N.I. 43-101 TECHNICAL REPORT & FEASIBILITY STUDY ON THE VALENTINE GOLD PROJECT

Newfoundland and Labrador, Canada

Effective date: April 15, 2021

Prepared for:

Marathon Gold Corporation

36 Lombard Street, Suite 600, Toronto, ON, M5C 2X3

Prepared by:

Ausenco

Qualified Persons

Mr. Paul Staples, P.Eng. – Ausenco Engineering Canada •
Mr. Robert Farmer, P.Eng. – John T. Boyd Company • Mr. Roy Eccles, P.Geo. – APEX Geoscience Ltd. •
Mr. Sheldon Smith, P.Geo. – Stantec Consulting Ltd. • Mr. Marc Schulte, P.Eng. – Moose Mountain Technical Services • Mr. Peter Merry, P.Eng. – Golder Associates Ltd. • Mr. Shawn Russell, P.Eng. &
Mrs. Carolyn Anstey-Moore, P.Geo. – GEMTEC Consulting Engineers and Scientists Ltd.

N.I. 43-101 TECHNICAL REPORT & FEASIBILITY STUDY ON THE VALENTINE GOLD PROJECT

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CERTIFICATE OF QUALIFIED PERSON

Paul Staples

I, L. Paul Staples, P. Eng., certify that I am employed as a VP and Global Practice Lead with Ausenco Engineering Canada ("Ausenco"), with an office address of 855 Homer Street, Vancouver, British Columbia, Canada, V6B 2W2. This certificate applies to the technical report titled "N.I. 43-101 Technical Report and Feasibility Study on the Valentine Gold Project," that has an effective date of April 15, 2021 (the "Technical Report").

I graduated from Queen's University, Kingston, Ontario, Canada in 1993 with a Bachelor of Science degree in Materials and Metallurgical Engineering. I am a Professional Engineer of Newfoundland and Labrador (PEGNL No. 10005). I have practiced my profession for 28 years. I have been directly involved in many similar projects in Canada and abroad.

I have read the definition of "Qualified Person" set out in the National Instrument 43-101 Standards of Disclosure for Mineral Projects ("NI 43-101") and certify that by virtue of my education, affiliation to a professional association and past relevant work experience, I fulfill the requirements to be a "Qualified Person" for those sections of the Technical Report which I am responsible for preparing.

I visited the Valentine Lake Property on February 6, 2020. I am responsible for Sections 1.1, 1.3, 1.10, 1.14, 1.15.1, 1.15.2, 1.15.4, 1.15.5, 1.17.1, 1.17.2, 1.18, 1.19.1, 1.19.4, 1.19.5, 1.19.6, 2, 5, 13, 17, 18.1 to 18.5, 18.9.2 to 18.9.5, 18.10, 19, 21 (except 21.2.2, 21.2.4, 21.3.1, 21.3.5.2, 21.4.2 and 21.4.4), 22, 23, 24, 25.7, 25.8, 25.10 to 25.12, 26.1, 26.5, 26.6, 26.7, and 27 of the Technical Report.

I am independent of Marathon Gold Corporation as independence is defined in Section 1.5 of NI 43-101. I have been involved with the Valentine Gold Project as co-author of the following technical report:

- Staples, L.P., Schulte, M., Farmer, R.J., Eccles, R., Merry, W.P.H., Smith, S., Deering, P.D., 2020: National Instrument 43-101 Technical Report & Pre-feasibility Study on the Valentine Gold Project, report prepared for Marathon Gold, effective date April 18, 2020.

I have read NI 43-101 and the sections of the Technical Report for which I am responsible have been prepared in compliance with that Instrument. As of the effective date of the Technical Report, to the best of my knowledge, information and belief, the sections of the Technical Report for which I am responsible contain all scientific and technical information that is required to be disclosed to make those sections of the Technical Report not misleading.

Dated: April 23, 2021

"Signed and sealed"

L. Paul Staples, P. Eng.

CERTIFICATE OF QUALIFIED PERSON

Robert J. Farmer

I, Robert J. Farmer, P. Eng., certify that I am employed as a Vice President with John T. Boyd Company with an office address of 4000 Town Center Boulevard, Suite 300, Canonsburg, PA, USA, 15317. This certificate applies to the technical report titled "N.I. 43-101 Technical Report and Feasibility Study on the Valentine Gold Project" that has an effective date of April 15, 2021 (the "Technical Report").

I graduated from Queen's University in Kingston, Ontario, Canada in 1994 with a Bachelor of Science in Mining Engineering. I am a registered Professional Engineer of Newfoundland and Labrador (PEGNL No. 09046). I have practiced my profession for 26 years. I have been directly involved in computerized geologic modeling, mineral resource and reserve estimation, underground and surface mine design and operations, production scheduling, and financial modeling. Deposit and mine commodity expertise includes coal, industrial minerals, base metals, and gold.

I have read the definition of "Qualified Person" set out in the National Instrument 43-101 Standards of Disclosure for Mineral Projects ("NI 43-101") and certify that by virtue of my education, affiliation to a professional association and past relevant work experience, I fulfill the requirements to be a "Qualified Person" for those sections of the Technical Report that I am responsible for preparing. I visited the Valentine Lake Property on October 29, 2019. I am responsible for Sections 1.11, 14, and 26.3 of the Technical Report.

I am independent of Marathon Gold Corporation as independence is defined in Section 1.5 of NI 43-101. I have been involved with the Valentine Gold Project as co-author of the following technical reports:

- Farmer, R.J., and Eccles, D.R. (2017): National Instrument 43-101 Technical Report Mineral Resource Estimate, Valentine Lake Gold Camp, report prepared for Marathon Gold Corporation, effective date November 27, 2017.
- Lincoln, N., Peung, R., Farmer, R.J., Eccles, D.R., and Deering, P.D. (2018): National Instrument 43-101 Technical Report, Preliminary Economic Assessment of the Valentine Lake Gold Project, Newfoundland, report prepared for Marathon Gold Corporation, effective date May 28, 2018.
- Lincoln, N., Farmer, R.J., Eccles, D.R., and Deering, P.D. (2018): National Instrument 43-101 Technical Report, Preliminary Economic Assessment of the Valentine Lake Gold Project, Newfoundland, report prepared for Marathon Gold Corporation, effective date October 30, 2018.
- Staples, L.P., Schulte, M., Farmer, R.J., Eccles, R., Merry, W.P.H., Smith, S., Deering, P.D. (2020): National Instrument 43-101 Technical Report & Pre-feasibility Study on the Valentine Gold Project, report prepared for Marathon Gold Corporation, effective date April 18, 2020.

I have read NI 43-101 and the sections of the Technical Report for which I am responsible have been prepared in compliance with that Instrument. As of the effective date of the Technical Report, to the best of my knowledge, information and belief, the sections of the Technical Report for which I am responsible contain all scientific and technical information that is required to be disclosed to make those sections of the Technical Report not misleading.

Dated: April 23, 2021

"Signed and sealed"

Robert J. Farmer, P. Eng.

CERTIFICATE OF QUALIFIED PERSON

Roy Eccles

I, Roy Eccles, P. Geo., certify that I am employed as a Senior Consulting Geologist and the Chief Operations Officer with APEX Geoscience Ltd., with an office address of #100, 11450 – 160 Street, Edmonton, Alberta, T5M 3Y7. This certificate applies to the technical report titled "N.I. 43-101 Technical Report and Feasibility Study on the Valentine Gold Project" with an effective date of April 15, 2021 (the "Technical Report").

I graduated from the University of Manitoba, in Winnipeg, Manitoba, Canada, in 1986 with a Bachelor of Science in Geology, and a Master of Science in Geology from the University of Alberta, in Edmonton, Alberta, Canada in 2004. I am a Professional Geologist with the Newfoundland and Labrador Professional Engineers and Geoscientists (PEGNL No. 08287), and with the Association of Professional Engineers and Geoscientists of Alberta (APEGA No. 74150). I have practiced my profession for 30 years. I have been directly involved in all aspects of mineral exploration, mineral research, and mineral resource estimations for metallic, industrial and specialty mineral projects and deposits in Canada. Work experience includes gold and multiple commodity projects within the Exploits sub-zone of central Newfoundland.

I have read the definition of "Qualified Person" set out in the National Instrument 43-101 Standards of Disclosure for Mineral Projects ("NI 43-101") and certify that by virtue of my education, affiliation to a professional association and past relevant work experience, I fulfill the requirements to be a "Qualified Person" for those sections of the Technical Report that I am responsible for preparing. I visited the Valentine Lake Property on October 16, 2019. I am responsible for Sections 1.2, 1.4 to 1.9, 1.19.2, 3, 4, 6, 7, 8, 9, 10, 11, 12, 25.1 to 25.5, and 26.2 of the Technical Report. I am independent of Marathon Gold Corporation as independence is defined in Section 1.5 of NI 43-101. I have been involved with the Valentine Gold Project as co-author of the following technical reports:

- Farmer, R.J., and Eccles, D.R. (2017): National Instrument 43-101 Technical Report Mineral Resource Estimate, Valentine Lake Gold Camp, report prepared for Marathon Gold Corporation, effective date November 27, 2017.
- Lincoln, N., Peung, R., Farmer, R.J., Eccles, D.R., and Deering, P.D. (2018): National Instrument 43-101 Technical Report, Preliminary Economic Assessment of the Valentine Lake Gold Project, Newfoundland, report prepared for Marathon Gold Corporation, effective date May 28, 2018.
- Lincoln, N., Farmer, R.J., Eccles, D.R., and Deering, P.D. (2018): National Instrument 43-101 Technical Report, Preliminary Economic Assessment of the Valentine Lake Gold Project, Newfoundland, report prepared for Marathon Gold Corporation, effective date October 30, 2018.
- Staples, L.P., Schulte, M., Farmer, R.J., Eccles, R., Merry, W.P.H., Smith, S., Deering, P.D. (2020): National Instrument 43-101 Technical Report & Pre-feasibility Study on the Valentine Gold Project, report prepared for Marathon Gold Corporation, effective date April 18, 2020.

I have read NI 43-101 and the sections of the Technical Report for which I am responsible have been prepared in compliance with that Instrument. As of the effective date of the Technical Report, to the best of my knowledge, information and belief, the sections of the Technical Report for which I am responsible contain all scientific and technical information that is required to be disclosed to make those sections of the Technical Report not misleading.

Dated: April 23, 2021

"Signed and sealed"

Roy Eccles, P. Geo.

CERTIFICATE OF QUALIFIED PERSON

Sheldon Smith

I, Sheldon Smith, P. Geo., certify that I am employed as a Senior Hydrologist with Stantec Consulting Ltd., with an office address of 300W-675 Cochrane Drive, Markham, Ontario, Canada, L3R 0B8. This certificate applies to the technical report titled “N.I. 43-101 Technical Report and Feasibility Study on the Valentine Gold Project” that has an effective date of April 15, 2021 (the “Technical Report”).

I graduated from Memorial University of Newfoundland in St John’s, Newfoundland, in 1994 with a Bachelor of Science (Honours) in Physical Geography, and from the University of Waterloo in Waterloo, Ontario, in 1998 with a Master of Environmental Studies. I am a Professional Geoscientist of Newfoundland and Labrador (PEGNL No. 07606). I have practiced my profession for 25 years. I have been directly involved in process operation, design and management for over 25 similar studies or projects including Vale in more than 25 locations in Canada and South America, Xstrata (Glencore), Newmont, Alderon Iron Ore, Century Iron Mines, Altius Resources, Palladin/Aurora Energy, Atlantic Gold, Trevali, Thomas Resources, Marathon Gold, Premier Gold, Greenstone Gold, Wesdome, Norcliff Resources, DeBeers, Richmont, Ontario Graphite, Northern Graphite, Ferromin Inc. and others.

I have read the definition of “Qualified Person” set out in the National Instrument 43-101 Standards of Disclosure for Mineral Projects (“NI 43-101”) and certify that by virtue of my education, affiliation to a professional association and past relevant work experience, I fulfill the requirements to be a “Qualified Person” for those sections of the Technical Report that I am responsible for preparing.

I visited the Valentine Lake Property between October 15 and 17, 2012 for a visit duration of 3 days. I am responsible for Sections 1.15.7, 1.16, 1.19.7, 1.19.9, 18.9.1, 18.9.6, 20, 26.8, and 26.10 of the Technical Report.

I am independent of Marathon Gold Corporation as independence is defined in Section 1.5 of NI 43-101. I have been involved as co-author of the following technical reports:

- Staples, L.P., Schulte, M., Farmer, R.J., Eccles, R., Merry, W.P.H., Smith, S., Deering, P.D., 2020: National Instrument 43-101 Technical Report & Pre-feasibility Study on the Valentine Gold Project, report prepared for Marathon Gold, effective date April 18, 2020.
- Stantec, 2020. Surface Water Baseline Assessment, Water Management Plan, Water Balance and Water Quality Modeling Reports, and Assimilative Capacity Assessment supporting the Federal/Provincial Environmental Impact Statement (EIS) and Chapter 7 of the EIS for the Valentine Gold Project, September. 2020.

I have read NI 43-101 and the sections of the Technical Report for which I am responsible have been prepared in compliance with that Instrument. As of the effective date of the Technical Report, to the best of my knowledge, information and belief, the sections of the Technical Report for which I am responsible contain all scientific and technical information that is required to be disclosed to make those sections of the Technical Report not misleading.

Dated: April 23, 2021

“Signed and sealed”

Sheldon Smith, P. Geo.

CERTIFICATE OF QUALIFIED PERSON

Marc Schulte

I, Marc Schulte, P. Eng., certify that I am employed as a Mining Engineer with Moose Mountain Technical Services, with an office address of #210 1510 2nd Street North, Cranbrook, British Columbia, Canada, V1C 3L2. This certificate applies to the technical report titled "N.I. 43-101 Technical Report and Feasibility Study on the Valentine Gold Project" that has an effective date of April 15, 2021 (the "Technical Report").

I graduated from the University of Alberta, in Edmonton, Alberta, Canada in 2002 with a Bachelor of Science in Mining Engineering. I am a member of the self-regulating Professional Engineers & Geoscientists of Newfoundland and Labrador (PEGNL No. 09971). I have practiced my profession for 19 years. I have been directly involved in open pit mine planning on numerous precious metals, base metals and coal mining projects, including both mine operations and evaluations.

I have read the definition of "Qualified Person" set out in the National Instrument 43-101 Standards of Disclosure for Mineral Projects ("NI 43-101") and certify that by virtue of my education, affiliation to a professional association and past relevant work experience, I fulfill the requirements to be a "Qualified Person" for those sections of the Technical Report that I am responsible for preparing.

I visited the Valentine Lake Property on October 29, 2019 for a visit duration of one day. I am responsible for Sections 1.12, 1.13, 1.17.3, 1.19.3, 15, 16, 21.2.2, 21.3.1, 21.4.2, 25.6, and 26.4 of the Technical Report.

I am independent of Marathon Gold Corporation as independence is defined in Section 1.5 of NI 43-101. I have been involved with the Valentine Gold Project as co-author of the following technical report:

- Staples, L.P., Schulte, M., Farmer, R.J., Eccles, R., Merry, W.P.H., Smith, S., Deering, P.D., 2020: National Instrument 43-101 Technical Report & Pre-feasibility Study on the Valentine Gold Project, report prepared for Marathon Gold, effective date April 18, 2020.

I have read NI 43-101 and the sections of the Technical Report for which I am responsible have been prepared in compliance with that Instrument. As of the effective date of the Technical Report, to the best of my knowledge, information and belief, the sections of the Technical Report for which I am responsible contain all scientific and technical information that is required to be disclosed to make those sections of the Technical Report not misleading.

Dated: April 23, 2021

"Signed and sealed"

Marc Schulte, P. Eng.

CERTIFICATE OF QUALIFIED PERSON
W. Peter H. Merry

I, W. Peter H. Merry, P. Eng., certify that I am employed as Principal of Golder Associates Ltd., with an office address of 6925 Century Avenue, Mississauga, Ontario, Canada, L5N 7K2. This certificate applies to the technical report titled "N.I. 43-101 Technical Report and Feasibility Study on the Valentine Gold Project," that has an effective date of April 15, 2021 (the "Technical Report").

I graduated from Queen's University, Kingston, Ontario, Canada in 2002 with a Bachelor of Science in Civil Engineering. I am a Professional Engineer of Newfoundland and Labrador (PEGNL No. 04809). I am also a P. Eng., registered in the Province of Ontario (PEO No. 100101561), and the Northwest Territories and Nunavut (NAPEG No. L2912). I have practiced my profession for 19 years. My relevant experience for the purpose of the Technical Report is:

- Principal, Golder Associates Ltd. 2017 – Present
- Associate, Golder Associates Ltd. 2001 – 2017
- Mine Waste / Geotechnical Engineer, Golder Associates Ltd. 2002 – 2011

I have read the definition of "Qualified Person" set out in the National Instrument 43-101 Standards of Disclosure for Mineral Projects ("NI 43-101") and certify that by virtue of my education, affiliation to a professional association and past relevant work experience, I fulfill the requirements to be a "Qualified Person" for those sections of the Technical Report that I am responsible for preparing.

I visited the Valentine Lake Property on October 29, 2019. I am responsible for Sections 1.15.3, 1.15.6, 1.19.8, 18.7, 18.8, 21.2.4, 21.3.5.2, 21.4.4, 25.9, and 26.9 of the Technical Report.

I am independent of Marathon Gold Corporation as independence is defined in Section 1.5 of NI 43-101. I have been involved with the Valentine Gold Project as the co-author of the following technical report:

- Staples, L.P., Schulte, M., Farmer, R.J., Eccles, R., Merry, W.P.H., Smith, S., Deering, P.D., 2020: National Instrument 43-101 Technical Report & Pre-feasibility Study on the Valentine Gold Project, report prepared for Marathon Gold, effective date April 18, 2020.

I have read NI 43-101 and the sections of the Technical Report for which I am responsible have been prepared in compliance with that Instrument. As of the effective date of the Technical Report, to the best of my knowledge, information and belief, the sections of the Technical Report for which I am responsible contain all scientific and technical information that is required to be disclosed to make those sections of the Technical Report not misleading.

Dated: April 23, 2021

"Signed and sealed"

W. Peter H. Merry, P. Eng.

GEMTEC
CONSULTING ENGINEERS AND SCIENTISTS

CERTIFICATE OF QUALIFIED PERSON
Shawn Russell

I, Shawn Russell, P. Eng., certify that I am employed as a Senior Geotechnical Engineer with GEMTEC Consulting Engineers and Scientists Limited with an office address of 10 Maverick Place, Paradise, Newfoundland and Labrador (NL), Canada, A1L 0J1. This certificate applies to the technical report titled “N.I. 43-101 Technical Report and Feasibility Study on the Valentine Gold Project” that has an effective date of April 15, 2021 (the “Technical Report”).

I graduated from Université Laval in Sainte-Foy, Quebec, Canada with a Bachelor of Applied Sciences degree in civil engineering in 1998. I am Professional Engineer of the Professional Engineers and Geologists of Newfoundland and Labrador (PEGNL No. 09684). I have practiced my profession for 20 years. I have been directly involved in civil/geotechnical engineering and design work for similar studies or projects including: Hammerdown Gold in Springdale, NL; Fort Hills Oilsands Mine, Regional Municipality of Wood Buffalo (RMWB), Alberta, CNRL Horizon Oilsands Mine, RMWB, Alberta, Syncrude Mildred Lake and Aurora Oilsands Mines, RMWB, Alberta and the Suncor Millennium and Steepbank Oilsands Mines, RMWB, Alberta.

I have read the definition of “Qualified Person” set out in the National Instrument 43-101 Standards of Disclosure for Mineral Projects (“NI 43-101”) and certify that by virtue of my education, affiliation to a professional association and past relevant work experience, I fulfill the requirements to be a “Qualified Person” for those sections of the Technical Report that I am responsible for preparing.

I visited the Valentine Lake Property on September 11, 2020. I am responsible for Sections 18.6.1 and 18.6.2 of the Technical Report.

I am independent of Marathon Gold Corporation as independence is defined in Section 1.5 of NI 43-101. I have been involved with the Valentine Gold Project as co-author of the following technical report:

- GEMTEC Consulting Engineers and Scientists Limited (GEMTEC), 2019. Limited Geotechnical Investigation, Proposed Site Development Valentine Gold Project, Draft Factual Report, Project 80018.06, Paradise, NL, CANADA.PFS level limited scope geotechnical investigation, dated December 2, 2019 (GEMTEC, 2019)

I have read NI 43-101 and the sections of the Technical Report for which I am responsible have been prepared in compliance with that Instrument. As of the effective date of the Technical Report, to the best of my knowledge, information and belief, the sections of the Technical Report for which I am responsible contain all scientific and technical information that is required to be disclosed to make those sections of the Technical Report not misleading.

Dated: April 23, 2021

“Signed and sealed”

Shawn Russell, P. Eng.

CERTIFICATE OF QUALIFIED PERSON

Carolyn Anstey-Moore

I, Carolyn Anstey-Moore, P. Geo., certify that I am employed as a Senior Environmental Geoscientist with GEMTEC Consulting Engineers and Scientists Limited, with an office address of 10 Maverick Place, Paradise, Newfoundland and Labrador, Canada, A1L 0J1. This certificate applies to the technical report titled "N.I. 43-101 Technical Report and Feasibility Study on the Valentine Gold Project" that has an effective date of April 15, 2021 (the "Technical Report").

I graduated from Memorial University of NL in 1987 with a B.Sc. (Hons) in Geology; from the University of Toronto in 1992 with a M.Sc. in Geology; and from Memorial University of NL in 2003 with a M.A.Sc. in Environmental Engineering. I am a Professional Geoscientist of Newfoundland and Labrador (PEGNL No. 04085). I have practiced my profession for 25 years. I have been directly involved in hydrogeological characterization studies for similar mine and industrial development projects, including: Maritime Resources Hammerdown Gold Project, NL; Kutcho Copper Mine Project, BC; Century Iron Mines Joyce Lake Iron Ore Project, NL; Atlantic Minerals Lower Cove Expansion Project, NL; Alderon Iron Ore Kami Project, NL; and Husky Energy White Rose Extension Graving Dock Development, NL.

I have read the definition of "Qualified Person" set out in the National Instrument 43-101 Standards of Disclosure for Mineral Projects ("NI 43-101") and certify that by virtue of my education, affiliation to a professional association and past relevant work experience, I fulfill the requirements to be a "Qualified Person" for those sections of the Technical Report that I am responsible for preparing.

I visited the Valentine Lake Property between July 12 and 14, 2020 for a visit duration of 2 days. I am responsible for Section 18.6.3 of the Technical Report.

I am independent of Marathon Gold Corporation as independence is defined in Section 1.5 of NI 43-101. I have had no previous involvement with the Valentine Gold Project.

I have read NI 43-101 and the sections of the Technical Report for which I am responsible have been prepared in compliance with that Instrument. As of the effective date of the Technical Report, to the best of my knowledge, information and belief, the sections of the Technical Report for which I am responsible contain all scientific and technical information that is required to be disclosed to make those sections of the Technical Report not misleading.

Dated: April 23, 2021

"Signed and sealed"

Carolyn Anstey-Moore, P. Geo.

Important Notice

This report was prepared as National Instrument 43-101 Technical Report for Marathon Gold Corporation (Marathon Gold) by Ausenco Engineering Canada (Ausenco), Moose Mountain Technical Services (Moose Mountain), John T. Boyd Company (BOYD), APEX Geoscience Ltd. (APEX), Golder Associates Ltd. (Golder), Stantec Consulting Ltd. (Stantec), and GEMTEC Consulting Engineers and Scientists Ltd. (GEMTEC), collectively the Report Authors. The quality of information, conclusions, and estimates contained herein is consistent with the level of effort involved in the Report Authors' services, based on i) information available at the time of preparation, ii) data supplied by outside sources, and iii) the assumptions, conditions, and qualifications set forth in this report. This report is intended for use by client abbreviation subject to terms and conditions of its contracts with each of the Report Authors. Except for the purposed legislated under Canadian provincial and territorial securities law, any other uses of this report by any third party is at that party's sole risk.

1 Summary

1.1 Overview

This report was prepared by Ausenco Engineering Canada Inc. (Ausenco) for Marathon Gold to summarise the results of the N.I. 43-101 Technical Report and Feasibility Study on the Valentine Gold Project. The report was prepared in compliance with the Canadian disclosure requirements of National Instrument 43-101 (N.I. 43-101) and in accordance with the requirements of Form 43-101 F1.

The N.I. 43-101 responsibilities of the engineering consultants are as follows:

- Ausenco was commissioned by Marathon Gold to manage and coordinate the work related to the N.I. 43-101. Ausenco also managed the metallurgical testwork, and developed the feasibility-level design and cost estimating of the process plant and surface infrastructure.
- John T. Boyd Company (BOYD) was commissioned to complete the mineral resource estimates.
- APEX Geoscience Ltd. (APEX) was commissioned to review the geological information including verification of drilling and the sample preparation and analyses for use in the mineral resource estimate.
- Stantec Consulting Ltd. (Stantec) was commissioned to support environmental planning, assessment, licensing, and permitting, as well as the feasibility-level design and bulk material estimates of the water management structures.
- Moose Mountain Technical Services (Moose Mountain) was commissioned to design the open pit mine plan, mine production schedule, and mine capital and operating costs.
- Golder Associates Ltd. (Golder) was commissioned to complete the feasibility-level design and bulk material estimates of the tailings management facility (TMF) and polishing pond.
- GEMTEC Consulting Engineers and Scientists Ltd. (GEMTEC) was commissioned to perform site-wide geotechnical and hydrogeological investigations.

1.2 Property Description

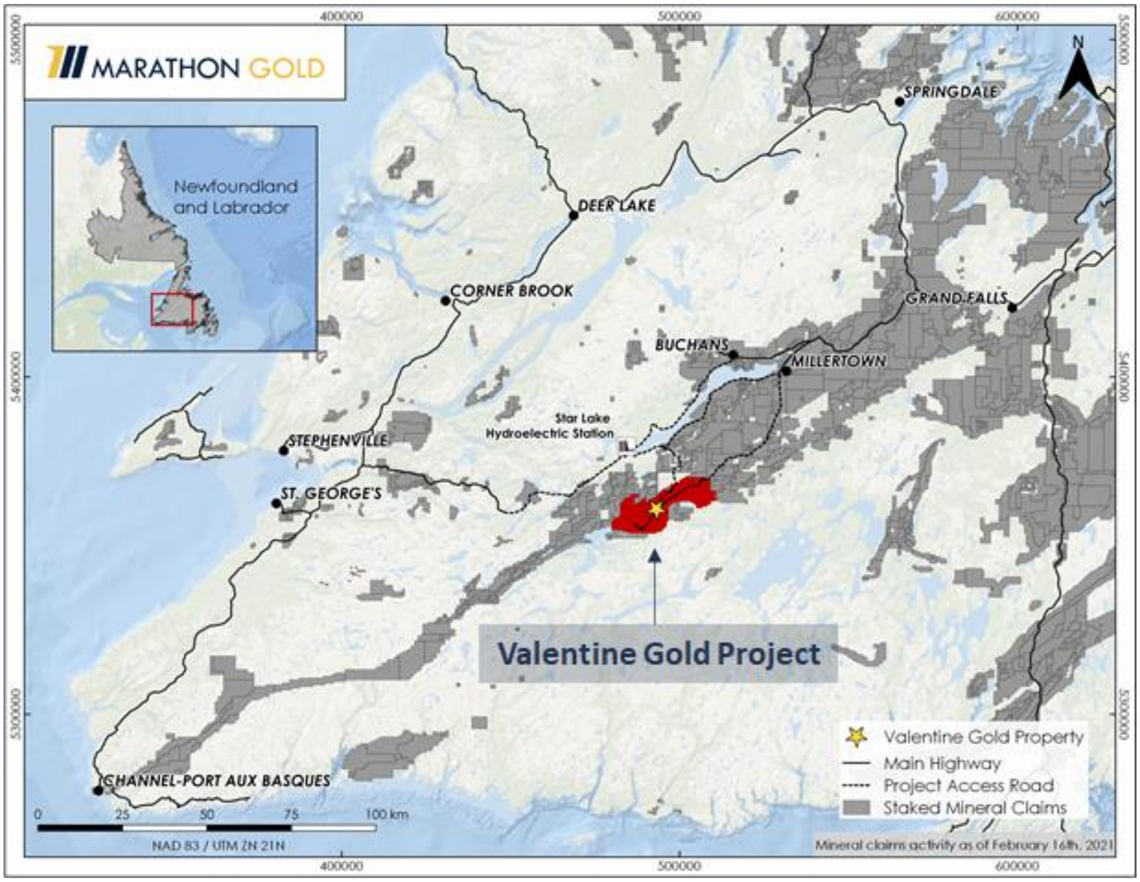
The Valentine Lake property is in the west-central region of the island of Newfoundland, Canada (Figure 1-1). The property is 100% owned by Marathon Gold and hosts five gold deposits, namely Leprechaun, Marathon, Sprite, Victory and Berry, and several other early-stage gold prospects. The collective deposits and occurrences occur within a 20 km long northeast-trending zone known as the Valentine Gold Project.

1.3 Accessibility, Climate, Local Resources, Infrastructure & Physiography

Access to the property is by existing roads, nominally the 84 km gravel road from the Town of Millertown. Using the Trans-Canada Highway and the Buchans Highway, Millertown can be accessed by paved road. The project is situated in between two major waterbodies, Valentine Lake and Victoria Reservoir. Local climate is “temperate maritime”, which means it has typically mild summers and cold winters. The weather station at Buchans shows an annual average precipitation of 1,100 mm, of which slightly more than one-fourth falls as snow with up to 1 m or more of accumulation.

Regarding temperatures, the historical average summer temperature is 14°C, and average winter temperature is -6°C. At times, short-term extreme temperatures can be observed at the project site, which have been accounted for in the project design, for a winter minimum of -26°C and the summer maximum temperature of 30°C.

Figure 1-1: Island of Newfoundland & Location of the Valentine Gold Project



Source: Marathon Gold, 2020.

1.4 History

The property has historically been explored by several companies since the 1960s (Table 1.1). The region was originally investigated for base metals by ASARCO Inc., and Hudson's Bay Oil and Gas Company; this exploration was consistent with historically significant base metal discoveries in the Dunnage Zone (e.g., Buchan's and Duck Pond-Boundary Cu-Zn±Au past-producing deposits).

The Valentine Lake property was first recognised as a gold prospect by Abitibi Price Inc. (Abitibi) in 1983 and was acquired by BP Canada Inc. (BP) in 1985. BP identified gold prospects at Leprechaun and Victory deposits (Victory was formerly known as Valentine East). Noranda Inc. (Noranda) acquired the property from BP in 1992, prior to entering into a joint venture agreement with Mountain Lake Resources Inc. (MOA) in 1998. Between 1998 and 2007, MOA and Richmont Mines Inc. (Richmont) conducted exploration programs focused on the Leprechaun and Valentine

East zones and drilled exploratory holes elsewhere along the 20 km long mineralised trend including the Sprite (formerly called Osprey) prospect. In 2009, MOA entered into an option and joint venture agreement with Marathon PGM Corporation. In 2010, the gold properties held by Marathon PGM Corporation, including the Valentine Lake property, were spun out into a new company, Marathon Gold Corp. (Marathon Gold), which commenced trading in December 2010. Marathon Gold acquired a 100% interest in the Valentine Lake property in July 2012.

Between 2010 and present, Marathon Gold conducted systematic exploration programs to explore historic prospects within the property and discovered numerous additional zones of mineralisation along the project trend. Marathon Gold subsequently discovered the Marathon, Sprite, and Berry deposits and has significantly expanded the known extents of mineralisation at the Leprechaun and Victory deposits. Additional early-stage exploration targets were identified by Marathon Gold along the 20 km mineralised trend—this includes the Frank, Rainbow, Triangle, Victoria Bridge, Narrows, Victory SW, and Victory NEoccurrences.

Table 1.1: Summary of Ownership History

Date	Operator
1960s	ASARCO Inc.
1970s to 1983	Hudson's Bay Oil and Gas Company
1983-1985	Abitibi Price Inc.
1985-1992	BP Canada Inc.
1992-1998	Noranda Inc.
1998-2003	Mountain Lake Resources Inc.
2003-2007	Richmont Mines Inc.
2007-2009	Mountain Lake Resources Inc.
2009-2010	Marathon PGM Corporation
2010-Present	Marathon Gold Corporation

1.5 Geology & Mineralisation

The Valentine Lake property is located within the Exploits Subzone of the Dunnage tectonostratigraphic zone of Central Newfoundland, part of the Newfoundland Appalachian system. Gold mineralisation within the Dunnage Zone is correlated with late syn- to post-Salinic orogenic events and is typically spatially related to major structural features and proximal to, or hosted within, intrusive bodies.

The gold deposits at the Valentine Lake property are hosted primarily by the Neoproterozoic Valentine Lake Intrusive Complex, which occurs proximal to the contact between the Victoria Lake Supergroup to the northwest and the Silurian (or younger) Rogerson Lake Conglomerate to the southeast. This contact correlates with a NE-SW lithotectonic boundary, the Valentine Lake Shear Zone, which is characterised by localised shearing and faulting and was previously described as exhibiting sinistral reverse transpressive deformation corelated with the Salinic (450-423 Ma) Appalachian Orogenic event.

The Valentine Lake Intrusive Complex comprises an elongate northeast-trending body of igneous rocks consisting of dominantly fine- to medium-grained trondhjemite and quartz-eye porphyry units with lesser aphanitic quartz porphyry, gabbro, and minor pyroxenite units. The Rogerson Lake Conglomerate occurs as a narrow linear unit that extends for approximately 160 km and lies unconformably (overturned) on the southeast margin of the Valentine Lake Intrusive Complex. The conglomerate is interpreted to have infilled a fault-bounded paleo-topographic depression. The entire project area is overlain by glacial till between 1 and 5 m thick, as well as boggy areas and ponds, with bedrock exposure along a ridge trending northeast-southwest through the property and in stream beds.

Regional metamorphism in the Valentine Lake area ranges from lower to upper greenschist facies with the higher grades in the southern portion of the property. Deformation of the Valentine Lake Intrusive Complex is ductile transitioning to late-stage brittle deformation. The Rogerson Lake Conglomerate exhibits a strongly developed pervasive foliation, isoclinal folding and flattened primary clasts indicative of a pure shear crustal shortening regime.

Recent project scale structural investigations by Terrane Geosciences Inc. for Marathon, and more regionally by the Geological Survey of Canada, has established a geotectonic chronology for the deformation within the project area. Five phases of deformation are recognised. A penetrative ductile fabric associated with initiation of the Valentine Lake Shear Zone during an initial D1 crustal shortening phase is characterised by a strong S1 foliation and L1 stretching lineation. These fabrics are observed in both the Rogerson Lake Conglomerate and in the Valentine Lake Intrusive Complex, with a SW strike and steep dip to the NW, paralleling the larger structure. Gold mineralisation occurs in Quartz-Tourmaline-Pyrite (QTP) vein sets developed within the Valentine Lake Intrusive Complex correlated with a D3 phase of renewed crustal shortening following a period of regional D2 relaxation. Overprinting fabrics include a late D4 crenulation fabric and a D5 brittle fault set.

The QTP-Au veining has been identified in prospecting samples, outcrop, trenching and drilling at numerous locations along the 20 km strike extent of the Valentine Lake Intrusive Complex and Valentine Lake Shear Zone within the Valentine Lake property. Significant QTP-Au veining occurs dominantly within the trondhjemite, quartz-eye porphyry and lesser mafic dike units along and proximal to the sheared contact with the Rogerson Lake conglomerate. Minor amounts of gold-bearing QTP veining extends across the Valentine Lake Shear Zone contact and into the Rogerson Lake Conglomerate.

The gold mineralisation at the Valentine Lake property occurs as structurally controlled, orogenic gold deposits consisting dominantly of en-echelon stacked SW dipping extensional vein sets (Set 1) and lesser shear parallel vein sets (Set 2) proximal to the VLSZ. This style of mineralisation occurs intermittently along the defined strike length of the main gold zone in which a series of deposits and occurrences have been, and continue to be, discovered. Discoveries to date include the Marathon, Leprechaun, Sprite, Victory and Berry gold deposits, and the Frank, Rainbow, Steve, Scott, Triangle, Victoria Bridge, Narrows, Victory SW, and Victory NE occurrences.

