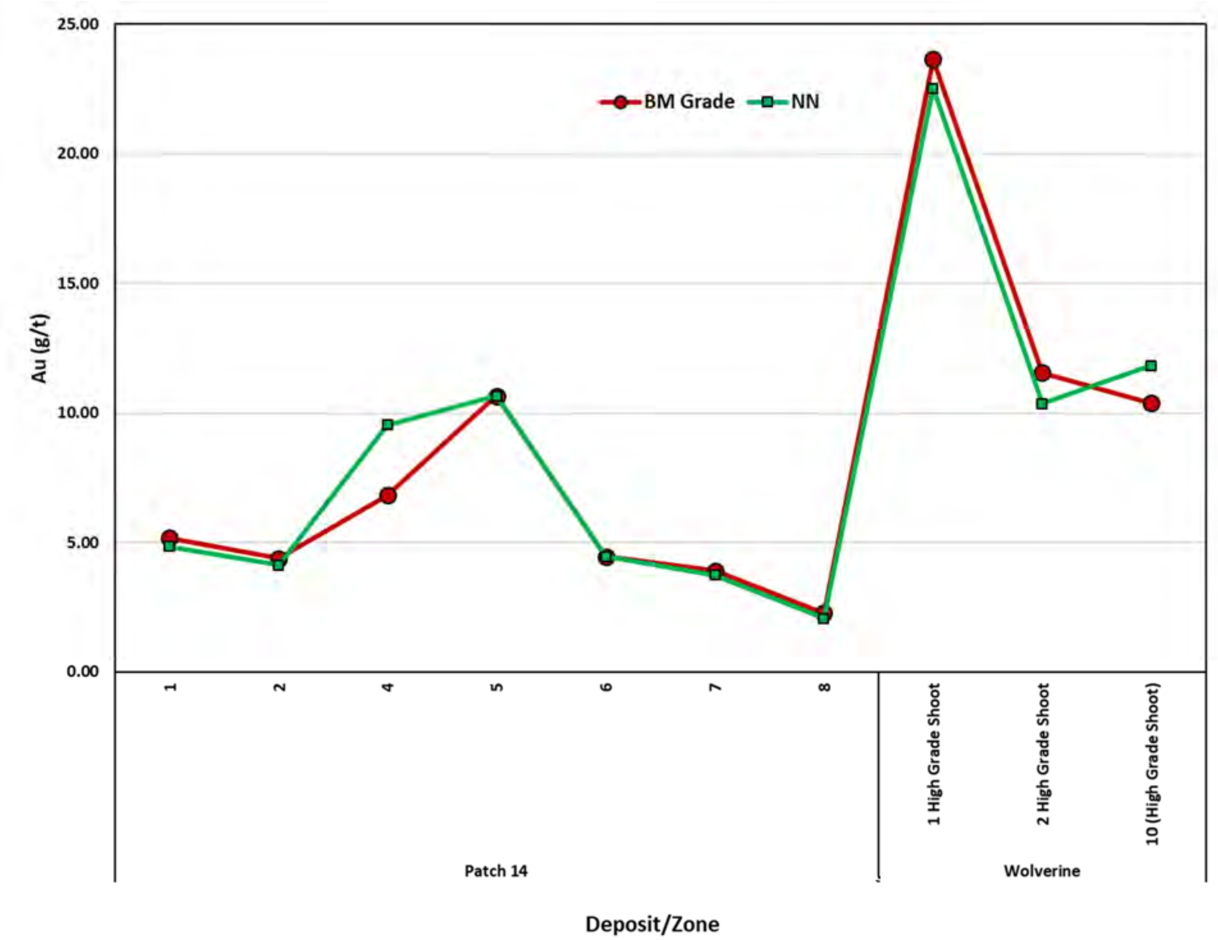


Figure 14-49. Madrid South Comparison Between Means

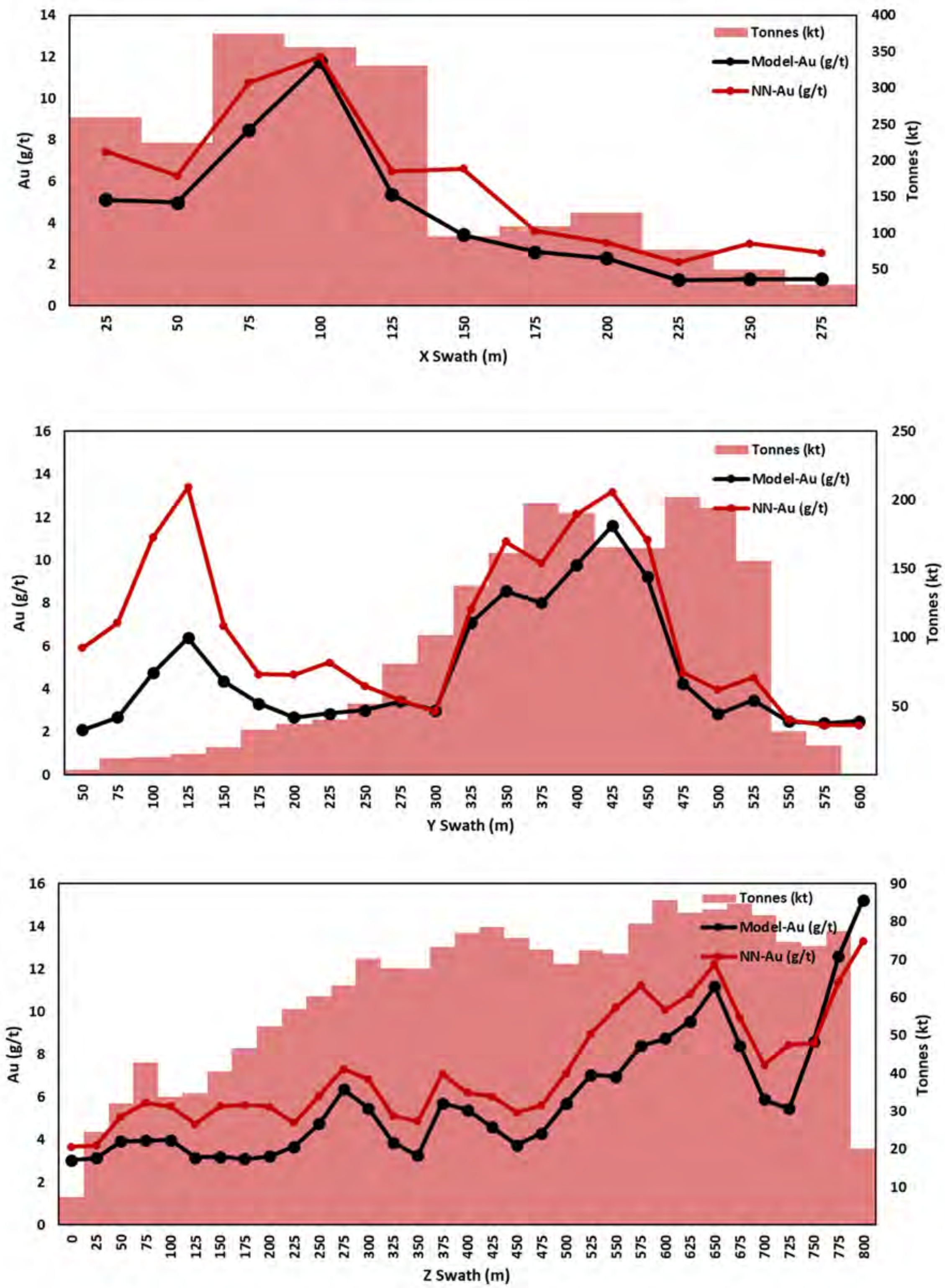


Figure 14-50. Patch 14 Swath Plots

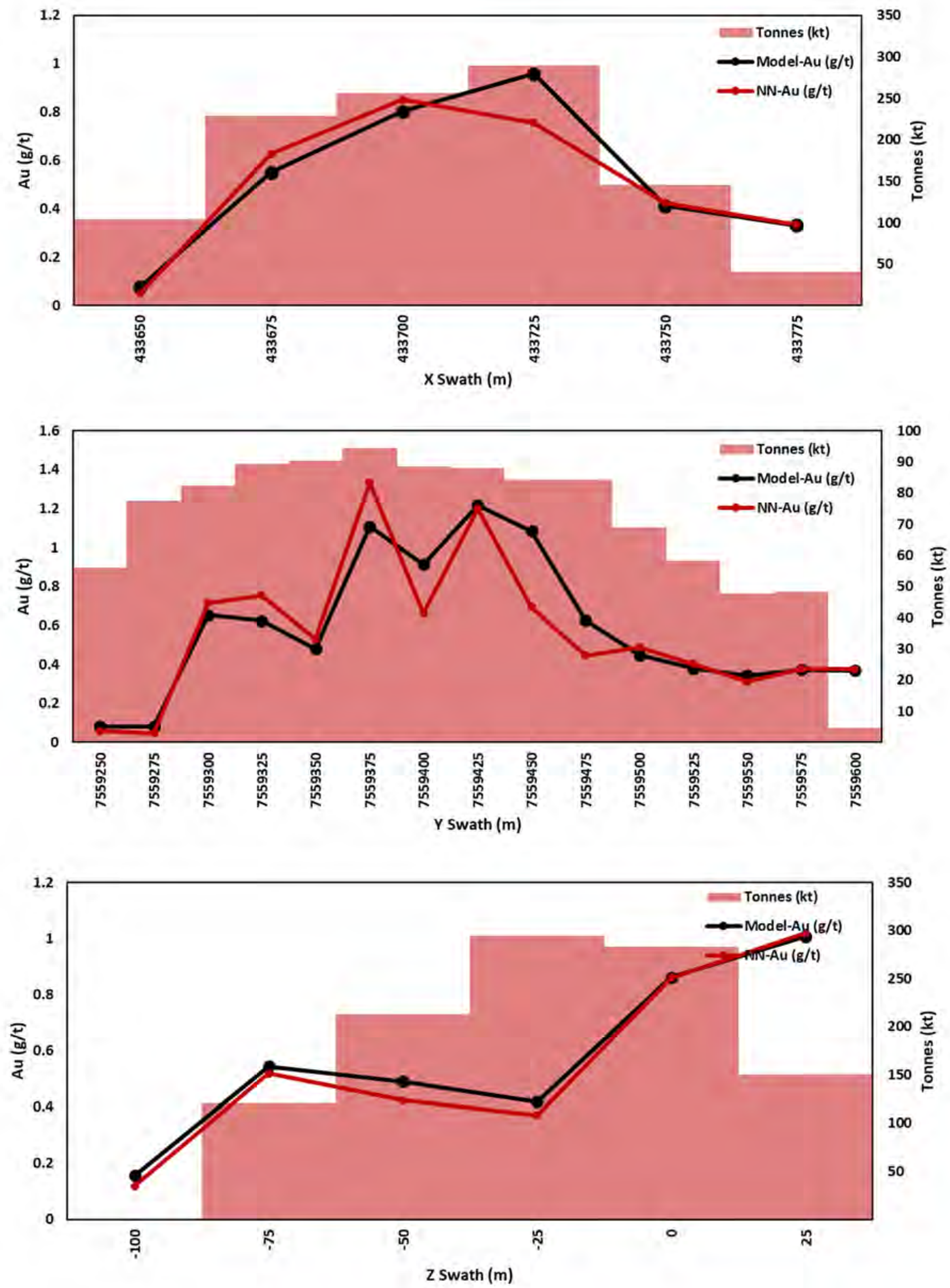


Figure 14-51. Wolverine Swath Plots

BOSTON

Boston represents approximately 22% and 23% of the total Hope Bay Measured and Indicated tonnes and ounces, respectively, and 28% of both the total Hope Bay Inferred tonnes and ounces. Some test mining was conducted at Boston in 1996 and 1997. The material mined during the bulk sampling program remains on surface in separate stockpiles for each underground round taken in mineralization.

The Boston Mineral Resources are presented in Table 14-32.

Table 14-32. Summary of Boston Mineral Resources – December 31, 2019

TMAC Resources Inc. – Hope Bay Project

Domain	Tonnes (000 t)	Grade (g/t Au)	Ounces (000 oz)
Measured			
Boston B2	1,193	9.7	370
Boston B3	137	6.0	26
Boston B4/B5	0	0.0	0
Total Measured	**1,330**	**9.3**	**397**
Indicated			
Boston B2	2,314	7.5	559
Boston B3	880	5.5	156
Boston B4/B5	247	7.8	62
Total Indicated	**3,441**	**7.0**	**776**
Measured and Indicated			
Boston B2	3,507	8.2	930
Boston B3	1,017	5.6	182
Boston B4/B5	247	7.8	62
Total Measured and indicated	**4,771**	**7.6**	**1,173**
Inferred			
Boston B2	1,103	6.3	224
Boston B3	1,393	6.1	272
Boston B4/B5	556	5.5	98
Total Inferred	**3,053**	**6.0**	**594**

Notes:

1. CIM definitions were followed for the statement of Mineral Resources.
2. Mineral Resources are inclusive of those resources converted to Mineral Reserves and are in-situ resources excluding stockpiles.

3. Mineral Resources that are not Mineral Reserves do not have demonstrated economic viability.
4. The Mineral Resources for each Individual deposit were defined utilizing a block cut-off grade of 3.5 g/t.
5. All Mineral Resources are estimated using an average long-term gold price of US$1,500 per ounce and a CAD/USD exchange rate of 1.34.
6. A 50-metre crown pillar allowance was applied to Mineral Resources located below lakes where applicable.
7. A minimum intercept width of 1.5 m was applied to the Mineral Resource modelling.
8. Ore density was calculated using the geological block model density field.
9. Numbers may not add due to rounding.

RESOURCE DATABASE

The Boston Mineral Resource estimate consists of 193,594 m of surface drilling, underground drilling, and underground channel sampling.

A summary of Boston's drill hole database is provided Table 14-33. The data presented in the table reflects the last database export supplied to RPA. The last drill hole was entered into the dataset in August 2017.

Table 14-33. Boston Mineral Resource Database

TMAC Resources Inc. – Hope Bay Project

Year	Historic Surface DDH		Historic Underground Channels		TMAC Surface DDH		Historic Underground DDH		Grand Total	
	No. of Holes	Length (m)	No. of Holes	Length (m)	No. of Holes	Length (m)	No. of Holes	Length (m)	Total No. of Holes	Total Length (m)
1992	24	4,176	-	-	-	-	-	-	24	4,176
1993	70	20,627	1	5	-	-	-	-	71	20,632
1994	54	23,873	2	2	-	-	-	-	56	23,875
1995	10	2,217	-	-	-	-	-	-	10	2,217
1996	113	7,448	382	1,240	-	-	-	-	495	8,688
1997	162	18,532	65	260	-	-	-	-	227	18,791
1998	39	10,500	-	-	-	-	-	-	39	10,500
2000	20	3,928	-	-	-	-	145	16,046	165	19,973
2001	42	9,554	-	-	-	-	-	-	42	9,554
2003	11	12,017	-	-	-	-	-	-	11	12,017
2004	39	22,448	-	-	-	-	-	-	39	22,448
2006	26	8,521	-	-	-	-	-	-	26	8,521
2007	29	8,840	-	-	-	-	-	-	29	8,840
2008	32	9,259	-	-	-	-	-	-	32	9,259
2009	3	720	-	-	-	-	-	-	3	720
2010	1	470	-	-	-	-	-	-	1	470
2011	19	8,704	-	-	-	-	-	-	19	8,704
2017	-	-	-	-	16	4,208	-	-	16	4,208
Grand Total	694	171,833	450	1,507	16	4,208	145	16,046	1,305	193,594

GEOLOGICAL INTERPRETATION

Mineralization and lithology wireframes were completed using Leapfrog Geo (various versions). Since acquiring the property, TMAC has drilled an additional 16 drill holes in the Boston Deposit area. Of these, 15 drill holes totaling 4,179 m intercepted the mineralized wireframes, while the remaining drill hole did not intercept significant mineralization. These drill holes are the first by TMAC to target the Boston deposit, with all previous drilling at Boston being historical in nature.

The geological interpretation was based on detailed investigation which was aided by:

- Additional drilling and sampling.
- Extensive re-logging from core photos.
- Mapping and compilation performed by TMAC, Orix Geoscience, and previous operators.

- The construction of a detailed lithological, alteration, and structural model for the deposit.

Six main types of mineralization were identified and captured, vein stringer sets hosted in transition breccia, discrete veins at lithologic contacts, fault-hosted veins, shear-hosted mineralization, vein domains at picrite contacts, and internal picrite-hosted mineralization.

The Boston lithology model is shown in Figure 14-52, while an isometric view of the mineralization wireframes is presented in Figure 14-53.

14-99

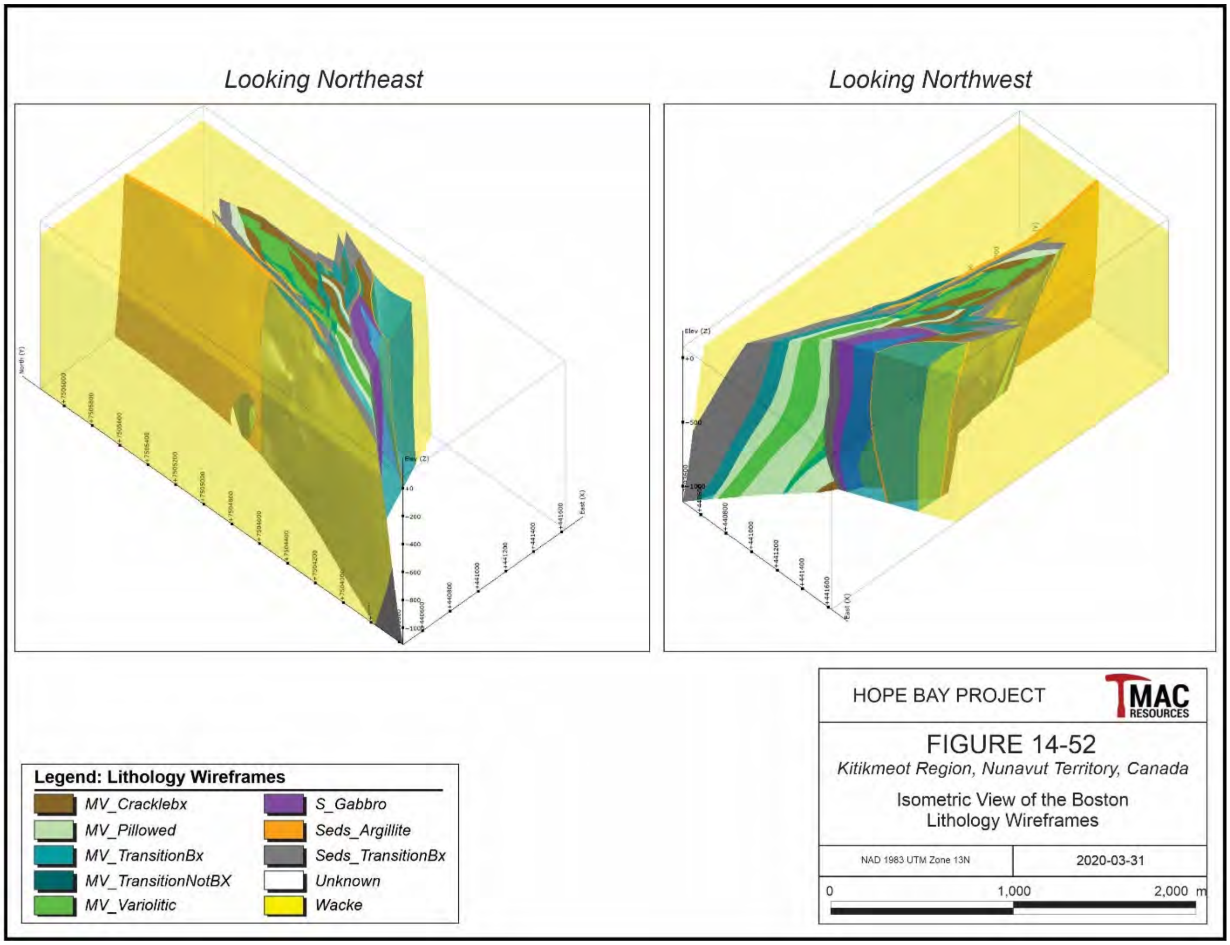


Figure 14-52. Isometric View of the Boston Lithology Wireframes

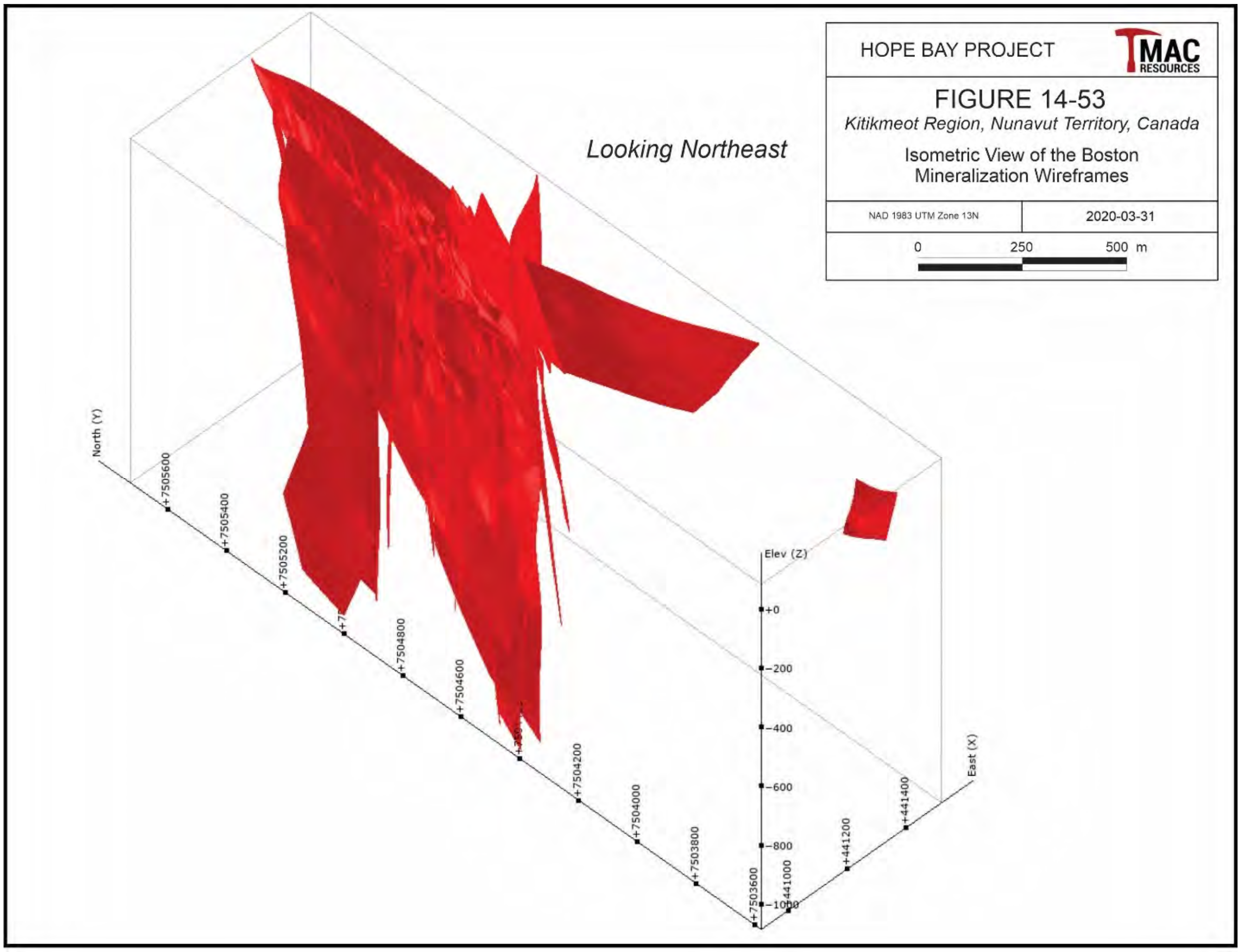


Figure 14-53. Isometric View of the Boston Mineralization Wireframes

TREATMENT OF HIGH-GRADE ASSAYS

Assay intervals were capped at various levels depending on their univariate and spatial distributions. Capping analysis involved the inspection of the spatial location of high-grades, log probability plots, histograms, decile analyses, and disintegration analysis. For distributions where capping, as implied by the decile analysis, resulted in excessive metal loss, a two-tier capping approach was adopted whereby an initial higher cap was applied within a specified distance. Beyond the specified distance a lower cap was used.

Raw assays within the wireframes were grouped for capping purposes, with grouping based on mean, coefficient of variation, and geological characteristics. Initial Exploratory Data Analysis (EDA) analysed up to 13 different groupings which resulted in seven different capping levels applied, based on a combination of univariate zone statistics, histogram and CDF plots, decile analysis, assay configuration, and geologic confidence of each domain.

A summary of the Boston uncapped and capped statistics is provided in Table 14-34 and the general capping strategy is presented in Table 14-35.

Table 14-34. Boston Uncapped and Capped Assay Statistics

TMAC Resources Inc. – Hope Bay Project

Domain	No. of Assays	Uncapped				Capping Level	Capped			
		Min (g/t Au)	Max (g/t Au)	Mean (g/t Au)	CV		Mean (g/t Au)	CV	No. of Caps	Metal Loss (%)
2101	266	0	1,751.2	13	8.69	35	2.38	2.7	9	82
2102	322	0	238.1	3.57	3.33	45	3.07	2.05	4	14
2103	167	0	415.4	7.43	4.26	90	5.57	2.69	3	25
2104	1,949	0	864.4	7.76	3.34	90	6.69	1.93	21	14
2105	345	0	86.502	1.15	3.95	20	0.99	2.66	2	14
2106	545	0	262.28	12.1	1.73	175	11.9	1.56	1	2
2107	318	0	282.6	5.14	4.66	45	3.21	2.42	5	38
2108	109	0	101.2	3.3	2.83	45	3.05	2.35	1	8
2111	81	0	12.7	0.63	3.38	20	0.63	3.38	0	0
2112	328	0	410	6.5	4.85	45	3.75	2.22	10	42
2113	51	0	102.21	7.92	1.9	175	7.92	1.9	0	0
2121	180	0	32.5	1.64	2.45	35	1.64	2.45	0	0
2122	116	0	101.6	2.18	3.66	20	1.57	2.52	5	28
2123	206	0	216.1	5.28	3.05	90	4.71	2.03	1	11
2124	108	0.005	43.46	3.99	1.72	35	3.89	1.62	1	3
2125	90	0	152.8	3.26	5.55	20	1.26	2.71	2	61
2201	463	0	144.8	2.85	2.74	35	2.59	1.76	4	9
2202	594	0	660.7	14.9	2.56	175	13.9	1.93	3	7
2203	538	0	233.6	3.71	3.7	45	3.02	2.16	5	19
2204	699	0	1127	8.59	5.6	25	3.24	2.02	47	62
2205	430	0	930.5	13.3	4.27	90	8.84	2	9	33
2206	61	0	35.2	2.24	2.19	35	2.24	2.19	1	0
2207	539	0	258.41	9.95	1.76	175	9.82	1.63	1	1
2208	311	0	216.05	7.81	2.45	175	7.68	2.31	1	2
2210	134	0	60.7	2.61	2.61	35	2.41	2.23	2	8
2211	193	0	158.59	6.73	1.89	175	6.73	1.89	0	0
2212	109	0	45.81	3.02	1.85	35	2.93	1.69	1	3
2213	166	0	25.29	3.2	1.36	35	3.2	1.36	0	0
2214	103	0	65.23	1.74	3.62	20	1.38	2.55	4	21
2215	195	0	438.9	10.7	3.79	90	7.25	2.83	11	32
2216	344	0	291.73	5.11	4.12	45	3.45	2.25	7	32

Domain	No. of Assays	Uncapped				Capping Level	Capped			
		Min (g/t Au)	Max (g/t Au)	Mean (g/t Au)	CV		Mean (g/t Au)	CV	No. of Caps	Metal Loss (%)
2217	77	0	281.58	5.77	5.42	20	1.49	2.73	3	74
2218	54	0	30.24	1.94	2.39	35	1.94	2.39	0	0
2219	58	0	25.2	3.01	1.71	35	3.01	1.71	0	0
2221	430	0	382.8	3.77	4.72	45	2.75	2.52	11	27
2222	48	0.005	65.03	4.78	2.41	35	4.02	1.95	1	16
2223	68	0	34.77	1.55	2.88	35	1.55	2.88	0	0
2224	79	0	10.64	0.75	2.34	35	0.75	2.34	0	0
2225	91	0	17.2	2.03	1.67	35	2.03	1.67	0	0
2501	556	0	812.96	8.49	3.94	90	7.33	1.92	4	14
2502	476	0	1030	11.8	3.92	90	8.12	2.24	14	31
2503	334	0	102.34	2.46	3.75	20	1.76	2.27	11	28
2505	292	0	337.8	12.4	2.46	175	11.7	2.08	3	6
2506	304	0	467.04	8.52	3.67	90	6.86	2.45	7	19
2507	328	0	192.58	4.39	2.86	35	3.73	1.9	9	15
2510	149	0	602.92	10.9	4.5	90	7.2	2.41	4	34
2511	68	0	33.99	2.43	2.25	35	2.43	2.25	0	0
2512	46	0.005	59.34	1.16	5.19	12	0.71	2.83	1	39
2513	31	0	9.87	1.61	1.73	35	1.61	1.73	0	0
2514	15	0.015	90.63	14.4	2.01	175	14.4	2.01	0	0
2515	198	0	34.765	1.14	2.75	12	1.05	2.31	3	8
2521	318	0	149.04	4.17	2.56	35	3.65	1.85	8	12
2522	120	0	39.6	2.75	2.24	35	2.71	2.18	1	1
2523	167	0	41.109	1.76	2.34	35	1.75	2.28	1	1
2524	78	0	55.73	1.63	3.84	20	1.22	2.43	1	25
2525	66	0	389.1	6.6	7.12	25	1.33	2.8	1	80
3202	131	0	19.79	1.17	2.05	35	1.17	2.05	0	0
3203	118	0	30.857	1.48	2.61	35	1.48	2.61	0	0
3204	67	0	176.2	3.18	5.93	20	1.38	2.27	2	57
3301	241	0	108	1.71	3.9	25	1.44	2.19	2	16
3302	119	0	23.7	3.06	1.24	35	3.06	1.24	0	0
3303	166	0	16.32	0.82	2.37	35	0.82	2.37	0	0
3305	53	0	11.08	1.14	1.96	35	1.14	1.96	0	0
3306	431	0	87.59	4.55	2.05	35	4.18	1.76	9	8
3307	83	0	22.045	2.27	1.74	35	2.27	1.74	0	0

Domain	No. of Assays	Uncapped				Capping Level	Capped			
		Min (g/t Au)	Max (g/t Au)	Mean (g/t Au)	CV		Mean (g/t Au)	CV	No. of Caps	Metal Loss (%)
3308	127	0	52.149	2.1	2.4	35	2	2.06	1	5
3309	144	0	112.81	1.87	4.03	25	1.51	2.54	3	19
3311	223	0	135.36	1.42	4.79	25	1.18	2.78	3	17
3312	30	0	12.28	1.27	1.8	35	1.27	1.8	0	0
3402	33	0	14.21	2.15	1.96	35	2.15	1.96	0	0
3404	48	0.01	23.29	2.66	1.35	35	2.66	1.35	0	0
3601	769	0	501.05	2.54	6.12	20	1.87	1.97	16	26
3602	841	0	297.6	3.46	3.65	25	2.72	1.84	20	21
3604	54	0	13.58	1.52	1.79	35	1.52	1.79	0	0
3605	123	0	63.3	3.61	2.58	35	3.1	2.04	1	14
3607	207	0	50.9	1.87	2.69	35	1.79	2.44	2	4
3610	82	0	19.68	2.49	1.5	35	2.49	1.5	0	0
3611	437	0	54.65	1.83	2.3	35	1.8	2.17	1	2
3612	447	0	149.2	2.76	3.22	25	2.28	1.96	9	17
3614	240	0	1,165	5.34	10.7	25	1.99	1.97	5	63
3615	99	0	13.25	1.56	1.55	35	1.56	1.55	0	0
3616	53	0	11.1	1.17	2.07	35	1.17	2.07	0	0
3618	59	0	18.7	1.36	2.05	35	1.36	2.05	0	0
3619	66	0	11.33	1.56	1.5	35	1.56	1.5	0	0
3651	176	0	120	4.07	2.41	35	3.64	1.62	2	11
3652	67	0.01	13.3	2.13	1.36	35	2.13	1.36	0	0
3653	105	0	17.03	2.15	1.34	35	2.15	1.34	0	0
3705	230	0	461.3	2.93	8.13	12	1.61	1.75	7	45
3706	51	0	81.67	2.36	3.59	45	2.03	2.62	1	14
4101	234	0	70.5	1.36	2.84	20	1.25	1.87	2	8
4102	55	0	37.6	2.31	3.1	20	1.76	2.66	3	24
4103	79	0	18.75	2.52	1.25	20	2.52	1.25	0	0
4111	66	0	25.919	0.87	3.36	20	0.84	3.16	1	3
4112	118	0	36.308	1.36	2.42	20	1.28	1.97	1	6
4113	51	0	18.8	1.95	2.16	20	1.95	2.16	0	0
5101	108	0	99.942	2.85	4.1	20	1.75	2.32	4	39
5102	165	0	334.97	4.51	5.93	20	1.45	2.71	8	68
5301	72	0	252.7	4.73	4.13	45	3.58	2.09	2	24
5302	382	0	253	1.42	7.45	12	0.8	2.82	15	44

Domain	No. of Assays	Uncapped				Capping Level	Capped			
		Min (g/t Au)	Max (g/t Au)	Mean (g/t Au)	CV		Mean (g/t Au)	CV	No. of Caps	Metal Loss (%)
5601	14	0.03	24.4	3.51	2.4	35	3.51	2.4	0	0
12801	2,245	0	67.65	0.8	3.95	12	0.67	2.4	26	16
12802	463	0	65.999	0.85	4.76	12	0.65	2.42	4	24
12803	1,729	0	89	0.4	4.28	12	0.37	3.15	15	8
12804	2,823	0	17.28	0.24	3.25	12	0.24	3.2	5	0
12805	1,669	0	135.14	0.55	4.79	12	0.44	3.02	12	20
13701	3,145	0	474.7	0.36	17.6	12	0.25	4.29	20	31
13702	3,851	0	87.59	0.44	5.58	12	0.37	3.44	24	16
14801	1,066	0	26.2	0.89	2.05	12	0.87	1.91	2	2
14802	452	0	34.2	0.61	3.67	12	0.54	2.64	4	11
15701	484	0	9.06	0.31	3.32	12	0.31	3.32	0	0
15702	204	0	3.15	0.13	2.89	12	0.13	2.89	0	0
Dilution	25,801	0	285.1	0.16	11.6	12	0.15	4.25	46	6

Table 14-35. Boston Capping Strategy for Restricted Search Domains

TMAC Resources Inc. – Hope Bay Project

Domain	Restricted Cap	Domain Cap
2101	175	35
2201	175	35
2506	175	90
2514	175	175
3705	175	12
4101	175	20
5102	175	20
2512	45	12
2515	45	12
5302	45	12
12801	45	12
12802	45	12
12803	45	12
12804	45	12
12805	45	12

Domain	Restricted Cap	Domain Cap
13701	45	12
13702	45	12
14801	45	12
14802	45	12
15701	45	12
15702	45	12
26000	35	12

COMPOSITING

A composite length was selected for each domain considering the dominant sampling length, block size domain variability, thickness and structural complexity. In order to properly preserve grade trends in spite of variable zone widths, a hybridized compositing approach was used in generating the Boston composites. In this approach, two sets of composites were generated. A set of full-width composites were generated for each domain, using a variable composite length and full-length compositing within high-grade domains. Concurrently, a set of constant-length 1.5 m composites were generated within each high-grade domain, as well as in the medium- and low-grade envelopes. Residuals shorter than half of the composite length (0.75 m) were discarded. Zones were grouped into estimation domains based on orientation and geological characteristics; these were used as soft boundary estimation groupings, and composites were continuous across these soft boundaries. To avoid errors due to desurveying inconsistencies between Leapfrog and Datamine, a zone field was generated from mineralization wireframe intercepts in Leapfrog. This zone field was then imported into Datamine, and composites were constrained by this zone field rather than directly by the imported wireframes.

During estimation, both full-width and constant-length composites were used, depending on the thickness of the zone. For zones consistently under 4.5 m (most high-grade zones), full-width composites were used. For zones consistently thicker than 4.5 m, constant-length (1.5 m) composites were preferred. For zones with variable thickness, an extrusion approach was used to define a coherent panel of ‘thick’ vein where 1.5 m composites were used, while outside of the panel the estimation was based on the full-width composites. In these cases, the panel boundary was used as a soft estimate, and assays on both sides of the boundary were used for both estimations. For this reason, it was necessary to maintain two parallel composite files, however, all statistical comparisons were made using the constant-length composites. All medium- and low-grade domains were estimated using the constant-length 1.5 m composites.

The Boston composite statistics are presented in Table 14-36.

Table 14-36. Boston Composite Statistics

TMAC Resources Inc. – Hope Bay Project

Domain	Variable and Unit	No. of Composites*	Min (g/t Au)	Max (g/t Au)	Mean (g/t Au)	CV	Composite Length (m)
2101	Au (g/t)	115	0	33.5	2.14	2.24	Full-Width
2102	Au (g/t)	166	0	35.24	3.01	1.63	Full-Width
2103	Au (g/t)	82	0	57.67	5.08	2.22	Full-Width
2104	Au (g/t)	922	0	80.16	6.63	1.49	Full-Width
2105	Au (g/t)	242	0	14.96	1.03	2.18	Full-Width
2106	Au (g/t)	243	0.01	120.72	11.63	1.28	Mix of 1.5 + Full-Width
2107	Au (g/t)	173	0	33.91	3.15	1.8	Full-Width
2108	Au (g/t)	58	0	30.48	2.95	1.91	1.5
2111	Au (g/t)	48	0	6.11	0.66	2.25	Full-Width
2112	Au (g/t)	163	0	29.84	3.83	1.55	Mix of 1.5 + Full-Width
2113	Au (g/t)	24	0	50.2	7.92	1.31	Full-Width
2121	Au (g/t)	123	0	29.16	1.7	2.19	Full-Width
2122	Au (g/t)	77	0	13.46	1.55	2.04	Full-Width
2123	Au (g/t)	105	0	43.34	4.53	1.56	Full-Width
2124	Au (g/t)	54	0.01	19.93	3.54	1.24	Full-Width
2125	Au (g/t)	54	0.01	17.31	1.33	2.35	Full-Width
2201	Au (g/t)	212	0	25.9	2.73	1.34	Full-Width
2202	Au (g/t)	344	0	133.19	13.81	1.59	Mix of 1.5 + Full-Width
2203	Au (g/t)	266	0	35.86	3.08	1.67	Full-Width
2204	Au (g/t)	382	0	25	3.25	1.72	Mix of 1.5 + Full-Width
2205	Au (g/t)	147	0	90	9.03	1.52	Full-Width
2206	Au (g/t)	39	0	18.61	2.15	1.81	Full-Width
2207	Au (g/t)	226	0	74.14	10.18	1.13	Mix of 1.5 + Full-Width
2208	Au (g/t)	109	0	99.94	7.76	1.67	Full-Width
2210	Au (g/t)	55	0	20.21	2.34	1.6	Full-Width
2211	Au (g/t)	81	0	57.63	7.04	1.26	Mix of 1.5 + Full-Width
2212	Au (g/t)	35	0	15.71	3.14	1.16	Full-Width
2213	Au (g/t)	51	0.03	11.42	3.2	0.85	Full-Width
2214	Au (g/t)	55	0	10.41	1.44	1.62	Mix of 1.5 + Full-Width
2215	Au (g/t)	90	0	77.08	7.52	2.4	Mix of 1.5 + Full-Width
2216	Au (g/t)	133	0	30.13	3.31	1.77	Full-Width
2217	Au (g/t)	35	0	13.43	1.48	2	Full-Width
2218	Au (g/t)	25	0	12.84	1.8	1.62	Full-Width

Domain	Variable and Unit	No. of Composites*	Min (g/t Au)	Max (g/t Au)	Mean (g/t Au)	CV	Composite Length (m)
2219	Au (g/t)	30	0	17.69	3.22	1.32	Full-Width
2221	Au (g/t)	275	0	38.62	2.78	2.05	1.5
2222	Au (g/t)	26	0.01	32.25	4.35	1.7	Full-Width
2223	Au (g/t)	35	0	14.05	1.5	1.77	Full-Width
2224	Au (g/t)	42	0.01	6.82	0.71	1.77	Full-Width
2225	Au (g/t)	50	0.01	16	2.13	1.56	Full-Width
2501	Au (g/t)	228	0	72.68	7.45	1.44	Full-Width
2502	Au (g/t)	199	0	82.8	7.72	1.77	Full-Width
2503	Au (g/t)	175	0	20	1.78	1.9	Full-Width
2505	Au (g/t)	118	0	175	11.7	1.81	Mix of 1.5 + Full-Width
2506	Au (g/t)	145	0	45	5.74	1.71	Full-Width
2507	Au (g/t)	135	0	25.14	3.77	1.51	Full-Width
2510	Au (g/t)	60	0	56.92	7.51	1.56	Full-Width
2511	Au (g/t)	40	0	20.47	2.48	1.89	Full-Width
2512	Au (g/t)	37	0.01	6.97	0.69	2.42	Full-Width
2513	Au (g/t)	14	0	9.42	1.66	1.63	Full-Width
2514	Au (g/t)	5	0.06	20.14	10.76	0.71	Full-Width
2515	Au (g/t)	87	0	9.25	0.98	1.78	Full-Width
2521	Au (g/t)	174	0	31.62	3.55	1.48	Full-Width
2522	Au (g/t)	72	0	23.56	2.76	1.68	Full-Width
2523	Au (g/t)	100	0	14.52	1.71	1.64	Full-Width
2524	Au (g/t)	51	0.01	9.62	1.18	1.67	Full-Width
2525	Au (g/t)	46	0	24.98	1.56	2.63	Full-Width
3202	Au (g/t)	63	0	10	1.19	1.45	Full-Width
3203	Au (g/t)	52	0	12.47	1.47	1.75	Full-Width
3204	Au (g/t)	40	0	7.45	1.4	1.28	Full-Width
3301	Au (g/t)	106	0	12.26	1.43	1.69	Full-Width
3302	Au (g/t)	80	0	17.54	3.06	1.03	Mix of 1.5 + Full-Width
3303	Au (g/t)	116	0	7.07	0.81	1.71	Full-Width
3305	Au (g/t)	26	0	7.39	1.14	1.55	Full-Width
3306	Au (g/t)	174	0	25.29	4.18	1.37	1.5
3307	Au (g/t)	38	0	12.23	2.34	1.32	Full-Width
3308	Au (g/t)	53	0	18.87	2.06	1.56	Full-Width
3309	Au (g/t)	70	0	15.92	1.59	1.83	Full-Width
3311	Au (g/t)	120	0	11.1	1.19	1.92	Full-Width

Domain	Variable and Unit	No. of Composites*	Min (g/t Au)	Max (g/t Au)	Mean (g/t Au)	CV	Composite Length (m)
3312	Au (g/t)	17	0.01	5.24	1.39	1.22	Full-Width
3402	Au (g/t)	15	0	7.69	2.28	1.27	Full-Width
3404	Au (g/t)	30	0.01	10.29	2.48	1.04	Full-Width
3601	Au (g/t)	386	0	20	1.8	1.52	Full-Width
3602	Au (g/t)	392	0	24.81	2.67	1.45	Full-Width
3604	Au (g/t)	19	0	10.75	1.69	1.61	Full-Width
3605	Au (g/t)	41	0	26.73	3.08	1.63	Full-Width
3607	Au (g/t)	88	0	16.88	1.81	1.65	Full-Width
3610	Au (g/t)	40	0.01	13.34	2.31	1.18	Full-Width
3611	Au (g/t)	228	0	18.84	1.79	1.68	Full-Width
3612	Au (g/t)	262	0	20.17	2.21	1.57	Full-Width
3614	Au (g/t)	142	0	18.45	2.04	1.53	Mix of 1.5 + Full-Width
3615	Au (g/t)	53	0.01	6.1	1.49	1.04	Full-Width
3616	Au (g/t)	26	0	6.42	1.23	1.44	Full-Width
3618	Au (g/t)	34	0	7.48	1.47	1.45	Full-Width
3619	Au (g/t)	42	0	8.77	1.6	1.29	Full-Width
3651	Au (g/t)	114	0	35	3.67	1.38	Full-Width
3652	Au (g/t)	43	0.01	8.54	2.16	1.1	Full-Width
3653	Au (g/t)	70	0	10.72	2.13	1.1	Full-Width
3705	Au (g/t)	120	0	10.99	1.7	1.43	Full-Width
3706	Au (g/t)	36	0	18.4	2.06	1.81	Full-Width
4101	Au (g/t)	160	0	8.97	1.26	1.45	Full-Width
4102	Au (g/t)	39	0	20	1.77	2.24	Full-Width
4103	Au (g/t)	60	0	12.51	2.51	1.05	Full-Width
4111	Au (g/t)	45	0	9.76	0.87	2.28	Full-Width
4112	Au (g/t)	66	0	9.26	1.32	1.58	Full-Width
4113	Au (g/t)	34	0	15	2.09	1.77	Full-Width
5101	Au (g/t)	63	0	9.14	1.66	1.6	Full-Width
5102	Au (g/t)	91	0	20	1.47	2.41	Full-Width
5301	Au (g/t)	38	0	20.67	3.59	1.57	Full-Width
5302	Au (g/t)	275	0	12	0.79	2.52	Full-Width
5601	Au (g/t)	4	0.11	13.06	3.4	1.89	Full-Width
12801	Au (g/t)	1,132	0	12	0.67	1.96	1.5
12802	Au (g/t)	238	0	7.54	0.65	1.88	1.5
12803	Au (g/t)	1,096	0	10.52	0.36	2.54	1.5

Domain	Variable and Unit	No. of Composites*	Min (g/t Au)	Max (g/t Au)	Mean (g/t Au)	CV	Composite Length (m)
12804	Au (g/t)	2,320	0	9.09	0.24	2.52	1.5
12805	Au (g/t)	1,187	0	12	0.44	2.71	1.5
13701	Au (g/t)	2,709	0	12	0.25	3.72	1.5
13702	Au (g/t)	2,538	0	12	0.37	2.83	1.5
14801	Au (g/t)	864	0	11.87	0.87	1.7	1.5
14802	Au (g/t)	366	0.01	12	0.54	2.22	1.5
15701	Au (g/t)	233	0	5.39	0.31	2.49	1.5
15702	Au (g/t)	86	0	1.73	0.14	2.37	1.5
Dilution	Au (g/t)	21,116	0	222.47	0.16	10.05	1.5

TREND ANALYSIS

Analysis of grade trends was performed on mineralization by inspecting grade trends in the block model and variography. Variogram models were interpreted from the experimental variograms and used to inform search parameters, classification decisions, and for validation purposes.

A summary of the Boston variogram models is provided in Table 14-37.

Table 14-37. Boston Variogram Models

TMAC Resources Inc. – Hope Bay Project

Domain	**Boston Wireframe Domains**									
	2121 to 2125, 2221 to 2225, 2523	2101 to 2104, 2106 to 2108, 2111, 2201, 2202, 2204, 2205 to 2208, 2211 to 2219, 2505	2112, 2113, 2203, 2210	2501, 2502, 2503, 2506, 2507, 2513, 2514, 2522, 2524, 2525	3202 to 3204, 3307, 3404	3301, 3303, 3305, 3306, 3308, 3309, 3311, 3312, 3614, 3615, 3616, 3618, 3653, 3705	3402, 3601, 3602, 3604, 3605, 3611, 3612, 3619, 3706	4101, 4102, 4103	5102, 5301, 5302	13701, 13702
Angle1	-75	-75	120	-55	-70	-50	105	95	140	-75
Angle2	85	80	95	90	95	95	95	100	80	85
Angle3	-155	-105	-50	-110	-110	-105	-60	-75	-75	-105
Axis1	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
Axis2	X	X	X	X	X	X	X	X	X	X
Axis3	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
Nugget	0.35	0.25	0.40	0.36	0.40	0.40	0.35	0.40	0.30	0.29
Sill(st1)	0.41	0.60	0.24	0.38	0.26	0.30	0.33	0.37	0.39	0.52
Range1(st1)	58	20	27	25	34	35	21	40	59	9
Range2(st1)	24	11	21	16	12	16	16	20	27	8
Range3(st1)	5	7	4	7	2	11	6	11	10	8
Type(st1)	Spherical	Spherical	Spherical	Spherical	Spherical	Spherical	Spherical	Spherical	Spherical	Spherical
Sill(st2)	0.24	0.15	0.36	0.26	0.34	0.30	0.32	0.23	0.31	0.19
Range1(st2)	79	197	47	46	61	52	89	72	67	31
Range2(st2)	36	93	29	33	23	33	44	46	38	21

Domain	Boston Wireframe Domains									
	2121 to 2125, 2221 to 2225, 2523	2101 to 2104, 2106 to 2108, 2111, 2201, 2202, 2204, 2205 to 2208, 2211 to 2219, 2505	2112, 2113, 2203, 2210	2501, 2502, 2503, 2506, 2507, 2513, 2514, 2522, 2524, 2525	3202 to 3204, 3307, 3404	3301, 3303, 3305, 3306, 3308, 3309, 3311, 3312, 3614, 3615, 3616, 3618, 3653, 3705	3402, 3601, 3602, 3604, 3605, 3611, 3612, 3619, 3706	4101, 4102, 4103	5102, 5301, 5302	13701, 13702
Range3(st2)	7	27	9	16	8	16	12	16	13	22
Type(st2)	Spherical	Spherical	Spherical	Spherical	Spherical	Spherical	Spherical	Spherical	Spherical	Spherical

BULK DENSITY

Bulk density values were assigned based on rock type and mineralization zones. A summary of the bulk densities assigned to blocks is provided in Table 14-38.

Table 14-38. Boston Bulk Density Assignment

TMAC Resources Inc. – Hope Bay Project

Domain	Bulk Density (t/m^3)
Mineralized Dilution	2.88
Mineralized Picrite Envelope	2.90
Mineralized Picrite Zone	2.92
Mineralized Vein Zone	2.87
Waste – Late Felsic Dikes	2.82
Waste – South Gabbro	2.87
Waste – Crackle Breccia	2.88
Waste – Finely Pillowed MV	2.86
Waste – MV Transition Breccia	2.88
Waste – MV Variolite	2.88
Waste – Picrite	2.88
Waste – Seds Argillite	2.87
Waste – Seds Transition Breccia	2.83
Waste – Seds Wacke	2.78

BLOCK MODELS

Block model dimensions and setups have been selected based on the proposed scale of mining, with consideration given to the available data and complexity of the mineralization wireframes. Parent blocks were split into sub-cells at wireframe boundaries, with the minimum sub-cell size set to 0.5 m with the intention of minimizing the variance between wireframe and block volumes while maintaining a manageable block model file size.

The Boston block model prototype is presented in Table 14-39.

Table 14-39. Boston Block Model Prototype

TMAC Resources Inc. – Hope Bay Project

Domain	Model Name	XINC	YINC	ZINC	XMORIG	YMORIG	ZMORIG	NX	NY	NZ
Boston All	boston_final.dm	1.5	3	3	440,890	7,503,120	-1,100	444	876	402

SEARCH STRATEGY AND GRADE INTERPOLATION PARAMETERS

Grade was interpolated using ID3, with NN also estimated for validation purposes. Dynamic anisotropy was used for all zones, with anisotropy angles extracted from hanging wall and footwall surfaces in Datamine and estimated into the blocks using ID2. Appropriate transformations were used to prevent angles from being mis-assigned in overturned sections of the model. Plunge directions for each zone were also assigned based on variography, on geologic relationships, and on visual inspection of composites and grade contours (produced for each zone in Leapfrog).

A summary of the search strategy and interpolation parameters is provided in Table 14-40 and Table 14-41.

Table 14-40. Boston Search Strategy and Interpolation Parameters

TMAC Resources Inc. – Hope Bay Project

Zone	Interpolation Method	Major (m)	Semi-Major (m)	Minor (m)	Minimum/ Maximum (Full-Width)	Major (m)	Semi-Major (m)	Minor (m)	Minimum/ Maximum (Full-Width)	Major (m)	Semi-Major (m)	Minor (m)	Minimum/ Maximum (Full-Width)	Max per hole (Full-Width)
2101	ID^3	55	22	8	2 / 4 (3 / 8)	110	44	16	2 / 4 (3 / 8)	220	88	32	1 / 4 (2 / 8)	1
2102	ID^3	55	22	8	2 / 4 (3 / 8)	110	44	16	2 / 4 (3 / 8)	220	88	32	1 / 4 (2 / 8)	1
2103	ID^3	55	22	8	2 / 4 (3 / 8)	110	44	16	2 / 4 (3 / 8)	220	88	32	1 / 4 (2 / 8)	1
2104	ID^3	55	22	8	2 / 4 (3 / 8)	110	44	16	2 / 4 (3 / 8)	220	88	32	1 / 4 (2 / 8)	1
2105	ID^3	55	22	8	2 / 4 (3 / 8)	110	44	16	2 / 4 (3 / 8)	220	88	32	1 / 4 (2 / 8)	1
2106	ID^3	55	22	8	2 / 4 (3 / 8)	110	44	16	2 / 4 (3 / 8)	220	88	32	1 / 4 (2 / 8)	2 (1)
2107	ID^3	55	22	8	2 / 4 (3 / 8)	110	44	16	2 / 4 (3 / 8)	220	88	32	1 / 4 (2 / 8)	1
2108	ID^3	55	22	8	2 / 4 (3 / 8)	110	44	16	2 / 4 (3 / 8)	220	88	32	1 / 4 (2 / 8)	2
2111	ID^3	55	22	8	2 / 4 (3 / 8)	110	44	16	2 / 4 (3 / 8)	220	88	32	1 / 4 (2 / 8)	1
2112	ID^3	45	25	9	2 / 4 (3 / 8)	90	50	18	2 / 4 (3 / 8)	180	100	36	1 / 4 (2 / 8)	2 (1)
2113	ID^3	45	25	9	2 / 4 (3 / 8)	90	50	18	2 / 4 (3 / 8)	180	100	36	1 / 4 (2 / 8)	1
2121	ID^3	60	20	6	2 / 4 (3 / 8)	120	40	12	2 / 4 (3 / 8)	240	80	24	1 / 4 (2 / 8)	1
2122	ID^3	60	20	6	2 / 4 (3 / 8)	120	40	12	2 / 4 (3 / 8)	240	80	24	1 / 4 (2 / 8)	1
2123	ID^3	60	20	6	2 / 4 (3 / 8)	120	40	12	2 / 4 (3 / 8)	240	80	24	1 / 4 (2 / 8)	1
2124	ID^3	60	20	6	2 / 4 (3 / 8)	120	40	12	2 / 4 (3 / 8)	240	80	24	1 / 4 (2 / 8)	1
2125	ID^3	60	20	6	2 / 4 (3 / 8)	120	40	12	2 / 4 (3 / 8)	240	80	24	1 / 4 (2 / 8)	1
2201	ID^3	55	22	8	2 / 4 (3 / 8)	110	44	16	2 / 4 (3 / 8)	220	88	32	1 / 4 (2 / 8)	1
2202	ID^3	55	22	8	2 / 4 (3 / 8)	110	44	16	2 / 4 (3 / 8)	220	88	32	1 / 4 (2 / 8)	2 (1)
2203	ID^3	45	25	9	2 / 4 (3 / 8)	90	50	18	2 / 4 (3 / 8)	180	100	36	1 / 4 (2 / 8)	1
2204	ID^3	55	22	8	2 / 4 (3 / 8)	110	44	16	2 / 4 (3 / 8)	220	88	32	1 / 4 (2 / 8)	2 (1)

Zone	Interpolation Method	Major (m)	Semi-Major (m)	Minor (m)	Minimum/ Maximum (Full-Width)	Major (m)	Semi-Major (m)	Minor (m)	Minimum/ Maximum (Full-Width)	Major (m)	Semi-Major (m)	Minor (m)	Minimum/ Maximum (Full-Width)	Max per hole (Full-Width)
2205	ID^3	55	22	8	2 / 4 (3 / 8)	110	44	16	2 / 4 (3 / 8)	220	88	32	1 / 4 (2 / 8)	1
2206	ID^3	55	22	8	2 / 4 (3 / 8)	110	44	16	2 / 4 (3 / 8)	220	88	32	1 / 4 (2 / 8)	1
2207	ID^3	55	22	8	2 / 4 (3 / 8)	110	44	16	2 / 4 (3 / 8)	220	88	32	1 / 4 (2 / 8)	2 (1)
2208	ID^3	55	22	8	2 / 4 (3 / 8)	110	44	16	2 / 4 (3 / 8)	220	88	32	1 / 4 (2 / 8)	1
2210	ID^3	45	25	9	2 / 4 (3 / 8)	90	50	18	2 / 4 (3 / 8)	180	100	36	1 / 4 (2 / 8)	1
2211	ID^3	55	22	8	2 / 4 (3 / 8)	110	44	16	2 / 4 (3 / 8)	220	88	32	1 / 4 (2 / 8)	2 (1)
2212	ID^3	55	22	8	2 / 4 (3 / 8)	110	44	16	2 / 4 (3 / 8)	220	88	32	1 / 4 (2 / 8)	1
2213	ID^3	55	22	8	2 / 4 (3 / 8)	110	44	16	2 / 4 (3 / 8)	220	88	32	1 / 4 (2 / 8)	1
2214	ID^3	55	22	8	2 / 4 (3 / 8)	110	44	16	2 / 4 (3 / 8)	220	88	32	1 / 4 (2 / 8)	2 (1)
2215	ID^3	55	22	8	2 / 4 (3 / 8)	110	44	16	2 / 4 (3 / 8)	220	88	32	1 / 4 (2 / 8)	2 (1)
2216	ID^3	55	22	8	2 / 4 (3 / 8)	110	44	16	2 / 4 (3 / 8)	220	88	32	1 / 4 (2 / 8)	1
2217	ID^3	55	22	8	2 / 4 (3 / 8)	110	44	16	2 / 4 (3 / 8)	220	88	32	1 / 4 (2 / 8)	1
2218	ID^3	55	22	8	2 / 4 (3 / 8)	110	44	16	2 / 4 (3 / 8)	220	88	32	1 / 4 (2 / 8)	1
2219	ID^3	55	22	8	2 / 4 (3 / 8)	110	44	16	2 / 4 (3 / 8)	220	88	32	1 / 4 (2 / 8)	1
2221	ID^3	60	20	6	2 / 4 (3 / 8)	120	40	12	2 / 4 (3 / 8)	240	80	24	1 / 4 (2 / 8)	2
2222	ID^3	60	20	6	2 / 4 (3 / 8)	120	40	12	2 / 4 (3 / 8)	240	80	24	1 / 4 (2 / 8)	1
2223	ID^3	55	22	8	2 / 4 (3 / 8)	110	44	16	2 / 4 (3 / 8)	220	88	32	1 / 4 (2 / 8)	1
2224	ID^3	60	20	6	2 / 4 (3 / 8)	120	40	12	2 / 4 (3 / 8)	240	80	24	1 / 4 (2 / 8)	1
2225	ID^3	60	20	6	2 / 4 (3 / 8)	120	40	12	2 / 4 (3 / 8)	240	80	24	1 / 4 (2 / 8)	1
2501	ID^3	55	22	8	2 / 4 (3 / 8)	110	44	16	2 / 4 (3 / 8)	220	88	32	1 / 4 (2 / 8)	1
2502	ID^3	55	22	8	2 / 4 (3 / 8)	110	44	16	2 / 4 (3 / 8)	220	88	32	1 / 4 (2 / 8)	1
2503	ID^3	55	22	8	2 / 4 (3 / 8)	110	44	16	2 / 4 (3 / 8)	220	88	32	1 / 4 (2 / 8)	1
2505	ID^3	55	22	8	2 / 4 (3 / 8)	110	44	16	2 / 4 (3 / 8)	220	88	32	1 / 4 (2 / 8)	2 (1)

Zone	Interpolation Method	Major (m)	Semi-Major (m)	Minor (m)	Minimum/ Maximum (Full-Width)	Major (m)	Semi-Major (m)	Minor (m)	Minimum/ Maximum (Full-Width)	Major (m)	Semi-Major (m)	Minor (m)	Minimum/ Maximum (Full-Width)	Max per hole (Full-Width)
2506	ID^3	55	22	8	2 / 4 (3 / 8)	110	44	16	2 / 4 (3 / 8)	220	88	32	1 / 4 (2 / 8)	1
2507	ID^3	55	22	8	2 / 4 (3 / 8)	110	44	16	2 / 4 (3 / 8)	220	88	32	1 / 4 (2 / 8)	1
2510	ID^3	45	25	9	2 / 4 (3 / 8)	90	50	18	2 / 4 (3 / 8)	180	100	36	1 / 4 (2 / 8)	1
2511	ID^3	45	25	9	2 / 4 (3 / 8)	90	50	18	2 / 4 (3 / 8)	180	100	36	1 / 4 (2 / 8)	1
2512	ID^3	45	25	9	2 / 4 (3 / 8)	90	50	18	2 / 4 (3 / 8)	180	100	36	1 / 4 (2 / 8)	1
2513	ID^3	55	22	8	2 / 4 (3 / 8)	110	44	16	2 / 4 (3 / 8)	220	88	32	1 / 4 (2 / 8)	1
2514	ID^3	55	22	8	2 / 4 (3 / 8)	110	44	16	2 / 4 (3 / 8)	220	88	32	1 / 4 (2 / 8)	1
2515	ID^3	45	25	9	2 / 4 (3 / 8)	90	50	18	2 / 4 (3 / 8)	180	100	36	1 / 4 (2 / 8)	1
2521	ID^3	45	25	9	2 / 4 (3 / 8)	90	50	18	2 / 4 (3 / 8)	180	100	36	1 / 4 (2 / 8)	1
2522	ID^3	45	25	9	2 / 4 (3 / 8)	90	50	18	2 / 4 (3 / 8)	180	100	36	1 / 4 (2 / 8)	1
2523	ID^3	60	20	6	2 / 4 (3 / 8)	120	40	12	2 / 4 (3 / 8)	240	80	24	1 / 4 (2 / 8)	1
2524	ID^3	45	25	9	2 / 4 (3 / 8)	90	50	18	2 / 4 (3 / 8)	180	100	36	1 / 4 (2 / 8)	1
2525	ID^3	45	25	9	2 / 4 (3 / 8)	90	50	18	2 / 4 (3 / 8)	180	100	36	1 / 4 (2 / 8)	1
3202	ID^3	60	20	6	2 / 4 (3 / 8)	120	40	12	2 / 4 (3 / 8)	240	80	24	1 / 4 (2 / 8)	1
3203	ID^3	60	20	6	2 / 4 (3 / 8)	120	40	12	2 / 4 (3 / 8)	240	80	24	1 / 4 (2 / 8)	1
3204	ID^3	60	20	6	2 / 4 (3 / 8)	120	40	12	2 / 4 (3 / 8)	240	80	24	1 / 4 (2 / 8)	1
3301	ID^3	50	25	7	2 / 4 (3 / 8)	100	50	14	2 / 4 (3 / 8)	200	100	28	1 / 4 (2 / 8)	1
3302	ID^3	45	25	9	2 / 4 (3 / 8)	90	50	18	2 / 4 (3 / 8)	180	100	36	1 / 4 (2 / 8)	2 (1)
3303	ID^3	50	25	7	2 / 4 (3 / 8)	100	50	14	2 / 4 (3 / 8)	200	100	28	1 / 4 (2 / 8)	1
3305	ID^3	50	25	7	2 / 4 (3 / 8)	100	50	14	2 / 4 (3 / 8)	200	100	28	1 / 4 (2 / 8)	1
3306	ID^3	50	25	7	2 / 4 (3 / 8)	100	50	14	2 / 4 (3 / 8)	200	100	28	1 / 4 (2 / 8)	2
3307	ID^3	60	20	6	2 / 4 (3 / 8)	120	40	12	2 / 4 (3 / 8)	240	80	24	1 / 4 (2 / 8)	1
3308	ID^3	50	25	7	2 / 4 (3 / 8)	100	50	14	2 / 4 (3 / 8)	200	100	28	1 / 4 (2 / 8)	1

Zone	Interpolation Method	Major (m)	Semi-Major (m)	Minor (m)	Minimum/ Maximum (Full-Width)	Major (m)	Semi-Major (m)	Minor (m)	Minimum/ Maximum (Full-Width)	Major (m)	Semi-Major (m)	Minor (m)	Minimum/ Maximum (Full-Width)	Max per hole (Full-Width)
3309	ID^3	50	25	7	2 / 4 (3 / 8)	100	50	14	2 / 4 (3 / 8)	200	100	28	1 / 4 (2 / 8)	1
3311	ID^3	50	25	7	2 / 4 (3 / 8)	100	50	14	2 / 4 (3 / 8)	200	100	28	1 / 4 (2 / 8)	1
3312	ID^3	50	25	7	2 / 4 (3 / 8)	100	50	14	2 / 4 (3 / 8)	200	100	28	1 / 4 (2 / 8)	1
3402	ID^3	50	25	7	2 / 4 (3 / 8)	100	50	14	2 / 4 (3 / 8)	200	100	28	1 / 4 (2 / 8)	1
3404	ID^3	60	20	6	2 / 4 (3 / 8)	120	40	12	2 / 4 (3 / 8)	240	80	24	1 / 4 (2 / 8)	1
3601	ID^3	50	25	7	2 / 4 (3 / 8)	100	50	14	2 / 4 (3 / 8)	200	100	28	1 / 4 (2 / 8)	1
3602	ID^3	50	25	7	2 / 4 (3 / 8)	100	50	14	2 / 4 (3 / 8)	200	100	28	1 / 4 (2 / 8)	1
3604	ID^3	50	25	7	2 / 4 (3 / 8)	100	50	14	2 / 4 (3 / 8)	200	100	28	1 / 4 (2 / 8)	1
3605	ID^3	50	25	7	2 / 4 (3 / 8)	100	50	14	2 / 4 (3 / 8)	200	100	28	1 / 4 (2 / 8)	1
3607	ID^3	50	25	7	2 / 4 (3 / 8)	100	50	14	2 / 4 (3 / 8)	200	100	28	1 / 4 (2 / 8)	1
3610	ID^3	50	25	7	2 / 4 (3 / 8)	100	50	14	2 / 4 (3 / 8)	200	100	28	1 / 4 (2 / 8)	1
3611	ID^3	50	25	7	2 / 4 (3 / 8)	100	50	14	2 / 4 (3 / 8)	200	100	28	1 / 4 (2 / 8)	1
3612	ID^3	50	25	7	2 / 4 (3 / 8)	100	50	14	2 / 4 (3 / 8)	200	100	28	1 / 4 (2 / 8)	1
3614	ID^3	50	25	7	2 / 4 (3 / 8)	100	50	14	2 / 4 (3 / 8)	200	100	28	1 / 4 (2 / 8)	2 (1)
3615	ID^3	50	25	7	2 / 4 (3 / 8)	100	50	14	2 / 4 (3 / 8)	200	100	28	1 / 4 (2 / 8)	1
3616	ID^3	50	25	7	2 / 4 (3 / 8)	100	50	14	2 / 4 (3 / 8)	200	100	28	1 / 4 (2 / 8)	1
3618	ID^3	50	25	7	2 / 4 (3 / 8)	100	50	14	2 / 4 (3 / 8)	200	100	28	1 / 4 (2 / 8)	1
3619	ID^3	50	25	7	2 / 4 (3 / 8)	100	50	14	2 / 4 (3 / 8)	200	100	28	1 / 4 (2 / 8)	1
3651	ID^3	50	25	7	2 / 4 (3 / 8)	100	50	14	2 / 4 (3 / 8)	200	100	28	1 / 4 (2 / 8)	1
3652	ID^3	50	25	7	2 / 4 (3 / 8)	100	50	14	2 / 4 (3 / 8)	200	100	28	1 / 4 (2 / 8)	1
3653	ID^3	50	25	7	2 / 4 (3 / 8)	100	50	14	2 / 4 (3 / 8)	200	100	28	1 / 4 (2 / 8)	1
3705	ID^3	50	25	7	2 / 4 (3 / 8)	100	50	14	2 / 4 (3 / 8)	200	100	28	1 / 4 (2 / 8)	1
3706	ID^3	50	25	7	2 / 4 (3 / 8)	100	50	14	2 / 4 (3 / 8)	200	100	28	1 / 4 (2 / 8)	1

Zone	Interpolation Method	Major (m)	Semi-Major (m)	Minor (m)	Minimum/ Maximum (Full-Width)	Major (m)	Semi-Major (m)	Minor (m)	Minimum/ Maximum (Full-Width)	Major (m)	Semi-Major (m)	Minor (m)	Minimum/ Maximum (Full-Width)	Max per hole (Full-Width)
4101	ID^3	45	25	9	2 / 4 (3 / 8)	90	50	18	2 / 4 (3 / 8)	180	100	36	1 / 4 (2 / 8)	1
4102	ID^3	45	25	9	2 / 4 (3 / 8)	90	50	18	2 / 4 (3 / 8)	180	100	36	1 / 4 (2 / 8)	1
4103	ID^3	45	25	9	2 / 4 (3 / 8)	90	50	18	2 / 4 (3 / 8)	180	100	36	1 / 4 (2 / 8)	1
4111	ID^3	45	25	9	2 / 4 (3 / 8)	90	50	18	2 / 4 (3 / 8)	180	100	36	1 / 4 (2 / 8)	1
4112	ID^3	45	25	9	2 / 4 (3 / 8)	90	50	18	2 / 4 (3 / 8)	180	100	36	1 / 4 (2 / 8)	1
4113	ID^3	45	25	9	2 / 4 (3 / 8)	90	50	18	2 / 4 (3 / 8)	180	100	36	1 / 4 (2 / 8)	1
5101	ID^3	55	22	8	2 / 4 (3 / 8)	110	44	16	2 / 4 (3 / 8)	220	88	32	1 / 4 (2 / 8)	1
5102	ID^3	55	22	8	2 / 4 (3 / 8)	110	44	16	2 / 4 (3 / 8)	220	88	32	1 / 4 (2 / 8)	1
5301	ID^3	55	22	8	2 / 4 (3 / 8)	110	44	16	2 / 4 (3 / 8)	220	88	32	1 / 4 (2 / 8)	1
5302	ID^3	55	22	8	2 / 4 (3 / 8)	110	44	16	2 / 4 (3 / 8)	220	88	32	1 / 4 (2 / 8)	1
5601	ID^3	45	25	9	2 / 4 (3 / 8)	90	50	18	2 / 4 (3 / 8)	180	100	36	1 / 4 (2 / 8)	1
12801	ID^3	55	22	8	2 / 4 (3 / 8)	110	44	16	2 / 4 (3 / 8)	220	88	32	1 / 4 (2 / 8)	2
12802	ID^3	55	22	8	2 / 4 (3 / 8)	110	44	16	2 / 4 (3 / 8)	220	88	32	1 / 4 (2 / 8)	2
12803	ID^3	55	22	8	2 / 4 (3 / 8)	110	44	16	2 / 4 (3 / 8)	220	88	32	1 / 4 (2 / 8)	2
12804	ID^3	55	22	8	2 / 4 (3 / 8)	110	44	16	2 / 4 (3 / 8)	220	88	32	1 / 4 (2 / 8)	2
12805	ID^3	55	22	8	2 / 4 (3 / 8)	110	44	16	2 / 4 (3 / 8)	220	88	32	1 / 4 (2 / 8)	2
13701	ID^3	45	25	9	2 / 4 (3 / 8)	90	50	18	2 / 4 (3 / 8)	180	100	36	1 / 4 (2 / 8)	2
13702	ID^3	45	25	9	2 / 4 (3 / 8)	90	50	18	2 / 4 (3 / 8)	180	100	36	1 / 4 (2 / 8)	2
14801	ID^3	45	25	9	2 / 4 (3 / 8)	90	50	18	2 / 4 (3 / 8)	180	100	36	1 / 4 (2 / 8)	2
14802	ID^3	45	25	9	2 / 4 (3 / 8)	90	50	18	2 / 4 (3 / 8)	180	100	36	1 / 4 (2 / 8)	2
15701	ID^3	45	25	9	2 / 4 (3 / 8)	90	50	18	2 / 4 (3 / 8)	180	100	36	1 / 4 (2 / 8)	2
15702	ID^3	45	25	9	2 / 4 (3 / 8)	90	50	18	2 / 4 (3 / 8)	180	100	36	1 / 4 (2 / 8)	2
Dilution	ID^3	45	25	9	2 / 4 (3 / 8)	90	50	18	2 / 4 (3 / 8)	180	100	36	1 / 4 (2 / 8)	2

CLASSIFICATION

Definitions for resource categories used in this report are consistent with those defined by CIM (2014) and adopted by NI 43-101. See the Doris Classification subsection for further details.