At the deposit scale, a pervasively altered, intensely QTP-veined core complex, which is referred to by Marathon Gold as the “Main Zone”, has been delineated at the Marathon, Leprechaun and Berry deposits. The Main Zones of the Marathon and Leprechaun deposits are well defined by thorough outcrop investigation and densely spaced subsurface drillhole information. At Leprechaun, the Main Zone transitions into the associated hanging wall and footwall mineralisation. Further exploration work is required at the other deposits and occurrences to determine if the Main Zone model is present at these locales.

Individual QTP-Au veins range in thickness from a few millimetres and centimetres to metres but are typically 2 to 30 cm thick. The Set 1 extensional and Set 2 shear-parallel QTP-Au veins are up to 1.5 m thick and have been traced in trenched outcrop exposures for over 280 m of continuous strike length; however, the observed strike length of individual veins is typically in the range of metres to tens of centimetres. Up to three separate vein sets have been identified at the Leprechaun and Marathon deposits, and up to four vein sets at the Berry deposit. Set 1 QTP-Au veins developed within brittle extensional fractures dipping at a low angle to the southwest are the dominant mineralisation style at the property. The QTP-Au veins represent the principal structural control on gold mineralisation in the mineral resource models for the Marathon, Leprechaun, Sprite, Victory and Berry deposits.

Visible gold in the QTP veins occurs as grains, ranging in size from <0.1 mm and up to 1-2 mm, hosted by quartz, tourmaline masses, within and along the margins of coarse cubic pyrite, or associated with minor tellurides. Highest gold grades are commonly associated with large (1 to 3 cm) cubic pyrite within the QTP veining.

The relationship between high-grade gold mineralisation and the location of the dykes supports the theory that the mafic dykes provide a rheologic contrast that (1) promotes brittle fracturing of the granitoid unit and therefore, acts as a controlling factor of mineralised fluid flow, and (2) incites the eventual emplacement of zones of gold enrichment.

The detailed geological work completed by Marathon Gold adds confidence to the continuity of the high-grade mineralised zones at Marathon and Leprechaun, and to the overall mineralisation model in which the Set 1 QTP-Au veins represent the principal structural control on gold mineralisation at the Valentine Lake property. This information has been integrated into the resource modelling and estimations presented in this technical report.

1.6 Deposit Type

In central Newfoundland, numerous examples of mesozonal to epizonal orogenic gold mineralising systems are spatially related to vein-hosted gold in association with crustal-scale fault zones and faults, late orogenic timing and possible wall rock alteration as manifested by extensive carbonate alteration.

The Valentine Lake property hosts a structurally controlled, mesothermal gold deposit associated with Salinic aged crustal shortening and deformation. Gold mineralisation is developed within QTP vein sets associated with brittle-ductile deformation of granitoid rocks of the Neoproterozoic Valentine Lake Intrusive Complex in contact with the Silurian Rogerson Lake Conglomerate. This contact is formed by the Valentine Lake Shear Zone, a major crustal-scale, NE-SW lithotectonic boundary.

Set 1 QTP-Au veins developed within brittle extensional fractures dipping at a low angle to the SW represent the dominant mineralisation style at the property. These represent the principal structural control on gold mineralisation in the mineral resource models for the Marathon, Leprechaun, Sprite, Victory and Berry deposits.

1.7 Exploration

Between 2010 and present, Marathon Gold has conducted a systematic exploration program to follow up on historic prospects within the Valentine Gold Property at what are now referred to as the Leprechaun and Victory deposits, and to discover additional zones of mineralisation along the project’s mineralised trend. This work includes geological mapping; litho-geochemical grab and channel sampling; ground geophysical surveying (induced polarisation, magnetic, and seismic); and drilling and metallurgical processing. Marathon Gold subsequently discovered the Marathon, Sprite and Berry deposits. Subsequent work has significantly expanded the known extents of mineralisation at all five gold deposits. Additional early-stage exploration targets were identified by Marathon Gold along the 20 km mineralised trend including the Frank, Rainbow, Triangle, Victoria Bridge, Narrows, Victory SW and Victory NE occurrences.

The results of the detailed mapping, litho-geochemistry, and petrographic studies were used to prepare detailed geological maps for each deposit area. Detailed prospecting, grab rock samples and channel sampling, in conjunction with geological mapping, have assisted Marathon Gold with prioritising drill targets for follow-up exploration. Geophysical data supports a complex structural geological association at the deposit areas. Distinct structural splays associated with the Valentine Lake Shear Zone and late-stage brittle fault offsets of the regional structural fabric are evident in the magnetic data and provide structural context for the exploration. Mineralisation at these deposits also appears spatially associated with areas of low magnetic intensity, interpreted to result from the potential magnetite destructive sericite alteration associated with the QTP vein arrays.

1.8 Drilling

Between 2010 and present, Marathon Gold has drilled 1,502 diamond drillholes totalling 339,044.25 m. The majority of the subsurface drillhole information has been concentrated at the Marathon and Leprechaun deposits followed by Sprite, Victory and Berry deposits, and the Frank, Rainbow, Triangle, Narrows, Victory SW and Victory NE occurrences, and the Scott and Steve zones.

Drilling was conducted using wireline double tube barrels that produced NQ size core. Drilling includes sub-vertical and inclined holes to accommodate the dip of the mineralised shallow-dipping stacked extensional vein and steeply dipping fault-filled shear vein domains. Exploration drilling has been conducted on nominal 100 m spaced lines with 30 m spaced holes, closing to 25 m x 25 m and up to 10 to 15 m drill centres at the Marathon and Leprechaun deposits. All drillholes undergo downhole surveys to obtain drillhole deviation data. Consequently, the relationship between the sample length and the true thickness of the mineralisation is well documented, and all assay sample intervals are given as core length unless noted as true thickness.

Geotechnical logging by Marathon Gold geologists included a description of the fractures, including number of fractures, fracture index, type and roughness, alteration, and core recovery. Drill core recovery is excellent, averaging 95%, and there is no evidence of bias between core recovery and assayed gold grade. Drill core samples were taken from half cut core, except in rare zones of intense fracturing where the core was split manually. Sample intervals were nominally taken at 1 m intervals in mineralised zones and 2 m intervals in barren zones.

During 2019, infill drilling efforts at the Marathon deposit focused on drilling the central core of the deposit as well as drilling along the northeastern and southwestern flanks of open pit shell. Most infill drillholes were designed to intersect the shallow southwest-dipping, en-echelon stacked gold-bearing quartz-tourmaline-pyrite veins that characterise the dominant veining of the main zone. These holes were successful in further demonstrating the continuity of gold mineralisation both along strike and at depth and further validating the geological model being used for the Marathon deposit.

The focus of the 2019 summer infill drilling campaign at the Leprechaun deposit was directed toward converting inferred mineral resources into measured and indicated mineral resources and further confirming the continuity of the gold mineralisation in the main zone. Overall, the drilling campaign was successful in increasing the width of the main zone and adding confidence to the continuity of the high-grade mineralised zone.

The results of the 2019 infill and exploratory drilling campaigns at the Marathon and Leprechaun deposits resulted in the conversion of a portion of the current resources into a higher level of resource category and outlined additional mineral resources. Strategic drilling through the main mineralised zones at high angle to the extensional QTP-gold veining greatly increased the confidence in the vertical and lateral continuity of the higher-grade gold mineralisation in the Marathon and Leprechaun deposits.

No new exploration drilling at the Marathon and Leprechaun deposits has been completed since the end of the 2019 infill drill program. Exploration drilling during 2020 and the first quarter of 2021 has focussed on areas of new discovery, such as the Berry deposit and the Narrows occurrence.

1.9 Sample Preparation & Data Verification

The QP has reviewed the sample preparation, analyses, and security procedures and found no significant issues or inconsistencies that would cause one to question the validity of the data. The QP is satisfied with the adequacy of the procedures implemented by Marathon Gold.

The QP has reviewed the adequacy of the exploration information and the visual, physical, and geological characteristics of the property and has found no significant issues or inconsistencies that would cause one to question the validity of the data. The samples collected by an independent QP, and the results of analytical work conducted at an independent laboratory, confirm the gold mineralisation at Marathon Gold's Valentine Lake property. The QP is satisfied to include the exploration data—including the drilling, drill litho-logs and sample assays—for the purpose of resource modelling, evaluation, and the estimations presented in this report.

1.10 Mineral Processing & Metallurgical Testing

Metallurgical testwork programs were conducted on mineralised samples from the Valentine Gold resources between 2006 and 2021. The majority of the testwork programs were carried out for the Leprechaun and Marathon deposits. Thus far, no samples from the Sprite or Victory deposits have been tested, although all the gold occurrences for these deposits share similar general characteristics, where gold mineralisation is associated with quartz-tourmaline-pyrite (QTP).

During the 2019 prefeasibility study, the testwork program was focused on a flotation flowsheet (gravity-flotation-leach) comprising:

- coarse primary grind (P_{80} 150 µm) to reduce capex and energy demand
- gravity and flotation to produce low mass pull concentrate
- ultra-fine grinding of concentrate to liberate fine gold contained in telluride-pyrite mineralisation
- intense cyanide leach of concentrate
- cyanide leach of flotation tails using tailings from concentrate leach
- cyanide destruction

During the feasibility study, the above flotation flowsheet design was progressed; however, the testwork program focussed on the simpler, lower capital cost alternative (gravity-leach) comprising:

- medium primary grind (P_{80} 75 µm)
- gravity
- leach-CIL
- cyanide destruction

The testwork programs conducted to date are listed in Table 1.2.

Table 1.2: Valentine Testwork Programs Conducted to Date

Year	Laboratory	Testwork Performed
2010	G&T Metallurgical Services KM2578	Preliminary flowsheet development – Marathon ore characterisation; gravity and cyanide leach extraction; gravity, sulphide flotation and cyanide extraction; ore hardness
2012	G&T Metallurgical Services KM3028	Preliminary flowsheet development – Leprechaun ore characterisation; gravity and cyanide leach extraction; gravity, sulphide flotation and cyanide extraction; ore hardness
2015	Thibault& Associates 6536 Phase II	Leprechaun master composite - gravity and grind size sensitivity; gravity leach and gravity-float-leach
2017	Thibault& Associates 6536 Phase I	Leprechaun and Marathon ore – grade and grind size variability; gravity-leach and gravity-float-leach
2019	SGS-Lakefield 16863	Comminution, whole ore leach, flotation-regrind-leach, heap leach, solid-liquid separation
2019	Outotec 324217	Solid-liquid separation – dynamic settling and filtration
2019	FLSmidth Rev 4	Gravity recoverable gold modelling
2021	BaseMet Laboratories, Kamloops BL639	Comminution, gravity-leach and gravity-flotation-leach, cyanide destruction, regrind power plot, thickening. Variability by lithology, grade, depth and spatial zone.

Drill cores consisting of NQ and HQ cores, from both the Marathon and Leprechaun deposits were delivered to BaseMet in August 2020 and September 2020, respectively.

Zone composites were selected based on spatial zone, head grade, and lithology for the metallurgical testwork campaign. Deposit composites were combined for metallurgical flowsheet development using a combination of zone composite samples.

During the test program, 142 half NQ samples were subject to head assaying, as well as comminution tests including Bond ball mill (BWi) testing, and preg-robbing testing, while eight half NQ waste samples underwent head assaying and fine BWi testing. Thirty full HQ core samples were designated for head assaying, detailed comminution testing including crusher work index (CWi) tests, SAG mill comminution tests (SMC), Bond rod mill (RWi) and Bond ball mill (BWi) tests, and Bond abrasion (Ai) tests, and metallurgical testing including E-GRG, gravity leach tests, and gravity flotation/leach tests.

The focus of the feasibility study testwork program was to optimise the gravity-leach flowsheet conditions. The purpose of flotation testing was to confirm the test conditions established during the pre-feasibility study with additional variability samples representing a range of grade, depth and zone parameters.

The main difference to the pre-feasibility study is the use of oxygen in the leach. This provided increased recovery of approximately 2% to 3%. An average gold recovery of 93.5% was achievable for the gravity-leach option with a primary grind size P_{80} of 75 µm, while a 96.1% recovery was attained for the gravity-flotation-leach option with a primary grind size of 150 µm and flotation concentrate (at 5% mass pull) regrind size of 15 to 17 µm. The results of the gravity-leach option and the gravity-flotation-leach option are summarised in Tables 1.3 and 1.4, respectively.

Table 1.3: Summary of the Gravity-Leach Variability Tests

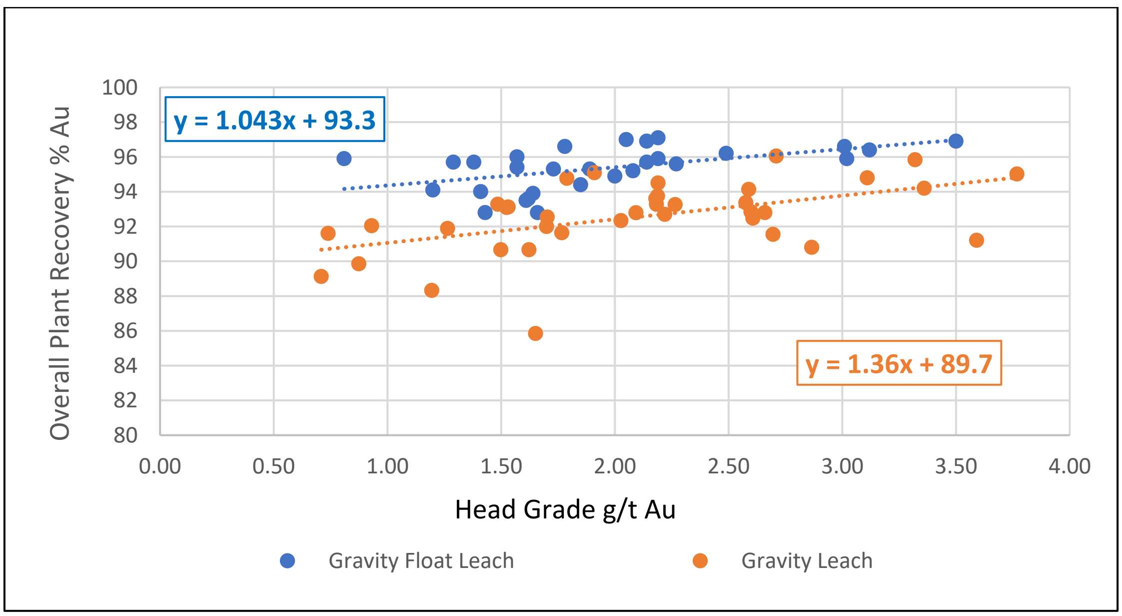
	Calc Head g/t Au	Consumption kg/t		Residue Grade g/t Au	Recovery %		Overall Recovery %
		NaCN	CaO		Gravity	Leach	
Average	2.14	0.27	2.23	0.14	20.1	91.9	93.5
Minimum	0.87	0.13	0.13	0.08	1.8	84.0	86.8
Maximum	3.77	0.83	0.83	0.28	50.8	96.5	97.0

Table 1.4: Summary of the Gravity-Flotation-Leach tests

	Calc Head g/t Au	Consumption kg/t		Distribution Au%			Stage Recovery %		Overall Recovery %
		NaCN	CaO	Gravity	Conc	Tail	Conc	Tail	
Average	1.94	0.60	0.32	19.42	72.4	8.20	97.5	73.1	96.1
Minimum	0.81	0.26	0.14	2.60	47.00	3.10	94.6	56.0	91.6
Maximum	3.50	1.09	0.53	43.20	91.20	20.90	99.6	86.5	98.1

A comparison of the overall estimated plant recovery for the two flowsheets is presented in Figure 1-2. Both trend with head grade over the range 0.7 to 3.5 g/t Au.

Figure 1-2: Grade Recovery Curves for Gravity-Flotation-Leach & Gravity-Leach Flowsheets



Source: Ausenco, 2021.

1.11 Mineral Resource

The mineral resource estimate was completed by BOYD and is reported below in Table 1.5. The resource estimate has an effective date of November 20, 2020 for Leprechaun, Sprite, Marathon and Victory. The effective date for the Berry resource estimate is April 15, 2021.

Table 1.5: Consolidated Valentine Gold Project Mineral Resources

Measured & Indicated Mineral Resource Estimate

Material/ Category	Open Pit			Underground			Total		
	Tonnes	Grade	Gold	Tonnes	Grade	Gold	Tonnes	Grade	Gold
	(t)	(g/t)	(oz)	(t)	(g/t)	(oz)	(t)	(g/t)	(oz)
Leprechaun Deposit									
Measured	8,498,000	2.207	602,900	98,000	3.567	11,200	8,596,000	2.222	614,100
Indicated	8,278,000	1.691	450,100	197,000	3.149	19,900	8,475,000	1.725	470,000
M+I	**16,776,000**	**1.952**	**1,053,000**	**295,000**	**3.279**	**31,100**	**17,071,000**	**1.975**	**1,084,100**
Sprite Deposit									
Measured	0	0.000	0	0	0.000	0	0	0.000	0
Indicated	695,000	1.737	38,800	6,000	2.196	400	701,000	1.741	39,200
M+I	**695,000**	**1.737**	**38,800**	**6,000**	**2.196**	**400**	**701,000**	**1.741**	**39,200**
Marathon Deposit									
Measured	23,578,000	1.650	1,250,500	413,000	4.169	55,400	23,991,000	1.693	1,305,900
Indicated	13,354,000	1.419	609,200	454,000	3.351	48,900	13,808,000	1.482	658,100
M+I	**36,932,000**	**1.566**	**1,859,700**	**867,000**	**3.741**	**104,300**	**37,799,000**	**1.616**	**1,964,000**
Victory Deposit									
Measured	0	0.000	0	0	0.000	0	0	0.000	0
Indicated	1,084,000	1.459	50,800	1,300	1.803	100	1,085,300	1.460	50,900
M+I	**1,084,000**	**1.459**	**50,800**	**1,300**	**1.803**	**100**	**1,085,300**	**1.460**	**50,900**
All Deposits									
Measured	32,076,000	1.797	1,853,400	511,000	4.054	66,600	32,587,000	1.833	1,920,000
Indicated	23,411,000	1.526	1,148,900	658,300	3.277	69,300	24,069,300	1.574	1,218,200
M+I	**55,487,000**	**1.683**	**3,002,300**	**1,169,300**	**3.616**	**135,900**	**56,656,300**	**1.723**	**3,138,200**

Inferred Mineral Resource Estimate

Material/ Category	Open Pit			Underground			Total		
	Tonnes	Grade	Gold	Tonnes	Grade	Gold	Tonnes	Grade	Gold
	(t)	(g/t)	(oz)	(t)	(g/t)	(oz)	(t)	(g/t)	(oz)
Leprechaun Deposit									
Inferred	2,667,000	1.439	123,400	325,000	3.233	33,800	2,992,000	1.633	157,200
Sprite Deposit									
Inferred	1,189,000	1.199	45,900	61,000	2.468	4,800	1,250,000	1.261	50,700
Marathon Deposit									
Inferred	9,770,000	1.534	481,700	1,910,000	3.521	216,200	11,680,000	1.859	697,900
Victory Deposit									
Inferred	2,200,000	1.157	81,800	130,000	3.050	12,700	2,330,000	1.262	94,500
Berry Deposit									
Inferred	10,711,000	1.645	566,400	622,000	3.616	72,300	11,333,000	1.753	638,700
All Deposits									
Inferred	26,537,000	1.523	1,299,200	3,048,000	3.469	339,800	29,585,000	1.723	1,639,000

Notes: **1.** The effective date for this mineral resource estimate is November 20, 2020 for the Leprechaun, Sprite, Marathon, and Victory deposits, and April 15, 2021 for the Berry deposit, and is reported on a 100% ownership basis. This estimate is an update to the previous mineral resource estimate (1/2020) and is an update to economics only while the Berry deposit is a new discovery. The qualified person for the mineral resource estimate is Robert Farmer, P. Eng. **2.** Mineral resources are calculated at a gold price of US$1,500 per troy ounce. **3.** The mineral resources presented above are global and do not include detailed pit or underground designs; only an economic open pit shell was used to determine the in-pit mineral resources. The underground mineral resources are that material outside of the in-pit mineral resources above the stated underground cut-off grade. **4.** Mineral resources, which are not mineral reserves, do not have demonstrated economic viability. The estimate of mineral resources may be materially affected by environmental, permitting, legal, title, socio-political, marketing, or other relevant issues. **5.** The mineral resources presented here were estimated using a block model with a block size of 6 m x 6 m x 6 m sub-blocked to a minimum block size of 2 m x 2 m x 2 m using ID3 methods for grade estimation. All mineral resources are reported using an open pit gold cut-off of 0.30 g/t Au and an underground gold cut-off of 1.44 g/t Au. Higher gold grades were capped by mineralised domain. Material above a 0.70 g/t gold cut-off is considered high-grade while material between a 0.30 and 0.70 g/t gold cut-off is considered low-grade. **6.** The mineral resources presented here were estimated using the Canadian Institute of Mining, Metallurgy and Petroleum (CIM), CIM Standards on Mineral Resources and Reserves, Definitions and Guidelines prepared by the CIM Standing Committee on Reserve Definitions and adopted by CIM Council May 10, 2014. **7.** Figures are rounded, and totals may not add correctly.

1.12 Mineral Reserve

Proven and probable mineral reserves have been modified from measured and indicated mineral resources at Marathon and Leprechaun and are summarised in Table 1.6. Inferred mineral resources are set to waste. Mineral reserves are supported by feasibility study engineering. Mineral resources from the Berry, Victory and Sprite deposits, and any underground mineral resources, are not included in the feasibility study mine plan or mineral reserves.

Table 1.6: Proven & Probable Mineral Reserves

Mine Area	Reserve Class	Mill Feed (Mt)	Diluted Gold Grade (g/t Au)	Contained Metal (Moz)
Marathon	Proven	20.6	1.36	0.9
	Probable	9.1	1.15	0.3
	Marathon Total	**29.7**	**1.30**	**1.2**
Leprechaun	Proven	9.1	1.69	0.5
	Probable	8.3	1.19	0.3
	Leprechaun Total	**17.4**	**1.45**	**0.8**
Subtotal	Proven	29.7	1.46	1.4
	Probable	17.4	1.17	0.7
Grand Total	**Total Proven & Probable**	**47.1**	**1.36**	**2.1**

Notes: **1.** The mineral reserve estimates were prepared by Marc Schulte, P.Eng. (who is also an independent Qualified Person), reported using the 2014 CIM Definition Standards, and have an effective date of March 13, 2021. **2.** Mineral Reserves are mined tonnes and grade; the reference point is the mill feed at the primary crusher. **3.** Mineral reserves are reported at a cut-off grade of 0.30 g/t Au. **4.** Cut-off grade assumes US$1,500/oz Au at a currency exchange rate of US$0.75 per C$1.00; 99.8% payable gold; US$5.00/oz off-site costs (refining and transport); and uses an 87% metallurgical recovery. The cut off-grade covers processing costs of $12.00/t, administrative (G&A) costs of $3.00/t, and a stockpile rehandle cost of $1.50/t. **5.** Mined tonnes and grade are based on an SMU of 6 m x 6 m x 6 m, including additional mining losses estimated for the removal of isolated blocks (surrounded by waste) and low-grade (<0.5 g/t Au) blocks bounded by waste on three sides. **6.** Numbers have been rounded as required by reporting guidelines.

Open pits are based on the results of Pseudoflow sensitivity analysis, and then designed into detailed pit phases to develop pit reserves for mine production scheduling. Mill feed tonnes and gold grades are based re-blocking the original resource model blocks to a selective mining unit (SMU) block size of 6 m x 6 m x 6 m. Further mining recovery parameters have been introduced, treating the following SMU blocks as waste:

- all isolated, mineralised blocks (blocks bounded by waste on all sides)
- all blocks below 0.50 g/t gold grade that are bounded by waste on all but one side

Factors that may affect the mineral reserve estimates include metal prices, changes in interpretations of mineralisation geometry and continuity of mineralisation zones, geotechnical and hydrogeological assumptions, ability of the mining operation to meet the annual production rate, process plant and mining recoveries, the ability to meet and maintain permitting and environmental license conditions, and the ability to maintain the social license to operate.

1.13 Mining

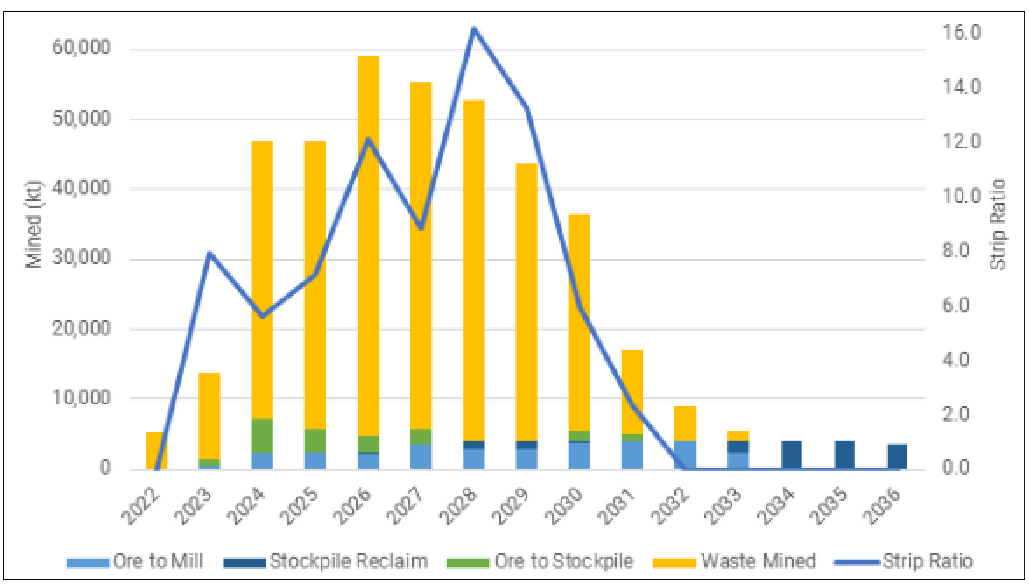
Mining is based on conventional open pit methods suited for the project location and local site requirements. The mining fleet will include diesel-powered rotary drills with 203 mm bit size for bulk production drilling and down the hole (DTH) drills with 165 mm bit size for selective drilling; diesel-powered RC drills for bench-scale grade control drilling; 15.5 m^3 bucket sized hydraulic excavators and 13 m^3 bucket sized wheel loaders for bulk production loading and 12.0 m^3 bucket-size diesel hydraulic excavators for selective production loading; 140- and 90-tonne payload rigid-frame haul trucks and 40-tonne articulated trucks for production hauling; plus ancillary and service equipment to support the mining operations. In-pit dewatering systems will be established for each pit. All surface water and precipitation in the pits will be handled by diesel-driven pumps.

Ore will be hauled to a crusher 3.5 km southwest of the Marathon pit and 3.0 km northeast of the Leprechaun pit. Ore will be crushed to feed the process plant, while waste rock will be deposited into waste rock storage facilities (WRSF) adjacent to the pits or used as rockfill to construct a tailings dam 2 km southwest of the Marathon pit and 4.5 km northeast of the Leprechaun pit. Ultimate pit limits are split into phases or pushbacks to target higher economic margin material earlier in the mine life. Both the Marathon and Leprechaun pits are split into three phases, or an initial phase followed by two pushbacks, with the initial phases containing higher gold grade mineralisation and a lower strip ratio.

During the pre-stripping phase, all ore mined in the pit will be stockpiled. Throughout the life of operations, ore grading between 0.30 and 0.80 g/t Au will be stored in low-grade stockpiles near the pits. Cut-off grade optimisation on the mine production schedule will send ore above 0.80 g/t Au to a high-grade ore stockpile near the primary crusher. The low-grade stockpiled mineral reserves are planned to be re-handled and fed to the crusher once the pits are exhausted.

Mining operations will be based on 365 operating days per year with two 12-hour shifts per day. An allowance of 15 days of no mine production has been built into the mine schedule to allow for adverse weather conditions. Maintenance on mine equipment will be performed in the field with major repairs to mobile equipment in the shops located near the plant facilities. Annual mine operating costs per tonne mined range from $2.05 to $4.50/t with a LOM average of $2.55/t mined. Owner-operated mine operations will include grade control and production drilling, blasting, loading, hauling, and pit, haul road and stockpile maintenance functions. Mobile equipment maintenance operations will also be managed by the Owner and are included in the mine planning and costs. The mine equipment fleet is planned to be purchased via a lease financing arrangement. Figure 1-3 summarises the proposed ore and waste schedule for the 2021 Feasibility Study Mine Plan. The summarised mine schedule is shown in Table 1.7.

Figure 1-3: Mine Production Schedule, Material Mined & Strip Ratio (All Deposits)



Source: Moose Mountain, 2021.

Table 1.7: Mine Production Schedule

Total Mine Production	Year	LOM	Pre-Prod	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036
Mill Feed Tonnes	kt	47,055	0	0	465	2,461	2,500	2,500	3,625	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	3,503
Mill Feed Grade, Au	g/t	1.36	0.00	0	2.56	2.62	2.55	1.82	1.81	1.24	1.16	1.49	1.79	1.48	1.11	0.49	0.49	0.49
Mill Feed Contained Metal	koz	2,050	0	0	38	207	205	146	210	160	149	192	230	190	142	62	62	55
Ore Tonnes from Pit	kt	47,055	504	57	1,527	7,024	5,746	4,475	5,620	3,000	3,000	5,180	5,097	4,000	2,328	0	0	0
Ore Grade from Pit, Au	g/t	1.36	1.09	0.90	1.27	1.32	1.46	1.21	1.33	1.32	1.23	1.24	1.49	1.48	1.55	0.00	0.00	0.00
Stockpile Tonnes to Mill	kt	15,849	0	0	55	119	0	250	0	1,000	1,000	250	0	0	1,672	4,000	4,000	3,503
Stockpile Grade to Mill, Au	g/t	0.57	0.00	0	2.51	1.12	0.00	1.01	0.00	1.01	0.94	0.51	0.00	0.00	0.49	0.49	0.49	0.49
Waste Tonnes from Pit	kt	339,816	9,957	5,203	12,096	39,620	41,101	54,383	49,696	48,630	39,816	30,896	11,931	5,006	1,436	0	0	0
Total Mined from Pits	kt	386,871	10,461	5,261	13,623	46,644	46,847	58,858	55,316	51,630	42,816	36,076	17,029	9,007	3,764	0	0	0
Total Moved	kt	402,720	10,461	5,261	13,678	46,764	46,847	59,108	55,316	52,630	43,816	36,326	17,029	9,007	5,436	4,000	4,000	3,503

1.14 Recovery Methods

The testwork provided was thoroughly analysed and several options of process routes were addressed in the initial stages of the feasibility study. Based on the analysis, a process route was chosen as the best suited for the testwork results and subsequent economic analysis for the material. The unit operations selected are typical for this industry.

Per the mining production schedule, as the high-grade ore is fed to the mill in the first three years, the project will utilise a more capital cost-effective mill design, including a grind size with 80% passing a screen size of 75 µm, gravity recovery of gold and gravity tails cyanidation.

As the mill feed grade decreases, and plant capacity is required to increase to maintain gold production, the project will use the existing grinding mills, and coarsen the primary grind to 150 µm. Flotation equipment will then be employed to recover the majority of the gold to a low mass concentrate stream, at 5% mass pull (of mill feed), and ultra-fine grinding and cyanidation will be applied. Using this approach, initial capital costs will be reduced where possible, and when the mill is required to expand to maintain a steady gold production profile, the flowsheet will be modified to again reduce the expansion capital costs and the operating costs.

In essence, the project will be constructed in two distinct phases, as follows:

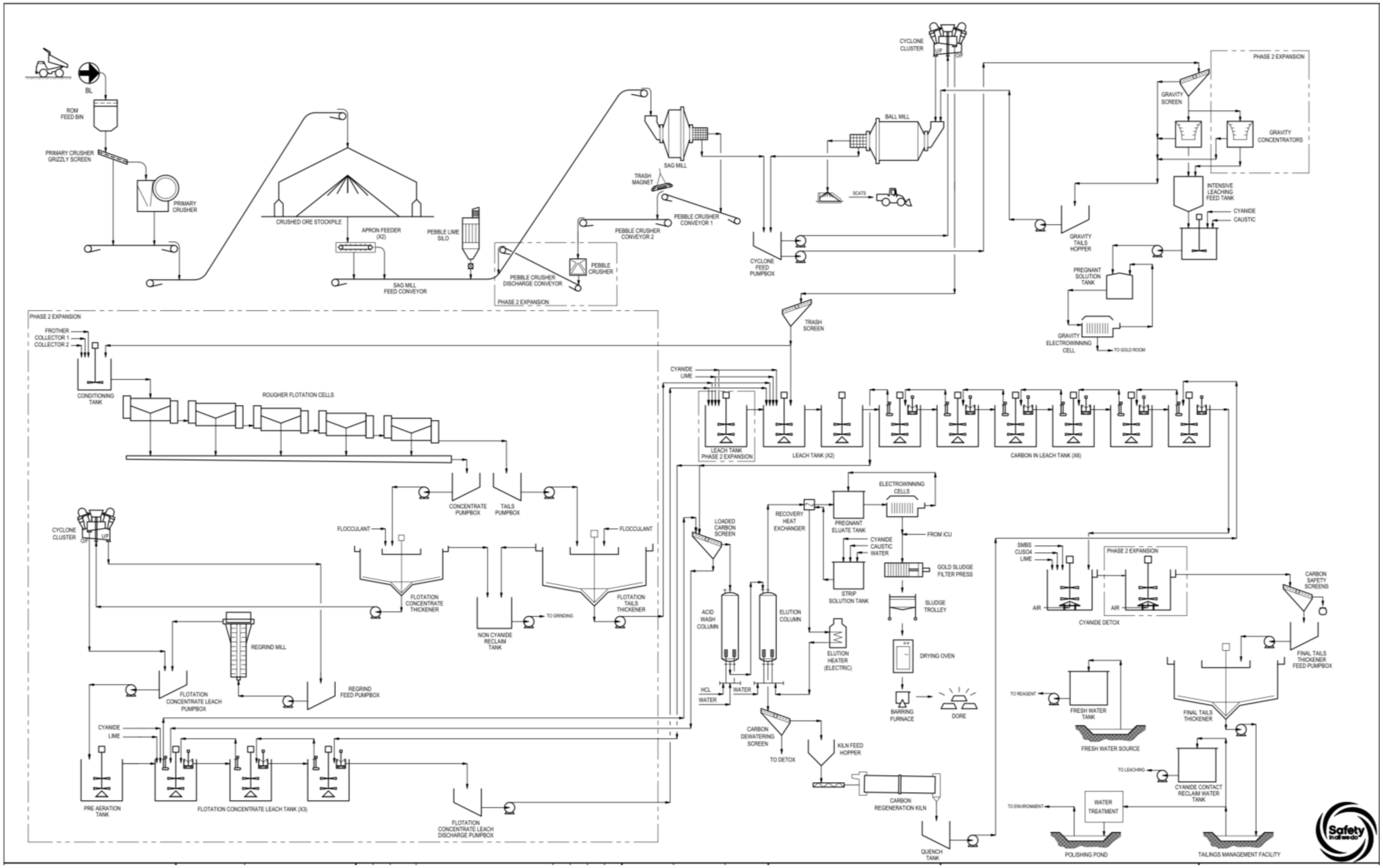
- Phase 1 (2.5 Mt/a) – Comprises a semi-autogenous grinding (SAG) mill, ball mill, gravity concentration, and gravity tails leaching, carbon elution, and gold recovery. Leach-adsorption tails will be treated for cyanide destruction, thickened, and deposited in the TMF.
- Phase 2 (expansion to 4.0 Mt/a) – Includes Phase 1 equipment with the addition of pebble crushing, gravity tails flotation, flotation concentrate regrind, float concentrate leaching, and thickening of both the float concentrate and tailings streams

Key process design criteria are listed below:

- Phase 1 nominal throughput of 6,850 t/d or 2.5 Mt/a
- Phase 2 nominal throughput of 10,960 t/d or 4.0 Mt/a
- crushing plant availability of 75%
- plant availability of 92% for grinding, gravity concentration, flotation, and leach plant and gold recovery operations

An overall process flow diagram showing the unit operations in the selected process flowsheet is presented in Figure 1-4.

Figure 1-4: Overall Process Flow Diagram



Source: Ausenco, 2020.

1.15 Infrastructure

The overall site plan (see Figure 1-5 on the following page) shows the major project facilities, including the open pit mines, tailings management facility (TMF), waste rock facilities, polishing pond, mine services, access road, accommodations camp, and effluent treatment plant. Access to the facility is from the northeast side of the property from the existing public access road. Access to the process plant will be via the security gate at the public road intersection.

1.15.1 Access

The site public access road will be refurbished / upgraded. The upgrades will include replacing timber bridges and repairing existing steel bridges on the public access road. The plant access road from the public road and in-plant roads will be a 6 m wide gravel road with surface drainage. New access roads will be built for the infrastructure areas, camp and explosive plant.

1.15.2 Power

Newfoundland and Labrador Hydro (NL Hydro) will supply power to the Valentine Gold Project as per conditions outlined in a Power Supply Agreement with Marathon Gold. The system supply point will be the Star Lake Terminal Station located approximately 20 km (in a straight line) to the northwest of the Valentine Gold Project.

Site power will be provided by tie-ins performed to NL Hydro's equipment at Star Lake Terminal Station. A 40 km long overhead line is proposed to be installed between NL Hydro's Star Lake Terminal Station and Marathon Gold's Valentine Lake Terminal Station. To facilitate the connection, the following infrastructure will be required:

- Upgrade of the existing Star Lake Terminal Station to support the addition of electrical, protection and control, and communications equipment required to provide power to the Valentine Terminal Station; communications equipment will also be installed at NL Hydro's Buchans Terminal Station and at Valentine Terminal Station for remote monitoring and protection.
- Construction of a 40 km 69 kV wood pole transmission line (TL 271) from the Star Lake Terminal Station to the Valentine Terminal Station.

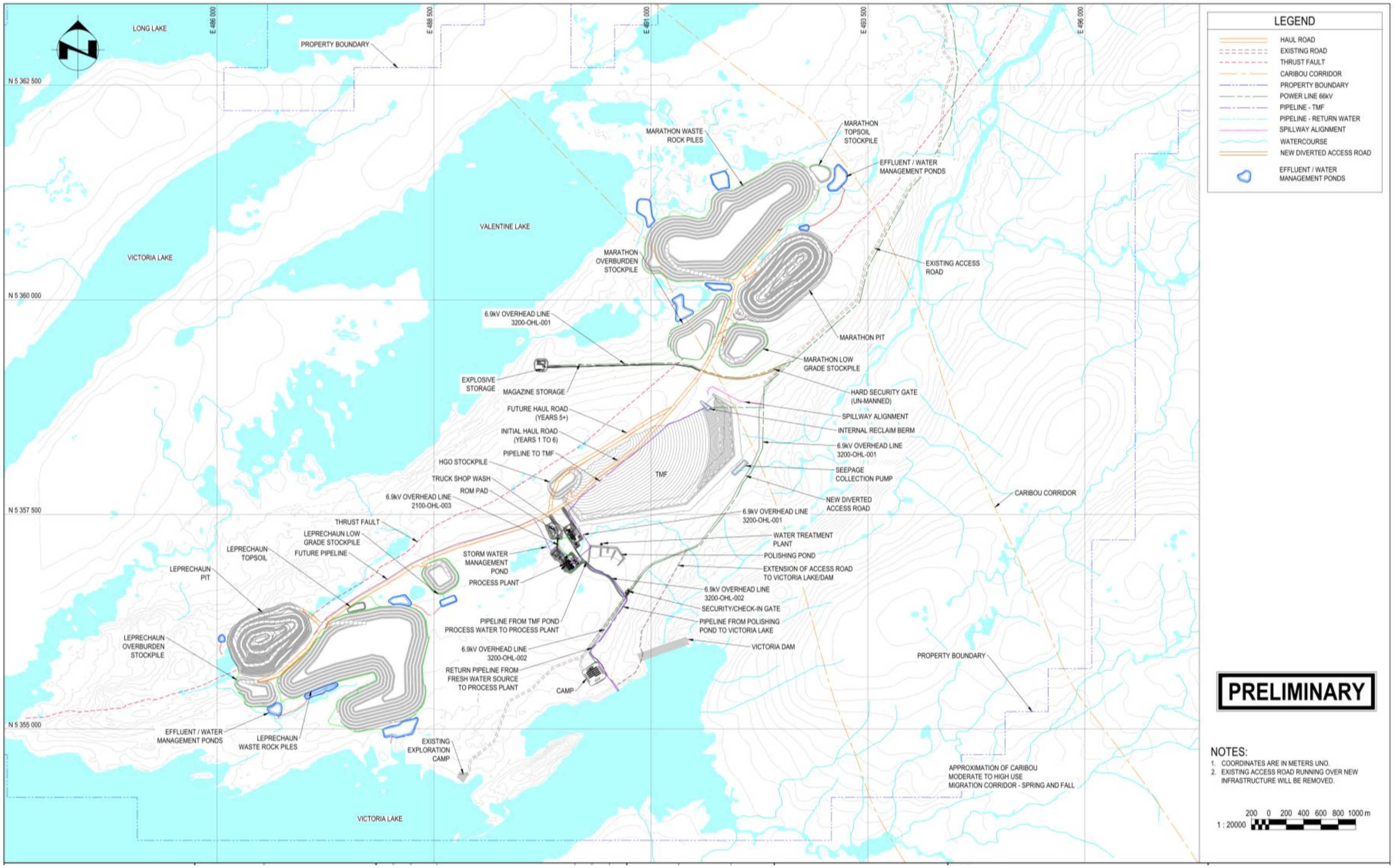
The Valentine Gold Project has the following load requirements:

- Phase 1: Initial start-up requirement between 2023 and 2027 – 17 MW
- Phase 2: Full load requirement in 2028 to end of life – 20 MW

The plant electrical system is based on 6.9 kV, 2,000 A, 60 Hz distribution. The 66 kV feed from local power authority will be stepped down to 6.9 kV at the plant main substation, and will supply the plant main 6.9 kV switchgear housed in the main process plant electrical room.

The larger variable frequency drives (VFDs) will have 6.9 kV input, fed by plant main 6.9 kV switchgear. Separate 6.9 kV / 600 V distribution transformers at the various electrical rooms will be fed from the plant main 6.9 kV switchgear. Overhead power lines of 6.9 kV will provide power to various remote facilities. Pole-mounted or pad-mounted transformers will step down the voltage at each location and supply the low-voltage distribution system to each equipment area.

Figure 1-5: Overall Site Plan



Source: Ausenco, 2021.

1.15.3 Tailings Management Facility

The TMF is located between the Leprechaun and Marathon pits to the south of the Valentine Lake Shear Zone and 200 m northeast of the process plant. Geotechnical and hydrogeological investigations were completed at the TMF site in late 2020. The results of the site investigations agree with available surficial geology mapping for the project site. The subsurface conditions encountered at the TMF comprise a surficial layer of organics up to approximately 2.2 m thick underlain by a non-cohesive glacial till deposit described as silty sand and gravel to sandy silt containing cobbles and boulders. The till extends to the bedrock surface and ranges in thickness from 0.7 m to 7.5 m. The TMF dam will be founded on the competent, compact to very dense till deposit or bedrock. In-situ testing of the overburden and bedrock indicate a general trend of decreasing hydraulic conductivity with depth. The mean hydraulic conductivity of the till and shallow bedrock is on the order of 10^{-6} m/s.

The TMF is designed to store 30.1 Mt of tailings to be processed over the initial nine to ten years of the mine life. For the remaining mine life, 16.9 Mt of tailings will be deposited in the mined-out Leprechaun pit. The dams are stage-raised rockfill embankments with lined upstream slopes. A seepage mitigation measure in the form of an upstream extension of the liner on the foundation is incorporated in the design. The dams will be raised by the downstream method. The facility has an emergency spillway and a downstream seepage and runoff collection system. Closure will include re-grading the tailings surface, lowering of the emergency spillway to remove the supernatant pond, and providing a vegetated overburden cover for the tailings.

The operational plan for the TMF is to deposit tailings via spigots as a thickened slurry. The deposition will initially be done from the perimeter embankment to provide a protective layer of tailings over the liner, and subsequently from the natural high ground on the northwest side of the TMF. This will allow the tailings pond to be located on the east side of the TMF and a tailings beach will form that slopes from the deposition points along the high ground down to the perimeter embankment.

The accumulation of water in the TMF has been modelled for the mean and 25-year wet and dry annual precipitation conditions. Reclaim water is pumped from the TMF to the process plant. A water treatment plant and polishing pond allow for the treatment and discharge of the excess site water to Victoria Lake. Treatment and discharge is designed to occur for 7 to 8 months each year. The TMF pond has been sized to store the excess water during non-discharge periods.

1.15.4 Accommodation

A permanent accommodation camp is included in the design for the pre-production and operations phases. It will be tied into the plant power grid and will accommodate 301 people. It is expected that the existing exploration camp (65 people) will be maintained as an overflow camp for shutdown events.

1.15.5 Buildings

The process plant consists of three main process buildings located southeast of the primary crusher building and east of the coarse ore storage stockpile/reclaim: the mill building (grinding/elution, gold room, gravity), reagent building, and flotation/regrind building (Phase 2 only). All buildings will be supported on reinforced concrete footings with concrete slabs and pedestals. All pre-engineered and fabric buildings will be fully enclosed with metal cladding and fabric covers, respectively.

Additional fabric and modular buildings will be provided for the mine truck workshop, mine truck wash bay, mining warehouse, process mill warehouse, reagent dry store, mining muster/administration block, process mill administration block, general administration block, and security-gatehouse.

1.15.6 Polishing Pond

The polishing pond is located east of the process plant site and has a footprint area of 8 ha. The pond will be constructed during construction of the TMF starter dam with an operational capacity of about 60,000 m^3 based on a maximum flow through rate of 350 m^3/h, which is sufficient to treat runoff, precipitation, and process flows for up to a 25-year wet precipitation year. To promote settling and flow distribution, the pond includes internal rockfill baffles designed to reduce short-circuiting.

1.15.7 Water Management

The mine site is divided into three complexes. From north to south, they are the Marathon Complex, the Process Plant Complex, and the Leprechaun Complex. Water management in these complexes functions independently with decentralised treatment and control in each complex.

Water management components for the Marathon and Leprechaun complexes consist of water management (i.e., flood attenuation and sedimentation) ponds, dams, berms, drainage ditches, and pumps to collect and contain surface water runoff from waste rock, low-grade stockpiles, overburden stockpiles, topsoil stockpiles, and pits.

The process plant pad and truck shop area will be served by a series of collection ditches and a sedimentation pond. Water management in the TMF consists of the tailings pond, effluent treatment plant, polishing pond, seepage collection ditches, pumps, and a discharge pipeline to Victoria Lake.

1.16 Environmental Studies, Permitting & Social or Community Impact

The project is located in part of the island that is characterised by a boreal forest (mainly coniferous forest) and continental climate (colder winters and warmer summers than coastal areas). The project is in a relatively undisturbed wilderness area.

The project is subject to the *Newfoundland and Labrador Environmental Protection Act*, associated Environmental Assessment Regulations, and the *Canadian Environmental Assessment Act* (CEAA, 2012). As indicated in Section 20.2.1, Marathon prepared and submitted an EIS to meet the requirements of CEAA (2012), the NL EPA and the project-specific guidelines issued by the federal and provincial governments.

The assessment of environment effects focused on valued components (VCs), which are the elements of the environment that could be affected by the project and are of importance or interest to regulators, Indigenous groups and stakeholders. The assessment included a characterisation of the existing conditions within the spatial boundaries of each VC, including a discussion of the influences of past and present physical activities on the VC, leading to the current conditions. The assessment followed standard EA methods for describing project interactions with each of the VCs and determining the potential environmental effects, including areas of federal jurisdiction, associated with the project for the construction, operation, and decommissioning, rehabilitation and closure phases.

The EA process has served as a mechanism for Marathon Gold to incorporate results of engagement in early project planning to reduce and avoid environmental effects. Several important aspects of the project concept and engineering design were modified, refined, and adapted to reduce potential adverse effects for incorporation into the EIS. These changes were made during the project pre-feasibility study and in consideration of discussions with regulators, stakeholders and Indigenous groups, and in response to input received during public, Indigenous and regulatory review of the Registration / Project Description submitted to the federal and provincial governments in April 2019.

The environmental assessment predicts that routine project activities will not cause significant adverse environmental effects on any of the VCs, except for caribou. Similar results were determined for cumulative effects, where project effects are considered in combination with the effects of other projects (past, present, and reasonably foreseeable future projects). A more detailed summary of residual effects for each VC are provided in Table 20.2 in Chapter 20. The EIS should be consulted for a full description of predicted residual effects of the project (Marathon Gold, 2020) (https://iaac-aeic.gc.ca/050/evaluations/document/136521).

The project must comply with all applicable federal and provincial acts and regulations; standard environmental permits and approvals will also be required, including water use authorisations, fish and fish habitat authorisation, emissions and discharge approvals, and approvals for infrastructure development within the project. These approvals can only be granted once the project has been released from the EA process. In support of the project and the environmental assessment and permitting processes, information requirements are being populated and the Fisheries Act authorisation application is being prepared. In addition, the baseline Environmental Effects Monitoring (EEM) is planned to commence in the summer of 2021.

Progressive and final rehabilitation and closure planning are requirements under the *Newfoundland and Labrador Mining Act*. As the planning and design stages of the project continue, consideration for the future closure issues and requirements will continue to be incorporated into project design. The approach to rehabilitation and closure and post-closure and long-term monitoring is described in Section 20.8.1. The environmental effects of rehabilitation and closure have been assessed as part of the EIS. The formal plan is currently being developed by GEMTEC to restore the site to pre-development conditions as practicable or to a suitable condition for an alternate use upon project closure. The plan will outline the methods to be used for progressive and closure rehabilitation, and post-closure monitoring.

There are substantial employment and economic benefits to flow from the project to the benefit of local communities, the central region of NL, and the province. The development of an on-site accommodations camp for all workers, on-site medical and emergency response resources will reduce potential effects on local community infrastructure and services. Local hiring and contracting policies for direct employment and contracts, and induced employment and business in the region will result in substantial benefits to the local and regional economy over a > 15-year period (including construction, operation and decommissioning, rehabilitation and closure).

Marathon Gold is committed to operating the project within a sustainable development framework which reduces harm to the environment, contributes to local communities, respects human and Indigenous rights, and adheres to openness and transparency in operations. One of the key principles of sustainable development is meaningful engagement with the individuals, communities, groups, and organisations interested in or potentially affected by the project to build and maintain positive, long-term and mutually beneficial relationships. Marathon Gold has engaged with relevant government departments and agencies, Indigenous groups, and stakeholder organisations, including communities, business and industry organisations, fish and wildlife organisations, environmental non-governmental organisations and individuals. Marathon Gold will continue this engagement process throughout the life of the Valentine Gold Project. Community relations and consultation efforts are further described in Section 20.9.

1.17 Capital & Operating Costs

1.17.1 Capital Cost

The estimate conforms to Class 3 guidelines for a feasibility study level estimate with a ±15% accuracy according to the Association for the Advancement of Cost Engineering International (AACE International). Table 1.8 (overleaf) provides a summary of the overall initial capital cost estimate. The costs are expressed in Q1 2021 Canadian dollars and include all costs related to the Valentine Gold Project (e.g., mining, site preparation, process plant, tailings facility, power infrastructure, camp, Owners' costs, spares, first fills, buildings, roadworks, and off-site infrastructure).

The project will be constructed in two distinct phases: Phase 1 (2.5 Mt/a) is based on a gravity-leach flowsheet, and Phase 2 (expansion to 4.0 Mt/a) is based on a gravity-flotation-regrind-leach concentrate-leach tail flowsheet. The estimate is based on an EPC execution approach for the process/infrastructure areas, and a EPCM execution for the civil-earthworks camp, and power infrastructure packages, as outlined in Chapter 24.

The following parameters and qualifications were considered:

- No allowance has been made for exchange rate fluctuations.
- There is no escalation added to the estimate.
- A growth allowance is included.
- For equipment sourced in US dollars, an exchange rate of 1.33 Canadian dollar per US dollar was assumed.
- Data for the estimates have been obtained from numerous sources, including:
  - mine schedules
  - feasibility-level engineering design
  - topographical information obtained from the site survey
  - geotechnical investigations
  - budgetary equipment quotes from Canadian and International suppliers
  - budgetary unit costs from numerous local NL contractors for civil, concrete, steel, electrical, piping and mechanical works
  - data from similar recently completed studies and projects

Major cost categories (permanent equipment, material purchase, installation, subcontracts, indirect costs, and Owner's costs) were identified and analysed. A percentage of contingency was allocated to each of these categories on a line-item basis based on the accuracy of the data. An overall contingency amount was derived in this fashion.

As outlined in Table 1.8, the overall capital cost of the project in Phase 1 will be approximately C$305 million, followed by the expansion in Phase 2 at C$44 million, with ongoing sustaining costs of C$332 million. Of the total Phase 1 capital costs, more than 88% of the project costs were derived from first principles bulk material take-offs and equipment sizing calculations, with supporting quotations for major equipment, and contractor supply/installation rates. Furthermore, above 70% of the project costs are projected to be spent within Newfoundland and Labrador.

Table 1.8: Summary of Capital Costs

WBS	Description	Phase 1 Cost (C$M)	Phase 2 Cost (C$M)	Sustaining Costs (C$M)
1100	Mine Development (Pre-strip)	32	0	0
1200	Mine Fixed Equipment	3	0	2
1300	Mine Mobile Equipment	16	0	184
2100	Primary Crushing	14	0	0
2200	Grinding	33	0	0
2300	Leaching	11	1	0
2400	Elution & Gold Room	11	0	0
2500	Tailings Disposal	6	0	0
2600	Reagents	3	0	0
2700	Air & Water Services	4	2	0
2800	Process Buildings	7	0	2
2900	Phase 2 - Flotation / Concentrate Leach / Pebble Crushing	0	23	0
3100	Bulk Earthworks	6	0	6
3200	High-Voltage Power Switchyard & Power Distribution	11	0	0
3400	Fuel Storage	0	0	0
3500	Sewage	1	0	8
3600	Infrastructure Buildings	6	0	0
3700	Water Supply	1	0	58
3800	Tailings Management Facility	16	0	15
3900	Permanent Camp	14	1	0
4100	Main Access Road	7	0	0
4200	High-Voltage Power Supply	13	0	0
5100	Temporary Construction Facilities & Services	10	5	0
5200	Commissioning Representatives & Assistance	1	0	0
5300	Spares	1	0	0
5400	First Fills & Initial Charges	1	0	0
5500	Freight & Logistics	3	0	0
6100	Phase 1 - Lump Sum EPC Scope Delivery	19	0	0
6200	Phase 1 - EPCM Scope Delivery	7	0	0
6300	Phase 1 - Engineering Subconsultants & QA/QC	3	0	0
6500	Phase 2 - EPCM Scope Delivery	0	6	0
7200	Pre-production Labour	3	0	0
7500	Owner's Cost	13	0	36
	Subtotal	**273**	**40**	**311**
8100	Project Contingency	32	4	21
	Total Project Costs	**305**	**44**	**332**

1.17.2 Operating Cost – Processing

The operating cost estimate is presented in Q1 2021 Canadian dollars. The estimate was developed to have an accuracy of ±15%. The estimate includes mining, processing, general and administration (G&A), and accommodations costs. The operating cost estimates for the life of mine are provided in Table 1.9.

Table 1.9: Average Annual Operating Cost Summary

	Phase 1 – 2.5 Mt/a		Phase 2 – 4.0 Mt/a	
Cost Centre	**C$M**	**C$/t**	**C$M**	**C$/t**
Processing & Tailings				
Consumables	19.4	7.77	28.5	7.13
Plant Maintenance	1.16	0.47	1.51	0.38
Power	6.89	2.75	8.66	2.16
Laboratory	0.17	0.07	0.21	0.05
Labour (O&M)	7.57	3.03	7.94	1.99
Processing Mobile Equipment	0.14	0.05	0.13	0.03
Subtotal	**35.3**	**14.1**	**47.0**	**11.7**
Effluent Treatment				
Plant Maintenance	0.11	0.04	0.11	0.03
Labour	0.05	0.02	0.05	0.01
Power	0.23	0.09	0.23	0.06
Other (including consumables)	0.70	0.28	0.79	0.20
Subtotal	**1.1**	**0.4**	**1.2**	**0.3**
Subtotal Plant Operating Cost	**36.4**	**14.6**	**48.1**	**12.0**
General & Administration				
Labour (G&A)	3.94	1.58	3.94	0.99
G&A Expenses	6.41	2.57	6.45	1.61
Site Maintenance	0.72	0.29	0.72	0.18
Camp	5.11	2.05	5.16	1.29
Subtotal	**16.2**	**6.5**	**16.3**	**4.1**
Total	**52.6**	**21.0**	**64.4**	**16.1**

The operating cost estimates are based on the following assumptions:

- No allowance has been made for inflation.
- For material sourced in US dollars, an exchange rate of 1.33 Canadian dollar per US dollar was assumed.
- Fuel costs and associated taxes were established with several fuel suppliers in Newfoundland and Labrador after reviewing the 18-month average for diesel and gasoline. Estimated diesel costs are C$0.914/L and gasoline costs are C$0.902/L.
- Rates are increased during the first three years of operation, as surcharges are applied to account for the suppliers cost of installing on site fuel distribution systems.
- Rates are decreased during the construction period of the project as the Newfoundland and Labrador Provincial Road Tax is assumed not to apply.
- Applied diesel rates are C$0.819/L during the construction period and C$0.959/L during the first two years of operations. Afterwards, the base rate of C$0.914/L is carried.
- The annual power costs were calculated using a unit price of C$0.063/kWh, based on quotations received for the project.
- Labour is assumed to come from the central Newfoundland region.

1.17.3 Operating Cost – Mining

Mine operating costs are built up from first principles. Inputs are derived from vendor quotations and historical data collected by Moose Mountain. This includes quoted cost and consumption rates for such inputs as fuel, lubes, explosives, tires, undercarriage, GET, drill bits/rods/strings, machine parts, machine major components, and operating and maintenance labour ratios. Labour rates for planned hourly and salaried personnel were supplied by Marathon Gold.

Annual average mine operating costs per tonne mined range from $2.05 to $4.50/t with a LOM average of $2.55/t mined. Owner-operated mine operations will include grade control and production drilling, blasting, loading, hauling, and pit, haul road and stockpile maintenance functions. Mobile equipment maintenance operations will also be managed by the Owner and are included in the mine planning and costs.

1.18 Economic Analysis

An economic model was developed to estimate annual pre-tax and post-tax cash flows and sensitivities of the project based on a 5% discount rate. It must be noted that tax estimates involve complex variables that can only be accurately calculated during operations and, as such, the after-tax results are approximations. A sensitivity analysis was performed to assess the impact of variations in metal prices, initial capital cost, total operating cost, foreign exchange rate, and discount rate.

1.18.1 Financial Model Parameters

A base case gold price of US$1,500/oz was derived from consensus analyst estimates and recently published economic studies. The forecasts are meant to reflect the average metal price expectation over the life of the project. No price inflation or escalation factors were considered. Commodity prices can be volatile, and there is the potential for deviation from the forecast.

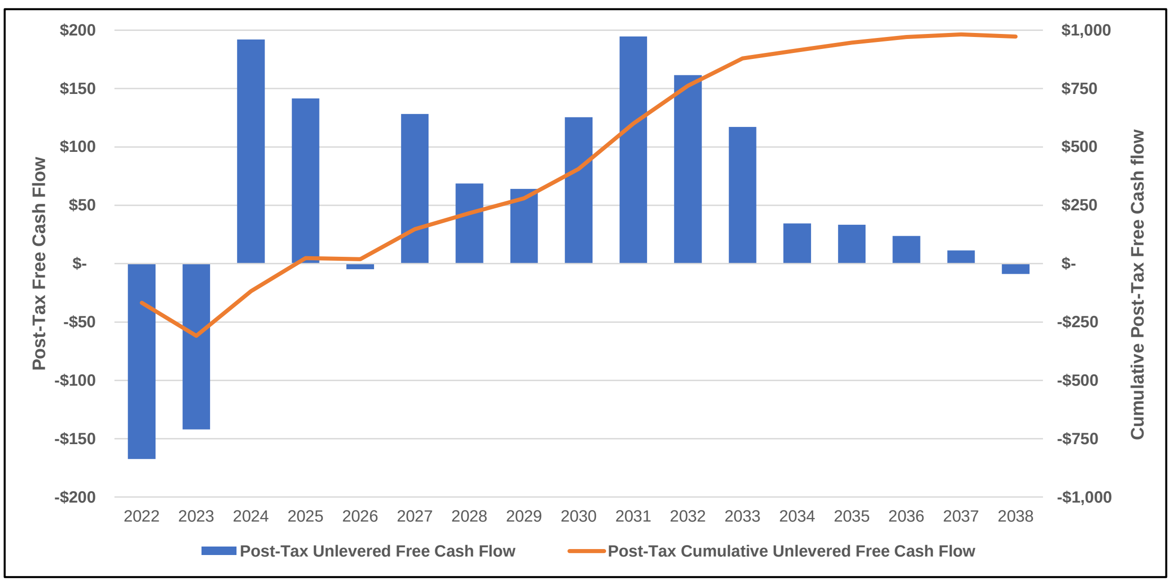
The economic analysis was performed using the following assumptions:

- construction starting January 1, 2022
- commercial production start-up on October 1, 2023
- mine life of 13.1 years
- an exchange rate of 0.75 (USD:CAD)
- cost estimates in constant Q1 2021 Canadian dollars with no inflation or escalation
- 100% ownership with 1.5% NSR (assumes buy back of 0.5% NSR)
- capital costs funded with 100% equity (no financing costs assumed)
- all cash flows discounted to December 31, 2021 using a mid-year discounting convention
- a working capital balance of C$15 million is carried through the first year, which is then reduced to a balance of C$5 million until the end of the mine life
- gold is assumed to be sold in the same year it is produced
- no contractual arrangements for refining currently exist

1.18.2 Economic Analysis

The economic analysis was performed assuming a 5% discount rate. The pre-tax NPV discounted at 5% is C$867 million; the internal rate of return IRR is 37%; and payback period is 1.8 years. On an after-tax basis, the NPV discounted at 5% is C$600 million; the IRR is 32%; and the payback period is 1.9 years. A summary of project economics is shown graphically in Figure 1-6 and listed in Table 1.10.

Figure 1-6: Project Economics



Source: Ausenco, 2020.

Table 1.10: Summary of Project Economics

General		LOM Total / Avg.
Gold Price (US$/oz)		$1,500
Mine Life (years)		13.1
Total Waste Tonnes Mined (kt)		339,816
Total Mill Feed Tonnes (kt)		47,055
Strip Ratio		7.2x
Production		**LOM Total / Avg.**
Mill Head Grade (g/t)		1.36
Mill Recovery Rate (%)		94%
Total Mill Ounces Recovered (koz)		1,932
Total Average Annual Production (koz)		147
Operating Costs		**LOM Total / Avg.**
Mining Cost (C$/t Mined)		$2.55
Processing Cost (C$/t Milled)		$12.51
G&A Cost (C$/t Milled)		$4.58
Refining & Transport Cost (C$/oz)		$3.93
Silver Credit (C$/oz)		($9.32)
Total Operating Costs (C$/t Milled)		$37.52
Cash Costs (US$/oz AuEq)		$704
AISC (US$/oz AuEq)		$833
Capital Costs		**LOM Total / Avg.**
Initial Capital (C$M)		$305
Sustaining Capital (C$M)		$294
Expansion Capital (C$M)		$44
Closure Costs (C$M)		$38
Salvage Costs (C$M)		($20)
Financials	**Pre-Tax**	**Post-Tax**
NPV (5%) C($M)	$867	$600
IRR (%)	36.9%	31.5%
Payback (years)	1.8	1.9

Notes: *Cash costs consist of mining costs, processing costs, mine-level G&A and refining charges and royalties. ** AISC includes cash costs plus sustaining capital and closure costs.

1.18.3 Sensitivity Analysis

A sensitivity analysis was conducted on the base case pre-tax and after-tax NPV and IRR of the project using the following variables: gold price, discount rate, initial capital costs, and operating costs. Table 1.11 shows the project's post-tax sensitivity results. The analysis revealed that the project is most sensitive to changes in gold prices and less sensitive to operating costs, discount rate and initial capital costs.

Table 1.11: Post-Tax Sensitivity

	Post-Tax NPV Sensitivity to Discount Rate						
		Gold Price (US$/oz)					
		$1,300	$1,450	$1,500	$1,550	$1,650	$1,750
Discount Rate	0.0%	$664	$809	$883	$957	$1,098	$1,234
	3.0%	$537	$663	$727	$792	$915	$1,033
	5.0%	$432	$544	$600	$657	$765	$868
	8.0%	$309	$402	$450	$497	$587	$672
	10.0%	$245	$328	$370	$412	$492	$568

	Post-Tax IRR Sensitivity to Discount Rate						
		Gold Price (US$/oz)					
		$1,300	$1,450	$1,500	$1,550	$1,650	$1,750
Discount Rate	0.0%	24.4%	29.2%	31.5%	33.9%	38.1%	42.2%
	3.0%	24.4%	29.2%	31.5%	33.9%	38.1%	42.2%
	5.0%	24.4%	29.2%	31.5%	33.9%	38.1%	42.2%
	8.0%	24.4%	29.2%	31.5%	33.9%	38.1%	42.2%
	10.0%	24.4%	29.2%	31.5%	33.9%	38.1%	42.2%

	Post-Tax NPV Sensitivity to Foreign Exchange						
		Gold Price (US$/oz)					
		$1,300	$1,450	$1,500	$1,550	$1,650	$1,750
FX	0.65	$667	$790	$849	$909	$1,028	$1,146
	0.70	$540	$661	$720	$776	$887	$998
	0.75	$432	$544	$600	$657	$765	$868
	0.80	$332	$442	$494	$547	$653	$755
	0.85	$237	$349	$402	$451	$549	$649

	Post-Tax IRR Sensitivity to Foreign Exchange						
		Gold Price (US$/oz)					
		$1,300	$1,450	$1,500	$1,550	$1,650	$1,750
FX	0.65	34.2%	39.1%	41.4%	43.7%	48.1%	52.3%
	0.70	29.0%	34.0%	36.4%	38.6%	42.9%	47.0%
	0.75	24.4%	29.2%	31.5%	33.9%	38.1%	42.2%
	0.80	19.7%	24.8%	27.1%	29.3%	33.7%	37.7%
	0.85	15.3%	20.5%	23.0%	25.2%	29.4%	33.6%

	Post-Tax NPV Sensitivity to Operating Costs						
		Gold Price (US$/oz)					
		$1,300	$1,450	$1,500	$1,550	$1,650	$1,750
Opex	(20.0%)	$590	$701	$752	$804	$907	$1,010
	(10.0%)	$510	$624	$680	$733	$836	$939
	--	$432	$544	$600	$657	$765	$868
	10.0%	$350	$465	$520	$577	$689	$797
	20.0%	$260	$386	$442	$498	$610	$721

	Post-Tax IRR Sensitivity to Operating Costs						
		Gold Price (US$/oz)					
		$1,300	$1,450	$1,500	$1,550	$1,650	$1,750
Opex	(20.0%)	31.0%	35.5%	37.5%	39.6%	43.6%	47.3%
	(10.0%)	27.7%	32.4%	34.7%	36.8%	40.9%	44.8%
	--	24.4%	29.2%	31.5%	33.9%	38.1%	42.2%
	10.0%	20.6%	25.8%	28.2%	30.6%	35.2%	39.5%
	20.0%	16.4%	22.3%	24.9%	27.3%	32.0%	36.5%

	Post-Tax NPV Sensitivity to Initial Capital Costs						
		Gold Price (US$/oz)					
		$1,300	$1,450	$1,500	$1,550	$1,650	$1,750
Initial Capex	(20.0%)	$470	$582	$639	$694	$799	$902
	(10.0%)	$451	$563	$620	$675	$782	$885
	--	$432	$544	$600	$657	$765	$868
	10.0%	$413	$524	$581	$638	$748	$851
	20.0%	$392	$504	$561	$618	$730	$834

	Post-Tax IRR Sensitivity to Initial Capital Costs						
		Gold Price (US$/oz)					
		$1,300	$1,450	$1,500	$1,550	$1,650	$1,750
Initial Capex	(20.0%)	30.0%	35.7%	38.5%	41.1%	46.2%	50.9%
	(10.0%)	27.0%	32.1%	34.7%	37.1%	41.8%	46.1%
	--	24.4%	29.2%	31.5%	33.9%	38.1%	42.2%
	10.0%	22.2%	26.7%	28.9%	31.0%	35.1%	38.8%
	20.0%	20.2%	24.5%	26.6%	28.6%	32.5%	36.0%

1.19 Recommendations

1.19.1 Overall

The financial analysis of this feasibility study demonstrates that the Valentine Gold Project has robust economics, and it is recommended to continue developing the project through engineering and de-risking, and into a construction decision in late 2021.

1.19.2 Exploration

Marathon Gold should continue with the company's current geophysical amalgamation to support and advance ongoing structural geological interpretation of the Valentine Lake Shear Zone. A new, detailed and low altitude aeromagnetic survey covering the immediate hanging-wall area of the Valentine Lake Shear Zone should be considered to delineate individual mafic dykes that are interpreted to have an important influence in the localisation of gold mineralisation.

Marathon Gold should continue with the company's infill and exploratory drill program strategies. Infill drilling should be focused on the recently defined Berry deposit to further increase confidence in the "Main Zone" style mineralisation found at Berry. Exploratory drilling should be used in collaboration with geophysical interpretations to test for gold mineralisation along the Valentine Lake Intrusive Complex-Rogerson Lake Conglomerate contact and trend of magnetic lows west of, and proximal to, the Valentine Lake Shear Zone, primarily between the Leprechaun and Marathon deposits.

Marathon Gold should continue with the company's current QA/QC protocols and consider new strategies intended to increase the confidence level of the QA/QC work, such as umpire assaying, and collection and analysis of variability of duplicate samples.

It is recommended that Marathon Gold continues to refine the constraining mineralised domains as part of a future mineral resource estimate. This would involve improving the mafic dike solids by manual geological modelling as well as the ≥100 ppb gold QTP vein domain. Future geological models and mineral resource estimates should incorporate refined structural attitudes for gold bearing vein sets obtained from the ongoing televiewer measurements on vein frequencies and orientations.

1.19.3 Mineral Reserve & Mine Plan

The following recommendations are made to advance the project into construction:

- Execute a grade control drilling and interpretation program in selected areas of the Marathon and Leprechaun deposits that are planned to be mined for initial mill feed. The resultant tonnes and grade from this interpretation should be compared to the equivalent area resource modelled tonnes and grade. Results should be incorporated in ongoing grade control strategy and mine planning.
  - Early in the mine's operating life a campaign of RC drilling, sampling, assaying should be compared to a campaign of blasthole sampling and assaying to determine ore/waste boundary prediction using each method. These campaigns can be performed over the same area of the pit to ensure a direct comparison. It may be possible to forego RC drilling and rely solely on blasthole sampling for ore/waste boundary prediction, which would lead to a reduction in mine operating costs.