The classification assigned to individual areas is given Table 14-41, and is shown in Figure 14-54.

Table 14-41. Boston Classification

TMAC Resources Inc. – Hope Bay Project

DDH spacing for 90% of the Tonnes			
Domain	**Measured**	**Indicated**	**Inferred**
Boston	<10m	<30m	<80m

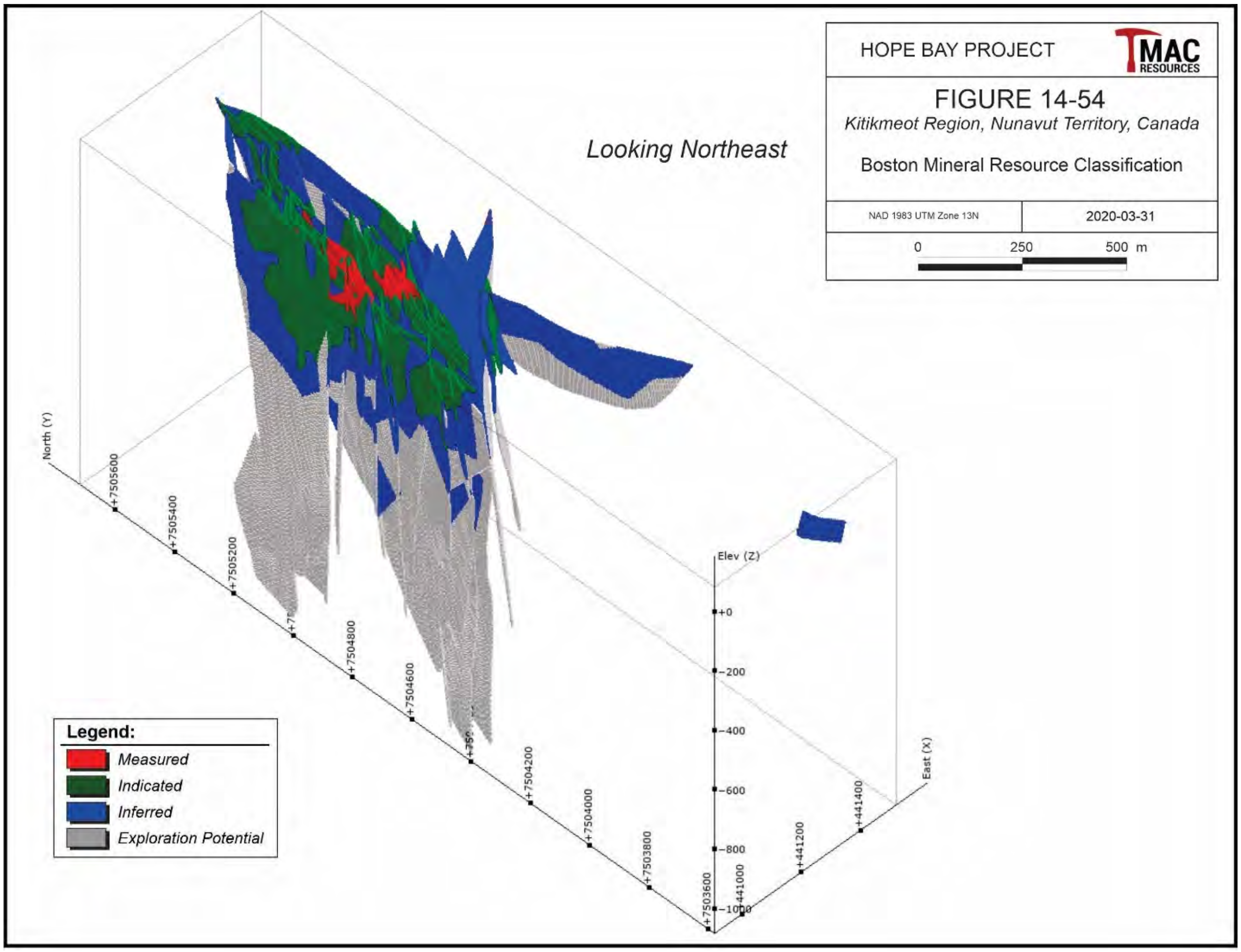


Figure 14-54. Boston Mineral Resource Classification

BLOCK MODEL VALIDATION

Blocks were validated using industry standard techniques including:

- Visual inspection of composite versus block grades (Figure 14-55)
- Comparison between ID, NN and composite means (Figure 14-56)
- Swath plots (Figure 14-57)

The QP is of the opinion that the Boston Mineral Resource estimates validate well and are appropriate for the public disclosure of Mineral Resources and the estimation of Mineral Reserves.

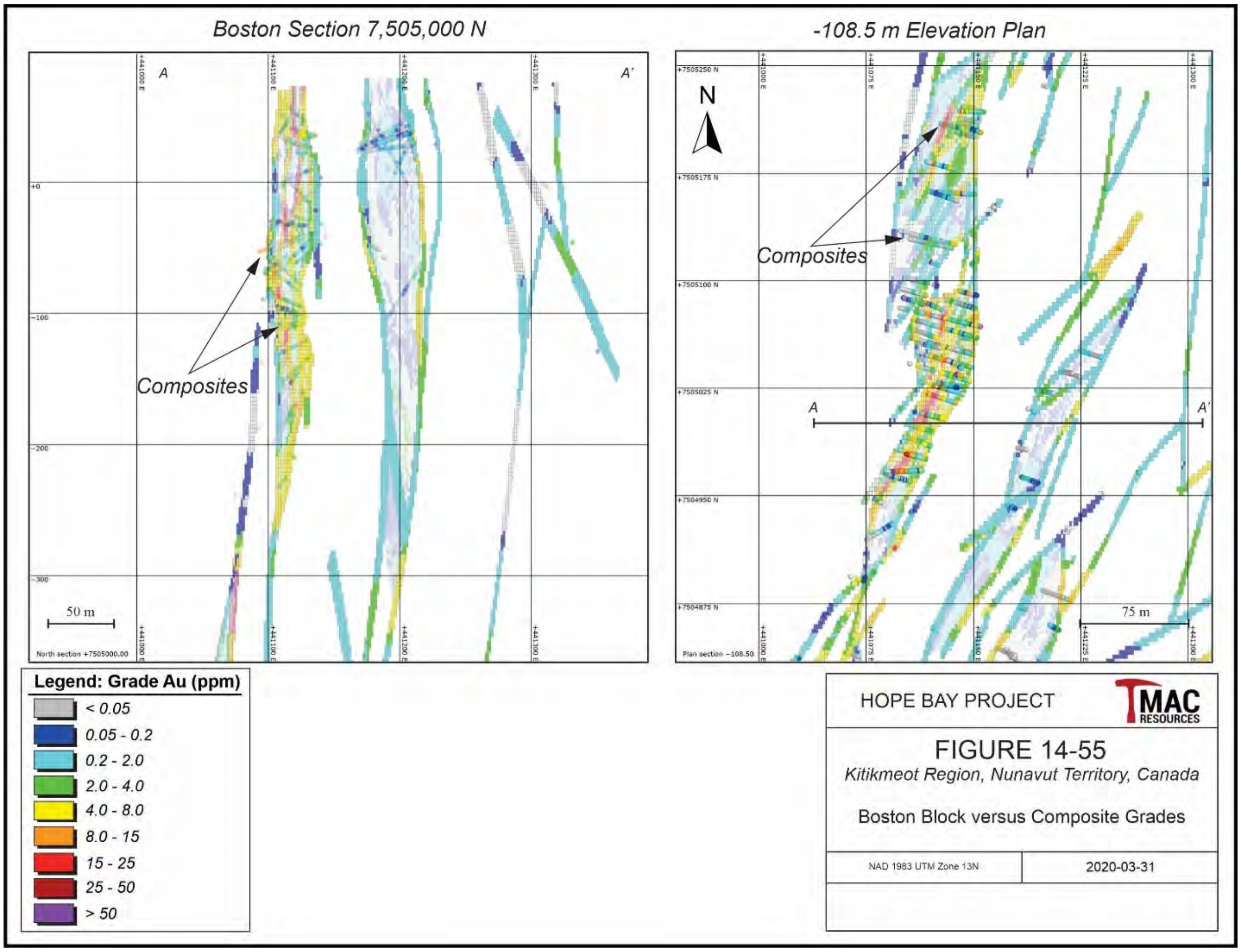


Figure 14-55. Boston Block vs. Composite Grades

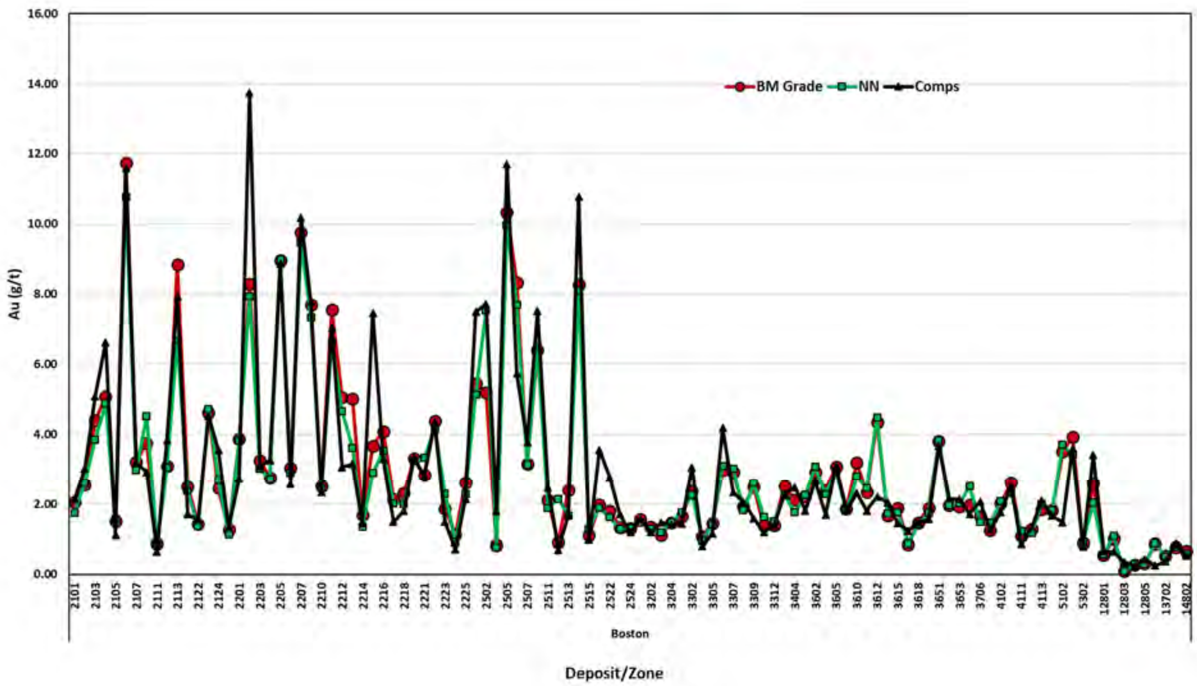


Figure 14-56. Boston Comparison Between Means

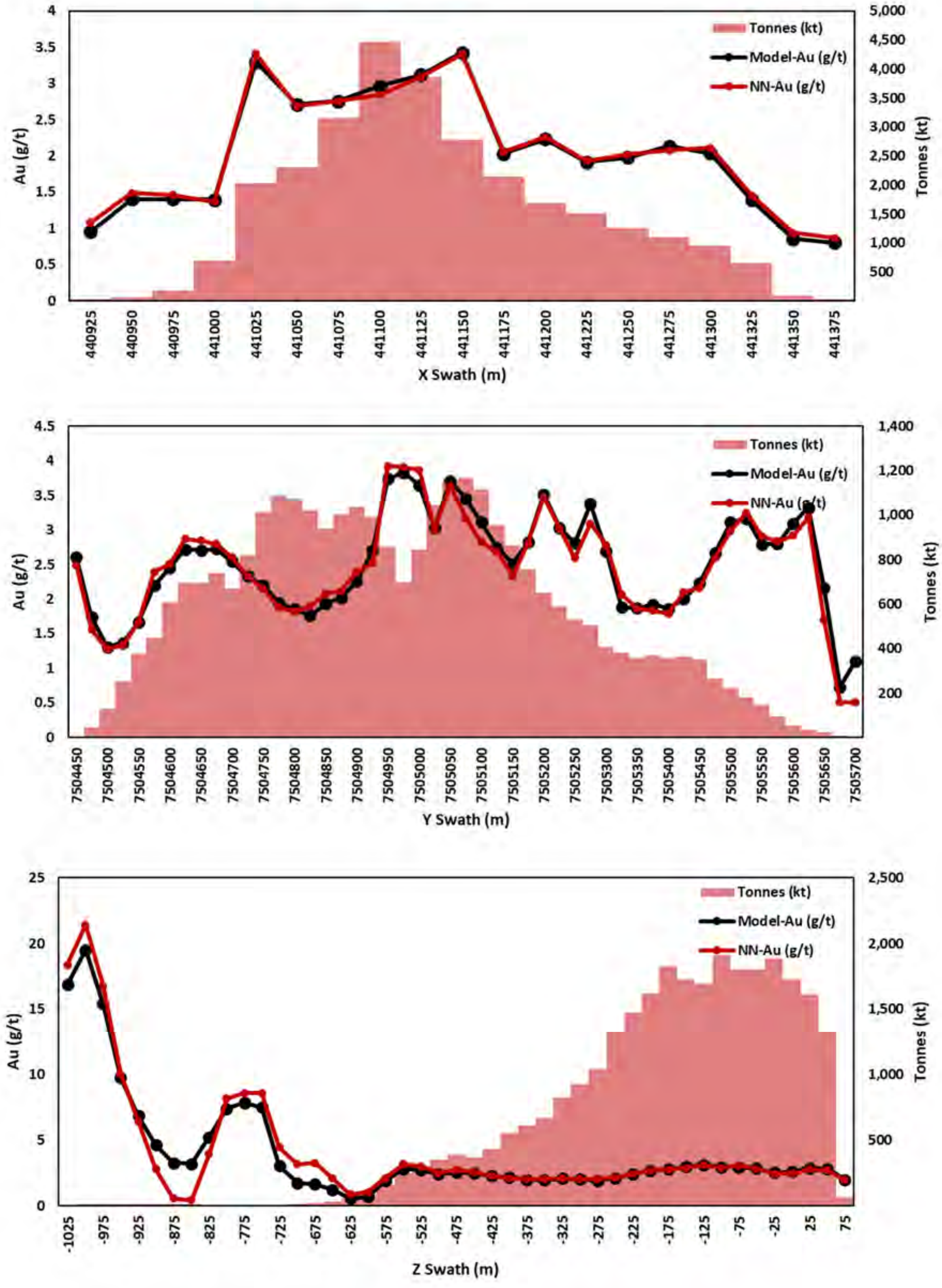


Figure 14-57. Boston Swath Plots

15.0 MINERAL RESERVE ESTIMATES

The estimated Mineral Reserves for the Project are summarized in Table 15-1.

Table 15-1. Mineral Reserves – Year End 2019

	Tonnes (000 t)	Grade (g/t Au)	Au Ounces (000 oz)
Proven			
Stockpiles	99	4.1	13
Total	**99**	**4.1**	**13**
Probable			
Doris	1,194	8.4	321
Madrid North UG	7,525	6.1	1,466
Madrid North Pit	212	5.7	39
Madrid North Subtotal	7,737	6.1	1,505
Suluk	3,703	5.8	695
Madrid South	842	9.1	245
Boston	3,306	7.2	766
Total	**16,782**	**6.5**	**3,532**
Proven and Probable			
Stockpiles	99	4.1	13
Doris	1,194	8.4	321
Madrid North UG	7,525	6.1	1,466
Madrid North Pit	212	5.7	39
Madrid North Subtotal	7,737	6.1	1,505
Suluk	3,703	5.8	695
Madrid South	842	9.1	245
Boston	3,306	7.2	766
Total	**16,881**	**6.5**	**3,545**

Notes:

1. CIM definitions were followed for the statement of Mineral Reserves.
2. The Mineral Reserves for each Individual deposit were defined utilizing the following cut-off grades
3. 4.0 g/t gold for longhole stopes.
4. 3.0 g/t gold for incremental development ore required for mining.
5. 2.0 g/t gold for the Madrid North crown pillar surface mining.
6. All Mineral Reserve are estimated using an average long-term gold price of US$1,325 per ounce and a CAD/USD exchange rate of 1.34.

7. A 50-metre crown pillar allowance was applied to Mineral Reserves located below lakes where applicable.
8. A minimum mining width of 2.0 m for long hole stopes was applied in the design prior to external dilution which results in a 3.3 m effective minimum mining width.
9. Ore density was calculated using the geological block model density field.
10. A 95% mining extraction factor and a minimum 20% external dilution factor was assumed for all stopes.
11. Numbers may not add due to rounding.

Mineral Reserve estimates were based on a life-of-mine plan developed in Deswik®, from the provided resource block model. Stope designs were created using the Deswik Stope Optimizer (Deswik.SO®), using a minimum initial width of 2.0 m for all designs. Dilution factors ranging from 20% to 57% were applied depending on the stope width to create mineable shapes and attain reasonable mining widths: the minimum mining width, including dilution, was 3.3 m.

15.1 CUT-OFF GRADE

A cut-off grade of 4.0 g/t was used for this exercise. Incremental ore was included in the plan when no waste development was required for access and the stope grade exceeded 3.0 g/t. The selected cut-off grade was then validated against the final mine cost model, after the life-of-mine plan exercise.

The break-even COG considers the total operating costs and was based on the consensus long-term price forecast, a gold price of US$1,325/oz was used for estimating Mineral Reserves. The exchange rate was fixed at CAD/USD equal to 1.34. Mill recovery varies by deposits; the life-of-mine average is 87.5%. An average milling cost of C$39/t was assumed. Other key assumptions include a power cost of C$0.23/kW-h and a diesel cost of C$0.96/L.

Certain stopes above the incremental COG are included in the production plan. This incremental COG considers all operating costs, less the waste development and G&A (fixed) costs, and will be used as a minimum target grade for an entire stope, after dilution and mine recovery are applied. This COG assumes that stopes above the break-even COG pay for the waste development.

The average calculated cut-off grade for all deposits is was estimated to be 3.8 g/t, with some variation between deposits. However, an overall 4.0 g/t cut-off target stope grade was utilized for the inclusion of a stope into the mineral reserve in order to account for the required capital investment. Incremental stopes ore development material with a grade between 3.0 and 4.0 g/t gold was also included in the Mineral Reserves and processing schedule where the mining of this material was required or provided flexibility in the mine plan such as not having to re-establish a stope slot raise. Some potential exists to further optimize the mine sequence in future mine plans.

The estimate of the break even and fully loaded cut-off grade are summarized in Table 15-2.

Table 15-2. Cut-off grade Estimate

Gold Price (USD/oz)	1,325
Exchange Rate (CAD/USD)	1.34
Mill Recovery	82-87.5%
Tonnages (000 t)	16,570

Unit Costs (CAD/t)	
Area	Average
Mine	99.45
Haulage	11.12
Surface/Processing	39.26
G&A	43.48
Total	**188 to 194**
Break-Even COG (g Au/t)	3.7 to 4.1
Incremental COG (g Au/t)	1.8 to 2.0

Notes:

1. Cut-off grade includes dilution and mine recovery parameters (See Table 15-3).

15.2 MODIFYING FACTORS

Conversion of Mineral Resources to Mineral Reserves is based on the dilution and extraction modifying factors listed in Table 15-3.

Table 15-3. Modifying Factors

Area	Mining Method	Design Method	Dilution	Extraction
Capital Dev	Development	Manual	5%	100%
Boston	Longhole Longitudinal	DSO*	20%	95%
Boston	Longhole Transversal 1	DSO*	20%	95%
Boston	Longhole Transversal 2	DSO*	20%	93%
Naartok	Longhole Longitudinal	DSO*	20%	95%
Naartok	Longhole Transversal 1	DSO*	20%	95%
Naartok	Longhole Transversal 2	DSO*	20%	93%
Suluk	Longhole Longitudinal	DSO*	20%	95%
Suluk	Longhole Transversal 1	DSO*	20%	95%
Suluk	Longhole Transversal 2	DSO*	20%	93%

Area	Mining Method	Design Method	Dilution	Extraction
Patch	Longhole Longitudinal Stope width <2.5m	DSO*	57%	95%
Patch	Longhole Longitudinal Stope width 2.5m - 3.5m	DSO*	30%	95%
Patch	Longhole Longitudinal Stope width >3.5m	DSO*	20%	93%
Wolverine	Longhole Longitudinal Stope width <2.5m	DSO*	57%	95%
Wolverine	Longhole Longitudinal Stope width 2.5m - 3.5m	DSO*	30%	95%
Wolverine	Longhole Longitudinal Stope width >3.5m	DSO*	20%	95%

DILUTION AND MINE RECOVERY

The Deswik stope shapes include internal dilution as well as an estimate of external dilution grade for each deposit, utilizing a dilution skin of 1.5 m (0.75 m each side of ore zone). Dilution grades were calculated as per the resource block model and were included in the production plan and Mineral Reserves estimate.

The average stope widths for each portion of the deposit used to determine dilution rates are summarized in Table 15-4. Average dilution grades are summarized in Table 15-5.

Mining recovery rates were based on typical values for the mining methods and equipment selected. A default rate of 95% extraction was applied for stopes while development is assumed to have 100% mine recovery. Recovery rates were reduced to 92.5% in secondary transverse stopes. Sill pillars will be recovered with up hole drillings, leaving a thin rib pillar (skin) to prevent dilution from backfill. A mine recovery of 80% has been applied to all sill pillars.

Table 15-4. Average Stope Widths

Area		Average Width (meters)
Doris		5.50
Madrid North	Naartok West	5.31
	Naartok East	8.28
	Rand & Spur	4.02
	Suluk	6.54
Madrid South	Patch	2.54
	Wolverine	2.56
Boston		4.13

Table 15-5. Average Dilution Grades

Area		Dilution Grade (g/t)
Doris		0.00
Madrid North	Naartok	2.36
	Suluk	1.60
Madrid South	Patch	0.67
	Wolverine	0.38
Boston		1.76

16.0 MINING METHODS

16.1 INTRODUCTION

Mining at the Hope Bay Project incorporates longhole mining methods in order to address the deposit geometry and anticipated ground conditions. Mining will take place under permafrost conditions where the mineralization is located away from any water bodies and under non-permafrost conditions in what is known as the talik in the vicinity and under the lakes in the area.

Doris North will be under permafrost while the Connector and Central zones at Doris will be beneath the lake. A portion of the Madrid North deposit (part of Naartok) as well as the Madrid South deposits (Patch and Wolverine) are situated beneath the lakes and therefore will not be under permafrost conditions.

The deposits will be accessed, and services will be provided by a decline from surface with an average grade of 13%. The ramp will also be used for ore and waste haulage from the underground operations.

The Doris deposit is currently in production, with an existing ramp decline reaching active mining areas. Mining will continue as per current methods until depletion. Transverse and longitudinal longhole mining is planned for Doris. Madrid North (Naartok and Suluk) and Boston will be mined using longhole stoping methods with sub-levels placed at 20-m vertical intervals (16-m drilling heights). Both longitudinal and transverse accesses are used, depending on width of the ore zones. The Madrid South (Patch and Wolverine), where ore zones are much narrower, will be mined using longhole stope method with sub-levels placed at 16-m intervals (12-m drilling heights). The majority of stopes in Madrid South will have longitudinal accesses.

Sill pillars are placed throughout the deposit to improve the mining sequence by providing additional stoping fronts. Sill pillars will be recovered at the end of the sequence using up-holes.

Stopes will be backfilled using a combination of CRF and unconsolidated rockfill (UCF). The CRF will generally contain 5% binder, except 10% in sill pillars. The CRF will be mixed on surface and trucked to the stopes.

16.2 GEOMECHANICS

In September 2019, the most recent issue of Ground Control Management Plan (GCMP) for Doris Underground Mine and the Madrid Ramp was prepared by Dr. Woo Shin, Ph.D., P.Eng.. Some portions of the GCMP are reproduced in the following sections. The first draft of the GCMP was issued in December 2015 and has been intermittently updated as underground mining has progressed at Doris and Madrid. The GCMP is a comprehensive document covering all aspects from strategy, scope, detailed processes and procedures, to risk assessment, ground control guidelines, roles and responsibilities, permafrost and hydrogeological conditions, program implementation, monitoring, review, data collection, and incident investigation. This will provide a very good guide for TMAC and contractor employees charged with the operating responsibilities at Hope Bay.

Unless specified, all geomechanics assumptions are based on the GCMP as well as the Geotechnical & Hydrogeological Assessments prepared by SRK in January 2012. No additional geotechnical work was performed for this phase of the project. Drift and stope dimensions are similar to previous work.

GEOTECHNICAL AND HYDROLOGICAL STUDIES

Previous geotechnical and hydrological analysis completed on the Project are summarized in Table 16-1. The current study is based on these reports in addition to the GCMP.

Table 16-1. Geotechnical and Hydrological Studies

Year	Company	Area Reviewed	Comments
1994	URSA	General	Field collection procedures rock mechanics data
1997	EBA Engineering	Roberts Bay	Geotechnical inspection of proposed port location
1998	URSA	General	Geotechnical rock mass characterization
2002	Golder Associates, SRK Consulting	Doris Hinge zone	Detailed geotechnical logging.
2002	SRK Consulting	Doris	Hope Bay Doris North Project, TIA dam site geotechnical investigation and conceptual design report
2008	SRK Consulting	Doris Lake	Thermistor testing
2008	SRK Consulting	Boston	2008 annual geotechnical inspection (water licence 2BB-BOS0712)
2009	SRK Consulting	Doris North	Geotechnical study, rock mass assessment for underground development; hydrogeological assessment
2009	SRK Consulting	Boston	2009 annual geotechnical inspection (water licences 2BB-BOS0712 and 2AM- DOH0713)
2009	SRK Consulting	Boston	Geotechnical study of likely geotechnical parameters for an open pit at Boston
2009	SRK Consulting	Madrid	Geotechnical study of likely geotechnical parameters for an open pit and underground operation at Madrid
2010	SRK Consulting	Doris North	Geotechnical study, portal ground assessment modelling,
2010	SRK Consulting	Boston, Doris North, Doris Central	Hydrological testing
2011	SRK Consulting	Doris Area	Conceptual hydrological flow, groundwater inflow assessments; additional hydraulic testing and water quality sampling
2004	TMAC Resources	Doris Area	Ground Control Management Plan for Doris

GROUND CONDITIONS

IN-SITU STRESS

Parameters from the SRK 2009 rock mass assessment were utilized for the underground assessment and geotechnical domains were developed for the rock mass assessment. The domains included:

- Undifferentiated mafics
- C-type volcanics
- Diabase dyke 1
- Diabase dyke 2
- Contact zone
- Vein

Four joint sets were also identified, and a number of fault structures observed. However, these are not anticipated to be too difficult to pass through using conventional mining and support practices, including the use of shotcrete when needed.

The expected in-situ stresses at the Doris site were estimated from the CANMET database of Canadian crustal stresses - Mining and Mineral Sciences Laboratories (Arjang, 2004). The stress gradients for an average 75 m depth used in the analysis are shown in Table 16-2. Stress states are assumed to be consistent throughout the Hope Bay Project.

Table 16-2. Expected Stress States and Magnitudes

Stress	Gradient (MPa/m)	Intercept (MPa)	Depth (m)	Stress Magnitude (MPa)
σ_1	0.0344	13.5	75	16.1
σ_2	0.0233	8.0	75	9.7
σ_3	0.0180	3.0	75	4.4

ROCK MASS CLASSIFICATION

From the SRK rock mass assessment completed in 2009, most portions of the Doris North deposit host Fair to Good rock mass conditions. Table 16-3 shows the rock mass parameters with accepted design values. Although a number of fault structures were observed to pass through the area of major infrastructure, these are not considered to be problematic from a mining perspective.

The prominent joint sets observed are shown in Table 16-4, and are expected to have a localized influence on stability. The rock mass parameters based on Barton's "Q" system were adopted for use in the underground evaluation in support of the stability graphs created for the underground excavation design. The parameters used for the underground evaluation are shown in Table 16-5. Doris North parameters are assumed to be applicable to the other deposits.

Table 16-3. Rock Mass Parameters – Doris North

Major Rock Types		Undifferentiated Mafics		C-Type Basalts		Vein		Diabase		Contact Zone: Mafics & Diabase	
		Range	Design	Range	Design	Range	Design	Range	Design	Range	Design
Field Parameters	RQD	75-100	95	86-100	95	80-100	95	93-100	98	50-100	85
	FF/m	0-9.0	1.5	0-0.7	0.5	0-0.7	0.5	0-2.3	0.3	0-20.0	5
	Fol/m	0-10.0	2	0-1.3	0.3	0-1.3	0.3	0-0.3	0	0-1.3	0.3
	Emprical IRS (R value)	R3-R5	R4	R3-R5	R4	R3-R5	R4	R4-R5	R5	R3-R4	R4
Laboratory Parameters	UCS (MPa)	27-239	89	-	89	-	-	135	-	-	-
	Dry Density (kg/M#)	2,623-3,157	2,845	-	2,949	-	-	2,911	-	-	-
	Moisture Content (%)	0.0-1.6	0.2	-	0	-	-	0	-	-	-
Accepted Design Strength		-	90	-	90	-	60	-	150	-	60
RMR_{90}		26-81	60	50-81	62	50-81	60	46-81	70	26-70	55

Table 16-4. Prominent Joint Sets – Doris North

Joint Set	Dip	Dip Direction	Description Data Quality
1	89	295	Foliation High confidence joint set based on current and historic data
2	12	99	Joint Large amount of scatter associated with this shallow set; high density of data points
3	34	114	Joint Scattered data; potentially enhanced by drilling bias
4	57	189	Joint Lower confidence, small number of joints intersected; drilling bias may have reduced intersections within this set

Table 16-5. Rock Mass Parameters

Domain	RQD Lower	RQD Upper	Jn	Jr	Ja	Jw	Q' Lower	Q' Upper	RMR Lower	RMR Upper
C-Type	86	100	9	1.5	2	1	7.17	8.33	62	63
Orebody	80	100	9	2	2	1	8.89	11.11	64	66
Undif. Volc.	75	100	12	1.5	2	1	4.69	6.25	58	60

FIELD NOTES

In the past, mining activity has taken place in the Hope Bay camp with mine development at both the Doris North (2011) and Boston (1995) sites. These campaigns included development via ramp access and drifting on ore for bulk sample testing. The authors are not aware of any major incidents that occurred during these programs. A site visit was performed in February 2020 to validate mining parameters. The ground conditions at Doris North provide evidence of very good rock quality and standard ground support techniques currently used in the industry. Mining at the Hope Bay mines will be to a depth of approximately 450 m, with access by ramp, and ground stress is not currently considered to present any major issues.

16.3 MINE DESIGN

DESIGN CRITERIA

EMPIRICAL STABILITY ANALYSIS

No man-entry openings were included in this study, although drift-and-fill methods have previously been used at Doris. Stope design was based on the Modified Mathews stability curves after Potvin and Hadjigeorgiou (1998, further modified by Trueman, 2000). Excavation design parameters for Doris were established for a range of stope spans, heights, and lengths as indicated in Table 16-6.

Table 16-6. Design Summary Non-Person Entry Openings

	Q'	Q'	N'	N'	HR	HR	Level Spacing (m)	Ore Width (m)	Stope Length (m)
Surface	Lower	Upper	Lower	Upper	Lower	Upper			
HW	4.7	6.2	8.1	10.8	3.9	7.1	15-25	3-7	15-40
FW	7.2	8.3	11.4	13.2	3.9	7.1			
Stope Ends	8.9	11.1	2.8	4.0	1.3	2.8			
Back/ Orebody	8.9	11.1	1.0	1.5	1.3	2.8			

The results of the analysis are plotted on a stope stability chart as shown in Figure 16-1. With the range of stope dimensions considered, the blocks indicated on the figure show the range of values considered for Q' and the calculated hydraulic radius (HR). The stope boundaries considered all fall within the stable zone, with the HW entering the failure zone at a stope length of 30 m.

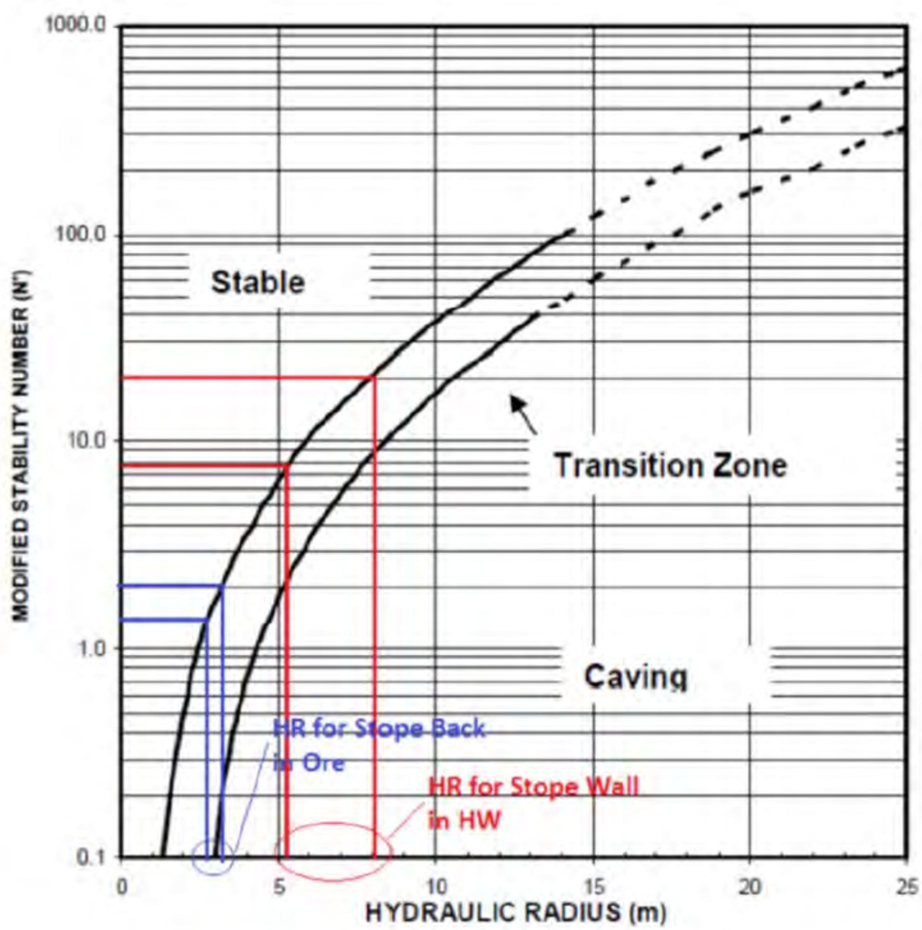


Figure 16-1. Stope Stability Plot for Doris North

The non-person entry opening dimensions for Doris North are shown in Table 16-7. Based on level spacing and the range of vein widths, the maximum unsupported stope length was

calculated using an average HR from the stope stability plot. As noted, for a 20 m sub-level interval with a vein width less than six m, up to 37 m of stope length can be developed without backfill, however, at a vein width above six m, the stope strike length should be kept under 25 m.

Table 16-7. Maximum Stope Strike Lengths Doris North

Area	Hydraulic Radius Applied (max/min)	Level Spacing (m)				Back Width (m)		
		15	20	25	30	5	6	7
HW	6.5 (8.0/5.2)	95	37	27	23	0	0	0
Back	2.7 (3.0/2.5)	0	0	0	0	N/A	54	23

RIB PILLARS

The function of the rib pillars is to provide stability during mining and in particular the hangingwall and also to keep the unconsolidated backfill in the stope. Rib pillars are not included in the mining plan due to the use of CRF.

CROWN PILLARS

Crown pillars are required by law under any bodies of water. A 100 m crown pillar is required under any lakes if no engineering study has been completed. For the current study, it is assumed that a 50 m crown pillar will be maintained under any lake, supported by a detailed engineering plan complete with monitoring instrumentation. Further work is required to confirm that all excavations are out of the area of influence of any lakes, that a diamond drill program is conducted to ensure that ground quality is sufficient to provide safe access to the work area, and that a grouting program be implemented where necessary to help control and reduce water inflows.

The Naartok East Crown Pillar is scheduled for extraction in 2020 using surface mining methods. The Naartok East portal will be developed from a lower level of this surface excavation beginning in 2021.

NUMERICAL MODELLING

Numerical analysis was carried out by Mr. Woo Shin, Ph.D., P.Eng., Rock Mechanics specialist retained by TMAC. Dr. Shin carried out a numerical parametric analysis on the strike length of stopes using Phase 2, which is described in more detail in the GCMP report. The analysis indicated good correlation with the empirical method of analysis which showed that failure depths started to develop at the centre of the longhole wall when the strike length was 35 m with the depth and width of overbreak dramatically increasing beyond a 40 m strike length. The longhole designs included in this plan do not exceed these values, and plot within the stable zone of the stability graph (Figure 16-1).

16.4 MINING METHOD

Sub-level longhole mining is forecast in all mining areas, with a combination of longitudinal and transverse stopes, depending on stope width. The use of Transverse Longhole mining was considered initially in the PEA study for the Madrid North Naartok zone, however, a review indicated that the large widths are made up of several veins with sufficient separation between them to allow a combination of Longitudinal and Transverse Longhole mining. Primary-secondary sequences are used in transverse stopes. Longitudinal stopes are planned with a retreat

sequence towards a centre access. The sub-level intervals were fixed at 20 meters for all the deposits except Patch and Wolverine where the interval is 16 meters to provide the required control for narrow lens of ore and the small diameter longholes that will be used. The nature of the veins did not appear conducive to the use of increased sub-level intervals and larger borehole diameters.

The sub-level retreat (SLR) or longitudinal stoping method will be in use at all of the deposits. Stopes will be filled with a combination of CRF and unconsolidated rockfill.

The SLR method is illustrated in Figure 16-2 and Figure 16-3. These figures show an SLR stoping level plan with infrastructure (ventilation raise, sumps, electrical panels, truck load-out) and the ramp access. It will be necessary to develop to the end of the vein prior to commencement of stoping operations. Figure 16-4 shows a longitudinal section of the stoping method indicating the stoping dimensions, location of slot raises, and backfilling sequence. While the waste development is reduced by developing on ore, additional drives could easily be developed if necessary, to increase number of available stopes.

The undercut drift and overcut drift are driven on ore and mining would start from the lower access retreating out towards the main access drift. Nominal stope strike lengths are 15 meters but will vary based on local geometry. Once a stope block is finished, CRF is introduced from the upper sub-level. CRF will be used until the fill covers all walls to be exposed with future mining; unconsolidated fill will be used for the remainder of the void.

Slot raises are drilled between three and four m from the previous stope to create the primary void. Most stopes will be drilled from the overcut downwards to the undercut. Upholes will be drilled to recover the level below the sill pillar, where a small “skin” will be left to prevent dilution of CRF.

Stope strike lengths are limited controlled in order to respect the HR values and prevent excessive dilution. This stoping system is advantageous by reducing waste development requirements but requires multiple active stoping sequences to maintain the planned production rate. Sill pillars are placed throughout the mine to divide the stope sequences.

The recommended drills are capable of drilling diameters from 50 to 89 mm in diameter. Drill holes of 63 mm are recommended for smaller stopes, combined with a tightly-space “dice-five” drill pattern. Larger diameter holes will be used in larger stopes with greater burden and spacing. Drill holes will be approximately 17m in length for most deposits, but 12 m at Madrid South.

Multiple veins are present in certain areas of the deposit. In some cases, spacing between the veins are sufficient to allow mining of each vein separately to minimize dilution. In some areas, particularly in Naartok and Suluk, the geometry is such that transverse stoping is more efficient. A primary stope sequence will be established in these areas, with secondary stopes later extracted.

Ammonium Nitrate/Fuel Oil (ANFO) is expected to be the primary blasting agent for both development and production, with standard Handidet detonators used for initiation.

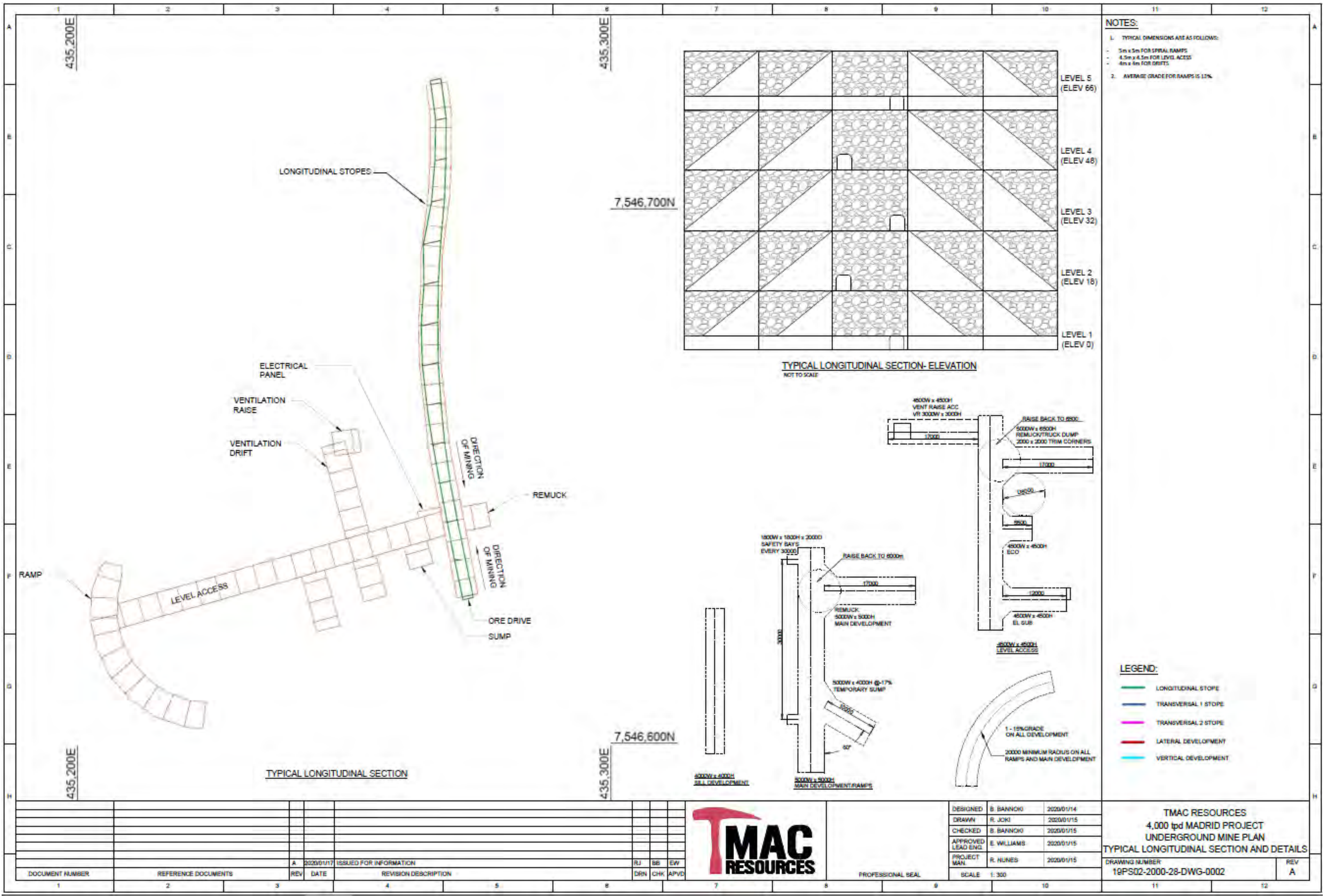


Figure 16-2. Typical Longitudinal Design

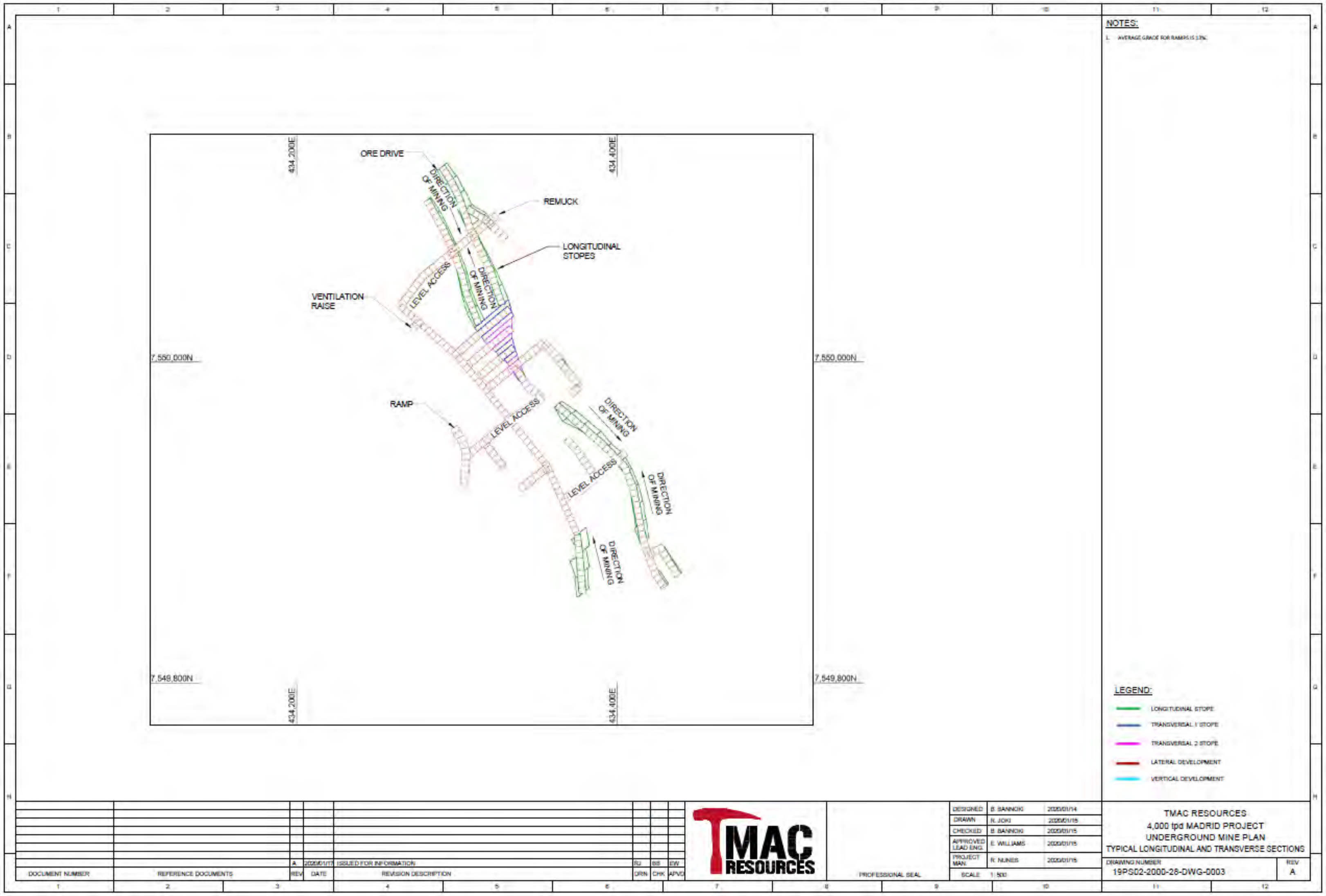


Figure 16-3. Typical Transverse Design

STOPE DESIGN

Stopes were designed using Deswik SO software. Level spacing is 16 m floor-to-floor for Madrid South and 20 m floor-to-floor elsewhere. The minimum mining width is 2 m. Dilution within 0.75 m each side of the ore zones include background gold grades as given by the block model; any dilution beyond this limit has a grade of 0.

PRODUCTIVITY ASSUMPTIONS

The productivity rates for each type of stope were used to develop a total cycle time for each stope, including fixed time such as mobilization/demobilization. The cycle time was then reported as a combined unit rate for each stope. The cycle times vary based on drilling factors (t/m), dilution, and any stope-specific constraints.

Productivity rates did not vary with depth. However, additional units were included at deeper levels to compensate additional haulage times and maintain productivity assumptions.

The combined productivity assumptions for stopes productivities are shown in Table 16-8.

Table 16-8. Productivity Assumptions

Drilling Rate:	200 m/day				
Fixed Cycle:	6 days: Mobilization (1), Slot Raise (2), Blasting (2), CMS/Fence (1)				
Muck Prod:	500 t/d	Longitudinal			
	1,000 t/d	Transverse			
CRF Prod.:	500 t/d	Longitudinal			
	1,000 t/d	Transverse			
		Madrid North/Boston		**Madrid South**	
		Long	Trans	Long	Trans
Drill Volume	tonnes (non-diluted)	2,000	8,500	1,600	2,500
Drilling	meters	640	960	360	360
Dilution	%	67%	20%	67%	20%
Recovery	%	94%	94%	94%	94%
Muck Volume	tonnes (diluted)	3,144	9,563	2,510	2,813
Drill factor	dil t/m	4.9	10.0	7.0	7.8
Stope Cycle					
Drill Cycle	days	3.2	4.8	1.8	1.8
Muck Cycle	days	3.1	9.6	2.5	2.8
CRF Cycle	days	4.5	13.7	3.6	4.0
Fixed Cycle	days	6.0	6.0	6.0	6.0
Total Cycle	days	16.8	34.0	13.9	14.6

Productivity				
mined t/day	187	281	181	192
undiluted t/day	112	234	108	160

DEVELOPMENT CRITERIA AND ASSUMPTIONS

The development productivity assumptions used for the PFS are shown in Table 16-9.

Table 16-9. Development Performance Assumptions

Heading	Dimension	Monthly Targets	Advance
Lateral			
Ramp	5.0mx5.0m	90 m/heading	3.7 m/round
Ore Drifts	4.0mx4.0m	45 m/heading	3.5 m/round
Access levels and Infrastructures	4.5mx4.5m	60 m/heading	3.7 m/round
Combined Maximum		220 m /crew	
Vertical			
Air return ventilation	1.8m diam		2.0 m/day
Raise Bore	3.0m diam		3.3 m/day

GROUND SUPPORT

The ground support design is presented in Table 16-10 and further detailed in the GCMP (Shin, 2019). This support was calculated for the Doris mine in particular and is considered adequate as a basis for the other Hope Bay mines. Ground support systems will be refined as operating experience is gained at each of the mines. An allowance was made in the development unit costs to account for potentially adverse ground conditions: ground support costs were increased by 20% in 20% of the lateral development. In addition, a 10% contingency was allocated to bolter requirements to ensure sufficient resources to manage ground conditions and any occasional rehabilitation required.

Table 16-10. Ground Support Requirements

Type	Section	(H × Ground Support Rule W, m) (Bolt space / Pattern)
RAMP I	Main Ramp (5.0 m ×5.0 m)	8' split set/swellex (1.2 m × 1.2 m) in back 6' split set/swellex (1.2 m × 1.2 m) in walls with wire mesh up to 1.5 m from the sill
II		8' swellex (1.0 m × 1.0 m) + 12' super spot bolts in back 6' split set/swellex (1.2 m × 1.0 m) in walls with wire mesh up to 1.5 m from the sill

Type		Section	(H × Ground Support Rule W, m) (Bolt space / Pattern)
RMK	I	Re-mucking Stope (6.0 m ×5.0 m)	8’ split set/swellex (1.2 m × 1.2 m) with wire mesh down to 1.0 m from the back
MD	R - I	Main Drift, SA (4.0 m × 4.0 m)	6’ split set (1.2 m × 1.2 m) with wire mesh down to 1.0 m from the back
	R - II		6’ split set (1.2 m × 1.2 m) + 8’ spot bolts with wire mesh up to 1.5 m from the sill
	W - I	Main Drift (Wide) (4.0 m × 7.0 m)	8’ swellex (1.2 m × 1.2 m) + 12’ super spot bolts with wire mesh down to 1.0 m from the back
	N - I	Main Drift (Narrow) (3.0 m × 3.0 m)	6’ split set (1.2 m × 1.2 m) with wire mesh down to 1.0 m from the back
RAISE - I		Vertical Raise (4.0 m × 4.0 m)	6’ split set (1.2 m × 1.2 m) + 8’ spot bolts with wire mesh
BENCH - I		Benching Area (7.0 m × 4.0 m)	Follows MDR – I or II Ground Support Rules, then 6’ split set with mesh up to 2.0m from the sill after bench
IS	I	Intersection (Max. Dia. < 7.0 m)	8’ spot bolts for the intersection area
	II		12’ super spot bolts for the intersection area

BACKFILL

The longhole mining methods selected for the Project assume all voids are filled with a combination of CRF and unconsolidated fill. CRF is required to allow for effective stoping sequencing, to maximize recovery and to keep dilution in control.

Primary stopes in transverse sequences, as well as the exposed areas of all longitudinal stopes, will required cemented fill. The backfill design consists of using of 5% binder for most stopes with 10% binder for the base of each sequence (sill pillars). Secondary stopes and portions of longitudinal stopes not exposed to adjacent stopes can be backfilled with unconsolidated rockfill or detoxified tailings. CRF will be prepared in a surface batch plant using underground waste and cement slurry, before being trucked underground.

Backfill productivity is estimated at 1,000 t/d. The same depth factors used for to modify truck haulage at depth are applied to backfill productivity. For the purposes of this study, in order to avoid contamination of ore with cement, trucks are assumed not to transport both ore/waste and CRF. In addition, all waste is assumed to be transported to surface as development and fill requirements were not matched by level during the design phase. These assumptions are conservative; optimizing the backfill process could result in decreases to the required fleet size.

Over the LOM, estimated waste rock produced totals approximately 7.0 Mt, insufficient to replace the 16.6 Mt of ore mined underground. Approximately 2.1 Mt of detoxified tailings will be returned underground. Assuming all voids are filled, a shortfall of approximately 6 Mt of waste is estimated, and quarrying will be required. Extraction of the Naartok crown pillar will reduce the quarrying

requirements. Developing a paste-fill network to return tailings to stoping areas could reduce the cost of waste quarrying and handling as well as the surface footprint.

16.5 PREPRODUCTION DEVELOPMENT

Each mine requires about 6-12 months of development before extraction can begin. Diamond drilling will be scheduled during development activities. Pre-production development is currently in progress at Naartok West. Pre-production will begin in 2025 for Boston and 2027 for Suluk and Madrid South deposits. While historical development exists at Boston, a portion of the ramp is considered too close to the orebody to allow safe extraction; a new portion of ramp will be developed at depth with a greater stand-off distance.

ACCESS

All of the accesses required to mine the Hope Bay deposits will be via figure-eight shaped ramps from surface. Two portals are required at Naartok, with the Naartok West portal being shared by Suluk later in the LOM. One portal will be developed to access both Patch and Wolverine ore at Madrid South. The existing portal at Boston will be maintained.

Ramp dimensions are 5 m by 5 m dimensions to allow for equipment clearances and ventilation ducting during the development phase of each operation. This will also allow for the required ventilation air velocity limits in the ramp which will be all upcasting ventilation air from the mine workings. As all ore is within approximately 500 m from surface, ramp access is adequate to support the production plan. The average grade of the ramp is 13%, assuming a maximum grade of 15%.

LATERAL DEVELOPMENT

Lateral development will be 5 m high by 5 m wide for the main ramps and reduced to 4.5 m high by 4.5 m wide for the level accesses and other openings. Ore drives are nominally 4 m high by 4 m wide but could vary somewhat with ore zone dimensions.

Figure 16-4 illustrates the typical development profiles. Ramps and level accesses provide adequate clearance for all equipment, including AD-45 haul trucks. Trucks will not access ore zones, being loaded in the level accesses by the LHD equipment.

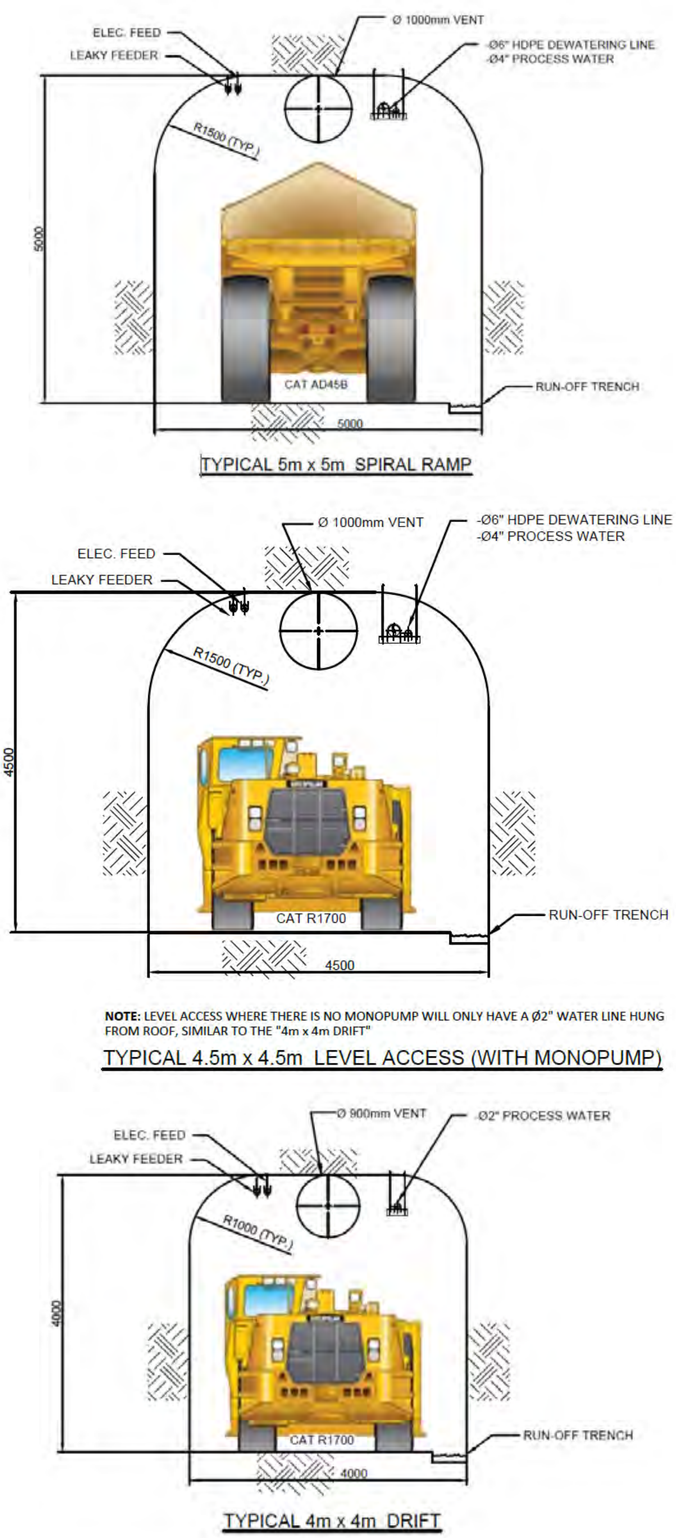


Figure 16-4. Typical Development Sections

VERTICAL DEVELOPMENT

Ventilation raises will be developed with Alimak raise climber units for longer raises and longhole drop raises for shorter inter-level connections. Escapeways will be installed in raises were needed to provide emergency egress for workers.

Drop raises will be drilled in stopes with the production drill to serve as primary openings. The production drill selected for this plan (Simba S7) was selected in part because of its ability to drill in all of the planned stope dimensions. However, a portion of the deposit is amenable to drilling with a Cubex-type ITH drill.

ORE AND WASTE HANDLING

Ore and waste will be mucked from both the development faces and stopes with Cat R1700 LHD (8 m^3 capacity). Ore from the stopes will be loaded in CAT AD-45 haul trucks at the load-out situated within approximately 50 m of the entry to the ore drifts. Smaller equipment, including CAT R1600 scoops (4.5 m^3 capacity) and CAT AD-30 haul trucks is currently in use at Doris and scheduled to transfer to Madrid South by 2027. Cycle time assumptions at Madrid South have been modified to correspond with the smaller equipment.

Ore and waste will be hauled to surface before being dumped at a stockpile near the portal. Surface crews including front-end loaders and surface haul trucks, will be used to manage stockpiles and transport ore to either the Doris Plant (2020-2024) or the new Madrid Plant (after 2024). Waste will be used to feed the CRF plant before being returned underground.

16.6 LIFE OF MINE PLAN

PRODUCTION PLAN ASSUMPTIONS

Production over the Madrid Plant LOM period (2024-2034) is on average 4,000 t/d from all the deposits. Four mines including the Doris (BTD, North and Connector veins), the Madrid North (Naartok, Suluk, Rand veins) the Madrid South (Patch 14 and Wolverine veins) and Boston make up the sources of ore that will be produced during the mine life. Of the 16.8 Mt of ore produced during the LOM, the distribution by mine will include Doris at 7%, Naartok at 46%, Suluk at 22%, Madrid South at 5%, and Boston at 20%. The LOM production is shown in Table 16-11 that follows.

Table 16-11. LOM Production Schedule

	Units	LOM Total	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
Mining																		
Doris Mine																		
Ore Tonnage	(t)	1,194,413	353,491	468,538	372,384	-	-	-	-	-	-	-	-	-	-	-	-	-
Gold Grade	(g/t)	8.39	10.98	7.50	7.06	-	-	-	-	-	-	-	-	-	-	-	-	-
Contained Gold	(oz)	322,166	124,741	112,932	84,493	-	-	-	-	-	-	-	-	-	-	-	-	-
Waste Mined	(t)	544,166	380,703	148,906	14,557	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Mined	(t)	1,738,579	734,194	617,444	386,941	-	-	-	-	-	-	-	-	-	-	-	-	-
Naartok Underground																		
Ore Tonnage	(t)	7,524,968	36,258	241,388	474,649	778,333	1,288,544	1,523,226	1,506,697	1,352,603	323,269	-	-	-	-	-	-	-
Gold Grade	(g/t)	6.06	7.70	6.28	5.79	5.97	5.91	6.36	6.01	5.99	6.06	-	-	-	-	-	-	-
Contained Gold	(oz)	1,466,294	8,977	48,741	88,406	149,331	244,815	311,414	291,330	260,345	62,934	-	-	-	-	-	-	-
Waste Mined	(t)	2,999,003	203,436	312,574	567,045	528,983	485,924	314,787	299,984	227,380	58,890	-	-	-	-	-	-	-
Total Mined	(t)	10,523,970	239,695	553,961	1,041,694	1,307,316	1,774,468	1,838,014	1,806,681	1,579,983	382,159	-	-	-	-	-	-	-
Naartok Open Pit																		
Ore Tonnage	(t)	212,125	212,125	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Gold Grade	(g/t)	5.68	5.68	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Contained Gold	(oz)	38,709	38,709	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Waste Mined	(t)	1,508,962	1,508,962	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Mined	(t)	1,721,087	1,721,087	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Suluk																		
Ore Tonnage	(t)	3,702,744	-	-	-	-	-	-	-	-	443,427	848,303	885,585	792,542	668,338	64,550	-	-
Gold Grade	(g/t)	5.83	-	-	-	-	-	-	-	-	5.71	5.75	6.14	5.32	6.23	5.88	-	-
Contained Gold	(oz)	694,531	-	-	-	-	-	-	-	-	81,366	156,712	174,743	135,545	133,959	12,204	-	-
Waste Mined	(t)	1,312,485	-	-	-	-	-	-	-	135,879	310,409	234,980	300,634	200,085	130,499	-	-	-
Total Mined	(t)	5,015,230	-	-	-	-	-	-	-	135,879	753,836	1,083,283	1,186,218	992,626	798,837	64,550	-	-
Madrid South																		
Ore Tonnage	(t)	841,672	-	-	-	-	-	-	-	18,896	179,946	186,973	156,021	126,558	128,467	44,811	-	-
Gold Grade	(g/t)	9.06	-	-	-	-	-	-	-	11.88	9.46	8.11	10.39	8.97	8.47	7.53	-	-
Contained Gold	(oz)	245,160	-	-	-	-	-	-	-	7,219	54,756	48,770	52,114	36,480	34,969	10,852	-	-
Waste Mined	(t)	963,825	-	-	-	-	-	-	-	181,325	338,773	288,770	140,866	7,125	6,121	844	-	-
Total Mined	(t)	1,805,497	-	-	-	-	-	-	-	200,221	518,719	475,743	296,887	133,684	134,588	45,655	-	-
Boston																		
Ore Tonnage	(t)	3,306,454	-	-	-	-	-	18,421	103,592	359,599	616,296	266,872	406,985	494,942	320,850	561,303	157,594	
Gold Grade	(g/t)	7.20	-	-	-	-	-	6.69	6.90	6.88	7.24	7.66	7.54	6.74	6.41	7.51	8.42	
Contained Gold	(oz)	765,736	-	-	-	-	-	3,961	22,980	79,499	143,443	65,743	98,637	107,240	66,088	135,460	42,685	
Waste Mined	(t)	1,862,227	-	-	-	-	-	147,774	338,484	260,431	294,702	341,536	361,509	117,792	-	-	-	
Total Mined	(t)	5,168,681	-	-	-	-	-	166,195	442,076	620,030	910,998	608,408	768,494	612,734	320,850	561,303	157,594	
Total Mining																		
Ore Tonnage	(t)	16,782,376	601,875	709,926	847,033	778,333	1,288,544	1,541,647	1,610,290	1,731,097	1,562,938	1,302,148	1,448,591	1,414,042	1,117,654	670,664	157,594	-
Gold Grade	(g/t)	6.55	8.91	7.08	6.35	5.97	5.91	6.36	6.07	6.24	6.82	6.48	6.99	6.14	6.54	7.35	8.42	-
Contained Gold	(oz)	3,532,595	172,427	161,673	172,899	149,331	244,815	315,375	314,310	347,063	342,499	271,226	325,495	279,265	235,016	158,516	42,685	-
Waste Mined	(t)	9,190,667	2,093,101	461,479	581,602	528,983	485,924	462,561	638,467	805,015	1,002,774	865,287	803,008	325,002	136,620	844	-	-
Total Mined	(t)	25,973,043	2,694,976	1,171,405	1,428,634	1,307,316	1,774,468	2,004,209	2,248,757	2,536,112	2,565,712	2,167,435	2,251,599	1,739,044	1,254,274	671,508	157,594	-
Ore Stockpile Balance																		
Ore Stockpile Open Balance																		
Ore Tonnage	(t)		98,909	-	-	117,033	165,366	176,410	258,057	408,346	679,444	782,382	624,530	613,120	567,162	224,817	-	-
Gold Grade	(g/t)		4.11	-	-	5.64	5.67	5.71	5.90	5.95	5.94	6.19	6.40	6.60	6.69	7.40	-	-
Contained Gold	(oz)		13,085	-	-	21,204	30,125	32,408	48,913	78,130	129,767	155,774	128,517	130,077	122,032	53,486	-	-
Ore Stockpile Closing Balance																		
Ore Tonnage	(t)		-	-	117,033	165,366	176,410	258,057	408,346	679,444	782,382	624,530	613,120	567,162	224,817	-	-	-
Gold Grade	(g/t)		-	-	5.64	5.67	5.71	5.90	5.95	5.94	6.19	6.40	6.60	6.69	7.40	-	-	-
Contained Gold	(oz)		-	-	21,204	30,125	32,408	48,913	78,130	129,767	155,774	128,517	130,077	122,032	53,486	-	-	-
Processing																		
Ore Processed	(t)	16,881,285	700,784	709,926	730,000	730,000	1,277,500	1,460,000	1,460,000	1,460,000	1,460,000	1,460,000	1,460,000	1,460,000	1,460,000	895,481	157,594	-
Gold Feed Grade	(g/t)	6.53	8.21	7.07	6.45	5.98	5.90	6.37	6.07	6.29	6.74	6.36	6.90	6.12	6.47	7.36	8.42	-
Ore Contained Gold	(oz)	3,544,557	185,069	161,274	151,414	140,409	242,532	298,870	285,093	295,426	316,491	298,483	323,934	287,310	303,563	212,002	42,685	-
Processing Recovery	(%)	87.5%	86.5%	86.2%	85.3%	82.0%	90.0%	90.1%	90.3%	91.1%	88.0%	83.9%	84.2%	85.4%	85.4%	93.0%	94.3%	-
Gold Production	**(oz)**	**3,101,365**	**160,000**	**138,997**	**129,212**	**115,136**	**218,279**	**269,154**	**257,572**	**269,230**	**278,400**	**250,569**	**272,638**	**245,296**	**259,391**	**197,240**	**40,252**	**-**

All mines were scheduled independently, with the sequences beginning as soon as possible. Start dates were then adjusted for each mine in order to optimize the throughput over the mine life. Based on these results, further optimization work could be performed, using consolidated resource leveling and an overall production target. The start dates selected for each deposit are as follows:

- Doris: Currently in production
- Naartok: Development in progress (begun December 2019)
- Suluk: Development begins January 2027
- Madrid South: Development begins January 2027
- Boston: Development begins July 2025

The development start dates assume any supporting infrastructure work is complete prior to that date, including construction of the Boston haul road.

Daily production rates are 2,000 t/d while the Doris Plant is in operation (2020-2024) and 4,000 t/d for the new Madrid Plant (2024 and beyond). Production will be slightly lower than nameplate in 2024 due to commissioning of the Madrid Plant. A stockpile, preferably of lower-grade material, will be created in 2022-2023 to support the commissioning process.

Mining rates will also slightly exceed milling rates from 2025 through 2028. The stockpile generated during that time will be used to compensate lower production rates as the various deposits are depleted. The period from 2027-2028 is characterized by significant development and production activity, as all deposits will be active. The available stockpile will also serve as a contingency during the ramp-up process of the new deposits. The stockpile may also serve for blending and grade-control purposes.

MINE PLANS

The following figures illustrate the final mine designs, including access and type of mining. Please note that the scale indicated on the figures is not valid at the scale they are shown. The figures are scaled to be plotted on A1 size paper.

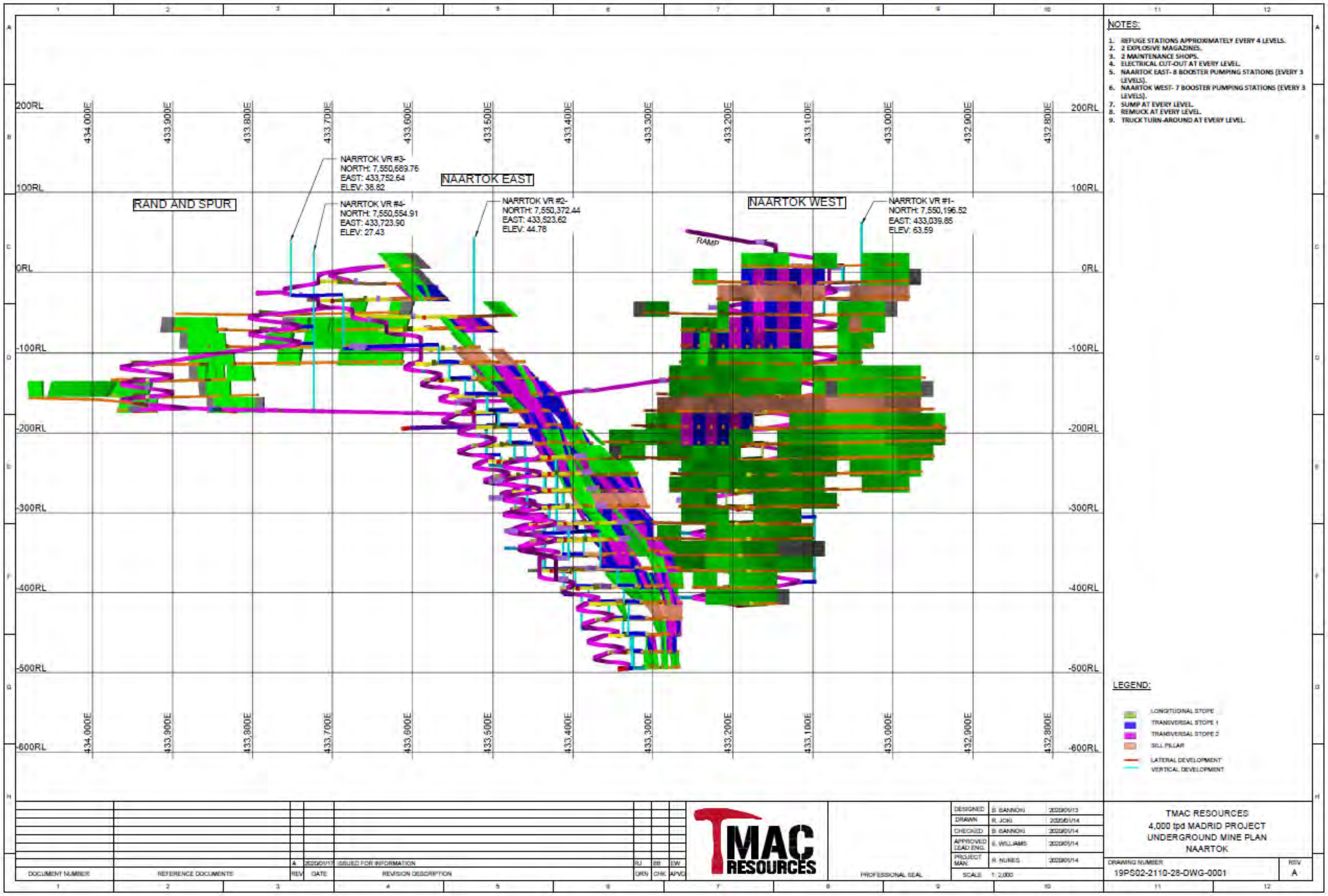


Figure 16-5. Naartok Longitudinal Section

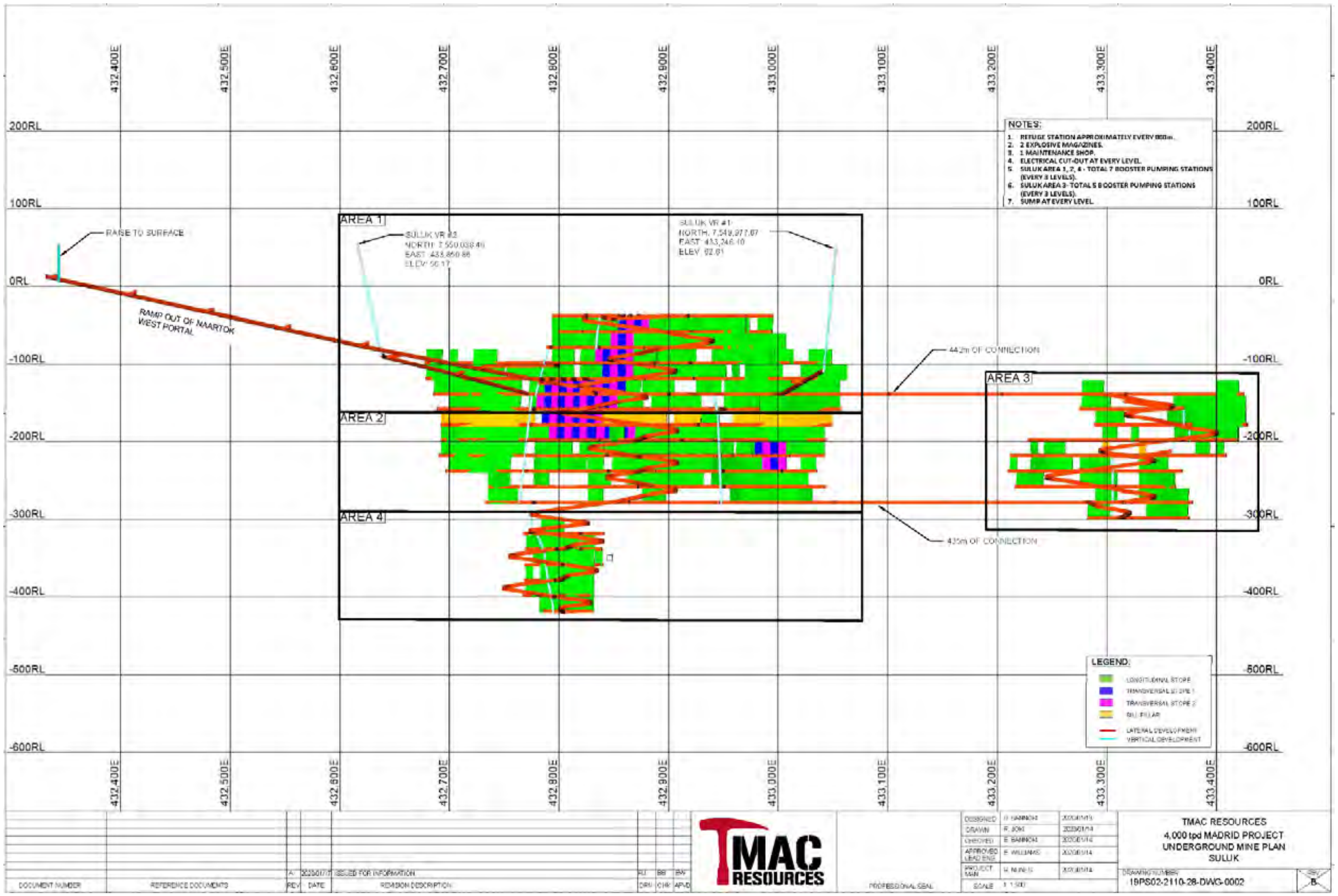


Figure 16-6. Suluk Longitudinal Section

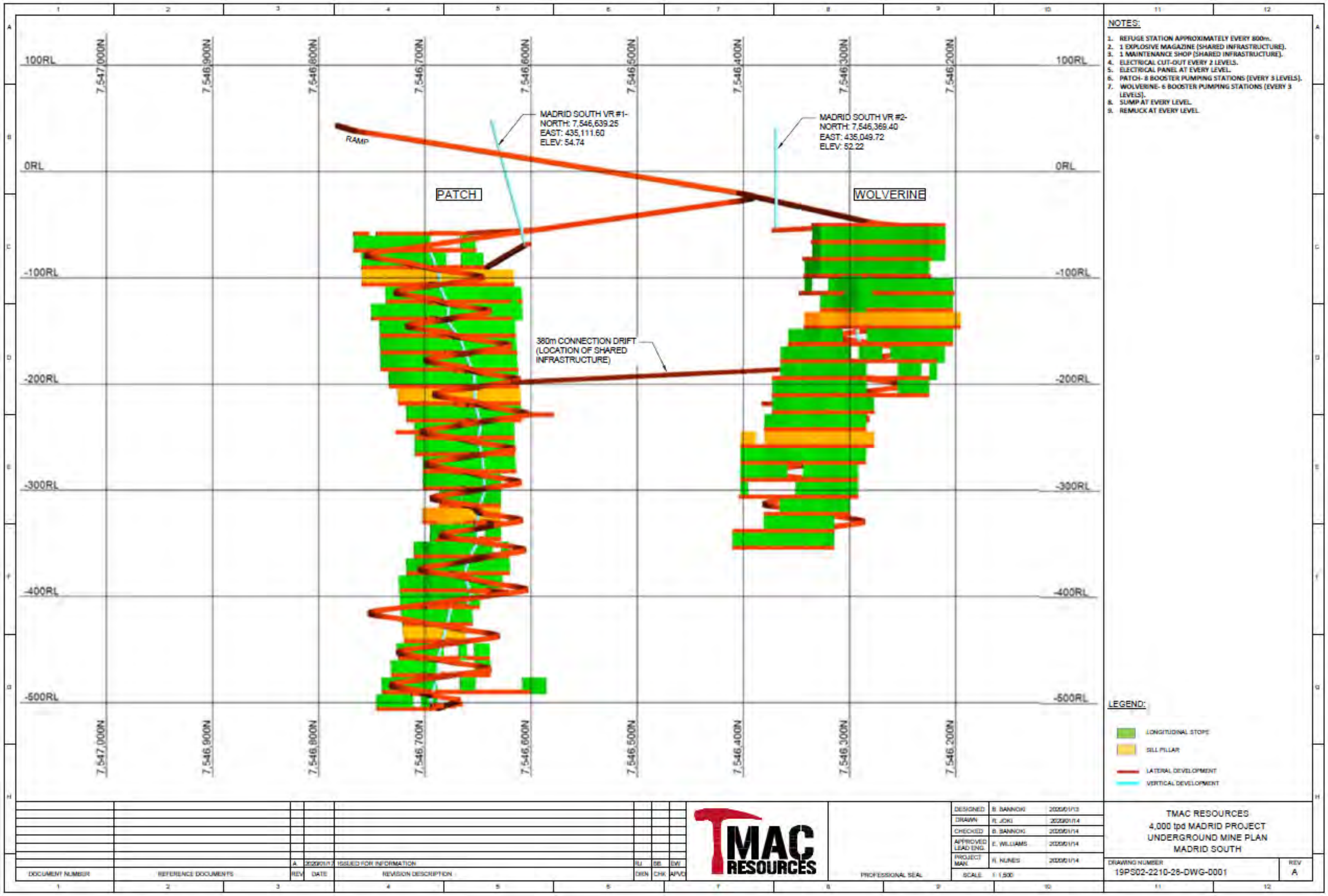


Figure 16-7. Madrid South Longitudinal Section

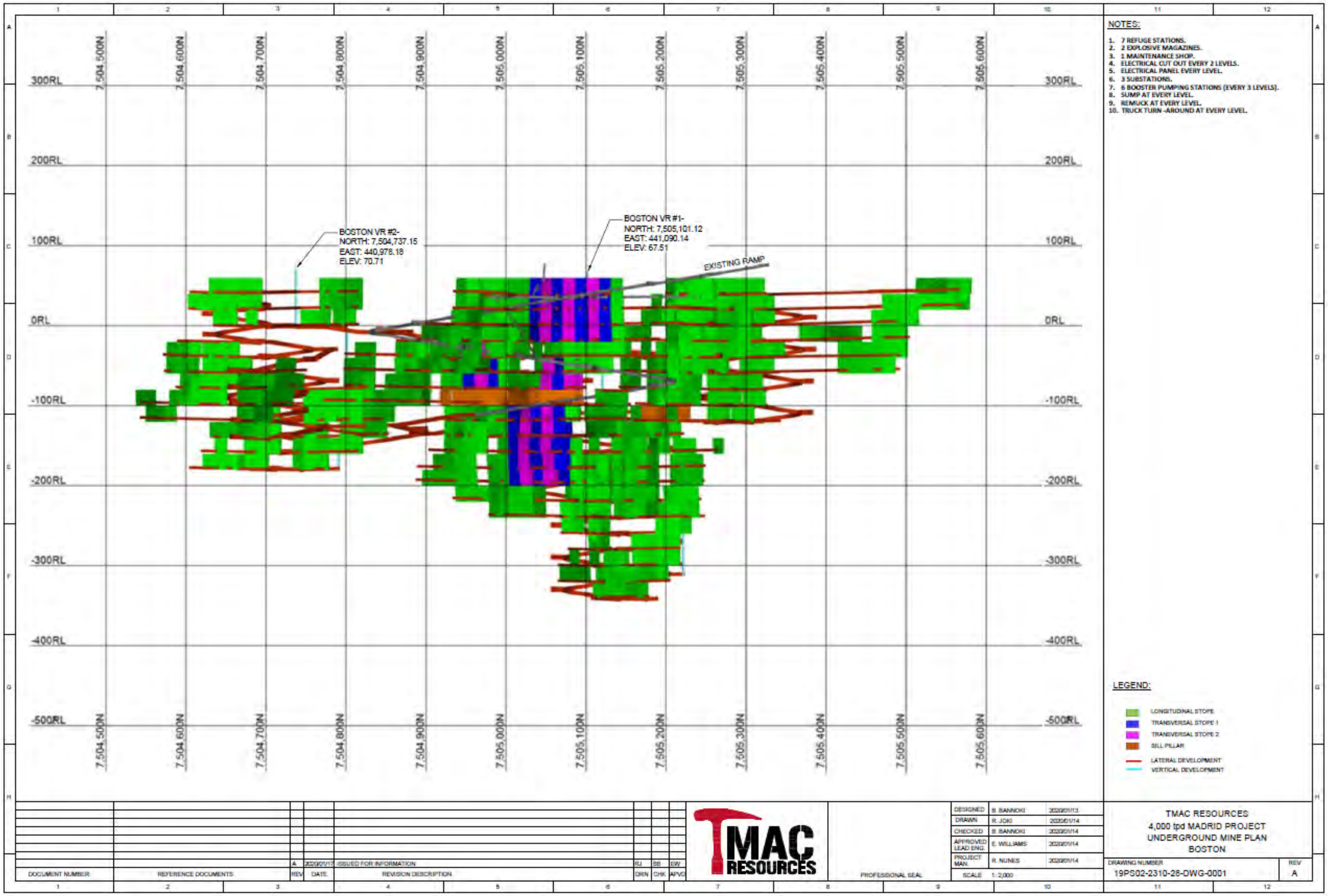


Figure 16-8. Boston Longitudinal Section

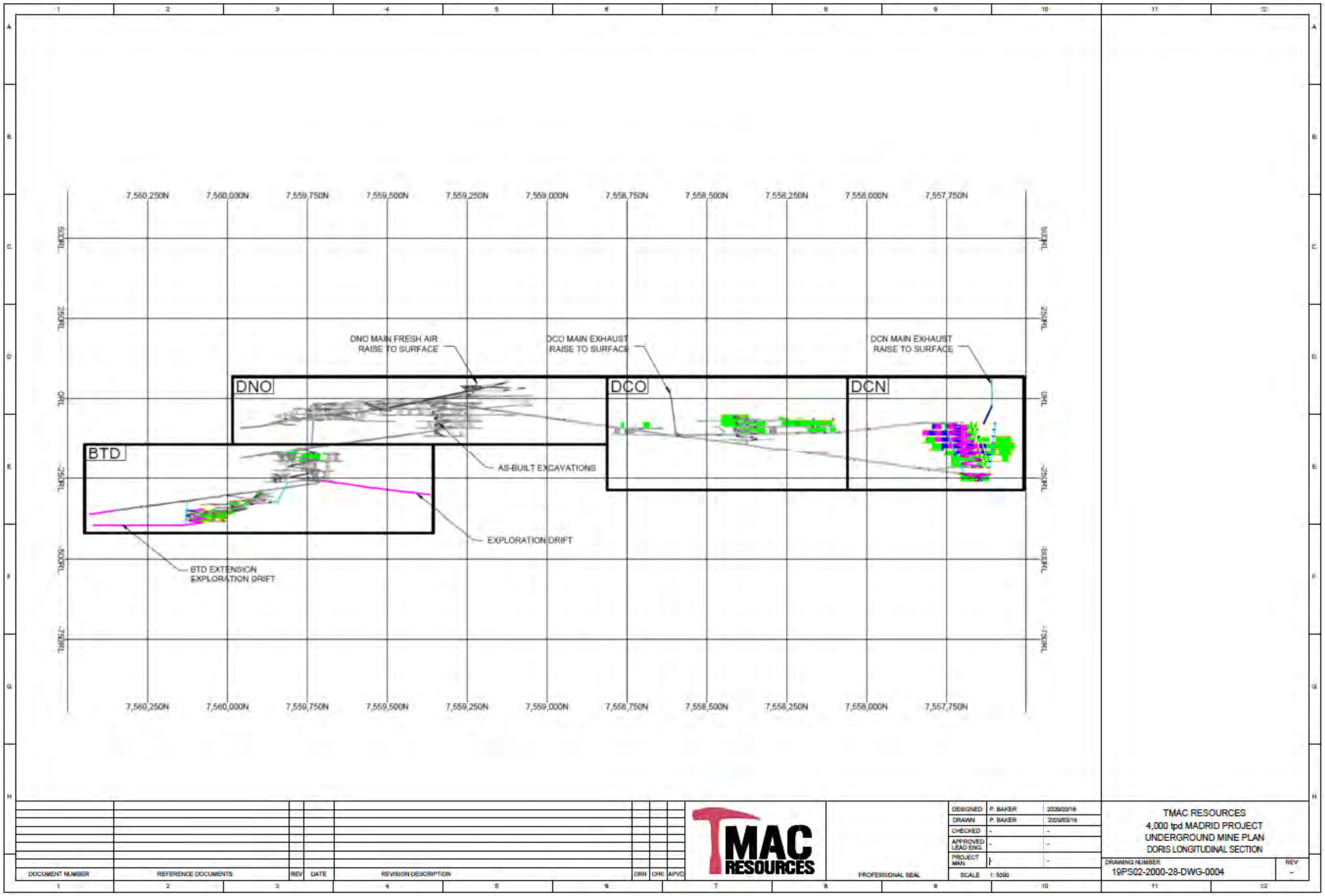


Figure 16-9. Doris Longitudinal Section

DEVELOPMENT SEQUENCE

A development schedule was prepared and is shown in Figure 16-10 and Figure 16-11. The rate of development shown in the table is based on the performance criteria outlined earlier in Section 16.4 DEVELOPMENT CRITERIA AND ASSUMPTIONS.

EXTRACTION SEQUENCE

Figure 16-12, Figure 16-13 and Table 16-11 summarize the extraction sequence. For the purposes of this study, all stoping activities are assumed to occur simultaneously, using an overall stope productivity rate. The small offsets between the derived activities in a stope, such as drilling, mucking and filling, are not considered material in a life-of-mine plan. The sequence is based on the combination of the productivity rates for each activity into a typical cycle time for each deposit and stope type.

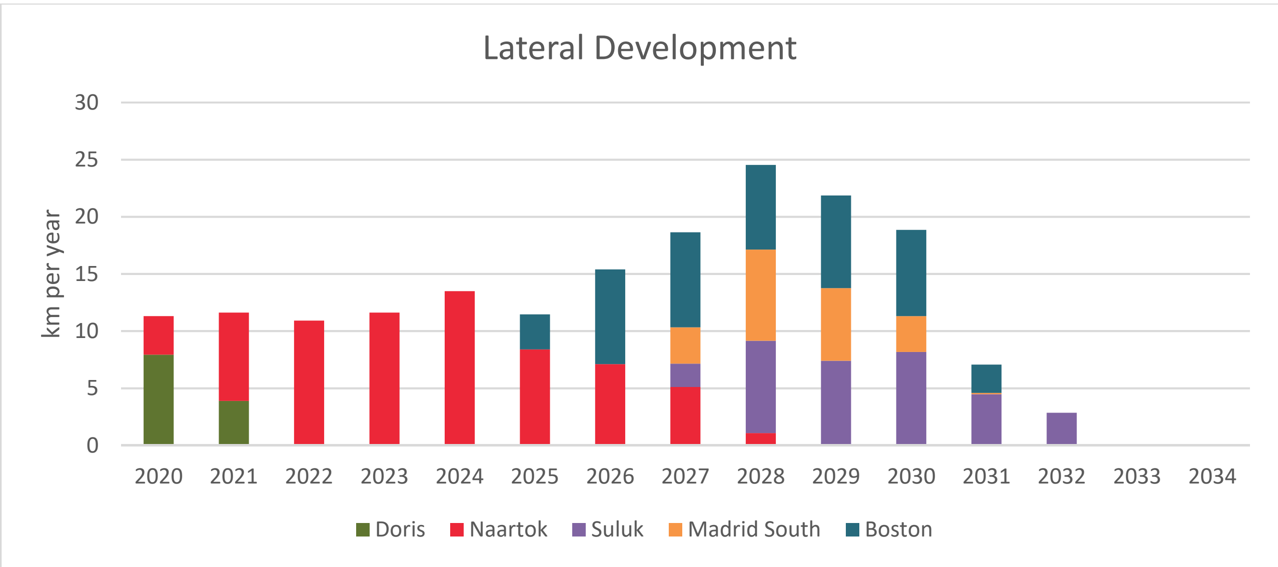


Figure 16-10. LOM Lateral Development Schedule

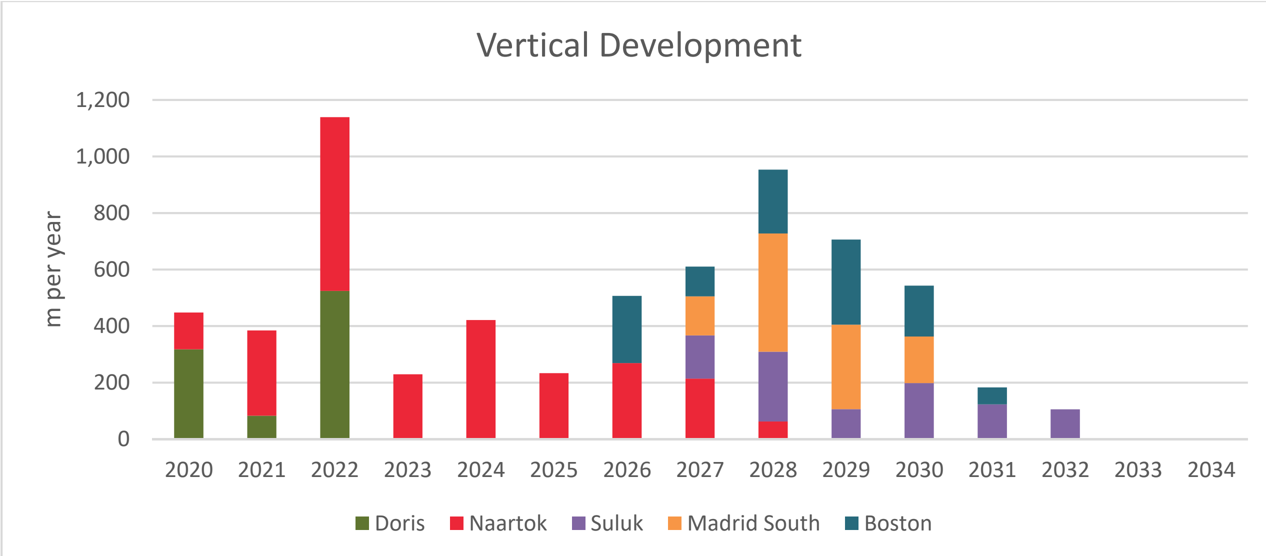


Figure 16-11. LOM Vertical Development Schedule

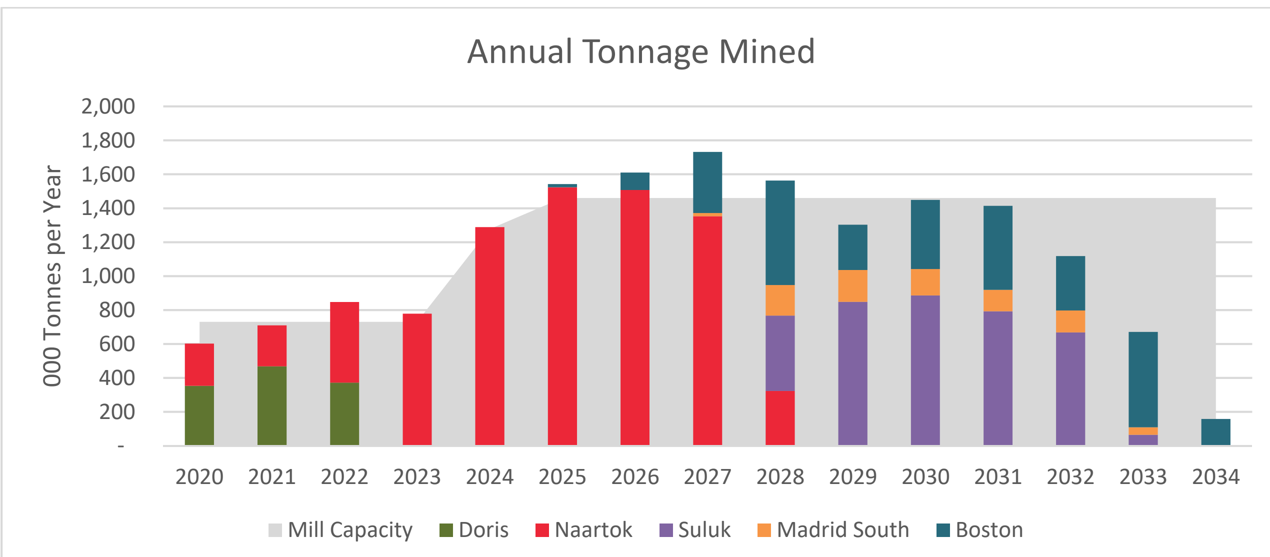


Figure 16-12. LOM Production Schedule – Volume

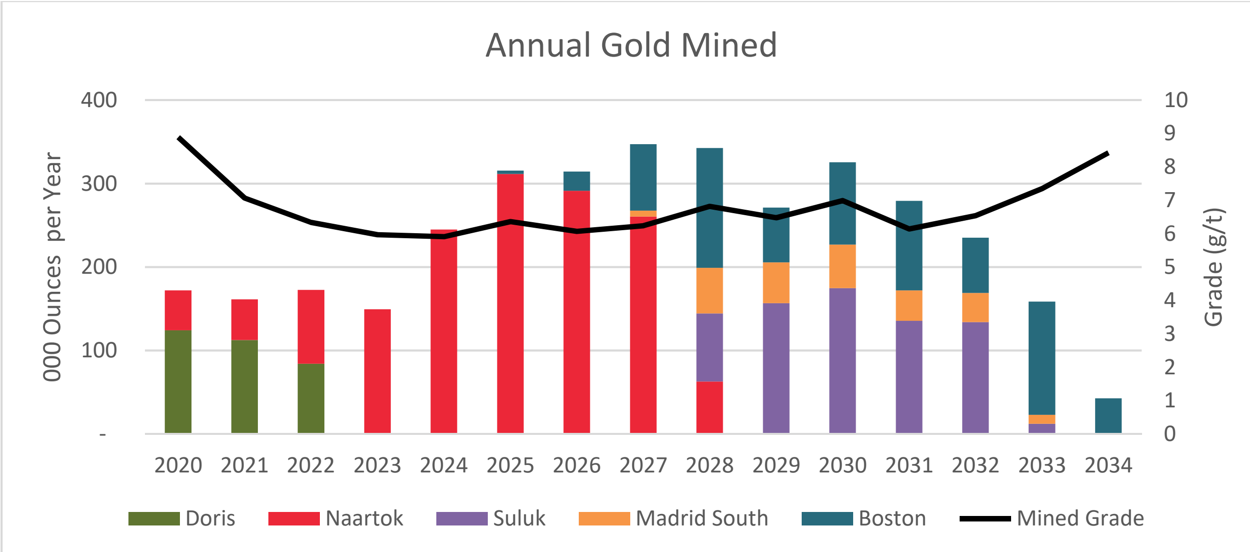


Figure 16-13. LOM Production Schedule – Gold Content

16.7 MINE EQUIPMENT

EQUIPMENT PRODUCTIVITY ASSUMPTIONS

The equipment productivity assumptions were based on the equipment data sheets provided by manufacturers, current performance at Doris, and estimated stope cycle parameters. The productivity rates shown in Table 16-8 were used to develop the stope cycle, and represent the equipment productivities in a working area. This are similar to the productivities used in the fleet sizing, with the exception of LHDs and haulage trucks, as described below. The peak equipment requirements for the underground mining fleet is shown in Table 16-12.

Development equipment was based on the development productivity rates of 220 m /month per crew. Bolter requirements exceed jumbo requirements to allow for occasional rehabilitation or increases in the ground support cycle time due to local adverse ground conditions; an allowance of 10% supplemental work was assumed. LHDs are allocated from the production fleet based on 30% cycle time requirement.

The Simba S7 long-hole drilling rig was selected for production drilling. This drill is capable of drilling 50 mm up to 89 mm diameter production holes. This will allow for drilling in longitudinal and transverse stopes. The drill fleet assumes a productivity of 200 m/day. Drilling of drop raises is included in the fixed portion of the total stope cycle time.

Productivity for haulage trucks was based on rates for the first mining block of each portal, with a target productivity of 1,800 t/d for ore/waste and 1,000 t/d for backfill. Equipment productivity was decreased over time as deeper mining blocks are put into production. Overall productivities are greater than individual cycle time productivities, which were more conservative to ensure sufficient allowance for delays between activities. Load and haul units are also easily transferable between stopes, even within a shift, justifying the higher overall productivities. Fleet size assumes all material is trucked to surface and a separate fleet of haul trucks is used for backfill. The haulage fleet could be reduced with alternative backfill strategies; future work plans include trade-off studies are recommended to optimize this activity.

A provision for major overhaul is included for all equipment. LHDs and trucks are forecast for overhaul every four years, resulting in 1-2 overhauls during the mine life. The manufacturer's recommended overhaul schedule was used to estimate costs. All other equipment is assumed to be overhauled every 5 years, resulting in one overhaul during the mine life. Overhaul costs are estimated at 30% of purchase cost.

Except as detailed in Section 16.7 EXISTING FLEET, all equipment is assumed to be purchased new. Initial capital may be reduced by purchasing refurbished equipment, but sustaining capital forecasts should be updated accordingly. Capital estimates are supported by quotes from manufacturers.

Table 16-12. Underground Mining Fleet

Class	Peak Requirements					
	Jumbo	Bolter	Scissor-Lift	Production Drill	LHD	Haulage Truck
Typical	Epiroc Boomer 282	MacLean 975	Maclean SL3	Simba S7	CAT R1700G	CAT AD45
Doris	4	4	4	3	3	3
Naartok	6	7	7	4	11	12
Suluk	4	4	4	4	5	5
Madrid South	4	4	4	2	2	2
Boston	4	4	4	3	5	4
Maximum	12	13	13	9	16	16

Notes:

1. Maximum requirements are not equivalent to sum of peaks due to equipment transfers.
2. Requirements include mechanical availability and may differ from fleet estimates used for infrastructure design.
3. Madrid South equipment will be transferred from Doris after overhaul.
4. Doris requirements are satisfied with current fleet.
5. Naartok, Suluk and Boston equipment is assumed new.
6. Fleet includes allocation for production, backfill and development requirements.

EXISTING FLEET

A mobile equipment fleet currently exists at the Doris operation. However, due to continuing requirements at Doris, the size differences as well as the age of the fleet, the majority of the mobile equipment for Madrid must be purchased. The existing fleet is assumed to be sufficient to complete extraction of the Doris deposit.

As stope sizes are generally larger at Madrid North and at Boston than at Doris, slightly larger equipment is required at these sites in order to ensure productivity targets are met. The fleet at Doris is considered well matched to the Madrid South Deposit. Doris equipment has been assumed to be unavailable through 2025. This will allow for completion of the current mining plan as well as an allowance for the mining of any additional resources that may be identified. Beginning in 2026, the Doris equipment will be overhauled before being put into service in Madrid South as of 2027. Table 16-13 summarizes the equipment that will be transferred from Doris to Madrid South. Overhaul costs are forecast at 40% of the equivalent purchase cost and included in the sustaining capital cost for Madrid South. Except where indicated, equipment from Doris is assumed to be equivalent to the new fleet selected.

No transfer of service equipment is currently included in the plan. The transfer of any additional equipment found to be in serviceable condition at the end of Doris mine-life could result in capital cost savings as compared to this estimate.

Table 16-13. Doris Equipment Transfer

Equipment Type	Quantity	Date Required
Jumbos	4	2026-2027
Bolters	4	2026-2027
Scissor-Lifts	4	2026-2027
Production Drills	2	2028-2029
LHD (R1600G)	3	2027-2028
Haulage Trucks (AD30)	4	2027-2028

DEVELOPMENT EQUIPMENT

The primary development equipment will consist of the Epiroc Boomer 282 jumbo drills, MacLean 975 Bolters for ground support, and MacLean SL3 scissor-lifts for loading and services. LHDs and haul trucks will be allocated from the production fleet. The service fleet includes service trucks and tractors that will be allocated as needed for loading and service operations. Equivalent equipment may be substituted according to site preference or cost. The two-boom jumbos are recommended for ramps and level accesses. Due to smaller dimensions, one-boom jumbos and MacLean SSB are acceptable for longitudinal sills at Madrid South.

PRODUCTION EQUIPMENT

Production equipment will consist of Simba S7 longhole drills, CAT R1700G LHDs and CAT AD-45 haul trucks. LHD and haul trucks are allocated to development, stope production, haulage and backfill as required. Smaller scoops, such as R1300 or R1600 may be used in the smaller longitudinal stopes, particularly in Madrid South. Stope cycle time has based on the smaller stope dimensions and the resulting productivities, and no further adjustments were deemed necessary for smaller equipment. Smaller trucks may be used at Madrid South due to low daily production rates.

SERVICE EQUIPMENT

Service equipment is included in the plan to support development, production and construction activities. Jeeps and tractors are included for supervisors, maintenance teams, technical services personnel and worker transportation. Anfo and utility trucks are required to support development and transportation of material. Equipment with interchangeable cassettes is recommended, particularly for Boston and Madrid South, in order to minimize the fleet size and increase utilisation. Graders are required to maintain the haulage roads. As a central compressed air system is not included in the plan, mobile compressors are required to support production and construction crews.

16.8 MINE INFRASTRUCTURE AND SERVICES

The following sections describe infrastructure and services located underground and at the portals. For discussion of supporting surface infrastructure, including access roads, see Section 18.0.

VENTILATION

The ventilation design was done for the mines to determine the air quantity and ventilation infrastructure needs. Each mine will have fresh air intake system(s) (FAR's) where the main surface force fans will force fresh air from surface to the underground workings and the return air will be via the ramp system to surface. The mine air heating system will be run with diesel fuel as the main source of heat and the units will be equipped with propane pilot tanks. The mine air will be heated to a minimum of approximately -8°C to provide for an adequate work environment both for the mine personnel and the equipment hydraulics.

The fresh air will intake from the surface fans at each mine, through the FAR connections to each working level. Each level will connect via a crosscut connection to the FAR and a regulator/door with a force fan(s) will be installed on each level to control the airflow quantity to each level. A 75 kW axial type force fan and lay flat flexible 1016 mm ø force duct will assist to force fresh air from the fresh air raises (FAR) to the production drift(s) on each operating level. At the split on a level production drift for the two-sided production areas will be a 900 mm diameter flexible force duct which will be installed to each side. The required quantity per side is 11 m^3/s for the LHD operation.

FAR will use an Alimak FAR's raise downcast system. Each FAR is 3 x 3 m square approximately and will be slashed to 4 x 4 m size as required by the ventilation air quantity and pressure needs. A force fan system will enclose the single shaft for the bifurcated surface force fan arrangement and heater system connected.

Axial type fans used underground are specified as 23 m^3/s at 2,200 Pa. Furthermore, mobile refuge bays will be installed at no further than 1,000 m from the workers to be within reach of personnel underground and development crews (approximately every 3 levels). Control and instrumentation systems will also be required; however, the level of application is not described at this stage.

MINE AIR VOLUME

The air quantity allowance was determined from a production requirement and from the diesel equipment point of view. An allowance used per vehicle as indicated by CANMET tests (10 – 15% equipment "aging" factor applied) or otherwise as 0.06 $m^3/s/kW$ (100 cfm/HP) was used to calculate the diesel air quantity needs. The ventilation requirements are shown in Table 16-14.

The maximum air quantity per mine including leakage and backup allowance is 511 m^3/s (Naartok), 231 m^3/s (Suluk), 150 m^3/s (Madrid South), and 234 m^3/s for Boston mine. This coincides with the peak production requirements from each mine. The main surface exhaust fan(s) specification per downcast shaft for Naartok is 170 m^3/s at a pressure of 2650 PaT (additional 5 - 10% is allowed for the fan quantity and pressure). It is proposed that VFD motor drives be used for all surface primary force fans to facilitate efficient operation of the equipment over time.

The schematic drawings of the ventilation systems are provided in Figure 16-3 through Figure 16-5.

Table 16-14. Mine Ventilation Requirements

Equipment type	Utilisation %	Quantity m^3/s	Power	Heat load
			kW	
Jumbo	35	3.7	58	31
Bolter		6.9	110	58
Scissor-Lift		5.4	86	45
Production Drill		3.7	58	31
LHD	70	12.7	290	305
Haulage Truck		19.3	439	461
Jeeps	35	5.4	86	45
Tractors		5.4	86	45
Service Trucks		5.4	86	45
Grader		5.9	93	49
Misc	25	7.1	112	42
Diamond drills		3.7	58	22

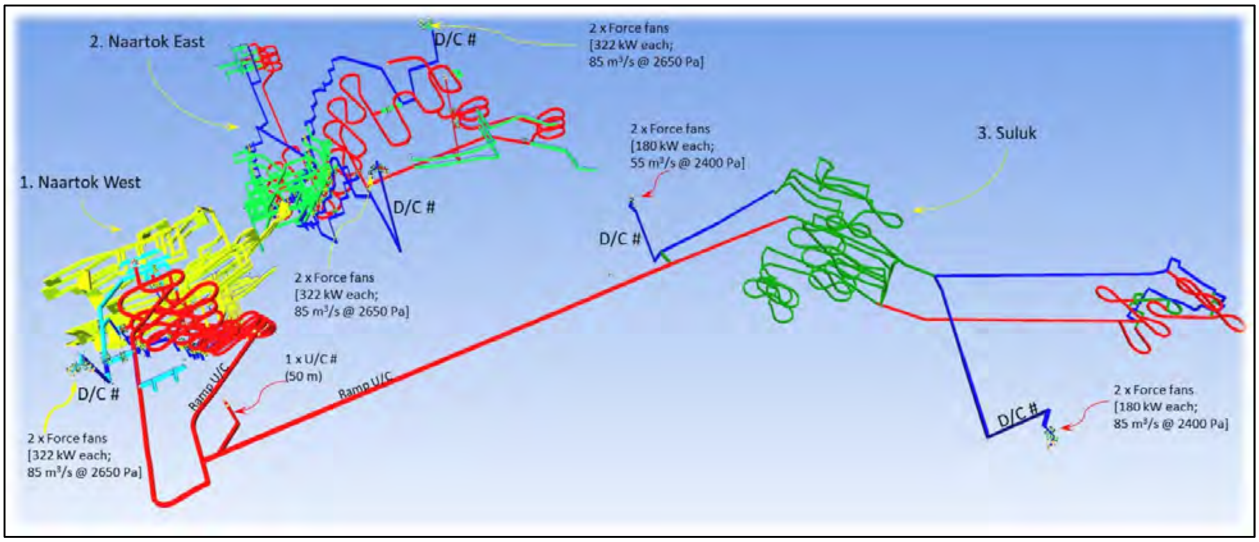


Figure 16-14. Naartok/Suluk Ventilation

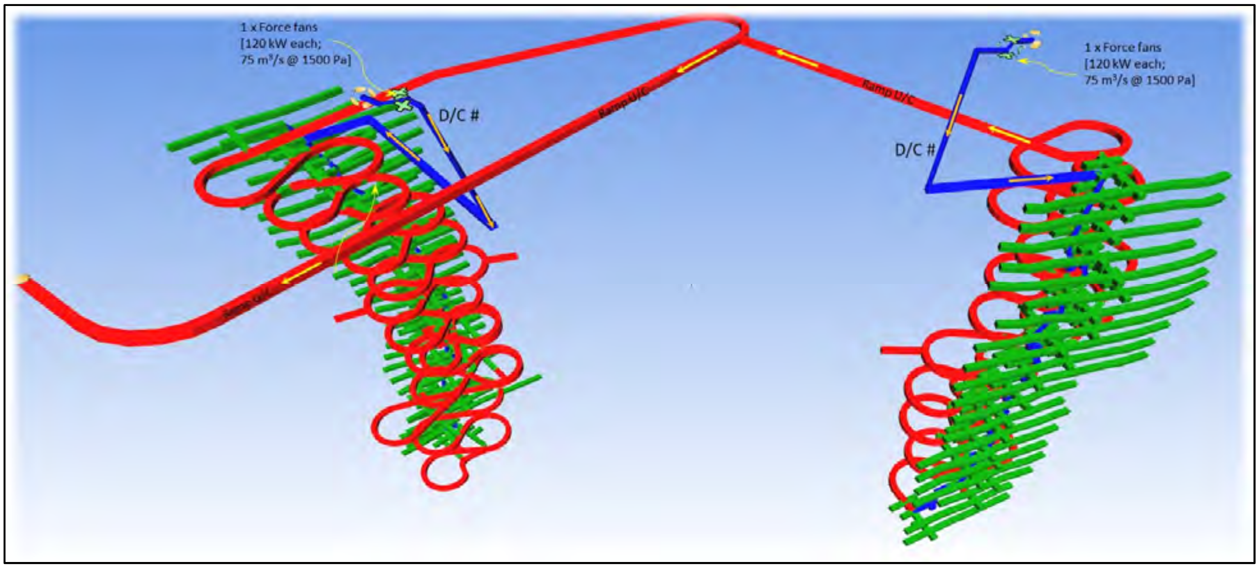


Figure 16-15. Madrid South Ventilation

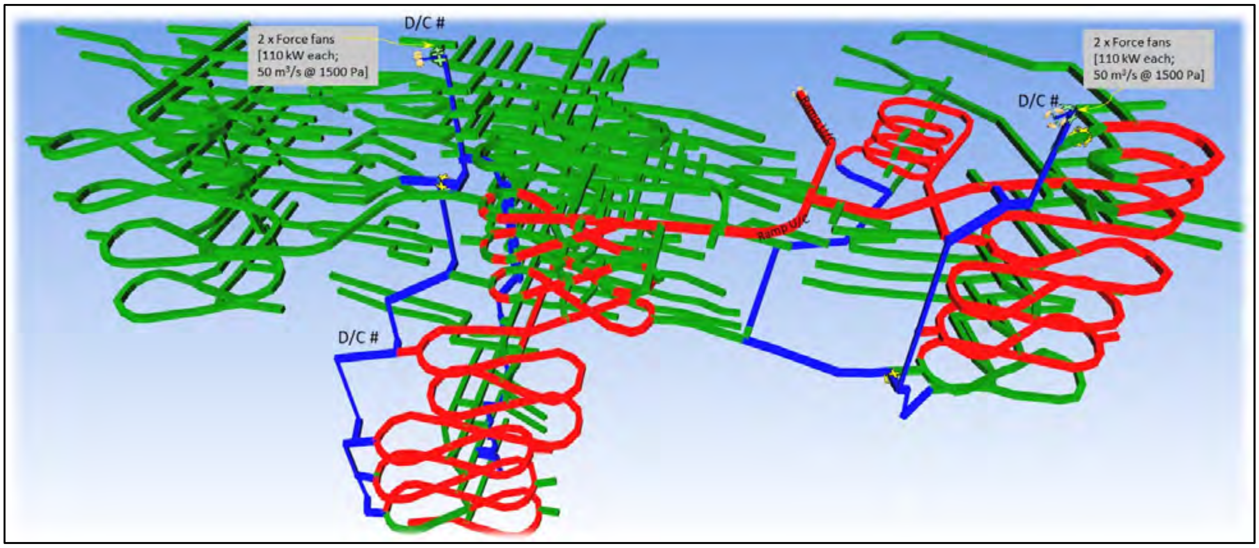


Figure 16-16. Boston Ventilation

VENTILATION INSTALLATION

The surface ventilation installations will be carried out by experienced contractors and suppliers to ensure an adequate installation that as a minimum meets all of the territorial regulations and laws. Equipment will be tested by the supplier during the commissioning process.

Underground ventilation installation will be completed by the mining crews who are experienced in this type of installation and supported by mechanical and electrical tradesman who are equally qualified.

MINE AIR HEATING

Diesel heaters will be installed in conjunction with the main ventilation fans at each site. Heaters are 6 million BTU each, and up to 6 units may be required per main fan system. Diesel for mine air heating will be stored in nearby tanks.

DEWATERING AND PROCESS WATER

The dewatering system is designed to discharge the water from underground directly to surface. Water management on surface is described in Chapter 18.0.

The 2017 SRK report *Hydrogeological Characterization and Modeling of the Proposed Boston, Madrid South and Madrid North Mines, Hope Bay Project*, indicates the following sustainable pumping rates must be maintained to prevent ground water accumulating in the mines:

- Madrid North:1,180 m^3/day; equivalent to an approximate pump flow rate of 14 liters per second.
- Madrid South: 550 m^3/day; equivalent to an approximate pump flow rate of 6.4 liters per second.
- Boston mines combined: In 2020, an SRK study of the Boston inflows were conducted, finding that an inflow rate of 30 m^3/day could possibly be observed in zones that overlapped with the talik. This range was stated with a high lack of confidence and possible variability of 1 to 2 orders of magnitude. During the pre-feasibility design phase, it was decided to locate the mine outside of the talik, with zero associated estimated hydrogeological inflow.

The mine inflows will be made up of fresh water from lake infiltrations and hypersaline water from the surrounding rock. Groundwater around Suluk and Madrid South are expected to be saline while Naartok and Boston are not.

In addition to groundwater, the dewatering design was based on the mobile equipment fleet size and estimated water consumption. Process water from all mines is expected to be approximately 3% CaCl2. Treatment of 50% of the process water is forecast for Naartok and 100% for Boston.

Permanent pumping station will be installed every 60-64 m of vertical height. Pump boxes are temporarily installed on levels below the permanent pumping stations until development attains the required depth. Drain holes are drilled between level sump pits to utilize gravity on levels without main pumps to feed the water to the next available dewatering pump skid. Level intervals are 16 or 20 meters apart in elevation. Temporary face pumps are always located in the ramp to pump drainage water up to the main pump box. For levels below the last pump box, a submersible pump will be installed in a sump located at the lowest level of the mine to pump the water up the last pump box.

Progressive cavity pump skids, such as the monopump EZ Strip dewatering system, have been recommended for use due to their significantly longer life than centrifugal pumps, flow control based on pump speed versus pump delivery head, beneficial equipment layout arrangement and their commercial availability as turnkey dewatering solutions.

Pipe design for the dewatering system is 6” High-Density Polyethylene (HDPE) throughout the mines. The Process water system is currently expected to be serviced by 3” HDPE piping throughout the mines. This value is subject to change according to any efficiencies that may occur in future phases for mine fleet process water requirements.

MAINTENANCE FACILITIES

Small maintenance facilities will be located underground at each mine. These facilities will be equipped to do minor repairs to minimize movement of equipment to surface. Equipment will be transported to the main surface maintenance facilities when needed for preventive maintenance and major repairs.

POWER

The surface power plant is described in Section 18.0 of the report. The power distribution system for the underground mine will be designed to tie-in to the surface power generation and distribution systems.

The underground electrical distribution for each mine will be provided by a 4.16 kV feeder coming from the surface. Underground portable unit substations 4160V- 575V will be used to provide power energy to the electrical loads. The size of the substation will be determined to optimize the electrical distribution system. Each site will require two underground feeders protected by disconnects and a separate feeder for the main ventilation fans.

To energize the mine site, a 4.160 kV feeder will be brought from the point of interconnection down the mine service ramp and to the incoming section of each portable unit substation. A separate feeder, also at 4.160 kV, will be installed to the main ventilation fans. A switchboard will be installed to allow connection to the primary of the transformer of the unit substation with the provision to connect the downstream substation and equipment as required.

The portable unit substation will allow a connection to mining equipment loads which are approximately 150 m away from the portable substation. The substations will be skid-mounted.

Each unit substation will include the following components:

- 5 kV circuit breaker;
- 4.16 kV/ 575 V kV Transformer;
- 575 V protection breaker panel to feed pumps and mining equipment.
- 575 V Distribution panel;
- 120/208 V Load centers c/w distribution panel (for auxiliary services).

Power requirements were based primarily on mobile equipment, ventilation and dewatering requirements, with minor allowances for lighting and auxiliary services. Peak running power requirements for each site are as follows:

- Naartok: 3,961 kW
- Suluk: 2,549 kW
- Madrid South: 1,647 kW
- Boston: 2,490 kW.