- Additional hydrogeological and geotechnical field and lab work to bring the models to a construction level of confidence.
  - Additional targeted geotechnical drilling on the south side of the Leprechaun deposit should be carried out, including scan line mapping to further characterise structural fabric in this zone, packer testing, and associated updates to the geotechnical model.
  - Installation of additional vibrating wire piezometers, as well as individual piezometers within the pits and outlying areas should be completed. Additionally, ongoing collection of monitoring data from the existing piezometers for further evaluation of hydraulic gradients and pore pressures should be continued.
  - Targeted pumping tests and new observation wells within each pit should be completed to provide another measure of bulk hydraulic conductivity of the rock mass at the pit-scale and to provide data on anisotropy (both horizontal and vertical) in the hydraulic response to refine predictions of pit inflows and dewatering requirements.
- Further engagement with potential mining contractors to obtain updated quotations for services should be carried out.
- Further engagement with equipment vendors to secure build spots for long lead time items should be carried out.
- Further engagement with blasting material and diesel fuel suppliers to provide detailed designs for supply chain and on-site storage in support of required operating permits should be carried out.
- Further engagement with tire vendors to secure supply for estimated early project tire needs should be carried out.
- Blasting to both minimise dilution while improving mine-to-mill performance can be optimised in future studies. This will require field measurements and adjustments during operations.
- Opportunities should be explored to increase project value via alternative deposit development strategies. The inclusion of the Berry, Sprite, and Victory resource deposits into the overall project should be examined.
- Completing a desktop study on the potential impacts of ore sorting is recommended. The variable nature of the mineralisation and the fact that it is a vein-gold deposit would strongly suggest that this deposit is a candidate for ore-sorting.

1.19.4 Metallurgical Testwork

The following activities are recommended to support the detailed design of processing facility beyond the feasibility study:

- Further optimise concentrate leach residence time before the Phase 2 expansion is deployed. Consider reducing from 48 hours to 36 hours, prior to transfer of the residue to tail leach for an additional 22 hours.
- Further optimise gravity-leach flowsheet cyanide detoxification reagent consumption before operation. Focus on control of pH and cyanide decay in leach discharge for presentation to cyanide detoxification.
- Given the significant reduction in concentrate regrind energy requirement using the HIG mill signature plot (feasibility study) compared with the IsaMill signature plot (pre-feasibility study), it is recommended to further explore the difference and consider additional concentrate testing, before the Phase 2 expansion is deployed.

1.19.5 Recovery Methods

The following activities are recommended to support the design of the processing plant beyond the feasibility study:

- Additional geotechnical site investigations (both test pit and borehole methods) should be carried out at the preferred process plant site locations to validate the existing information that has been gathered on the foundation conditions associated with the proposed buildings.
- Material flowability testwork results and recommendations should be incorporated into the crushing and stockpile circuit detailed design.

1.19.6 Site Infrastructure

The following activities are recommended to support the detailed design of the site infrastructure beyond the feasibility study:

- Further confirmatory geotechnical site investigations should be carried out at the preferred surface infrastructure site locations to characterise the foundation conditions associated with the proposed buildings.
- The access road to site should be further analysed, reviewed and engineered, culminating in a detailed work package to be tendered to local contractors.
- The design of the 66 kV high-voltage powerline and substation should be further refined by NL Hydro and their selected consultants in mid-2021.

1.19.7 Water Management

The following activities are recommended to support the design of the water management systems beyond the feasibility study and into detailed design:

- progress the design of de-centralised water management in each complex (i.e., sedimentation ponds, berms, drainage ditches and outlet channels)
- maintain adequate component waterbody setbacks to account for regulatory buffers and water management infrastructure
- identify opportunities to enhance sedimentation pond volumes at select locations
- continue geochemical testing and assessment of ARD/ML to further refine parameters of potential concern
- refine assimilative capacity study of effluent meeting MDMER criteria in keeping with water management infrastructure updates
- further optimise cut and fill of water management components and/or use of surplus material
- conduct a geotechnical program at the locations of proposed water management features prior to detailed design to refine the assumptions associated with overburden, bedrock, and required grubbing

1.19.8 Tailings Management Facility

The following activities are recommended to support the design of the TMF in the next phase of study:

- Supplemental geotechnical and hydrogeological site investigations are recommended to further define the subsurface conditions and to support construction material quantity estimation.
- Geotechnical investigations should be carried out within the property boundary to identify potential borrow sources and requirements for development of the borrow areas.
- Additional in-situ permeability tests of the overburden soils and bedrock beneath the proposed dam foundations are recommended. The results of the investigation shall be used to optimise the design of the current seepage mitigation measure (i.e., upstream geomembrane liner installed on foundation).
- A site-specific seismic ground motion hazard assessment should be carried out to determine the appropriate earthquake design input parameters for dam design.
- Optimisation of the proposed dam alignment, deposition planning (including in-pit disposal at Leprechaun Pit), and construction staging should be carried out based on the findings of the geotechnical site investigations and other project developments.
- The 2020 Dam Breach and Inundation Study should be updated to support the dam classification and consideration for the updated TMF infrastructure layout.
- Detailed TMF water balance modelling should be carried out that includes monthly wet, average and dry year scenarios for each year of operation to set operating guidelines for the TMF pond. Adequate process plant-make up water supply storage will be required at start-up and before winter.
- The design of the water treatment plant and polishing pond should be optimised.
- Construction drawings and technical specifications for the first stage of construction should be developed.

1.19.9 Environment, Permitting & Community Relations

As indicated in Section 20.2.1, Marathon Gold prepared and submitted an EIS to meet the requirements of CEAA 2012, the NL EPA and the project-specific guidelines issued by the federal government and the provincial government. Upon release from the provincial and federal EA processes, numerous approvals, authorisations, and permits will be prepared and submitted for approval prior to initiating project construction. As permits can only be issued after the project is released from EA, these will be initiated at that time. However, some long-lead items are currently being initiated such as the Fisheries Act authorisation application. A detailed list of anticipated permitting is provided in Chapter 20. Compliance with terms and conditions of approvals, standards contained in federal and provincial legislation and regulations, and commitments made during the EA processes (including application of mitigation measures and monitoring and follow-up requirements), will need to be addressed throughout project planning, construction, operation, and decommissioning. Approvals, authorisations, and permits will be required prior to initiating project construction. A complete list of anticipated permitting and approval activities is provided in Chapter 20. Permits can only be issued after the project is released from EA. Key permitting activities are described below:

- To reduce potential scheduling delays a Fisheries Act Authorisation Application is currently being prepared prior to the release from the EA processes. This authorisation will be prepared in accordance with Section 35 (2) of the *Fisheries Act* to receive authorisation to cause Harmful Alteration and Disruption to fish habitat as a result of the project. Regulatory consultation will be completed with key stakeholders and indigenous groups as part of the Fisheries Act authorisation and offsetting plan.

- Baseline Environmental Effects monitoring project as part of the Metal and Diamond Mining Effluent Regulations is planned for 2021.
- Marathon Gold will continue to engage with regulatory authorities throughout project planning to confirm permitting requirements.
- Municipal approvals, authorisations, and permits are not anticipated, as the project is not located within a municipality.
- Marathon Gold currently has mineral licenses and a range of permits in place for their existing exploration activities and accommodations camp.

The environmental and community consultation work required to advance the project to the detailed design stage is being conducted as part of the information request response and will be part of the upcoming baseline environmental effects monitoring planned for summer 2021.

2 Introduction

2.1 Terms of Reference & Purpose of this Report

This report was prepared by Ausenco Engineering Canada Inc. (Ausenco) for Marathon Gold to summarise the results of the N.I. 43-101 Technical Report and Feasibility Study of the Valentine Gold Project. The report was prepared in compliance with the Canadian disclosure requirements of National Instrument 43-101 (N.I. 43-101) and in accordance with the requirements of Form 43-101 F1.

The feasibility study was prepared in accordance with N.I. 43-101 Standards of Disclosure for Mineral Projects. Readers are cautioned that the feasibility study report is preliminary in nature.

John T. Boyd Company (BOYD), APEX Geoscience Ltd. (APEX), Stantec Consulting Ltd. (Stantec), Moose Mountain Technical Services (Moose Mountain), Golder Associates Ltd. (Golder) and GEMTEC Consulting Engineers and Scientists Ltd. (GEMTEC) provided input to the report, and the individuals presented in Table 2.1, by virtue of their education, experience, and professional association, are considered Qualified Persons (QPs) as defined by N.I. 43-101. The QPs meet the requirement of independence defined in N.I. 43-101.

2.2 Units of Measurement

All units of measurement in this report are metric and all currencies are expressed in Canadian dollars (C$ or CAD) unless otherwise stated. Contained gold metal is expressed as troy ounces (oz), where 1 oz = 31.1035 g. All material tonnes are expressed as dry tonnes (t) unless stated otherwise.

2.3 Site Visits

The most recent site visit dates for each of the qualified persons are listed in Table 2.1.

Table 2.1: Report Contributors

Qualified Person	Professional Designation	Position	Employer	Independent of Marathon Gold	Date of Last Site Visit	Report Sections
Paul Staples	P.Eng. (NL)	VP and Global Practice Lead	Ausenco Engineering Canada	Yes	Feb. 6, 2020	1.1, 1.3, 1.10, 1.14, 1.15.1, 1.15.2, 1.15.4, 1.15.5, 1.17.1, 1.17.2, 1.18, 1.19.1, 1.19.4, 1.19.5, 1.19.6, 2, 5, 13, 17, 18.1 to 18.5, 18.9.2 to 18.9.5, 18.10, 19, 21 (except 21.2.2, 21.2.4, 21.3.1, 21.3.5.2, 21.4.2 and 21.4.4), 22, 23, 24, 25.7, 25.8, 25.10 to 25.12, 26.1, 26.5, 26.6, 26.7, 27
Robert J. Farmer	P.Eng. (NL)	Vice President	John T. Boyd Company	Yes	Oct. 29, 2019	1.11, 14, 26.3
Roy Eccles	P.Geo. (NL), P.Geol. (AB)	Chief Operations Officer and Senior Consulting Geologist	APEX Geoscience Ltd.	Yes	Oct. 16, 2019	1.2, 1.4 to 1.9, 1.19.2, 3, 4, 6, 7, 8, 9, 10, 11, 12, 25.1 to 25.5, 26.2
Sheldon Smith	P.Geo. (NL & ON)	Principal, Senior Hydrologist	Stantec Consulting Ltd.	Yes	Oct. 15-17, 2012	1.15.7, 1.16, 1.19.7, 1.19.9, 18.9.1, 18.9.6, 20, 26.8, 26.10
Marc Schulte	P.Eng. (NL)	Mining Engineer	Moose Mountain Technical Services	Yes	Oct. 29, 2019	1.12, 1.13, 1.17.3, 1.19.3, 15, 16, 21.2.2, 21.3.1, 21.4.2, 25.6, 26.4
Peter Merry	P.Eng. (NL), P.Eng. (ON), P.Eng. (NT, NU)	Principal	Golder Associates Ltd.	Yes	Oct. 29, 2019	1.15.3, 1.15.6, 1.19.8, 18.7, 18.8, 21.2.4, 21.3.5.2, 21.4.4, 25.9, 26.9
Shawn Russell	P.Eng. (NL)	Senior Geotechnical Engineer	GEMTEC Consulting Engineers and Scientists Ltd.	Yes	Sep. 11, 2020	18.6.1, 18.6.2
Carolyn Anstey-Moore	P.Geo. (NL); P.Geo. (NB)	Senior Environmental Geoscientist	GEMTEC Consulting Engineers and Scientists Ltd.	Yes	July 12-14, 2020	18.6.3

3 Reliance on Other Experts

The authors of this report have assumed and relied on the fact that all the information and technical documents listed in Chapter 27, References, are accurate and complete in all material aspects. While the authors have carefully reviewed, within the scope of their technical expertise, all the available information presented to them, they cannot guarantee its accuracy and completeness. The authors reserve the right, but will not be obligated to, revise the technical report and its conclusions if additional information becomes known to them after the effective date of this report.

The authors are not experts with respect to legal, socio-economic, land title, or political issues, and are therefore not qualified to comment on issues related to the status of permitting, legal agreements, and royalties. Information related to these matters has been provided directly by Marathon Gold or via Marathon Gold News Releases during the preparation of this report (March to April 2021) and include, without limitation, validity of mineral tenure, status of environmental and other liabilities, and permitting to allow completion of annual assessment work. These matters were not independently verified by the QPs but appear to be reasonable representations that are suitable for inclusion in Chapter 4 of this report. Furthermore, the authors have not attempted to verify the legal status of the property; however, the Government of Newfoundland and Labrador, Natural Resources' online mineral claims staking system, Mineral Rights Administration System (MIRIAD), reports that the Marathon Gold mineral claims are active and in good standing at the effective date of this report.

4 Property Description & Location

4.1 Location

The Valentine Lake property is in the west-central region of the island of Newfoundland, Canada, within National Topographic System map sheets: 12A/06 and 12A/07 (Figure 4-1). The centre of the property is located at Universal Transverse Mercator 494550 m Easting and 5362789 m Northing, Zone 21, North American Datum 1983, (NAD83 Zone 21). T

The property is 100% owned by Marathon Gold and hosts five gold deposits, namely Leprechaun, Marathon, Sprite, Victory, and Berry, as well as several other early-stage gold prospects. The collective deposits and occurrences are located within a 20 km long northeast-trending zone known as the Valentine Gold Project.

Figure 4-1: Island of Newfoundland & Location of the Valentine Lake Property

Source: Marathon Gold, 2020.

4.2 Property Description

4.2.1 Governance

The Newfoundland-Labrador (NL) Mineral Lands Division of the Department of Natural Resources is responsible for the administration of mineral land tenure, which includes issuance of mineral licenses, exploration approvals, and mining leases. A mineral license grants the licensee exclusive right to explore for minerals in, on, or under the area of land described in the license. Mineral licenses are registered through the Mineral Claims Recorders Office. Mineral licenses are comprised of individual 500 m^2 claim blocks that are arranged on a standard reference.

Mineral licenses can be grouped if the following conditions are met:

- they are held by one company/individual
- the licenses are adjoining and total no more than 256 claims
- the first-year assessment work report has been filed
- no 12-month extensions exist on any license

The acquisition of Mineral Rights in NL is by online map staking using the Province's MIRIAD system. Each claim in a mineral license requires a fee of C$65; this includes a C$15/claim staking fee and a C$50/claim security deposit, which is refunded upon completion and submission of the first-year assessment requirements.

Each mineral license is issued for a five-year term and may be held for a maximum of 30 years if the annual assessment work is completed, and renewal fees are paid. The minimum expenditure per claim increases each year from Years 1 to 5 and is then subject to increases in five-year increments (see Table 4.1). Renewal fees are due on the anniversary date in assessment Years 5, 10, 15, and Years 20 to 30 (see Table 4.1). For the mineral license to remain in good standing, the minimum annual assessment work must be completed on or before the anniversary date. The assessment report must then be submitted within 60 days after the anniversary date.

Excess assessment work above what is required in any one year is carried forward as a credit to the mineral license. Excess expenditure credit incurred in Years 1 to 20 can be carried forward for a maximum of nine years; however, no excess credits can be carried past Year 20. Excess expenditure incurred in Years 21 to 30 can be carried forward for a maximum of five years.

Table 4.1: NL Mineral Claim Renewal Fees & Minimum Expenditures

Assessment Year(s)	Minimum Expenditure per Year (C$ per claim)	Renewal Fees (C$ per claim)
1	200	-
2	250	-
3	300	-
4	350	-
5	400	25
6 through 10	600	50 (Payable in Year 10)
11 through 15	900	100 (Payable in Year 15)
16 through 20	1,200	-
21 through 25	2,000	200 (Payable every year)
26 through 30	2,500	

The mineral license holder may convert any part of a mineral license to a mining lease, providing the following conditions are met:

- The equivalent of the first three years of assessment work has been completed and accepted by the Department of Natural Resources and the claim is in good standing.
- The applicant demonstrates to the satisfaction of the Minister of Natural Resources that a mineral resource exists under the area of application and that the mineral resource is of significant size and quality to be potentially economic.
- Confirmation by a Qualified Person that the mineral resource exists and is of significant size and quality to be potentially economic.
- The application for a mining lease is accompanied by a legal survey of the relevant area.

Mining leases are charged an annual rental of C$120/ha, payable in advance. In addition, the first-year rental must be paid, and the lease boundary surveyed before the lease is issued by the minister. A mining lease issued under the *Mineral Act* confers upon the lessee the exclusive right to develop, extract, remove, sell, mortgage, or otherwise dispose of all unalienated minerals described in the lease, subject to registration under NL's *Environmental Protection Act* and in compliance with applicable regulations.

Mineral licenses do not include surface rights. For a mining project, the license holder must obtain surface rights, including rights of way, sufficient to cover the entire footprint of the mine and related infrastructure. Provisions for granting surface rights are included in the *Mineral Act*. The surface lease application is reviewed by the Minister of Natural Resources in consultation with the Minister appointed to administer the *Lands Act*.

4.2.2 Valentine Lake Property

The Valentine Lake property consists of 14 contiguous mineral licenses for a landholding of 240 km^2 or 24,000 hectares (see Figure 4-2). The status of the Valentine Gold mineral licenses, numbers, renewal dates, and annual exploration expenditures is shown in Table 4.2. The mineral licenses in Table 4.2 are all 100% controlled by Marathon Gold and are in good standing as of the effective date of this report (as per mineral land tenure records at the NL Department of Natural Resources).

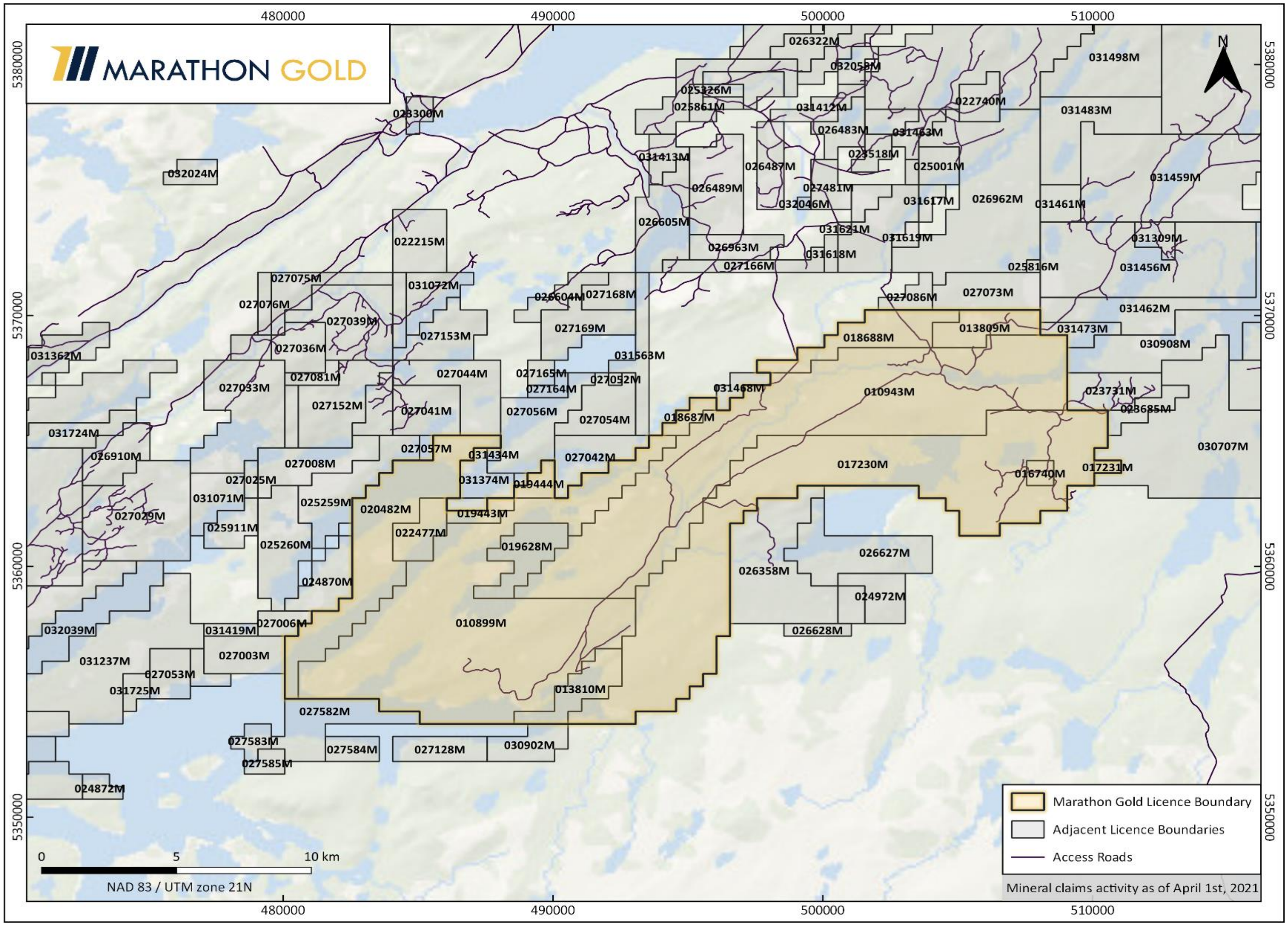
4.3 Exploration Program Permits & Approvals

An Application for Exploration Approval and Notice of Planned Mineral Exploration Work must be submitted for approval by the NL Department of Natural Resources prior to conducting exploration on a mineral license.

Exploration work requiring a Mineral Exploration Approval Permit includes fly camps (occupation period of less than 90 days), water use, prospecting, mapping, line cutting, drilling, trenching, bulk sampling, geochemical surveys, airborne geophysical surveys, motorised vehicle use, and fuel storage.

For camps with occupancy of more than 90 days, a Temporary License to Occupy must be approved by the Department of Environment and Conservation. Information provided in the Application for Exploration Approval is used to approve a Water Use License.

Figure 4-2: Marathon Gold Project Mineral Licenses



Source: Marathon Gold, 2021.

Table 4.2: Valentine Lake Property License Summary

License ID	Issuance Date	Years Held	Renewal Date	No. Claims	Area km²	Expenditures Required (C$)	Expenditure Due Date
010899M	27-Apr-04	16	27-Apr-24	246	61.5	492,000.00	28-Apr-25
010943M	27-Apr-04	16	27-Apr-24	256	64	512,000.00	28-Apr-25
013809M	06-Sep-07	13	06-Sep-22	18	4.5	18,079.33	06-Sep-24
013810M	06-Sep-07	13	06-Sep-22	19	4.75	9,228.76	06-Sep-23
017230M	09-Feb-10	11	10-Feb-25	256	64	156,798.02	09-Feb-27
017231M	09-Feb-10	11	10-Feb-25	2	0.5	2,187.40	09-Feb-27
018687M	29-Mar-11	10	30-Mar-26	6	1.5	4,426.33	29-Mar-27
018688M	29-Mar-11	10	30-Mar-26	29	7.25	32,450.55	29-Mar-27
016740M	26-Nov-09	11	26-Nov-24	4	1	1,160.03	26-Nov-26
019443M	17-Oct-11	10	18-Oct-21	6	1.5	2,823.45	17-Oct-27
019444M	17-Oct-11	10	18-Oct-21	6	1.5	2,823.45	17-Oct-27
019628M	29-Dec-11	10	29-Dec-21	21	5.25	23,926.33	29-Dec-29
020482M	08-Oct-12	9	08-Oct-22	77	19.25	21,454.91	08-Oct-25
022477M	06-Nov-14	7	06-Nov-24	14	3.5	11,514.46	06-Nov-28
			Totals	960	240	1,290,873.02	

Source: Newfoundland-Labrador, Department of Natural Resources, Mineral License Status Report, February 10, 2020.

Exploration activities are subject to the following permits:

- A temporary camp requires a license of operation from the Department of Fisheries and Land Resources.
- The use of all-terrain vehicles is subject to the possession of a license of occupation for the property.
- A permit obtained from the Water Resources Division of the Department of Environment and Climate Change is required before drilling can take place on any watercourse or body of water.
- Blasting requires a valid blasters certificate issued by the Department of Environment and Climate Change.

Under the provisions of the *Mineral Act* (1990), Marathon Gold has the right to conduct exploration for minerals on the property. Marathon Gold has indicated to APEX that all the necessary permits are in place to conduct mineral exploration and complete their annual assessment work.

4.4 Surface Rights

Marathon Gold does not own the surface rights to the property. In the province of NL, a mining operator must obtain surface rights, including rights of way, sufficient to cover the entire footprint of the mine and related infrastructure (see Section 4.2.1, Governance).

4.5 Royalties & Other Agreements

Gold production from the property is subject to the following royalty agreements:

- A 7.5% net profits interest (NPI) royalty is payable to Reid Newfoundland Company for gold recovered from the Leprechaun and Sprite deposits, and part of the Berry deposit.
- A 2% net smelter return (NSR) is payable to Mr. Kevin Keats for gold recovered from mineral license 016740M for which no mineral resource estimate is available.
- In February 2019, Marathon Gold announced the company had sold a 2% NSR royalty to Franco-Nevada Corporation; the NSR royalty applies to the entire Valentine Lake property and covers the sale of precious and base metals and minerals (Marathon Gold, 2019). Marathon Gold has the option to buy back 0.5% of the NSR royalty until December 31, 2022 for a price of US$7 million.

APEX is not aware of any other royalties, back-in rights, payments, or other agreements and encumbrances to which the property is subject.

4.6 Environmental Liabilities

The NL Environmental Assessment Regulations (2003) states that all undertakings that will be engaged in the mining, beneficiating, and preparing of a mineral as defined in the *Mineral Act* shall be registered for environmental assessment. The *Environmental Protection Act* states that the purpose of environmental assessment is to "protect the environment and quality of life of the people of the province; and facilitate the wise management of the natural resources of the province". The environmental assessment process ensures that projects proceed in an environmentally acceptable manner, and mining projects are asked to describe the anticipated impact of their project on businesses and employment in the province.

The property is located within the Victoria Lake Steadies Waterfowl area. For known waterfowl staging areas, a minimum of 30 m must be left as a buffer from the water’s edge with at least 20 m of established forest. Exploration activity within a waterfowl-sensitive area that may cause disturbance (e.g., drilling, line cutting, or blasting) should be avoided during May to mid-July. There is no information available at the Department of Natural Resources regarding the location or species proximal to or within the property, therefore Marathon Gold has initiated a local waterfowl baseline study. The NL Environmental Protection Guidelines (2018) states that no clearing activity is to occur within 800 m of a bald eagle or osprey nest during the nesting season (May 15 to July 31) and 200 m outside of the nesting season. All hardwoods within 30 m of a body of water occupied by beavers are to be left standing.

With respect to regulations pertaining to protected water supply areas, any development of protected or unprotected public water supply areas requires written approval from the Water Resources Division, Provincial Department of Environment and Climate Change. Stream alterations require approval from the Water Resources Division, Provincial Department of Environment and Climate Change and the Federal Department of Fisheries and Oceans (i.e., authorisation for works or undertakings affecting fish habitat).

Several acts and regulations are applicable to the project, as noted in Chapter 20, Environmental Studies, Permitting and Social or Community Impact, and these will be addressed throughout the EA and permitting processes.

5 Infrastructure & Physiography

5.1 Accessibility

Access to the site is via existing roads. An 84 km gravel road from site leads to the Town of Millertown (see Figure 5-1). From Millertown, the Buchans Highway can be accessed, which itself is connected to the Trans-Canada highway. The Trans-Canada highway crosses the island of Newfoundland from east to west, connecting the major cities and towns. Using this route, the Marathon Gold regional office in Grand Falls Windsor (central Newfoundland) can be accessed as well.

Total travel time by road from Grand Falls Windsor to site is approximately four hours. The nearest airport is in Gander. Helicopter access to site is also possible, from Gander. With reference to Figure 5-1, the project site can be identified by the marker “Valentine Lake Property”.

There are two potential shipping ports, one to the west (Turf Point Port at the Town of St. George’s) and one to the north (Goodyear’s Cove Port at the Town of South Brook) of the site. The former was used to ship copper and zinc concentrates for the Duck Pond Mine between 2007 and 2015. Other major shipping ports on the island of Newfoundland are in St Johns and Port O’Basques.

5.2 Proximity to Population Centre

Newfoundland and Labrador is a province with a population of 520,000, of which more than half is on the Avalon Peninsula on the eastern side of the province. The largest town in Newfoundland is its capital, St. John’s and the largest regional town is Grand Falls-Windsor. Several towns between the project site and Grand Falls-Windsor will service the mining operation, such as Buchans, Millertown. Buchans Junction and Badger.

5.3 Physiography

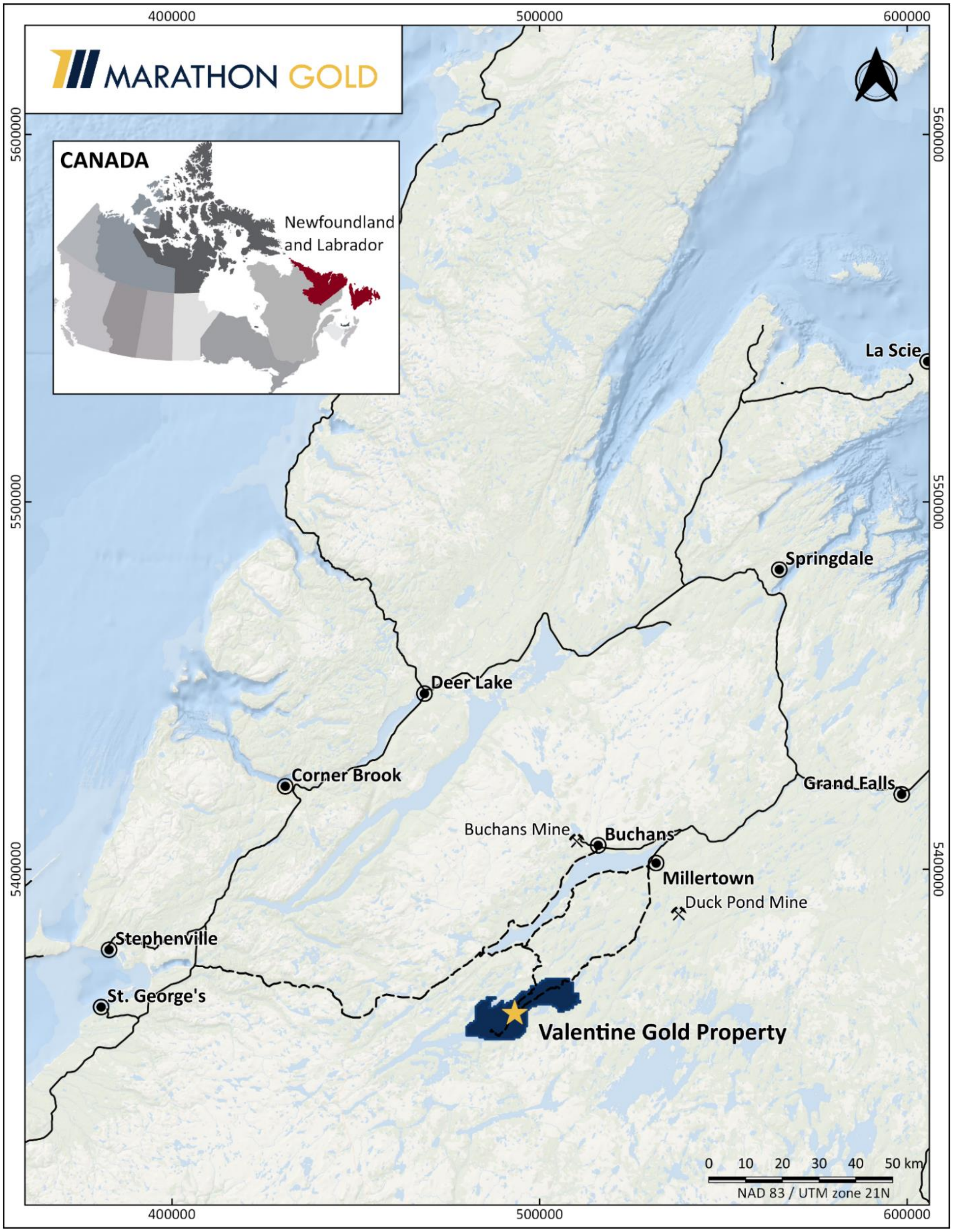
The project is typified by gentle to moderately steep, hilly terrain. The project is situated at the southern end of Valentine Lake. Numerous small ponds occur within the property, and a distinct northeast-trending ridge occurs along the length of the property, dissected by shallowly incised ephemeral streams.

Elevation in the property varies from 320 masl (level of Victoria Lake) to 480 masl. Boggy ground covers a plateau in the central part and the northwest of the ridgeline. The remainder of the central ridgeline is mostly spruce and fir forest, with grassy clearings. Outcrops are mostly in streambeds and banks, with some occurrences along the ridgeline. However, the overburden layer along ridge areas is thin, providing abundant outcrop exposure in numerous excavated trenches.

5.4 Climate

Local climate is temperate maritime, which means it has typically mild summers and cold winters. The weather station at Buchans shows an annual average precipitation of 1,100 mm, of which slightly more than one-fourth falling as snow with up to 1 m or more of accumulation. Regarding temperatures, the historical average summer temperature is 14°C, and average winter temperature is -6°C. At times, short-term extreme temperatures can be observed at the project site, which have been accounted for in the project design, for a winter minimum of -26°C and the summer maximum temperature of 30°C.

Figure 5-1: Infrastructure & Accessibility at the Valentine Gold Project



Source: Marathon Gold, 2020.

Figure 5-2: Marathon Deposit looking SW to the Sprite Zone, including Visible Outcrops of QTP-Au Veining

Source: Marathon Gold, 2020.

5.5 Infrastructure

The property is already equipped with an exploration camp in the south with a maximum occupancy of 65 people. Power for the existing camp is provided by a diesel generator and includes back-up generators in the event the main generator fails. The camp consists of accommodation quarters, a mess hall, cold/dry storage, core cutting, core shed and offices. Permitted and gated access roads from the camp to the exploration points have been developed by Marathon Gold and their predecessors.

Regarding power sources for the project, NL Hydro has advised that the hydroelectric power stations 40 km north at Star Lake are the nominated source of incoming power for the project, as developed with NL Hydro. Sufficient raw water is available for potential mining operations, notwithstanding the relevant permitting requirements.

5.6 Local Resources

Mining is not a new industry in Newfoundland and Labrador, with numerous operations in production around the province. Skilled personnel are available in the province, as well as suppliers and contractors in central Newfoundland communities, such as Millertown, Springdale, Grand Falls-Windsor, Badger and Buchans. Mineral exploration companies and local government are practicing strategies to attract, recruit, diversify, and retain skilled mining workers.

6 History

6.1 Exploratory Ownership History

The property has historically been explored by several companies since the 1960s (see Table 6.1). The region was originally explored for base metals exploration by ASARCO Inc. and Hudson's Bay Oil and Gas Company; this exploration was consistent with historically significant base metal discoveries in the Dunnage Zone (e.g., Buchan's and Duck Pond-Boundary Cu-Zn±Au past-producing deposits).

The Valentine Lake property was first recognised as a gold prospect by Abitibi in 1983 and was acquired by BP in 1985. Noranda acquired the property from BP in 1992, prior to entering into a joint venture agreement with Mountain Lake Resources (MOA) in 1998.

Table 6.1: Summary of Ownership History

Date	Operator
1960s	ASARCO Inc.
1970s to 1983	Hudson's Bay Oil and Gas Company
1983-1985	Abitibi Price Inc.
1985-1992	BP Canada Inc.
1992-1998	Noranda Inc.
1998-2003	Mountain Lake Resources Inc.
2003-2007	Richmont Mines Inc.
2007-2009	Mountain Lake Resources Inc.
2009-2010	Marathon PGM Corporation
2010-Present	Marathon Gold Corporation

In 2002, MOA earned a 50% interest in the property and retained an option to acquire a 100% interest by expending $2.5 million on exploration within five years, and either paying $1 million or issuing one million shares to Noranda. Noranda retained a 2% NSR royalty on base metal production, and a 3% NSR royalty on precious metal production. A 7.5% NPI royalty was retained by Reid Newfoundland Company Inc. on Reid Lots 227 and 229.

In November 2003, Richmont entered into an option agreement with MOA, whereby Richmont had the option to acquire a 70% interest in the property by expending $2.5 million in exploration by October 31, 2007. Richmont relinquished its role as operator in October 2007 to MOA. In March 2008, MOA acquired the remaining interest in the property from Noranda.