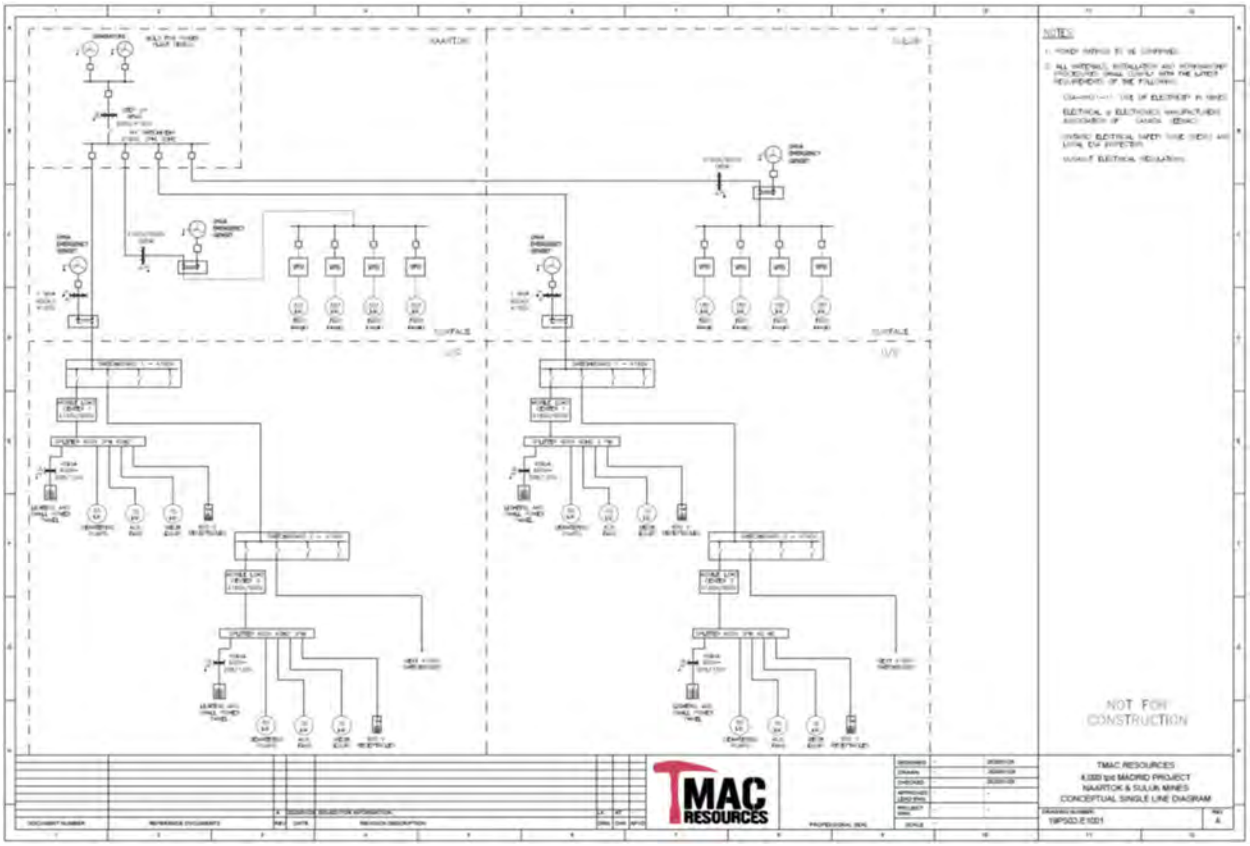


Figure 16-17. Typical Single-Line Diagram (Madrid North)

FUEL STORAGE AND DISTRIBUTION

Satstat fuel stations will be located at strategic points underground to allow for efficient fueling of mobile equipment, particularly equipment such as jumbos and bolters. Trucks will refuel on surface. Satstats will refuel either by exchanging the bladder or by refilling it with the fuel truck. A fuel line is not considered in the current plan; future work plans include a trade off study for a distributed fuel line from surface.

COMMUNICATIONS

Underground communications will be provided by a Leaky Feeder system and the line carried throughout the mine workings to ensure adequate communications for the mine supervisors and operators. Communications costs are included in the unit development cost.

COMPRESSED AIR

No central compressed air system is included in the mine plans for Madrid and Boston. All drilling equipment selected includes on-board compressors. Mobile compressors are included for each site to support pneumatic drilling and other mining activities.

REFUGE STATIONS

Mine refuge stations are planned approximately every three levels to ensure that travel distance to the nearest refuge station does not exceed 1,000 m, as per health-and-safety regulations (Section 1.64 Consolidation of Mine Health and Safety Regulations). Portable refuge chambers will be used to ensure timely deployment of refuge stations as well as the ability to relocate the chambers as needed in the mine and between the mines. When possible, muck bays used during ramp development will be adapted to house the refuge chambers. Latrines will be located near each of the refuge stations.

The chambers are designed to protect 12 workers each for a minimum of 36 hours. All emergency equipment is included in the chambers. Fresh air raises are equipped with ladders to allow for emergency egress.

MATERIAL STORAGE

Materials laydowns are planned for each mine to ensure ready access to frequently used material such as ground support and piping. The laydowns are sized to allow loading of scissor-lifts and bolters. Inventory will be replenished by utility trucks.

Explosives are required for development and production blasting. ANFO will be the most common explosive, with an allowance of approximately 20% emulsion included in the plan. Surface storage of explosives is described in Section 18.0. Separate underground magazines will be constructed at each site to safely store both explosives and detonators. Underground storage near the working areas will minimize the frequency of explosives transportation in the ramp and thus the impact on haulage. Explosives and detonator magazines are designed as per the current standards at Doris.

17.0 RECOVERY METHODS

17.1 OPERATIONS HISTORY

The Process Plant, initially constructed with one train, referred to as the North Concentrating Line (CL1), consisted of secondary and tertiary crushing in series with coarse gold recovery by the Gekko Inline Pressure Jig (IPJ), and downstream ball mill grinding, cyclone classification, and flotation of the sulphide.

Concentrate was transferred from the crushing circuit to the IPJ which concentrated gold and sulphide. That concentrate was sent to the regrinding circuit, where a low G-force gravity centrifugal concentrator also manufactured by Gekko called the Inline Spinner (ISP) was responsible for recovering liberated free gold and directing it to the batch intensive leach circuit for recovery. Flotation concentrate was also transferred into the regrinding circuit where it was subject to treatment of the ISP.

The original process plant design and operation is detailed in the Gekko report "TMAC Resources Inc. Hope Bay Project SC0540 Engineering Study Final Report Gekko Systems Pty Ltd" dated October 2014.

17.2 CURRENT RECOVERY AND THROUGHPUT

ORIGINAL DESIGN CRITERIA

- Concentrator availability was 92% (8,059 hours per annum), which included availability in the CTP.
- CL feed was 2 x 62.5 t/h (IPJ con bypassed mill), 9.8 g/t, 2 x 605 g/h Au.
- Plant throughput the mill was 55 t/h for Doris ore. For Naartok ore, it was 43.0 t/h.
- SG of ore was 2.8
- Concentrator recovery was 96.8%. 69.4% by gravity, 27.4% was by flotation.
- Flotation Feed was 52.5 t/h, 2 x 174 g/h Au. Flotation tail was net 52 g/h Au at 0.36 g/t.
- Leach throughput design was 10 t/h. Generated by mass pull 4.55% to gravity by IPJ, 4.55% by flotation = 9.09%.
- Leach Treatment recovery was 97.9%. Leach residue tail grade was 23.56 g/h consisting of 82% solids at 6.9 g/t (8.4 g/h) and 18% solution at 0.8 PPM (15.2 g/h). 6.9 g/t.
- Solution tail grade was reported a 0.6 g/h at 0.8 g/t.

CURRENT OPERATING PARAMETERS (2019)

- Concentrator availability is 65.5% in CL1 and 67.0% in CL2 (2019). CTP availability was 86.3%.
- CL1 feed was 49.5 t/h to CL1 and 52.7 to CL2.
- Concentrator recovery was 90.0%. Flotation tail grade was 0.93 g/t.
- Leach throughput was 2.5 t/h. Combined gravity and flotation mass pull was 3.2%.
- Leach Treatment recovery was 96.3%. Leach residue tail grade was 9.3 g/t. Solids loss represented 3.3 %.
- Solution loss was 5.1 % at 5.5 mg/L.
- Overall recovery was 81.6%

In the first two months of 2020:

- Combined gravity and flotation recovery was 92.1% (CL1 = 92.6% and CL2 91.6%).
- Recovery from Gravity by leach circuit was 95.2%.
- Losses were: 7.9% to flotation tail, 2.6% to solid tail, 5.4% to solution loss.
- Overall recovery = 84.7%

The recovery projected over the next 4 years of operation using the existing plant is 85.1% at a feed grade of 6.9 g/t.

17.3 CURRENT FLOWSHEET DESCRIPTION

The plant recovers gold from the ore using a combination of gravity concentration and flotation. Flotation tailings, devoid of sulphides are sent to the TIA at a relatively coarse grind of 80% passing (P_{80}) 150 µm. Gravity concentrates recovered by batch continuous centrifugal concentration are treated by intensive cyanidation at elevated pH and cyanide concentration for recovery of gold from the leach liquor by direct electrowinning in the Batch In-Line Leach Reactor (BILR). Flotation and continuous centrifugal concentrate are ground to P_{80} 37 µm in the presence of cyanide at concentration relatively lower than that in the BILR, in a series of six horizontal, rotating, leach vessels, referred to as the Continuous In-Line Leach Reactor (CILR), and the resulting pregnant solution is contacted by resin and the gold adsorbed. That resin is subsequently stripped of the gold in an elution circuit and directed to electrowinning. Subsequently, electrowinning sludge is collected and directly smelted.

CRUSHING, SURGE TANK, GRINDING, AND GRAVITY

Refer to Figure 17-1 – Block Flow Diagram: Crushing, Surge Tank, Grinding, Gravity.

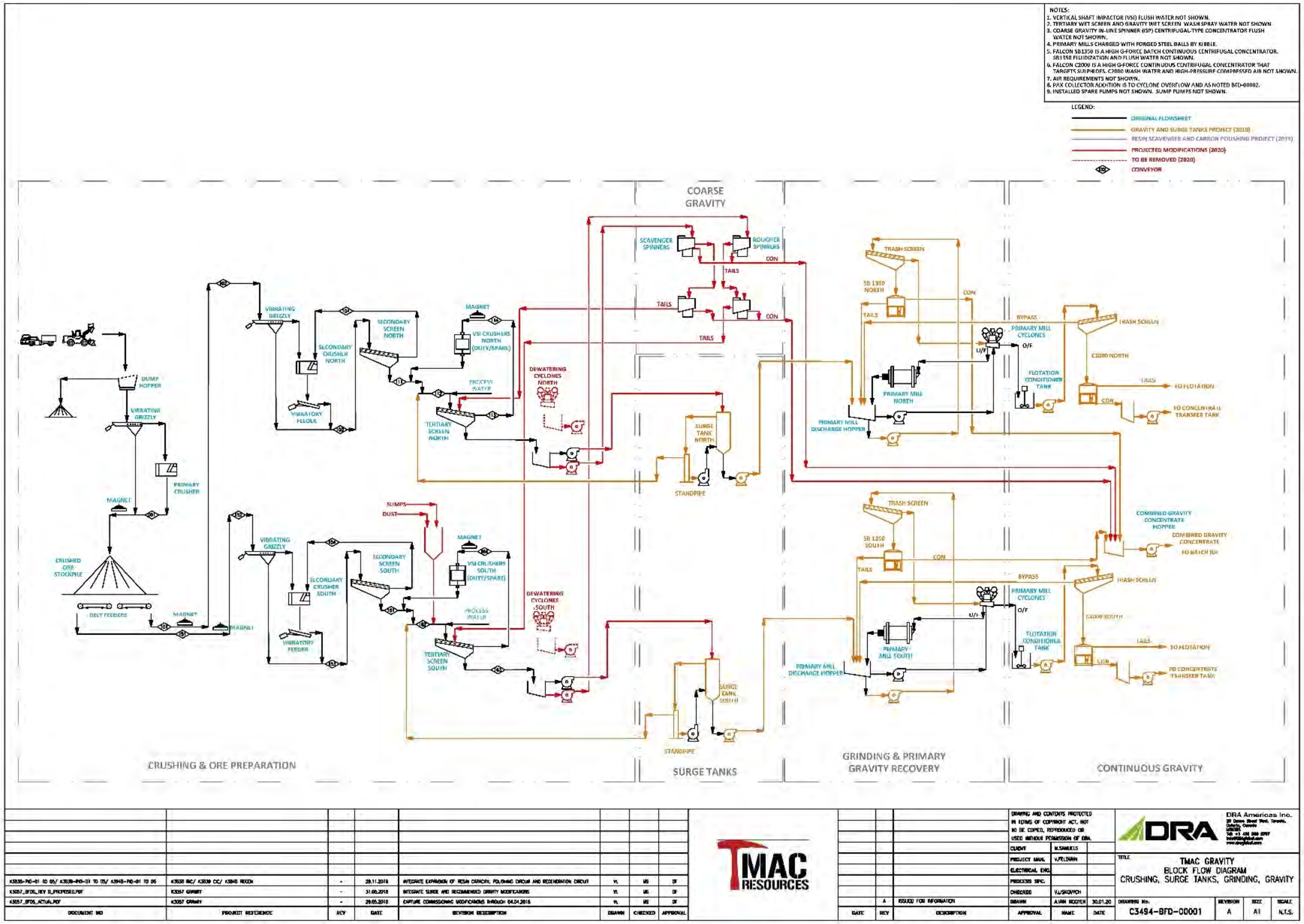


Figure 17-1. Block Flow Diagram: Crushing, Surge Tank, Grinding, Gravity

The primary, secondary and tertiary crushing circuits reduce Run of Mine (ROM) ore to a size where grinding and separation processes can effectively operate. A wet surge bin is installed between the crushing circuit and the grinding circuit to allow for approximately 45 minutes of operational capacity to be built up, in order to ensure that the downtime in the crushing circuit does not disrupt grinding and flotation operations.

PRIMARY CRUSHING AND STOCKPILE

The primary crushing circuit is a fixed construction installed outside and to the east of the main plant building. It effectively operates at ambient temperature. After installation, the perimeter of the crusher "building" was established by the stacking of sea-containers to support a sprung-type roof that was installed above the crusher to protect it from rain and snow.

ROM material is hauled by trucks to the ROM pad to designated high-grade, intermediate, and low-grade stockpiles adjacent to the primary crusher area. A front-end loader reclaims ore from the ROM pad and feeds it onto the 600 mm primary crushing static grizzly to scalp oversize material into, a 26 m^3 dump hopper. Oversize is removed and crushed by a mobile rock breaker.

A vibratory grizzly feeder scalps out minus 80 mm ore via a fines feed chute, and feeds the oversize into the primary jaw crusher, a Metso Nordberg C100, with a product that is 95% passing (P_{95}) 125 mm. The vibrating grizzly undersize and crusher discharge are conveyed by the primary crusher discharge conveyor (CV), under a self-cleaning belt-type tramp metal magnet t to the stockpile. A weightometer is installed on the stockpile feed conveyor for throughput measurement and control.

The primary crushing circuit product has a P_{80} of 100 mm. At 50% utilization, the nominal operating rate is approximately 200 t/h but crushing rates can exceed 250 t/h if required. The stockpile has a live storage capacity of 4 hours and can store and total capacity of 36 hours. The crushed ore stockpile was completely enclosed by a steel-fabricated structure following the plant start up.

Crushed ore is reclaimed to feed each concentrating line, CL1 North and CL2 South, via separate reclaim tunnels for each train using two reclaim tunnel apron feeders, discharging onto two plant feed conveyors. A weightometer is installed on each plant feed conveyor for feed rate control. The secondary and tertiary crushing circuits are low profile, modular construction supplied by Gekko systems, known commercially as the Python crushing trains. Both North and the South concentrating lines are nearly identical.

SECONDARY AND TERTIARY CRUSHING

The plant feed conveyor discharges to the secondary crusher feed conveyor and onto a vibrating grizzly feeder. A fixed-type electromagnet is installed to remove tramp iron at the transfer point between conveyors. The vibrating grizzly removes minus 50 mm material and the secondary jaw crusher, Metso model C80 crushes the oversize to a P_{95} of 50 mm. A metal detector is will stop the conveyor travel when metal is detected in the conveyed material. Metal can be ground-engagement steel from mobile mining equipment, as well as ground support material from underground.

The secondary crusher discharge reports to a vibrating feeder that combines the crusher product with the grizzly undersize, and the blended feed is then to the secondary dry horizontal screen, 1.2 m x 2.45 m, for sizing at 40 mm. The oversize is returned to the secondary jaw crusher for

further crushing. A fixed-type magnet has been installed the head end of screen feed conveyor, along with metal detection. The undersize product is transferred to the wet tertiary screen.

The tertiary screen is fitted with panels having a 4 mm aperture by 25 mm long. The oversize from tertiary screen, is conveyed to one of the duty/standby tertiary crushers, Remco model 1530 vertical shaft impactor (VSI-type), 260 kW, for further size reduction. The transfer conveyors are fitted with a fixed-type magnet for removal of scat metal. Each train with two sets of crushers is fitted with a dedicated hydraulic changeover system, and the VSI set are run off a common Variable Speed Drive (VSD), intended to allow for adjustment of the speed to increase rock breakage, or alternatively reduce wear on the rotors. The tertiary crusher product is conveyed to the tertiary screen for closed circuit operation.

The tertiary screening operation is a critical unit operation to provide feed appropriately sized for the grinding circuit, and for coarse gold in the gravity circuit. One of the two wet tertiary screens was replaced by a new 1.8 m x 6 m Con-Weld screen in November 2019. Maintenance management of the tertiary screen will likely require the presence of a rotatable spare on site, or further monitoring to ensure delivery in the year of replacement by sealift.

The crusher product at a design transfer size of approximately P_{80} 1.7 mm reports to the tertiary screen undersize hopper from which it is pumped by one of two duty/spare pumps to the dewatering cyclones. The dewatering cyclones return water to the tertiary screen feed box for mixing with new feed, while the underflow discharges in the surge tank feed pump hopper.

Dust from the secondary and tertiary crushing circuits is collected by a dedicated dust collector. In 2019, the dust collector was moved to allow for the space to be dedicated to expansion of the adsorption operation. Further modifications and improvements are planned to be engineered and installed in 2020 to improve dust collection from the crushing circuit, which is effectively installed within the main mill building.

The availability of the secondary and tertiary crusher is a critical factor in establishing the achievable throughput to the plant. While originally designed for 92% availability by the supplier, actual operating hours of the circuit are considerably lower. Nominal design criteria of 55 t/h per train have been regularly reported, and to some extent, the operation team compensates by operating the crushing circuit at up to 62 t/h when available.

Some of the reasons for the lower than design operability include: tramp metal removal, conveyor belt breakages, build up in chutes and feeders, build up below the conveyors due to spillage, VSI rotor breakage, and VSI wear resulting in frequent changeover between duty crusher and the spare. Crushing circuit operating data for 2019 is shown in Table 17-1 below, benchmarked against the reclaim feeders feeding the CLs from under the crushed ore stockpile:

Table 17-1. 2019 Crushing Circuit Data

Line	t/h (operating hour)	Availability*Utilization
Concentrating line 1 (N)	49.5	65.5
Concentrating line 2 (S)	52.7	67.0
Concentrating line (Blended)	51.1	-

WET SURGE TANK

The 2 m^3 surge tank feed hopper transfers dewatered slurry from the dewatering cyclones to the surge tank at a density of no less than 37% solids, typically 50% solids. The slurry top size has been measured to be P_{90} 3157 µm, with a typical transfer size P_{80} of 1700 to 2200 µm. Approximately 7% of the slurry is fines at less than 75 µm.

The surge tank has a total fill volume is 70 m^3. Surge tank design feed rate is up to 62 t/h, which exceeds the design capacity of the grinding and flotation circuits downstream.

Solution injection is used to fluidize settled slurry in the surge tank for consistent flow to the grinding circuit at the design rate of 55 t/h and a target density of 55-60% solids via duty/spare surge tank underflow pump.

The surge tank has allowed for an increase in operating time of 10% to 11% in the grinding and flotation operations for the 6-month period between August 2019 and January 2020, representing more stable grinding and flotation density.

PRIMARY GRINDING AND GRAVITY CONCENTRATION

The primary milling circuit grinds ore to a target of P_{80} of 150 µm for flotation. The primary ball mill operates in closed circuit with the primary cyclones, with the overflow reporting onto the continuous gravity concentrator and the flotation circuit. Like the crushing circuit, the grinding and gravity concentration circuits are duplicated.

The surge tank underflow pump feeds the grinding circuit by transfer of slurry into the primary mill discharge pumpbox. This pumpbox originally had a volume of 2.5 m^3 but was increased to 7.5 m^3 during the gravity circuit upgrade in 2018. The duty/spare primary mill discharge pump feeds the primary grinding cyclone cluster in closed circuit. The cyclone distributor feeds the six Weir Cavex 250CVX20 cyclones mounted parallel to each other. Normally 3 cyclones are run to produce the target cut size to the cyclone overflow, allowing 3 cyclones to be on standby or for the completion of maintenance. Automated valves feeding the cyclones can be remotely opened and closed from the mill supervisory control and data acquisition system (SCADA)

The underflow slurry from the cyclones return to the primary mill at 78-80% solids for further grinding, while the overflow at 28-32% solids reports to the agitated 5 m^3 rougher flotation feed tank at a grind target of P_{80} of 150 µm, which was lowered from the original design criteria of 212 µm.

The primary mill is a frame-mounted overflow-type Outotec model 15-04 which is 2.7 m in diameter and has a 4.88 m long effective grinding length (EGL). The mill is installed with a 450 kW variable voltage variable frequency (VVVF) drive. Like the crushing circuit, the ball mill was installed quite low to the ground, which challenges operational removal of steel scat built up from the integrated trommel screen. The primary gravity batch centrifugal concentrator is fed from the ball mill discharge pumpbox. The duty/standby batch concentrator feed pump delivers slurry from the ball mill discharge pump box to a Sizetec stepdeck vibrating wet trash screen, 0.9 m x 2.4 m, fitted with 2.4 mm aperture screens. This removes oversize material and returns it to the ball mill for further grinding.

Underflow from the vibrating screen is directed to a Falcon SB1350B semi-batch centrifugal gravity concentrator to recover the liberated gold particles. The feed stream particles are

subjected to gravitational forces of up to 200G and are segregated according to effective specific gravity along the smooth spinning rotor wall.

When the bed has built up to a sufficient grade, the feed is stopped, and a built-in spray manifold rinses the concentrate into a concentrate launder. The system is automated to bypass the concentrator during its wash and flush cycle.

Gravity concentrate is directed to the gravity concentration pumpbox, where it is transferred onto the intensive leach circuit. The cycle time and the G-force is varied to maximize mass pull to the intensive leach circuit. Typically, gravity concentrate is produced that grades 750 g/t to 7,500 g/t.

CONTINUOUS GRAVITY CONCENTRATION

Continuous gravity concentration was inserted into the circuit in 2018 with commissioning into early 2019, to mitigate the low calculated residence time in flotation. A Falcon C2000 was installed upstream of the flotation circuit to reduce the loading of sulphide into the flotation circuit.

Cyclone overflow at P_{80} 150 µm is transferred by gravity to the rougher flotation feed tank. The feed tank has been modified to allow for overflow directly to the first rougher flotation cell when the continuous gravity circuit is not operating. Instead, slurry is withdrawn from the feed tank at nozzle located near the bottom of the tank and pumped by the continuous concentrator duty/standby pump to the Sizetec stepdeck vibrating wet trash screen, 0.9 m x 2.4 m, fitted with 0.9 mm aperture screens at 55 t/h. Oversize trash and ore particles are subsequently removed from the flotation circuit and returned to the ball mill by gravity.

The undersize of the continuous gravity feed screen is directed to a Falcon SB2000B continuous concentrator to scavenge sulphide particles as well as finer liberated gold particles from the slurry stream. The screen undersize can be bypassed around the continuous gravity concentrator by an automated valve to allow for maintenance and to continue to ensure trash removal to the flotation circuit downstream.

Concentrate is bled out of the unit without feed interruptions into a concentrate collection standpipe and transferred by dedicated slurry pump to the combined concentrate transfer (CCT) tank. Concentrate produced by the C2000 concentrator typically grades between 100 to 300 g/t and represents up to 2% of the mass pull.

FLOTATION, CONCENTRATE AND TAILINGS HANDLING

For the subsequent section, refer to Figure 17-2– Block Flow Diagram: Flotation, Concentrate and Tailings Handling.

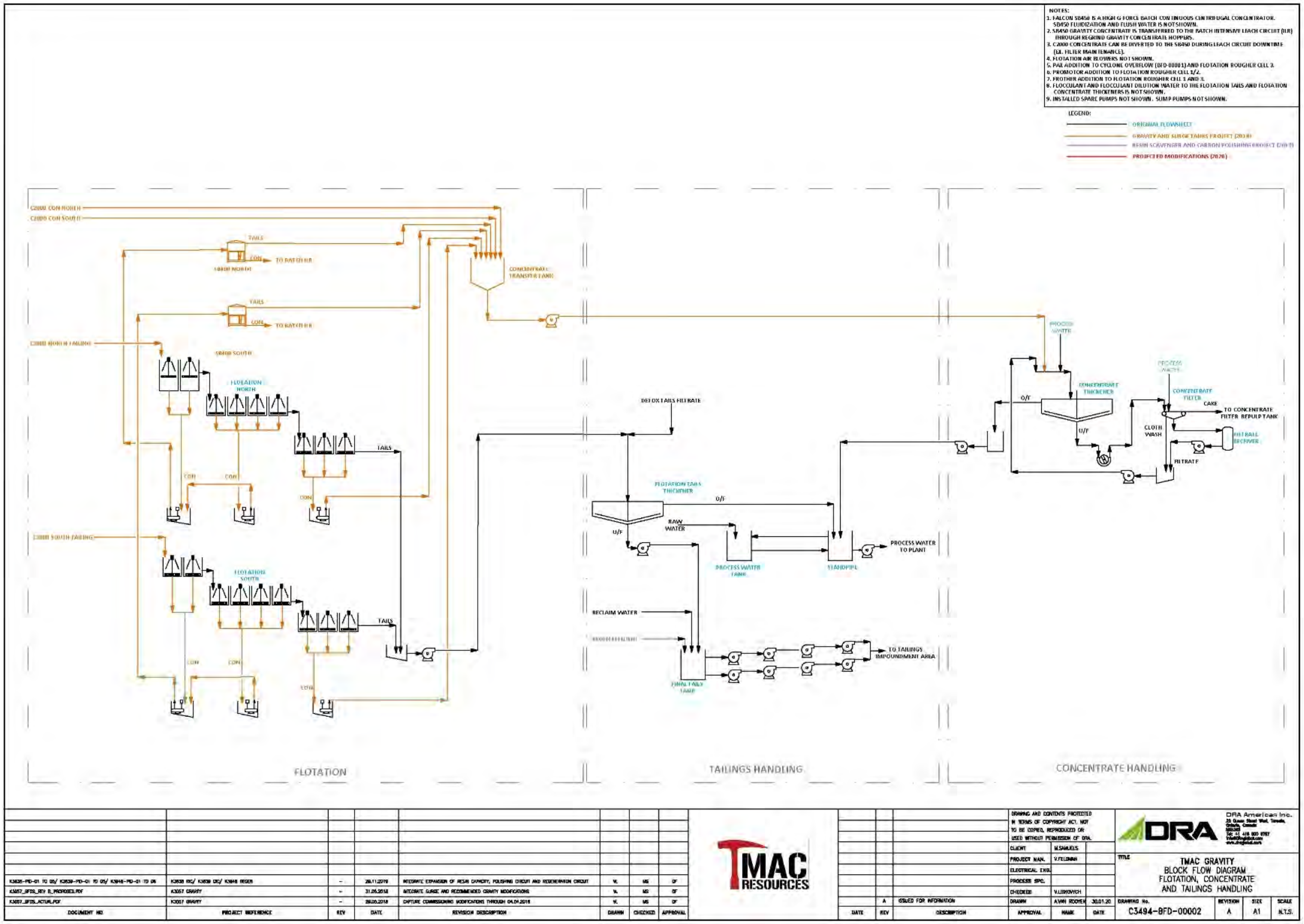


Figure 17-2. Block Flow Diagram: Flotation, Concentrate and Tailings Handling

ROUGHER FLOTATION

Reject from the continuous concentrator (or overflow from the flotation feed tank) is directed to the rougher flotation circuit. The flotation circuit consists of nine 5 m^3 Metso RCS-5 tank cells. Originally installed as a rougher-scavenger with a 2,2,3 bank configuration and two cleaner cells at the start of the flotation train, the circuit has since been converted to a single rougher circuit with a bank series profile of 1,1,2,2,3. The reason for the change in strategy was the observation that the greater the mass pull, the greater the flotation recovery. At the time, circuit sampling also indicated that the sulphide (relatively low in concentration for Doris ore at less than 1%) was slow floating, and very fine gold and sulphide at 5-20 µm was observed in the flotation tailing. This observation also indicated that the prior gravity set up consisting of the IPJ installation was not successfully removing gold and sulphide, leading to overgrinding in the ball mill circuit.

Reagents (collector, promoter and frother, respectively) are added as required at the locations shown in Table 17-2 below:

Table 17-2. Flotation Reagent Dosing

Location	PAX (g/t)	Promotor (g/t)	Frother (g/t)
Cyclone Overflow	60	0	0
Float Cell 1	0	5	2
Float Cell 3	30	10	5

Rougher flotation concentrates from the first six cells pumped to the SB400 batch continuous concentrator. Similar in operation to the SB1350, the SB400 operates without pre-screening to upgrade fine particles and directs that concentrate directly to the intensive leaching circuit by gravity flow. The SB400 can generate substantial grades because of the low feed rate (1.1 t/h). Concentrate grade produced by the SB400 typically grades 10,000 to 40,000 g/t depending on the cycle time and the plant feed rate. The reject from the SB400 concentrator is directed by gravity flow back to the CCT.

Similarly, rougher concentrate from cells 7 to 9 is collected and pumped to the CCT. CCT concentrate is pumped to the concentrate thickener.

Froth depth in the rougher cells is controlled by releasing slurry through dart valves at the base of each of the banks. Froth depth can be monitored by a Siemens Sitrans probe (float), and the set point entered by an operator.

Total retention time in the rougher circuit is approximately 22 minutes of retention time at a flow rate of approximately 53 t/h (accounting for gravity concentrates removed).

FLOTATION TAILINGS

Flotation tailings are recombined by the flotation tailing pump box and pumped by the tailing thickener duty/standby pump to the flotation tailings thickener feed launder. Flocculant is added to assist with settling. The tailings thickener is a 14 m diameter Outotec high-rate thickener. The flotation tailings thickener underflow is pumped to the tailings transfer tank by the duty/standby thickener underflow peristaltic pumps. The thickener overflow water reports to the process water tank, which has a capacity of 20 m^3. The thickened flotation tailings at 50% solids may be mixed with other waste streams such as those from the reagent mixing area and the resin regeneration

system, and pumped to the TIA via one of two sets of duty/spare four-stage centrifugal slurry pumps. The single tailings line is insulated and heat traced from the mill to the final discharge point at the TIA.

CONCENTRATE THICKENING, FILTERING, (STORAGE)

Flotation concentrates are combined in the CCT and pumped to the concentrate handling area. The concentrate handling area prepares both bulk-continuous gravity and flotation concentrates for further treatment. The concentrate handling area separates the two distinct water/solution types of the plant. Downstream of the concentrate handling area of the plant, unit operations utilize makeup barren solution containing high levels of cyanide and caustic in the solution, with minimal addition of raw water; whereas upstream, all areas must use process or raw water that is free of cyanide. As a result, operations in the concentrate handling area are critical for minimizing the amount of cyanide-containing barren solution that is bled from the circuit, along with lowering cyanide and caustic soda consumption, by minimizing the amount of raw water and process water entering that circuit.

Concentrate from the flotation circuit and the C2000 continuous concentrator is pumped to the concentrate thickener, nominal capacity 10 t/h, to recover excess water. The tailings thickener is a 4 m diameter Outotec high-rate thickener. The modelled net feed loading rate is 4 $m^3/(m^2 \cdot h)$, which is currently under engineering review by Paterson & Cooke to examine the potential to refit the thickener with a more robust feed system and increase the achievable throughput. The thickener underflow, drawn by the duty/spare underflow peristaltic hose pump at up to 65% solids is then pumped to the concentrate continuous belt filter. The belt filter is an Outotec LAROX RB-SV belt filter. Nominal feed capacity of filter is 6.6 t/h with a design filtration rate of 1.5 $t/h/m^2$, producing a target filter cake moisture of 12% solids. Filtrate is transferred by a set of duty/spare pumps back to the concentrate thickener.

The concentrate thickener overflow and the concentrate filter filtrate (cyanide-free) are pumped to the tailing thickener overflow tank for re-use. The filter cake product is discharged to the concentrate re-pulp tank by gravity. While originally the filter cake discharged onto a discharge conveyor, this proved to be ineffective, and it was replaced with a chute and spray water, discharging the re-slurried product by gravity to the agitated concentrate re-pulp tank. The ability to increase bleed rates of barren solution through the polishing circuit being constructed in 2020 may allow for complete removal of the filter.

During periods when the CTP is not running due to regularly weekly maintenance, temporary by-passing of the combined continuous gravity concentrators allows for continued operation of flotation unit operations, with the concentrate accumulated in the concentrate thickener. In 2020, it is planned that a dedicated surge tank will be constructed in the concentrate handling area to more effectively address this situation and reduce process upset.

CONCENTRATE REGRIND, LEACH, AND DETOXIFICATION

For the subsequent section, refer to Figure 17-3 - Block Flow Diagram: Concentrate Regrind, Leach, and Detoxification.

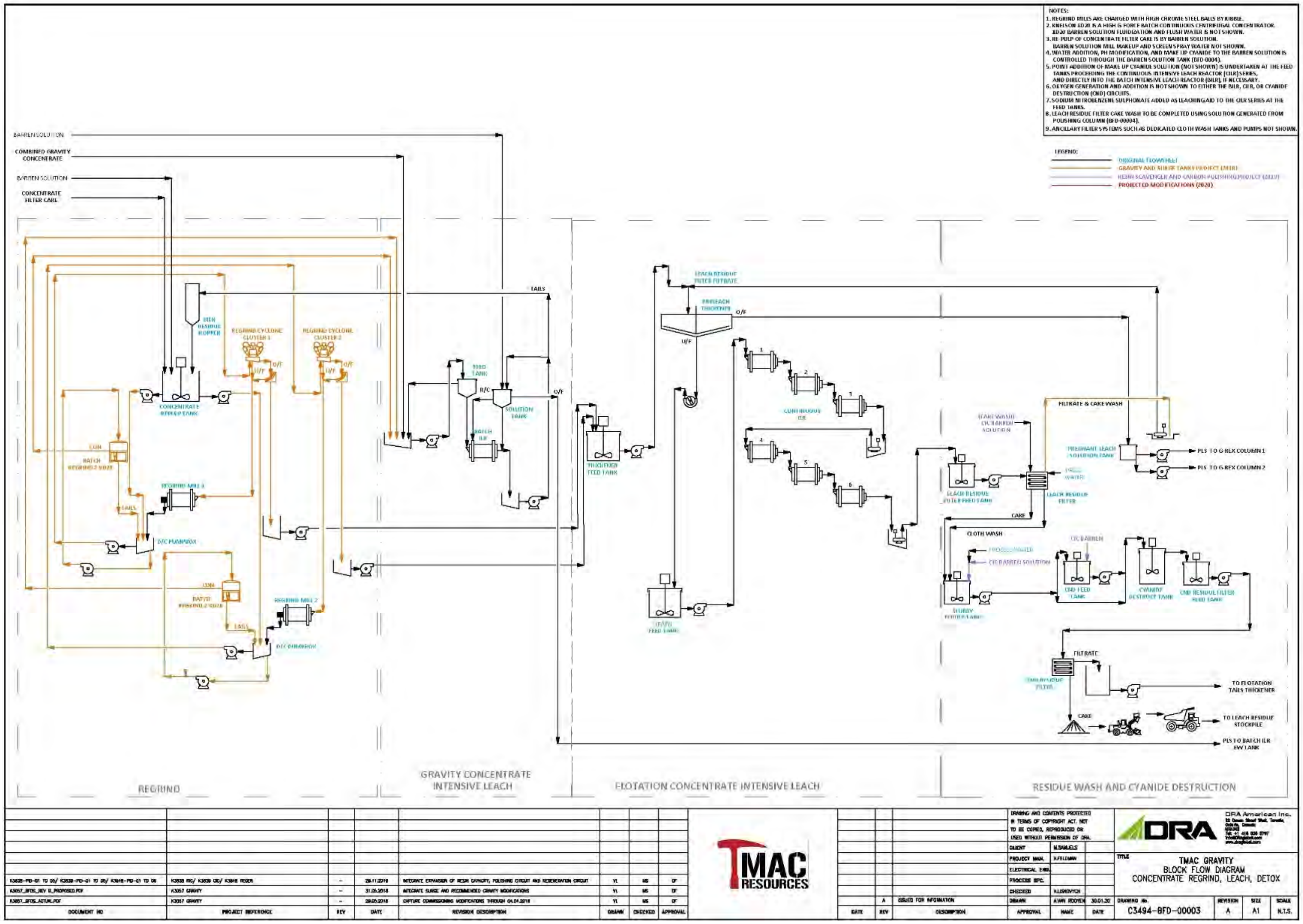


Figure 17-3. Block Flow Diagram: Concentrate Regrind, Leach, and Detoxification

REGRIND AND REGRIND GRAVITY

Operation of the flotation and continuous concentrating circuit produces concentrate that typically has a P_{80} of 88 µm. The regrind milling circuit grinds material to a size appropriate for processing by cyanide leaching. Regrinding the filter cake in barren solution pre-treats the materials to provide extra leach time and reduces the volume of solution bled to the detoxification circuit. The regrind ball mill operates in closed circuit with the regrind cyclone, with the overflow reporting to the continuous leaching circuit. Like the crushing circuit, the regrind ball mill and regrind gravity concentration circuits are duplicated with regrind circuit. Under current conditions, where the combined mass pull from continuous gravity concentration and flotation rarely reaches 5%, only one regrind circuit is required to run.

Concentrate filter cake is fed to the concentrate re-pulp tank where barren leach solution is added to blend the solids to a target density of 57%. This tank is a 2.4 m^3, fitted with a 4kW agitator and duty/standby pump to transfer slurry into the regrind ball mill discharge pumpbox. This pumpbox originally had a volume of 0.4 m^3 but was increased to 0.9 m^3 during the gravity circuit upgrade in 2018. The duty/spare regrind mill discharge pump feeds the regrind cyclone cluster. The cyclone distributor feeds the two Weir Cavex 150CVX06 cyclones. Normally, only 1 cyclone is run to produce the target cut size to the cyclone overflow, allowing one cyclone to be on standby or for the completion of maintenance.

The underflow slurry from the cyclones returns to the regrind mill at a target of 65-75% solids for further grinding, while the overflow at 20-25% solids reports to a safety screen integrated into the cyclone overflow discharge launder, fitted with 1 mm slots. Screen oversize is returned to the grinding mill, while undersize flows by gravity to the agitated 5 m^3 continuous leach feed tank. The regrind target product was originally a P_{80} of 37 µm, although it has subsequently been lowered to 25 µm to achieve recovery targets. The circulating load target in the regrind circuit is now more than 350%.

The primary mill is a frame-mounted overflow-type Outotec model 15-05, which is 2 m in diameter and has a 3.4 m EGL. The mill is installed with a 160 kW VVVF drive. Grinding media consists of high chrome steel, containing 30% chrome, at 38 mm in diameter, in order to reduce the generation of iron and oxidation of the pyrite at the fine grind target.

Should the mass pull increase in the future beyond 5%, the second regrind circuit may need be run in parallel. Since the regrind mills were original designed to handle material up to P_{80} 700 µm produced by an IPJ circuit, the point at which the second mill will need to be turned on to reach the target grind. Data presented on Naartok indicates that flotation mass pull will be higher and the ore harder.

The regrind batch centrifugal concentrator is fed from the regrind mill discharge pumpbox. The duty/standby batch concentrator feed pump delivers slurry from the regrind mill discharge pump box to the batch centrifugal concentrator without screening. This orientation minimizes the cyclone installation height and maximizes the presentation of the slurry to the gravity concentrator.

Gravity gold and some sulphide is recovered by the FLSmidth Knelson XD-20 semi-batch centrifugal gravity concentrator. The mechanics of operation of the machine is like the Falcon SB.

Gravity concentrate is directed to the regrind gravity concentration hopper, where it is transferred onto the intensive leach circuit. The cycle time and the G-force is varied to maximize mass pull

to the intensive leach circuit. Typically, gravity concentrate that is produced is 500 g/t to 2,600 g/t.

INTENSIVE LEACH CIRCUIT

Gravity concentrates produced in the primary circuit, the flotation circuit, and in the regrind circuit are pumped to a 5 m^3 conical bottom feed tank. As an overall strategy, deportment of gold to the intensive leach reactor is favoured rather than the downstream continuous leach circuit due to the very high recoveries achieved. Combined with direct electrowinning, gold recovery from this circuit exceeds 98.5%

Leaching is undertaken by feed of this material in batch to a single batch reactor, the Gekko In-Line Reactor (ILR) model 2000. Treatment capacity is nominally 4 t per cycle over an average batch residence time of 12 to 16 hours; and accounting for loading and unloading, there is one cycle undertaken each day. The gold is leached in the rotating drum using contact with sodium cyanide, the leaching aid sodium nitrobenzene sulphonate (SNBS), and oxygen as reagents; with sodium hydroxide used for pH adjustment. Typically, the cyanide target can reach 20% as CN^- on a mass weighted basis to the concentrate.

At the end of the cycle, flocculant is added to the discharge to aid in solid settling and to obtain clarified pregnant leach solution, which is pumped to the batch electrowinning feed tank. Barren solution from the barren solution distribution pump is used to further wash the solid residue to recover addition solution that is also sent to the batch electrowinning feed tank.

The leach residue is pumped to batch ILR residue hopper to be bled back into the regrind circuit. Given the grades involved, even at 98.5% recovery, the grade of the residue from intensive leaching can be significant, so it is bled slowly into the circuit over the 24 hours cycle of the subsequent batch.

CONTINUOUS LEACHING

The leaching process recovers gold from regrind circuit into solution. Gold is extracted by the chemical reaction with cyanide and oxygen, which dissolves the gold into solution, producing the $Au(CN)_2^-$ anion. The leaching reaction is augmented by use of the leaching aid, SNBS, which is a slow-acting oxygenator.

The regrind cyclone overflow reports over the 1 mm safety screen and flows by gravity to the agitated leach feed tank, 9 m^3. A set of duty/standby pumps directs the slurry immediately to the pre-leach thickener.

Pre-leach thickener solution separates the gold-bearing pregnant leach solution from the solid gangue material. That solution is sent to the resin circuit to be further upgraded, while the underflow solids are sent to the CILR for further leaching.

About 50-60% of gold recovery comes directly from the regrind circuit by deporting to the overflow of the pre-leach thickener. The balance of the gold recovered is from the continuous ILR circuit by leaching with additional residence time and separately recovered from the leach residue filter by solid-liquid separation.

The pre-leach thickener is a 6 m diameter Outotec high rate thickener. Modelled net feed loading rate is 4 $m^3/(m^2 \cdot h)$. The feed system, consisting of launder and well, is currently under engineering review by Paterson & Cooke to examine the potential to refit the thickener with a more robust feed

system. Flocculant is added to the thickener to assist with the settling rate and clarity. The thickener underflow, drawn by the duty/spare underflow peristaltic hose pump at 52% solids is forwarded onto the continuous ILR circuit via the second agitated leach tank, 9 m^3, the density dictated by the ability for mass transfer of oxygen into the system.

Overflow pregnant solution from the thickener is directed to the 15 m^3, resin feed tank.

The continuous ILR vessels are made up of six horizontal, rotating drums, operated in series. Each vessel can hold approximately 5 t of solids. Slurry from the second leach tank is pumped by the duty/standby leach feed pump to the head of the ILR train. Slurry flow cascades through ILR vessel 1 to 3 by gravity, whereby, the slurry is returned by a single duty pump from a 0.3 m^3 discharge pumpbox to ILR vessel 4. Slurry flow cascades through ILR vessel 4 through 6 by gravity, whereby the residue product at ILR vessel 6 is pumped by a dedicated duty pump to the leach residue filter feed tank, an agitated 85 m^3 tank. The leach residue filter feed tank provides up to 6 hours of additional leach residence time to the circuit.

As a system, gold is leached using sodium cyanide and oxygen as reagents; with sodium hydroxide used for pH adjustment. Free cyanide concentration in the feed to the circuit is targeted at 5000 to 6000 mg/L and a range of 2000-3000 mg/L at discharge. pH is maintained above 10.8. An important operational consideration is that the pregnant solution pH should not exceed pH 11.0 since this is detrimental to adsorption on resin. An online cyanide analyser monitors and controls cyanide addition to the ILR feed tank. Since April 2018, the leaching agent SNBS, a slow acting oxygenator has been added to the feed to the ILR drums to augment oxygen addition. The impact of SNBS was significant reducing the leach residue gold grade from above 15 g/t to less than 8 g/t.

RESIDUE FILTRATION

Leach residues are stored in the leach residue filter feed tank and pumped to the leach residue filter. The filter is a vertical tower Outotec model LAROX PF 28/32 automated pressure filter with a filtration area of 12 m^2. The original design criteria filter availability was 87.5%, and it is regularly exceeded on a monthly basis. The filter operates on a batch basis. There is no standby filter installed.

The filtrate from the filter is sent to the continuous leaching area sump. The filter cake is squeezed by the filter membrane and washed with barren filter solution to displace high-grade gold solution in the filter cake. Wash cycle solution, drips, and the cake drying solution from the filtration cycle is also sent to the sump. This sump pump delivers the reclaimed solution to pre-leach thickener feed launder for further removal of solids before the clarified solution reports to the thickener solution overflow.

the filter cake is discharged onto the leach residue filter discharge screw conveyor, which deposits the cake into the leach residue re-pulp tank. Currently, the solids are re-pulped using a prescribed volume of barren bleed solution containing cyanide and process water; however, in 2020 this barren cyanide solution, as well as cake wash solution, will be replaced with polishing solution before being pumped to the detox holding tank. Because barren solution is currently used, the amount of gold in the barren solution controls the losses of the solution tail. For this reason, construction commenced in 2019 on the addition of a polishing stage referred to as the carbon-in-column (CIC) circuit to further reduce the gold solution tenor that is achieved by current resin operations and obviate the losses created by the presence of gold in the washed filter cake pore volume water and in the solution used to re-slurry the cake for transfer to the detoxification circuit.

DETOXIFICATION

Leach residue solids are pumped from the 15 m^3 agitated detoxification (detox) holding tank to achieve a slurry density of 30-40%. That slurry is then pumped to the detox reaction tank at up 10 t/h.

Detox is carried out using sodium metabisulphite (SMBS), copper sulphate, oxygen gas, and sodium hydroxide as reagents over an average residence time of 2 hours. This process is commonly referred to as the SO_2/air cyanide destruction process.

An online CN_{WAD} cyanide analyser is used to monitor detox feed and discharge CN_{WAD} levels and adjust reagent additions accordingly. Plant reagent consumption is summarized Table 17-3. Operations targets a WAD cyanide concentration of 1.0-1.2 mg/L exiting detox. The regulatory discharge criterion is that the total cyanide concentration must be less than 1.0 mg/L benchmarked as release from the TIA.

The detoxified slurry overflows the detox tank into the detox tail filter feed tank from where it feeds the detox pressure filter.

The filter is a vertical tower Outotec model LAROX PF 28/32 automated pressure filter with a filtration area of 12 m^2. The original design criteria filter availability was 87.5%, and it is regularly exceeded on a monthly basis; however, like the leach residue filter, the detox filter press is also the major source of downtime in the CTP; and that downtime is not necessarily coincidental with that experienced upstream.

The filtrate from the detoxification filter drains to the 9 m^3 detox filtrate tank and is pumped to the flotation tailings thickener.

The filter cake from the detox filter at 12% moisture is deposited with a screw conveyor that is identical to the leach residue installation. Product is stacked outside the building to be reclaimed for final deposition as underground backfill. The detoxified leach residue is stored in a dedicated extension to the plant building under cover.

ADSORPTION, STRIPPING, AND REFINING

Refer to Figure 17-4 – Block Flow Diagram: Adsorption, Stripping, and Refining as reference to the following sections.

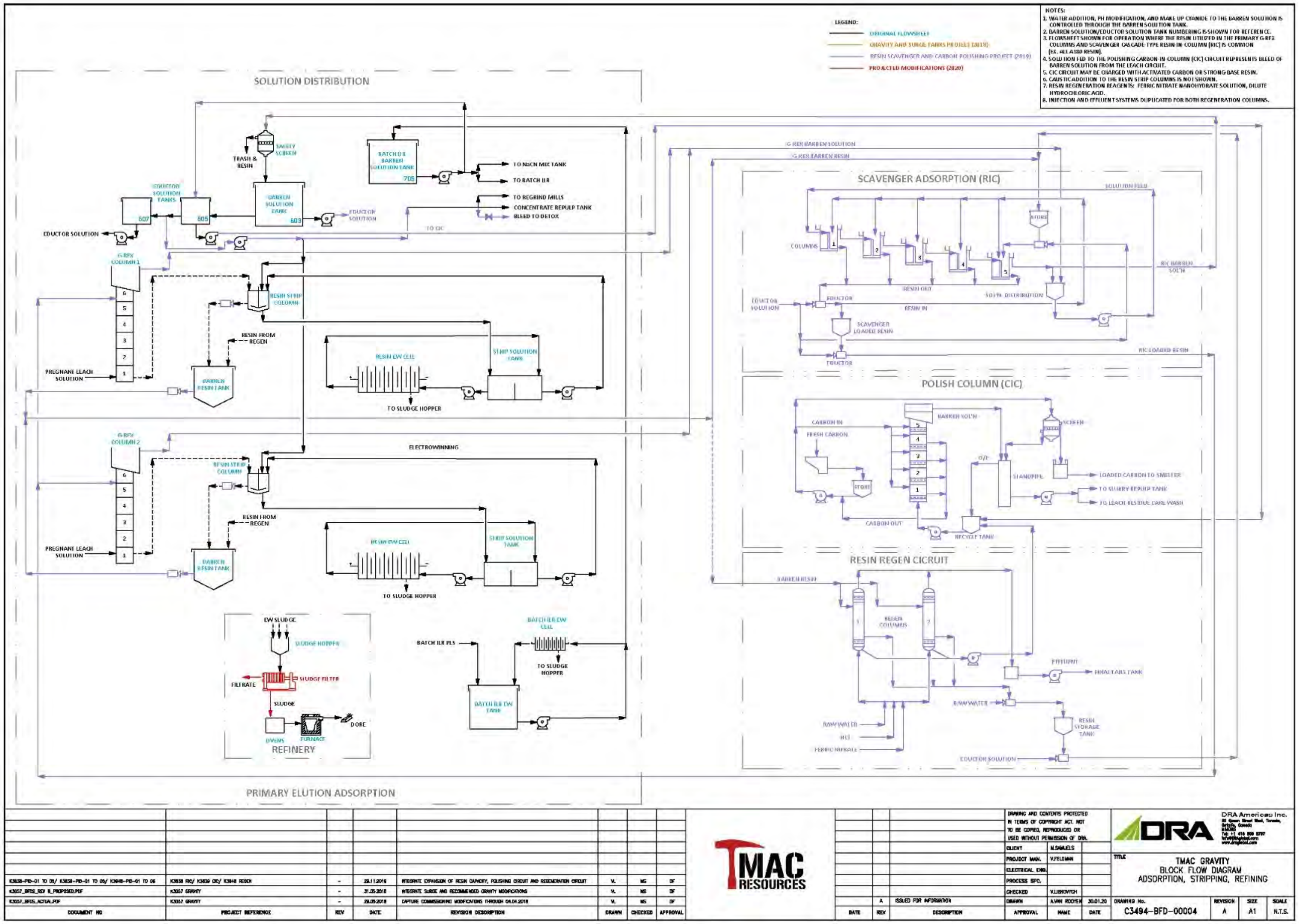


Figure 17-4. Block Flow Diagram: Adsorption, Stripping, and Refining as reference to the following sections

The resin circuit upgrades the clarified pregnant leach solution in preparation for electrowinning. Gold from the pregnant solution is preferentially adsorbed onto weak-base resin, which is then separated from the barren solution exiting the system. Subsequently the gold can be stripped from the resin under high pH and elevated temperature into a significantly higher-grade solution that is absent of most of the impurities. The strip solution is directly electrowon. Clarified leach solution from the intensive leach circuit is independently electrowon in a dedicated circuit.

Integration of the polishing adsorption and resin regeneration circuits in 2020 will improve management of gold bled from the circuit in barren solution and improve the activity of weak base resin.

PRIMARY RESIN ADSORPTION

The pregnant leach solution is pumped from the pregnant leach solution tank to one of two resin adsorption columns operated in parallel. These pumps share a common standby pump. The operation of the primary resin adsorption columns in parallel reduces the impact of frequent transfer of resin between different compartments and transfer of resin to the strip circuit. Each column consists of a series of six compartments loaded with approximately 800 L of weak base resin per compartment. The columns are commercially known as “G-Rex” as they are manufactured by Gekko Systems. The column stages are separated by a 500 µm screen that hold the resin in place.

Two resins are utilized in the system, either Gekko AuRIX®100 or Purolite Purogold™ MTA9920, although they are not practically intermixed. These resins are typically 600 µm to 1100 µm in diameter and have a high resistance to osmotic and thermal shock, as well as mechanical attrition. In addition to thermal shock and attrition, factors which affect resin life include fouling and chemical oxidation. Current life in the circuit is approximately 1 year.

The column is pulsed using a hydraulic diaphragm located at the base of the column to ensure:

- There is no blinding in the screens by either resin or suspended fine solids.
- There is enough contact between the leach solution and the resin.
- Fine solids are kept fluidized so that they are not held-up within the column.

Leach solution is pumped as feed into the bottom of the column, while the fresh resin is progressed down the column by intermittent transfer. Solution flows up through each compartment at a nominal rate of 7 m^3/h (average site data), to a maximum design rate of 14.6 m^3/h.

Resin addition is either from the scavenger resin circuit or from stripped resin. The loaded resin at a grade of up to 2,800 (typically 2,100) mg/L is educted out of the resin column first stage compartment (at the bottom of the column) over the loaded resin screen to separate the resin from barren transport solution, with the solid transferred into one of the two resin stripping vessels.

Inter-stage transfer of the resin down the column is achieved using eductors with barren solution as the motive solution, sourced from one of two small barren solution storage tanks dedicated to providing eductor solution service.

Solution that overflows from the primary adsorption columns flows to the scavenger adsorption circuit solution distribution tank. If that flow rate exceeds 21 m^3/h, excess solution is returned to the barren solution tank over the resin safety screen. It is an intermediate-grade barren solution because after a single pass through the primary circuit, the solution still has a gold grade of

approximately 15-30 mg/L. Pregnant solution feed and consequently, barren solution grades, are highly dependent on the plant feed grade as well as the success of the centrifugal gravity equipment to divert gold to the intensive leach circuit.

SECONDARY RESIN ADSORPTION

The scavenger resin circuit is a five-stage cascade series that is referred to as a Resin-in-Column (RIC) design. The RIC circuit operates counter currently with the solution moving through the circuit by gravity and resin moving upstream with educator transfers. The intermediate grade solution from the primary adsorption circuit can be blended with barren solution produced by the RIC to control the pregnant solution tenor. The system can treat up to 21 m^3/h of flow.

Each tank in the RIC can nominally hold 1600 L of resin. Each tank in the RIC is fitted with a dart valve in the weir to ensure that the columns are flooded above the discharge weir, preventing significant air entrainment that can disrupt the operation of the fluidized resin bed.

Barren solution from the fifth stage, can be directed back to the scavenger adsorption circuit solution distribution tank or to the barren safety screen and into the barren solution tank.

Solution sampling is done through the two continuous wire samplers installed in the feed and barren solution lines.

To manage resin within the circuit, two closed-top conical-bottom tanks are employed

Barren solution exiting the system is directed to the safety screen, with the underflow by gravity flow to the main barren solution tank. This ensures that any entrained resin is captured for return to the circuit or consolidated as by-product resin to be shipped off site and smelted.

The RIC barren solution is re-used in:

- Re-slurry of concentrate in filter cake to the regrind circuit
- Makeup and spray water to the regrind circuit
- Fluidization water to the regrind batch centrifugal concentrator
- Batch ILR solution make up water (directed to the leach solution cone in the intensive leach circuit)
- Resin eduction solution in the primary and scavenger resin circuits (to provide motive solution between stages, storage hoppers, and the resin elution circuit)
- Bleed to the solution polishing circuit

SOLUTION POLISHING CIRCUIT (UNDER CONSTRUCTION 2020)

The solution polishing circuit will recover residual gold from barren solution. Barren solution treated by the solution polishing circuit is used for:

- Cake wash water for the leach residue filter
- Re-pulp of the leach residue filter cake
- Makeup of solution to the detox feed tank to ensure the correct density

Cake wash water should have low gold content to minimize gold losses. Barren solution should result in loses of about percent; and recently, relying on only the primary adsorption circuit this value has been up to 5-6% of the overall plant feed.

The polishing circuit will also treat EW barren solution bled out of the electrowinning circuits. EW solution must be kept out of the barren solution tank due to its very high pH which is detrimental to resin adsorption (target pH 10.8 -11.0). This solution is typically 0.8-1.0 mg/L gold; and is currently directed to the detox circuit to minimize gold loss. Bleeding the solution through the polishing circuit will provide incremental improvement gold recovery.

The polishing circuit is a five-stage stacked column. Between each stage, there is a removable screen assembly with a screen aperture of 500 µm. The column was originally designed to operate with activated carbon, as a CIC, but can also be operated with a strong base resin. The column has the dimensions of 1.54 m diameter and 13.1 m in height. Solution flow is pumped to the bottom of the column and up through each stage where it overflows at the top of the column.

Barren solution overflows into the collection weir at the top of the column (fitted with a removeable screen) and flows by gravity to a standpipe. The bleed rate out of the polishing circuit is controlled by the demand of cake washing water at the detox filter or re-pulp requirements of the detox circuit. The solution bled from the polishing circuit is filtered using a 150 µm duplex bag filter to recover carbon or resin fines.

The design recycle rate for solution flow through the column is 21 m^3/h for carbon (less for resin), with solution entering from the barren tank at a rate of up to 14 m^3/h, a recycle ratio of approximately 50%. This ensures fluidization of the carbon or resin for optimum recovery.

Carbon or strong base resin is transferred between stages utilizing an electric-diaphragm slurry transfer. Loaded carbon is removed from the first stage (bottom) of the column and transported to the carbon dewatering screen and is then directed to a dedicated bagging area. The carbon or resin is washed on the dewatering screen and bagged for shipment offsite for recovery of the gold and silver by smelting contract.

Fresh makeup resin or carbon is fed the last stage (top) compartment. Several types of carbon and resin are under evaluation for use in the polishing circuit.

ELUTION

Resin from the adsorption circuit is eluted or stripped by desorption using a heated sodium hydroxide solution in closed circuit with electrowinning cells for gold recovery. Loaded resin is transferred from the first stage of one of the two G-Rex resin columns approximately every 8 hours, reflecting the cycle time of the elution stage, and into one of the two agitated strip vessels, approximately 10 m^3 in volume, which represents two stages of the primary resin adsorption columns.

The gold is eluted using a hot sodium hydroxide strip solution at 55-60ºC and a pH of 12.5 pumped through the resin bed from the strip solution tank. Heating of the solution is accomplished by use of 150 kW electric heating elements. Electrowinning solution is returned to the strip solution tank where it is recycled back to the resin strip column. The recirculation continues until most of the gold is removed from the resin.

The stripped resin is then transferred into the barren resin tank, where the eluted resin can be transferred to the scavenger resin circuit, or alternatively directly to the primary adsorption circuit.

RESIN REGENERATION

Resin can become fouled by the adsorption of iron and thiocyanate which is present in the leach solution.

To remove the iron and thiocyanate, the resin is periodically washed with ferric nitrate solution or hydrochloric acid before it is returned to the resin column. The original resin regeneration circuit consisted of a stirred tank and resin was batch washed, but this approach was found to be ineffective. Subsequently, the TMAC team reviewed the original patent and in further discussions with the inventor, simulated regeneration using a plug flow reactor at different concentrations in the laboratory.

Construction of the revised resin regeneration was completed in Q1 2020, and the system is ready for commissioning. The installation consists of two columns. At the bottom of each column, there is a manifold that allows for the injection of 0.3-0.6 M ferric solution, up to 2% hydrochloric acid solution, and raw rinse water. The column is also fitted with removable 600 µm polypropylene mesh screens at the top and bottom of the vessel to control resin movement.

Regenerated resin can be distributed into the primary adsorption circuit by a dedicated eduction circuit from the regenerated resin storage hopper.

All solutions exiting the system are screened using in-line duplex strainers using 250 µm screens. Evacuated motive solution is directed to the polishing circuit distribution tank; whereas, ferric nitrate, hydrochloric acid, and rinse water is directed to the resin regeneration effluent tank. Intermittently, the contents of that tank are pumped to the final tails tank by the duty resin regeneration pump.

Based on laboratory testing, this regeneration approach indicated that 80% of the AuRIX®100 activity was restored as compared to fresh resin. Subsequently, the laboratory has also confirmed that Purolite Purogold™ MTA9920 may also be regenerated using the same technique.

GOLD ROOM

The gold room is the final processing stage in the plant. Pregnant solution from the resin stripping circuit is passed through the electrowinning (EW) cells to plate gold onto the cathodes. Pregnant solution from the intensive leach circuit is electrowon in a separate cell. The gold-rich sludge is then washed off the cathodes and prepared for smelting.

The pregnant strip solution from the resin column circuit is pumped through two stainless steel electrowinning cells operating in parallel, plating out and recovering the gold onto the 316 stainless steel mesh cathodes with the return barren solution recycled to the resin stripping tanks. The closed loop stripping solution is bled 10% by volume after the electrowinning cycle to prevent build up of deleterious solution chemistry.

Pregnant and wash solutions from the BILR are collected in the batch pregnant solution tank. Sodium hydroxide is added as needed, and solution is circulated through the batch ILR electrowinning cell to plate out the gold on the cathodes. The recirculation of solution is continued until a low barren solution level is achieved. On completion of the EW process, the barren solution from the cells is pumped to the BILR barren solution tank. The EW cycle is very efficient, and the pregnant solution grade is typically reduced to 0.8 to 1.0 mg/L.

The EW cells are stripped at regular intervals by hand in the cathode wash station. After filtering, the cathode sludge is filtered and dried. The dry precipitate is mixed with flux before being smelted

in the high temperature, diesel-fired furnace. In 2020, the sludge filtration system will be replaced with a plate and frame pressure filter for more efficient and secure operation. The smelting process produces a doré (containing gold and silver) bar with high gold content. By-product slag is re-melted to separate any entrained gold and returned to the grinding circuit for processing.

The doré bars are securely stored and intermittently sold to refineries. Typically, the gold content in bars from Hope Bay exceeds 85%.

A fume scrubbing system is used to scrub the fumes and particulate matter from the electrowinning cells, ovens and furnace.

17.4 ANCILLARY SERVICES AND REAGENTS

Ancillary systems are not shown on the block flow diagrams for clarity.

REAGENT MIXING STORAGE AND DISTRIBUTION

The reagents module consists of the tanks, mixers and pumps required for mixing and distribution of the reagents as described in Table 17-3 below, which includes the typical plant reagent consumption.

Table 17-3. Reagent Consumption

Consumable	Consumption (kg/t)
Ball, forged carbon steel, 50 mm	1.00
Potassium Amyl Xanthate, 90%	0.16
Promotor, Danafloat™ 245	0.030
Frother, Polyfroth® 30	0.013
Flocculant, Polyclear® A2501	0.021
Ball, 30% Chrome, 38 mm	0.25
Sodium Cyanide	0.45
Sodium Hydroxide	0.64
Sodium 3-Nitro Benzene Sulphonate	0.002
Sodium Metabisulphide	1.20
Copper Sulphate Pentahydrate	0.80
Resin, either Gekko AuRIX®100 or	0.031 L/t

Consumable	Consumption (kg/t)
Purolite Purogold™ MTA9920	
Activated carbon	0.28
Ferric Nitrate Nonahydrate	0.010
Hydrochloric Acid	0.010
Silica	0.002
Sodium Tetraborate Decahydrate	0.0021
Sodium carbonate, anhydrous	0.0010
Potassium Nitrate	0.0010

Sodium cyanide, sodium metabisulphite, potassium amyl xanthate and ferric nitrate are fitted with dedicated scrubbing systems.

The reagent mixing and concentrate treatment area has fixed HCN detectors installed around positions where cyanide solution is added as either fresh addition or recycled barren solution, along with equipment where there is vigorous agitation and open vessels. Ambient perimeter HCN monitors are also installed around the concentrate treatment area for further monitoring and protection.

Flotation blower air (1 duty/1 standby) is shared between the two flotation trains.

Oxygen gas is generated by four operating vacuum swing absorption units. Oxygen was selected over air to increase detox reaction rates and reduce compressor and agitator power requirements. Oxygen demand, delivered at 90-92% purity, is split between the intensive leach ILR, continuous ILR leach vessels, and the detox unit operation, but the three online units can produce up to a design capacity of 120 Nm^3/h. Oxygen consumption equates to 17.2 kg/t of concentrate.

UTILITIES

Each of the North and South bays of the plant are installed with a 20 t overhead crane. The South bay also has a 5 t overhead crane due to the overhead crane demands for maintenance and reagent mixing.

The plant design strategy made significant use of E-houses containing motor control centres (MCC) and VSD's.

While not described in detail, other utilities installed in the process plant include low and high pressure compressed process air systems, process water storage tanks and distribution pumps, gland water filtration and distribution pumps, vacuum and pressure filter service water pumps (cloth wash and seal water), and potable water storage tanks and distribution pumps.

OCEAN DISCHARGE

TIA water level is managed through discharging decant water that meets environmental discharge quality through a series of three pumping stations that sub-aqueously discharged to Roberts Bay.

At the second pump house, treated mine water is added to the tailings decant for discharge into Roberts Bay.

The first pump house (building 710) uses a duty/standby pump to draw water from the TIA decan water and pump it 2.2 km to the second pump house at the Doris camp, East of the mobile maintenance building. The suction pumps are Cornell 112 kW pumps capable of pumping 360 m^3/h. The suction pump discharge line is heat traced and insulated DR17 HDPE of 254 mm in diameter. The feed line is bi-directional, to be used as a return to the TIA if the mine water treatment plant fails to meet dischargeable water quality.

In the second pump house (building 720), TIA decant water is combined with treated mine water from the mine water treatment plant to be discharged to the ocean. Two differently sized discharge pumps are utilized based on required flow to the ocean. One pump is a Cornell 18.6 kW pump capable of 125 m^3/h that is used for discharge at low flows either directly to the ocean, or for discharge of out-of-specification mine water back to the TIA. At full capacity, a second Cornell 268 kW pump capable of 360 m^3/h is used to pump water to the ocean. Both pumps discharge through a common heat traced and insulated 254 mm DR11 HDPE pipeline 6.1 km to a pump house located at the shore of Roberts Bay.

The pump house at Rob's Bay (building 730), has a vacuum/air release system to prevent backflow back to the second pump house. Discharge is by continuous sub-aqueous flow into the ocean 2.0 km from shore. The discharge line to the ocean is 254 mm DR17 HDPE pipe and is heat traced for the first 15 m below the ocean surface. A second 254 mm DR17 HDPE suction line 160 m long and heat traced for the first 15 m below the ocean surface is used to flush and circulate salt water through the 2.0 km sub-aqueous pipeline to provide freeze protection in the winter when not continuously discharging tailings and treated mine water. The pump utilized to recirculate sea water is a Cornell 18.6 kW pump capable of 165 m^3/h flow.

MINE WATER TREATMENT PLANT

The mine water treatment plant (WTP) is used to treat water from the underground workings in the Doris deposit. Treatment is for reduction in total suspended solids (TSS) to meet the required discharge. Treated water is combined with the TIA decant meeting discharge quality in the second pumphouse (720 building) for sub-aqueous deposition in the ocean.

Mine water is pumped through two 45 kW Techosub pumps at the 1350 mine elevation through the Doris North vent raise in an insulated and heat traced 153 mm DR17 HDPE pipe to a lamella clarifying thickener. Flocculant is added to the feed of the lamella to aid in the settling rate. The lamella is a 42 m^3 Met-Chem clarifier with 121 m^2 of effective settling area and capable of processing 80 – 100 m^3/h of mine water, depending on the concentration of solids in the feed. Clarified overflow is then sent through a bank of four micro media filters (MMF). Settled solids are pumped to a collection tank and then to the tailings pump box in the processing plant for eventual deposit in the TIA.

The four MMF are operated in parallel and cycle in and out of use depending on back-pressure build up and backwash cycles. The MMF are 1.2 m diameter x 1.8 m high and contain four layers of media for filtration. The base filtration media is coarse, medium, and fine gravel at a volume of 0.08 m^3. The second media type is coarse and fine garnet at 0.08 m^3. The third media layer is a fine filter sand of 0.1 m^3. The final top layer is anthracite at 0.5 m^3. Filtered water is then collected and transferred to the second pumphouse (720 building) for combination with tailings water for discharge.

Given a foreseeable increase in Doris mine water production as the mine development expands, additional mine water volumes generated by the Madrid underground development, and new federal effluent discharge regulations in 2021, it is likely that additional treatment of the TIA decant will be directly required. Planning for the installation of a 500 m^3/h treatment plant at the TIA for 2021 sealift is underway. The new water treatment plant will be centrally located at the TIA to accept water from Doris, Madrid and the TIA for the treatment of un-ionized ammonia. Design and equipment orders are to be phased for the 2020 and 2021 shipping season.

ASSAY LAB

The assay lab is located within the milling complex. The lab processes both mill and mine production samples. The lab was recently expanded in 2019 to facilitate processing of 250 fire assay samples a similar number of solution samples per day. Until January 2020, SGS Canada managed the laboratory on a contract basis, and TMAC transitioned to the operator on January 1. Prior to the expansion, sample processing was limited to roughly 100-125 fire assay samples per day. The expansion separated the wet and dry processes of the assay lab and added a second fusion furnace and acid digestion hood to increase throughput.

Sample preparation and fire assay remained in the original assay lab facility. The prep lab consists of two Rocklab crushers, three Rocklab pulverisers and sample drying ovens. Fire assay is conducted with two 25-crucible fusion furnaces and a single 100-cupellation furnace. The fusion furnaces are electric and supplied by Furnace & Assay and Mine Assay Supply. The cupellation furnace is supplied Furnace & Assay. Along with fire assay, the lab can determine carbon (total and organic) and sulfur (total) with the ELTRA C2000 fusion analyzer. Adequate ventilation for sample preparation and furnace operation is provided by two bag houses.

The wet lab was relocated to an adjacent trailer. The new wet laboratory has two acid digestion fume hoods to prepare solutions for atomic absorption spectrometry (AAS) for measuring gold, sliver, copper and iron. In 2020 a micro plasma analyzer will be commissioned to provide multi-element analysis for solutions.

Cyanide species analysis is conducted with a continuous flow SKALAR San++.

IMPROVEMENT PLAN

- Expand the mine dry to allow personnel to shower and exchange work clothing with street clothing.
- Continue to engineer and install new dust collection venting to optimize dust collection capacity by the crushing circuit continuous duty dust collection and filtration scrubbing system.
- Investigate the means to further isolate the secondary and tertiary crushing circuit to mitigate the propagation of dust throughout the process plant.
- Construct a separate work area to complete mechanical repair work. This space could be allocated toward expansion of flotation residence time.
- Remove plant compressors and oxygen generators from the mill building. Add additional compressed air and air-drying capacity that is dedicated for instrument air.
- Further the de-bottlenecking study of the secondary and tertiary crushing circuit CLs to increase the combined utilization and availability above 70%. Such study should consider the evaluation of options to replace the VSI crusher.
- In 2020, complete the replacement of the tertiary screen in CL2.

- Proceed with installation of the 5 t overhead crane in the North Bay of the plant to assist with crushing circuit maintenance.
- Evaluate the reduction in pumping power for transfer of crushing circuit product to the grinding circuit by removal of the tertiary screen underflow dewatering cyclones and the related pumps and transfer the slurry directly to the surge tanks as shown in Figure 17-1.
- In 2020, integrate a single pump at the bottom of the tertiary screen undersize hopper to create feed to the coarse gravity circuit consisting of one each rougher and scavenger low G-force batch centrifugal separators, Gekko systems model 30 Inline Spinner (ISP), operating in series at up to 30 t/h: the equipment exists, was designed to be integrated and installed into surge bin structural steel, and will target chunky, coarse gold such as that present in the Doris North BTD deposit, and recover it to a high-grade concentrate at a target recovery rate of 60 kg per hour, assuming for 3 flush cycles per hour from the rougher and 1 cycle per hour in the scavenger, recovering the coarse gold before it is exposed to the grinding circuit where ultra fine unrecoverable gold particles are generated by attrition.
- In 2020, purchase a spare solution injection and suction spool assembly for the surge bin, which is subject to abrasive wear from coarse particles.
- Modify the primary grinding circuit cyclones distribution system, so that the cyclones can be operated vertically, allowing for easier operator inspection and to prevent roping and overgrinding. Evaluate the installation of an automated cyclone detection system that controls the automated feed valves to each cyclone to account for throughput changes in the grinding circuit, which represent relatively large magnitudes in the circulating load due to the very low throughput to each grinding circuit.
- Evaluate options to modify or expand the flotation circuit: including (1) modification of the last bank (cells 7 to 9) in the flotation circuit to induced air flotation that will target ultrafine sulphide and gold particles, and (2) expansion of residence time utilizing emerging flotation cell technology that can be installed in compact footprints.
- Evaluate installation of froth camera systems in the last 3 cell banks (cells 3-4, 5-6, and 7-9) to optimize mass pull.
- Install surge capacity between the flotation circuit and the regrinding circuit to disconnect the CTP from the flotation circuit operation, to alleviate the unsteady state conditions created when the operations group “stacks”, or stores, concentrate in the flotation concentrate thickener and the leach feed thickener, due to downtime in the CTP, particularly during the weekly planned maintenance on the leach residue filter and the cyanide detox filter.
- In 2020, install nuclear density gauges to assist with optimisation of slurry density in the grinding and regrinding circuit, as well as assist in thickener performance.
- Evaluate the installation of a pug mill mixer to assist with re-pulp of vacuum filter cake with barren solution and transfer of the cake to the concentrate re-pulp tank, since agitation alone in the re-pulp tank is sometimes insufficient to break up chunky filter cake.
- Evaluate the modification of the CTP by installation of an additional thickener between the regrind circuit and the leach circuit to allow for the regrind circuit to operate without barren solution. Such a modification would need to consider the additional pre-aeration and leach residence time required to compensate for the fact that approximately 80% of gold recovery in the CTP occurs during regrinding in cyanide prior to the pre-leach thickener. This modification would allow for the following concurrent modifications and additions in the CTP leach circuit:
    - Eliminate the concentrate vacuum filter.

  - Allow spray water and fluidization water (to the regrind batch continuous concentrator) to be provided by process water or raw water.
  - Complete regrind with the addition of slaked lime addition as an alternative to the use of sodium hydroxide that results in highly soluble sulphate concentrations (leading to thiocyanate formation).
  - Allow for installation of pre-aeration tanks, that when combined with oxygen and lime addition would ensure the precipitation of gypsum and ferric hydroxides generated from sulphate and soluble iron during fine grinding.
  - Ensure recovery of the process water (with an elevated pH) for disposal to the final tails tank (noting that elevated pH in the process water may depress pyrite in flotation) through the solution overflow of new thickener.
  - Makeup of cyanide to the new thickener underflow slurry by recycle of barren solution.
  - Augment or replace the existing CILR leach vessels with conventional leach tanks to add residence time and address the loss in recovery benefit from regrinding in cyanide.
  - Allow for re-deployment of the pre-leach thickener for service as a leach residue thickener, with the thickener underflow directed the leach residue filter.
- In 2020, continue with engineering and replacement of all thickener feed launders and feed wells, referred to as the Vector® thickener feed system by Paterson & Cooke to improve froth removal, reduce suspended solids loading in the solution overflow, increase capacity, and/or reduce flocculant consumption.
- Evaluate the installation of a third filter press, that would operate as spare for both the leach residue thickener and detox thickener operating as duty.
- Add a filtrate receiving tank to more evenly distribute the solution generated by the leach residue filter in a controlled steady state manner over entire filtration cycle to the pre-leach thickener feed launder.
- Evaluate the means to remove sediments from the pregnant gold solution prior to pumping through the resin adsorption circuits. Technology options should consider the potential benefits of recent testwork that evaluated the use of further filtration at 20-25 µm, ultrafiltration, nanofiltration and reverse osmosis membranes for the removal of thiocyanate and ferric cyanide complexes (foul resin), increase the gold tenor to the resin, and the recovery and recycling of free cyanide.
- In 2020, continue with construction of the 5-stage vertical tower column to further polish (and remove nearly all gold from solution) the barren solution prior to discharge to the detoxification circuit, or when using as cake wash water to displace barren solution in the filter cake pore volume, utilizing either sacrificial carbon (ex. Cabot Norit® 3515 extruded carbon) or strong base resin (ex. Puromet™ MTA 5012).
- Continue optimization of chemical regeneration of weak base resin Gekko AuRIX®100 and Purolite Purogold™ MTA9920 utilizing the recently installed plant-scale equipment.
- In 2020, install all automated sampling systems that were purchased and stored onsite, but not yet installed in the flotation tailings, CILR feed, CILR discharge and Detox feed slurry streams.
- Evaluate increasing oxygen demand requirements related to the increase in sulphide concentration in Naartok ores, which impacts leaching and detoxification requirements.
- Upgrade or replace the detox filter screw conveyor, a significant source of unplanned maintenance downtime.

- In 2020, install the plate and frame filter for the collection of electrowinning sludge to better ensure security of the high value feed to the furnace when washing cathode and storing prior to smelting.
- In 2020, replace the existing furnace with a larger, more robust furnace induction furnace.
- In 2020, completion and shipment of Veolia water treatment plant for removal of total suspended solids from the TIA and mine water treatment.
- Continue to evaluate un-ionized ammonia treatment options for discharge compliance in 2021.

POTENTIAL OPERATIONAL CONTRAINTS

- Continued plant operation with elevated dust levels in the processing plant.
- Increasing sulphide levels associated with Naartok ore, requires good planning of plant feed blends to ensure the flotation circuit and concentrate treatment plant are not overloaded.
- Increasing oxygen demand due to increasing sulphide associated with Naartok ore, that results in higher mass pull by flotation, reducing cyanidation and detoxification residence time.
- Continue ongoing monitoring for organic carbon in crown pillar removal and underground development in the Naartok deposits, since that material should be stockpiled for campaign treatment at a later date if the organic carbon concentration is greater than 0.2% due to the potential for preg-robbing; noting that current modelling of carbon intercepts in Naartok East and West are primarily in the hanging and footwalls.
- Limitation of power supply, which may impact the ability to run both regrinding circuits at a mass pull greater than 5%.
- Limitation in pumping physical capacity in flotation to achieve greater that 5% mass pull from both concentrate circuits.
- While dimensionally equivalent to laboratory test apparatus, the new resin regeneration circuit remains to be proven effective during commissioning at plant scale.
- The adsorption circuit relies on the supply and intermittent replacement of weak base resins, either Gekko AuRIX®100 and Purolite Purogold™ MTA9920, both based on styrene-benzene copolymers, and both of which are exclusively manufactured in China, manufactured on demand, and subject to supplier manufacturing capacity and extended supply chain timelines.
- TIA and current WTP not achieving discharge quality effluent and the TIA increasing in solution level
- Current WTP capacity and underground water production exceeding predicted levels, requiring discharge of excess solution into the TIA.

17.5 NEW MADRID PROCESS PLANT

Following is a summary of the process plant design and operation. Ore will be sourced from the Madrid (Naartok, Suluk, Madrid North, Wolverine, Patch 7 and 14) and Boston deposits. The annual tonnage processed is expected to be up to 1,460,000 t/a.

The plant recovers gold from the ore through the Madrid Plant which is based on conventional crushing and grinding and cyanide leaching to achieve an overall process plant recovery of 88.0% over the life of mine. The unit operations included are:

- Crushing
- Grinding (SABC type circuit)
- Batch gravity concentration/intensive cyanidation
- Flotation
- Flotation tails thickening
- Concentrate regrind and thickening
- Concentrate pre-aeration and CIL
- Cyanide detoxification of CIL tails
- Thickening and filtration of CIL tails
- Carbon elution and regeneration; and gold electrowinning
- Smelting of doré bullion
- Reagent mixing, storage and distribution

Preg-robbing carbonaceous matter has been identified primarily in Suluk and to a lesser-extent in Wolverine, Patch 7 and 14 and Boston. The occurrence and extent of the carbonaceous matter requires further characterization. CIL processing provides some mitigation and Suluk recoveries have been appropriately discounted. Suluk ore production is scheduled toward the end of the life of mine. TMAC recommends that a trade-off study be undertaken to determine if a blending strategy can result in an overall improvement of gold recovered.

The Madrid Plant is designed for 365 days per year continuous operation to process 1,460,000 t of ore with an average throughput of 4,000 t/d. The primary crushing area is designed with an operating availability of 75%. The balance of the Madrid Plant is designed with an operating availability of 92%.

The key process design criteria include:

PRIMARY CRUSHING

- Number of trains: 1
- Feed top size: 600 mm
- Nominal capacity: 200 t/h
- Product size P_{80} = 100 mm
- 4% moisture
- Surge Bin capacity: 8 hours live, 9.6 hours total

GRINDING AND GRAVITY CONCENTRATION

- Number of trains: 1
- SAG mill with pebble crushing followed by ball mill
- Nominal capacity (fresh feed): 181 t/h
- P_{80} = 150 µm
- Batch centrifugal concentrators followed by intensive cyanidation of concentrate

FLOTATION

- Number of Trains: 1
- 30 minutes flotation retention time
- Nominal capacity: 181 t/h
- Nominal flotation concentrate: 27 t/h (15% mass recovery)

CONCENTRATE REGRIND AND THICKENING

- Number of trains: 1
- Nominal capacity: 27 t/h
- Concentrate regrind product P_{80} = 150 µm
- Thickener underflow density = 45% solids

PRE-AERATION

- Number of trains: 1
- Residence time: 9 h
- 92% availability
- Nominal capacity: 27 t/h

CARBON-IN-LEACH (CIL)

- Number of units: 10, carousel type operation
- Residence Time: 30 h
- Nominal capacity: 27 t/h
- Carbon concentration: 22 g/L

DETOX

- Target: <0.5 mg/L CN_{WAD}
- Residence Time: 1 h
- Solid Content: 40% w/w
- Nominal capacity: 27 t/h

CIL TAILINGS THICKENING AND FILTRATION

- Number of trains: 1
- Nominal capacity: 27 t/h
- Thickener underflow density = 62% solids
- Tailings filter type = plate and frame.
- Filter solids moisture content = 18.5% w/w

The simplified overall flowsheet is shown in Figure 17-5. A plan view of the Madrid Plant is shown in Figure 17-6.

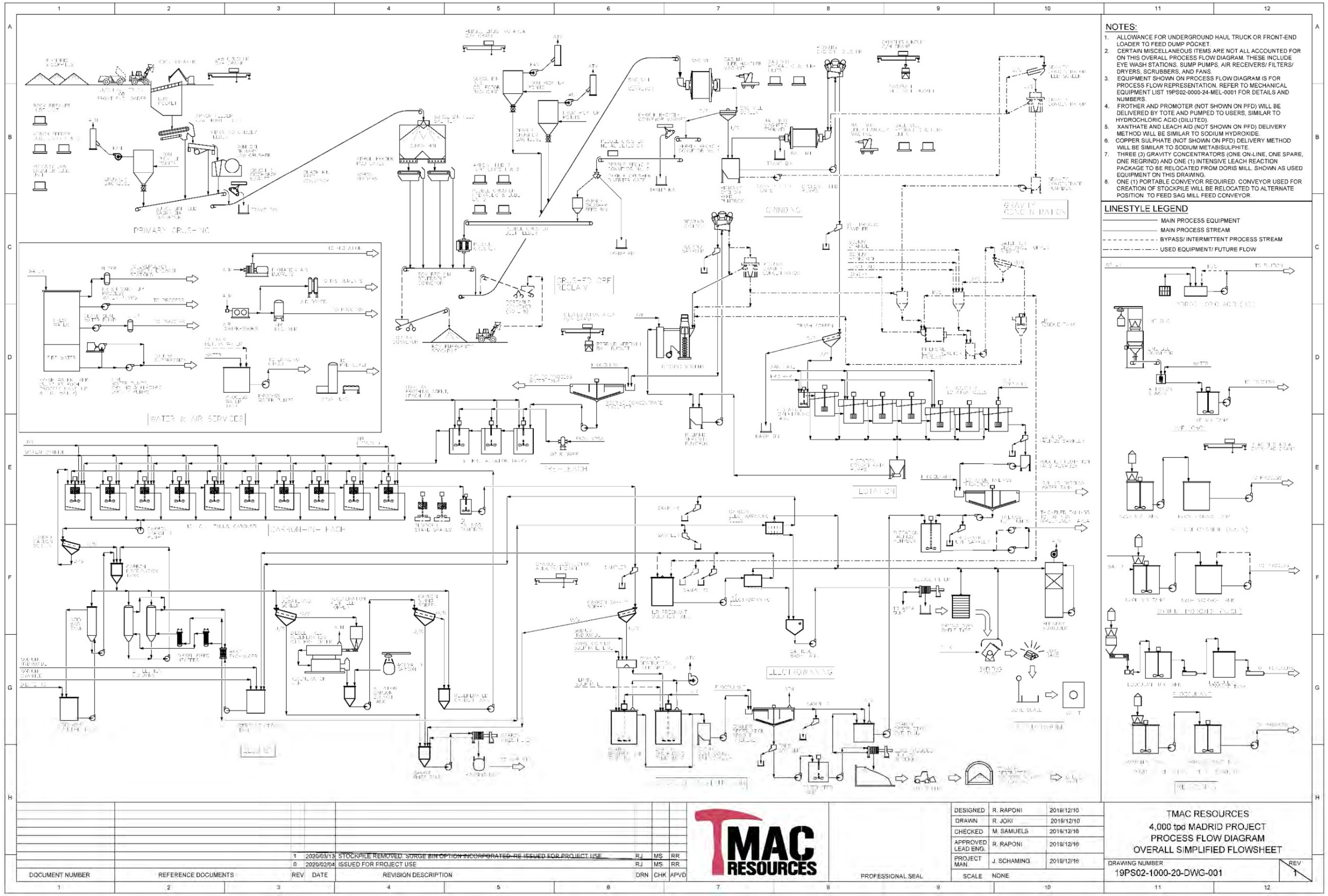


Figure 17-5. Simplified overall flowsheet

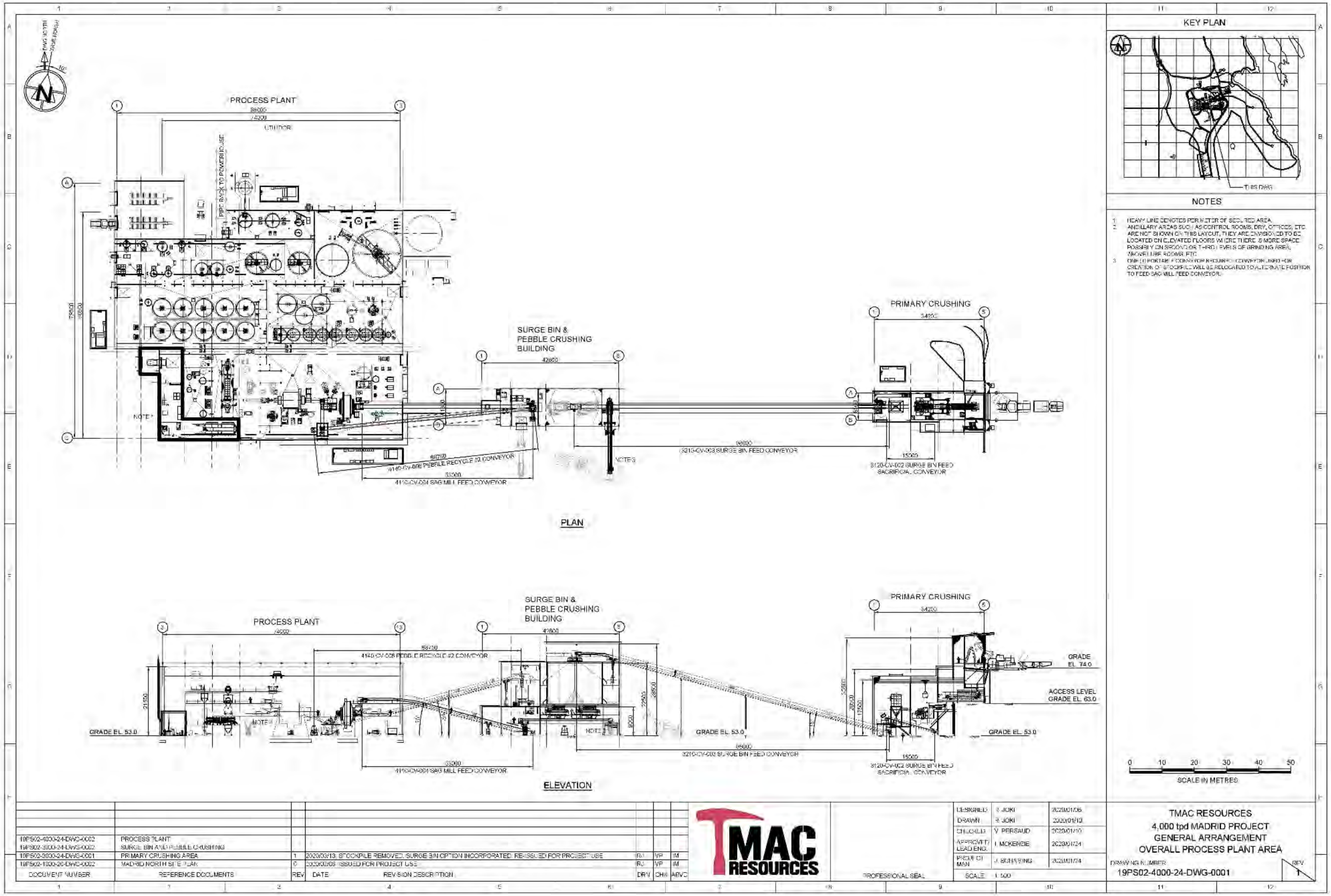


Figure 17-6. Plan view of the Madrid Plant

17.6 PROCESS DESCRIPTION

CRUSHING, SCREENING, AND CRUSHED ORE STORAGE

Run of Mine (ROM) material from the mine is trucked to the ROM pad. A front-end loader recovers the ore from the ROM pad and tips onto the Primary Grizzly to scalp out +600 mm material. The oversized +600 mm material is presented to the Rock Breaker to be broken and stockpiled for reclaim, while the -600 mm material flows via gravity into the dump hopper which has a capacity of 100 t. The dump hopper discharges onto an apron feeder followed by a vibrating grizzly feeder.

The vibrating grizzly scalps out minus 75 mm ore and feeds the oversize into the primary jaw crusher to be crushed to P_{95} 125 mm. The vibrating grizzly undersize and crusher discharge are conveyed by the primary crusher discharge conveyor under a belt magnet to the surge bin feed conveyor and transferred to the surge bin. A metal detector is installed on the surge bin feed conveyor. A weightometer is installed on the crushed ore bind feed conveyor for primary crushing circuit control.

Crushed ore from the surge bin is metered using two apron feeders discharging onto the SAG mill feed conveyor. A weightometer is installed on the plant feed conveyor for feed rate control.

GRINDING AND GRAVITY CONCENTRATION

The grinding line consists of a single variable speed semi-autogenous grinding (SAG) mill, followed by a single ball mill operating in closed circuit with a cyclone cluster. The product from the grinding circuit (cyclone overflow) has a typical P_{80} of 150 µm. SAG mill discharge flows onto a vibrating screen to remove +12 mm pebbles. Screen oversize is transported by conveyor to the pebble crusher (cone crusher). Crushed pebbles are recycled to the SAG mill feed conveyor.

The SAG mill feed conveyor discharges ore, along with pebble recycle and grinding media, into the feed chute of the SAG mill together with mill feed dilution water. The SAG mill is fitted with discharge grates to retain grinding media and larger pebbles while allowing smaller particles to discharge from the mill. SAG mill grinding media is also added to the SAG mill feed chute with a 1 t kibble with a false bottom.

The SAG mill discharge screen undersize gravitates to the primary cyclone feed hopper where it is combined with the discharge from the ball mill. The slurry is transported to a single cyclone cluster using two variable-speed cyclone feed pumps (duty and stand-by).

Dilution process water is added to the cyclone feed hopper before the slurry is pumped to cyclone cluster for classification. Coarse particles report to the cyclone underflow and are directed to the ball mill feed chute via a boil box. The cyclone overflow stream gravitates to the vibrating trash screen via a cross-stream sampler.

A SAG mill feed chute removal system and a ball mill feed chute removal system are used to service the mills. A mill liner handler for each mill is provided.

The gravity circuit is fed from a dedicated pump on the cyclone feed pumpbox, with all tails and oversize stream recollected and pumped back to the ball mill feed. The screen undersize is fed to a centrifugal gravity concentrator. A batch of concentrate is produced every 45 minutes and fed to the intensive cyanidation unit (ICU) holding tank. The gravity tails are gravity fed back to the cyclone feed pumpbox by gravity.

Gravity concentrate will be fed to the ICU cone. Process water will be fed to the cone for approximately 30 minutes to deslime the contents. The ICU solution tank contains of a mixture made of sodium hydroxide, sodium cyanide, leach aid and fresh water. The reagent mixture is pumped through the bottom of the ICU cone producing a fluidized bed. Overflow returns to the solution tank.

The solution pumping cycle is continued for 16 hours to leach the gold into the solution. At the end of the cycle any remaining solution in the cone is pumped to the solution tank. The solids are rinsed with fresh water. The rinse solution reports to the solution tank. The pregnant leach solution is pumped to the gold room for electrowinning and refining. The barren solids are pumped back to the cyclone feed pumpbox.

The gravity concentration circuit will be installed after commissioning using equipment relocated from the Doris Mill.

FLOTATION AND CONCENTRATE REGRIND

The flotation circuit consists of a vibrating trash screen, single train of rougher flotation cells, rougher concentrate regrind.Cyclone overflow gravitates over a vibrating trash screen with the undersize reporting to flotation feed. Reagents added include a collector (potassium amyl xanthate), promotor (A208) and a polyglycol type frother.

Flotation feed reports to single rougher flotation bank consisting of seven forced air mechanical flotation tank cells. The rougher flotation cells produce a pyrite concentrate that requires further liberation prior to leaching. Rougher concentrate is pumped to the regrind mill.

The rougher tailings stream is pumped to the flotation tailings thickener. The tails thickener underflow is pumped to the agitated tailings transfer tank from where they are pumped to the TIA. Thickener overflow reports to the process water tank. Flocculant solution is added to the thickener feed to promote settling and increase thickener underflow density.

Flotation concentrate is reground in a vertical ball mill (Vertimill) operating in closed circuit with small diameter regrind cyclones. Flotation concentrate is reground to nominal P_{80} of 25 µm.

CIL FEED THICKENER

Regrind cyclone overflow gravitates to the CIL thickener feed. The CIL feed thickener overflow reports to the process water tank for reuse, while the thickener underflow is pumped to pre-aeration and CIL. Flocculant solution is added to the thickener feed to promote settling and increase thickener underflow density.

PRE-AERATION AND CIL

CIL feed thickener underflow reports to the pre-aeration and CIL circuit. There are three pre-aeration tanks and ten CIL tanks that provide a total 39 hours retention time (9 hours pre-aeration and 30 hours CIL). Overflow launders connect the tanks and a feed diversion box is used to direct the feed to one of two tanks. The combination of the feed diversion box and overflow launders allow for one tank to be offline for maintenance as required.

In the CIL circuit, the gold bearing solids are brought into contact with cyanide and air in the CIL that dissolves the gold from the ore into solution by forming stable gold-cyanide. The pH of slurry in the tanks is monitored and hydrated lime slurry is added as necessary to maintain target pH of

10.5. High purity oxygen air is blown into slurry in the tank through spargers mounted in the bottom of each leach tank.

Slurry exiting each leach tank flows by gravity to the next through an up-comer inside the tank to an overflow launder. Each tank is connected to the next two tanks via overflow launders with knife gate valves for tank isolation on each discharge point. This arrangement will allow the slurry to bypass the next tank in the series if one of the downstream tanks must be taken out of service for maintenance.

The purpose of the CIL circuit is to recover gold simultaneously as the slurry leaches before the barren slurry is directed to the cyanide destruction circuit. The gold is recovered by bringing the leached slurry, containing gold in solution, in contact with activated carbon so that the dissolved gold can be loaded onto it through the process of adsorption. Each CIL tank is equipped with an agitator, and an inter-stage screen. The CIL circuit is designed and operated in a carousel mode. Carbon is retained in each CIL tank and is only moved to elution when fully loaded. Slurry flow into the CIL circuit is moved sequentially to the next tank in series on a daily basis.

Slurry in each CIL tank is pumped by the inter-stage screen to a common connecting launder. Gates are opened and closed to direct slurry to the next tank in sequence while the screen retains the carbon. Slurry from the last tank in sequence gravity flows to the cyanide destruction circuit.

As the slurry proceeds through the CIL circuit, metal values in the leach solution will progressively decrease. As the Pumpcells progress from being the tenth cell fed to being the first the gold loading on the carbon in the Pumpcell will increase. Once the carbon is fully loaded and the Pumpcell taken offline a loaded carbon pump will transfer the carbon to the elution circuit acid wash column via the loaded carbon screen.

The slurry tailings stream from the carousel circuit will flow by gravity to the carbon safety screen to capture any carbon particles that may have escaped from the final Pumpcell. Carbon collected on the safety screen oversize will be collected in bins and sold or disposed of periodically, depending on the contained gold value. Reactivated carbon from the carbon quench tank is screened through the Carbon Sizing Screen where the oversize reactivated carbon is directed into the last CIL tank.

Once the loaded carbon in the lead CIL tank is fully loaded, carbon slurry is pumped to the Loaded Carbon Screen where the loaded carbon is screened and separated from the slurry under water spray. Water sprays on the vibrating screen decks assist in washing off process slurry from the loaded carbon before reporting to the acid wash column. The loaded carbon gravity flows to the acid wash column ahead of the next elution cycle and the slurry returns to the CIL launder.

CIL TAILINGS CYANIDE DETOXIFICATION

CIL tailings gravitate to cyanide detoxification. Cyanide detoxification is based on the well established SO_2/air process. Detoxification is carried out using sodium-metabisulphite (SMBS) as the SO_2 source, copper sulphate, oxygen gas and lime slurry as reagents over an average residence time of one hour using two tanks operating in parallel. An online CN_{WAD} analyzer is used to monitor detox feed and discharge CN_{WAD} levels and adjust reagent additions accordingly. The target CN_{WAD} concentration is <0.5 mg/L.

CIL TAILINGS THICKENING AND FILTRATION

The detoxified slurry overflows the detox tank into the CIL tailings thickener feed pumpbox where it is transferred to the CIL tailings thickener. Flocculant solution is added to the thickener feed to promote settling and increase the thickener underflow density.

CIL tailings thickener overflow is directed to the flotation tailings thickener underflow pumpbox. The overflow stream is high in dissolved salts and residual cyanide which may impair flotation and is sent to tailings as a result. CIL tailings thickener underflow is pumped to the CIL tailings filter feed tank. The tank is agitated to maintain slurry suspension. Slurry is pumped to the CIL tailings filters which operate on a batch basis. The filters are plate and frame filters.

The filter cake from the detox filter is deposited in a bunker area below the filters. A loader transfers the solids to a storage building to be reclaimed for final deposition underground.

CARBON ELUTION AND REGENERATION

Loaded carbon from the lead CIL tank is recovered on the Loaded Carbon Screen oversize and directed to an acid wash column. Diluted hydrochloric acid is circulated through the acid wash column. The acid solution is circulated through the Acid Wash Column two bed volumes (BVs) acid rinse per hour and discharged to the cyanide destruction.

The carbon is rinsed with fresh water to remove residual acid from the loaded carbon. The neutralized acid solution is drained to the acid wash area sump. Acid washed carbon is then transferred to one of two elution columns.

A pressure Zadra elution circuit has been selected for elution of gold and silver from loaded carbon. The elution system comprises an elution column, elution eluate tank, elution eluate pump, an elution water tank/pump and an elution heater package. This equipment operates in a closed loop with the electro-winning cell located inside the gold room.

Within the package, there is a recovery heat exchanger, trim heat exchanger, diesel-fired heater, control panel, all interconnecting electrics and pipework. The heater is designed for a heat output to maintain the strip solution at 135 °C during the elution cycle. Both heat exchangers ensure that the nominal temperature of solution entering the electro-winning cell is 95°C.

After completion of the elution process, stripped carbon is transferred from the elution column to the kiln dewatering screen. The screened carbon is fed into the kiln feed hopper then metered into the carbon regeneration kiln. The carbon regeneration kiln is propane-fired, and is a horizontal, rotary unit designed to regenerate 100% of the stripped carbon.

Regenerated or reactivated carbon discharges by gravity from the kiln to a quench tank to cool down and is then transferred via recessed impeller transfer pump to the carbon sizing screen. The barren carbon is screened and reports to the CIL circuit. Fine carbon is collected for off site treatment and gold recovery.

The gold room contains electrowinning cells for both carbon elution and gravity concentrate intensive leach solution. Cathodes from each are treated in a similar manner.

Cathode wash material and cell floor sludge are drained from the electrowinning cell to a sludge hopper. A positive displacement pump feeds a plate and frame filter. The filter cake (gold/silver sludge) is loaded from the sludge filter into trays on the electrowinning sludge trolley. The trays slide into the gold room drying oven, which dries the sludge.

The dried and cooled sludge is combined with fluxes (silica, nitre, borax and sodium carbonate) in the flux mixer. The sludge-flux mix is direct smelted in an induction furnace. The fluxes react with impurities to form a slag, whilst the gold and silver remains as a molten metal.

A fume scrubbing system is used to scrub the fumes from the electrowinning cells, ovens, and furnace.

The gold doré is poured into a cascade pouring table of doré moulds. The doré bars solidify and are quenched in water, cleaned to remove slag, weighed, stamped for identification, sampled for analysis and stored in a secured vault while awaiting dispatch.

REAGENTS

The reagents module consists of the tanks, mixers, and pumps required for the following reagents:

- SMBS – Sodium Metabisulphite
- NaCN – Sodium Cyanide
- NaOH – Sodium Hydroxide
- Leach aid for the intensive leach reactor
- Lime (quicklime) – Calcium oxide
- $CuSO_4 \cdot 5H_2O$ – Copper Sulphate Pentahydrate
- Collector: Potassium Amyl Xanthate (PAX)
- Frother: AF65
- Promoter: A208
- Hydrochloric Acid
- Anti-Scalant- Milsperse 8132
- High pH Flocculant - SNF AN977SH
- Low pH Flocculant- Anionic Polyacrylamide - High MW
- Activated carbon

UTILITIES

This module includes:

- Low Pressure (LP) Process Air System
- High Pressure (HP) Air System
- Mine water
- Process water
- Gland water
- Potable water
- Safety shower water

Oxygen gas is generated by a pressure swing absorption plant and has been selected over air to increase cyanide leach detox reaction rates and reduce compressor and agitator power requirements.

INTERFACES WITH SITE INFRASTRUCTURE

Sewage treatment plant effluent located at Madrid North will report to the tailings transfer tank to enable transfer to the TIA.

The Sediment Pond contents will be intermittently pumped to the flotation tailings thickener (when installed) for water reclaim.

Slimes from the underground mine's sumps could be processed in the plant via hosing the slimes into the crushing area sump pump which pumps to the secondary screen. The water balance in this area allows for a discretionary addition of up to 20 m^3/h of water to this screen via water addition and/or the sump pump to minimise disruption to the plant's overall water balance.

18.0 PROJECT INFRASTRUCTURE

Hope Bay has significant existing infrastructure at Roberts Bay and at the Doris Mine site, including:

- A Jetty at Roberts Bay for unloading cargo arriving by ship
- Fuel storage at Roberts Bay – installed capacity of 20.5 ML storage tanks
- Fuel storage at Doris camp – 5 x 1.5 ML storage tanks
- All-weather airstrip - 1,525 m by 40 m wide, allows for gravel-certified aircraft such as the Dash 8, Buffalo, 737-200, Hercules, ATR-72 and Avro RJ85 Avroliner
- Waste management facility including an incinerator and hazardous waste storage
- A concrete batching facility
- Sea container storage and cargo laydown areas
- Power generation plant – 8 x 1.45 MW diesel powered generators
- Doris Plant – 2,000 t/d
- Mine water treatment plant and ocean discharge pipeline
- TIA – 2.5 Mt storage and permitted for 18 Mt
- Accommodation – 345-person capacity - office complex with potable water and wastewater treatment plants
- Mine dry and Doris Plant dry
- Maintenance workshops and warehouses
- Fire water tower
- Contact water ponds
- Road network connecting all infrastructure

For general arrangement drawings please refer to APPENDIX 1.

18.1 WATER SUPPLY AND DISTRIBUTION

Fresh water is drawn from two sources. Doris Lake is a raw water source for process needs through a pump house with primary filtration located on the lake shore. Doris Lake water can also serve as backup potable water supply through an existing water treatment facility attached to the accommodation complex at Doris via the heat traced and insulated fire water supply line.

Primary potable water supply is trucked from a pump house with filtration at Windy Lake. The quality of water at Windy Lake is superior to Doris Lake for potable needs as it requires less treatment.

18.2 ROADS

The existing all-weather road network connects Roberts Bay, Doris site, TIA, Madrid North and Windy Lake.

The Doris Road connects the existing jetty at Roberts Bay to the Doris Camp and will continue to be used for the life of mine. The roads at Doris are well linked between various buildings and facilities. The Doris Plant is connected via an approximately six km single lane service road with an integral berm protected pipe path to provide for access to the southern end of the TIA.

The 8 km-long Windy Road from the Doris site south to the Madrid North Portal location and Windy Lake pump house is complete and in use. A road to Madrid South portal site is planned for future development of that infrastructure.

Roads to be developed include a haul road from Madrid North to Boston and a service road from Madrid North to the TIA.

The overall design concepts for the 51 km Madrid-Boston all-weather road, and associated infrastructure (quarries and quarry access roads), is based on the same principles used for existing roads at Doris. Road alignments will be designed to minimize crossings and unfavorable foundation conditions.

The Madrid-Boston all-weather road will consist of the main road, turnouts to allow for passing, and stream crossings. Quarries and quarry access roads are also associated with the road.

Haul road design criteria are as follows:

- The design vehicles will be crew cab trucks, personnel transfer buses, Super B-fuel trucks, Super B-trucks, and lowbed trucks. In addition, construction equipment will periodically travel the road, which is expected to include CAT 988 loaders, CAT 16H graders, and CAT 730, CAT 773 haul trucks and long-haul road trains for transportation of ore from Boston to Madrid North.
- The maximum design speed for any vehicle will be 50 km/h.
- The minimum allowable radius of curvature for the road is 100 m; however, at this radius the maximum speed is reduced to 35 km/h. The maximum radius of curvature while maintaining a maximum speed of 50 km/h is 231 m. Wherever possible, corners with wider radii of curvature shall be targeted.
- Minimum fill thickness of 1 m over permafrost soils and 0.3 m over bedrock.
- The minimum crest road width will be 8 m for single lane traffic and 11 m for dual lane traffic.
- The maximum allowable grade is 10%; however, wherever possible, grades less than 4% will be targeted.
- Turnouts shall be included at a frequency of at least one per km. Each turnout shall be at least 30 m long and 4 m wide.
- The road shall be crowned at 0.5% to allow for water drainage.
- The road side slopes shall be 1.5H:1V when the road is less than 2 m thick and 2H:1V when the road is greater than 2 m thick; and where road thickness is greater than or equal to 3 m safety berms or barriers will be placed along the road edge, and the road crest will be widened to accommodate the berms.

Service roads are designed for smaller service vehicles to enable access for installing, inspecting and maintaining pipelines that will run along the sides of the road. Service roads will be built as cost effective as possible as speed is not a priority for service roads.

Service roads will be designed as single lane roads. The minimum road crown width will generally be eight m and the maximum allowable grade will be 10%. At approximately 1 km intervals, pullouts will be constructed to allow traffic to coordinate passing via radio communication.

Safety berms or barriers will be constructed along any section of the road where the shoulder is more than three m above natural ground. Where safety barriers are required, the road crown will be widened by one m. Where services (pipeline or electrical cabling) follow road corridors, the

roadway will be widened to accommodate these services and a traffic separator will be placed between the active roadway and the service corridor.

Roads will cross both ephemeral and perennial streams. Site-specific crossings will be designed to conform to Department of Fisheries and Oceans Canada policies, and may consist of rock drains, arch culverts, or free span bridges depending upon the presence or absence of fish habitat or navigability concerns.

Foundation conditions generally consist of ice-rich, saline, marine silt and clay permafrost. Excavation of these soils, or activities that would lead to ground thaw, will result in permafrost degradation which can be difficult to mitigate. Furthermore, when thawed, these soils have insufficient bearing capacity to sustain loads from the roads. The roads have therefore been designed to preserve the permafrost, through placement of a sufficiently thick layer of fill (quarry rock) to insulate permafrost. Thermal analysis confirmed that a minimum fill thickness of one metre with appropriately tapered shoulders are required to ensure that the depth of the active layer does not increase, thus limiting the risk of permafrost degradation and foundation bearing failure.

Roads will be constructed with rock from locally developed quarries. Before use, rock from these quarries will be geochemically characterized to confirm that the material will have low Acid Rock Drainage (ARD) and/or Metal Leaching (ML) potential. The quarry sites have been identified by past site investigations for outcrops proximate to the routes as well low ARD and metal potential and are currently permitted. The bulk of the roads will be constructed using run-of-quarry material placed in lifts and compacted. The final traffic surface will consist of a specified crush to preserve tires.

Construction and operational dust suppression will be managed using water spray trucks or environmentally acceptable chemical dust suppressants as needed.

18.3 TAILINGS IMPOUNDMENT AREA

The TIA was designed to be constructed in two phases. Phase one has already been completed and allows for up to 2.5 Mt of tailings storage. Phase 2 construction will increase storage capacity to 18 Mt (14 million m^3).

To ensure environmental compliant effluent containment, the TIA will comprise three dams: North, South, and West dams. The existing North Dam will remain unchanged from the current design and functions as a water retaining dam, while the South and West dams will have tailings deposited against their upstream face keeping the reclaim water pond away from these structures.

The existing North Dam was constructed in 2012 as a water retaining frozen core dam, while the South and West dams are designed as frozen foundation rock fill dams incorporating a geosynthetic clay liner (GCL). The South Dam Phase 1 construction has been completed and will be raised as part of the planned Phase 2 development. The West Dam will be a newly built structure.

Tailings will be discharged into the TIA via spigots from several points along the eastern perimeter of the TIA, and from the South and West dams, creating a landscape that drains towards the North Dam at an average slope of about 1%.

At closure, the TIA will be closed through application of a 0.3 m thick quarry rock isolation cover intended to mitigate tailings dust and prevent direct contact of tailings with terrestrial wildlife. Water quality modeling has confirmed that after the cover has been applied, water discharge from

the TIA will meet environmental discharge criteria. Once that has been demonstrated to occur, the North Dam will be breached as originally intended, returning the natural outflow to the original elevation of 28.3 m.

18.4 MINE WASTE ROCK STORAGE

Mine waste rock produced from underground mining activities will be temporarily stored on the surface before being used as mine backfill. All mine waste rock will be used for back filling underground mine works. No mine waste rock will remain on surface post mining activities.

Temporary waste rock storage areas will be designed such that all run-off water is contained in contact water ponds. Contact water ponds will be kept dry by removing water as water accumulates in the ponds.

Contact water ponds will be built at Madrid North, Madrid South and Boston.

18.5 BULK FUEL STORAGE

In addition to the existing and operating 20.5 ML fuel storage capacity at Roberts Bay, an additional tank farm of 20 ML is permitted for construction and operation at Roberts Bay as well as an additional 4.5 ML in the existing tank farm, for a total storage capacity of 45 ML at Roberts Bay. New storage tanks will be connected to existing storage tanks by a piping and valve arrangement.

The existing fuel dispensing facilities at Roberts Bay are used to fill fuel tanker trucks for transportation of fuel to various smaller fuel storage tanks located in the vicinity of facilities such as power generating plants that require fuel.

Once tanks are constructed, fuel will be transferred by truck daily to the Madrid North Diesel Storage facility. Two 1.5 ML tanks, for a total storage of 3.0 ML, will be equipped with offloading, transfer and truck filling capabilities. Fuel will be piped to a day tank at the Madrid Power Plant.

A similar arrangement is planned for Boston. Fuel storage at Boston will be sized to allow for one week of storage in the event of white-out conditions and fuel trucks are unable to provide fuel delivery services.

18.6 POWER GENERATION

The existing Doris power plant supplies power to the entire Doris area, including the underground mine.

The power plant at Doris consists of eight 1.45 MW packaged generators complete with switchgear. Facilities in this area include:

- Diesel engine powered generators
- Doris substation
- Glycol Boiler System
- Fuel Storage Tanks and Distribution System
- Foam type fire monitoring and protection

These eight units provide installed capacity of 11.6 MW operating in N+2 configuration.

In addition to the existing power plant located at Doris, a new power generation facility will be built at the Madrid North site. The new power plant at Madrid will consist of four 7 MW diesel engine powered generators in an N+1 arrangement. Low rotations per minute (RPM) fuel efficient diesel powered gensets will provide optimal fuel efficiency compared to the current units installed at Doris.

Genset heat recovery systems will be used to recover heat using a glycol-based heat exchanger. A glycol distribution system will be implemented to transfer heated glycol by pipelines to various heated buildings including the accommodation complex, the Madrid Plant and the maintenance workshop facility at Madrid North. It is anticipated that almost all of the excess recovered heat will be used during the winter months to heat facilities and that no auxiliary diesel-powered boiler heater will be needed to make up for a shortfall in heat produced by the gensets.

The power plant at Madrid North will be designed in such a way that should the need arise in the future, an additional genset can be installed in the power plant building.

A new power plant will be installed at Boston mine site. Three 1.45 MW gensets will be relocated from Doris mine to provide power for Boston infrastructure, utilities and mining activities.

18.7 ACCOMMODATIONS

Existing accommodations at Doris consist of a complex containing a kitchen and dining facility, sleeping facilities for approximately 345 personnel, medical, and small suite of offices. Recreational and meeting facilities are also housed in this facility.

Boston has an existing camp with a capacity of 65 persons, which will be replaced for full operations by moving existing infrastructure from Doris after the Doris mine is depleted. This will include a kitchen and dining facility, a laundry, a recreation area and an exercise room.

A new accommodation facility will be built at Madrid North that will include 400 bedrooms, a kitchen and dining facility, a recreation and exercise facility, a first aid room and a housekeeping laundry room. Included in the accommodation complex is an office complex for mine management and support teams, a potable water treatment plant, a wastewater treatment plant and tanks for potable and fire water storage.

The accommodation complex will connect with the process plant, power plant and maintenance / truck shop buildings via an enclosed “arctic” corridor that will also be used to route services such as water, glycol, power and communications cabling. Potable water will be pumped from Windy Lake via an insulated and heat traced pipeline to the potable water tank at the accommodation complex.

Additional space will be allowed for in the site layout for additional dormitories as may potentially be needed if current mining plans change.

18.8 MAINTENANCE FACILITIES AND WAREHOUSING

At the Doris site, in addition to small craft shop spaces in camp (plumbing and electrical), there is a single mobile equipment shop facility for both surface and underground fleets.

Underground primary service and lubrication will be carried out underground to minimize the transit of equipment and exposure to cold weather. Underground service bays are served by two

modular fuel and lube storage units equipped with automatic fire suppression and fire doors to comply with mining regulations for underground flammable storage.

Major repairs will be carried out in the 640 m^2 main maintenance facility which consists of a high bay shop that can accommodate up to six units of mobile equipment at any one time.

The mobile equipment maintenance facility (truck shop) at Madrid North will consist of:

- A pre-engineered building with wall cladding and roof cladding with R40 insulation
- A concrete floor
- 7 - Service Bays
- 1 - Wash Bay
- 1 - Welding Bay with Overhead crane access
- Equipment with adequate fume exhaust fans
- Safety eyewash and shower
- Light Vehicle Service Bay
- Lean-to for lube storage
- 2 x 25 tonne Service Bay Overhead Crane with 14.0m span each to be supported by the pre-engineered building frame
- Glycol heat exchangers to heat building to minimum indoor temperature of 15 degrees Celsius
- Ducting, piping, and cable trays supported by the pre-engineered building frame
- Electrically operated, vertical, insulated overhead doors
- High pressure water cleaner module/pump/heater
- Wash water tank and pumps
- Wash Bay complete with sump and oil-water separator

The mobile equipment maintenance facility (Truck Shop) at Boston will consist of:

- Fabric-clad, pre-engineered-type building with insulation, similar to the one currently used at Doris
- A compacted gravel floor with dust suppressant applied
- Mobile air compressor for tools
- Sea containers for parts storage
- A trailer office with a lunch/meeting room
- Electrical heaters and electrical welding power outlets
- A light welding-bay

The maintenance facility at Boston is intended for preventive maintenance and minor repair work. Major repairs will be performed at the Madrid North Maintenance Facility. Equipment needing repairs at Madrid North will be loaded onto a low bed trailer at Boston and floated to Madrid North.

Warehouse facilities at Madrid North include a mobile equipment parts and consumables warehouse inside the maintenance / truck shop building and one separate warm and three cold fabric covered storage buildings with compacted gravel floors to store spare parts, consumables, reagents and other materials, and equipment for maintenance and operations.

18.9 MOBILE MAINTENANCE EQUIPMENT

Mobile maintenance equipment includes all equipment needed to maintain the site excluding the underground mines.

Existing equipment currently used at Doris will be used at Madrid and Boston where possible. It is anticipated that the following additional mobile equipment will be needed:

- Transport Bus (two)
- Pickup Trucks (six)
- Fuel & Maintenance Vehicle (Pickup with tools etc.)
- Fuel Trucks (3500 gal) (two)
- Container Handler
- Forklifts (5 t)
- Tractors
- Flatbed Trailer
- Cement truck (3) & Boom Pump
- Front-End Loader
- Road Grader
- Medical Vehicle/Ambulance

18.10 WATER TREATMENT FACILITIES

In addition to the current mine water treatment plant at Doris an additional plant is planned to treat water from the TIA and water from mining activities at Madrid North and Madrid South and will also be located at Doris near the TIA.

The new water treatment plant is planned to treat water for compliance to the Metal and Diamond Mining Effluent Regulations (MDMER) and new additional MDMER criteria for un-ionized ammonia coming into effect in 2021. Water from the TIA will be treated for Total Suspended Solids and potentially metals over the life of mine. It is not anticipated that treatment will be needed for un-ionized ammonia at present but in the event that effluent discharge criteria are exceeded within the TIA or in mine water, the planned water treatment plant will have the ability to be modified to treat water containing un-ionized ammonia.

18.11 COMMUNICATION AND INFORMATION SYSTEMS

Doris site has an established adequate satellite support infrastructure and site-based server capacity to support modern mining operations. A corporate wide Enterprise Resource Planning (ERP) platform is in operation and connects to a site server to allow rapid data processing of site computational needs with periodic financial and administrative updates of selected data to the corporate server during off peak times.

Mine planning software is installed at Hope Bay on a planning server with licenced based access by planners as needed. The site wi-fi system is fully functional in all office and dormitory spaces.

All bedrooms at Doris have televisions to provide in-room entertainment and wi-fi is available for private use. A policy to limit personal bandwidth use to maximize availability to all camp residents has been successfully implemented and modeled after similar restrictions in place at remote fly in/fly out operations.

Telephones will be provided in the offices in the accommodation complex at Madrid North and shared ‘public’ telephones will be provided at various location in the camp for employee use.

The communications and entertainment systems currently at Doris will be replicated at Madrid North. Wi-Fi and satellite television (distributed locally by cable) services will be available through the Madrid North accommodation complex.

Computers, VOIP telephones and associated networking equipment will installed in the Accommodation complex, Process Plant, Power Plant and Maintenance Facility.

The site radio system communicates across all active areas of the belt from Windy Lake to Roberts Bay by means of a series of repeaters which will be extended to include coverage on all new roads.

18.12 WASTE MANAGEMENT FACILITIES

Domestic waste from Doris, Madrid and Boston will be incinerated using incinerators compliant with appropriate Environment Canada requirements. Where practical, waste oil will be used to fuel these incinerators. The Doris incinerator is located at Roberts Bay and is already functional. Domestic waste generated at Madrid and Boston sites will be trucked to Doris and disposed with the Doris waste.

Landfills to contain generally dry, non-leachable waste materials will be constructed at Doris and Boston sites. Similar waste from the Madrid site will be trucked to the Doris site for disposal. The proposed landfill sites are within the watershed of the TIA.

Waste will be placed in two 0.85 m thick lifts and each lift will be compacted under the weight of heavy equipment. A 0.15 m thick intermediate fill, of 32 mm minus (1 ¼ inch) crushed rock, will be graded over the debris to fill the voids in order to reduce settlement and final cover subsidence. An intermediate cover will also be placed over the waste during the winter months or extended periods when no landfill activity is anticipated.

Once completed, landfills will be capped with a one metre thick rock fill cover of 150 mm minus (6 inch) clean compacted quarry rock material. The final surface of the landfill will be graded similar to the foundation base grade, of 1%, to shed water and minimize infiltration.

The capping material will move the active thaw layer away from the stored waste so it is expected that permafrost will partially aggrade into the landfill waste over time.

If additional landfill capacity is required, it is possible to place additional layers of waste along the rock face, on the north and east sides of the landfill, and have the landfill cover slope from northeast to southwest.

The Boston landfill will be developed within the designated rock quarry immediately behind the portal. The general landfill development concept will be identical to the Doris site.

There are no hazardous waste disposal facilities on site. All hazardous waste will be stored using standard industry best practice methods and shipped off site, either via sealift or airlift backhaul as the opportunities arise. Final disposal will be under contract at a designated licenced hazardous waste disposal site close to the designated port or airport.

For soil contaminated by hydrocarbons, contaminated soils will be tested and if found to exceed industrial standards the soils will either be bio-remediated in situ, or alternately excavated and treated in a purpose-built land farm on site. Should the quantities of contaminated soils be small, consideration will be given to shipping these contaminated sills off site to a designated and licenced disposal site.

Waste oil and lubricants will be managed and disposed of in accordance with existing management plans for Hope Bay. Dedicated modules for focussing on the Madrid and Boston sites will be added to these management plans. The primary premise of these management plans rests on the fact that as far as practical waste oil will be reused as fuel for the incinerator or as a heat source in non-inhabited areas. If necessary, excess waste oil and lubricants will be collected and disposed of off site, at a designated and licenced disposal site under contract. Transport of these products will be by either sea or air backhaul.

The existing waste management facilities at Roberts Bay and Doris will be used to manage waste for the entire Hope Bay site. No new waste management facilities other than a landfill at Boston are anticipated.

18.13 EXPLOSIVES STORAGE AND HANDLING

Explosives will be used on site for blasting of the underground mine development headings. The primary materials to be used are Ammonium Nitrate (AN) and fuel oil (which are premixed to create ANFO), explosive boosters, emulsion based packaged explosive and detonators. Due to the volume and nature of these materials, facilities meeting specific safety and regulatory conditions are required such as adequate separation between components. All staff accessing the explosives storage must be trained in the safe handling of the materials.

Explosives will be delivered via the sea lift, thus requiring a storage facility with the capacity to store a minimum of one year's supply. Ammonium nitrate prills will be delivered in sealed 1 t minimum bags in sea containers to protect them from moisture. Ammonium nitrate, fuel oil and other products will be removed from the sea containers stored in the main supply magazine facility and transported to the underground magazines as consumed. The site magazine area is adequate for current annual usage and is expandable as required.

As required, detonators and packaged explosives will be stored in steel Type 4 magazines or better (NFPA 495, 2006, Sect. 9.2). The detonators must be housed separately from the explosives in their own magazine(s). Magazines for detonators, properly separated from explosives, are approved by the regulator and have adequate storage capacity for several months of supply on surface and underground. The current explosives and detonator storage magazines are within Quarry A, 1.6 km from the nearest occupied structure and shielded within the highwalls of the quarry.

18.14 SAFETY, SECURITY AND FIRE CONTROL

Site security is achieved primarily by the remote location of Hope Bay and the limited access points. All persons entering and leaving the site are tracked by passenger manifest and approved for entry prior to boarding aircraft. All persons entering and leaving site are informed they are subject to search at any time to reduce the opportunity for theft. The gold room is a secure facility requiring coded access and is surveyed by video recorders. Access to the gold room will be tracked and inventory of gold reconciled and verified daily by multiple individuals. Searches of persons and or baggage leaving site will be randomly conducted to further inhibit theft.

All persons entering site for a visit or work will receive an orientation on site safety rules, relevant regulations, evacuation procedures, and camp occupancy rules. Violation of rules can lead to immediate revocation of their site access with penalties including transportation off site.

The Hope Bay site is a dry camp, and there is zero tolerance for alcohol or drug use. Pre-employment screening and testing for cause will be utilized to ensure the site remains free of the hazard of drugs and alcohol.

Site safety follows best practices with oversight by site safety coordinators ensuring site rules, procedures, and regulations are followed. Safety coordinators will audit employees and contractors for conformance. Failure to follow safety criteria could lead to immediate revocation of the privilege to be on site and transport off site. Contractors with repeated problems will be removed from site and not eligible for future tenders.

Fire control will generally be managed by training and vigilance of the workforce in identifying fire hazards and responding with handheld equipment. In addition, automatic detection and suppression systems are deployed for high risk and/or high value installations. The camp offices and sleeping quarters are protected by automatic fire alarm systems to alert the occupants. The camp sleeping quarters are further protected by firewalls with automatic closing doors to prevent a rapid spread of fire. High value equipment such as the power generators are protected by automatic inert chemical fire suppression systems with integral alarms. Large underground mobile equipment is protected with manually actuated dry chemical fire suppression systems to limit the risk that an equipment fire can lead to entrapment of mine employees. Mill equipment with flammable liquids will be protected by automatic dry chemical fire suppression systems in addition to handheld equipment.

Fire evacuation plans for all areas are formal and include designated muster points and identification of potentially missing persons. The Doris camp has an emergency shelter capable of sustaining camp occupants until site evacuation should there be a catastrophic loss of camp facilities.

Underground operations will be provided with two means of escape and refuge chambers utilized for areas beyond access to a second escape way or where escape would take longer than 40 minutes. Refuge stations will be provided underground in accordance with Nunavut mining regulations.

Site emergency response is achieved through the training and equipping of an emergency response team (ERT). The ERT will be trained in surface and underground rescue to maximize the number of available responders among the relatively small camp population. The site currently has a mine rescue station with adequate apparatus and most support equipment required to make it operational on recertification by manufacturers' representatives.

18.15 TRANSPORTATION AND FREIGHT

An existing all-weather 1,525 m gravel airstrip located between Roberts Bay and the Doris camp is capable of landing gravel-certified aircraft as well as air freight, including Hercules. There are no plans to build a new airstrip at Boston as the planned all-weather road meeting Boston site will satisfy logistics needs.

Roberts Bay is located approximately five km from the Doris site and is the main port entry point to the Hope Bay volcanic belt. The facility provides a cargo offloading jetty, a diesel fuel offloading facility, and fuel storage facility.

An approximately 100 m long, 30 m wide jetty was constructed in the summer of 2007 and improved in 2013 and 2014 at the south end of Roberts Bay for Phase 1. Water depth at the jetty head is approximately three m. Five land-based mooring points were installed in the summer of

2010 to provide more fixed points for vessel moorage. They are located on rock outcrops near the Roberts Bay shore, one on either side of the jetty, one near the existing Roberts Bay fuel tank, and two approximately one-km northwest on the west shore of the loading facility. Each mooring point consists of steel anchor rods grouted into solid rock to a depth of ten m, attached to a steel superstructure with a shackle to attach a mooring line from a vessel.

The existing jetty had suffered loss of material at the northwest end as a result of erosion and was repaired and upgraded in 2013 and 2014. The jetty has been enhanced to safely support cargo loads that are anticipated to cross the structure during operations.

The jetty was improved in accordance with the existing Doris Fisheries Authorization, Federal Land Lease, and Navigable Waters Approval. The improvement included widening and armouring the jetty as well as creation of fish breeding habitat to replace habitat lost in the development of the Jetty.

In order to provide for the economic supply of material, equipment, etc., into the Hope Bay site, an annual sealift is required. This sealift generally occurs in the August-September period, when the ships and barges can access the site.

The main sealift will use the ports of Becancour in Quebec and/or Vancouver as the embarkation point. There is also the capability to use the Mackenzie River system, using Hay River as the embarkation point. Freight will move to site along the lowest cost route with emphasis on reducing risk by splitting key deliverables such as fuel to two or more routes.