In February 2009, an agreement was reached between Richmont and MOA in which MOA had the option to acquire a 100% interest in the property. Subsequently, in December 2009, MOA entered into an option and joint venture agreement with Marathon PGM Corporation (MAR), under which MAR was granted the option to earn a 50% interest in the property. MAR became the operator in 2010.

In November 2010, MAR was acquired by Stillwater Mining Company. The gold properties held by MAR, including the subject property, were amalgamated into a new company, Marathon Gold Corp. (Marathon Gold), which commenced trading in December 2010. In January 2011, Marathon Gold funded MOA's commitments to Richmont under the February 2009 agreement. Marathon Gold later acquired a 100% interest in the property upon acquiring all outstanding shares in MOA in July 2012.

6.2 Historical Exploration

Between 1960 and 2010, the various historical operators completed a variety of soil sampling, surface stripping and channel sampling, ground and airborne geophysical surveys, and geological mapping (Murahwi, 2017) which are summarised in Sections 6.2.1 to 6.2.6. In addition, the NL Department of Natural Resources, Mines and Energy Branches conducted 1:50,000-scale geological mapping from 1970 to 1983.

Drilling for gold mineralisation was first conducted in the late 1980s by BP (see Table 6.2). This ultimately led to an initial mineral resource estimate on the Leprechaun deposit by Richmont in 2004 (Murahwi, 2017). This historical resource is (1) not compliant with Canadian Institute of Mining, Metallurgy and Petroleum (CIM) Definition Standards; (2) not considered relevant by Marathon Gold or the authors; and (3) superseded by the mineral resource estimate presented in this report.

Table 6.2: Summary of Historic Drillholes Completed by Other Companies

Operator	Date	No. of Drill Collars	Metres
ASARCO Inc.	1960-1983	4	Not Known
BP Canada Inc.	1986-1991	47	5,974.0
Mountain Lake	1998-1999	29	3,645.0
	2002	9	1,041.0
Richmont	2003-2004	24	6,965.0
	2005	8	1,745.5
	2007	8	2,280.0
Mountain Lake	2009	11	1,908.0
Totals		140	23,558.5

Between 2010 and the present, MAR and later Marathon Gold, continued to expand the mineral resource at Leprechaun and made significant new discoveries at the Marathon, Sprite, and Victory deposits. Mineral resource estimates were subsequently issued for each of these new discoveries (see Section 6.3). Marathon Gold's exploration work and drill programs from 2010 onwards are presented in Chapters 9 and 10 of this report.

A summary of work completed by the historical operators is provided in the subsections below, as summarised from the Micon Report (Murahwi, 2017). The summary provides details about exploration work conducted largely within the boundaries of the current Valentine Lake property.

6.2.1 ASARCO Inc. & Hudson's Bay Oil & Gas (1960 to 1983)

Between 1960 and 1983, ASARCO and Hudson's Bay targeted base metal mineralisation at the Valentine Lake property. Reconnaissance geological mapping and soil and stream sediment sampling completed by ASARCO resulted in the identification of a 1 m wide quartz-pyrite-chalcopyrite vein, which was tested with four short diamond drillholes (lengths not known), a 1 km^2 soil sampling, and very low frequency electromagnetic (VLF-EM) survey. ASARCO determined that the vein pinched out 30 m below surface. The vein is in the brook draining from Frozen Ear Pond although exact coordinates are unknown. In 1966, an airborne EM magnetic survey was flown by Canadian Aero Mineral Surveys Ltd., but the results were not publicly reported.

Hudson's Bay commissioned an Aerodat airborne EM magnetic survey in 1980; however, the area that was surveyed and survey results are not known. Follow-up work did not produce significant results.

6.2.2 Abitibi Price Inc. (1983 to 1985)

Abitibi completed a 400 m x 25 m spaced soil sampling survey targeting gold mineralisation over the Valentine Lake Intrusion, southeast of Valentine Lake. The survey defined gold anomalies; however, Abitibi did not follow up on the anomalies. Results and locations of the Abitibi surveys are not known.

6.2.3 BP Canada Inc. (1985 to 1992)

BP advanced the gold-in-soil anomalies identified by Abitibi through grab rock sampling and geological mapping over a 20 km strike length. A 13 km long zone was prioritised and subjected to 100 m spaced line cutting to allow further geological mapping, soil sampling, and VLF-EM and magnetic geophysical surveys.

BP identified gold prospects at the Leprechaun and Victory deposits (Victory was formerly known as Valentine East). A diamond drillhole program that drilled 47 drillholes totalling 5,974 m was completed at Leprechaun. Significant intercepts from this program included 23.1 m at 4.6 g/t gold and 9.6 m at 0.1 g/t gold (estimated true widths). Overall, the drilling identified gold mineralisation over a strike length of 3 km. A small-scale induced polarisation survey was conducted at Leprechaun by BP; however, the results and locations of the survey are unknown.

6.2.4 Noranda Inc. (1992 to 1998)

Noranda's exploration programs between 1992 and 1998 included a soil and till sampling program over the Quinn Lake area; line cutting, geological mapping, an airborne EM survey and resampling of historical drill core in the Long Lake area, as well as compilation of historical grab sampling and drill core data. The soil and till sampling programs defined a large area of gold and base metal anomalies proximal to Quinn Lake.

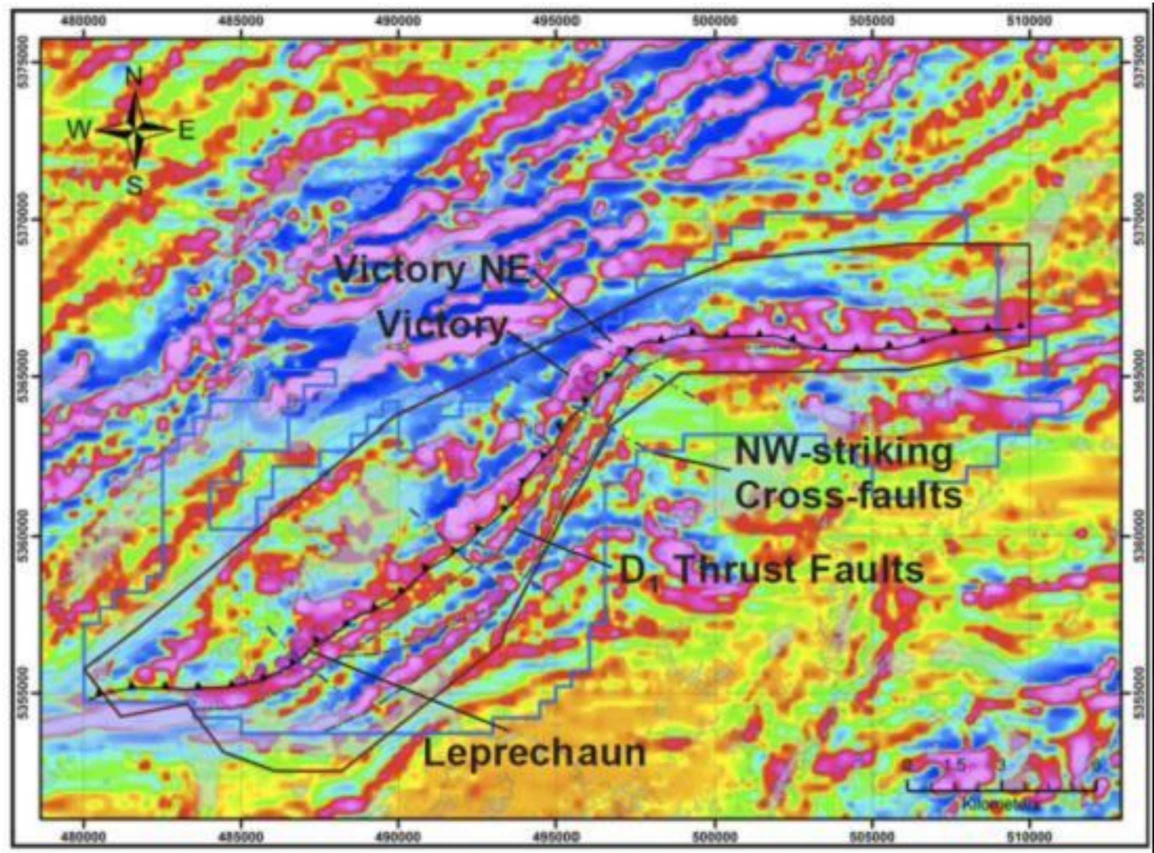
6.2.5 Mountain Lake Resources Inc. & Richmont (1998 to 2007)

MOA and Richmont conducted several drill programs between 1998 and 2007 totalling 78 diamond drillholes for 15,676.5 m. The drilling was focused on the Leprechaun and Valentine East zones, as well as exploratory holes elsewhere along the 20 km long mineralised trend, including the Sprite prospect and along-strike extensions of the Leprechaun and Valentine Lake prospects. In December 2004, the results of drilling were used to prepare a maiden resource estimate for Leprechaun.

MOA conducted a helicopter-borne magnetic, radiometric, and VLF-EM survey over the entire project area in 2007. Interpretation of the magnetic data (see Figure 6-1) has identified the large-scale structural features of the property, including the regional scale Valentine Lake Shear Zone and late northwest striking normal faults. Other results and interpretations of the geophysical surveys are discussed in more detail in Chapter 9, Exploration.

The historical mineral resource estimate in Table 6.3 is superseded by the mineral resource estimate presented in Chapter 14 and is not considered relevant. A qualified person has not done sufficient work to classify the historical estimate as current mineral resource and the issuer and the authors of this report are not treating the historical estimate as a current mineral resource.

Figure 6-1: First Vertical Derivative Aeromagnetic Data for the Valentine Lake Property



Source: SRK, 2014

Table 6.3: Historical Mineral Resource Estimate, Leprechaun Deposit

Effective Date	Operator	Deposit	Category	Tonnage (Mt)	Grade (Au g/t)	Contained Gold (koz)	Reference
December 15, 2004	Richmont	Leprechaun	Inferred	1.3	8.5	359	Pilgrim, 2005

Notes: 1. CIM definitions were followed for mineral resources. 2. The estimate was carried out using the polygonal method. 3. Mineral resources are estimated at a cut-off grade of 0.5 g/t gold. 4. A long-term gold price of US$425 per ounce was used for this mineral resource estimate. 5. A minimum mining width of 3 m was used. 6. A top cut of 58 g/t gold was applied to composites based on statistical analysis. 7. Numbers may not add due to rounding.

In 2007, Geophysics GPR International was commissioned to conduct an airborne magnetic, radiometric, and VLF-EM survey comprising 1766-line kilometres at a 100 m line spacing. Results are discussed in Chapter 9, Exploration.

Eight diamond drillholes were completed in 2007 to test mineralisation identified outside of the VLIC, with one significant intercept of 7.4 m at 1.3 g/t gold (394.1 m to 401.5 m, VL07-123) including 0.9 m at 8.3 g/t gold (400.6 to 401.5 m).

6.2.6 Mountain Lake & Marathon PGM (2007 to 2010)

Exploration work between late 2007 and 2008 was limited to geological mapping, prospecting, and soil sampling at Quinn Lake and Victoria Dam. The results of this work were insignificant, and no follow-up work was conducted.

In 2009, 11 drillholes were completed (see Table 6.2 above) to test exploration targets north of Leprechaun; however, this drilling did not return any significant results.

Micon was retained by Marathon PGM to prepare a mineral resource estimate for the Leprechaun deposit, with an effective date of December 11, 2010 (see Table 6.4). The mineral resource estimate in Table 6.4 is superseded by the mineral resource estimate in Chapter 14 of this Technical Report and is not being treated by the issuer or the authors as a current mineral resource estimate.

Table 6.4: Historical Mineral Resource Estimate for the Leprechaun Deposit, December 11, 2010

Effective Date	Deposit	Category	Tonnage (Mt)	Grade (Au g/t)	Contained Gold (koz)	Reference
December 11, 2010	Leprechaun Pond	Measured	2.1	2.8	187	Gowans, Murahwi and Shoemaker, 2011
		Indicated	1.2	2.4	90	
		Inferred	4.4	2.0	285	

Notes: **1.** CIM definitions were followed for mineral resources. **2.** The estimate was carried out using a kriging method. **3.** Mineral resources are estimated at a cut-off grade of 0.5 g/t gold. **4.** A long-term gold price of US$1,000 per ounce was used for this mineral resource estimate. **5.** A minimum mining width of 3 m was used. **6.** Composites were based on uncapped assays, but the influence of high-grade gold assays was limited by conditions applied to the search ellipse. **7.** Numbers may not add due to rounding.

The mineral resource estimate summarised in Table 6.4 was prepared in accordance with CIM Definition Standards but is superseded by the mineral resource estimates presented in Chapter 14 of this report. The issuer and authors are not treating the mineral resource estimate in Table 6.4 as current mineral resources.

6.3 Previous Mineral Resource Estimates Issued by Marathon Gold

Exploration work conducted by Marathon Gold is discussed in Chapters 9 and 10. Marathon Gold's exploration work between 2010 and the present included making significant new discoveries throughout the Valentine Gold Property and preparing five near-surface, mainly pit-shell constrained, deposits with various resource classifications (i.e., Marathon, Leprechaun, Sprite, Victory and Berry gold deposits). The five deposits identified to date occur over a 20 km system of gold-bearing veins, with much of the 24,000 ha property having had only minimal exploration activity to date.

During this period, Marathon Gold issued several mineral resource estimates as the exploration work progressed (Tables 6.5 to 6.12).

Note: The mineral resource estimates were prepared in accordance with CIM Definition Standards but are historical and are superseded by the mineral resource estimations presented in Chapter 14 of this report. The mineral resource estimates in Tables 6.5 to 6.13 are not being treated by the issuer or the authors as a current mineral resource estimate.

Table 6.5: Summary of January 9, 2012 Historical Mineral Resource Estimate

Effective Date	Deposit	Category	Tonnage (Mt)	Grade (Au g/t)	Contained Gold (koz)	Reference
January 9, 2012	Leprechaun	Measured	1.4	1.9	84	Gowans, Murahwi and Stubens, 2012
		Indicated	5.1	2.1	340	
		Inferred	5.7	1.7	305	

Notes: **1.** The estimate was carried out using ordinary kriging. **2.** Mineral resources are estimated at a cut-off grade of 0.5 g/t gold. **3.** A long-term gold price of US$1,300 per ounce was used for this mineral resource estimate. **4.** Composites were capped using statistical analysis per domain. **5.** Numbers may not add due to rounding.

Table 6.6: Summary of October 22, 2012 Historical Mineral Resource Estimate

Deposit / Category	Open Pit (0.50 g/t Au cut-off)			Underground (1.5 g/t Au cut-off)			Total		
	Tonnes (kt)	Grade (g/t Au)	Gold (koz)	Tonnes (kt)	Grade (g/t Au)	Gold (koz)	Tonnes (kt)	Grade (g/t Au)	Gold (koz)
Leprechaun Deposit									
Measured (M)	2,890	2.25	209	141	3.34	15	3,033	2.3	224
Indicated (I)	5,270	2.07	352	1,230	2.69	106	6,505	2.19	458
M+I	**8,166**	**2.14**	**561**	**1,371**	**2.75**	**121**	**9,537**	**2.22**	**682**
Inferred	900	1.93	56	1,062	2.6	89	1,959	2.3	145

Notes: 1. CIM Definition Standards were followed for mineral resources. 2. The Qualified Person for the Leprechaun mineral resource estimate is Rosmery Cárdenas, MAusIMM CP (Geo.). 3. Open pit mineral resources are reported at a cut-off grade of 0.5 g/t Au. Pit optimisations were used to constrain the resources. 4. Underground mineral resources are estimated at a cut-off grade of 1.5 g/t Au, beneath the open pit constraint. 5. Mineral resources are estimated using an average long-term forecast, gold price of US$1,500 per ounce and an exchange rate of US$:C$ of 1:1. 6. Totals may not add correctly due to rounding.

Table 6.7: Summary of August 1, 2013 Historical Mineral Resource Estimate

Effective Date	Deposit	Category	Tonnage (Mt)	Grade (Au g/t)	Contained Gold (koz)	Reference
August 1, 2013	Leprechaun	Measured	3.6	2.3	263	Valliant 2013
		Indicated	7.0	2.3	511	
		Inferred	1.6	2.8	139	
	Victory (Open Pit)	Measured	-	-	-	Valliant, 2013
		Indicated	0.8	1.7	41	
		Inferred	0.2	1.5	9	

Notes: **1.** The estimate was carried out using ordinary kriging. **2.** Mineral resources are estimated at a cut-off grade of 0.5 g/t gold for Leprechaun open pit and 0.6 g/t gold for Victory. Pit optimisations were used to constrain the resources. **3.** Underground mineral resources are estimated at a cut-off grade of 2.0 g/t gold, beneath the open pit constraint and inside high-grade wireframe models. **4.** A long-term gold price of US$1,350 per ounce was used for this mineral resource estimate. **5.** Numbers may not add due to rounding.

Table 6.8: Summary of April 30, 2015 Historical Mineral Resource Estimate (Open Pit & Underground) for Marathon, Sprite & Victory Deposits

Category	Open Pit (0.50 g Au/t cut-off)			Underground (3.0 g Au/t cut-off)			Total		
	Tonnes (kt)	Grade (g/t)	Gold (oz)	Tonnes (kt)	Grade (g/t)	Gold (oz)	Tonnes (kt)	Grade (g/t)	Gold (oz)
Marathon Deposit									
Indicated	3,008	1.924	186,100	65	4.527	9,500	**3,073**	**1.979**	**195,600**
Inferred	234	2.209	16,600	46	4.853	7,200	**280**	**2.643**	**23,800**
Sprite Deposit									
Indicated	301	2.033	19,700	36	4.734	5,500	**337**	**2.322**	**25,200**
Inferred	158	2.720	13,800	49	5.277	8,300	**207**	**3.325**	**22,100**
Victory Deposit									
Indicated	939	1.829	55,200	58	4.889	9,100	**997**	**2.007**	**64,300**
Inferred	80	1.801	4,600	62	4.644	9,300	**142**	**3.042**	**13,900**

Notes: **1.** The estimate was carried out using Inverse Distance Cubed methods. **2.** Mineral resources are estimated at a cut-off grade of 0.5 g/t gold for open pit and 3.0 g/t gold for underground. Pit optimisations were used to constrain the open-pit resources. **3.** Underground mineral resources are beneath the open pit constraint and inside high-grade wireframe models. **4.** A long-term gold price of US$1,200 per ounce was used for this mineral resource estimate. **5.** Composites were capped using statistical analysis per domain. **6.** Numbers may not add due to rounding.

Table 6.9: Summary of February 21, 2017 Historical Mineral Resource Estimate

Deposit / Category	Open Pit (0.40 g Au/t cut-off)			Underground (1.60 g Au/t cut-off Marathon Deposit; 2.00 g Au/t cut-off Leprechaun)			Total		
	Tonnes (kt)	Grade (g/t)	Gold (oz)	Tonnes (kt)	Grade (g/t)	Gold (oz)	Tonnes (kt)	Grade (g/t)	Gold (oz)
Marathon Deposit									
Measured (M)	1,153	1.73	64,100	3	2.71	300	**1,156**	**1.73**	**64,400**
Indicated (I)	7,514	1.70	411,800	80	2.94	7,600	**7,594**	**1.72**	**419,400**
M+I	8,667	1.71	475,900	83	2.93	7,900	**8,750**	**1.72**	**483,800**
Inferred	6,842	1.99	437,500	1,428	3.18	145,900	**8,270**	**2.20**	**583,400**
Leprechaun									
Measured (M)	4,096	2.00	263,000	50	5.00	8,100	**4,146**	**2.04**	**271,100**
Indicated (I)	7,797	1.91	479,000	543	3.71	64,800	**8,340**	**2.03**	**543,800**
M+I	11,893	1.94	742,000	593	3.82	72,900	**12,486**	**2.03**	**814,900**
Inferred	1,758	1.89	106,700	291	4.32	40,400	**2,049**	**2.24**	**147,100**
Sprite Deposit									
Measured (M)	0	0	0	0	0	0	**0**	**0**	**0**
Indicated (I)	301	2.033	19,700	36	4.734	5,500	**337**	**2.32**	**25,200**
M+I	301	2.03	19,700	36	4.73	5,500	**337**	**2.32**	**25,200**
Inferred	158	2.72	13,800	49	5.277	8,300	**207**	**3.33**	**22,100**
Victory Deposit									
Measured (M)	0	0	0	0	0	0	**0**	**0**	**0**
Indicated (I)	939	1.829	55,200	58	4.889	9,100	**997**	**2.01**	**64,300**
M+I	939	1.83	55,200	58	4.89	9,100	**997**	**2.01**	**64,300**
Inferred	80	1.801	4,600	62	4.644	9,300	**142**	**3.04**	**13,900**
Total Measured (M)	5,249	1.94	327,100	53	4.87	8,400	5,302	1.97	335,500
Total Indicated (I)	16,551	1.81	965,700	717	3.77	87,000	17,268	1.90	1,052,700
Total M+I	21,800	1.84	1,292,800	770	3.85	95,400	22,570	1.91	1,388,200
Total Inferred	8,838	1.98	562,600	1,830	3.47	203,900	10,668	2.24	766,500

Notes: **1.** The estimate was carried out using Inverse Distance Cubed methods. **2.** Mineral resources are estimated at a cut-off grade of 0.4 g/t gold for open pit and 3.0 g/t gold for underground. Pit optimisations were used to constrain the open-pit resources. **3.** Underground mineral resources are beneath the open pit constraint and inside high-grade wireframe models. **4.** A long-term gold price of US$1,200 per ounce was used for this mineral resource estimate. **5.** Composites were capped using statistical analysis per domain.

Table 6.10: Summary of November 27, 2017 Historical Mineral Resource Estimate

	Open Pit			Underground			Total		
Deposit Category	Tonnes (t)	Grade (g/t)	Gold (oz)	Tonnes (t)	Grade (g/t)	Gold (oz)	Tonnes (t)	Grade (g/t)	Gold (oz)
Leprechaun Deposit									
Measured	5,329,000	2.432	416,700	114,000	4.309	15,800	5,443,000	2.471	432,500
Indicated	3,302,000	1.927	204,600	104,000	4.137	13,800	3,406,000	1.994	218,400
M+I	8,631,000	2.239	621,300	218,000	4.223	29,600	8,849,000	2.288	650,900
Inferred	6,237,000	1.533	307,400	478,000	4.019	61,800	6,715,000	1.71	369,200
Victory Deposit									
Measured	0	0	0	0	0	0	0	0	0
Indicated	1,074,000	1.448	50,000	0	0	0	1,074,000	1.448	50,000
M+I	1,074,000	1.448	50,000	0	0	0	1,074,000	1.448	50,000
Inferred	2,167,000	1.156	80,500	134000	3.32	14,300	2,301,000	1.281	94,800
Sprite Deposit									
Measured	0	0	0	0	0	0	0	0	0
Indicated	343,000	1.988	21,900	71,000	4.64	10,600	414,000	2.442	32,500
M+I	343,000	1.986	21,900	71,000	4.644	10,600	414,000	2.442	32,500
Inferred	929,000	1.232	36,800	90,000	3.03	8,800	1,019,000	1.392	45,600
Marathon Deposit									
Measured	7,618,000	1.813	444,000	405,000	3.903	50,800	8,023,000	1.918	494,800
Indicated	11,002,000	1.402	496,000	1,116,000	3.409	122,300	12,118,000	1.587	618,300
M+I	18,620,000	1.57	940,000	1,521,000	3.54	173,100	20,141,000	1.719	1,113,100
Inferred	6,276,000	1.077	217,200	2,710,000	3.27	284,900	8,986,000	1.738	502,100
Total – All Deposits									
Measured	12,947,000	2.068	860,700	519,000	3.991	66,600	13,466,000	2.142	927,300
Indicated	15,721,000	1.528	772,500	1,291,000	3.534	146,700	17,012,000	1.681	919,200
M+I	28,668,000	1.772	1,633,200	1,810,000	3.665	213,300	30,478,000	1.884	1,846,500
Inferred	15,609,000	1.279	641,900	3,412,000	3.371	369,800	19,021,000	1.654	1,011,700

Notes: **1.** CIM Definition Standards of 10 May 2014, were followed for mineral resource estimation. **2.** Open-pit mineral resources are reported at cut-off grades of 0.295 g/t Au (Leprechaun and Sprite) and 0.290 g/t (Marathon and Victory). Pit optimisations were used to constrain the estimates of mineral resources. **3.** Underground mineral resources are estimated at cut-off grades of 1.906 g/t Au (Sprite and Leprechaun), 1.878 g/t Au (Victory), and 1.489 g/t (Marathon), outside the open pit constraint. **4.** Mineral resources are estimated using an average long-term forecast, gold price of US$1,250 per ounce. **5.** Totals may not add correctly due to rounding.

Table 6.11: Summary of May 28, 2018 Historical Mineral Resource Estimate

Material/Category	Open Pit			Underground			Total		
	Tonnes	Grade	Gold	Tonnes	Grade	Gold	Tonnes	Grade	Gold
	(t)	(g/t)	(oz)	(t)	(g/t)	(oz)	(t)	(g/t)	(oz)
All Material Leprechaun Deposit									
Measured	4,926,000	2.390	378,500	234,000	5.276	39,600	5,160,000	2.521	418,100
Indicated	2,961,000	1.900	180,900	224,000	4.649	33,500	3,185,000	2.093	214,400
M+I	7,887,000	2.206	559,400	458,000	4.969	73,100	8,345,000	2.358	632,500
Inferred	5,716,000	1.372	252,000	705,000	4.544	103,000	6,421,000	1.720	355,000
All Material Sprite Deposit									
Measured	0	0.000	0	0	0.000	0	0	0.000	0
Indicated	330,000	1.954	20,700	74,000	4.534	10,700	404,000	2.426	31,400
M+I	330,000	1.954	20,700	74,000	4.534	10,700	404,000	2.426	31,400
Inferred	854,000	1.223	33,600	74,000	4.534	10,700	928,000	1.487	44,300
All Material Marathon Deposit									
Measured	8,198,000	1.912	503,900	534,000	4.769	81,900	8,732,000	2.087	585,800
Indicated	13,357,000	1.506	646,600	1,573,000	3.823	193,300	14,930,000	1.750	839,900
M+I	21,555,000	1.660	1,150,500	2,107,000	4.063	275,200	23,662,000	1.874	1,425,700
Inferred	3,885,000	1.246	155,600	4,366,000	3.359	471,500	8,251,000	2.364	627,100
All Material Victory Deposit									
Measured	0	0.000	0	0	0.000	0	0	0.000	0
Indicated	947,000	1.540	46,900	5,000	3.714	600	952,000	1.552	47,500
M+I	947,000	1.540	46,900	5,000	3.714	600	952,000	1.552	47,500
Inferred	1,453,000	1.198	56,000	221,000	3.152	22,400	1,674,000	1.456	78,400
All Material All Deposits									
Measured	13,124,000	2.092	882,400	768,000	4.924	121,500	13,892,000	2.248	1,003,900
Indicated	17,595,000	1.582	895,100	1,876,000	3.950	238,100	19,471,000	1.810	1,133,200
M+I	30,719,000	1.800	1,777,500	2,644,000	4.233	359,600	33,363,000	1.993	2,137,100
Inferred	11,908,000	1.299	497,200	5,366,000	3.522	607,600	17,274,000	1.989	1,104,800

Notes: **1.** The effective date for this mineral resource estimate for Leprechaun, Sprite, and Victory is November 27, 2017 and is reported on a 100% ownership basis. The effective date for the mineral resource estimate for Marathon is March 5, 2018. The resources have been restated using the updated PEA economics. All material tonnes and gold values are undiluted. **2.** Mineral resources are calculated at a gold price of US$1,250 per troy ounce. **3.** The open-pit mineral resources presented above uses a PEA level open-pit design. The underground mineral resources are that material outside of the in-pit mineral resources above the stated underground cut-off grade. **4.** The PEA was prepared in accordance with National Instrument 43-101 Standards of Disclosure for Mineral Projects ("N.I. 43-101"). Readers are cautioned that the PEA is preliminary in nature. It includes inferred mineral resources that are considered too speculative geologically to have the economic considerations applied to them that would enable them to be categorised as mineral reserves, and there is no certainty that the PEA will be realised. Mineral resources that are not mineral reserves do not have demonstrated economic viability. The estimate of mineral resources may be materially affected by environmental, permitting, legal, title, socio-political, marketing, or other relevant issues. **5.** The mineral resources presented here were estimated using a block model with a block size of 6 m x 6 m x 6 m sub-blocked to a minimum block size of 2 m x 2 m x 2 m using ID3 methods for grade estimation. Mineral resources for the Leprechaun and Sprite deposits are reported using an open-pit gold cut-off of 0.267 g/t Au and an underground gold cut-off of 1.840 g/t Au. Material between a 0.267 Au g/t value and 1.055 Au g/t is assumed to be processed on a heap leach. Material above a 1.055 Au g/t is assumed to be processed in a mill. Higher gold grades were given a limited area of influence and applied during grade estimation by mineralised domain. Mineral resources for the Marathon deposit are reported using an open-pit gold cut-off of 0.312 g/t Au and an underground gold cut-off of 1.619 g/t Au. Material between a 0.312 Au g/t value and 0.707 Au g/t is assumed to be processed on a heap leach. Material above a 0.707 Au g/t is assumed to be processed in a mill. Higher gold grades were given a limited area of influence and was applied during grade estimation by mineralised domain. Mineral resources for the Victory deposit are reported using an open-pit gold cut-off of 0.328 g/t Au and an underground gold cut-off of 1.803 g/t Au. Material between a 0.328 Au g/t value and 0.707 Au g/t is assumed to be processed on a heap leach. Material above a 0.707 Au g/t is assumed to be processed in a mill. Higher gold grades were given a limited area of influence and applied during grade estimation by mineralised domain. **6.** The mineral resources presented here were estimated using the Canadian Institute of Mining, Metallurgy and Petroleum (CIM), CIM Standards on Mineral Resources and Reserves, Definitions and Guidelines prepared by the CIM Standing Committee on Reserve Definitions and adopted by CIM Council May 10, 201**4. 7.** Figures are rounded and totals may not add correctly.

Table 6.12: Summary of October 30, 2018 Historical Mineral Resource Estimate

Material / Category	Open Pit			Underground			Total		
	Tonnes (t)	Grade (g/t)	Gold (oz)	Tonnes (t)	Grade (g/t)	Gold (oz)	Tonnes (t)	Grade (g/t)	Gold (oz)
All Material Leprechaun Deposit									
Measured	5,760,000	2.381	440,800	81,000	3.910	10,200	5,841,000	2.402	451,000
Indicated	3,010,000	1.916	185,500	64,000	3.460	7,100	3,074,000	1.949	192,600
M+I	8,770,000	2.221	626,300	145,000	3.711	17,300	8,915,000	2.246	643,600
Inferred	7,533,000	1.476	357,400	388,000	4.274	53,300	7,921,000	1.613	410,700
All Material Sprite Deposit									
Measured	0	0.000	0	0	0.000	0	0	0.000	0
Indicated	708,000	1.703	38,800	9,000	2.403	700	717,000	1.712	39,500
M+I	708,000	1.703	38,800	9,000	2.403	700	717,000	1.712	39,500
Inferred	1,291,000	1.173	48,700	46,000	2.702	4,000	1,337,000	1.226	52,700
All Material Marathon Deposit									
Measured	10,637,000	1.985	679,000	142,000	7.990	36,500	10,779,000	2.064	715,500
Indicated	23,211,000	1.559	1,163,700	513,000	4.797	79,100	23,724,000	1.629	1,242,800
M+I	33,848,000	1.693	1,842,700	655,000	5.489	115,600	34,503,000	1.765	1,958,300
Inferred	13,784,000	1.693	750,100	1,839,000	3.862	228,300	15,623,000	1.948	978,400
All Material Victory Deposit									
Measured	0	0.000	0	0	0.000	0	0	0.000	0
Indicated	1,009,000	1.537	49,900	2,000	1.848	100	1,011,000	1.538	50,000
M+I	1,009,000	1.537	49,900	2,000	1.848	100	1,011,000	1.538	50,000
Inferred	1,821,000	1.264	74,000	155,000	3.174	15,800	1,976,000	1.414	89,800
All Material All Deposits									
Measured	16,397,000	2.124	1,119,800	223,000	6.508	46,700	16,620,000	2.183	1,166,500
Indicated	27,938,000	1.601	1,437,900	588,000	4.605	87,000	28,526,000	1.663	1,524,900
M+I	44,335,000	1.794	2,557,700	811,000	5.128	133,700	45,146,000	1.854	2,691,400
Inferred	24,429,000	1.566	1,230,200	2,428,000	3.862	301,400	26,857,000	1.774	1,531,600

Notes: **1.** The effective date for this mineral resource estimate for Sprite, and Victory is 27 November 2017, and is reported on a 100% ownership basis. The effective date for the mineral resource estimate for Marathon is 9 October 2018. The effective date for the mineral resource estimate for Leprechaun is 5 October 2018. The resources have been restated using the updated PEA economics. All material tonnes and gold values are undiluted. **2.** Mineral resources are calculated at a gold price of $1,250 /troy oz. **3.** The open-pit mineral resources presented above use an economic pit shell to determine material available for open-pit mining. The underground mineral resources are that material outside of the in-pit mineral resources above the stated underground cut-off grade. **4.** Mineral resources which are not mineral reserves do not have demonstrated economic viability. The estimate of mineral resources may be materially affected by environmental, permitting, legal, title, socio-political, marketing, or other relevant issues. **5.** The mineral resources presented here were estimated using a block model with a block size of 6 m x 6 m x 6 m sub-blocked to a minimum block size of 2 m x 2 m x 2 m using ID^3 methods for grade estimation. Mineral resources for the Leprechaun and Sprite deposits are reported using an open-pit gold cut-off of 0.281 g/t Au and an underground gold cut-off of 1.767 g/t Au. Material between a 0.281 Au g/t value and 1.142 Au g/t is assumed to be processed on a heap leach. Material above a 1.142 Au g/t is assumed to be processed in a mill. Higher gold grades were given a limited area of influence and applied during grade estimation by mineralised domain. Mineral resources for the Marathon and Victory deposits are reported using an open-pit gold cut-off of 0.328 g/t Au and an underground gold cut-off of 1.731 g/t Au. Material between a 0.328 Au g/t value and 0.700 Au g/t is assumed to be processed on a heap leach. Material above a 0.700 Au g/t is assumed to be processed in a mill. Higher gold grades were given a limited area of influence which was applied during grade estimation by mineralised domain. **6.** The mineral resources presented here were estimated using the Canadian Institute of Mining, Metallurgy and Petroleum (CIM), CIM Standards on Mineral Resources and Reserves, Definitions and Guidelines prepared by the CIM Standing Committee on Reserve. Definitions and adopted by CIM Council 10 May 2014. **7.** Figures are rounded and totals may not add correctly.