The site is set up to receive the material using the existing jetty and laydown areas at Roberts Bay via direct shipment on barge or via lightering barge transfer from freighters moored in the Bay.

Logistics surrounding the sealift are planned and booked in Q2 of each year to maximize supply of material, equipment and consumables during the short shipping season at the Hope Bay site.

Air freight service to Hope Bay is accomplished on regularly scheduled crew transports which typically accommodate 2,000 lb of cargo each trip out of the 5,600 lb payload capacity. In addition to the available payload on crew rotation charters the site has access to cargo service from Buffalo aircraft (14,000 lb cargo capacity) via the main airstrip and Hercules aircraft (35,000 lb cargo capacity).

Personnel transport services are based on commercial travel to Edmonton for non-Nunavut based employees and charter to site on Avro RJ 85 jets.

Nunavut residents are transported to site via Cambridge Bay and various type of smaller aircraft such as a King Air or similar aircraft.

18.16 PROCESSING PLANT

PROCESS PLANT FACILITIES OVERVIEW

The Madrid North process plant facilities will include:

- Blending Stockpile
- Primary Crushing
- Crushed Ore Surge Bin
- Primary and Secondary Grinding

- Secondary/Pebble Crushing
- Gravity Concentration
- Flotation
- Pre-Aeration
- Carbon-In-Leach
- Carbon Elution
- Electrowinning
- Cyanide Destruction
- Gold Room
- Reagent Storage

MECHANICAL / LAYOUT DESIGN BASIS

The process plant facilities were positioned in order to maintain some of the main criteria outlined below:

- Minimize cycle time of the mining trucks to the blending/ore stockpile area.
- Process facilities (buildings, conveyors, etc.) to be built on bedrock.
- Minimize conveyor lengths by using topography.
- All conveyors to be considered insulated in a self-contained gallery.
- Surge bin with 8h live capacity.
- House thickeners and all process equipment indoors to avoid freezing potential outdoors.
- Ensure equipment sizes matched Process Design Criteria (PDC) (at minimum) or vendor drawings (as they became available).
- Allow for bobcat or forklift to be able to move freely around the major process areas;
- Size Fresh Water Tank to hold fire water volume.
- Include a reagents area that would be easy to load / offload materials.
- Minimize the building footprint and height.
- Minimize over-handling/transport of high concentrate gold-bearing solution.
- Use overhead crane for maintenance as much as possible, to reduce necessity of large mobile cranes navigating through the process plant.
- Sumps positioned to prevent cross-contamination of certain solutions.
- House all processing areas under one structure, where practical, to reduce:
  - Piping/electrical runs/ racks
  - Site grading
  - Cost of pre-engineered structure
  - HVAC requirements
  - On-site roads

The main consideration in the layout of the processing facilities is, of course, the flowsheet. The facilities have been laid out in such a way to accommodate all of the equipment determined to be necessary as per the flowsheet, to allow this equipment to interact as per the flowsheet and provide for maintainability of equipment while preserving operator safety.

Other major considerations which drove the layout in each of the major processing areas are as follows.

COARSE ORE CRUSHING

The chosen equipment and process flow in the coarse ore crushing area is quite common for plants of this throughput and run-of-mine ore parameters. The layout provided an overhead crane, as well as access from outside the building at three (3) locations to maintain critical equipment- at the dump pocket elevation, at the apron feeder tail section, and at the discharge elevation near the transfer point between sacrificial conveyor and stockpile feed conveyor.

COARSE ORE SURGE BIN

Required live capacity (8 hours) and requisite conveyor angles are the determinative factors in the footprint and orientation of the combined surge bin and secondary crushing building.

A surge bin was chosen as the reclaim infrastructure under the bin can be built on elevated steel, rather than excavated out of the permafrost, as would be the case for a stockpile. This allows the building to retain heat under artic conditions. Material from the surge bin is discharged via two apron feeders which discharge to a reversible conveyor. The reversible conveyor allows for flexibility in operations. It allows normal discharge to the SAG mill feed conveyor, however, during SAG or Ball Mill maintenance, the reversible conveyor can be used to create a stockpile of crushed material. Also incorporated into the building is the pebble crusher, which receives oversize from the SAG Mill discharge, which discharges to the reversible conveyor.

PROCESS PLANT

The process plant is laid out in such a way to minimize footprint and height, group equipment with similar overhead height requirements under the same roof line, locate subsequent process steps relatively close to each other to reduce piping and pumping requirements.

Ore reports to the grinding area of the plant via the SAG mill feed conveyor located at plant south. From there it continues to flotation/CIL portion of the plant, located in the middle bays between plant north and south. Flotation/CIL products continue on to either plant north, or back to plant south; tailings report to plant north where tailings are processed, flotation concentrate is directed back to plant south, adjacent the grinding area where the elution area and gold refinery are located.

The height drivers in the entire plant are the grinding cyclones, gravity concentrator feed screen, and the regeneration kiln feed screen. As some of these are located in the grinding area, and some in the elution area this drove the decision to place these areas adjacent to each other. The elution area feeds the electrowinning/gold refinery circuits, and while these are not significant footprint or height drivers it was the logical choice to place them under this roof line next to the elution area, so the transfer of high concentrate gold solution happens in a relatively small, controlled area.

The flotation/CIL area is in the middle of the plant. The roof height in flotation/CIL is driven by the height required to remove agitators from the tanks. Rougher flotation is immediately north of the grinding area to optimize piping between the wo, and CIL is immediately north of the elution area, to minimize movement/degeneration of gold bearing carbon between the two areas. Oxygen plant is located outside, next to the CIL, which is the major oxygen use.

Tailings and reagents areas are located at the north of the plant. There will be a fair amount of traffic in/out flow in these areas (front-end loader for tailings filter cake, reagent delivery by various means, lime delivery, etc.). By grouping these areas together, a traffic plan can be created for this specific area that can minimize traffic interference with operation/maintenance activities in other

areas of the plant. Flotation tailings are also processed at the north of the plant so the tailings lines to TIA, which are large and under high pressure, are not required to run through the process plant, which could introduce a major safety risk. The fresh water tank is located in it's own heated area adjacent the tailings area. The fresh water tank contains process water and, at all times, contains enough fire suppression water to satisfy design conditions. As this tank is very large, and is not fed by any unit operation in the plant, it is appropriate to segregate it from the rest of the plant so it doesn't drive the footprint of the plant structure.

Each area of the plant can be accessed by the mobile equipment necessary to perform maintenance in that area. To minimize footprint, generally there is no 'drive-thru' access between areas; they must be accessed individually via overhead door for that area. Where there is an overhead crane, an appropriately sized laydown area has been provided with direct access from the overhead doors, so large components for maintenance can be brought in/out easily. In the case of the flotation tailings thickener there is no overhead crane, however allowance is provided for a 10 t mobile crane with boom to access the rake drive components.

A pipe rack runs in a central area in the plant. The pipe-rack will be supported independently from the ground, without impeding critical maintenance access. The pipe rack main begins in the grinding area and runs north, branching off to feed flotation/CIL areas. The pipe rack then 'T's and runs parallel to the tailings and reagents areas in the north, branching off from there to access users.

GENERAL ARRANGEMENT DRAWINGS

Below are the general arrangement drawings of the crushing facility, surge bin building, the process plant, and overall area layout for the 4,000 t/d Madrid Plant.

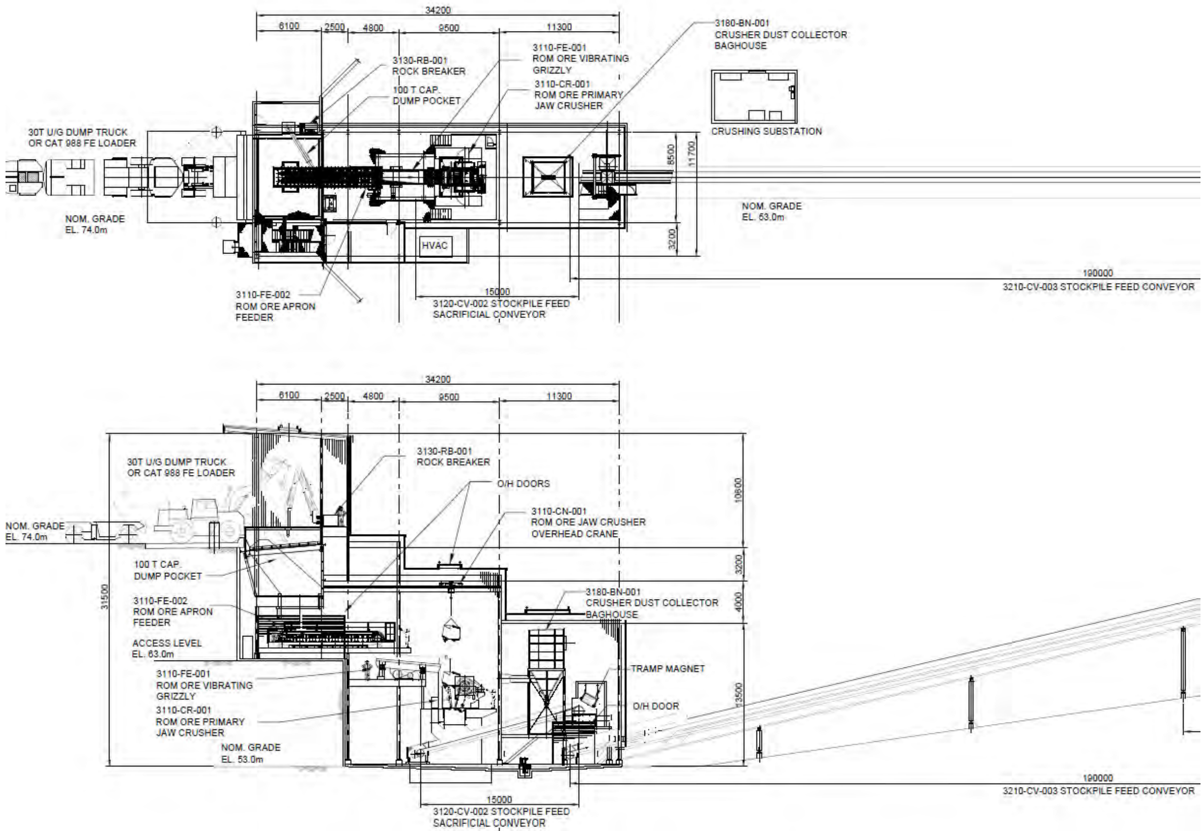


Figure 18-1. Primary Crusher Building with ROM ore bin and Jaw Crusher

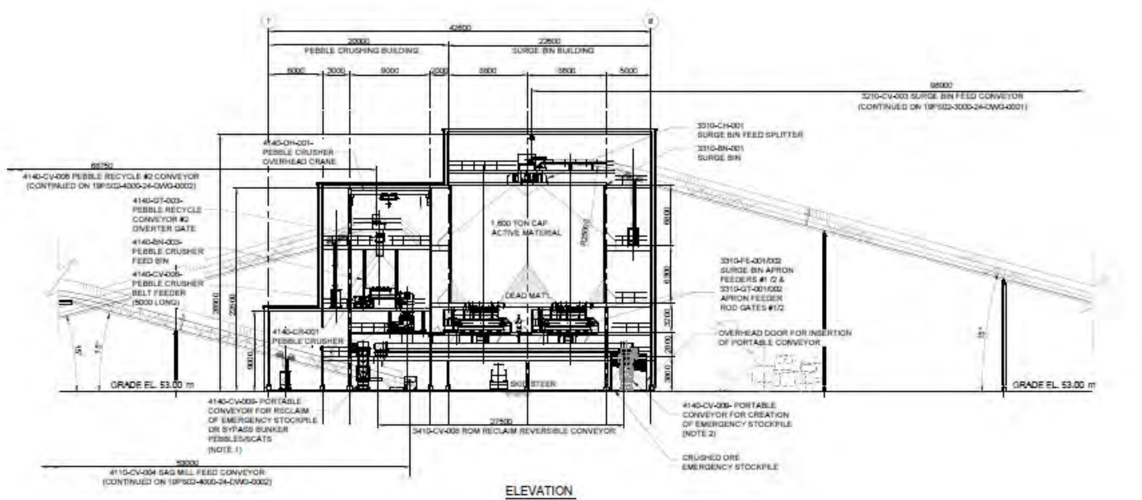


Figure 18-2. Combined Surge Bin & Secondary Crushing Building Elevation View

19.0 MARKET STUDIES AND CONTRACTS

Gold sales are expected to be at the precious metal spot prices of the London and New York Metals Exchanges (LME and NYMEX). All gold bullion is assumed to be sold at spot prices with no hedging program in place.

The Hope Bay Mine produces gold doré in the form of bars. Contracts for the purchase and refining of these bars has been entered into with Royal Canadian Mint and Asahi Refining, a subsidiary of Asahi Holdings. The terms and conditions described within these contracts have been used in the financial modelling of the mine. Transfer of responsibility occurs at the nearest commercial airport through a secure liability carrier who is responsible for transporting the bars to the refiner. There is also a contract with Sipi Metals and Materials for processing and recovery of gold from spent resins as required.

The contract with Asahi Refining expires in December 2020 and the contract with Royal Canadian Mint expires in March 2021 and both contracts can be extended as required. Transportation and refining charges have been agreed to and are typical to charges in the industry.

Other than as disclosed elsewhere in this report, including without limitation, the agreements referred to in Section 4.0 PROPERTY DESCRIPTION AND LOCATION, and agreements referred to in Section 21.0 CAPITAL AND OPERATING COSTS, there are no contracts material to the issuer that are required for property development. All major contracts are within industry norms.

20.0 ENVIRONMENTAL STUDIES, PERMITTING AND COMMUNITY IMPACT

This section discusses the relevant information on the environmental, permitting, and social or community factors related to the Project. This section has been prepared by TMAC. Environmental baseline studies related to geology, geochemistry, and hydrogeology; and the resultant plans for water management and waste disposal have been prepared by others and are discussed in further detail in other sections of this Technical Report.

20.1 INTRODUCTION

The Hope Bay Project is TMAC's sole asset and is its focus for exploration, development and mining. TMAC holds mineral claims, leases and one Inuit MEA that comprise an approximately 20 × 80 km property. These mineral holdings comprise the Project, on which the primary gold deposits Doris, Madrid North, Madrid South and Boston are located. The Project is host to numerous other prospective areas which suggest that economic reserves will continue to be delineated, permitted and developed, creating a multigenerational operation.

The Property is located east of Bathurst Inlet, approximately 150 km southwest of Cambridge Bay in western Kitikmeot, Nunavut, and 700 km northeast of Yellowknife. The nearest settlements are Omingmaktok, located approximately 60 km to the west, and Kingaok (Bathurst Inlet), located 130 km southwest. Both Omingmaktok and Kingaok are historical settlements; past residents have moved to Cambridge Bay or other communities, although the settlements continue to be used seasonally.

The Property is situated in an Arctic environment of extreme climatic conditions, wildlife, vegetation, ice-rich soils, pristine water quality, and abundant aquatic life that require careful planning to manage. These extremes also create challenges to human safety that require attention. Due to unique conditions of the Arctic environment, development of environmental management plans prior to any disturbance is paramount to the successful development, operation, and closure of mining facilities. Completing the regulatory process, and achieving consensus on best management practices, allows development to be managed within an officially recognized framework that protects valued ecosystem components while providing a business climate that supports development in the Kitikmeot Region and Nunavut. The project has an excellent history in this regard and has extensive permits for both existing and future activities and infrastructure.

Consistent with its existing operation, TMAC is committed to carefully considering cultural factors associated with the Inuit way of life in the development of this Project, as well as complying fully with its obligations as a proponent under the Nunavut Agreement. The Project is envisioned such that the land and resources continue to support the cultural and economic needs of Inuit while providing new economic opportunities. The following core stakeholder values will be carefully considered when developing this Project:

- Respect for existing Inuit values
- Use of Traditional Knowledge (TK) or Inuit Qaujimajatuqangit (IQ – Inuit specific TK) in the review and operation of the Project
- Respect for and protection of the land
- Sharing of economic benefits
- On-going engagement with the Inuit

TMAC recognizes the significance of TK in ongoing collection of detailed knowledge of the land, wildlife behaviors, and land use knowledge of local Inuit. Collaboration between the people of the Kitikmeot Region and TMAC has already built successful and sustainable partnerships that are critical to creating mutually beneficial economic opportunities and TMAC will continue to maintain and expand these as required.

With the Project, TMAC will continue with a focus on maximizing the socio-economic benefits derived from the development of non-renewable resources at the Project for the residents of the Kitikmeot Region and Nunavut. This requires a focus on direct employment and business opportunities that meaningfully support the economic operation of the Project. This will lead to opportunities such as secondary business creation, training, and community development that will strengthen local capacity to take on other opportunities not directly associated with the Project.

The value of expenditures associated with development and operational activities will continue to include tens to hundreds of million dollars annually to Kitikmeot, Nunavut, and Canada. For example, land- use fees and capacity funding from TMAC help the KIA implement policies that move the management of Inuit Owned Land (IOL) toward cost recovery with the fees being a source of revenue for the KIA. Other economic benefits, such as royalties paid by TMAC for mining on both Crown and Inuit-owned subsurface lands will strengthen all of Nunavut through NTI and the Nunavut Trust.

20.2 REGULATORY FRAMEWORK, PERMITTING AND PLANS

REGULATORY FRAMEWORK

The territory of Nunavut was created on April 1, 1999 through the Nunavut Land Claims Agreement (Nunavut Agreement). Nunavut is made up of three Regions; Kitikmeot, Kivalliq and Qikiqtani (or Baffin). The Hope Bay Project is in the Kitikmeot Region. The 1.9 million square km of land in Nunavut are classified as Crown land, IOL surface land, IOL surface/subsurface lands, or Commissioners land.

At present, the regulatory process for mineral resource development in Nunavut is co- managed by the Government of Canada, Nunavut Tunngavik Incorporated, Regional Inuit Associations (RIAs), the Government of Nunavut (GN), and Institutions of Public Government (IPGs). Each has specific mandates and responsibilities, however, there is some overlap.

The Crown-Indigenous Relations and Northern Affairs Canada (CIRNAC) administers Crown land through the Territorial Lands Act (TLA), which provides for the disposition, use, and protection of territorial lands. The TLA and its regulations govern the administration and disposition of mineral rights, and access to these rights. The Nunavut Mining Regulations (NUMR) regulate subsurface mineral exploration. The Territorial Land Use Regulations (TLUR) regulate surface activities related to mineral exploration and mining.

Pursuant to the Nunavut Agreement, the NTI has responsibility for surface and subsurface land and resource management on Inuit Owned Lands. NTI has further designated some of its responsibilities for surface management to the three RIAs. The RIAs are the:

- Kitikmeot Inuit Association (KIA)
- Kivalliq Inuit Association (KivIA)
- Qikiqtani Inuit Association (QIA)

NTI manages subsurface resources by entering into exploration agreements or by signing mineral production leases with the project proponents, such as the Mineral Production Lease TMAC holds for the existing operation. For the Project, the KIA administers IOL surface rights. Further information on land tenure is provided in Section 4.0.

The current federal Acts and Regulations that most commonly apply to mining projects in Nunavut include the following:

- Aeronautics Act, Canadian Aviation Regulations
- Arctic Waters Pollution Prevention Act, Arctic Waters Pollution Prevention Regulations
- Canada Shipping Act
- Canada Transportation Act, Ammonium Nitrate Storage Facilities Regulations, Flammable Liquids Bulk Storage Regulations
- Canadian Environmental Protection Act
- Explosives Act
- Fisheries Act; and Regulations, including Metal and Diamond Mining Effluent Regulations
- Greenhouse Gas Pollution Pricing Act, and Regulations
- Migratory Birds Convention Act, and Regulations
- Navigation Protection Act
- Nunavut Land Claims Agreement Act
- Nunavut Waters and Nunavut Surface Rights Tribunal Act
- Species at Risk Act
- Territorial Lands Act
- Transportation of Dangerous Goods Act, and Regulations

The Nunavut legislation that most commonly apply to projects in Nunavut includes the following:

- Apprenticeship, Trades and Occupations Certification Act
- Building Codes
- Business Corporations Act
- Emergency Medical Aid Act
- Engineers, Geologists and Geophysicists Act
- Environmental Protection Act, Spill Contingency Planning and Reporting Regulations
- Explosives Use Act, Explosives Use Regulations
- Fair Practices Act
- Fire Prevention Act, Fire Prevention Regulations
- Historical Resources Act
- Human Rights Act
- Information and Protection of Privacy Act
- Labour Standards Act
- Mine Health and Safety Act, Mine Health and Safety Regulations
- Nunavut Planning and Project Assessment Act
- Occupational Training Agreements Act
- Public Health Act, Camp Sanitation Regulations
- Scientist Act
- The Safety Act
- Transportation of Dangerous Goods Act
- Wildlife Act
- Workers Compensation Act

Five (5) IPGs were created through the Nunavut Agreement to manage various aspects of project development within Nunavut. These are:

- Nunavut Impact Review Board (NIRB)
- Nunavut Planning Commission (NPC)
- Nunavut Surface Rights Tribunal (NSRT)
- Nunavut Water Board (NWB)
- Nunavut Wildlife Management Board (NWMB)

Currently an approved land use plan is not in place for the Kitikmeot Region in which the Project is based and as such a review of applications relating to the Project is not required by the NPC. Once an approved land use plan is in place, NPC will carry out an initial review to determine compliance of proposed project applications.

The environmental assessment process is run by the NIRB. The Nunavut Agreement sets out the environmental assessment process for Nunavut and the requirements for the NIRB to conduct screenings and reviews. Once the process is complete and approved, the NIRB issues a Project Certificate that sets out the terms under which the project can proceed and related project approvals can be issued. CIRNAC participates as an intervener in the Project Certificate process and, once issued, enforcing the terms and conditions of the NIRB Project Certificate(s). In relation to its current operation, TMAC currently holds two (2) Project Certificates from the NIRB as summarized in Table 20-1.

The NWB is responsible for issuing water licences that allows the use of water and deposit of compliant effluents into water. Like the NIRB process, CIRNAC participates as an intervener in the licensing process and, once issued, enforcing the terms and conditions of the NWB water licence(s). The NWB, through the water licensing process, may identify additional legislation and regulations governing waters that may be applicable. In relation to its current operation, TMAC currently holds five (5) Water Licences from the NWB as summarized in Table 20-1.

The Nunavut Agreement requires the establishment of legislation for land use planning and environmental assessment. The Nunavut Planning and Project Assessment Act formally establishes the NIRB and the NPC in legislation, describes in detail the processes under which they operate, and provides timelines which are expected to provide additional predictability and certainty for developers such as TMAC.

CURRENT STATUS

For close to 30 years, the Hope Bay Project has undergone considerable exploration and development activities by TMAC and previous operators. The Hope Bay volcanic belt has significant existing infrastructure including a tailings impoundment area, airstrips, roads, fuel storage, a port facility, accommodation camps, power plants, administration, geology and lab buildings, and underground development at the Doris, Madrid and Boston areas.

Phase 1 of the Hope Bay Project development plan, known as Doris North, consists of gold production from an underground mine located near Doris Lake. Phase 2 of the Hope Bay Project development plan, known as the Madrid Boston Project, consists mining of the Madrid North, Madrid South, and Boston deposits by utilizing and expanding upon the Phase 1 infrastructure for the integrated development of the Hope Bay Project. At time of publishing, TMAC is executing Phase 1 and Phase 2 of the Hope Bay Project development plan including commercial mining at Doris and Madrid North.

Table 20-1 summarizes the key permits and approvals currently in place for the Hope Bay Project. The existing permits and approvals provide as a strong foundation and understanding of expectations for future permitting efforts required to support the full scope of the Project as described in this PFS.

Table 20-1. Key Permits and Approvals (As of March 2020)

TMAC Resources Inc. - Hope Bay Project

Name	Approval No.	Scope / Purpose	Term / Duration	Expiration Date
NIRB Project Certificate	009	Authorization for Madrid-Boston to proceed, provided certain conditions and requirements are incorporated in the various regulatory permits and authorizations issued by the regulatory agencies with permitting authority for the Hope Bay Project. The Project includes the construction of all required surface Infrastructure and operation of three new mines at Hope Bay: Madrid North, Madrid South and Boston.	Life of Doris Project	None
NIRB Project Certificate	003	Authorization for Doris to proceed provided certain conditions and requirements are incorporated in the various regulatory permits and authorizations issued by the regulatory agencies with permitting authority for the Hope Bay Project.	Life of Doris Project	None
NWB Type A Water Licence Amendment No.2	2AM-DOH1335	Water Licence for Doris and Madrid project that authorizes the construction, operation and reclamation of the Doris, Madrid and the all- weather road of the Hope Bay Project. Licence scope includes Amendment No.1.	22 years	March 2035
NWB Type A Water Licence Amendment	2AM-BOS1835	Water Licence for the Phase 2 Boston Site that authorizes the construction, operation and reclamation of the Boston Project.	17 years	March 2035
Type B Water Licence for the HBVB including a camp at Windy Lake	2BE-HOP1222	Water Licence that allows for the use of water and disposal of waste associated with regional exploration program including drilling and camp operations.	10 years	June 2022
Type B Water Licence for bulk sample exploration at Boston	2BB-BOS1727	Water licence that allows for the use of water and the disposal of waste for the Boston Advanced Exploration Project. Licence was renewed in July 2017, was formerly 2BB-BOS1217.	10 years	July 2027

Name	Approval No.	Scope / Purpose	Term / Duration	Expiration Date
Type B Water Licence for Madrid Advanced Exploration Amendment No.2	2BB-MAE1727	Water licence that allows for the use of water and the disposal of waste for an undertaking classified as Mining and Milling as per Schedule II of the Regulations for the Madrid Advanced Exploration Project (Amended in 2018).	10 years	May 2027
Framework Agreement		Framework Agreement provides comprehensive land tenure governing the issuance of surface exploration licences, advanced exploration leases, commercial leases, and compensation associated with tenure. Framework Agreement includes a project wide Land Use Licence, an IIBA and a Water and Wildlife Agreement. Framework Agreement was signed in March 2015 for project wide land tenure.	20 years	March 2035
Water and Wildlife Agreement		Included as a Schedule to the Framework Agreement, this Agreement details compensation to be provided to the KIA and Inuit beneficiaries for negative effects that may occur to wildlife harvesting and water as a result of mining related activities across the Project.	20 years	March 2035
Amended and Restated Inuit Owned Lands Commercial Lease	KTCL 313D001	Commercial Lease for use of designated lands associated with the Hope Bay Project. Currently, lands have been designated that encompass Doris and Madrid North. Expansion to include other areas is administrative in nature. Original Commercial Lease was amended and restated in March 2015 as a means to obtain surety of project-wide land tenure.	20 years	March 2035
Inuit Impact and Benefits Agreement		Included as a Schedule to the Framework Agreement, this Agreement details the benefits to be provided to the KIA and Inuit beneficiaries from the Hope Bay Project, including compensation, employment and contracting opportunities. The IIBA originally signed in association with Doris was revised in March 2015 and expanded in scope to encompass project wide activities.	20 years	March 2035

Name	Approval No.	Scope / Purpose	Term / Duration	Expiration Date
KIA Advanced Exploration Agreements	KTAEL15C001 KTAEL15C002	Two agreements as per the terms of the Framework Agreement enabling quarry operations at designated locations in the Hope Bay Project and advanced exploration at Boston.	5 year renewable annually thereafter for up to 20 years	March 2020
KIA Land Use Licences		Enables exploration activities across the Hope Bay Project as per the terms of the Framework Agreement.	1 year automatic renewable for 20 years	March 2016
DFO authorization	NU-02-0117.2	Construction of the jetty in Roberts Bay.		December 2009
DFO authorization	NU-1000-0028	Changes to the Doris jetty.		July 2012
DFO authorizations	NU-02-01117.3	Construction of the Doris TIA north dam.	Life of Mine	None
Navigable Waters Permit	8200-02-6565	Installation of the jetty in Roberts Bay.	N/A	N/A
Navigable Waters Permit	2018-600028	Approval for Jetty in Roberts Bay	N/A	N/A
Navigable Waters Permit	2018-600006	Approval for Marine Outfall Berm	N/A	N/A
Jetty Lease	77A3-1-2	Foreshore lease from the Crown for construction and operation of the Roberts Bay Jetty.	30 years	June 2047
Marine Outfall Berm	77A/3-3-2	Lease from Crown for construction and operation of Roberts Bay Marine Outfall Berm.	30 years	July 2048
Amendment to Schedule 2 of the Metal Mining Effluent Regulations (MMER)	Registration SOR/2008-216	Designation of Tail Lake as a tailings impoundment area.	Life of Mine	None

FUTURE PERMITTING

TMAC continues to proceed with a staged approach to permitting. It is TMAC's expectation the Project will require screening by the NIRB before any federal or territorial permits can be issued beyond the currently approved scope of the Hope Bay Project. The current Scope of Project approvals are described most profoundly in the 2 Project Certificates and 2 Type A Water Licences referenced in Table 20-1 above.

TMAC is expecting to file an application to the NIRB and the NWB. The application to the NIRB is expected to demonstrate that a significant amendment to current Hope Bay Project NIRB Project Certificates is not required to accommodate the Project. The application to the NWB will be to request an amendment to the current Type "A" Water Licence to allow for the Project. If

approved by the regulatory community, this amendment will facilitate sustained commercial production at an expected rate of approximately 4000 t/d at Madrid.

Amongst other changes, the amendment application will most notably request approval to increase mining and milling rates at Madrid North, and changes to financial security. Once submitted, regulatory consideration of the amendments may take in the order of 8 to 12 months, depending on the level of environmental review required by intervening parties. This amendment has not been scoped as yet and will be dependent on further analysis prior to a formal submission to the NIRB and NWB. However, a significant amount of infrastructure and activities that may support the Project are already permitted and should be evaluated to determine what Project components could be constructed in advance of any outstanding permits.

The permits and other approvals that will be required to be maintained, updated or expanded to consider, construct and operate the Project include, but are not limited to the following:

- Project Certificate from the NIRB
- Type A Water Licence from the NWB
- Mineral Production Lease from NTI
- Commercial Surface Land Lease from the KIA
- Authorizations from the Minister of Fisheries and Oceans (Canada) under section 35 of the Fisheries Act
- Permit from Natural Resources Canada (NRCan) under the Explosives Act to manufacture explosives, as well as a licence for magazine and explosives transportation permit
- Additional Explosives Factory Licences
- Radio Licence from Industry Canada
- Approval from the Nunavut Office of the Fire Marshall, Department of Community, Government and Transportation under the National Building Code of Canada and National Fire Code of Canada
- Scientific Permits will be required to conduct some of the environmental monitoring activities under the Scientist Act and Wildlife Act
- Archaeological Permits may be required under the Nunavut Archaeological and Paleontological Sites Regulations

It must be emphasized that regulatory permitting timelines are inherently uncertain. Regulatory permitting is on the critical path of the development schedule presented in the PFS. Any delays to obtaining necessary permits, including necessary approvals from the land and mineral owners (such as a production lease) pose an inherent risk to cost and schedule and could be material to the Project.

20.3 ENVIRONMENTAL AND SOCIO-ECONOMIC STUDIES UNDERTAKEN

BASELINE STUDIES

Pre-operational baseline environmental and socio-economic studies were conducted in the Hope Bay volcanic belt from 1993 to 2011. A comprehensive baseline study was conducted in 2010 and 2011 and was intended to fill in any gaps to support regulatory permitting to capture the scope of Phase 1 and Phase 2 of the existing Project. Supplemental field work has been undertaken since then to fill final gaps and it is the view of TMAC that the environmental baseline information is available to support the preparation of an application to the NIRB and NWB for the Project.

The following components have been included in baseline studies which have been conducted on behalf of the Hope Bay Project, primarily by ERM (formerly Rescan):

- Air quality
- Archaeology
- Bathymetry
- Ecosystem mapping, vegetation, and soils
- Freshwater fish and fish habitat
- Freshwater water quality, sediment quality, and aquatic biology
- Hydrology
- Land use
- Marine fish and fish habitat
- Marine water quality, sediment quality, and aquatic biology
- Meteorology
- Noise
- Public consultation
- Plants
- Socio-economic
- Traditional Knowledge
- Wildlife, including caribou, muskox, wolves, Arctic fox, wolverine, grizzly bear, upland breeding birds, waterfowl, raptors, seabirds, carnivore dens, small mammals, and marine mammals

Hydrogeology and geochemistry baseline studies have also been conducted across the belt to support the planning of the Hope Bay Project. These studies were conducted by SRK.

The following sections provide high-level summaries of the existing environmental conditions within the immediate Project area and the Melville Sound region where appropriate. Brief descriptions of the study communities within the Kitikmeot Region are also provided.

Table 20-2 provides a list of all relevant baseline data collected at various stages of the Project development. Details on the relevant hydrogeology and geochemistry baseline studies are provided in Section 18.0.

Table 20-2. Existing Baseline Studies

TMAC Resources Inc. - Hope Bay Project

Area	Studies
Climate and Meteorology	Meteorological monitoring data is available for 1993 to 2000, 2003 to 2005 and 2009 to 2019.
Air Quality	Air quality assessment data is available for 2003 and 2005, and through compliance monitoring for 2009 to 2019.
Noise and Vibrations	Noise data available through measurements and abatement programs for 2006 to 2010 and is ongoing for existing operation.
Hydrology	Hydrological monitoring has taken place in the project development area streams and lakes since 1996 and is ongoing.
Fish and Fish Habitat (Marine and Freshwater)	Marine fish and fish habitat data was collected since 2000 since 1996 and is ongoing. Freshwater fish and fish habitat data was collected in the project development area in since 1993 and is ongoing.
Aquatics (including Surface Water Quality)	Aquatic baseline and monitoring studies for the Project began in 1995 and is ongoing.
Soils, Terrain and Ecology (including Wetlands)	Terrestrial Ecosystem baseline and rare plant survey data was collected in the project development area in since 1996 and is ongoing.
Wildlife	Terrestrial wildlife data in the project development area has been collected since 1994 and is ongoing. Marine mammal wildlife data has been collected periodically since 1996.
Heritage Resources	Archaeological studies have been undertaken throughout the project development area dating back to 1995.
Socio-Economics and Land and Resource Use	Existing Data on Economic Development and Opportunities, Education and Training, Contracting and Business Opportunities, Population Demographics, Traditional Activity and Knowledge, Non-Traditional Land Use and Resource Use, Health and Well-being, Community Infrastructure and Public Service is as recent as 2019.
Marine Environment	Marine water quality, sediment quality, phytoplankton and benthos data has been collected since 1996 and is ongoing.

PHYSICAL ENVIRONMENT

The climate in the Hope Bay Project area is one of extremes. There is relatively little precipitation, and temperatures stay below freezing for most of the year, reaching over 20 degrees for short periods in the summer. Summer is a season of nearly constant light, while darkness, twilight, and extreme cold dominate winter.

Inuit have noted changes in climate trends, and their observations are supported by historical climate data collected over the last half a century. While predicting the effects of climate change is difficult, effects are believed to include higher temperatures and precipitation, which in turn may affect permafrost and snow depth.

Air quality in the Hope Bay Project area and elsewhere in Nunavut is generally of good quality, reflecting the low amount of air pollution from large human populations. Outside of the Hope Bay Project area, most air emissions are from the use of diesel generators, heaters, vehicles, snowmobiles, all-terrain vehicles and boats. Noise levels are generally low.

The Project is located on the Canadian Shield, a huge geological formation made up of ancient volcanic rock scraped level by glaciers. Exposed bedrock outcrops are common. Sediment deposited by glaciers and rivers have collected to form long, winding ridges known as eskers. The Madrid-Boston Project is within the continuous permafrost region of western Nunavut, where a layer of soil and rock stays frozen year-round.

From a surface water perspective, the northern portion of the Hope Bay Project consists of several watersheds that drain into Roberts Bay, and the Koignuk River which flows into Hope Bay west of Roberts Bay. Watersheds in the southern portion of the belt drain into the upper Koignuk River. The entire area lies within the Bathurst Inlet-Burnside Watershed.

BIOLOGICAL ENVIRONMENT

The Project area lies north of the tree line in the West Kitikmeot region. Vegetation is in the form of low shrubs of willow, birch, Labrador tea, and mountain cranberry. Heath tundra is also common. For vegetation zones, the Project area lies within the “tundra, high shrub zone” (WKRLUP, 2005). Where rock outcrops, water and cliffs are absent on the landscape, trees and summer flowers are numerous and widespread in the tundra of the Project area. Trees are short and stunted forms of dwarf birch, green alder, willow, and white and black spruce can be found in some areas. Sedge meadows and wetlands are common in low moist areas. More than 870 plant species grow in the Project area, including many species of lichens, mosses, and algae.

Terrestrial animals in the region include barren-ground caribou (of the Dolphin/Union, and Beverly herds), muskox, grizzly bear, wolverine, and grey wolves, as well as several species of raptor, waterfowl, and upland breeding birds. Caribou and caribou hunting are central to Inuit culture, identity, recreation, and kinship and are of economic importance to the Inuit and other residents of Nunavut.

Physically, the Project area is divided into two areas. The coastal zone has exposed rocky hills, and volcanic sills and dikes with abundant exposed rock and gravel. These rocky hills and outcrops serve as excellent habitat for raptors. Further inland, the topography is flatter, and is dominated by low shrubs and heath tundra.

Four species of cliff-nesting raptors (peregrine falcon, gyrfalcon, rough-legged hawk, and golden eagle) and three ground-nesting raptor species (snowy owl, short-eared owl, and northern harrier) may live in the area. Waterbird species in the area include geese, tundra swan, several species of ducks, gulls, Arctic tern, four species of loons, and sandhill crane.

Eskers occur in the region, but are not common, particularly in the northern part of the belt. They serve as important habitat for caribou, grizzly bears, wolves, fox, muskox, wolverine, sandhill cranes and other birds, and small mammals. Wolves and fox den in the sandy slopes, grizzly bears feed on the animals and berries, some birds use eskers for feeding and nesting, and other animals use eskers for travel and as shelter from wind during the winter.

Arctic char are found in the region, in lakes and rivers, and along the Arctic coast. Char are important to the diet of Inuit, for sport fishing, and for commercial fishing. A total of fourteen fish species are found in lakes, ponds, and streams in the Project area. The most common fish species is the Ninespine Stickleback, followed by Lake Trout, Arctic Char, Arctic Grayling, Slimy Sculpin, Lake Whitefish, Cisco, Least Cisco, Burbot, Broad Whitefish, Arctic Flounder, Fourhorn Sculpin, Greenland Cod, and Starry Flounder. The latter four species were captured at outflows leading to Roberts Bay. Other fish species that are common in the thousands of lakes and streams in the region include lake trout and Arctic grayling.

The Project area is located on Melville Sound, south of Kent Peninsula. Marine mammals such as ringed seals thrive in the coastal waters and offshore. Marine fish include Saffron Cod, Capelin, Arctic Flounder, Pacific Herring, Fourhorn Sculpin, Arctic Char, Bering Wolffish, Inconnu and Greenland Cod. Ringed seals are sometimes seen in Roberts Bay.

SOCIO-ECONOMIC ENVIRONMENT

There are seven (7) Kitikmeot communities that are considered affected by the development at the Project. They include Kugluktuk, Cambridge Bay, Gjoa Haven, Taloyoak, Kugaaruk, Umingmaktok, and Bathurst Inlet. The nearest settlements are the unincorporated, occasionally seasonally occupied, communities of Umingmaktok (population zero to 20), located 65 km to the west, and Bathurst Inlet (population zero to 20), 160 km to the southwest. The next nearest permanently populated settlement is Cambridge Bay (population 1,800), 170 km to the northeast, on the southeast corner of Victoria Island. West of the Project site, 600 km away, is Kugluktuk (population 1,500), and northeast of the Project is Gjoa Haven (525 km distant, population 1,300) on King William Island. Further east on the mainland are Taloyoak (570 km distant, population 1000), and Kugaaruk (700 km distant, population 900).

All affected communities, with the exceptions of Umingmaktok and Bathurst Inlet, possess recreational facilities, police stations, nursing stations, K-12 Education, and Adult Education facilities and administered by local, municipal governments. Communities are linked via common sea lift transportation systems, and scheduled commercial air service; no road or rail system is in place.

The largest community in the area, Cambridge Bay, is a regional government, logistics, and services hub. Emergency Measures and Medical support is available in Cambridge Bay, as well as warehousing, expediting, financial, and training facilities, including a number of current project contractors such as the head office of the Kitikmeot Corporation. The head office of Kitikmeot Inuit Association, the Lands Division for NTI, the NIRB and an office for the Nunavut Planning Commission (NPC) are also located in Cambridge Bay. In addition, the Canadian High Arctic Research Station (CHARS) is location in Cambridge Bay.

Kugluktuk, has the largest Inuit population in the region and houses a traditional knowledge database that can be used to inform development activities. Gjoa Haven is the head office location for the Nunavut Water Board and Taloyoak and Kugaaruk are traditional non-decentralized communities. TMAC has negotiated an impact and benefit agreement with these communities, represented by the Kitikmeot Inuit Association, as described previously in this section.

There are local and commercial land uses in the area. Commercial land use is seasonal and intermittent, consisting of sport hunting, guide outfitting and lodges, and tourism (e.g., nature tourism, recreation, and cruise ships). Lodges offers tourism activities (e.g., hiking, wildlife observation, and photography). Sport hunters and harvesters rely upon muskox, caribou, wolf, and wolverine. Land uses consist of hunting, trapping, fishing, camping and travel. Harvested game is used for personal consumption and shared throughout the community.

Social and economic conditions in Nunavut are unique within Canada and have changed significantly over the last 50 years. Prior to this, almost the entire population of the regional area lived semi-nomadically involved in both subsistence harvesting and participating in the fur trade with ringed seal and white fox being the predominant commodities. In response to variations in fur prices, and the provision of day school education, policing, medical services and universal social programs at selected locations, many people transitioned to live in settled communities in the 1950's and 1960's. The transition to live in communities accelerated through new wage-based

job opportunities at Distant Early Warning military bases and within expanding communities. The importance of subsistence harvesting and living on the land continued to erode during further decades through residential schooling, more wage-based opportunities stemming from Beaufort Sea and High Arctic Oil and Gas exploration, and regional mineral exploration activities. The efforts of anti-fur activists in the 1980’s and 1990’s effectively ended the ability of residents within the region to maintain a self-supported land-based lifestyle.

This change in mode of life seen over the past 3 generations has resulted in significant changes in all aspects of society within the region. Lifespans and live births have increased substantially with the provision of medical services. At the same time, inequality now exists based on levels of engagement in wage employment. Male roles as hunters and primary providers has been displaced. Similarly, female roles in managing family affairs has been supplanted by the use of public housing, the availability of retail goods, and government interventions. Child rearing has changed through the introduction of formal education and family services. The role of Elders in guiding personal and group decisions while ensuring cultural continuity has also been supplanted by modern governance mechanisms, the Canadian justice system, and the introduction of mass media. English, rarely heard 50 years ago, is now in common usage. People in the study area continue to hold land based activities, the Inuktun language, and traditional Inuit societal values in high regard. At the same time, communities struggle with the results of cultural displacement such as substance abuse and domestic violence.

In 1993, Inuit within the region agreed along with other eastern regions to the Nunavut Agreement, a constitutionally recognized modern treaty. This treaty recognized Inuit land, water and harvesting rights, and guaranteed Inuit a prominent role in governance. In 1999, as the political development portion of the land claim negotiation process, Nunavut Territory was formed, providing for public government within a predominantly Inuit jurisdiction. At the same time locally, other avenues have opened for self-determination with the formation of active municipal councils, cooperative ventures, housing associations, education authorities and wellness groups. These developments have provided people in the region with new tools to manage change and reconcile their traditions with modern life. Society continues to evolve within the region with a new emphasis on language revitalization, economic development and improving educational and health outcomes.

20.4 ACID ROCK DRAINAGE AND METAL LEACHING STUDIES

WASTE ROCK AND ORE

A comprehensive geochemical data set exists for waste rock and ore for the various mineral deposits at Hope Bay. The program includes both static and kinetic testwork designed to assess the risks associated with ML and/or ARD from potential mine facilities such as waste rock dumps, and ore and low-grade stockpiles.

Samples for static testing are selected to obtain adequate spatial and geological representation of waste rock and ore that is located within the proposed mining envelope. A comprehensive suite of tests have been completed, including paste pH, sulphur speciation (i.e., total sulphur and sulphate sulphur), modified Sobek NP, total inorganic carbon, and metals by ICP.

The kinetic testwork includes both accelerated weathering of small-scale samples (one kilogram) under laboratory conditions (i.e., humidity cell tests) and large-scale tests (hundreds of kilograms) allowed to weather under site-specific climactic conditions (i.e., barrel tests). Kinetic tests are

selected based on the results from the static program. Both typical and conservative samples representing each of the main rock types in each of the deposit areas are included in the program.

In general, samples from Doris, Madrid, and Boston are characterized by high levels of neutralization potential (NP) and total inorganic carbon (TIC). Carbonate mineralogy was dominated by iron carbonates, which have less NP as compared with other carbonate minerals, such as calcite and calcium-magnesium dolomites. Other carbonate minerals included calcite ($CaCO_3$) and magnesite ($MgCO_3$). All samples from Madrid North and most samples from the other deposits were characterized as not-potentially acid generating, or non- PAG (i.e., ratios of NP to acid potential (AP) or TIC/AP greater than 3). However, many of the samples contained relatively high concentrations of sulphur in the form of sulphide minerals, suggesting that metal leaching under neutral to alkaline pH conditions may be a concern with respect to water quality.

Humidity cell test data for Doris, Madrid, and Boston suggests that metal leaching is a potential concern, with generally higher concentrations associated with rocks from the Madrid and Boston deposits, and lower concentrations associated with rocks from Doris. Results indicate that differences in metal leaching are more strongly related to deposit, rather than rock type.

TAILINGS

Samples for the tailings characterization program are generated from metallurgical testwork. Metallurgical samples are produced from a head sample of ore that is considered representative of the mill feed. Three types of tailings were included in the characterization program: flotation tailings, detoxified tailings and mixed tailings (a mixture of flotation and cyanide detoxified residue). TMAC plans to use the detoxified tailings as backfill in the underground mine workings, and to deposit flotation tailings in the Doris TIA. Therefore, under the current mine plan, there will be no mixed tailings. The findings are based on ABA analyses, trace element, mineralogy data, process water chemistry, and results from humidity cell, saturated column and aging tests.

Results for Doris, Madrid, and Boston tailings samples indicate that ARD predictions based on humidity cell test data have been consistent with ABA analyses conducted on the test samples. In summary, the available data suggest that ARD will develop for the cyanide detoxified residue samples, whereas flotation tailings and mixed tailings are projected to remain neutral. Results suggest contaminants of potential concern include ammonia, arsenic, and selenium for selected tailings types and deposits.

20.5 MANAGEMENT AND CONTROLS

TMAC has a functioning environmental health and safety management system (EHSMS) composed of numerous management plans that were developed and approved under its NIRB Project Certificate No. 003, No.009 and, Type A Water Licence 2AM-DOH1335 and 2AM-BOS1835 for the Hope Bay Project development.

The EMS and its associated management plans provide the mechanism by which TMAC will monitor and report on the performance of the proposed mitigations to avoid, reduce, or eliminate adverse residual effects of Project. Where practicable, the management plans for VECs and VSECs include indicators and thresholds that are used to assess and evaluate performance of the proposed mitigation measures. The plans are reviewed and updated as required to incorporate adaptive changes or additional mitigation measures based on information and feedback collected by the monitoring programs.

A list of all TMAC's existing and approved Management Plans for the Hope Bay Project are provided in Table 20-3.

Table 20-3. Hope Bay Project Management Plans

Topic	Management Plans	Revision Date
Environmental Management System	Hope Bay Project Environmental Management System	Dec-17
Management Plans		
Emergency Response	Hope Bay Project Emergency Response Plan	Mar-19
Spill Contingency	Hope Bay Project Spill Contingency Plan	Mar-19
Hazardous Waste Management Plan	Hope Bay Project Hazardous Waste Management Plan	Mar-19
Incinerator Management Plan	Hope Bay Project Incinerator Management Plan	Mar-19
De-icing Management	Hope Bay Project Aircraft De-icing Management Plan	Mar-19
QA/QC	Hope Bay Project Quality Assurance Quality Control Plan	Mar-19
Water Management	Hope Bay Project Doris-Madrid Water Management Plan	Mar-19
	Hope Bay Project Boston Water Management Plan	Dec-17
	Hope Bay Project Water and Ore/Waste Rock Management Plan for Boston Site	Jan-17
Waste Rock Management Plan	Hope Bay Project Waste Rock, Ore and Mine Backfill Management Plan	Mar-19
	Hope Bay Project Water and Ore/Waste Rock Management Plan for Boston Site	Jan-17
Landfarm Management	Hope Bay Project Hydrocarbon Contaminated Material Management Plan	Dec-17
Air Quality	Air Quality Management Plan, Hope Bay Project*	Apr-19
Domestic Waste Water Management	Hope Bay Project Domestic Wastewater Treatment Management Plan	Dec-17
	Boston Sewage Treatment Operations and Maintenance Management Plan	Sep-17
WWMP	Doris North Project Wildlife Mitigation and Monitoring Plan	Dec-19
	Wildlife Mitigation and Monitoring Plan	Dec-17
AMEP	Hope Bay Project Aquatic Effects Monitoring Plan	Apr-18
Ground Water Management Plan	Hope Bay Project Ground Water Management Plan	Apr-18
Tailing Management Plan	Hope Bay Project, Phase2 Doris Tailings Impoundment Area – Operations, Maintenance, and Surveillance Manual	Dec-17
	Hope Bay Project Boston Tailings Management Area - Operations, Maintenance, and Surveillance Manual	Dec-17
Non-Hazardous Waste	Hope Bay Project Non-hazardous Waste Management Plan	Dec-17
Quarry Management	Hope Bay Project Quarry Management and Monitoring Plan	Dec-17

Topic	Management Plans	Revision Date
Closure	Hope Bay Project Doris-Madrid Closure and Reclamation Plan	Nov-17
	Hope Bay Project Boston Conceptual Closure and Reclamation Plan	Nov-17
	Hope Bay Project Windy Camp and Patch Lake Facility Updated Closure Plan (SRK)	May-14
	Hope Bay Project: Madrid Advanced Exploration Program: Conceptual Closure and Reclamation Plan (SRK)	Oct-14
Explosives	Hope Bay Project Explosives Management Plan	Nov-17
OPEP	Oil Pollution and Emergency Preparedness Plan	Aug-18
Noise Management	Hope Bay Project Noise Abatement Plan	Dec-17
Socio-economic Management Plans		
Health and Safety	Hope Bay Health and Safety Management Plan	Dec-17
Human Resources	Hope Bay Project Human Resources Plan	Sep-16
Community Involvement	Hope Bay Project Community Involvement Plan	Dec-16
Cultural Heritage	Cultural Heritage and Natural Resources Management Plan	Dec-17

The Project will leverage the existing infrastructure in place and/or approved for the Doris Project and the Madrid-Boston Project so these management plans will all still apply. Additional ore from Doris will be accessed as will ore from underground mining operations at the Madrid and Boston deposits that will be trucked along an all-weather road. All processing is planned to occur at the existing Doris Plant or a proposed mill at Madrid North and all tailings will be managed within the existing tailing management area, which is approved and constructed. The TIA and water management facilities currently in place and as contemplated, are described in Section 18.0.

The majority of the activities that will be associated with the Project were the subject of environmental assessment for the Doris and the Madrid-Boston Project, for which approvals are in place. Mitigating measures and controls have been established, implemented, and proven during periods of operations, construction or care and maintenance within the current phase of the Hope Bay Project. The expansion of ore processing at Madrid will include many of the same activities that have already been assessed and approved. Elements of an Environmental Management System are already in place for the existing operation and include environmental/social management plans and detailed monitoring programs that will continue to serve for the Project or as the basis for amendments.

In general, potential environmental impacts and risks associated with changes to the existing permits and the introduction of increased mining and milling rates require similar mitigation and management measures to those already identified and incorporated in previous phases of the Hope Bay Project. These existing measures will be expanded to encompass the full scope of the Project as contemplated by the PFS. Future permitting efforts will be used to inform the revision of management plans and controls that are specific to the Project including increased mining and milling rates and associated activities.

Interception of groundwater inflows when mining in talik zones found underneath lakes and when mining below permafrost (approximately 450 m) will result in saline ground water. Delineation of ground water at the main deposits at Hope Bay have been completed and further delineation is recommended in advance of mining or as it progresses.

Table 20-4 presents a summary of key environmental and socio-economic risks inherent in the Project and the mitigation measures and controls contemplated. This table is not intended to be exhaustive, rather it highlights those risks requiring particular note and attention.

Table 20-4. Project Impacts, Mitigation and Control Measures
TMAC Resources Inc. – Hope Bay Project

Area	Impact Description	Mitigation and Control Measures
Geology	Increased exposure of new rock surfaces to air and water, potentially leading to leaching of trace elements from the mine workings into waters; and Mobilization of fine particles by wind or water, potentially leading to increased amounts of dust in the air or suspended sediments in the water column.	Geochemical testing of materials to be disturbed through development and mining for ARD/ML potential. Only low risk materials will be used for construction of civil works and storage facilities will be designed to collect run-off and seepage for controlled release to the environment. Waste rock will be stored temporarily on surface in engineered structures. Run-off and seepage waters will be captured in collection ponds and directed to the tailings area for management. Waste rock will be returned underground as backfill to the mine workings.
Ground stability and permafrost	Alteration of the active layer.	Effects to permafrost will be mitigated as far as practical by reducing the extent of cut and fill areas. Where cutting occurs, appropriate thermal insulation will be placed to prevent onset of thermal erosion. Where fill is required, it will be of adequate thickness and quality to ensure the active layer is not reduced. Where practical, swales or culverts can be installed as part of road construction and maintenance to prevent the ponding of water that may arise from the damming effect of the raised permafrost level in the road-bed. To address this issue upon closure, swales can be left in place, or alternatively, the road-bed can be breached to allow drainage.
Soil Quality	Covering or removing soils by building roads; Erosion of soils around road crossings; Alteration of soils via dust-generating activities (e.g. road); and Hydrocarbon contamination of soils caused by vehicle refueling, maintenance, and spills.	In order to mitigate the effects of covering or removal of soils, soils can be salvaged, where feasible, and stored. These soils could then be used for rehabilitation of disturbed areas at closure. Compacted soils could be ripped and seeded with native species. Soil erosion will be minimized by avoiding vegetation removal, where possible. Soil metal and hydrocarbon contamination will be minimized by ensuring that vehicles are properly maintained, maintenance is carried out at designated locations which are properly designed with liners, berms, etc., and cleaning of spills is done in a timely manner.
Groundwater	Changes in groundwater quality due to the interaction between deep groundwater and mine water for the underground deposits.	The volume and quality of groundwater infiltration into the mine workings will vary by deposit and location within the workings. Groundwater will be intercepted within the unfrozen zones when mining beneath lakes and when mining at levels below the permafrost (approximately 450m). Mitigation measures during operations will include by necessity pumping water from the underground mines and eventual discharge to the ocean or other prudent management solutions.

Area	Impact Description	Mitigation and Control Measures
Hydrology	Freshwater use for mining and milling impacts fish and fish habitat by altering hydrological conditions. Loss of surface waters to underground mine workings located within the talik zones where hydraulic connections extend to surface underneath lakes and streams impacts fish and fish habitat. Alteration in runoff patterns due to road construction.	Freshwater will be extracted from Doris Lake and other water bodies to support mining and milling. Milling represents the greatest demand for freshwater. Freshwater demand will be minimized to the extent possible through recycling. If mining occurs within the talik zones at Doris, Madrid (South) and Boston, t he amount of infiltration into the mine workings will be minimized by establishing a mine plan that avoids areas of potential high inflows, controlling inflows once intercepted (i.e. grouting), and sealing off mined out areas where access is no longer required. A detailed site-wide water balance is required at each operating centre and further environmental study is needed to confirm that removal of surface water (beyond what is currently permitted) from the hydrological system can be sustained with acceptable environmental effects. Impacts to fish and fisheries habitat may be required to be offset through the construction of new fish habitat as compensation. Proposed mitigation for water quantity management in areas of surface infrastructure construction (roads and pads for example) includes identifying any watercourses that are critical for fish passage and maintaining flows where necessary through the design. Flows can be maintained by installing culverts in roads, and otherwise intercepting and redirecting water around infrastructure.
Water Quality	Dust-generating activities (e.g. elevation of TSS due to construction and road use); ANFO use and storage (e.g., release of nitrogen compounds to surface waters); Runoff from roads (e.g., ANFO residues, high metals and TSS); Fuel transport and handling (e.g., elevated hydrocarbons); Disposal of underground mine water, including intercepted groundwater (e.g., suspended solids, ANFO residues, and salts) to Roberts Bay; Release of water from the TIA to Roberts Bay.	Dust generation from the use of roads or from sub-aerial tailings deposition will be mitigated by either watering or by using some other non-toxic, non-wildlife attractant substance to suppress dust. Drainage and sediment control structures will be used according to best management practices during construction. Ammonium nitrate prill will be stored on engineered pad(s) and spillage around the storage and loading area will be minimized by having an ammonium nitrate handling protocol. Runoff from the storage and loading pad(s) will be directed away from surface waters. Nitrogen residues in mine sump water will be minimized to the extent possible through careful handling of blasting product. Management practices will be used for the handling and use of explosives to minimize excessive residue and nitrogen loading. TSS generated during in-water construction will be mitigated by the use of silt curtains or as directed by DFO. Fuel storage and handling areas will be lined to contain any hydrocarbon leakage. Where practicable double walled tanks will also be installed. Water from underground workings, including talik water (working under lakes) and connate groundwater (when working below the level of permafrost) will be sent to the mill at Doris for treatment by filtration (from all mining areas Doris, Madrid, and Boston). Treated water will be pumped to the treated decant water discharge line for release to Roberts Bay. The discharge will meet the requirements of the Metal and Diamond Mining Effluent Regulations

Area	Impact Description	Mitigation and Control Measures
		under the Fisheries Act. Additional studies, including the completion of a robust water balance and water quality modeling are under way to confirm that the discharge will not have an impact to the environment in Roberts Bay and that further treatment is not required. The TIA is currently designed and approved for release of compliant water to Roberts Bay to reduce the risk for environmental impacts to the freshwater environment. Further studies are required, including detailed water balance and water quality modeling to confirm that the discharge will not have an impact to the environment in Roberts Bay without further treatment.
Freshwater Sediments Quality	On-land construction activities, and runoff of TSS (introduction of additional particulate material to sediments); In-water construction activities (e.g., bridges) (disturb and mix up sediments); Fuel transport and handling (e.g., hydrocarbons); And Disposal of sump water.	Dust generation from the use of roads and from tailings deposition will be mitigated to minimize the effects on surface water quality and sediment quality. In-stream construction mitigation measures to minimize the effects on surface waters will also minimize the effects on lake and stream sediment quality. Sumps will intercept contact water from site development areas. Sump water will be discharged to the tundra if confirmed to meet regulatory criteria for sediments and other parameters or will be redirected to the TIA for disposal. Treated sewage effluent will be handled in the same manner.
Air Quality	Airborne particulates; Sulphur dioxide; Nitrogen oxide; Fugitive dust; Volatile organic compounds (VOCs); Greenhouse gasses (GHG); and Diesel engine exhaust from vehicles.	Vehicles used for the Project will be high in fuel efficiency and movement of vehicles will be managed to reduce fuel consumption. “No idle” rules are already in place. As well, the existing Noise Abatement Plan influences fuel use by eliminating idling vehicles when possible (and safe). A variety of mitigation measures, and dust suppression methods will be used to minimize fugitive dust from roads and the TIA. Further studies, including air quality modelling are required confirm that mitigating measures can be expected to be effective.
Climate	Release of greenhouse gasses.	Vehicles used for the Project will be high in fuel efficiency and movement of vehicles will be managed to reduce fuel consumption. As well, the existing Noise Abatement Plan influences fuel use by eliminating idling vehicles when possible and safe.
Noise	Vehicles and equipment; and Blasting during construction and mining.	All mining and road construction equipment that will be used during the construction and mining program will be modern or new, and equipped with appropriate mufflers when possible. A focus of mitigation is ensuring a safe work environment with appropriate personal protective equipment to minimize impacts.
Vegetation	Loss of ecosystems and vegetation to road development;	Project design is the most effective mitigation strategy for ecosystems and vegetation.

Area	Impact Description	Mitigation and Control Measures
	Degradation of ecosystems and vegetation through increased dust deposition, potential introduction of invasive plants, alteration of local hydrology, and effects caused by chemical spills.	Access corridors will be synchronized as much as possible. Disturbance of critical wildlife habitats and fish habitat (e.g. riparian areas) will be avoided. Potential indirect effects to vegetation will be mitigated by following an Air Quality Management Plan and the Spill Contingency and Response Plan. To minimize the possibility of the introduction of invasive plant species to newly disturbed areas, vehicles will be thoroughly washed prior to their use on site. Critical riparian habitat will be avoided for road designs of the project.
Terrestrial Wildlife	Habitat loss (direct and indirect); Changes in movements and/or behaviors; Mortality (direct and indirect); Attraction of animals to human use sites.	Land disturbance controls are in place to make sure construction plans are adhered to. As with vegetation, Project design is the most effective mitigation strategy for minimizing effects to wildlife habitat. Access corridors will be synchronized as much as possible. Disturbance of critical wildlife habitats and fish habitat (riparian areas) will be avoided, and, if necessary, mitigated. Mitigation measures to avoid/minimize wildlife-person interactions will include employee training. Potential effects associated with wildlife attractants will be largely mitigated by maintaining the Waste Management Plan(s), which address food, waste incineration, and waste management.
Aquatic life	Project activities potentially affecting water quality; Project activities potentially affecting sediment quality; and Project activities directly removing or altering aquatic habitat (e.g., culvert installation, reduction in stream flows below normal low levels, reduction in lake levels below normal low levels).	The mitigation measures already described for hydrology and water quality and sediment quality will help minimize the potential effects to aquatic life, by minimizing changes to water and sediment. The direct effects caused by habitat removal or alteration will be mitigated via fish habitat mitigation measures, which include creating new habitat for habitat that is lost.
Fish and Fisheries Habitat	Project activities directly removing or altering fish habitat (e.g., culvert installations and reduction in stream flows below normal low levels); and Project activities potentially affecting water quality or sediment quality.	The main mitigation measure that will be used to avoid or reduce the potential for impacts to fisheries and fish habitat will be avoidance. Measures to limit the introduction of deleterious substances to watercourses and to minimize the adverse effects of any unavoidable disturbances to fish habitat, a range of specific and generally accepted techniques for sediment control, riparian care, site isolation, timing windows, reclamation and rehabilitation will be used. The mitigation measures already described for hydrology and water quality and sediment quality will help minimize the potential effects to fish health and habitat, by minimizing changes to water and sediment.

Area	Impact Description	Mitigation and Control Measures
Land Use	Changes in land users' access—spatially and temporally—to the land and land use activities, including, but not limited to, tourism, recreation, traditional activities, and industrial activities.	The goal of mitigation measures will be to avoid or minimize any potential adverse effects on land and resource use, while enhancement measures will focus on enhancing potential beneficial effects. Communication will be a major component of land use mitigation, to ensure that land users are informed of activities associated with Project construction and operations, including potential restricted areas, travel delays, blasting activities, and wildlife management
Socio-Economic	Employment and income opportunities; as well as issues; Education, training, and skills development opportunities; Business opportunities and economic development; Community stability and well-being impacts.	Control measures include monitoring and evaluation of socio-economic issues through the IIBA Implementation Committee with the KIA, and the Socio-Economic Monitoring Committee and Kitikmeot Socio-Economic Monitoring Committee with community and government members. IIBA implementation is the main instrument for socio-economic mitigation for impacted communities and individual Inuit. **<u>Health</u>** Enforcement of an alcohol- and illegal drug-free mine site. Provision of qualified medical personnel at the mine site. Other medical provisions, including plans for medical evacuation, and communication with regional health services. **<u>Communication</u>** Issue resolution process for workers, on-site telephone and internet services for employees to communicate with family, and encouragement of use of Inuit language while at site, where safe and practicable. **<u>Safety</u>** Inspections and procedures related to transportation, health, and food service. Transportation. Free transportation to and from home communities. **<u>Education and Training</u>** Implement and comply with IIBA as it relates to "Training and Education Opportunities". **<u>Employee Support</u>** Implement and comply with IIBA as it relates to employment. **<u>Employment Opportunities</u>** Ensure that Inuit employees from Kitikmeot communities are given preferential hiring for sequential employment opportunities in the belt. Promote awareness of employment and career opportunities, and communicate skill requirements associated with employment opportunities. Collaborate with KIA to develop a recruitment strategy that will maximize opportunities for Inuit and Kitikmeot residents. Promote gender equality, including women's participation in non-traditional jobs. Implement and comply with IIBA as it relates to Business and Contracting Opportunities.

20.6 MINE CLOSURE AND RECLAMATION PLAN

CLOSURE OBJECTIVES

Most of the Project areas will be actively used during the Construction and Operation phases of the Project. However, where practicable, areas which are no longer needed to carry out Project activities will be progressively reclaimed.

Closure and Reclamation Plans for the Hope Bay Project have been prepared and addresses three closure scenarios:

Short-term temporary mine closure may occur if activities are suspended for a period of less than one year. The project will enter a Care and Maintenance phase, wherein equipment and facilities are maintained in a state of readiness to resume operation, while also maintaining appropriate environmental protection measures.

Long-term temporary mine closure occurs when activities are suspended (in Care and Maintenance) for more than one year (e.g., due to prevailing economic conditions). In this scenario, TMAC will ensure that sites are maintained in a secure condition; all facilities and equipment are de-energized and winterized, and hazardous waste and explosives are removed from the site. Essential personnel (including environmental staff) will maintain site security and monitoring. A Long-term Care and Maintenance Plan would be submitted, and operations would resume when the influencing circumstances change.

Final mine closure would involve full closure and reclamation activities as described. This includes removal of site buildings and infrastructure. Tailings facilities will be prepared for long-term closure, with reclamation and monitoring measures to ensure environmental integrity. The Madrid-Boston all weather road will remain in place as a permanent permafrost protection measure, although peripheral equipment (e.g., signposts) and water management infrastructure (e.g., drains, culverts, bridges) will be removed.

The goal of the final closure activities is to return Project sites and affected areas to viable and, wherever practicable, self-sustaining ecosystems that are compatible with a healthy environment and with human activities. TMAC's closure principles, objectives and criteria have been developed to achieve this goal in as short a duration as reasonably practical. Post-closure monitoring will take place at the site until such time that the objectives of the closure and remediation activities have been met to the satisfaction of the regulatory authorities and all affected parties.

CLOSURE PHASES

All mining areas will remain active until the end of the Project; therefore, opportunities for progressive reclamation are limited. Closure will be completed in three phases:

- Closure Phase 1 will be the active closure period during which the majority of physical activities such as demolition will take place.
- Closure Phase 2 will entail a period of active water management at the Doris North Area.
- Closure Phase 3 will be the final monitoring period to confirm that all the closure activities remain stable.

Closure Phase 2 activities (active water management) at Boston, Madrid North, and Madrid South are not expected to be necessary, with the closure moving directly from Closure Phase 1 to Closure Phase 3.

20.7 CLOSURE AND RECLAMATION ACTIVITIES

ROCK FILL PADS

All site infrastructure that is not constructed on bedrock is on thermal rock fill pads constructed from geochemically suitable rock. These pads preserve the underlying permafrost. Removal of these pads at closure will result in permafrost degradation since the organic layer, which normally preserves the permafrost in an undisturbed state, will have been damaged by placement of the rock, and will take many decades to recover. Since the rock fill pads are constructed of geochemically benign material, the preferred closure strategy is to leave these pads in place.

Once all surface infrastructure on the pads has been removed and any areas of contamination have been addressed, the pads will be re-graded to ensure positive drainage. Active re-vegetation of these pads is not practical because the rock fill pads cannot support vegetation, there is no viable source of organic soil available, and the growth season is simply too short to make this a sustainable scenario. Over the very long term, lichens will colonize the rock fill pad surface, similar to the rocky outcrops around the site.

ALL-WEATHER AIRSTRIPS AND ROADS

All-weather airstrips and roads are constructed similar to and based on the same rationale as the rock fill pads described in the preceding section. Therefore the closure strategy is similar, i.e., leaving these structures in place but re-grading to provide positive drainage. In addition, any stream crossings, whether bridges or culverts, will be removed and the stream crossings, restored. These culverts and/or bridges will be landfilled if they have no salvage value. In areas where water may pond behind these linear structures, they will be breached and the tundra remediated to prevent onset of permafrost degradation.

FUEL STORAGE AREAS

Bulk fuel storage facilities at Roberts Bay, Doris North, Madrid North, and Boston will be decommissioned, decontaminated and the tanks dismantled. Any material deemed non-hazardous will be disposed of in one of the on-site landfills. The protective granular fill overlying the geosynthetic liners will be tested and, if deemed uncontaminated, will be removed and reused as general fill in the landfill or elsewhere on site where granular fill is required. If this gravel is contaminated with hydrocarbons, it will either be land farmed on site, or shipped off site for disposal at a licenced facility.

The geosynthetic liners will be removed and, if uncontaminated, disposed of in the landfill. The remaining surface will be re-graded to ensure positive drainage, including breaching of containment berms as required in select areas.

Temporary and smaller fuel storage facilities (i.e., aviation fuel, day tanks, etc.) will be decommissioned, decontaminated, and removed from site for reuse or alternately disposal in the on-site landfills. Secondary containment areas will be reclaimed in a similar manner to the bulk fuel storage facilities.

BUILDINGS AND FACILITIES

Large equipment in buildings will be decontaminated and dismantled and components with salvage value separated. All buildings and other surface structures will be stripped from any material that has salvage value, or is deemed reusable. Anything that has salvage value will be shipped off site, with the remaining components disposed of in one of the on-site landfills.

All concrete floors, walls, and foundations will be demolished and disposed of in the on-site landfills, or in areas where general fill is required. Any exposed concrete will be covered by clean quarry rock.

WATER MANAGEMENT STRUCTURES

Pollution control ponds will be breached to restore natural outflow, once appropriate water discharge limits have been reached. Prior to breaching ponds, sediment containment in them will be tested. If uncontaminated, the sediments will be excavated and disposed of in the on-site landfills. If contaminated, they will be disposed of in the TIA. Any geosynthetic liners will be removed and disposed of in the landfills. Where necessary permafrost degradation will be remediated. Suitable erosion protection and sediment control measures will be installed where necessary.

WASTE ROCK

All waste rock stockpiled temporarily on dedicated pads will be returned underground to be used as structural backfill; therefore at closure, there will be no waste rock left on surface. The temporary pads will be graded as required, to prevent permanent ponding but will be otherwise left in place similar to rock fill pads.

TAILINGS IMPOUNDMENT AREA

The final pond surface will be discharged to the environment as a time frame that will ensure discharge water quality criteria are met. Once the pond is drained, an outlet channel through the deposited tailings will be constructed to ensure free drainage of the tailings area from the pond towards the North Dam. The North Dam will be breached to the elevation of the drainage channel invert, thus creating a permanent spillway. The South Dam will be left in place as a tailings-retention structure, with no water spilling over it.

At the end of operations, the TIA will be reclaimed by construction of an isolation cover, consisting of a 0.3 m thick layer of geochemically suitable quarry rock.

UNDERGROUND WORKINGS

No specific closure measures are required for the underground workings. Mine access portals will be backfilled with waste rock or quarry rock to provide a permanent seal. Vent raises will be capped with a properly designed reinforced concrete plug to prevent access, and appropriate signage will be placed to warn of existence of these closed openings. The areas surrounding the decline portals and vent raises will be re-graded to promote positive drainage from these areas.

LANDFILL

The on-site landfills will be covered with one metre of compacted quarry rock and the surface shaped to promote free drainage.

POST-CLOSURE MONITORING AND MAINTENANCE

Post-closure monitoring will be required to confirm that closure work achieved the closure purpose and satisfies the selected criteria. The scope and frequency of monitoring activities are as follows:

- Water quality monitoring will be performed periodically for 25 years following closure.
- Geotechnical stability inspections will be required annually for the first three years following closure, and less often afterwards, up to 25 years.
- Any covers constructed on site (e.g., TIA rock cover) will require monitoring by way of occasional inspections for 25 years following construction.

RECLAMATION SECURITY AND CLOSURE COST ESTIMATE

A cost estimate was projected based on the existing closure plan and financial security estimate for the Hope Bay Project. The detailed costs calculated for the existing Doris, Madrid North, and Madrid South (SRK, 2017) and Boston (SRK, 2017) facilities were reviewed in comparison to the proposed facilities and activities to obtain a PFS level closure cost estimate. Based on this process, it is expected the total closure cost estimate for the existing Project will remain representative, if not conservative due to the elimination of tailings management at Boston. Although the total closure cost estimate for the Project is not expected to increase, the cost allocations across installments is expected to have to be adjusted to reflect the revised development plan.

For the licences and permits currently in place, the bonding and security posted is shown in Table 20-5.

Table 20-5. Bonding and Security

TMAC Resources Inc. – Hope Bay Project

Description	Beneficiary	Required to Posted (C$)	Posted to Date (C$)	No. of Installments
Doris-Madrid Type "A" Water Licence 2AM-DOH1335 or Commercial Lease	Total	$62.0M	$34.8M	9
	KIA	$51.7M	$24.6M	9
	Crown	$10.4M.	$10.2M	4 (5 installments KIA only)
Boston Type "A" Water Licence No. 2AM-BOS1835 or Commercial Lease	Total	$37.5M	$0	6
	KIA	$10.0M	$0	3 (3 installments Crown only)
	Crown	$27.5M	$0	6

Description	Beneficiary	Required to Posted (C$)	Posted to Date (C$)	No. of Installments
Boston Type “B” Water Licence No. 2BB-BOS1727	Total	$3.61M	$3.61M	1
	KIA	$0	$0	0
	Crown	$3.61M	$3.61M	1
Regional Type “B” Water Licence No. 2BE-HOP1222	Total	$0.75M	$0.75M	1
	KIA	$0.75M	$0.75M	1
	Crown	$0	$0	0
Crown Lease for Jetty	Crown	$0.08M	$0.08M	1
Crown Lease for Marine Outfall	Crown	$0.54M	$0.54M	1
DFO Monitoring	Crown	$0.07M	$0.07M	1
Total	**-**	**$104.55M**	**$38.25M**	**20**

21.0 CAPITAL AND OPERATING COSTS

21.1 CAPITAL COST ESTIMATE

Table 21-1 summarizes the LOM project capital costs required to mine (and subsequently process) the defined Mineral Reserves from the effective date of the Technical report and are estimated to be $1.29 billion over the life of mine. A further breakdown of capital cost details is provided in Table 21-2. The annualized spend of the capital costs is outlined in Table 22-2 in Section 22.0 of this report.

On an annualized basis, 66% of the estimated $1.29 B capital costs will be incurred in the next four years (2020 to 2023-year end) with the remainder incurred as mine sustaining and infrastructure capital as additional underground mines on the belt are brought into production.

The scope of the capital cost estimate covers all capitalized costs from January 1, 2020 and include the engineering, administration, procurement services, construction, pre-commissioning, commissioning and sustaining operations of 5 underground mining operations, construction and operation of a new 4,000 t/d Madrid Plant and all required surface infrastructure required over the 15 year mine life of the operation.

Additional items such as the construction of the haulage road to the Boston mine site, TIA expansions and mine capital development costs have also been included in the estimate.

Table 21-1. LOM Capital Cost Summary

Capital Cost	Costs Estimate ($ 000s)	Contingency (%)	Total Costs ($ 000s)
Expansion Capital			
Processing	152,647	20%	183,838
Site Development	76,340	18%	89,905
Infrastructure and Utilities	198,465	18%	234,415
Owners Costs	4,985	35%	6,730
Indirect Project Costs	131,501	28%	167,884
Total Expansion Capital	**563,938**	**21%**	**682,772**
Sustaining Capital			
Mining (1)	555,862	8%	602,605
Environmental Equipment	1,500	0%	1,500
Total Sustaining Capital	**557,362**	**8%**	**604,105**
Total Costs			
Total Costs	**1,121,300**	**15%**	**1,286,877**

Notes:

1. Includes $294 M in capital mine development which is included in mine production in Table 22-2.

For the capital estimate, variable allowance for contingency was used based on the details of the pricing estimate. The contingency was based on experience and consultation with the engineering

leads, considering the level of engineering, and the source of unit cost information. Contingency has been included to cover items which are included in the scope of work, but which cannot be adequately defined at this time due to lack of accurate detailed design information. Contingency, as defined herein, is not intended to cover such items as labour disputes, changes in scope or price escalation.

Table 21-2. Detailed Capital Cost Breakdown

Capital Category	Units	LOM Total	Contingency	Contingency (%)	LOM Total
Mining Capital					
Capital Development	($)	293,679,426	-	0%	293,679,426
Lateral Development	(m)	95,654			
Vertical Development	(m)	6,462			
Mobile Equipment	($)	88,886,255	4,444,313	5%	93,330,568
Underground Fixed Equipment	($)	89,242,993	26,772,898	30%	116,015,890
Mining Infrastructure	($)	37,742,176	13,209,762	35%	50,951,938
Sustaining Capital	($)	46,311,287	2,315,564	5%	48,626,852
Total Mining Capital	**($)**	**555,862,137**	**46,742,536**	8%	**602,604,673**
Environmental Capital Costs					
Environmental Equipment	($)	1,500,000	-	-	1,500,000
Site Development Capital					
Access Roads	($)	43,454,545	6,154,773	14%	49,609,318
Pads	($)	14,084,024	3,972,152	28%	18,056,176
Tailings Impoundment Area	($)	15,801,000	2,725,673	17%	18,526,673
Mine Rock Waste	($)	3,000,000	712,500	24%	3,712,500
Total Site Development Capital	**($)**	**76,339,569**	**13,565,098**	18%	**89,904,667**
Processing Facility Capital					
Coarse Ore Crushing	($)	8,396,330	1,682,956	20%	10,079,287
Ore Conveying	($)	3,921,597	855,691	22%	4,777,288
Coarse Ore Stockpiling	($)	3,651,499	726,715	20%	4,378,213
Primary Comminution/Screening	($)	46,338,771	8,996,634	19%	55,335,404
Classification/Grinding	($)	13,683,976	2,869,300	21%	16,553,276
Concentration	($)	11,854,770	2,719,959	23%	14,574,729
Cyanide Leaching	($)	14,698,813	2,838,872	19%	17,537,684
Elution, Cementation, Other Metal Treatment	($)	5,248,436	938,427	18%	6,186,863
Smelting & Refining	($)	281,494	54,794	19%	336,288
Flotation Reagents	($)	1,187,890	235,240	20%	1,423,130
Leach & pH Control Reagents	($)	7,109,185	1,557,997	22%	8,667,181
General Reagents	($)	894,887	197,356	22%	1,092,243
Plant Mobile and Maintenance Equipment	($)	1,295,457	136,023	11%	1,431,480
Process Utilities	($)	4,570,217	1,039,345	23%	5,609,562
Cyanide Destruction / SO2 Production Systems	($)	1,990,274	436,356	22%	2,426,631
Water Management for Thickened Tails	($)	3,807,321	847,241	22%	4,654,563
Tailings Disposal	($)	2,657,819	603,091	23%	3,260,910
Process and Reclaim Water	($)	21,058,274	4,455,314	21%	25,513,588
Total Processing Facility Capital	**($)**	**152,647,010**	**31,191,310**	20%	**183,838,320**
Infrastructure and Utilities Capital					
Bulk Fuel Storage	($)	30,870,848	6,202,718	20%	37,073,566
Power Generation & Distribution	($)	80,888,028	13,429,745	17%	94,317,773
Accommodation	($)	36,149,206	3,839,305	11%	39,988,511
Maintenance Workshops & Warehouse	($)	2,299,832	320,232	14%	2,620,065
Mobile Equipment	($)	16,233,219	2,445,070	15%	18,678,290
Water Systems (Utility)	($)	7,090,000	1,223,025	17%	8,313,025
Communication & Information Systems	($)	1,580,000	316,000	20%	1,896,000
Off-Site Storage and Logistics	($)	23,353,725	8,173,804	35%	31,527,529
Total Infrastructure and Utilities Capital	**($)**	**198,464,860**	**35,949,899**	18%	**234,414,759**
Owners Project Costs					
Project Management Team Costs	($)	641,602	224,561	35%	866,163
Pre-Production Operations Costs	($)	921,952	322,683	35%	1,244,635
Capital Spares Costs	($)	3,421,879	1,197,658	35%	4,619,536
Total Owners Project Costs	($)	**4,985,433**	**1,744,902**	35%	**6,730,335**
Indirect Capital Costs					
Engineering Consultant Costs	($)	74,349,833	20,446,204	28%	94,796,038
Temporary Construction Facilities	($)	11,550,600	3,538,148	31%	15,088,748
Site Support Services (during construction)	($)	29,999,422	8,537,772	28%	38,537,194
Construction Power & Heating	($)	2,450,000	245,000	10%	2,695,000
Camp and Catering	($)	13,150,922	3,616,504	28%	16,767,426
Total Indirect Capital Costs	($)	**131,500,777**	**36,383,627**	28%	**167,884,404**
Total LOM Capital Costs	($)	**1,121,299,786**	**165,577,372**	15%	**1,286,877,158**

The estimate is based upon first quarter 2020 Canadian dollars (CAD$ or $) and does not include allowances for escalation or exchange rate fluctuations. The exchange rates that were assumed in the capital estimate are outlined in Table 21-3.

Table 21-3. Foreign Currency Exchange Rates

Country	Currency	Code	Value in CAD
Canada	Canadian Dollar	CAD	1.00
USA	Dollar	USD	1.34
United Kingdom	Pound	GBP	1.69
European Union	Euro	EUR	1.47

Engineering, Procurement and Contracting scope of work for the estimate will be completed to a level consistent with AACE International Recommended Practice 'No.47R-11 Cost Estimate Classification System – as applied in the mining and mineral processing industries for a Class IV level estimate.

The estimate is deemed to have an accuracy within -15% to +25% based on the amount of design, engineering and procurement completed at the time of writing the PFS report.

Logistics and freight cost to deliver all capital purchases to the Hope Bay site have been included in the capital cost estimate and were developed using a budgetary quote provided for sea vessel transportation. Total freight costs for the project construction were estimated to be approximately $19.4 M. These costs are over and above the costs associated with annual operational supply deliveries related to ongoing operations.

Table 21-4. Freight Costs by Category

Description	Cost (M$)
Land Freight	7.12
Barge Freight	5.67
Sea Lift Labor	2.63
Air Freight	4.00
Total Cost	**19.43**

The estimate for domestic and international freight costs were developed in the following manner:

Land freight is the estimated freight cost to the Port of Becancour, Quebec, based on a percentage of the supply cost and the likely country of origin. The percentage ranged from 5% to 10% based on the nature and location of the supply. Canada and the USA were assumed to be the most likely countries of origin.

The barge freight is a combination of the sealift vessel cost per tonne and the lightering cost per tonne. The tonnage was factored for concrete and structural steel. For the remaining disciplines the weight was estimated and for a few major items of equipment the weight was provided in the manufacturer equipment list. The cost of sealift vessels was quoted at $421.03/t and the lightering cost was quoted at $44.00/t. The sealift vessel includes loading at the Becancour Port. Air freight is an allowance.

The following costs and scope are excluded from the capital cost estimate outlined above:

- All taxes, including VAT, duties, Custom Clearance Tax, etc.
- Any additional work that is required as a result of conditions, both subsurface and related to the plant, that were not known as of the base date of the estimate (i.e. equipment conditions, unknown geotechnical conditions, etc.), including any costs incurred in establishing and confirming as-built information over and above those defined in the estimate;
- New permits and permit amendments
- Costs for community relations and services
- Fees or royalties relating to use of certain technologies or processes
- Sunk costs
- Contract incentives
- Additional costs for accelerated or decelerated deliveries of equipment, materials or services resultant from a change in Project schedule
- Lost time due to force Majeure
- Environmental/ecological/cultural considerations other than those incorporated in the design
- The cost of producing any environmental related document to obtaining permits or approvals or variances from governing authorities and attendant mitigating actions
- Financing charges and interest during construction
- Credits for salvage value of any demolition, modification work, residual construction materials, vehicles, and temporary buildings
- Costs associated with decontamination of site and associated facilities
- All costs associated with material weather interruption of construction operations
- Warehouse inventories other than first fills identified and spares identified
- Lost time due to civil unrest
- Training of operations personnel
- Land acquisition cost
- Closure bonding or site closure costs
- Escalation cost.

All inclusive labour rates (using built up hours for each activity) were used in the estimate for estimate items based on detailed mechanical take off such as mechanical and electrical equipment. The hours utilized are derived from database standards and are consistent with published resources such as RS Means and John S. Page.

Where possible, budgetary quotes were obtained locally for various craft labour which is based on a 14 days on 7 days off, 10 hours per day work shift. This information was analysed and converted into all-inclusive rates for use in the capital cost estimate.

Where applicable, the unit hours (and associated productivity factors) are Canadian construction norms based on historical information for projects located in northern Canada.

The labour rates are inclusive of the following:

- Base labour rate, payroll burdens and benefits, completion bonus, incentives, overtime premiums
- Small tools and consumables including welding rods, sealant, adhesives and lubricants.
- Safety clothing and safety supplies.
- Contractors' supervision and administration.

- Contractors' head office overhead and insurance.
- Contractors' mark-up and profit.

Earthworks quantities and costs were developed by independent infrastructure consultants for inclusion into overall capital expenditure estimate (CAPEX) for the following siteworks:

- Roberts Bay Fuel Offloading
- Tailings Dam Earthworks - South Dam Rise
- Tailings Dam Earthworks - West Dam Rise
- Tails Piping Road
- North Madrid Site
- South Madrid Pad
- Boston Road
- Boston Site

21.2 OPERATING COSTS

Table 21-5 summarizes the LOM project operating costs required to mine, and subsequently process, the defined Mineral Reserves from the effective date of the Technical report and are estimated to be $3.28 billion, which is equivalent to life of mine unit operating cost of $194.19 per total tonne of ore processed. A further breakdown of operating cost details is provided in Table 21-6. and the annualized spend of the operating costs is outlined in Section 22.0 of this report.

Table 21-5. LOM Operating Cost Summary

Operating Category	Cost Estimate ($ 000's)	LOM Unit Costs ($/relative t)	LOM Unit Cost ($/t processed)
Underground Mining	1,647,994	117.18/t ore mined (1)	97.62
Open Pit Mining Costs	20,441	96.36/t ore mined	1.21
Surface Ore Haulage	58,677	9.96/t ore hauled	3.48
Ore Stockpile Rehandle	11,212	1.16/t ore rehandled	0.66
Processing in Current Doris Mill	160,760	56.00/t processed	9.52
Processing in New Madrid Mill	555,055	39.26/t processed	32.58
General and Administration	734,000	43.48/t processed	43.48
Environmental, Levies and Land Taxes	95,070	5.63/t processed	5.63
Total Operating Costs	**3,278,208**		**194.19**

Notes:

1. Includes $294 M in capital mine development which is included in underground mine production in Table 22-2.

Operating costs were developed from first principles for mining, haulage, processing and administration and validated against current 2019-2020 actual costs where applicable. Environmental, levies and land taxes are based upon 2020 actual values. The estimate is based

upon first quarter 2020 Canadian dollars and does not include allowances for escalation over the life of mine.

Labour rates assume owner operated and are based on current fully loaded costs TMAC labor costs for the operation. The staffing is based on current rotations, with most employees on a three-week rotation and some management positions on two-week rotations.

Consumption for materials and supplies is upon current actuals in the case of mining and the current process plant and based on testwork and relevant industry standards for the new process plant. Power costs are based on the current power production rates from 2020 to 2023 and then by power rates by the new proposed power plant to be constructed.

Logistics and freight cost to deliver all materials, equipment and consumable purchases to the Hope Bay site have been included in the operating cost estimate and were developed using a budgetary quote provided for sea vessel transportation.

Table 21-6. Operating Cost Details

Operating Cost Category	Units	LOM Total	% of Total Costs	Unit Cost/tonne
		Underground Mining		
Mine Labour	($)	344,998,023	18%	20.82
Mine Materials	($)	422,371,770	22%	25.49
Power and Fuel	($)	178,018,668	9%	10.74
Maintenance Parts and Equipment	($)	182,071,312	9%	10.99
Maintenance labour	($)	215,658,715	11%	13.01
Mine Services	($)	296,128,534	15%	17.87
Management and Technical Services	($)	102,868,140	5%	6.21
Backfill Quarry Contract	($)	44,458,134	2%	2.68
In-fill Diamond Drilling	($)	155,100,000	8%	9.36
Minus Mining Capital Development Costs	($)	-293,679,426	-15% -	17.72
Mining Total Costs (excluding Capital Development)	**($)**	**1,647,993,870**	**85%**	**99.45**
Mining Total Costs (including Capital Development)	**($)**	**1,941,673,296**	**100%**	117.18
Total Underground Ore tonnes	(t)	16,570,251		
Mining Costs/tonne of Ore	**$/t Ore**	**117.18**		
		Open Pit Mining Costs		
Open Pit Mining Costs	($)	20,441,312	100%	96.36
Total Open Pit Ore tonnes	(t)	212,125		
Mining Costs/tonne of Ore	**$/t Ore**	**96.36**		
		Surface Ore Haulage and Rehandle		
Haulage Labour	($)	12,758,530	22%	2.17
Haulage Fuel and Consumables	($)	20,987,740	36%	3.56
Road Maintenance	($)	24,930,254	42%	4.23
Total Ore Haulage Cost	**($)**	**58,676,524**	**100%**	**9.96**
Total LOM Ore Hauled	(t)	5,890,879		
Haulage Costs/tonne Ore Hauled	**$/t Ore**	**9.96**		
Rehandle Labour		4,485,970	40%	0.46
Rehandle Fuel and Consumables		6,726,214	60%	0.69
Total Ore Rehandle Cost	**($)**	**11,212,184**	**100%**	**1.16**
Total LOM Ore Rehandled	(t)	9,697,083		
Cost/tonne Ore Rehandled	**$/t Ore**	**1.16**		
		Processing		
Current Doris Process Plant				
Labour	($)	44,077,759	27%	15.35
Operating Consumables	($)	37,771,996	23%	13.16
Plant Maintenance	($)	45,879,174	29%	15.98
Power	($)	27,893,722	17%	9.72
Assay and Metallurgical Lab	($)	5,137,093	3%	1.79
Doris Plant Total Processing Cost	**($)**	**160,759,745**	**100%**	**56.00**
Tonnes Processed in Doris Process Plant	(t)	2,870,710		
Doris cost/tonne Processed	**$/t Ore**	**56.00**		
New Madrid Process Plant				
Labour	($)	176,113,032	32%	12.57
Operating Consumables	($)	211,843,900	39%	15.12
Plant Maintenance	($)	26,478,943	5%	1.89
Power	($)	131,899,514	24%	9.41
Assay and Metallurgical Lab	($)	3,719,802	1%	0.27
Madrid Plant Total Processing Cost	**($)**	**550,055,191**	**100%**	**39.26**
Tonnes Processed in Madrid Process Plant	(t)	14,010,575		
Cost/tonne Ore Processed	**$/t Ore**	**39.26**		
		General and Administration		
Camp Costs	($)	160,763,284	22%	9.52
Surface Operations	($)	163,513,604	22%	9.69
Safety	($)	42,656,895	6%	2.53
Logistics and Travel	($)	194,829,882	27%	11.54
Power	($)	67,982,373	9%	4.03
Administration	($)	41,398,833	6%	2.45
Warehouse and Procurement	($)	34,352,091	5%	2.03
Information Technology	($)	28,503,038	4%	1.69
Total Administration Costs	**($)**	**734,000,000**	**100%**	43.48
Total Ore tonnes Processed	(t)	16,881,285		
Administration Cost/tonne Processed	**$/t Ore**	**43.48**		

22.0 ECONOMIC ANALYSIS

22.1 SUMMARY

The Hope Bay Project economics (Project Case) were analyzed using a US$ gold model as follows in Table 22-1.

Table 22-1. USD/oz Gold Price Assumption for Project Case

Year	2020	2021	2022	2023	2024-2034
USD/oz	1,500	1,500	1,475	1,474	1,400

At a discount rate of 5%, the Project Case generates an after-tax net present value (NPV) of $486 million and an internal rate of return (IRR) of 19.7%. The initial Project capital achieves payback in 7 years. The Property has a LOM All-In Sustaining Cost (AISC) of US$986/oz and a LOM Cash Cost of US$841/oz.

The test of economic extraction for the Hope Bay Project mineral reserves is demonstrated by means of a sensitivity analysis. At the mineral reserve metal gold price of US$1,325/oz, the Hope Bay Project operation shows positive economics with an after-tax NPV of $272 million and an IRR of 12.0%.

22.2 METHODS, ASSUMPTIONS AND BASIS

The economic analysis is based on the mineral reserves as outlined in Section 15.0, the mining methods and production schedule as outlined in Section 16.0, the recovery and processing methods in Section 17.0, and the capital and operating costs as outlined in Section 21.0.

All dollars are in Canadian currency unless otherwise stated. A CAD/USD exchange rate of 1.34 was used for the economic analysis.

It is assumed 100% of the payable gold is recovered and transport and refining costs are $3.55/oz.

The model has been prepared on a year-by-year life of mine basis. The LOM is 15 years from the start of 2020 until the depletion of Mineral Reserves in 2034.

The basis of the Project Case gold price model is the median consensus commodity forecast from a broad list of 38 Brokers consolidated on March 5, 2020 by a major Canadian bank.

22.3 PRODUCTION SCHEDULE

The Doris Plant will operate from 2020 to 2023, and then the Madrid Plant will operate from 2024 to the end of the LOM. Gold recovery is estimated for each year of production. Table 22-2 shows the annual production schedule.

22.4 CASH FLOWS

The Project Case cash flows are built from a first principles financial model and presented in Table 22-2.

Table 22-2. Project Case Cash Flows

	Units	LOM Total	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036
Production Summary																			
Underground Ore Mining																			
Ore	kt	**16,570**	390	710	847	778	1,289	1,542	1,610	1,731	1,563	1,302	1,449	1,414	1,118	671	158	-	-
Waste	kt	**7,682**	584	461	582	529	486	463	638	805	1,003	865	803	325	137	1	-	-	-
Total	kt	**24,252**	974	1,171	1,429	1,307	1,774	2,004	2,249	2,536	2,566	2,167	2,252	1,739	1,254	672	158	-	-
Open Pit Mining																			
Ore	kt	**212**	212	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Waste	kt	**1,509**	1,509	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	kt	**1,721**	1,721	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Processing	kt	**16,881**	701	710	730	730	1,278	1,460	1,460	1,460	1,460	1,460	1,460	1,460	1,460	895	158	-	-
Gold Production	**(oz)**	**3,101,365**	**160,000**	**138,997**	**129,212**	**115,136**	**218,279**	**269,154**	**257,572**	**269,230**	**278,400**	**250,569**	**272,638**	**245,296**	**259,391**	**197,240**	**40,252**	**-**	**-**
Refining Fees and Royalties (@US$ Property Case Gold Prices)																			
Gold Refining Fees	$ 000's	**11,010**	568	493	459	409	775	955	914	956	988	890	968	871	921	700	143	-	-
Royalty Payments	$ 000's	**206,309**	12,039	9,761	8,922	7,945	14,305	17,639	16,880	17,644	18,245	16,421	17,867	16,076	16,999	12,926	2,638	-	-
Total Refining and Royalty Costs	**$ 000's**	**217,319**	**12,607**	**10,255**	**9,381**	**8,354**	**15,080**	**18,595**	**17,795**	**18,600**	**19,233**	**17,311**	**18,835**	**16,946**	**17,920**	**13,626**	**2,781**	**-**	**-**
Direct Operating Costs																			
Underground Mining	$ 000's	**1,448,436**	58,760	78,509	82,715	74,909	99,338	109,257	120,227	150,566	160,464	131,627	130,497	105,616	80,359	52,407	13,185	-	-
Backfill Quarry Costs	$ 000's	**44,458**	-	-	-	-	-	5,179	4,066	3,969	3,771	3,417	3,785	7,293	5,233	5,722	2,023	-	-
In-Fill Diamond Drilling	$ 000's	**155,100**	6,600	6,600	9,900	9,900	9,900	9,900	9,900	13,200	13,200	13,200	13,200	13,200	13,200	9,900	3,300	-	-
Open Pit Mining	$ 000's	**20,441**	20,441	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Surface Ore Haulage	$ 000's	**69,889**	1,669	1,951	2,976	4,311	3,761	4,371	5,269	6,146	6,828	5,717	6,221	6,392	5,638	5,404	3,233	-	-
Processing	$ 000's	**710,815**	39,244	39,756	40,880	40,880	50,155	57,320	57,320	57,320	57,320	57,320	57,320	57,320	57,320	35,157	6,187	-	-
General and Administration	$ 000's	**734,000**	51,000	52,000	52,000	52,000	54,000	54,000	54,000	56,000	57,000	57,000	57,000	57,000	50,000	23,000	8,000	-	-
Environmental Compliance	$ 000's	**48,000**	3,200	3,200	3,200	3,200	3,200	3,200	3,200	3,200	3,200	3,200	3,200	3,200	3,200	3,200	3,200	-	-
Levies and Land Taxes	$ 000's	**47,070**	3,138	3,138	3,138	3,138	3,138	3,138	3,138	3,138	3,138	3,138	3,138	3,138	3,138	3,138	3,138	-	-
Total Direct Operating Costs	**$ 000's**	**3,278,209**	**184,052**	**185,154**	**194,809**	**188,338**	**223,492**	**246,364**	**257,119**	**293,539**	**304,920**	**274,619**	**274,361**	**253,159**	**218,088**	**137,927**	**42,267**	**-**	**-**
Mining Capital Costs																			
Capital Mine Development	$ 000's	**293,679**	21,744	16,222	25,062	17,477	15,368	14,722	22,406	30,934	42,530	36,523	32,953	12,882	4,857	-	-	-	-
Mobile Equipment	$ 000's	**93,331**	11,660	11,844	12,614	9,085	13,936	9,655	6,722	14,125	3,689	-	-	-	-	-	-	-	-
Underground Fixed Equipment	$ 000's	**116,016**	6,480	6,508	8,546	6,933	6,999	8,919	11,567	18,982	11,113	8,484	7,842	5,713	5,247	2,580	103	-	-
Mining Infrastructure	$ 000's	**50,952**	1,537	3,581	3,675	2,716	2,734	2,082	3,946	4,089	8,198	5,307	6,309	3,172	1,809	1,361	436	-	-
Sustaining Capital	$ 000's	**48,627**	-	-	-	1,173	2,658	3,407	6,838	7,050	6,701	3,350	6,729	4,960	1,040	3,036	1,684	-	-
Total Mining Capital	**$ 000's**	**602,605**	**41,422**	**38,155**	**49,897**	**37,384**	**41,695**	**38,785**	**51,479**	**75,180**	**72,231**	**53,664**	**53,833**	**26,727**	**12,954**	**6,977**	**2,223**	**-**	**-**
Process and Infrastructure Capital Costs																			
Site Development	$ 000's	**89,905**	5,597	9,420	40,820	34,068	-	-	-	-	-	-	-	-	-	-	-	-	-
New Process Plant	$ 000's	**183,838**	-	838	64,194	118,806	-	-	-	-	-	-	-	-	-	-	-	-	-
Infrastructure and Utilities	$ 000's	**234,415**	24,369	65,326	95,998	48,722	-	-	-	-	-	-	-	-	-	-	-	-	-
Owners Property Costs	$ 000's	**6,730**	673	2,019	2,019	2,019	-	-	-	-	-	-	-	-	-	-	-	-	-
Indirect Property Costs	$ 000's	**167,884**	17,608	106,342	34,686	9,249	-	-	-	-	-	-	-	-	-	-	-	-	-
Environmental Costs	$ 000's	**1,500**	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	-	-
Total Surface Capital Costs	**$ 000's**	**684,272**	**48,347**	**184,045**	**237,817**	**212,964**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**-**	**-**
Total Expansion Capital	$ 000's	**682,772**	**48,247**	**183,945**	**237,717**	**212,864**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Total Sustaining Capital	$ 000's	**604,105**	**41,522**	**38,255**	**49,997**	**37,484**	**41,795**	**38,885**	**51,579**	**75,280**	**72,331**	**53,764**	**53,933**	**26,827**	**13,054**	**7,077**	**2,323**	**-**	**-**
Total LOM Capital Costs	**$ 000's**	**1,286,877**	**89,769**	**222,199**	**287,715**	**250,348**	**41,795**	**38,885**	**51,579**	**75,280**	**72,331**	**53,764**	**53,933**	**26,827**	**13,054**	**7,077**	**2,323**	**-**	**-**
Property Closure Costs	**$ 000's**	**100,000**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**50,000**	**50,000**	**-**
Property Cash Flow Model (@Property Case Gold Prices)																			
Gold Production	**(oz)**	**3,101,365**	**160,000**	**138,997**	**129,212**	**115,136**	**218,279**	**269,154**	**257,572**	**269,230**	**278,400**	**250,569**	**272,638**	**245,296**	**259,391**	**197,240**	**40,252**	**-**	**-**
Gold Price US$	(US$/oz)		1,500	1,500	1,475	1,474	1,400	1,400	1,400	1,400	1,400	1,400	1,400	1,400	1,400	1,400	1,400	1,400	1,400
CAN$/US$ Exchange Rate	CAN$/US$		1.34	1.34	1.34	1.34	1.34	1.34	1.34	1.34	1.34	1.34	1.34	1.34	1.34	1.34	1.34	1.34	1.34
Gold Price CAN$	(CAN$/oz)		2,010	2,010	1,977	1,975	1,876	1,876	1,876	1,876	1,876	1,876	1,876	1,876	1,876	1,876	1,876	1,876	1,876
Gross Revenue from Gold Sales	$ 000's	**5,882,626**	321,600	279,383	255,387	227,411	409,491	504,932	483,205	505,075	522,278	470,068	511,468	460,176	486,617	370,021	75,513	-	-
Less Refining and Royalties	$ 000's	**217,319**	12,607	10,255	9,381	8,354	15,080	18,595	17,795	18,600	19,233	17,311	18,835	16,946	17,920	13,626	2,781	-	-
Net Revenue From Gold Sales	$ 000's	**5,665,307**	308,993	269,129	246,006	219,057	394,411	486,337	465,410	486,475	503,045	452,757	492,632	443,229	468,697	356,395	72,733	-	-
Total Operating Costs	$ 000's	**3,278,209**	184,052	185,154	194,809	188,338	223,492	246,364	257,119	293,539	304,920	274,619	274,361	253,159	218,088	137,927	42,267	-	-
Total Capital Costs	$ 000's	**1,286,877**	89,769	222,199	287,715	250,348	41,795	38,885	51,579	75,280	72,331	53,764	53,933	26,827	13,054	7,077	2,323	-	-
Property Closure Costs	$ 000's	**100,000**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	50,000	50,000	-
Corporate Taxes	$ 000's	**106,956**	4,374	3,583	2,636	-	-	-	-	434	3,291	2,931	3,132	40,321	46,873	11,201	-11,821	-	-
Working capital and Financing	$ 000's	**-66,000**	-1,228	-16,691	-9,396	5,480	21,675	-2,495	-2,931	-7,515	-1,054	6,109	11	-18,711	-18,644	-13,983	-18,448	5,574	6,250
Property Net Free Cash Flow (Pre-Tax)	**$ 000's**	**1,066,221**	**36,400**	**-121,533**	**-227,122**	**-225,108**	**107,449**	**203,583**	**159,643**	**125,171**	**126,848**	**118,265**	**164,327**	**181,955**	**256,200**	**225,374**	**-3,408**	**-55,574**	**-6,250**
Cumulative Property Net Cash Flow (Pre Tax)	**$ 000's**		**36,400**	**-85,133**	**-312,254**	**-537,363**	**-429,913**	**-226,330**	**-66,687**	**58,485**	**185,333**	**303,598**	**467,925**	**649,880**	**906,079**	**1,131,453**	**1,128,044**	**1,072,471**	**1,066,221**
Property Net Free Cash Flow (After-Tax)	**$ 000's**	**959,265**	**32,026**	**-125,116**	**-229,758**	**-225,108**	**107,449**	**203,583**	**159,643**	**124,737**	**123,556**	**115,334**	**161,194**	**141,633**	**209,327**	**214,173**	**8,413**	**-55,574**	**-6,250**
Cumulative Property Net Cash Flow (After Tax)	**$ 000's**		**32,026**	**-93,090**	**-322,848**	**-547,956**	**-440,507**	**-236,923**	**-77,280**	**47,458**	**171,014**	**286,348**	**447,543**	**589,176**	**798,503**	**1,012,675**	**1,021,088**	**965,515**	**959,265**

Discounted Property Cash Flow		**Net Present Value**	
(%)		**(Pre Tax)**	**(After Tax)**
5%	$ 000's	**548,964**	**485,943**
8%	$ 000's	**358,867**	**311,736**
10%	$ 000's	**264,587**	**225,297**
Property IRR (After Tax)	**(%)**	**19.7%**	

22.5 SENSITIVITY ANALYSIS

The economic model was subjected to a sensitivity analysis to determine the effects of changing metal prices, capital and operating costs on the Project financial returns and presented in Table 22-3.

With regard to the specific case of the potential impact of a world health pandemic affecting critical sealift deliveries in 2020 and forcing a delay of one year of the proposed LOM, it is judged by the QP that the Capital Cost +10% scenario presented in Table 22-3, would represent the maximum NAV impact of this event.

Table 22-3. Sensitivity Analysis

NPV ($ 000's) Sensitivity to Gold Price and Discount Rate						
			Discount Rate			
			0%	5%	8%	10%
Gold Price US$/Ounce	1,225	Pre Tax	302,341	16,236	-81,321	-126,766
	1,325	Pre Tax	703,325	288,740	140,179	67,976
	Property Case(1)	Pre Tax	1,066,221	548,964	358,867	264,587
	1,525	Pre Tax	1,505,292	833,750	583,179	457,460
	1,625	Pre Tax	1,906,276	1,106,255	804,680	652,202
NPV ($ 000's) Sensitivity to Other Variables at Property Case Gold Price and 5% Discount Rate						
			Operating Costs		Capital Costs	
+10%		Pre Tax	321,064		441,406	
Property Case(1)		Pre Tax	548,964		548,964	
-10%		Pre Tax	776,864		656,522	

(1) Property Case Gold Price Defined in Table 22-1

22.6 ROYALTIES AND OTHER FEES

TMAC has a 100% interest in Hope Bay, subject to a KIA 1% NSR on mineral production from the Hope Bay claims payable to the KIA and a 1% NSR royalty on mineral production from the Hope Bay claims and an area of interest around Hope Bay which was originally owned by Newmont and sold to Maverix on June 29, 2018. On August 14, 2019, TMAC entered into an amending agreement to the existing 1% NSR with Maverix that provided Maverix with an additional 1.5% NSR for proceeds of US$40 million. The amendment includes negotiated step down and buyback rights in favour of the Company. A more detailed explanation can be found in Section 4.0.

22.7 CLOSURE AND SALVAGE VALUE

Closure costs are captured by the Project Case economic model to account for dismantling of project infrastructure and rehabilitation. The estimate used in the economic model is $100 million at the end of the LOM over two years ending in 2035. There is no salvage value assumed.

22.8 TAXATION

Local land taxes are included in the economic model and the tax model utilizes Nunavut and Federal taxes.

22.9 FINANCING COSTS

Cost of financing the Project, such as interest on loans, are not included in the economic model and beyond the scope of the analysis.

22.10 THIRD PARTY INTERESTS

TMAC Resources Inc. is the 100% owner of the Hope Bay Project.

23.0 ADJACENT PROPERTIES

There are no mineral properties of importance adjacent to the Hope Bay Project for consideration.

24.0 OTHER RELEVANT DATA AND INFORMATION

24.1 ENGINEERING EXECUTION PLAN

An Engineering Execution Plan (EEP) has been developed for the Madrid Project, the planned expansion project for Hope Bay. The plan provides a description of the Madrid design process beginning in March of 2020 and continuing through the end of final design phase scheduled for August of 2022.

The EEP describes the engineering process for each area in the Level 2 Work Breakdown Structures (WBS) and defines a generic workflow for each deliverable for each system (or structure) within the scope of responsibility defined by WBS element.

The EEP is intended to be a working document that describes the engineering/design process and is updated as the Madrid design progresses. As such, the major emphasis of the EEP, in its initial issue, is the preliminary/final design phases. It will be modified during the final design phase to provide engineering support during construction.

The primary objectives of engineering for Madrid Project are:

- Provide engineering design work for the project that meets the overall project objectives including scheduling and timely delivery of all items required for the completion of the Sealifts
- Comply with all TMAC health, safety, security, environmental and quality standards
- Provide a design that complies with the defined operability, reliability, maintainability, and constructability requirements
- Provide designs that complies with regulatory requirements

STRUCTURE OF THE ENGINEERING EXECUTION PLAN (EEP)

The EEP is separated into nine major sections, with each section providing specifics as they relate to different elements and stages of the design process.

- Describes the primary function of and the purpose behind such a Plan.
- Overview of the Final Design and related milestones, documents and the WBS structure.
- Describes the design inputs, preparation, reviews, approval and issuance of Engineering documents and design engineering processes.
- Design phases and the engineering activities are recognized for the completion of the Madrid Project.
- Levels of detail required in Madrid engineering documents for the Final Design phase.
- Engineering Contracting Strategy.
- Final Design Package, including a discipline-based description of each of the generic products of the phase such as drawings, calculations, models and others.
- Engineering Work Packages.
- Engineering Control method and monitoring the progress of work.

24.2 PROCUREMENT EXECUTION PLAN

The Procurement Execution Plan (PEP) has been developed for the Procurement and Procurement Management activities on the TMAC Madrid Gold Project. The Plan details all the

requirements and strategies that will be employed on the project from the issue of the Technical Report in March of 2020 and continuing to the Project Execution and Close-out.

The Plan integrates the Procurement activities in the Engineering Design and Construction phase and allows for the successful manufacture and delivery of the Engineered Equipment and Materials.

A Procurement Schedule will be developed from this plan, establishing the timelines for executing each step in the procurement process from design to tendering, award, manufacturing and delivery of equipment.

The primary objectives of the Procurement Execution Plan are:

- A tool to organize, perform and execute the procurement-related responsibilities on the Madrid Project;
- Outlining and documenting the procurement requirements to meet the needs of the project;
- Monitoring of the procurement process;
- Enhancing the transparency and predictability of the procurement process.

The Procurement Execution Plan allows for the consolidation of packages bearing similar criteria under one purchase order using an Execution Readiness Procurement Model, called "PEpC approach. The "PEpC" approach considers that most strategic and project-critical procurement transactions occur prior to detailed design engineering, and early vendor input related to these critical items then influence and define subsequent engineering efforts. This approach breaks the process into the following sequence:

- Procurement: competitive tender and vendor selection in the early front-end stages
- Engineering: collaborative design, design criteria definition, study of engineering progression
- procurement: finalization of any smaller details with vendors, final equipment sizing, vendor document and data review
- Construction: release for fabrication, quality surveillance.

PROCUREMENT PACKAGING STRATEGY

The Procurement packages will be created based on criticality, for example, Category A items will be Long-Lead items, Category B, Major Equipment and Category C, the Balance of Equipment.

For critical packages, Category A and some Category B items, the equipment to be used in the facility construction will undergo preliminary Procurement activities during Studies using a Procurement, Engineering, procurement, and Construction (PEpC) approach.

By having the same equipment nominated in the FEL-3 Studies be the same as what is actually procured during execution, the PEpC model eliminates rework in the detailed design engineering phase caused by changing dimensions, changing feed configurations, improper sizing, and the like. The packages will then be divided based on the different Work Breakdown Structure (WBS) Areas and tendered according to schedule.

These Long-Lead and Major Equipment packages will be tendered to vendors who can supply multiple pieces.

The Long Lead and Major Equipment packages are:

- SAG Mill
- Ball Mill
- Jaw Crusher
- Pebble Crusher
- Regrind Mill
- Thickeners
- CIL Plant
- Elution Plant
- Conveyors
- Process Buildings
- Surface Haulage Equipment
- Camp

During the procurement process the Logistics Planning for the Project will commence and will be based on the sealift schedule and the delivery lead time of the equipment packages. As part of the Procurement Planning strategy, the various Equipment will be transported to and marshalled at the Port of Becancour, Quebec. At this point, items will be inspected, received into inventory, and repackaged if necessary, for stronger protection against the environmental conditions of the ocean voyage, sealift, and the Project site arctic conditions. Equipment will then be transported to Hope Bay where the Construction Manager and the General Contractor will manage all aspects of receiving, handling, and warehousing the equipment.

24.3 PROJECT LOGISTICS

The Project is located in the central Canadian arctic and relies on sealifts and air freight resupplies for its supply chain logistics. Although these methods work well from an Operations perspective for a low-risk, consistent resupply of regular goods, Project Construction logistics have much higher risks due to the acutely large volume of goods purchased in relation to sourcing locations, delivery locations and coordination, multiple multi-modal handlings, extremely variable environmental conditions, and schedule constraints.

A well-planned and executed project logistics plan accounts for the above factors and strives to fully mitigate them with a focus on time and place utility as the prime KPIs; goods that are not in the right place at the right time result in increased immediate and downstream project costs. The goal of project logistics is to minimize transportation costs and maximize the flow of goods, facilitating a construction project that finishes on time and on budget.

The Preliminary Logistics Study provides a general overview of the logistics efforts required by the Project upon execution and serves as the foundation for further investigation throughout the PFS and FS phases. The document describes the direction the Project should continue planning its logistics efforts.

A Preliminary Logistics Study was conducted based on the early information provided by the Project. In summary, this information consisted of some process equipment, project layout, project location, and locations of ports currently used by the Owner. Using this information as a starting point, TMAC researched the following for development of a preliminary logistics plan: capital equipment, construction goods, procurement sourcing areas, transportation routes, marshalling areas, inventory packaging methods, inventory and warehouse management, and a hypothetical logistics schedule based on the probable vessel departure date.

Generally, mining procurement is a global initiative due to lowest-price sourcing requirements. It is recommended to follow this philosophy as much as possible, with the caveat that time and place utility is of ultimate value to the project. Global procurement holds the risk of global supply chain disruptions which can cause delivery delays; depending on the construction schedule, a delivery of key equipment that misses the sealift window can cause catastrophic delay costs to the Project. Therefore, it is recommended to follow a global sourcing philosophy that includes a bias for North American (NA) sourcing as a hedge for time and place utility risk.

As part of the logistics plan, transportation routes from suggested sourcing areas were studied, as well as methods, second- and third-party logistics companies, marshalling and load consolidation areas, pre-assembly and modularization opportunities, packaging methods, inventory and warehousing strategies, and an approximate logistics schedule.

Lastly, recommendations for further logistics planning in later project stages were listed. Investigation of these logistics pieces can add value to the project through both reduced transportation costs and streamlined delivery of project goods.

24.4 CONSTRUCTION EXECUTION PLAN

Construction activities will commence in the spring of 2021 with bulk earthworks and preparation of construction grading of the Madrid site. Works will be completed with existing equipment on site by the surface mining contractor currently working at Hope Bay. Based on the current site disturbances and permits, major earthworks will be completed under existing permits.

Various elements of the Madrid infrastructure are planned to arrive on the 2021 Sealift, including the Madrid camp, kitchen, administration, and warehousing buildings. These facilities will arrive modularized and pre-assembled to the greatest degree possible. Since the facilities do not require permanent concrete foundations, they will be erected and commissioned within 6 weeks of arrival for use as the main construction camp going forward, prior to construction manpower increasing to approximately 200 people in October 2021. Construction personnel and other support personnel will continue to be housed and messed in the existing Doris camp until this time.

The 2021 Sealift will also bring the mill pre-engineered building, cranes, and associated materials for major concrete pours to Hope Bay. The strategy will be to reduce the amount of outdoor winter labour, and associated heating and hoarding costs, by having perimeter concrete foundations and grade beams poured and to have as much of the building enclosed as possible prior to the onset of winter. Once the building is enclosed, temporary heat will be supplied by means of temporary heaters. This will allow workers to complete the balance of the internal foundations and slab on grade through the winter.

Major mechanical, electrical, and instrumentation equipment items will arrive on the 2022 Sealift for subsequent erection inside the already completed mill building. The balance of any bulk material items required for mechanical completion will arrive on the 2023 Sealift. A contingency allowance has been made in the project cost estimate for annual emergency air freight to bring critical equipment to site should the equipment miss the Sealift.

Additional infrastructure and facilities including freshwater system, wastewater treatment, effluent treatment, on-site communications, pipelines, site roads, and power transmission will be constructed during the summer months of 2022 and 2023. The lifts and improvements will be completed during the summer months of 2022 and 2023.

New Madrid facilities will be mechanically complete in Q4 2023 with turnover to operations and commissioning completed by the end of Q1 2024.

After Doris Mine is decommissioned, associated infrastructure including the camp, kitchen, warehouses, and power plant, will be relocated to Boston and upgraded based on current maintenance needs at that time. The relocation will be done using cranes, tractor trailers, and lowboy trailers that need to be purchased to support the offloading of construction materials during annual Sealift windows. This equipment will also be used as necessary to support Madrid construction efforts. Existing Doris infrastructure including the assay lab and reagent storage will remain in situ. The mill building at Doris can subsequently be converted to additional warehousing on site.

Detailed Design & Engineering activities will be staggered to support long-lead procurement activities around annual sea-lift windows. The sealift windows will naturally force the schedule to adopt a "hurry up and wait" mentality to ensure all key equipment is delivered to Becancour Port on-time. As such, the execution approach envisions multiple Engineering & Procurement contractors performing the works on individual elements of the plant with site-based Construction Management contractors responsible for different areas of the work. All efforts will be overseen by a small Owner’s Team that will transition to site during construction activities.

Construction labour will be predominantly sourced from Edmonton, Alberta and Yellowknife, Northwest Territories as TMAC currently engages charter flights to the site through these municipalities. This will help to greatly reduce travel costs; however specialized labour will still be sourced nationally as required to meet specific project objectives.

24.5 PROJECT SCHEDULE

This document outlines the methodologies, assumptions, risks, and constraints used in the development of the Level 2 Execution schedule for the Madrid Project.

The scope of this project schedule includes the following:

- Major engineering activities
- Major procurement and contract deliverables
- Logistics activities (Shipping Requirements)
- Construction activities for all major disciplines and areas
- High level Commissioning activities
- Methodology
- Software

The schedule was developed using Primavera P6 Professional 19 Release 19.9.0 software. The P6 specific scheduling options utilized are listed in APPENDIX 2.

The schedule was developed using the full project CAPEX, the package list, the procurement strategy, the logistics strategy, and consultation with project managers, engineers, and team members from all responsible persons involved in the project study.

Engineering activities will commence concurrently with the detailed feasibility study planned for Madrid Project. This is necessary to ensure project milestones are achievable. The early engineering activities will focus on initial infrastructure, such as the accommodation complex, needed to commence major construction activities. Early engineering activities are grouped as Front-End Engineering and Design “FEED” activities.

LEVEL OF DETAIL

The schedule was developed to a Level 2 detail. Key activities that potentially impact the completion have been expanded to greater detail.

RESOURCE LOADING

The schedule was resource loaded to an activity level to provide an estimated Full-Time Equivalent (FTE) count for the life of the construction portion of the project. Resources were applied by discipline and responsible entity.

WORK BREAKDOWN STRUCTURE

The schedule was harmonized with the Project WBS.

KEY MILESTONES

Table 24-1. Key Schedule Milestones

Activity	Quarter
Feasibility / FEED Study Start	Q2 2020
Engineering Start	Q2 2020
Geotechnical Program Complete	Q3 2020
Site Preparation / Bulk Earthworks Start	Q3 2020
Permitting Start	Q3 2020
Feasibility Study Complete	Q4 2020
Detailed Engineering Start	Q4 2020
Procurement Start	Q1 2021
Construction Permit Issued	Q3 2021
Engineering Complete	Q2 2022
Concrete Installation Start	Q2 2022
Structural, Mechanical Piping Installation Start	Q3 2022
All Equipment Delivered to Site	Q4 2023
Mechanically Complete (Construction Complete)	Q4 2023
Commissioning Start	Q4 2023
Turnover to Operations (Commissioning Complete)	Q1 2024

CALENDARS

Table 24-2. Calendars Used for Schedule Development

Calendar	Description	Activities Used For
5 days, 8 hours per day	5-day schedule working 8 hours per day. Typical engineering work schedule.	All construction activities excluding summer specific activities
7 days, 12 hours per day	7-day schedule to reflect 20 in and 20 out shift working 12 hours per day.	All construction activities excluding summer specific activities
7 days, 12 hours per day Summer	Identical calendar as 7 day 12 hours but only during May to October summer season	Summer-only construction activities

CONSTRAINTS AND RELATIONSHIPS

CONSTRAINTS

- Turnover to Operations – Set to March 13, 2024
- Sealift Windows
    - Window 1: Aug. 4 – Sep. 30, 2021
    - Window 2: Aug. 4 – Sep. 30, 2022
    - Window 3: Aug. 4 – Sep. 30, 2023
- Major concrete foundations limited to summer calendars
    - Buildings
    - SAG Mill
    - Pebble Crusher
    - Primary Crusher
    - Conveying
    - Stockpile
    - Thickening

RELATIONSHIPS

The schedule primarily features two types of relationships common to this level of detail.

- Finish to Start
    - This is the most common and easily understood relationship type. One activity must finish for the successor to begin. This is common and easily recognized in the schedule.
- Finish to Finish
    - This is an activity relationship where an activity must finish prior to the successor finishing.
    - This is common when the schedule is not broken down to a more detailed level, which is typical for Level 2 Execution Schedules.
    - This relationship is commonly featured with lag. For example, electrical work could be underway in a specific area while instrumentation work is being complete, but the power systems need to be completed prior to finalizing the instrumentation work. In this case a finish to finish relationship with the appropriate amount of lag

will show that electrical work needs to finish prior to instrumentation but that they can carry on in parallel.

PROJECT SCHEDULE RISKS AND INTERFACE POINTS

RISKS

- A substantial constraint to the project schedule is the Sealift window.
    - Limits the timeframe for shipping equipment and materials to site.
    - Shipping window is near the end of summer. Any equipment needed for summer works will need to be shipped one year earlier than required.
- Permitting activities and approval by regulatory authorities/third parties are a concern, any delays will delay the start of construction.
- Camp construction and any delays will cause issues with starting the larger scope of construction, including the concrete works and structural scope.
- Any delays to the earthwork's activity and or the concrete scope could lead to a later peak in the resource curves. The seasonal restrictions could magnify any potential delays.
- With the structure of the resource curves there is less ability to mitigate delays to work fronts with large labour requirements. Specifically, anything that delays major mechanical and electrical scope could potentially lead to a delay in the completion of the project.

CRITICAL PATH

The Critical Path for the scope of this project is driven by the 2022 Sealift Window. This Sealift Window is critical to the project as most of the key / long lead mechanical equipment will be shipped to site during this period. Specifically, the SAG Mill Equipment and the SAG Mill Building will be delivered during the 2022 Sealift Window.

The SAG Mill installation is on the Critical Path through the construction of the project. This is typical of major process plants at mining facilities, as the fabrication of the SAG Mill components and construction of the mill concrete plinth/foundation is typically the most time-consuming task. The project's Critical Path runs through the building installation, the structural, mechanical, platework, piping, and finally electrical & instrumentation of the milling systems.

Based on approval of the PFS, it is recommended that the SAG mill be included in the Procurement early contract award package to expedite engineering and construction related information as quickly as possible.

Following the completion of the mill construction the Critical Path will shift to the commissioning of the entire facility. C1 includes the construction verifications i.e. walk downs, deficiencies, and punch-lists prior to moving into C2 the dry commissioning portion. Following the completion of C1 and C2 the commissioning team will begin C3 wet commissioning and then C4 ore commissioning prior to turning the project over to operations for ramp-up and full-scale production.

The critical path schedule can be seen in APPENDIX 3APPENDIX 3.

25.0 INTERPRETATION AND CONCLUSIONS

25.1 KEY STUDY CONCLUSIONS

In TMAC's opinion, the Project represents a significant opportunity for the improved development of the Hope Bay mining camp in the Canadian Arctic. The property encompasses an area of significant exploration potential. Hope Bay's assets are well advanced and there has been significant de-risking through the expenditures both on site and off site, detailed understanding of operating costs in an Arctic environment, including construction of significant on-site infrastructure from which expansionary construction can be conducted. The development plan has been designed to build on the existing assets to generate cash flow that can sustain expansion and exploration.

TMAC has established credible relationships with the Inuit residents and organizations and the Government of Nunavut. TMAC has developed trust, demonstrated results and achieved agreements that will allow development to the benefit of all stakeholders.

TMAC offers the following general conclusions for each area.

GEOLOGY AND MINERAL RESOURCES

- The Hope Bay Property is located within the Hope Bay volcanic belt which is part of a massive structural-geological complex called the Slave Structural Province.
- The Doris gold deposit is a typical Archean lode deposit which occurs within a more than 3 km long, a steeply dipping quartz vein system in folded and metamorphosed pillow basaltic rocks.
- The Madrid deposit area lies within a north-south striking package of mafic volcanic rocks, comprising a sequence of Fe-Ti tholeiitics, Mg tholeiitics, komatiitic basaltic, synvolcanic to late gabbroic, and ultramafic rocks.
- The geology in the area of the Boston deposit is a bimodal assemblage of mafic and felsic volcanic rocks in contact with sedimentary rocks, all of which are complexly folded about a large-scale synformal-anticline. The core of the anticline is occupied by mafic volcanic rocks that host the Boston deposit and these are in turn overlain by sedimentary rocks.
- The drilling, sampling, sample preparation, analysis, and data verification procedures are appropriate for estimation of Mineral Resources.
- Current Mineral Resources contained within the Doris, Madrid, and Boston deposits (inclusive of Mineral Reserves, and excluding stockpiles):
  - Measured Mineral Resources are estimated at 1,570,000 t, grading 9.5 g/t Au, containing 482,000 oz Au.
  - Indicated Mineral Resources are estimated at 20,246,000 t, grading 7.2 g/t Au, containing 4,691,000 oz Au.
  - Measured plus Indicated Mineral Resources are estimated at 21,816,000 t, grading 7.4 g/t Au, containing 5,173,000 oz Au.
  - Inferred Mineral Resources are estimated at 10,917,000 t, grading 6.1 g/t Au, containing 2,127,000 oz Au.
- There is high potential to add to the current Mineral Resource base through continued exploration drilling, designed to upgrade confidence in the Inferred Mineral Resources and follow-up on significant exploration drilling results beneath and along strike of the known deposits.

  - There is good potential to add to the Mineral Resources at Doris beneath the diabase dyke with continued drilling on the BTD Extension, BTD Connector and BTD Central zones, as underground drilling platforms become available. Exploration drilling in 2019 in the Doris Valley area, has intersected Doris stratigraphy and significant mineralization approximately 325m north of the current BTD Extension zone.
  - There are high-grade exploration intercepts beneath the Madrid Suluk zone Mineral Resources, and along strike to the south in the Patch 7 area. Continued drilling to upgrade Inferred Resources and identify higher-grade trends has the potential to add to the Mineral Resources at Madrid North.
  - Exploration drilling below the current Mineral Resources at Boston has intersected high-grade mineralization as demonstrated by the 2019 exploration drilling at Boston. Historical drilling has intersected significant mineralization at the approximately 1000 m level. Continued drilling has the potential to add to the Boston Mineral Resources.
- There is good exploration potential within the Hope Bay and Elu greenstone belts. The majority of historical and recent exploration has focussed on defining and expanding the known deposits. There are over 90 exploration target areas defined by geological relationships characteristic of Archean orogenic gold deposits, surface mapping and sampling, geophysical surveying and geochemical anomalies identified to date.