Table 6.13: Summary of January 20, 2020 Historical Mineral Resource Estimate

Material / Category	Open Pit			Underground			Total		
	Tonnes (t)	Grade (g/t)	Gold (oz)	Tonnes (t)	Grade (g/t)	Gold (oz)	Tonnes (t)	Grade (g/t)	Gold (oz)
All Material Leprechaun Deposit									
Measured	8,432,000	2.211	599,500	102,000	3.877	12,700	8,534,000	2.231	612,200
Indicated	8,174,000	1.693	444,800	194,000	3.479	21,700	8,368,000	1.734	466,500
M+I	16,606,000	1.956	1,044,300	296,000	3.616	34,400	16,902,000	1.985	1,078,700
Inferred	2,547,000	1.441	118,100	314,000	3.478	35,100	2,861,000	1.665	153,200
All Material Sprite Deposit									
Measured	0	0.000	0	0	0.000	0	0	0.000	0
Indicated	675,000	1.764	38,200	7,000	2.441	500	682,000	1.771	38,700
M+I	675,000	1.764	38,200	7,000	2.441	500	682,000	1.771	38,700
Inferred	1,127,000	1.223	44,300	62,000	2.503	5,000	1,189,000	1.29	49,300
All Material Marathon Deposit									
Measured	22,663,000	1.667	1,214,600	488,000	4.506	70,700	23,151,000	1.727	1,285,300
Indicated	12,538,000	1.431	576,800	506,000	3.813	62,000	13,044,000	1.523	638,800
M+I	35,201,000	1.583	1,791,400	994,000	4.153	132,700	36,195,000	1.653	1,924,100
Inferred	8,791,000	1.53	432,400	1,782,000	4.069	233,100	10,573,000	1.958	665,500
All Material Victory Deposit									
Measured	0	0.000	0	0	0.000	0	0	0.000	0
Indicated	1,074,000	1.468	50,700	1,000	1.803	100	1,075,000	1.468	50,800
M+I	1,074,000	1.468	50,700	1,000	1.803	100	1,075,000	1.468	50,800
Inferred	2,019,000	1.189	77,200	124,000	3.252	13,000	2,143,000	1.309	90,200
All Material All Deposits									
Measured	31,095,000	1.814	1,814,100	590,000	4.397	83,400	31,685,000	1.863	1,897,500
Indicated	22,461,000	1.538	1,110,500	708,000	3.705	84,300	23,169,000	1.604	1,194,800
M+I	53,556,000	1.698	2,924,600	1,298,000	4.02	167,700	54,854,000	1.753	3,092,300
Inferred	14,484,000	1.443	672,000	2,282,000	3.901	286,200	16,766,000	1.777	958,200

Notes: 1. The effective date for this mineral resource estimate is January 10, 2020 and is reported on a 100% ownership basis. The estimates for Leprechaun and Marathon are a new estimate using additional assays and exploration drilling as well as updated economics. The estimates for Sprite and Victory are economic updates using the November 2017 mineral resources. The qualified person for the mineral resource estimate is Robert Farmer, P.Eng. 2. Mineral resources are calculated at a gold price of US$1,300 per troy ounce. 3. The mineral resources presented above are global and do not include a detailed pit or underground design, only an economic open pit shell was used to determine the in-pit mineral resources. The underground mineral resources are that material outside of the in-pit mineral resources above the stated underground cut-off grade. 4. Mineral resources, which are not mineral reserves, do not have demonstrated economic viability. The estimate of mineral resources may be materially affected by environmental, permitting, legal, title, socio-political, marketing, or other relevant issues. 5. The mineral resources presented here were estimated using a block model with a block size of 6 m x 6 m x 6 m sub-blocked to a minimum block size of 2 m x 2 m x 2 m using ID3 methods for grade estimation. All mineral resources are reported using an open pit gold cut-off of 0.300 g/t Au and an underground gold cut-off of 1.663 g/t Au. Higher gold grades were capped by mineralised domain. Material above a 0.7 g/t gold cut-off is considered high-grade while material between a 0.3 and 0.7 g/t gold cut-off is considered low-grade. 6. The mineral resources presented here were estimated using the Canadian Institute of Mining, Metallurgy and Petroleum (CIM), CIM Standards on Mineral Resources and Reserves, Definitions and Guidelines prepared by the CIM Standing Committee on Reserve Definitions and adopted by CIM Council May 10, 2014. 7. Figures are rounded, and totals may not add correctly. Summed average gold grades are calculated using a weighted average of tonnes and gold grade.

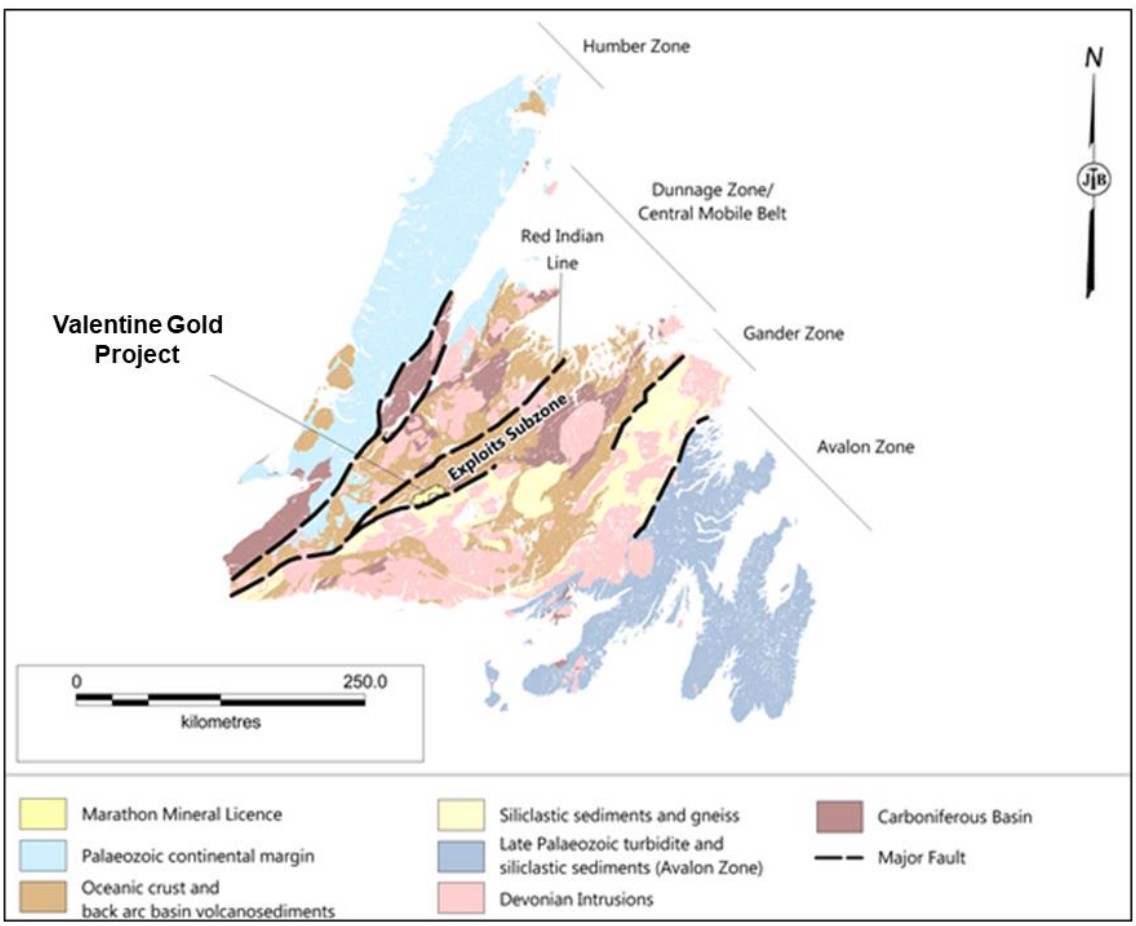
7 Geological Setting & Mineralisation

7.1 Geotectonic Setting

The Valentine Lake property is located within the Newfoundland Appalachian system, which displays typical southwest to northeast alignment, and was formed during closure of the Iapetus Ocean in the Cambrian to Ordovician periods, resulting in the accretion of Laurentia and Gondwana (Piercey et al., 2014). The island of Newfoundland is divided into four major tectonostratigraphic zones that are juxtaposed by major regional sutures (see Figure 7-1). The Humber Zone located in the west, is comprised of Palaeozoic sedimentary rocks deposited on the Grevillian basement of the eastern margins of the Laurentian continent. The Gander Zone in the east is comprised of Ordovician volcano-sedimentary sequences that formed proximal to the Gondwanan continental margin (Coleman-Sadd, 1980; Blackwood, 1982).

Situated between these two continental margin terranes, the Dunnage Zone comprises a structurally controlled assemblage of ophiolitic and arc to back-arc volcanics, volcaniclastic to epiclastic sedimentary rocks representing remnants of early to middle Palaeozoic oceanic terranes.

Figure 7-1: Major Tectonic Subdivisions of Newfoundland & Location of Valentine Gold Project



Source: Modified from Colman-Sadd, Hayes and Knight (2000) and Piercey et al. (2014)

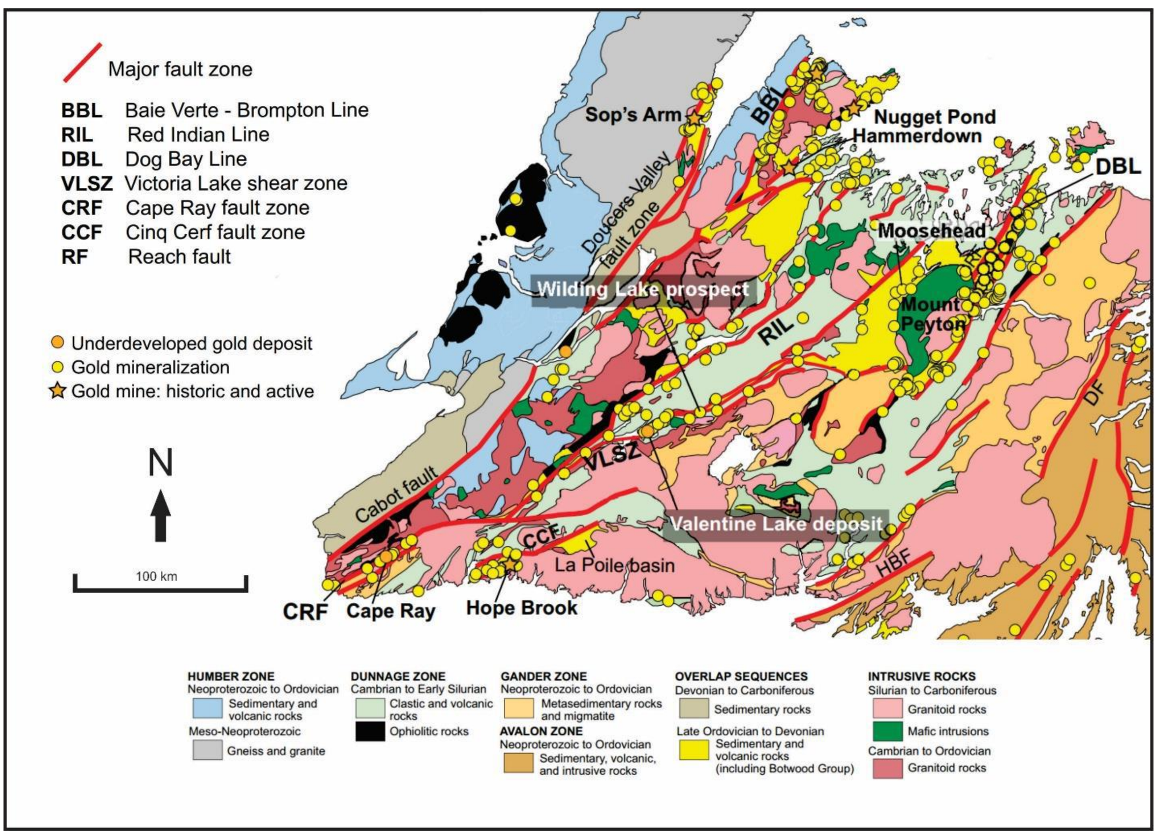
Widespread magmatism and deformation characterise the Appalachian and pre-Appalachian tectonic evolution of the Newfoundland Orogeny. Formation of largescale gold bearing hydrothermal alteration systems accompanied localised magmatism. This system hosts gold systems in both the late Proterozoic and Palaeozoic rocks commonly associated with major crustal structures and range from epithermal, orogenic, sediment hosted and intrusive related deposit types.

The Dunnage Zone, host to the Valentine Lake property, is further subdivided into two subzones by the Red Indian Line which represents the major crustal suture zone in this area of the Appalachian Orogen. The Notre Dame Subzone and the Exploits Subzone occur north and south of the Red Indian Line, respectively, and are characterised by island arc volcano sedimentary sequences and ophiolite lenses that formed during the Middle to Late Ordovician, Taconic, and Penobscot orogenies.

The Dunnage Zone was subjected to later deformation during the Silurian Salinic orogeny and was intruded by Devonian granitoid plutons, and mafic stocks and dykes.

Gold mineralisation within the Dunnage Zone occurred coincident with late syn- to post-Salinic orogenic events (Murahwi, 2017) and is typically spatially related to major structural features and proximal to, or hosted within, intrusive bodies. The Dunnage Zone also hosts past producing Buchans and Duck Pond copper-zinc volcanogenic massive sulphide (VMS) deposits and several other VMS occurrences (see Figure 7-2).

Figure 7-2: Geology, Major Structures & Gold Occurrences in the Central Newfoundland Gold Trend

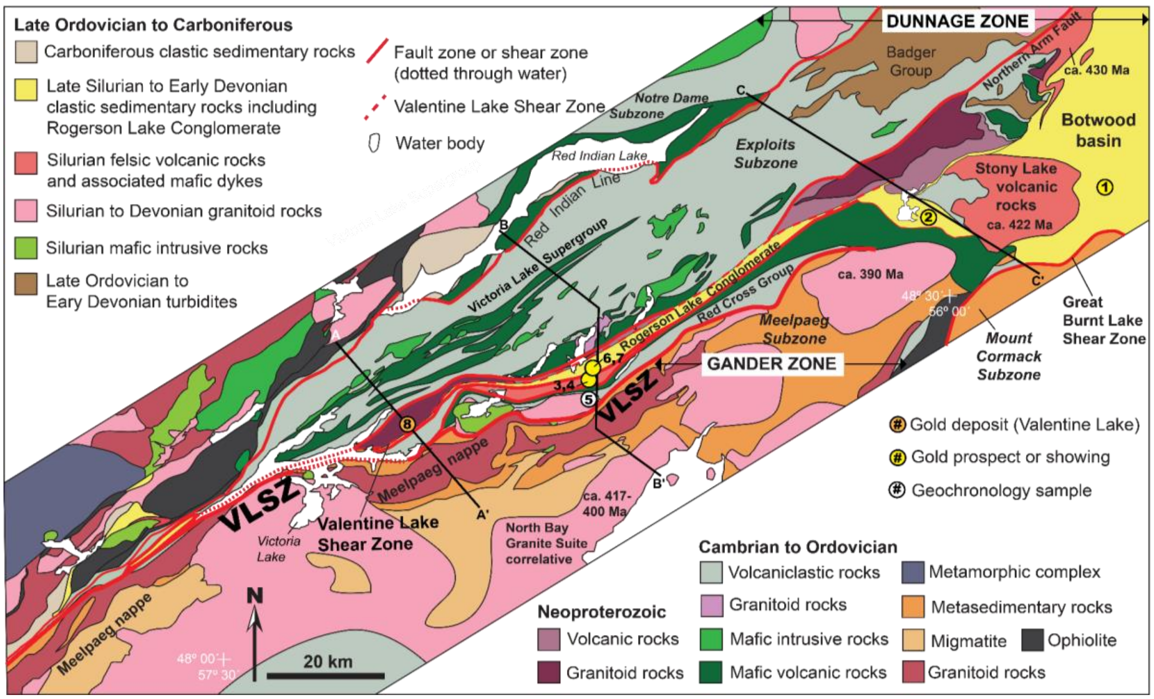


Source: Modified from Honsberger et al., 2020.

7.2 Regional Geology

The Valentine Lake property is located within The Victoria Lake Group which constitutes part of the Exploits Subzone of the Dunnage Zone and is composed of mainly low-grade Cambro-Ordovician (513 to 462 Ma) island arc and back arc volcanic, volcaniclastic and epiclastic rocks of the Talley Pond volcanic assemblage (513± Ma) and the Tulks Hill volcanic assemblage (498 +6/-4 Ma) (see Figure 7-3). These assemblages are volcanically dominant with one or more sequences of clastic sedimentary rocks. Localised younger Middle Ordovician sedimentary rocks are present (Evans and Kean 2002). These assemblages consist of rocks of varied age and geochemical properties representing various tectonic environments intruded by granodioritic to gabbroic intrusions, metamorphosed to lower greenschist facies and subjected to heterogeneous regional deformation (Evans et al., 1990; Pollack et al., 2002).

Figure 7-3: Regional Geology of the Dunnage Zone & Valentine Lake Property



Source: Modified from Honsberger et al., 2020.

Large plutonic bodies on the south-southeast margin of the Victoria Lake Supergroup are significantly older than the volcanic rocks and include the Precambrian Valentine Lake and Crippleback Lake intrusive complexes.

The Victoria Lake Group is bounded to the south- east by the Rogerson Lake Conglomerate and to the north-west by the Middle Ordovician Harbour Round and Sutherlands Pond assemblages (Rogers and van Staal, 2002) and is structurally complex.

The Valentine Lake property occurs within a large multiphase, trondhjemite, quartz-eye porphyry, and gabbroic Valentine Lake Intrusive Complex (VLIC) dated 563 ±2 Ma (U-PB zircons; Evan et al., 1990) and forms the structural inlier within the Victoria Lake Group volcano-sedimentary rocks. More specifically, the Valentine Lake gold deposits occur proximal to the unconformable contact between two structural domains: the Neoproterozoic VLIC (NW) and the Silurian Rogerson Lake Conglomerate. These are in contact along a NE-SW lithotectonic boundary of the locally sheared and faulted Valentine Lake Shear Zone (VLSZ), which was previously described as exhibiting sinistral reverse transpressive deformation corelated with the Salinic (450-423 Ma) Appalachian Orogenic event (vanStaal et al., 2009).

The VLSZ has a kinematic history with multiple pulses of Appalachian orogenesis and exhibits a NW to subvertical dip. At the Valentine Lake property, the Precambrian VLIC forms a rigid inlier that correlates with a structural flexure point in which the overall trend of the VLSZ was deflected.

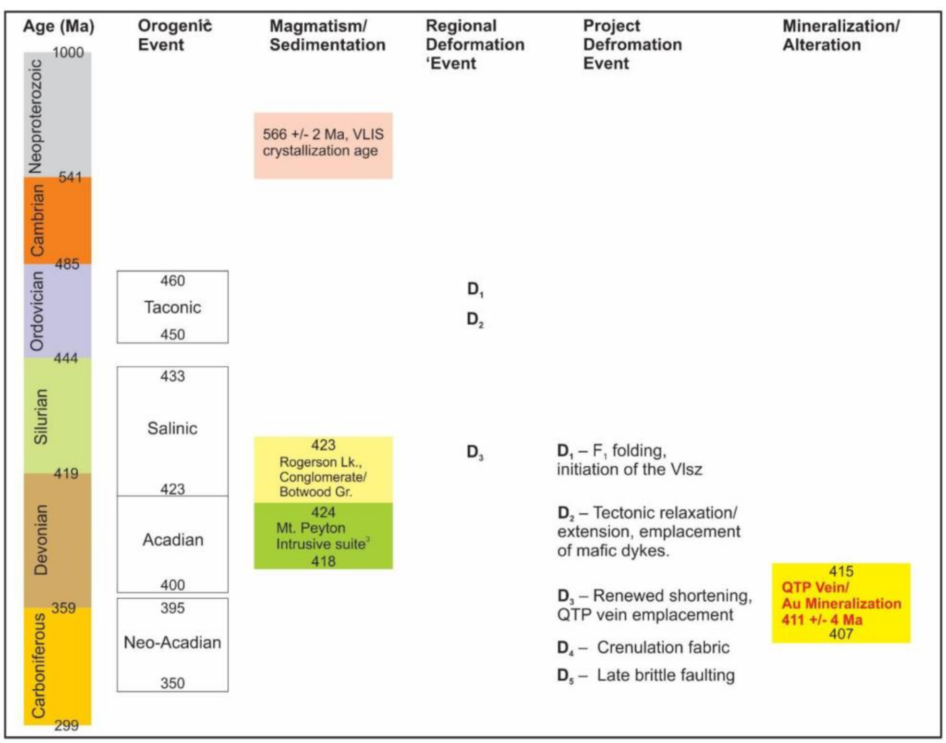
The VLIC predates the surrounding host volcanic and sedimentary rocks which are similar in age to the Roti Bay Granodiorite at Hope Brook (Woods, 2009), and comprises an elongate northeast-trending body of Upper Precambrian igneous rocks ranging from trondhjemitic through to gabbroic and minor pyroxenitic compositions.

The Silurian Rogerson Lake Conglomerate forms a long narrow elongated belt that extends for approximately 160 km and lies southeast margin of the VLIC. Unsorted, pebble- to cobble-sized polymictic conglomerate characterise the unit with layers of finer grained sedimentary sequences.

Regional metamorphism in the Valentine Lake area ranges from lower to upper greenschist facies with the higher grades in the southern portion of the property. Deformation of the VLIC is ductile transitioning to late-stage brittle deformation. Heterogeneous ductile deformation is characteristic of the Rogerson Lake Conglomerate.

Recent project-scale structural investigations by Kruse (2020) for Marathon, and more regionally by Honsberger et al. (2020) and others, has established a geotectonic chronology for the deformation within the project area, within which Kruse (2020) recognises five phases of deformation (see Figure 7-4).

Figure 7-4: Regional geochronology of the Dunnage Zone & Valentine Lake Property



Source: Kruse (2020) and incorporating Barbour (1990), Barrington et al. (2016), Dunning (2017), Honsberger et al. (2020), Sandeman (2017) and vanStaal et al. (2009).

A penetrative ductile fabric associated with initiation of the VLSZ and characterised by a strong S_1 foliation and L_1 stretching lineation is observed in both the Rogerson Lake Conglomerate and in the VLIC, with a southwest strike and steep dip to the northwest, paralleling the larger structure. Gold mineralisation is associated with mineralised veining within the VLIC during a D_3 phase of renewed crustal shortening following a period of regional D_2 relaxation. Overprinting fabrics include a late D_4 crenulation fabric and a D_5 brittle fault set (Kruse 2020).

7.3 Property Geology

The Valentine Lake property is underlain by five major lithological units including, from northwest to southeast, the Victoria Lake Supergroup (bimodal volcanic rocks, volcanogenic and siliciclastic sedimentary units), the VLIC, the Rogerson Lake Conglomerate, the Victoria Lake Supergroup metasedimentary units and lesser gabbroic and mafic volcanic rocks and the Red Cross lake intrusion (see Figure 7-5).

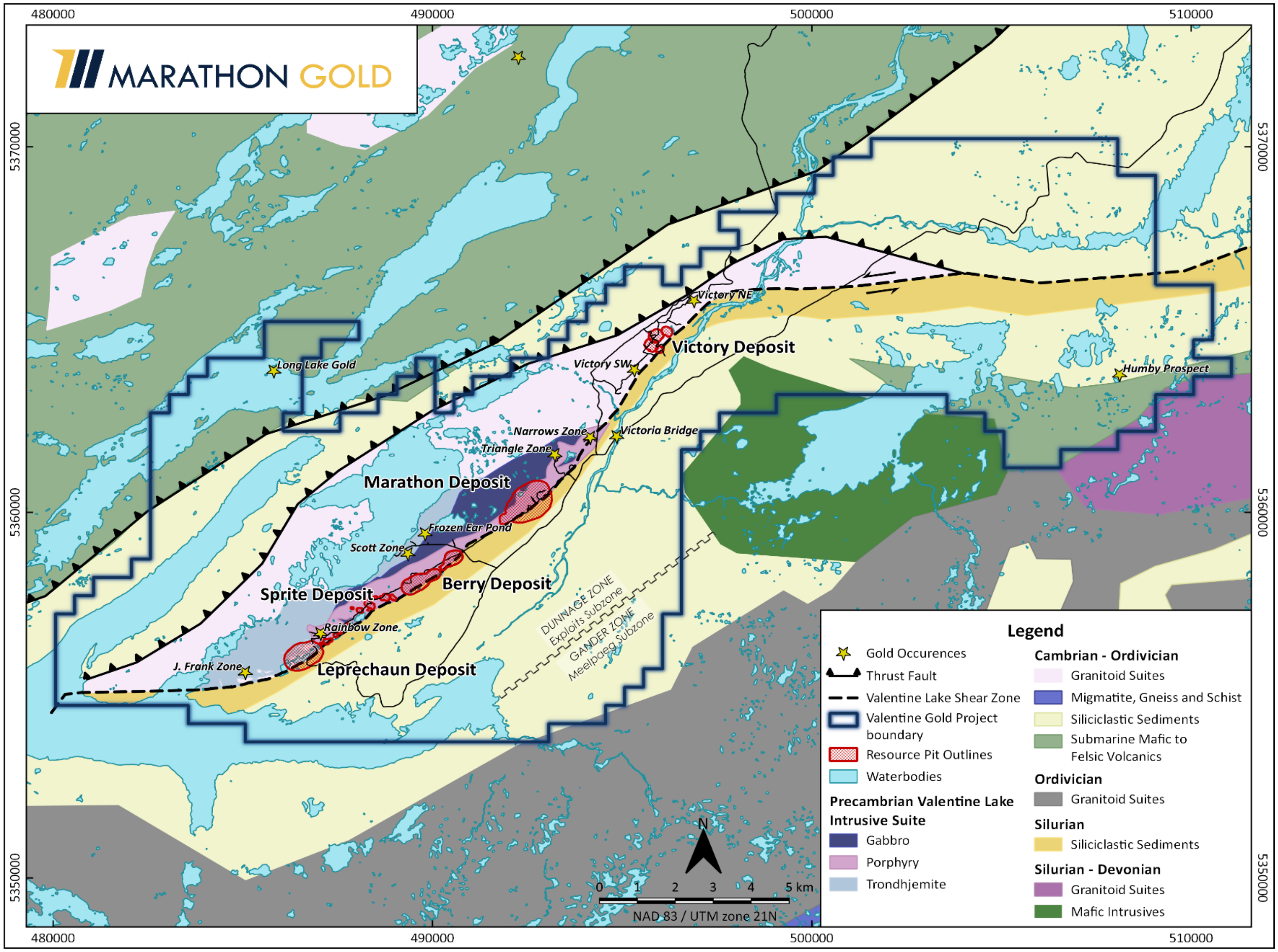
The Victoria Lake Supergroup outcropping along the northwest boundary of the Valentine Lake property area consists mainly of low-grade Cambrio-Ordovician volcanic and sequences of clastic sedimentary rocks of the Tulks Hill assemblage. This assemblage represents two packages of bimodal volcanic and clastic sedimentary rocks referred to as the Long Lake volcanic belt and the Tulks sequence of banded to finely laminated siltstone, argillite, and tuffaceous siltstone with minor intercalated mafic tuff. License 020482M covers a portion of the Long Lake volcanic belt and is dominantly underlain by felsic and mafic volcanic rocks. In this area, the Long Lake volcanic belt is underlain by a thick sequence of black graphitic shale which separates the Long Lake volcanic belt from volcaniclastic sedimentary units of the Stanley Waters Formation.

The VLIC hosts all five major gold deposits and numerous early-stage prospects and occurrences on the Valentine Lake property. The VLIC is an elongated northeast trending intrusion consisting dominantly of fine- to medium-grained trondhjemite and quartz-eye porphyry with lesser aphanitic quartz porphyry, gabbro and minor pyroxenite units of the Upper Precambrian (563 Ma, Evans et al., 1990). All intrusive rocks demonstrate varying degrees of sausseritisation of plagioclase and strong alteration of mafic minerals to chlorite and epidote. The east end of the VLIC consists of medium- to coarse-grained, equigranular quartz monzonite to monzonite.

Abundant mafic dyke systems on the scale of tens of centimetres to tens of metres thick cut the trondhjemite and quartz porphyry units on a NE-SW orientation and exhibit strong ductile deformation and boudinage.

The Silurian Rogerson Lake Conglomerate forms a narrow linear unit extending NS-SW for 160 km through central Newfoundland, lies unconformably (overturned) on the southeast margin of the VLIC, and is interpreted to have infilled a fault bounded paleo-topographic depression (Kean, 1977; Kean et al., 1982). An unsorted, pebble- to cobble-sized, polymictic conglomerate with interbedded coarse sandstone dominates the unit. A high percentage of the clasts are trondhjemite, quartz porphyry and mafic intrusive rocks of the VLIC. Also common are fine-grained foliated mafic, epidote-quartz, white and red chert, and black, fine-grained sedimentary clasts in a fine-grained, schistose matrix.

Figure 7-5: Geology & Gold Deposits of the Valentine Gold Project



Source: Marathon Gold, 2017

The conglomerate has undergone penetrative ductile deformation resulting a strong NE striking and steep NW dipping to sub-vertical S1 foliation, and most clasts showing strong elongated parallel to the regional penetrative L1 fabric and sinistral rotation.

The Victoria Lake Supergroup outcropping along the southeast boundary of the Valentine Lake property area consists of Ordovician-aged mixed sedimentary, gabbroic, and mafic volcanic sequence. These units have been strongly deformed, resulting in a complex intercalated, tightly folded, boudinaged and sheared package of rocks. Sedimentary units are generally metamorphosed argillaceous to sandy and/or tuffaceous rocks with minor metaconglomerate and represent the bulk of the sequence. The gabbroic units are generally medium-grained, strongly foliated gabbro, which grades into fine-grained schist. The gabbro and schist are interspersed with pillowed and massive basalt units.

The Red Cross Lake intrusion consists of a mafic phase, comprised of well-layered peridotite and gabbro along with a medium- to coarse-grained granite phase.

The entire project area is overlain by glacial till between 1 and 5 m thick, as well as deeper boggy areas and ponds, with only rare bedrock exposures along the ridge and in stream beds.

7.4 Structure

The Valentine Gold Project is one of several structurally hosted gold deposits within the central Newfoundland Dunnage Zone that are associated with Appalachian age orogenesis. At the Valentine Lake property, mineralisation is associated with deformation across the VLSZ. This large-scale crustal structure is one of several, such as the Cape Ray Fault, the Dog Bay Line and the Red Indian Line, which are currently the target of broad exploration programs across a large swath of central Newfoundland.

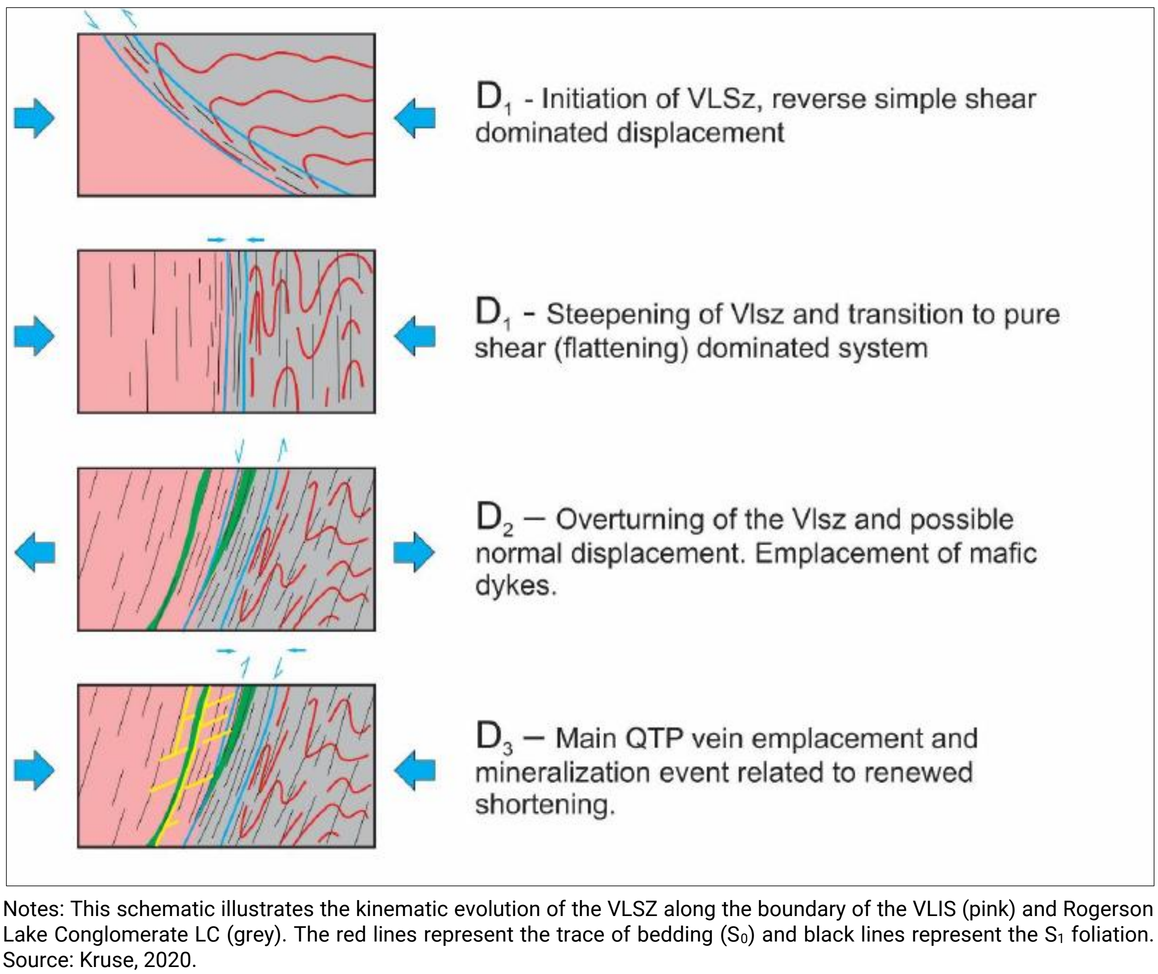
On a property scale, the Valentine gold deposits occur proximal to the unconformable contact between two structural domains, the Neoproterozoic VLIC, and the Silurian Rogerson Lake Conglomerate. The VLIC is generally characterised by lower strain, brittle-ductile deformation with the Rogerson Lake Conglomerate exhibiting more intense penetrative foliation and shearing. The competency contrast between these two domains and the crustal scale nature of the VLSZ provide an ideal environment for mesothermal fluid flow and the development of gold mineralisation within local deformational traps.

On behalf of Marathon, Kruse (2020) developed a kinematic model and deformational history for the property that identified five phases of deformation (see Figure 7-6). In this model the Silurian Rogerson Lake Conglomerate is interpreted as forming in a sedimentary basin bounded to the NW by a listric boundary fault. Onset of Salinic-aged crustal shortening reactivates the main boundary fault as a low angle reverse thrust which is rotated into a steep orientation during a transition to a pure shear dominated flattening phase. This phase of crustal shortening is correlated with the S_1 fabrics that dominate the property. The Rogerson Lake Conglomerate exhibits strongly developed S_1 penetrative foliation, tight F_1 isoclinal folds, and locally preserved S_0 bedding (Kruse 2020). Flattened and stretched, primary conglomerate clasts are indicative of the pure shear regime. Within the intrusive rocks of the VLIC, S_1 is manifested as a spaced fracture cleavage.

A period of relaxation during shortening and lithospheric extension (D_2) is evidenced by the suite of mafic dykes intruded within the VLIC and locally within the Rogerson Lake Conglomerate. This extensional event is further evidenced by the late Silurian magmatism of the gold-mineralised Windsor Point Group in the Cape Ray deposit area, and the contemporaneous Mount Peyton Intrusive suite (dated at 424-418 Ma; Sandeman et al., 2017). Accordingly, the D_2 extensional event occurred before the Acadian Orogeny. At the Valentine Lake property, two sets of mafic dykes are associated with this event: a WSW-SW striking main set parallel to the main S_1 foliation and the VLSZ, and dipping to the NW. A second, subordinate set, oriented at a high angle to the first set in a “ladder rung” pattern, have shorter strike extent and are strongly folded. Larger (>1m) dykes are commonly sheared at their contacts and undeformed internally. The dykes are rheologically weak compared to the host granitoid rocks of the VLIC.

Mineralisation of quartz-tourmaline-pyrite-Au (QTP-Au) veins are associated with a renewed D_3 shortening phase correlated with the late Acadian Orogeny. Recent geochronological studies by Honsberger et al., (2020) suggest a main pulse of hydrothermal gold mineralisation between 415 Ma and 407 Ma. Up to three separate QTP-Au vein sets are recognised at the Marathon and Leprechaun deposit areas. Previous descriptions of these vein sets (Robert and Poulsen, 2001) has described the first two as “extensional” and “shear” respectively based on the orientation of the veins to the S_1 foliation and in the parlance of the classic shear zone hosted gold deposit model. All three vein sets are observable in outcrop and drill core within the granitoid rocks of the VLIC, but the Set 1 extensional veins, dipping at a low-angle to the SW, are the dominant set associated with the bulk of gold mineralisation. These vein sets are described further in the following section.