MINING

- Current Mineral Reserves hosted by the Doris, Madrid, and Boston areas include:
  - Proven Reserves are estimated to be 99,000 t, grading 4.1 g/t Au, containing 13,000 oz Au.
  - Probable Reserves are estimated to be 16,782,000 t, grading 6.5 g/t Au, containing 3,502,000 oz Au.
  - Proven plus Probable Reserves are estimated to be 16,881,000 t, grading 6.5 g/t Au, containing 3,515,000 oz Au.
- The Hope Bay Project reserve base is sufficient to support production over the LOM, over a 15-year period.
- Mine designs and schedules have been completed on an annual basis.
- Production for the Doris Plant LOM period (2020-2023) is on average 1,963 t/d from two mines including Doris and Madrid North (Naartok).
- Production for the Madrid Plant LOM period (2024-2034) is up to 4,000 t/d from three mines including the Madrid North (Naartok, Suluk, Rand zones) the Madrid South (Patch 14 and Wolverine zones) and Boston.
- Mining will comprise a combination of largely longhole methods plus some cut and fill with a combination of cemented rock fill (CRF) and loose rock fill.
- Ground conditions at Doris mine have been proven to be good and are expected to be fair to good at Madrid and Boston, with minimal ground stress. Ground support systems are standard within industry and effective.
- Ground water in rock fabric has been demonstrated to be possible in the talik zones of Doris, and likely will occur for future mines at Suluk and Madrid South. Pumping systems are designed for mines in talik based on hydrogeological modeling by SRK (2017).

PROCESSING

- The Doris Plant has undergone extensive change in circuit design since initial commissioning. This technical report provides a detailed description of the current state of the circuit and performance description.
- There are further circuit improvements in the Doris Plant expected to be completed in 2020, and other improvements to be studied as outlined in this technical report.
- The Doris Plant is expected to have an average recovery of 85.1% over the next four years of its operating period.
- A new Madrid Plant design is described in this technical report and is expected to be capable of processing up to 1,460,000 t/a at an average recovery of 88.0% over its operating period.
- Further metallurgical testwork of ore samples is required to complete a Feasibility Study design of the Madrid Plant.

ENVIRONMENT, PERMITTING, AND SOCIAL ASPECTS

- The Project area is well known and has been the subject of detailed environmental baseline studies.
- Mining developments in Nunavut are subject to a robust environmental assessment and permitting process. Terms and conditions of permits and approvals are a reflection of the nature of the arctic environment and goals of minimizing environmental risks throughout the mining lifecycle.
- Elements of an Environmental Management System are already in place for the current operation and are an applicable and dependable basis for the additional activities and impacts associated with the Project as a whole.
- Maximizing the socio-economic benefits derived from the development of non-renewable resources at the Project for the residents of the Kitikmeot and Nunavut requires a focus on direct employment and business opportunities that meaningfully support the economic operation of the Project. Continued engagement and compliance with the Framework Agreement and associated Inuit Impact and Benefit Agreement will be a support to achieving these goals.
- Key permits and approvals required to construct and operate major portions of the Project are already in place.
- The Project will require a project description and screening document to be reviewed by NIRB and an amendment application submitted to the NWB before any permits can be issued for mining and related activities beyond the scope of existing infrastructure and the extent of existing permitted infrastructure and activities at Doris, Madrid and Boston deposits.
- Any amendments to the existing permits will require ongoing design and evaluation by TMAC to ensure that the Project is acceptable from an environmental standpoint.
- The permitting and amendment timelines provided within the PFS are considered reasonable for planning purposes. TMAC has reasonable assurance that Hope Bay Project will obtain the necessary approvals required to support the Project presented in the PFS.

INFRASTRUCTURE

- Hope Bay has significant existing infrastructure at Roberts Bay and at the Doris Mine site, but this infrastructure is aging and as a result maintenance costs are relatively high.
- Power generation costs at Doris are higher than average for diesel powered generator plants. Building a new power plant and process plant at Madrid will result in a more cost-effective operation.
- Current mobile maintenance facilities at Hope Bay are adequate for Doris Mine but not optimal in terms of efficiency. Building a new mobile equipment maintenance facility at Madrid North will improve maintenance efficiency and result in quicker turn-around times for repairs, less maintenance persons required and lower maintenance persons turnover.
- Operating costs of new infrastructure facilities are expected to significantly improve the current ratio of General and Administration to Mining and Processing costs, resulting in more cost-effective operation.

25.2 RISKS AND UNCERTAINTIES

TMAC has assessed critical areas of the expansion Project and identified key risks associated with the technical and cost assumptions used. In all cases, the level of risk refers to a subjective assessment as to how the identified risk could affect the achievement of the Project objectives. The risks identified are in addition to general risks associated with mining projects, including, but not limited to:

- general business, social, economic, political, regulatory and competitive uncertainties.
- changes in project parameters as development plans are refined.
- changes in labour costs or other costs of production.
- adverse fluctuations in commodity prices.
- failure to comply with laws and regulations or other regulatory requirements.
- the inability to retain key management employees and shortages of skilled personnel and contractors.

A summary of key Project related risks identified by TMAC in its review is shown in Table 25-1. The following definitions have been employed by TMAC in assigning risk factors to the various aspects and components of the Project:

- **Low Risk** - Risks that could or may have a relatively insignificant impact on the character or nature of the deposit and/or its economics. Generally, can be mitigated by normal management processes combined with minor cost adjustments or schedule allowances.
- **Moderate Risk** - Risks that are average or typical for a deposit of this nature. These risks are generally recognizable and, through good planning and technical practices, can be minimized so that the impact on the deposit or its economics is manageable.
- **High Risks** - Risks that are largely uncontrollable, unpredictable, unusual, or are considered not to be typical for a deposit of a particular type. Good technical practices and quality planning are no guarantee of successful exploitation. These risks can have a major impact on the economics of the deposit including significant disruption of schedule, significant cost increases, and degradation of physical performance.

Table 25-1. Risks and Uncertainties

TMAC RESOURCES INC. - HOPE BAY PROJECT

Project Element	Issue	Risk Level	Mitigation(s)
Geology	Resource tonnes and grade estimates	Low	There is upside potential in the grade estimates through elimination and control of dilution, continued reconciliation of short-term models to resource models
Mining	Groundwater quantity in talik ore zones	Moderate	Advanced development sequences for Doris, Suluk and Madrid South ore in talik to permit drill probing prior to scheduled need for advance, complete grouting programs to mitigate inflows, design pumping system with sufficient contingency capacity
	Ground conditions outside permafrost	Low	Host rock is typical of many greenstone hosted mines in the Canadian shield. Ground support strategies have been successful to date. Maintain focus on quality mining for dilution control.
	Mining development rate	Moderate	Development rates and number of workplaces can be monitored through detailed planning and close control. Employ short interval controls to monitor poor performance and be able to react with solutions to low productivity by use of root cause analysis.
	Transition from 2,000 t/d to 4,000 t/d	Moderate	Ensure there are enough stopes through detailed planning and management/monitoring/control of advance rates and sufficiently developed inventory.
Process (Doris)	Throughput	Moderate	Complete and commission circuit changes as outlined for 2020. Evaluate other improvement ideas as outlined. Continue to improve maintenance and operating practices. Effective training programs to facilitate quick learning of a complex circuit by operators.
	Gold recovery	Moderate	Complete and commission circuit changes as outlined for 2020. Evaluate other improvement ideas as outlined. Continue to improve operating practices.

Project Element	Issue	Risk Level	Mitigation(s)
Process (Madrid)	Throughput	Moderate	Ensure engineering designs reviewed by operations prior to approvals. Planned commissioning schedule and sign offs, ensure training completed prior to commissioning.
	Gold recovery	Moderate	Adequate testwork in place for Madrid and Boston ore types at the PFS level. Design process plant to maximize recovery using standard recovery processes. Additional testing with samples representative of current mine plan to reduce recovery and throughput risks. Organic carbon is known to occur primarily in Suluk and to lesser extents in the other Madrid and Boston deposits. The distribution and concentrations of the organic carbon are not defined. Higher concentrations of organic carbon negatively impact recovery. Review of the geological models to identify areas of organic carbon and including organic carbon assays in the block models to define areas of low recovery.
Construction Schedule	Sealift logistics to ensure delivery of materials and supplies.	Moderate	Advance engineering well ahead of time to ensure adequate lead time. Requires detailed planning and control. Goods and most equipment can be flown in if required.
Pre-production Capital Cost Estimate	See Construction Schedule	Moderate	Perform Geotechnical Investigations. Ensure engineering is complete to understand scope of work. Ensure adequate team is in place with the right skills and project controls are in place. Ensure long lead items are ordered on time.
	Execute construction plan	Moderate	
Operating Cost Estimate	Cost of key materials and supplies	Low	Close management of purchasing and logistics.
Land Tenure	Relationships with Kitikmeot	Low	Agreements in place, TMAC has built and maintains good working relationships.
Project	World Health Pandemic	Undefined	See “Current and Special Risks” discussion below

CURRENT AND SPECIAL RISKS

TMAC's operations are subject to the risk of emerging infectious diseases or the threat of outbreaks of viruses or other contagions or epidemic diseases. These infectious disease risks may not be adequately responded to locally, nationally or internationally due to lack of preparedness to detect and respond to outbreaks or respond to significant pandemic threats. As such, there are potentially significant economic and social impacts of infectious disease risks, including the inability of TMAC's mining and exploration operations to operate as intended due to shortage of skilled employees, shortages in supply chains, inability of employees to access sufficient healthcare, significant social upheavals, government or regulatory actions or inactions, decreased demand or the inability to sell precious metals or declines in the price of precious metals, capital market volatility, or other unknown but potentially significant impacts. There are potentially significant economic losses from infectious disease outbreaks that can extend far beyond the initial location of an infection disease outbreak. As such, both catastrophic outbreaks as well as regional and local outbreaks can have a significant impact on TMAC's operations. TMAC may not be able to accurately predict the quantum of such risks. In addition, TMAC's own operations are exposed to infection disease risks noted above and as such TMAC's operations may be adversely affected by such infection disease risks. Accordingly, any outbreak or threat of an outbreak of a virus or other contagions or epidemic disease could have a material adverse effect on TMAC, its business, results from operations and financial condition.

At this time, the world is experiencing a global health pandemic related to the COVID-19 virus, which is affecting the operations of multiple organizations and worldwide populations. Governments are making decisions to shut down borders and air travel and the impact on international business is not understood. How this will affect many of the assumptions regarding timelines and production assumptions in this Technical Report are unquantifiable at this time. While these effects are expected to be temporary, the duration of the business disruptions and related financial impact cannot be reasonably estimated at this time. As a result, this Technical Report does not take into account a significant delay in carrying out critical tasks, being able to order long lead items or complete critical test work, analysis and engineering necessary to maintain the schedules presented in this report impacted by the world health pandemic. This item is a factor beyond reasonable control and estimation of a QP.

While conducting initial underground delineation diamond drilling in the Doris Central zone in the first two months of 2020, TMAC encountered groundwater of a high enough pressure and flowrate to warrant suspension of development in this zone and re-evaluation of the development strategy. Geological structural modelling indicates there are several ways water may be entering the mine, including sub-vertical faults and/or historical surface diamond drill holes from Doris Lake. The size and extent of the water bearing structures relative to the orebody is not yet known. Grouting experts have now completed a successful test grouting program and the Company will perform further probing of the Doris Central zone once the current inflow of water in this area is mitigated. As a result, development of the Doris Central zone is expected to be delayed by at least several months. TMAC had anticipated Doris Central to represent nearly 15% of its 2020 production, commencing in the second half of the year, and a significant portion of its 2021 production. There is a risk that Doris Central production in 2020 will be significantly less and that 2021 production from Doris Central may also be impacted. The Company is assessing the anticipated costs to controlling these water flows, the length of the potential delay of development, the impact of the water issues on resources and how any lost production from the Doris Central zone could be replaced with other ore within the Hope Bay project and the ultimate impact of this issue.

Since the public disclosure of this information on March 6, 2020, TMAC has re-evaluated several mine sequencing opportunities to potentially mitigate the production delay in Doris Central as a result of the disclosed water issues. Given the recent timeframe of disclosed events, these mine sequencing opportunities have not been incorporated into the LOM plan contained within the PFS and this report.

- At the time of the writing of this report, the world is experiencing a global health pandemic related to the Covid-19 virus, which is affecting the operations of multiple organizations and worldwide populations. Governments are making decisions to shut down borders, air travel and the impact on world business is not understood, therefore how this will affect many of the assumptions regarding timelines and production assumptions in this Technical Report are unquantifiable at this time. While these effects are expected to be temporary, the duration of the business disruptions and related financial impact cannot be reasonably estimated at this time. As a result, this Technical Report does not take into account a significant delay in carrying out critical tasks, being able to order long lead items or complete critical testwork, analysis and engineering necessary to maintain the schedules presented in this report related to the world health pandemic. This item is a factor beyond reasonable control and estimation of a QP.
- While conducting initial underground delineation diamond drilling in the Doris Central zone in the first two months of 2020, TMAC encountered groundwater of a high enough pressure and flowrate to warrant suspension of development in this zone and re-evaluation of the development strategy. Geological structural modelling indicates there are several ways water may be entering the mine, including sub-vertical faults and/or historical surface diamond drill holes from Doris Lake. The size and extent of the water bearing structure relative to the orebody is not yet known. Grouting experts have now completed a test grouting program and the Company will perform further probing of the Doris Central zone, once the current inflow of water in this area is mitigated. As a result, development of the Doris Central mining zone is expected to be delayed by at least several months. TMAC had anticipated Doris Central to represent nearly 15% of its 2020 production, commencing in the second half of the year, and a significant portion of its 2021 production. There is a risk that Doris Central production in 2020 will be significantly less and that 2021 production from Doris Central may also be impacted.
- Since the public disclosure of this information on March 6th, 2020, TMAC has revaluated several mine sequencing opportunities to potentially mitigate the production delay in Doris Central as a result of the disclosed water issues. Given the recent timeframe of disclosed events, these mine sequencing opportunities have not been incorporated into the LOM plan contained within the PFS and this report.

26.0 RECOMMENDATIONS

EVALUATE ALTERNATIVE DEVELOPMENT SCENARIO

- Revisit alternative design concepts for operational strategy, throughput and location of a new Process Plant to reduce construction footprint and capital infrastructure cost, prior to advancing to the Feasibility Study for the Hope Bay Project.

GEOLOGY AND MINERAL RESOURCES

- Continue underground definition drilling to facilitate mine planning and stope design.
- Near mine exploration has the potential to extend the Doris mine life. Exploration drilling is recommended to delineate the northern strike extent of the high-grade BTD Extension zone, and the relationship to the Doris Valley mineralization, intersected during the 2019 exploration program.
- Continue metallurgical testwork in advance of development of the Madrid North Suluk, Madrid South and Boston orebodies.
- Construct a geo-metallurgical model for gravity gold, sulphide and organic carbon for ore blending strategy and metallurgical recovery optimising.
- Design and implement reconciliation processes to help refine the Mineral Resource and Mineral Reserve estimates.
- Continue exploration drilling to upgrade Inferred Mineral Resources and add to the existing Mineral Resource inventory at Doris, Madrid and Boston.

MINING AND MINERAL RESERVES

- Complete test grouting programs in 2020 at Doris Central to calibrate ability to mitigate underground water flows against the groundwater model
- Investigate most optimal methodology for CRF placement, binder content and additives, including possible use of frozen fill in permafrost mining areas.
- Investigate further optimization of mining rates, development and stope sequencing, district mine sequences and higher cut-off grade scenarios to maximize NPV.
- Develop a comprehensive hydrogeology model for predicting water ingress for Madrid South and Suluk mines for pump design.
- Investigate the economics of utilizing emulsion based explosive products and manufacturing explosives onsite for reducing costs, ammonia in groundwater and better blasting and dilution controls.
- Complete optimization of ventilation layouts with goal of reducing long term energy costs.
- Investigate the use of ventilation on demand fan controls to minimize energy use for auxiliary ventilation.
- Investigate the use of remote controlled LHD operations to extend operational hours between shifts for productivity gains.

MINERAL PROCESSING

- Complete testwork and analyse the impact of a gravity recovery system in the new Process Plant design to maximize recovery.

- Complete all Doris Plant process improvement projects in the 2020 sustaining capital budget
- Evaluate further Doris Plant process improvements with capital investments against short term payback targets to improve throughput and recovery
- Complete further metallurgical testwork to support detailed Process design for the Feasibility Study.
- Conduct metallurgical testing on samples selected to define the extent of organic carbon occurrences primarily in the Suluk deposit and its impact on gold recovery.
- Investigate potential for Flotation Tails leaching for economic gold recovery

INFRASTRUCTURE

- Perform geotechnical investigations for infrastructure buildings and facilities. Geotechnical information is limited in the areas targeted for new infrastructure. It's recommended to complete a geotechnical investigation program to confirm ground condition prior to commencing detailed design.
- Perform a business case / trade-off study to determine if a permanent cargo dock will financially benefit the operation. Currently cargo is brought to Hope Bay by ship and lightering barges. It may be financially beneficial to build a permanent dock and eliminate the need for a lightering barge and the associated costs.
- Perform a scoping study for wind power. Installing wind turbines could potentially be financially beneficial in displacing diesel consumed by the diesel-powered generator-based power plant planned for Madrid.
- Perform an optimisation study for the diesel power plant planned for Madrid. The current PFS level estimate is based on a preliminary load list. An in-depth electrical load study could reduce the capital cost of the power plant as well as the operating costs by optimising the current design which consists of 4 x 7MW gensets in an N+1 arrangement.
- Perform an optimisation study on the design of the Madrid Boston Road. The current estimate for the road is based on a preliminary design. It's recommended that the design be finalised and concurrently optimised to potentially reduce material quantities and to minimise road maintenance during operations.
- Investigate option of running power cables or an overhear power line from Madrid Power Plant to Doris Mine area. This could potentially reduce the overall cost of power generation at Hope Bay.
- Further investigate truck shop (surface maintenance facility) options at Madrid. The current design included in the PFS is an adaptation of another similar mine in Nunavut. Designing a truck shop from 1st principles in collaboration with maintenance and operations currently at the Doris Mine may potentially result in a more cost effective surface maintenance facility.

WATER AND WASTE MANAGEMENT

- Complete a comprehensive groundwater model for all deposits to ensure sufficient treatment capacity is designed for the water treatment facilities over the long term.
- Complete the design of a land waste fill site at Quarry 2 for long term storage of waste products and sea cans.

ENVIRONMENT, PERMITTING, AND SOCIAL ASPECTS

- Submit a screening document, including project description, to the NIRB, and water licence amendment application package to NWB as soon as possible given some uncertainty in the timing of the regulatory process and its direct impact on the development schedule.
- Integrate engineering and permitting planning schedules and ensure that sufficient design level information will be available to support future permitting efforts.
- Undertake further studies to validate freshwater demand, the potential loss of surface water to underground workings, mine water discharges (particularly talik water), and tailings discharges to confirm that the proposed Project has acceptable environmental impacts. Completion of site-wide water balance and water quality modelling is required to support Project planning and permitting.
- Continue to engage with the local community stakeholders, maintain a constructive relationship with the KIA, and implement the requirements of the Framework Agreement.

ECONOMIC ANALYSIS

- Complete the Feasibility Study for the Project prior to a development decision on the expansion concept presented in the PFS to validate Project economics and schedule delivery.

27.0 REFERENCES

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28.0 DATE AND SIGNATURE PAGE

This report entitled NI 43-101 *Technical Report on the Hope Bay Project, Nunavut, Canada,* dated *March 30, 2020 with an effective date of January 1, 2020* was prepared for TMAC Resources Inc. by Gilbert Lawson, P.Eng., David King, P.Geo., Dan Redmond, P.Geo., Brendan Barron, P.Eng. and Tommaso Roberto Raponi, P.Eng, each of whom are qualified persons as defined by NI 43-101.

Signed, Sealed and Submitted on March 30, 2020:

Prepared By:

(signed)

Gilbert Lawson, P.Eng.	March 30, 2020
Name	Date

Prepared By:

(signed)

David King, P.Geo.	March 30, 2020
Name	Date

Prepared By:

(signed)

Dan Redmond, P.Geo.	March 30, 2020

Prepared By:

(signed)

Brendan Barron, P.Eng.	March 30, 2020
Name	Date

Prepared By:

(signed)

Tommaso Roberto Raponi, P.Eng.	March 30, 2020
Name	Date

29.0 CERTIFICATE OF QUALIFIED PERSON

TOMMASO ROBERTO RAPONI, P.ENG.

I, Tommaso Roberto Raponi, am a Professional Engineer, employed as a Senior Metallurgist with the Optimize Group Inc., 145 Wellington Street West, Suite 1001, Toronto, ON, Canada M5J IH8 and reside at 15 – 223 Rebecca Street, Oakville, Ontario.

I am a co-author of a technical report entitled "NI 43-101 Technical Report on the Hope Bay Property, Nunavut, Canada" dated March 27th, 2020. Prepared for TMAC Resources Inc. ("The Technical Report").

I am registered as a Professional Engineer in the Province of Ontario (Reg. #90225970) and the Association of Professional Engineers and Geoscientists of BC (Reg. #23536). I have worked as an independent consultant since 2016 and graduated from the University of Toronto with a BASc. in Geological Engineering, 1984.

My relevant experience for the purpose of the Technical Report is in the development, design, commissioning and operation of mineral processing plants in Canada, United States, Mexico, Brazil, Venezuela, Surinam, Chile, Kyrgyzstan, Mongolia, Turkey, and Saudi Arabia.

- I have been employed as independent consultant since April 2016.
- From 2005 to 2016 I was employed as Director, Metallurgy with Centerra Gold Inc.
- From 1995 to 2005 I held the position of Senior Metallurgist with SNC-Lavalin Inc.

I personally inspected the Hope Bay Property in February 2020 for a duration of 2 days.

I am responsible for sections 13, 17 and 21 of the Technical Report.

I have read the definition of "qualified person" set out in National Instrument 43–101 Standards of Disclosure for Mineral Projects ("NI 43-101") and certify that by reason of my education, affiliation with a professional association (as defined in NI 43-101) and past relevant work experience, I am a "qualified person".

I have read NI 43-101 and Form 43-101F1, and the sections in the report that I am responsible for within the Technical Report has been prepared in compliance with that instrument.

I am independent of the issuer, TMAC Resources Inc., applying all of the tests in Section 1.5 of NI 43-101, as a result of my employment with TMAC Resources Inc.

I have had no prior involvement with the subject property.

As at the effective date of the Technical Report, to the best of my knowledge, information and belief, the Technical Report contains all scientific and technical information that is required to be disclosed to make the Technical Report not misleading.

Dated this 30th day of March 2020 in Toronto, Ontario.

"Signed"

Tommaso Roberto Raponi

Tommaso Roberto Raponi, P.Eng.

BRENDAN BARRON, P.ENG.

I, Brendan Barron, am a Professional Engineer, employed as Project Director by TMAC Resources Inc. located at Suite 300, 181 University Avenue, Toronto, ON, Canada M5H 3M7 and reside at 5419 Blue Spruce Ave, Burlington, Ontario L7L 7C5.

I am a co-author of a technical report entitled "NI 43-101 Technical Report on the Hope Bay Property, Nunavut, Canada" dated March 27th, 2020. Prepared for TMAC Resources Inc. ("The Technical Report").

I am a member, in good standing, of Professional Engineers Ontario (Reg. #100168355) the licensing and regulating body for professional engineering in the province of Ontario and graduated with a degree in Bachelor of Science in Engineering from the University of the Witwatersrand (South Africa) in 1992.

From 1992 to the present I have been actively employed as an Engineer and a Project Manager in the area of capital project development in the resources industry.

My relevant work experience for the purpose of this technical report is:

- Project Engineer for the development of a diamond mine in Ontario
- Project Manager for the development a diamond mining operation in Northwest Territories
- Manager of Projects for operating diamond mine in Northwest Territories.
- Project Director for TMAC Resources Inc. based in Toronto, Ontario.

I last personally inspected the Hope Bay Property on various occasions during 2019 for a total duration approximately one month. Prior to this, I visited Hope Bay in 2011.

I am responsible for sections 18 and 24 of the Technical Report.

I have read the definition of "qualified person" set out in National Instrument 43–101 Standards of Disclosure for Mineral Projects ("NI 43-101") and certify that by reason of my education, affiliation with a professional association (as defined in NI 43-101) and past relevant work experience, I am a "qualified person".

I have read NI 43-101 and Form 43-101F1, and the sections in the report that I am responsible for within the Technical Report has been prepared in compliance with that instrument.

I am not independent of the issuer, TMAC Resources Inc., applying all the tests in Section 1.5 of NI 43-101, as a result of my employment with TMAC Resources Inc.

As at the effective date of the Technical Report, to the best of my knowledge, information and belief, the Technical Report contains all scientific and technical information that is required to be disclosed to make the Technical Report not misleading.

Dated this 30th day of March 2020 in Toronto, Ontario.

"Signed"

Brendan Barron

Brendan Barron, P.Eng.

DAN REDMOND, P.GEO.

I, Dan Redmond, am a Professional Geologist, employed as Director of Strategic Mine Planning of TMAC Resources Inc. located at Suite 300, 181 University Avenue, Toronto, ON, Canada M5H 3M7 and reside at 3 Westbrook Avenue, Toronto, Ontario.

I am a co-author of a technical report entitled "NI 43-101 Technical Report on the Hope Bay Property, Nunavut, Canada" dated March 27th, 2020. Prepared for TMAC Resources Inc. ("The Technical Report").

I am a member, in good standing, of the Association of Professional Geoscientists in the province of Ontario (Reg. #1386) and graduated with a degree in Master of Science in Structural Geology from Brock University in 1993.

From 1994 to the present I have been actively employed as a Geologist in the area of resource and reserve estimation, mine planning and mine operations.

- I have been employed as Director of Strategic Mine Planning for TMAC Resources Inc since April 2017.
- From 2014 to 2017 I held a similar position as Director, Reserves and Mine Planning with Goldcorp Inc.
- From 2004 to 2013 I held the position as Director Mining with Centerra Gold Inc.

I last personally inspected the Hope Bay Property on July 2019 for a duration of 2 days. Prior to this, I have completed two inspections of the Hope Bay property since 2017.

I am responsible for sections 15, 16 and 21 of the Technical Report.

I have read the definition of "qualified person" set out in National Instrument 43–101 Standards of Disclosure for Mineral Projects ("NI 43-101") and certify that by reason of my education, affiliation with a professional association (as defined in NI 43-101) and past relevant work experience, I am a "qualified person".

I have read NI 43-101 and Form 43-101F1, and the sections in the report that I am responsible for within the Technical Report has been prepared in compliance with that instrument.

I am not independent of the issuer, TMAC Resources Inc., applying all of the tests in Section 1.5 of NI 43-101, as a result of my employment with TMAC Resources Inc.

As at the effective date of the Technical Report, to the best of my knowledge, information and belief, the Technical Report contains all scientific and technical information that is required to be disclosed to make the Technical Report not misleading.

Dated this 30th day of March 2020 in Toronto, Ontario.

"Signed"

Dan Redmond

Dan Redmond, P.Geo.

DAVID M. KING, P.GEO.

I, David King, am a Professional Geologist, employed as Vice President, Exploration and Geoscience of TMAC Resources Inc. located at Suite 300, 181 University Avenue, Toronto, ON, Canada M5H 3M7 and reside at 3 Westbrook Avenue, Toronto, Ontario.

I am a co-author of a technical report entitled "NI 43-101 Technical Report on the Hope Bay Property, Nunavut, Canada" dated March 27th, 2020. Prepared for TMAC Resources Inc. ("The Technical Report").

I am a member, in good standing, of the Association of Professional Geoscientists in the province of Ontario (Reg. #0681) and Northwest Territories and Nunavut Association of Professional Engineers and Geoscientists, in the territory of Nunavut, (Reg. #L3360) and graduated with a degree in Master of Science, Geology from Lakehead University in 1998.

From 1996 to the present I have been actively employed as a Geologist in the areas of exploration, production geology and resource estimation.

- I have been employed as Vice President, Exploration and Geoscience for TMAC Resources Inc since May 2013.
- From March 2012 to May 2013 I was employed as Senior Manager, Geoscience and Mineral Resources with KGHM International.
- From June 2010 to March 2012 I held a similar position as Senior Manager, Geoscience and Mineral Resources with Quadra FNX Mining.
- From February 2002 to June 2010 I held progressively senior positions, concluding with Manager, Geoscience and Mineral Resources with FNX Mining Inc.

I last personally inspected the Hope Bay site in February 2020 and spent considerable time at Hope Bay each year since May 2013.

I am responsible for sections 4, portions of 5, 6-12, 14, 23 and portions of 25 and 26 of the Technical Report.

I have read the definition of "qualified person" set out in National Instrument 43–101 Standards of Disclosure for Mineral Projects ("NI 43-101") and certify that by reason of my education, affiliation with a professional association (as defined in NI 43-101) and past relevant work experience, I am a "qualified person".

I have read NI 43-101 and Form 43-101F1, and the sections in the report that I am responsible for within the Technical Report has been prepared in compliance with that instrument.

I am not independent of the issuer, TMAC Resources Inc., applying all of the tests in Section 1.5 of NI 43-101, as a result of my employment with TMAC Resources Inc.

As at the effective date of the Technical Report, to the best of my knowledge, information and belief, the Technical Report contains all scientific and technical information that is required to be disclosed to make the Technical Report not misleading.

Dated this 30th day of March 2020 in Toronto, Ontario.

"Signed"

David M. King

David M. King, P.Geo.

GILBERT J. LAWSON, P.ENG.

I, Gilbert Lawson, am a Professional Engineer, employed as Chief Operating Officer of TMAC Resources Inc. located at Suite 300, 181 University Avenue, Toronto, ON, Canada M5H 3M7 and reside at 55 Bremner, Toronto, Ontario.

I am a co-author of a technical report entitled "NI 43-101 Technical Report on the Hope Bay Property, Nunavut, Canada" dated March 27th, 2020 prepared for TMAC Resources Inc. ("The Technical Report").

I am registered as a Professional Engineer in the Province of Ontario (Reg. #90291683) and graduated with a degree from McGill University, Montreal, Quebec, Canada in 1986 with a Bachelor of Engineering (Mining).

I have worked as a mining engineer for a total of 34 years since my graduation. My relevant work experience for the purpose of this technical report is:

- COO of TMAC Resources with overall responsibility for all aspects of operations
- V.P. of Technical for a large gold mining company responsible as Qualified Person for this corporation operating over 9 large scale operations domestically and internationally
- GM of two underground mining operations in Canada
- Multiple senior technical and operational roles within the Canadian underground mining arena and mineral project studies

I last personally inspected the Hope Bay Property in January 2020 and spent over 100 days on the site in 2019.

I am responsible for overall preparation of the Technical Report and I am responsible for sections 1-3, 19, 20, 22, 25 and 26.

I have read the definition of "qualified person" set out in National Instrument 43–101 Standards of Disclosure for Mineral Projects ("NI 43-101") and certify that by reason of my education, affiliation with a professional association (as defined in NI 43-101) and past relevant work experience, I am a "qualified person".

I have read NI 43-101 and Form 43-101F1, and the sections in the report that I am responsible for within the Technical Report has been prepared in compliance with that instrument.

I am not independent of the issuer, TMAC Resources Inc., applying all of the tests in Section 1.5 of NI 43-101, as a result of my employment with TMAC Resources Inc.

As at the effective date of the Technical Report, to the best of my knowledge, information and belief, the Technical Report contains all scientific and technical information that is required to be disclosed to make the Technical Report not misleading.

Dated this 30th day of March 2020 in Toronto, Ontario.

"Signed"

Gilbert J. Lawson

Gilbert Lawson P.Eng.

APPENDIX 1. GENERAL ARRANGEMENT DRAWINGS

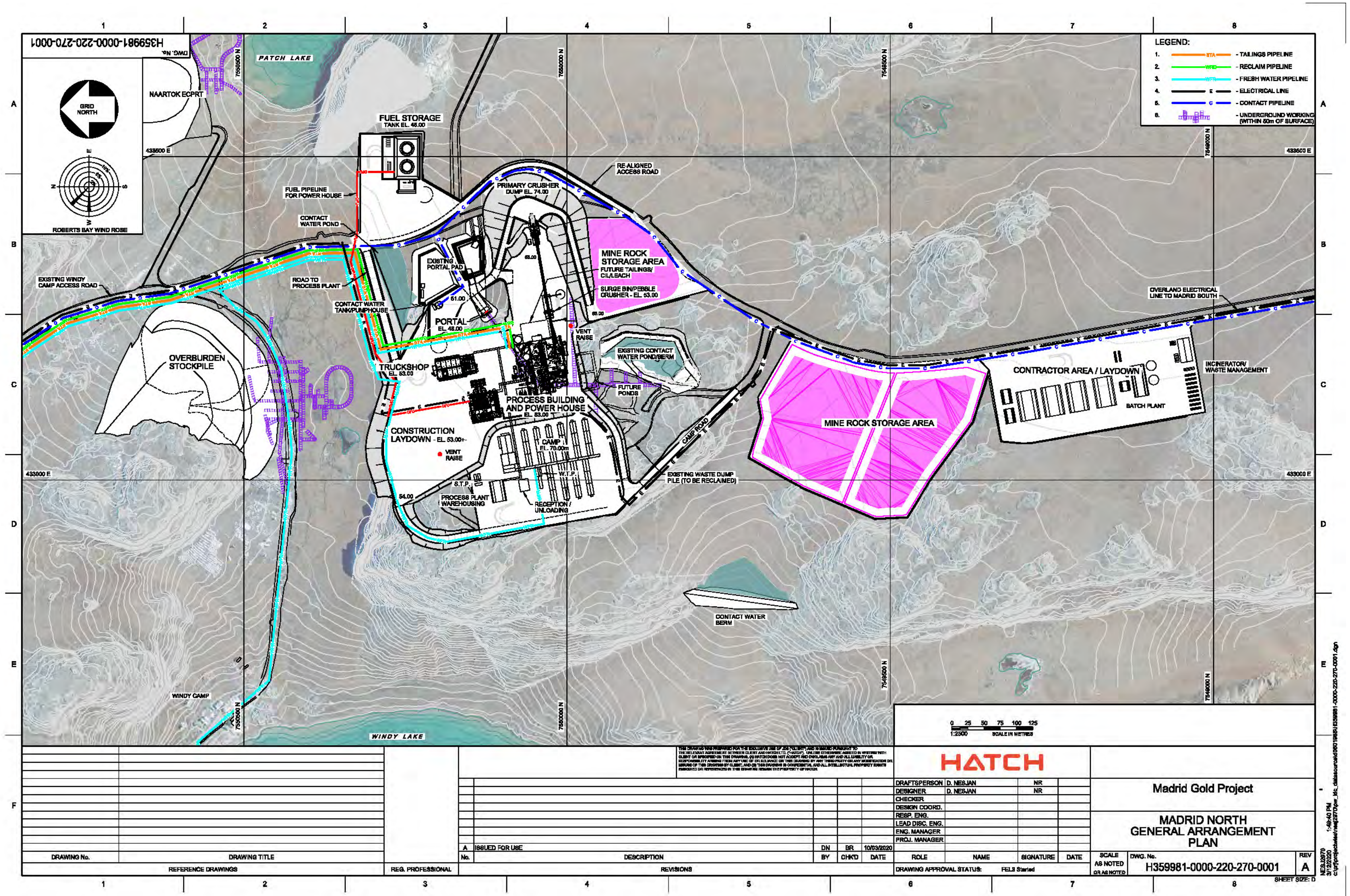


Figure A1-1. Madrid North General Arrangement Plan

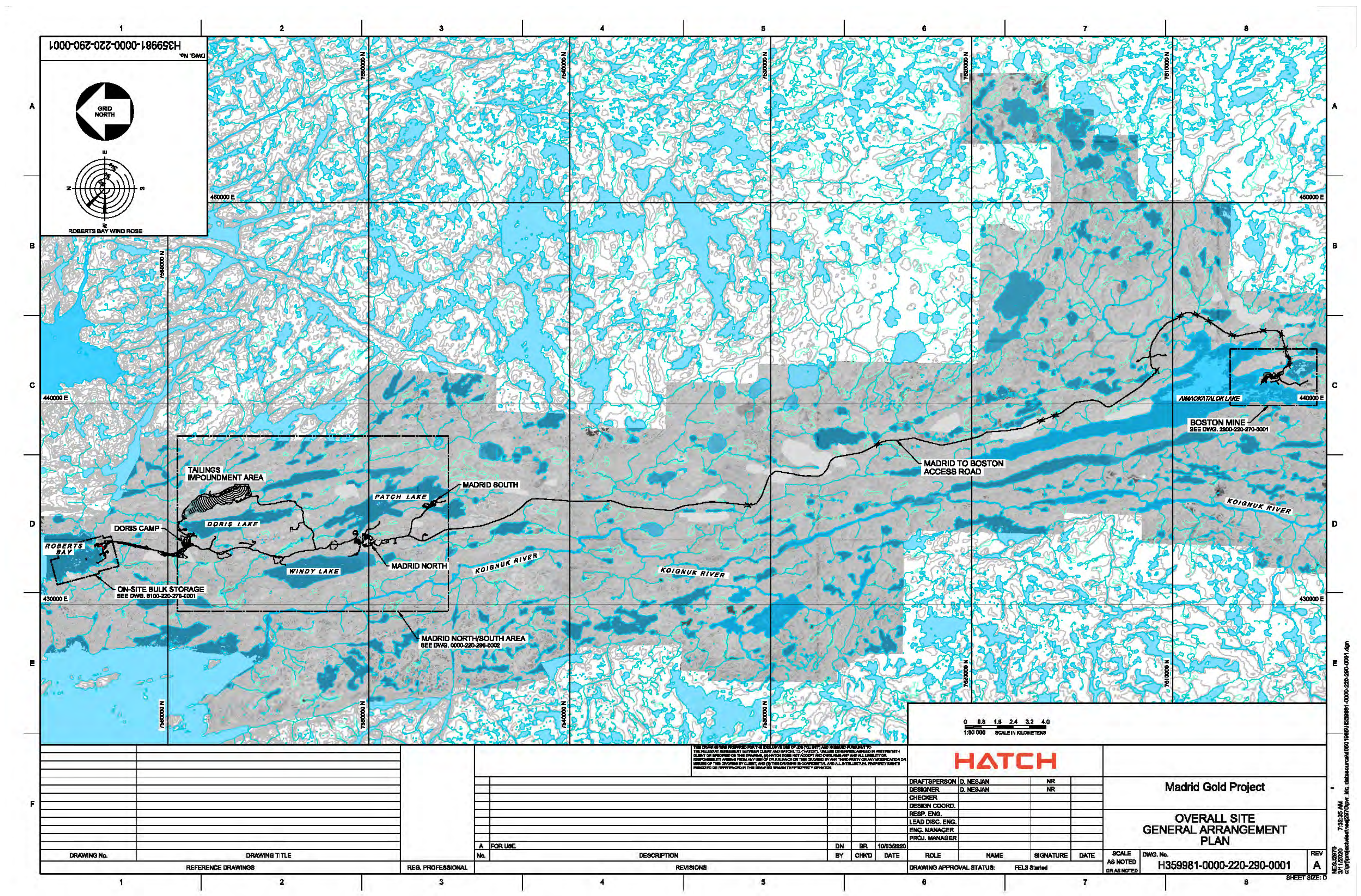


Figure A1-2. Overall Site General Arrangement Plan

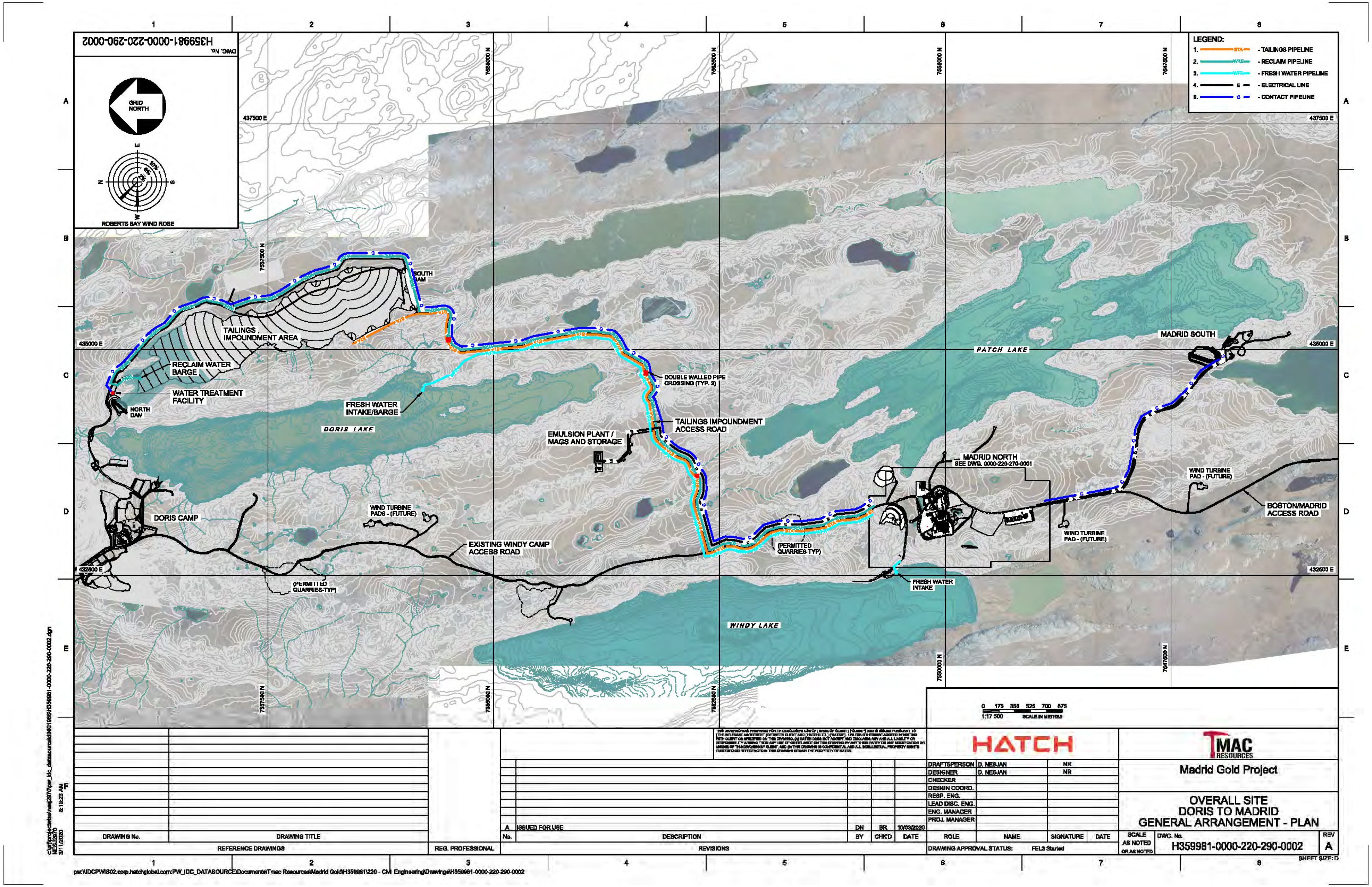


Figure A1-3. Overall Site Doris to Madrid General Arrangement - Plan

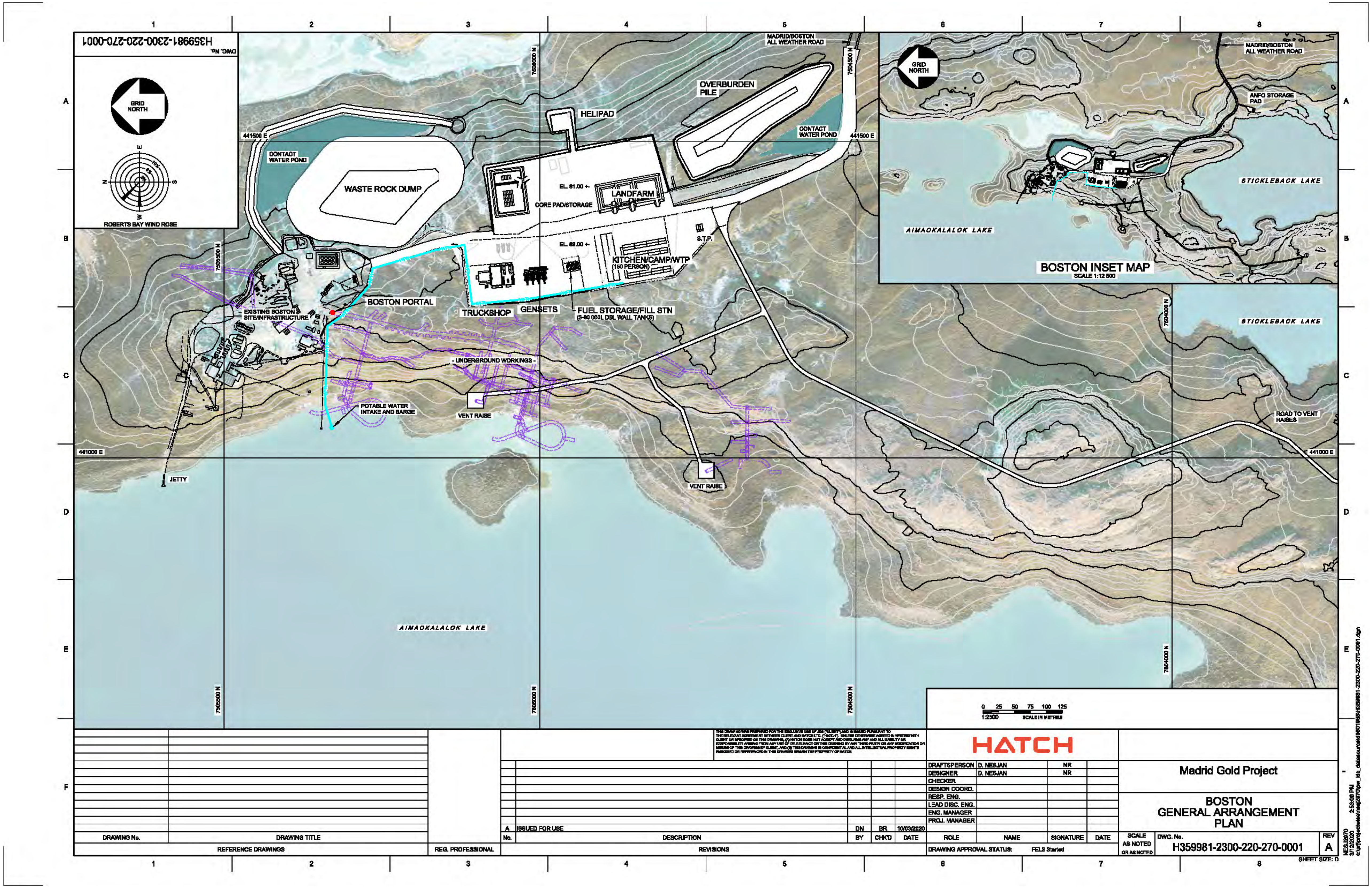


Figure A1-4. Boston General Arrangement Plan

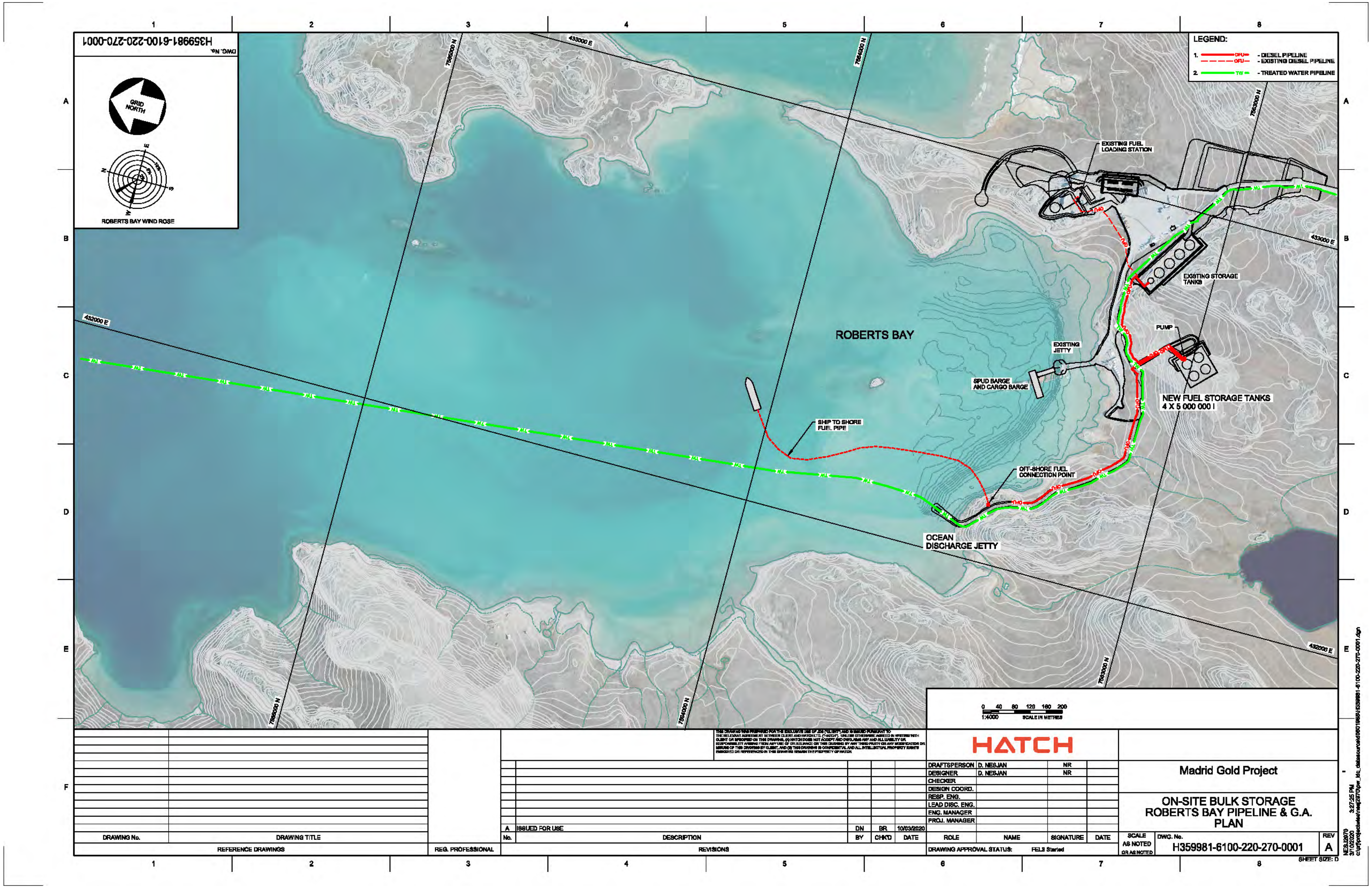


Figure A1-5. On-Site Bulk Storage Roberts Bay Pipeline & G.A. Plan

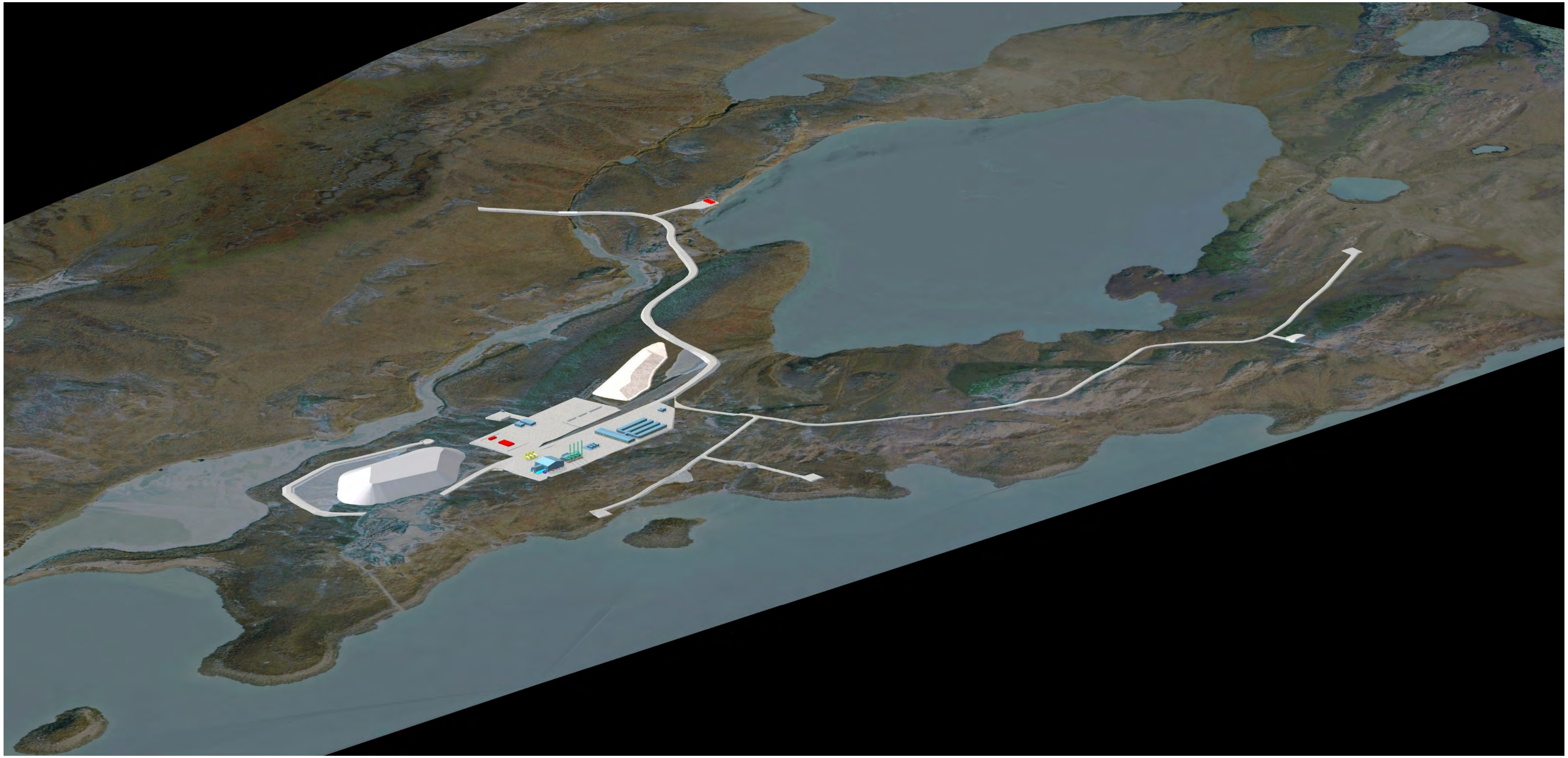


Figure A1-6. Boston 3D Rendered Image

Figure A1-7. Madrid 3D Rendered Image 1

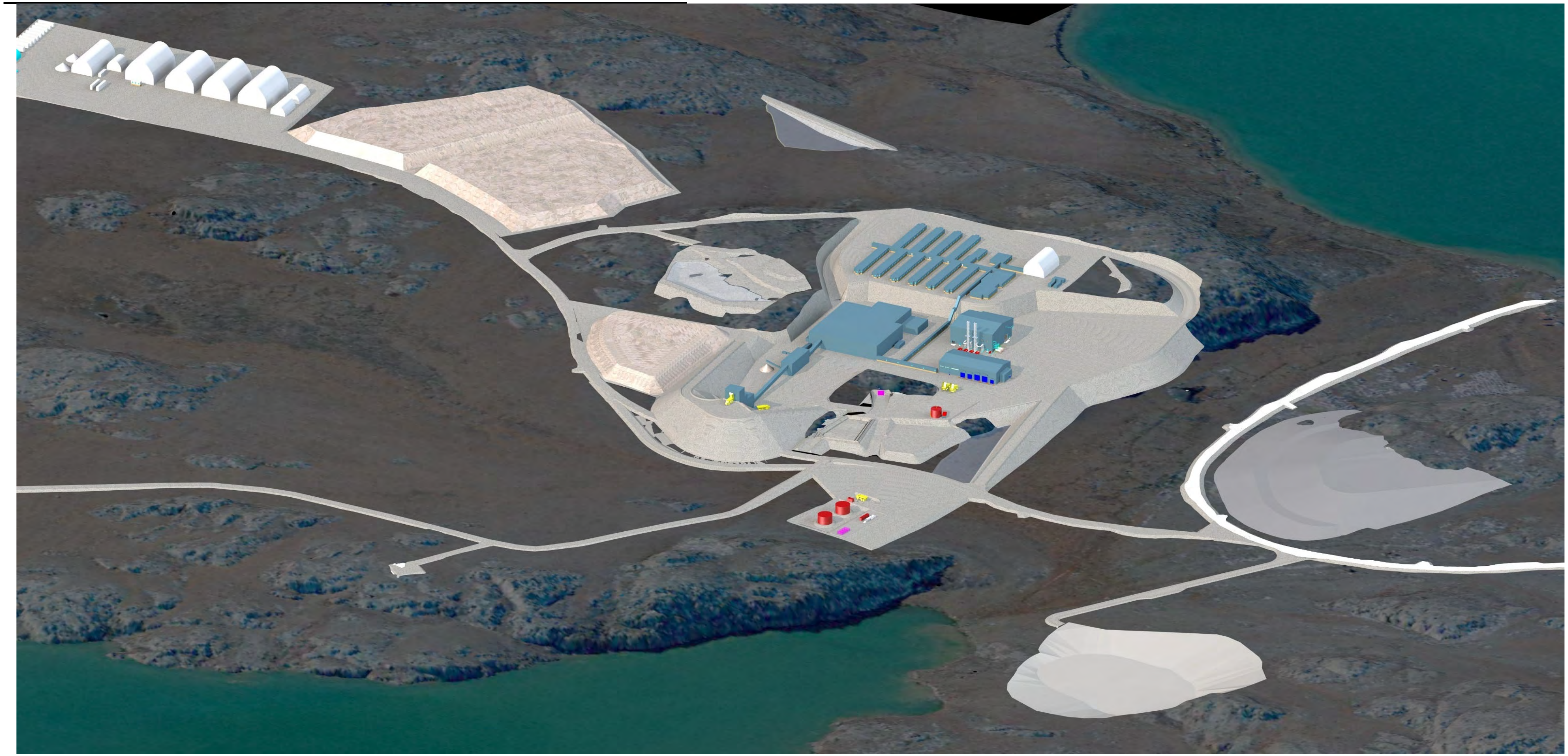


Figure A1-8. Madrid 3D Rendered Image 2

APPENDIX 2. SCHEDULE OPTIONS

Table A2-1. Schedule Options

Option	Selection
Use Expected Finish Dates	Yes
When scheduling progressed activities use	Retained Logic
Define Critical Activities as	Total Float Less than or Equal to 0h
Compute Total Float as	Finish Float = Late Finish – Early Finish
Calendar for scheduling Relationship Lag	Predecessor activity calendar
Calculate multiple float paths	Yes

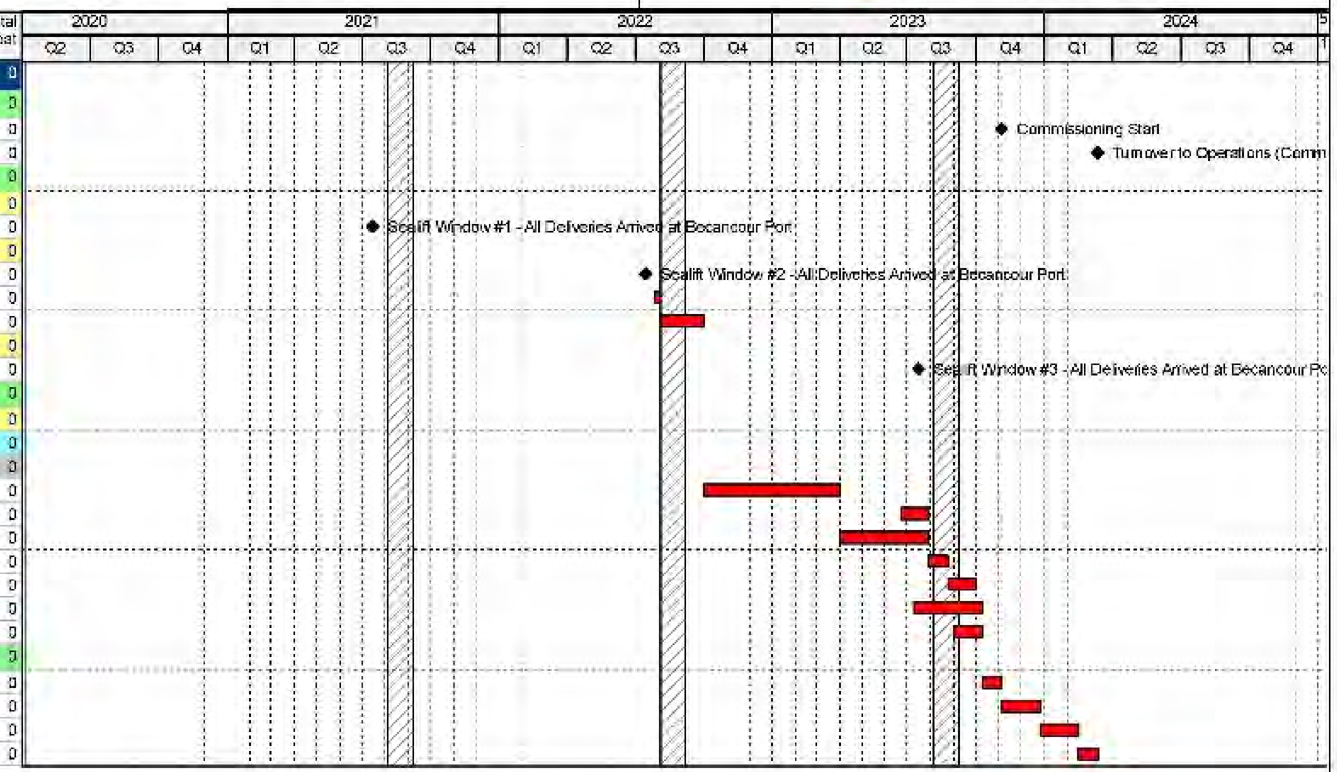
APPENDIX 3. CRITICAL PATH SCHEDULE

TMAC Resources

Madrid Project Critical Path Schedule

OPTIMIZE GROUP

Activity ID	Activity Name	Remaining Duration	Start	Finish	Total Float
	TMAC - Madrid Gold Project - Level 2 Execution Schedule	692	15-Jul-21	12-Mar-24	0
	Project Milestones	70	04-Nov-23	12-Mar-24	0
A4870	Commissioning Start	0	04-Nov-23		0
A4940	Turnover to Operations (Commissioning Complete)	0		12-Mar-24*	0
	Transportation & Logistics	521	15-Jul-21	15-Jul-23	0
	Sealift Window #1	0	15-Jul-21	15-Jul-21	0
A4990	Sealift Window #1 - All Deliveries Arrived at Becancour Port	0		15-Jul-21*	0
	Sealift Window #2	54	15-Jul-22	30-Sep-22	0
A5050	Sealift Window #2 - All Deliveries Arrived at Becancour Port	0		15-Jul-22*	0
A5060	Sealift Window #2 - Vessel Loading	4	27-Jul-22	04-Aug-22	0
A5070	Sealift Window #2 - Transportation Window to Site	31	04-Aug-22	30-Sep-22	0
	Sealift Window #3	0	15-Jul-23	15-Jul-23	0
A5020	Sealift Window #3 - All Deliveries Arrived at Becancour Port	0		15-Jul-23*	0
	Construction	205	30-Sep-22	10-Oct-23	0
	Processing Plant	205	30-Sep-22	10-Oct-23	0
	Primary Communition / Screening	205	30-Sep-22	10-Oct-23	0
	SAG Mill	205	30-Sep-22	10-Oct-23	0
A8520	SAG Mill - Building Installation	100	30-Sep-22	01-Apr-23	0
A1410	SAG Mill - Steel Installation	21	21-Jun-23	29-Jul-23	0
A1430	SAG Mill - Mechanical Equipment Installation (SAG Mill)	65	01-Apr-23	29-Jul-23	0
A1420	SAG Mill - Platework Installation (Chutes, Trommel, and Pump	14	29-Jul-23	24-Aug-23	0
A1440	SAG Mill - Piping Installation	21	24-Aug-23	01-Oct-23	0
A1450	SAG Mill - Electrical Installation	50	10-Jul-23	10-Oct-23	0
A1460	SAG Mill - Instrumentation Installation	21	01-Sep-23	10-Oct-23	0
	Commissioning	84	10-Oct-23	12-Mar-24	0
A4950	C0 - Construction Verification	14	10-Oct-23	04-Nov-23	0
A4960	C1 - Dry Commissioning	28	04-Nov-23	26-Dec-23	0
A4970	C2 - Wet Commissioning	28	26-Dec-23	15-Feb-24	0
A4980	C3 - Ore Commissioning	14	15-Feb-24	12-Mar-24	0



Actual Work | Critical Remaining Work | Remaining Work | Milestone

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Data Date: 06-Apr-20

Date	Revision	Checked	Approved
13-Mar-20	Critical Path Schedule	NOC	

Figure A3 -1. Madrid Project Critical Path Schedule

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