Figure 7-6: Schematic of Northwest-Southeast Oriented Sections



Notes: This schematic illustrates the kinematic evolution of the VLSZ along the boundary of the VLIS (pink) and Rogerson Lake Conglomerate LC (grey). The red lines represent the trace of bedding (S_0) and black lines represent the S_1 foliation. Source: Kruse, 2020.

Finally, additional brittle-ductile to fully brittle fabrics and structures (D_4 and D_5) occurred post-mineralisation and are associated with late Acadian to Neo-Acadian deformation. The first of these is a broad crenulation fabric and the latter a brittle fault set. Neither of these later deformational events impact the deposit-scale development of gold mineralisation, other than the potential for D_5 structures to locally create fault offsets in areas of D_3 vein development.

7.5 Mineralisation

Gold mineralisation at the Valentine Lake property is developed within QTP-Au vein sets associated with D_3 extensional and shear deformation within granitoid rocks of the VLIC in contact with the Rogerson Lake conglomerate across the NE-SW oriented VLSZ (Kruse, 2020).

The QTP-Au veins are identified in prospecting samples, outcrop, trenching and drilling at numerous locations long the 20 km strike extent of the VLIC and VLSZ within the Valentine Lake property. Significant QTP-Au veining occurs dominantly within the trondhjemite, quartz-eye porphyry and lesser mafic dyke units along and proximal to the sheared contact with the Rogerson Lake Conglomerate. Minor amounts of gold-bearing QTP veining extend across the VLSZ contact and into the Rogerson Lake Conglomerate. Gold-bearing QTP veining is also exposed in the VLIC at 500 m and 1000 m from the VLIC-conglomerate contact at the Steve Zone and Scott Zones, respectively. All the gold occurrences share similar general mineralogical characteristics, with coarse gold mineralisation occurring predominantly within the quartz-tourmaline-pyrite veins, and lesser amounts in alteration selvages. Visible gold is common.

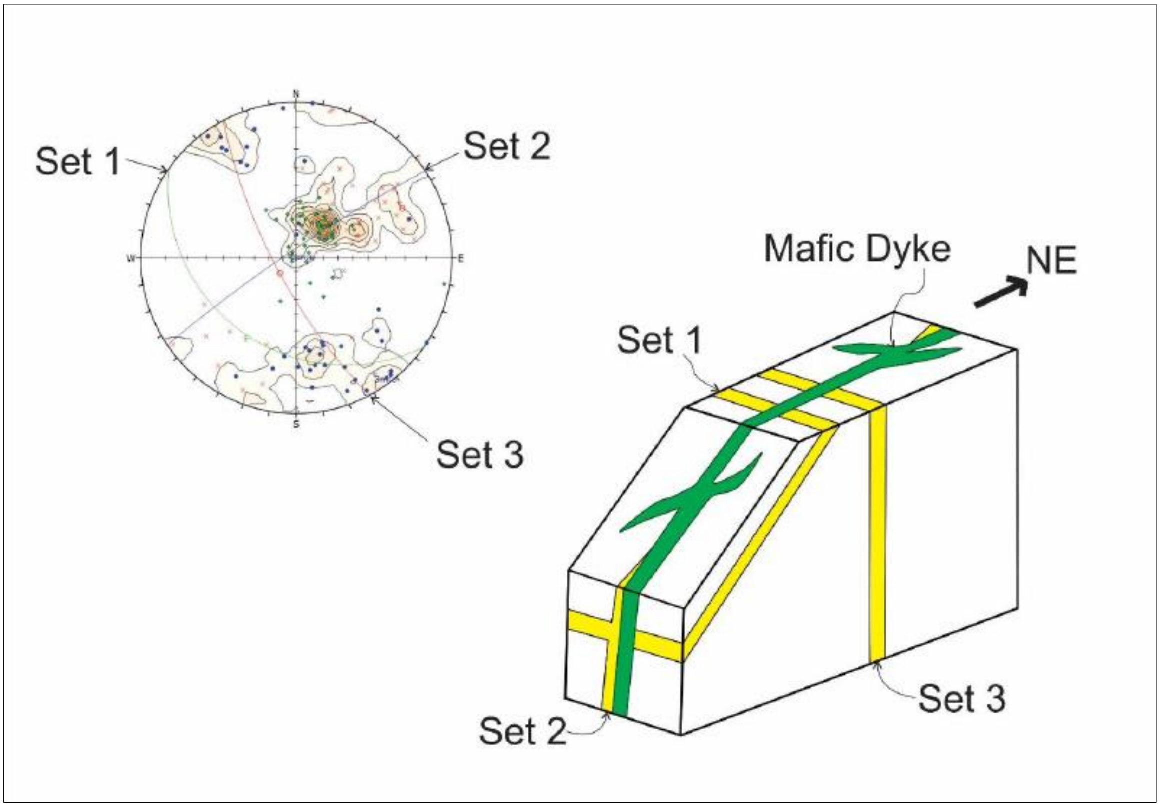
Individual QTP-Au veins range in thickness from a few millimetres and centimetres to metres but are typically 2 to 30 cm thick. QTP-Au veins developed within brittle extensional fractures and dipping at a low angle to the SW (Set 1 veins) represent the dominant structural control on mineralisation at the property and inform the mineral resource models for each of the Marathon, Leprechaun, Sprite, Victory and Berry deposits.

The gold mineralisation at the Valentine Lake property occurs as structurally controlled, orogenic gold deposits consisting dominantly of en-echelon stacked SW dipping extensional vein sets (Set 1) and lesser shear parallel vein sets (Set 2) proximal to the VLSZ. This style of mineralisation occurs intermittently along the defined strike length of the main gold zone in which a series of deposits and occurrences have been, and continue to be, discovered. Discoveries to date include the Marathon, Leprechaun, Sprite, Victory and Berry gold deposits, and the Frank, Rainbow, Steve, Scott, Triangle, Victoria Bridge, Narrows, Victory SW and Victory NE occurrences.

At the deposit scale, a pervasively altered, intensely QTP veined core complex, which is referred to by Marathon Gold as the “Main Zone”, has been delineated at the Marathon, Leprechaun and Berry deposits. The Main Zones of the Marathon and Leprechaun deposits are well defined by thorough outcrop investigation and densely spaced subsurface drillhole information. At Leprechaun, the Main Zone transitions into the associated hanging wall and footwall mineralisation. Further exploration work is required at the other deposits and occurrences to determine if the Main Zone model is present at these locales. A field based structural study (Kruse, 2020) followed by a program of optical televiewer analysis of oriented drill core (Kruse and Bartsch, 2021) has provided recent, comprehensive structural data on the orientation and frequency of up to three vein sets at the Leprechaun and Marathon gold deposits and up to four vein sets at the Berry deposit.

Set 1 QTP-Au veins occur as uniformly shallow southwest dipping, en-echelon arrays orientated at high angle to the regional penetrative S_1 foliation and cleavage fracture, (Figure 7-7). Lesser Set 2 QTP-Au veins are steeply northwest dipping to subvertical, parallel the regional S_1 shear fabric, and commonly developed at contacts with mafic dykes or as localised zones of intense stockwork veining. Rare Set 3 QTP-Au veins are steeply dipping with a NW-SE orientation orthogonal to the strike of the S_1 foliation (Kruse, 2020). At the Berry deposit, a fourth vein set has been identified with a very low angle dip to the NNE (Kruse and Bartsch, 2021). Each vein set is mineralised, with a strong dominance in frequency of occurrence and gold content exhibited by Set 1.

Figure 7-7: Schematic Illustration of the Geometrical Relationship between Mafic Dykes and Veins (Marathon and Leprechaun Deposits)



Source: Kruse, 2020.

The Set 1 extensional and Set 2 shear-parallel QTP-Au veins are up to 1.5 m thick and have been traced in trenched outcrop exposures for over 280 m of continuous strike length; however, the observed strike length of individual veins is typically in the range of metres to tens of centimetres (see Figures 7-8 to 7-11).

The visible gold in QTP veining occurs as grains, ranging in size from <0.1 mm and up to 1-2 mm, hosted by quartz, tourmaline masses, within and along the margins of pyrite, or associated with minor tellurides. Highest gold grades are commonly associated with large (1-3 cm), euhedral and occasionally subhedral pyrite in QTP veining. In weathered surfaces, the gold is observed in limonite patches derived from weathering of the pyrite (Barbour, 1999). Other sporadically observed sulphides, in decreasing order of abundance, include chalcopyrite, pyrrhotite, sphalerite and galena. These minerals form minor components to the overall mineralisation.

Figure 7-8: Sheeted, Shallow Southwest-Dipping Quartz Tourmaline Pyrite Vein Array (Set 1), Marathon Deposit

Figure 7-9: Gold-bearing Quartz-Tourmaline-Pyrite Veins at the Frank Zone

Figure 7-10: Stockwork Quartz Tourmaline Pyrite Veins Hosted in Strongly Sericite-Silica Altered Quartz Porphyry, Marathon Deposit

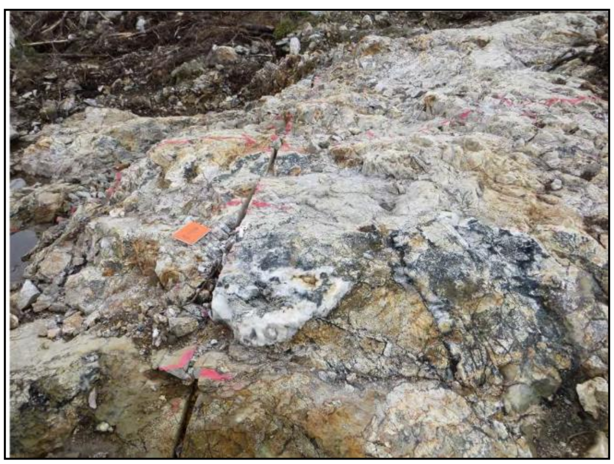
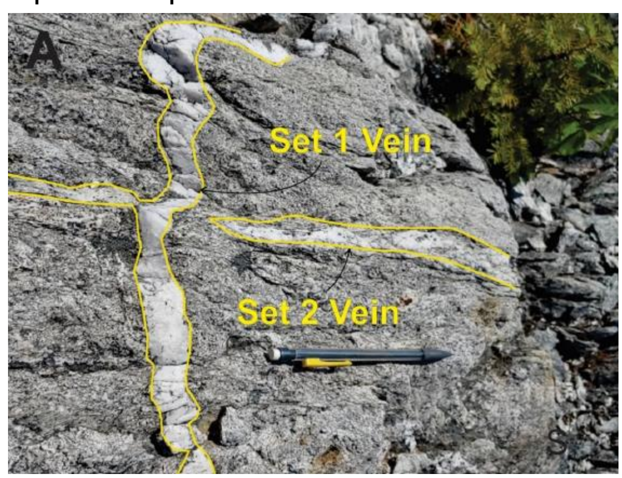


Figure 7-11: Field Relationship Between Set 1 (Extensional) and Set 2 (shear parallel) veins, Leprechaun Deposit



Source for the above photos: Marathon Gold, 2021.

In addition to structural studies, the relationship between high-grade gold mineralisation and the location of the dykes supports the theory that the mafic dykes provide a rheologic contrast that (1) promotes brittle fracturing of the granitoid unit and therefore, acts as a controlling factor of mineralised fluid flow, and (2) incites the eventual emplacement of zones of gold enrichment.

The individual characteristics of mineralisation at the Marathon, Leprechaun and Berry deposits are described below. The information in the following sections is summarised from Murahwi (2017), Dunsworth et al. (2017), and Capps and Dunsworth (2019). Downhole surveys were conducted on all drillholes, and the azimuth and dip were measured at varying intervals such that the drillholes could be plotted in real space. Measurements were typically taken every 25 m for holes drilled prior to 2019 and every 2 to 5 m for anything drilled during 2019 or later. Consequently, the relationship between the sample length and the true thickness of the mineralisation is well documented and all assay sample intervals are given as core length unless noted as true thickness.

7.6 Marathon Deposit

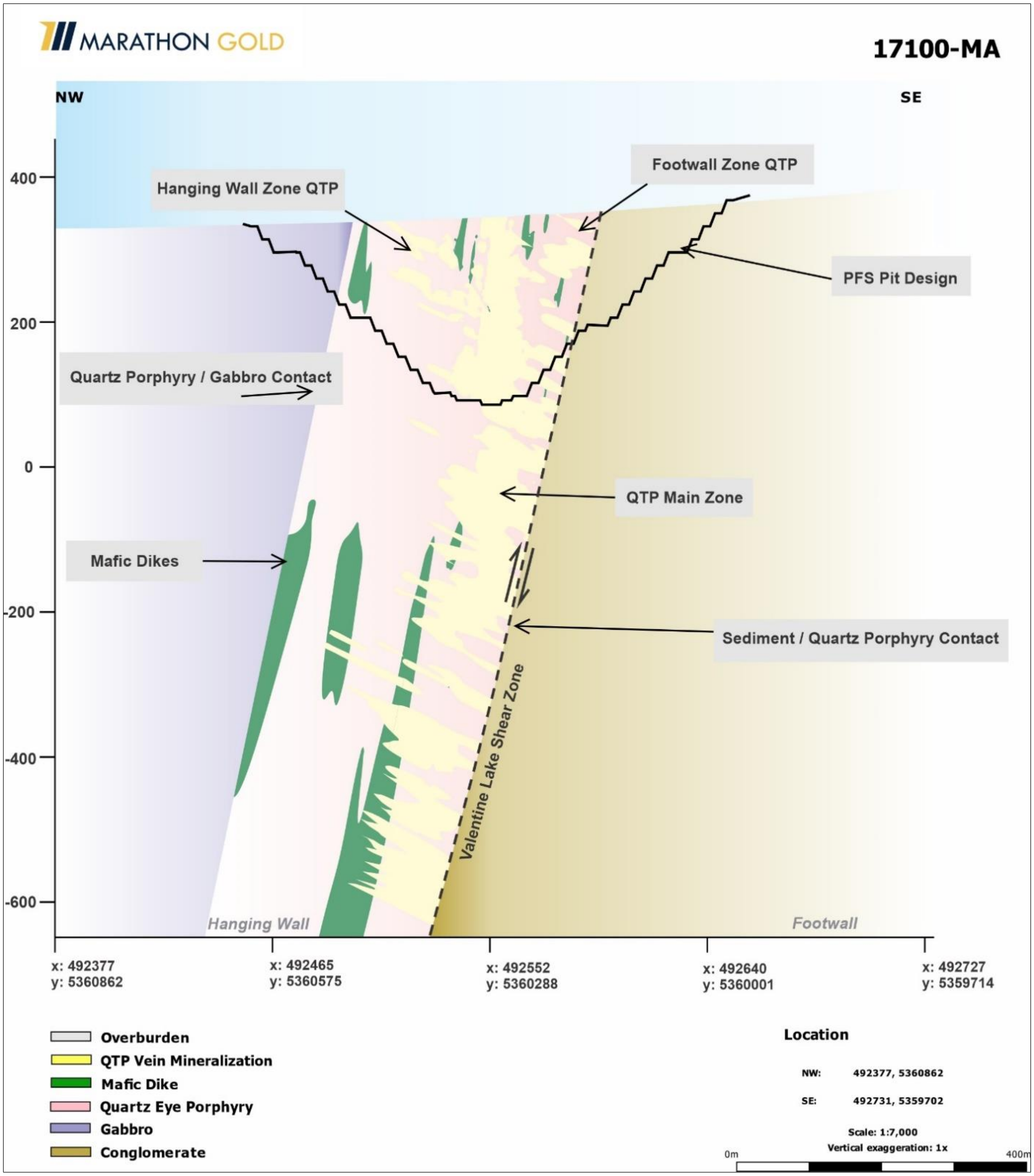
The Marathon deposit is located 6 km northeast of the Leprechaun deposit and consists dominantly of shallow, southwest-dipping en-echelon stacked QTP gold veins that intrude dominantly quartz-porphyry and lesser aphanitic quartz-porphyry and mafic dykes of the VLIC. The gold-bearing QTP veining occurs up to 250 m to the northwest of the VLSZ.

The Main Zone of gold-bearing QTP veining forms a northeast-trending sub-vertical mineralised corridor of intense QTP gold veining that ranges between 50 to 200 m in width, occurs over a strike length of more than 1.5 km, and has been observed in outcrop and drill-observed to a depth of 1,000 m (Dunsworth, et al.; 2017; see Figure 7-12).

The Main Zone contains a lenticular series of shallow, SW-dipping, gold-bearing QTP veining and is open at depth. Figure 7-13 highlights select gold grade intervals within the gold-bearing QTP veining. Characteristic gold intervals from drillholes that penetrated downward at high angle through the shallow, SW-dipping, en-echelon stacked QTP-Au vein swarms of the Marathon deposit are presented in Table 7.1.

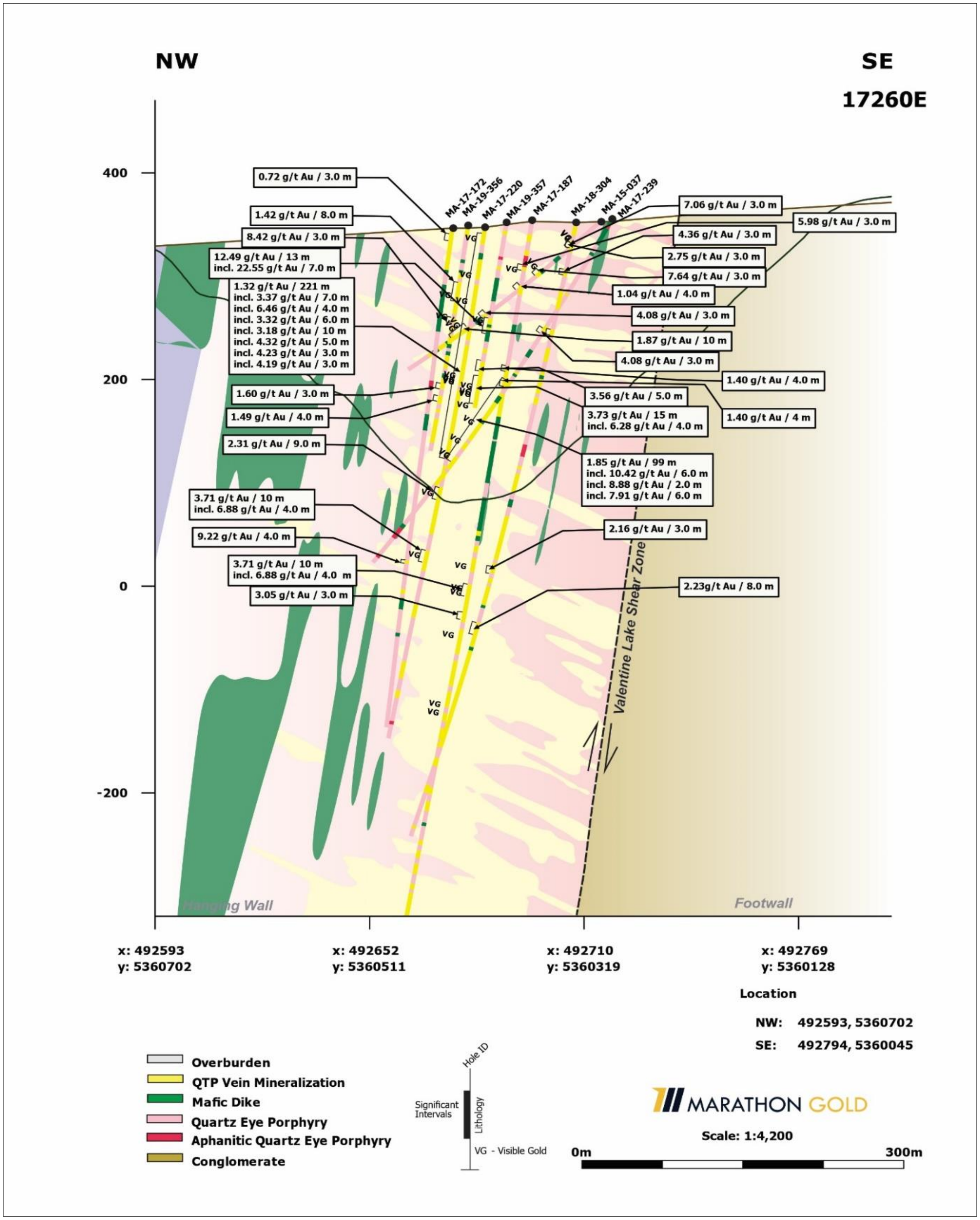
At present, the peripheries of the Marathon deposit mineralised zone are relatively poorly defined, with a preliminarily observed outward gradational decrease in quartz vein density northwest and southeast from the central, dense vein zone. Limited drilling on the northeast and southwest margins suggest that deposit is cut-off at surface in these directions, but with high grade intercepts at depth suggesting potential continuity of mineralisation below surface.

Figure 7-12: Section 17100 Showing Geology of the Marathon Deposit



Note: Elevation in 200 m Increments. Source: Marathon Gold, 2021.

Figure 7-13: Section 17260 E showing the Geology & Mineralised Zones of Quartz-Tourmaline-Pyrite-Gold-Bearing Veins at the Marathon Deposit with Selected Core Length Gold Assay Intervals



Source: Marathon Gold, 2021.

Table 7.1: Selection of Significant Fire Assay Gold Intervals, Marathon Deposit

DDH	Section	Az	Dip	From	To	Core Length (m)	True Thickness (m)	Gold g/t (uncut)	Gold g/t (cut)
MA-19-442	16750	343	-87	168	220	52	49.4	2.17	
including				215	220	5	4.8	7.14	
MA-19-372	17220	345	-80	17	62	45	42.8	3.52	3.48
including				30	34	4	3.8	14.25	13.90
MA-18-303	17350	163	-85	100	249	149	141.6	1.54	
including				129	134	5	4.8	6.60	
including				185	191	6	5.7	6.35	
MA-18-295	17110	343	-79	437	496	59	56.1	7.97	4.13
including				489	494	5	4.8	57.74	22.11
MA-17-239	17260	343	-61	183	282	99	79.2	1.85	
included				183	189	6	4.8	10.42	
MA-17-220	17260	342	-82	6	227	221	210.0	1.32	
including				15	22	7	6.7	3.37	
including				140	150	10	9.5	3.18	
MA-17-218	17210	344	-82	4	213	209	198.6	1.36	
including				4	32	28	26.6	3.63	
MA-17-217	17230	340	-82	24	195	171	162.5	1.51	1.49
including				51	63	12	11.4	4.68	
MA-17-213	17160	334	-83	17	242	225	213.8	1.88	
including				17	42	25	23.8	3.38	
including				171	196	25	23.8	4.87	
MA-17-188	17190	343	-80	21	347	326	309.7	2.13	
including				78	139	61	58.0	3.36	
including				209	241	32	30.4	4.04	
including				317	339	22	20.9	3.18	
MA-17-186	17330	342	-82	195	386	191	181.5	1.61	
including				279	306	27	25.7	3.16	
MA-17-176	17330	343	-81	141	259	118	112.1	1.56	
including				204	226	22	20.9	3.58	
MA-17-162	17170	343	-82	35	160	125	118.75	2.12	
including				109	125	16	15.2	4.34	
				210	253	43	40.9	4.18	4.08
including				239	244	5	4.8	9.11	
MA-17-160	17270	343	-82	134	209	75	71.3	3.92	2.29
including				183	188	5	4.8	33.4	8.96
MA-17-159	17240	343	-82	88	138	50	47.5	3.43	2.30
including				131	138	7	6.7	15.36	7.24
				161	211	50	47.5	2.57	
including				161	173	12	11.4	6.10	

Note: Fire assays cut to 45.0 g/t Au.

7.7 Leprechaun Deposit

The Leprechaun deposit consists of QTP gold-bearing extensional and lesser shear parallel veins that intrude the variably sheared and fractured trondhjemite, as well as sheared mafic dykes of the VLIC.

Mineralisation at Leprechaun occurs over a strike length of greater than 900 m and has been identified at surface in outcrop in drilling at depths of up to 400 m. The Leprechaun deposit differs from the Marathon deposit in the relatively tight concentration of mineralisation in Main Zone type configurations of en-echelon stacked QTP-Au vein sets. These Main Zones range from 30 to 120 m wide, dip to the northwest, and are located proximal to the VLSZ contact within the VLIC trondhjemite. In the characteristic fashion, the dominant en-echelon stacked, southwest-dipping extensional QTP-Au (Set 1) veins occur at high angle to the penetrative regional L1 stretching lineation, while the lesser shear parallel QTP-Au veins strike subparallel to slightly oblique to the VLSZ (Dunsworth, 2011; Dunsworth et al. 2017; Lincoln et al., 2018). Set 1 extensional QTP-Au veins at Leprechaun appear to have a moderately steeper SW dip than at Marathon (Kruse and Bartsch, 2021).

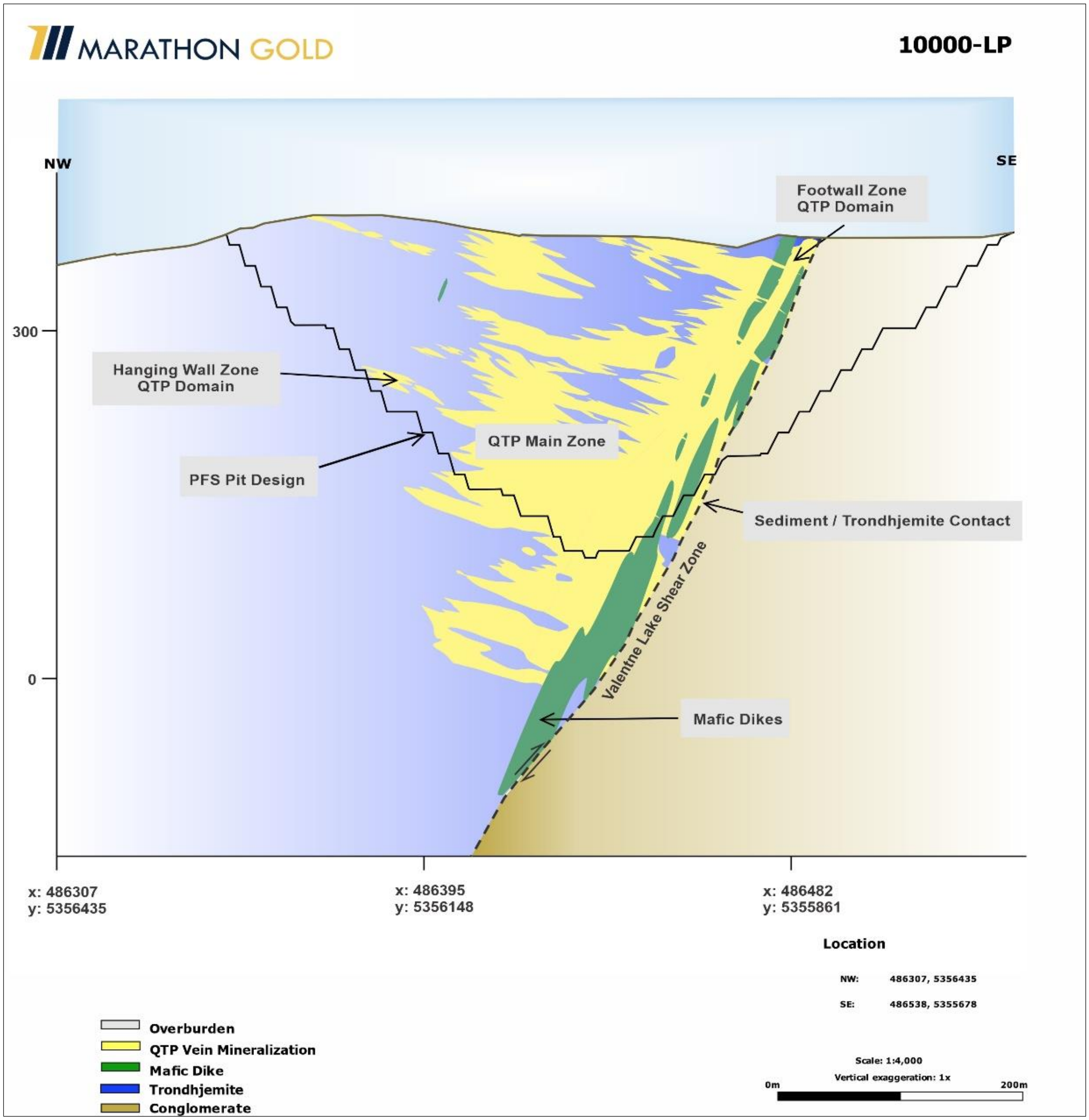
The QTP-Au mineralisation at Leprechaun has been modelled in three zones from west to east: Hanging Wall Zone, Main Zone and Footwall Zone (Lincoln et al., 2018; see Figure 7-14). The Main Zone is open at depth and is constrained to the southeast by the VLSZ (Figure 7-15) with a gradational transition to the Hanging Wall to the northwest. A high-grade central core exists within the Main Zone, bounded by mafic dykes to the northwest and the Rogerson Lake Conglomerate to the southeast, forming a lenticular body of dense QTP veining open at depth.

The Hanging Wall Zone occurs transitionally west of the Main Zone and consists of a series of variably shallow to moderately dipping, stacked en-echelon extensional QTP tension gashes with minor steeper-dipping QTP veins that extend up to 350 m northwest into the hanging wall. The vein density and concentration of vein arrays increases toward the east, proximal to the Main Zone, and remains open to the northwest.

The Footwall Zone is a minor component of the Leprechaun deposit and comprises localised extensional QTP veins that extend into the structurally underlying Rogerson Lake Conglomerate. Toward the southern part of the deposit, the Main Zone appears to peel slightly further away from the fault contact which spatially coincides with a marked increase in the volume of wide, discontinuous mafic dykes observed near the contact in this area. The gold-bearing mineralising fluids appear to have localised flooding along the mafic dyke contacts and regular breaching and brecciation within.

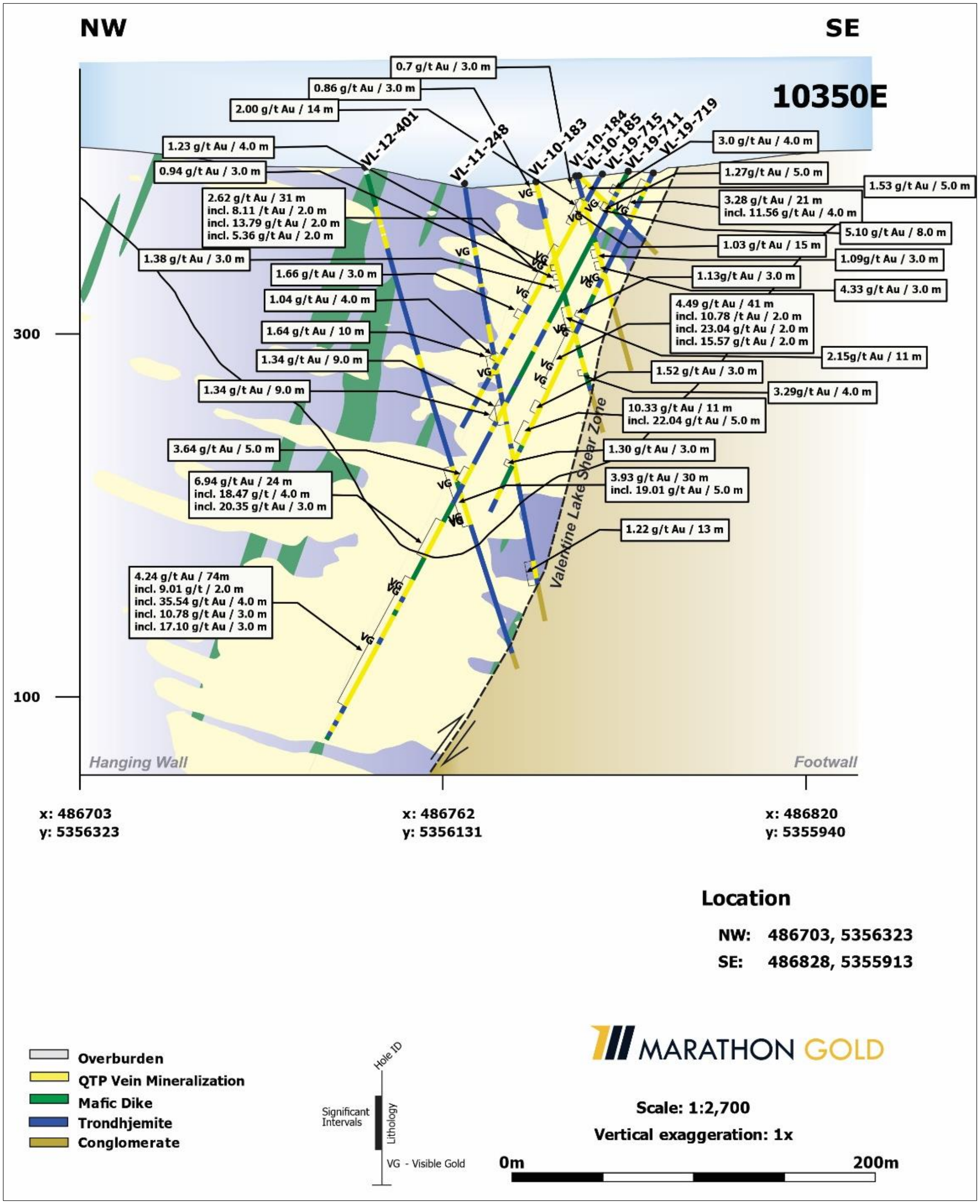
The QTP-Au mineralisation at Leprechaun occurs as visible gold grains, up to 2 mm in size, occurring in quartz and along the margins as well as within tourmaline masses and pyrite. A selection of the best gold intervals from drillholes that penetrated downward at high angle through the en-echelon stacked QTP-Au vein swarms of the Leprechaun deposit are presented in Table 7.2.

Figure 7-14: Section 10000 Showing Geology of the Leprechaun Deposit



Source: Marathon Gold, 2021.

Figure 7-15: Section 10350 E showing the Geology & Mineralised Zones of Quartz-Tourmaline-Pyrite-Gold-Bearing Veins at the Leprechaun Deposit with selected Core Length Gold Assay Intervals



Source: Marathon Gold, 2021.

Table 7.2: Selection of Significant Fire Assay Gold Intervals, Leprechaun Deposit

DDH	Section	Azimuth	Dip	From (m)	To (m)	Core Length (m)	Gold g/t	Gold g/t (cut)
VL-10-165	10000	162.6	-45	164	173	9	13.4	
VL-10-225	10012	169	-80	64	91	19	6.53	
VL-10-226	10000	164.5	-80	78	103	17	6.94	
VL-10-226	10000	164.5	-80	90	103	13	11.81	
VL-11-246	10513	161	-72	79	146	37.5	3.75	
VL-11-261	10538	165	-48	167	183	12.8	9.68	
VL-11-288	10500	165	-75	155	237	65.6	2.09	
VL-11-306	9938	160	-54	196	210	13.3	16.15	
VL-11-352	10288	161	-45	136	165	26.1	13.95	
VL-12-401	10350	164	-75	176	206	30	3.93	
VL-12-403	10175	164	-57	210	232	22	7.23	
VL-12-407	10125	164	-62	289	304	15	9.19	
VL-12-408	10000	160	-42	153	172	19	13.81	
VL-12-416	9988	163	-30	52	60	8	15.8	
VL-12-465	10100	161	-63	328	341	13	13.2	
VL-12-504	10010	161	-71	314	321	7	45.58	
VL-13-523	10360	162	-81	261	264	3	52.73	
VL-13-526	9960	163	-70	228	264	36	4.26	
VL-13-537	10080	164	-63	268	271	3	39.55	
VL-17-653	10000	342	-58	102	283	181	3.42	3.17
VL-17-654	10000	340	-57	6	307	301	2.65	2.63
VL-17-655	10120	342	-59	280	431	151	2.34	
VL-17-656	10250	341	-55	69	76	7	19.01	
VL-17-656	10250	341	-55	3	36	33	3.72	
VL-19-679	10060	341	-61	8	14	6	25.78	8.69
VL-19-679	10060	341	-61	152	174	22	9.02	7.55
VL-19-679	10060	341	-61	189	211	22	11.83	8.95
VL-19-680	10080	344	-59	21	92	71	2.52	
VL-19-681	10100	344	-59	179	305	126	4.27	
VL-19-681	10100	344	-59	334	376	42	4.11	
VL-19-686	10040	344	-61	246	399	153	3.02	
VL-19-688	9960	342	-55	245	275	30	5.06	
VL-19-688	9960	342	-55	299	323	24	5.04	
VL-19-695	10020	343	-63	42	140	98	2.41	
VL-19-697	9940	344	-60	169	205	36	5.45	
VL-19-700	10190	344	-65	62	91	29	4.39	
VL-19-703	10280	342	-59	52	71	19	10.03	
VL-19-711	10350	345	-62	256	330	74	4.24	
VL-19-711	10350	345	-62	219	243	24	6.94	
VL-19-719	10350	343	-64	99	140	41	4.49	

Note: Fire assays cut to 45.0 g/t Au.

7.8 Berry Zone

The Berry deposit is located approximately 3 km northeast of the Leprechaun deposit and 2 km southwest of the Marathon deposit and spans a strike length of 1.5 km. This recently discovered area consists of dominantly shallowly southwest-dipping, en-echelon, extensional QTP veining hosted in quartz-eye porphyry and lesser mafic dykes and aphanitic quartz porphyry. The mineralised corridors are generally 20 to 60 m wide and have been traced to depths of over 350 m. In localised zones, mineralisation penetrates across the VLSZ and is found up to 20 m into the Rogerson Lake Conglomerate. Mineralisation at the Berry deposit is found in tight packages bounded to the southeast by the VLSZ and the NW by a series of mafic dykes oriented sub-parallel to the shear zone (see Figure 7-16 on the following page). This style and configuration of mineralisation is reminiscent of the tightly concentrated mineralised packages of the Leprechaun deposit.

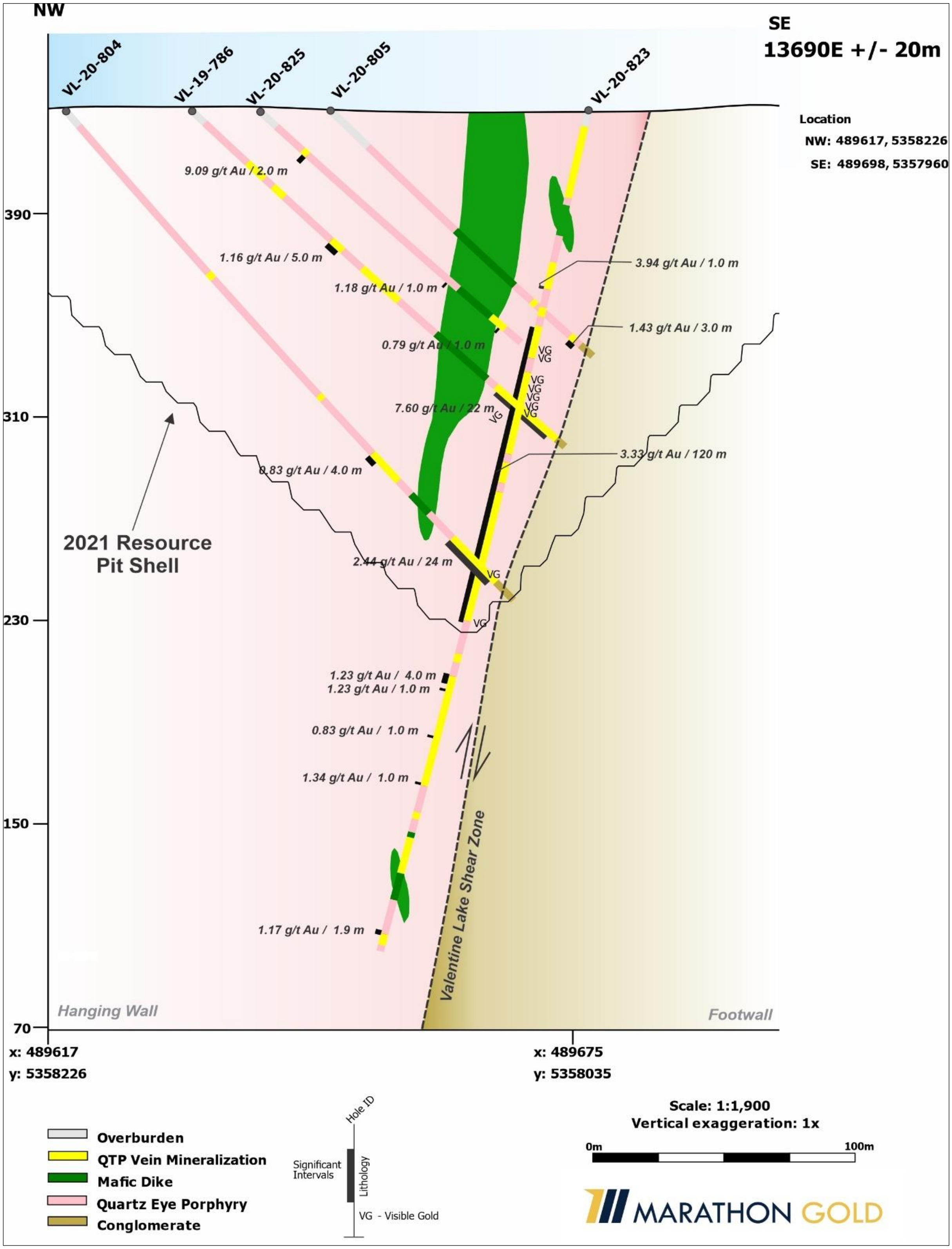
The dominant vein orientation in the Berry deposit was found to be the extensional Set 1 veining dipping shallowly to the southwest, like that found in Leprechaun and Marathon deposits. In addition to the three vein sets found in Leprechaun and Marathon, Kruse (2020) documented a fourth orientation of mineralised veining at Berry which dips shallowly to the NNE. This vein set, referred to as “Set 3” of the four, appears unique to Berry, appears to have a moderate (yet secondary) association with gold mineralisation, and has been integrated along with Set 1 veins in the Berry mineral resource estimate.

Drilling at the Berry deposit has defined multiple intervals of high-grade gold, with visible gold throughout up to 3 mm in size. A summary of best results from the Berry deposit to date can be found in Table 7.3 below.

Table 7.3: Berry Zone Drilling Results

DDH	Section	Az	Dip	From	To	Core Length (m)	True Thickness (m)	Gold g/t (Uncut)	Gold g/t (Cut)
VL-18-676	13410	163	-75	145	194	49	41.7	6.17	5.86
VL-19-776	14740	162	-46	9	14	5	3.5	10.43	
VL-19-778	13430	342	-80	183	189	6	5.7	9.74	
VL-19-779	13380	337	-80	85	96	11	10.5	5.54	
				50	63	13	12.4	3.82	
VL-19-780	14740	163	-45	121	131	10	7	7.25	
VL-19-786	13700	163	-44	165	187	22	15.4	7.6	6.97
VL-20-799	13500	343	-82	113	168	55	52.3	2.24	
VL-20-806	13730	163	-45	155	169	14	9.8	8.06	
VL-20-813	13380	163	-69	165	177	12	10.2	8.03	
VL-20-823	13690	343	-77	87	207	120	114	3.33	3.31
VL-20-824	13720	344	-80	19	23	4	3.8	51.52	8.18
				107	143	36	34.2	3.37	3.2
VL-20-835	13420	343	-83	166	213	47	44.65	2.96	2.41
VL-20-838	13650	345	-73	121	232	111	94.35	1.47	1.43
VL-20-839	13940	163	-45	12	21	9	6.3	14.39	7.69
VL-20-873	13740	343	-75	6.74	92	85.26	81.04	2.61	2.6
VL-20-876	14700	164	-45	87	109	22	15.4	4.91	3.85
VL-20-889	13580	342	-77	37	79	42	39.9	3.7	2.67
VL-20-907	13680	344	-76	97	104	7	6.65	18.16	6.69

Figure 7-16: Section showing the Geology & Mineralised Zones of Quartz-Tourmaline-Pyrite-Gold-Bearing Veins at the Berry Deposit with selected Core Length Gold Assay Intervals



Source: Marathon Gold, 2021.

8 Deposit Types

A schematic model for gold mineralisation in central Newfoundland with the geological setting of the Valentine Gold Project within the Dunnage Zone of the Newfoundland Appalachian system, is shown in Figure 8-1.

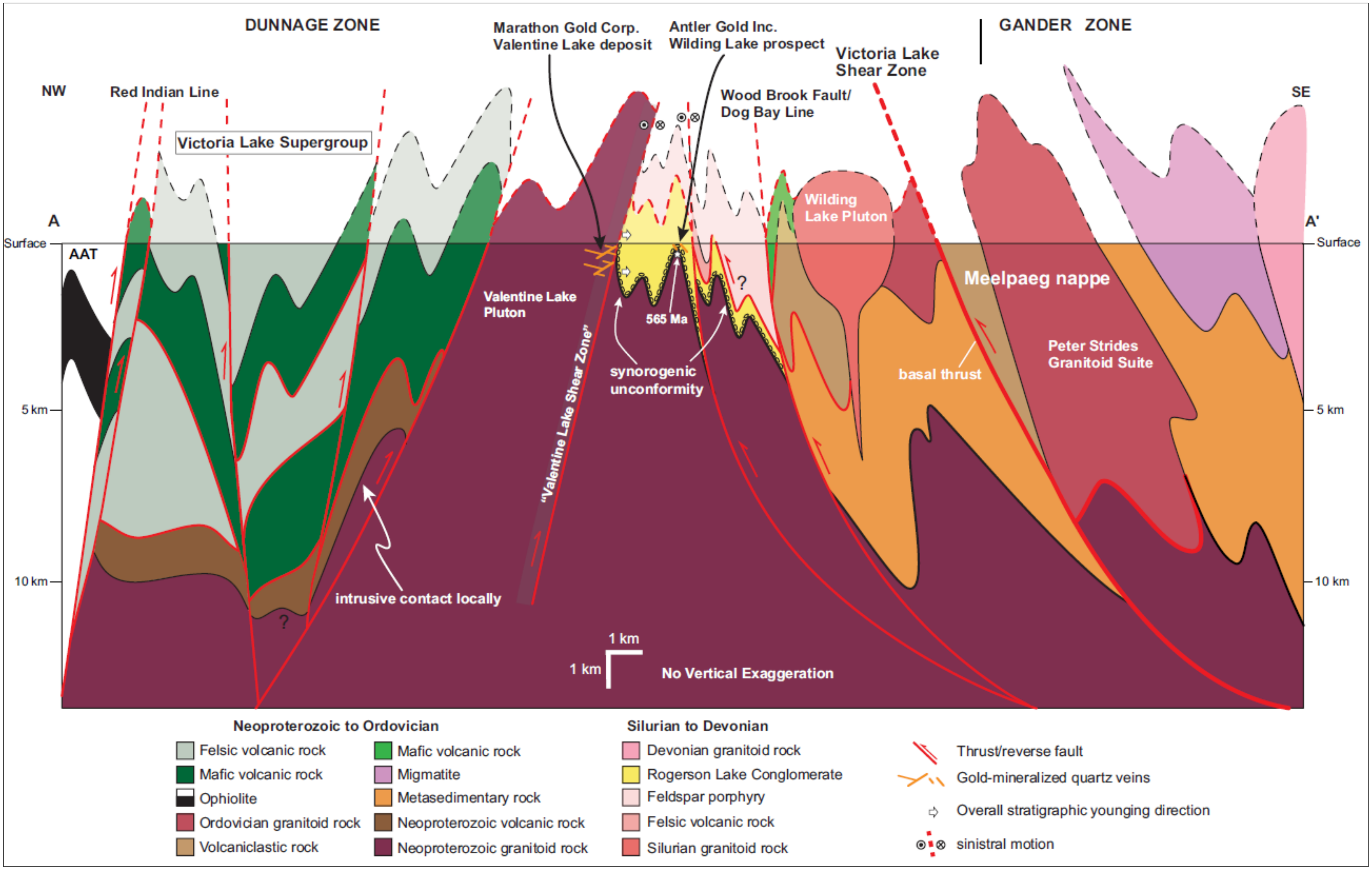
There are four principal types of gold mineralisation found in Newfoundland: orogenic (or mesothermal); epithermal; sediment-hosted; and VMS-related gold (e.g., Swinden et al., 1991; Evans, 1993; Evans and Wilson, 1994; Evans, 1996; Evans and Wilton, 2000; Wardle, 2005; Sandeman et al., 2010; Barrington et al., 2016). In central Newfoundland, numerous examples of mesozonal to epizonal, orogenic gold mineralising systems appear to be spatially related to vein-hosted gold in association with crustal-scale fault zones and faults, late orogenic timing and possible wall rock alteration as manifested by extensive carbonate alteration (Tuach et al., 1988; Evans, 1996, 1999; Groves et al., 2003; Wardle, 2005). The ultimate genetic origin is uncertain; in some occurrences, gold mineralisation may be intrusion-related and/or have textures suggestive of epithermal styles.

The gold mineralisation at the Valentine Lake property occurs as structurally controlled, orogenic gold deposits associated with Salinic aged crustal shortening and deformation. Recent field based and oriented drill core structural studies (Kruse, 2020; Kruse and Bartsch, 2021) has advanced the structural model at the Valentine Lake property. Gold mineralisation is developed within QTP vein sets associated with brittle-ductile deformation of granitoid rocks of the Neoproterozoic VLIC in contact with the Silurian Rogerson Lake Conglomerate. This contact coincides with the VLSZ, a major crustal-scale, NE-SW lithotectonic boundary. The VLIC and VLSZ are important constituent elements of the Dunnage Zone of the Newfoundland Appalachian system.

Development of en-echelon stacked SW dipping extensional vein sets (Set 1), with lesser shear parallel vein sets (Set 2) have been delineated at the Marathon, Leprechaun, Sprite, Victory and Berry deposits, and at the Frank, Rainbow, Steve, Scott, Triangle, Victoria Bridge, Narrows, Victory SW and Victory NE occurrences. In addition to the Set 1 and Set 2 veins, the Marathon, Leprechaun and Berry deposits also include localised, intensely QTP veined core complexes (Main Zones). This vein morphology and structural framework is commonly observed in shear zone hosted gold deposits where the shallow dipping extension veins are less laterally extensive, and the steeper fault-fill veins may display a large vertical extent. However, at the Valentine Lake property the QTP-Au en-echelon stacked, extensional Set 1 veins represent the dominant structurally controlled mineralisation style at the property and define the mineral resource models for the Marathon and Leprechaun deposits.

Individual QTP-Au veins range in thickness from a few millimetres and centimetres to metres, but are typically 2 to 30 cm thick. The extensional Set 1 and shear-parallel Set 2 QTP-Au veins are up to 1.5 m thick and have been traced in trenched outcrop exposure for over 280 m continuous strike length; however, the observed strike length of individual veins is typically in the range of metres to tens of centimetres. At the Marathon deposit, where mineralisation has been traced to at least 1,000 m below surface within an approximately 150 m wide mineralised corridor, individual southwest-dipping Set 1 extensional veins have been traced laterally in outcrop and trenches for tens of metres and sometimes over 100 m.

Figure 8-1: Gold Mineralisation in Central Newfoundland



Source: Honsberger et al., 2020.

9 Exploration

9.1 Introduction

Since 2010, Marathon Gold has conducted extensive exploration programs across the Valentine Lake property, including diamond drilling, trenching, channel sampling, mapping, prospecting, and ground-based geophysical surveys (including IP, magnetics and seismic). These programs have been approached with the overarching goal of increasing the gold resources of the property.

Five deposits with mineral resources have been delineated, the Marathon, Leprechaun, Sprite, Victory and Berry deposits, as well as the Frank, Rainbow, Steve, Scott, Triangle, Victoria Bridge, Narrows, Victory SW and Victory NE occurrences. The Marathon and Leprechaun deposits are the focus of the current mine development plan and feasibility study.

No new diamond drilling at the Marathon and Leprechaun deposits has been completed since the end of the 2019 infill drill program. Rather, Marathon Gold has focused on new discoveries along the mineralised VLSZ. Exploration drilling during 2020 and the first quarter of 2021 focussed on areas of new discovery, such as the Berry deposit and the Narrows occurrence. A summary of the drilling at the Berry deposit is presented in Chapter 10.

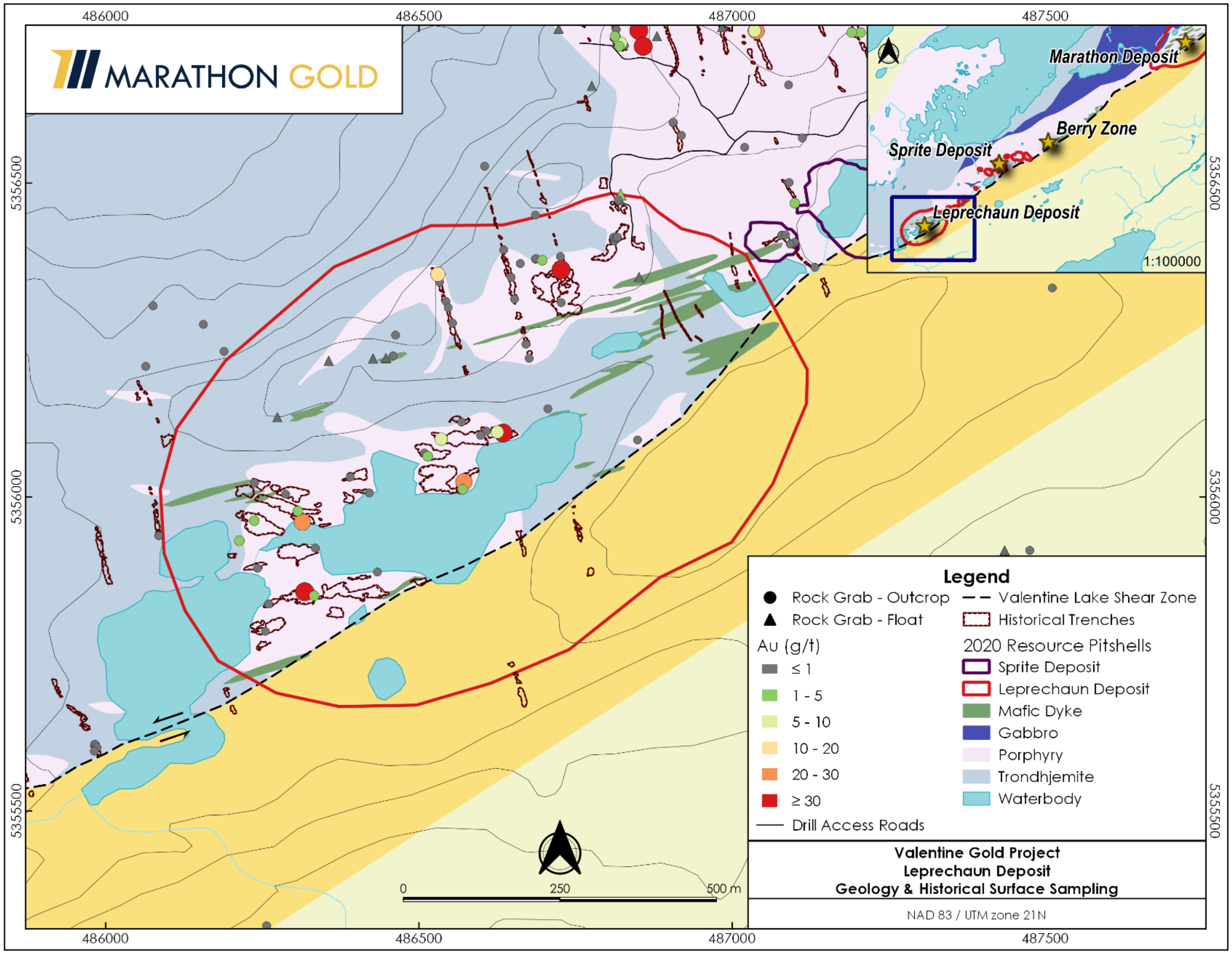
A summary of ground exploration work completed by Marathon Gold since 2010 is described in this chapter. This information is summarised from Murahwi (2017), Dunsworth et al. (2017), and Capps and Dunsworth (2020). The collective ground exploration work completed by Marathon Gold has formed the basis for understanding the geology at the property, and these data were considered during the construction of the 3D geological model and resource estimations presented in this report. However, none of the groundwork assay data was used in the actual estimation processes. Rather, the assay file used in this report is restricted to the drill core analytical dataset; all drilling information is summarised in Chapter 10. The metallurgical testwork is described in Chapter 13.

9.2 Geological Mapping (2010 to Present)

Marathon Gold has routinely conducted detailed 1:5000 scale geological mapping along cut grid lines in areas of exposed outcrop and across excavated trenches. Selected rock exposures were channel sampled and/or grab sampled for lithogeochemistry, petrography, and thin section study. Thin sections were prepared and analysed at Memorial University of Newfoundland. Petrographic samples were prepared and analysed by Vancouver Petrographic Inc. in Vancouver, British Columbia. Lithogeochemical samples were prepared and analysed by Activation Laboratories Ltd. in Ancaster, Ontario. The results of the detailed mapping, lithogeochemistry, and petrographic studies were used to prepare 1:5000 scale detailed geological maps for each deposit area (see Figures 9-1 to 9-4).

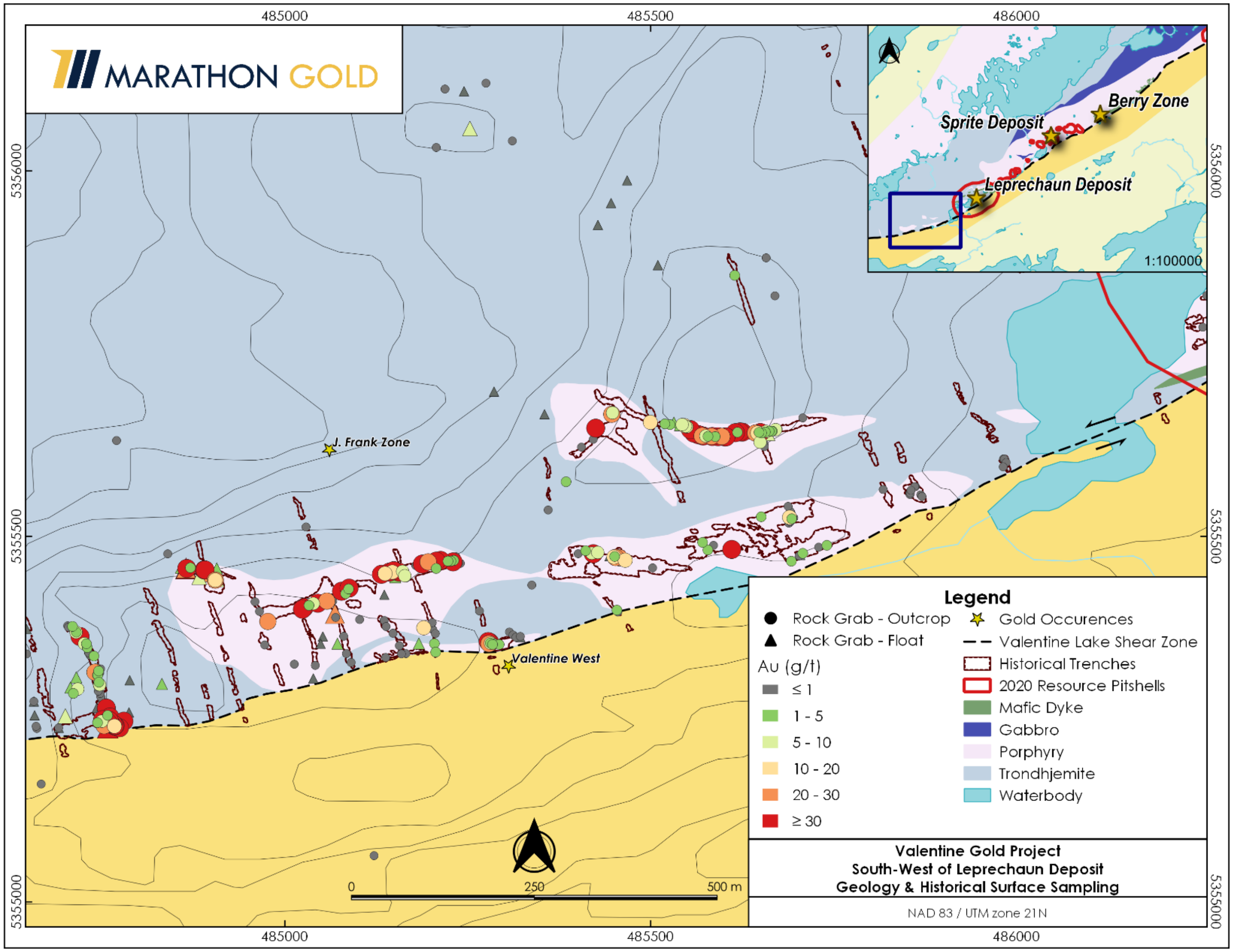
Marathon Gold engaged SRK Consulting in 2014 to conduct a structural geology investigation of the property, which included field mapping, diamond drill core logging, and geophysical data review. The study concluded that mineralisation is hosted in the hanging wall of the VLIC-Rogerson Lake conglomerate contact and is related to sinistral shear movement and extensional and fault fill veining along the Valentine Lake Shear Zone. Mineralisation is inferred to have formed proximal to sub-units of the VLIC that display greater magnetic intensity, where mineralisation is associated with fault splays, duplexes and bends.

Figure 9-1: 1:5000-Scale Geological Map of the Leprechaun Area



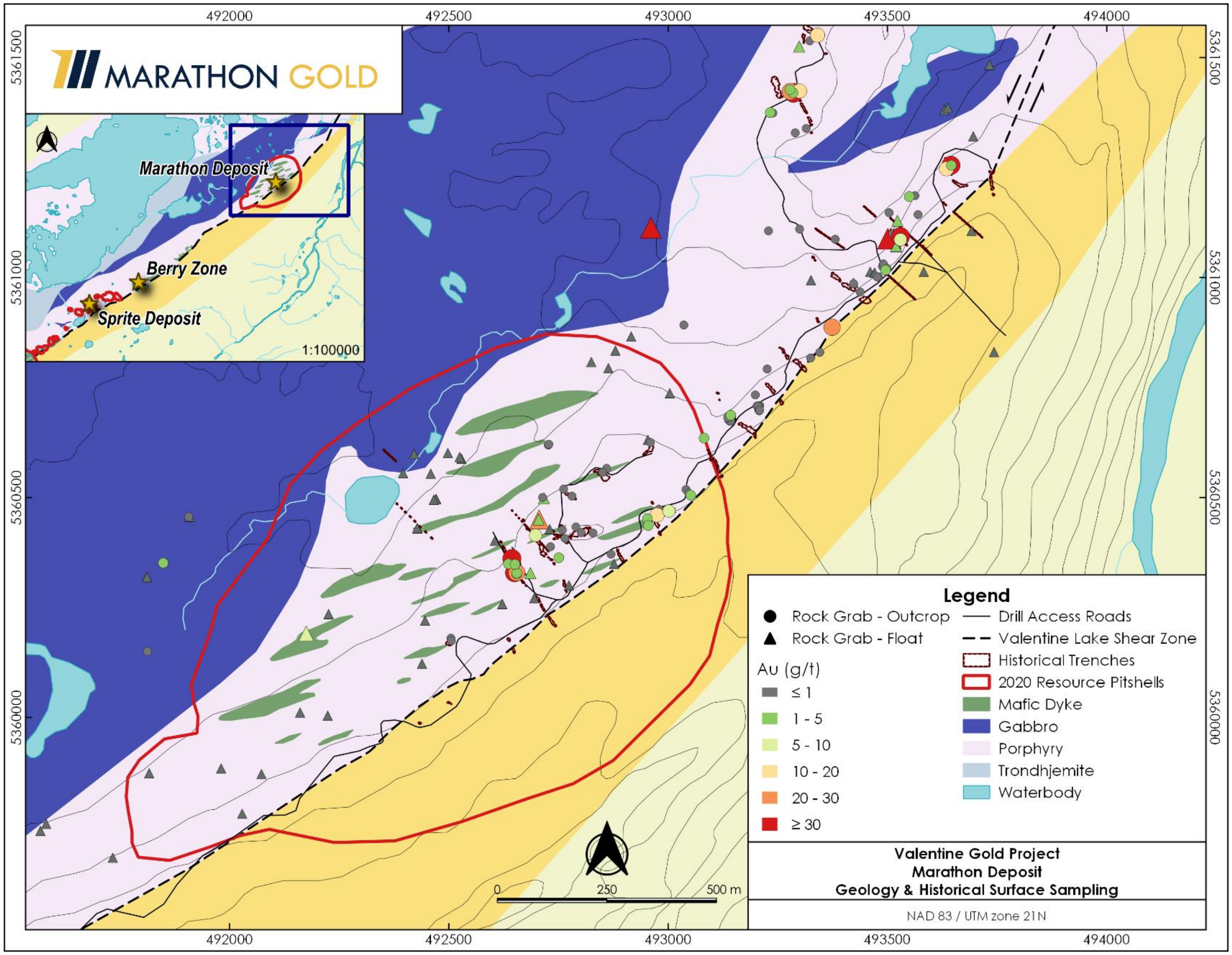
Source: Marathon Gold, 2021.

Figure 9-2: 1:5000-Scale Geological Map of the Frank to Leprechaun Area



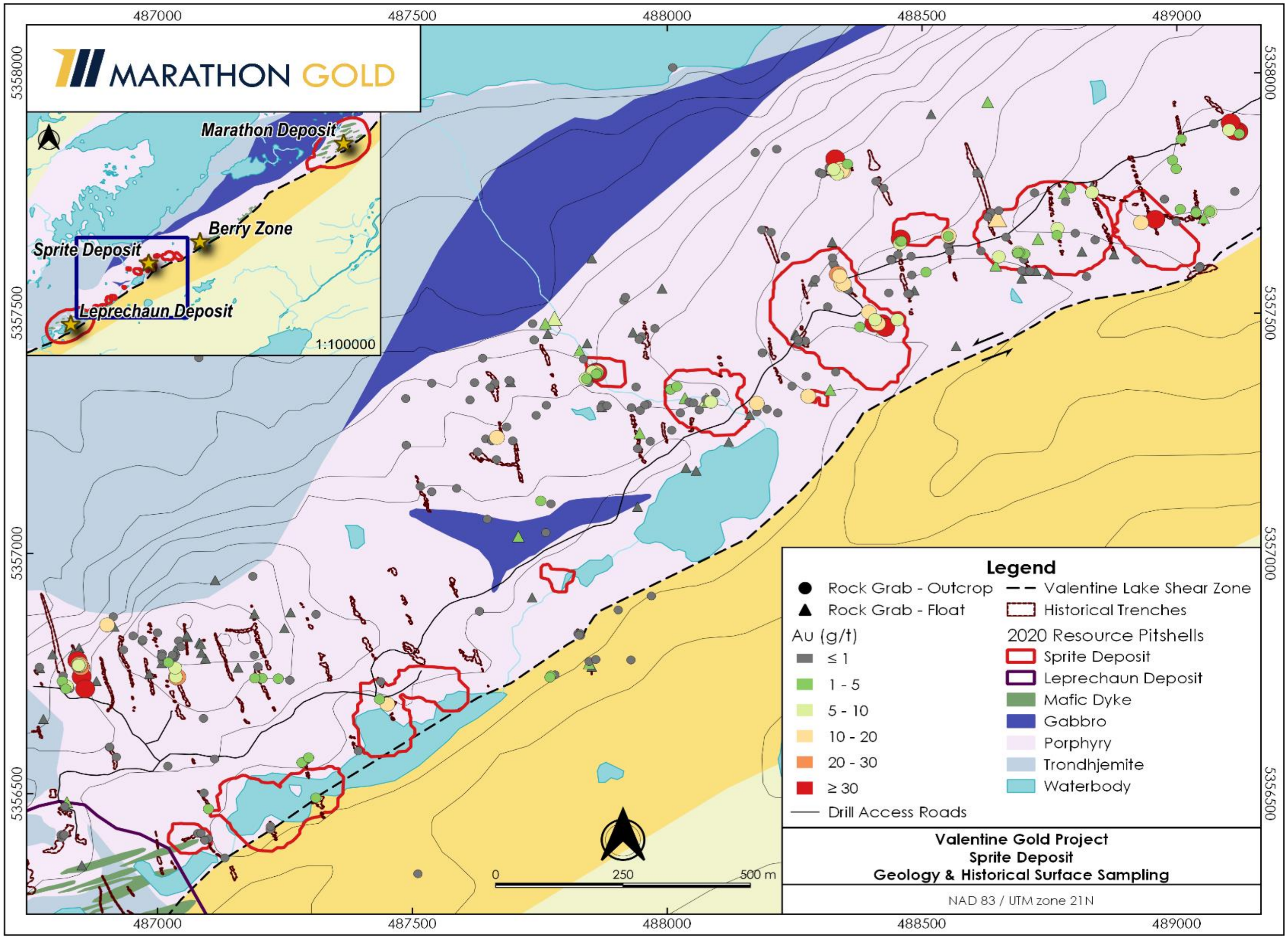
Source: Marathon Gold, 2021.

Figure 9-3: 1:5000-Scale Geological Map of the Marathon Area



Source: Marathon Gold, 2021.

Figure 9-4: 1:5000-Scale Geological Map of the Sprite Zone



Source: Marathon Gold, 2021.

Terrane Geosciences Inc. was retained in the spring of 2020 to conduct a field assessment of the current structural model, focusing on the Leprechaun, Marathon and Berry deposits. The assessment included a review of previous structural literature, lineament analysis and field-based structural mapping and analysis. This study established a revised kinematic model for the property and identified five phases of deformation. A penetrative ductile fabric associated with initiation of the Valentine Lake Shear Zone and characterised by a strong S1 foliation and L1 stretching lineation is observed in both the Rogerson Lake Conglomerate and in the Valentine Lake Intrusive Complex, with a southwest strike and steep dip to the northwest, paralleling the larger structure. Gold mineralisation is associated with veining within the Valentine Lake Intrusive Complex during a D3 phase of renewed crustal shortening following a period of regional D2 relaxation. Overprinting fabrics include a late D4 crenulation fabric and a D5 brittle fault set (Kruse 2020). These observations are consistent with regional geotectonic and geochronological models being developed by Honsberger et al., (2020) and others within the Dunnage Zone of Central Newfoundland.

The 2020 field-based structural study (Kruse, 2020) and a follow-up program of optical televiewer analysis of oriented drill core (Kruse and Bartsch, 2021) identified up to three distinct mineralised vein sets at the Leprechaun and Marathon gold deposits and up to four vein sets at the Berry deposit. In both studies, QTP-Au veins developed within brittle extensional fractures dipping at a low angle to the SW (Set 1 veins) were identified as the dominant mineralisation style at the property. The Set 1 veins represent the principal structural control on gold mineralisation in the mineral resource models for the Marathon and Leprechaun deposits, consistent with previous interpretation. Recommendations for further refinement of vein set attitudes form additional televiewer measurements, and manual modelling of mafic dykes within the deposit-scale geological models, to highlight their importance in the localisation of gold mineralisation.

9.3 Grab Rock Sampling (2010 to Present)

Marathon Gold collected 2,721 grab rock samples throughout the property during prospecting and geological mapping. Grab samples were collected as rock chip samples from outcrop, subcrop and float, with a target sample size of 1 to 2 kg. Samples were submitted to Eastern Analytical Ltd. in Springdale, NL, for preparation and analysis by fire assay (see Chapter 11).

Rock chip sample analytical results have not been used as part of the assay database used in the mineral resource estimation presented in this report. However, the results of grab sampling are a useful exploration tool and, in conjunction with geological mapping, have assisted Marathon Gold with prioritising targets for follow up exploration.

9.4 Channel Rock Sampling (2010 to Present)

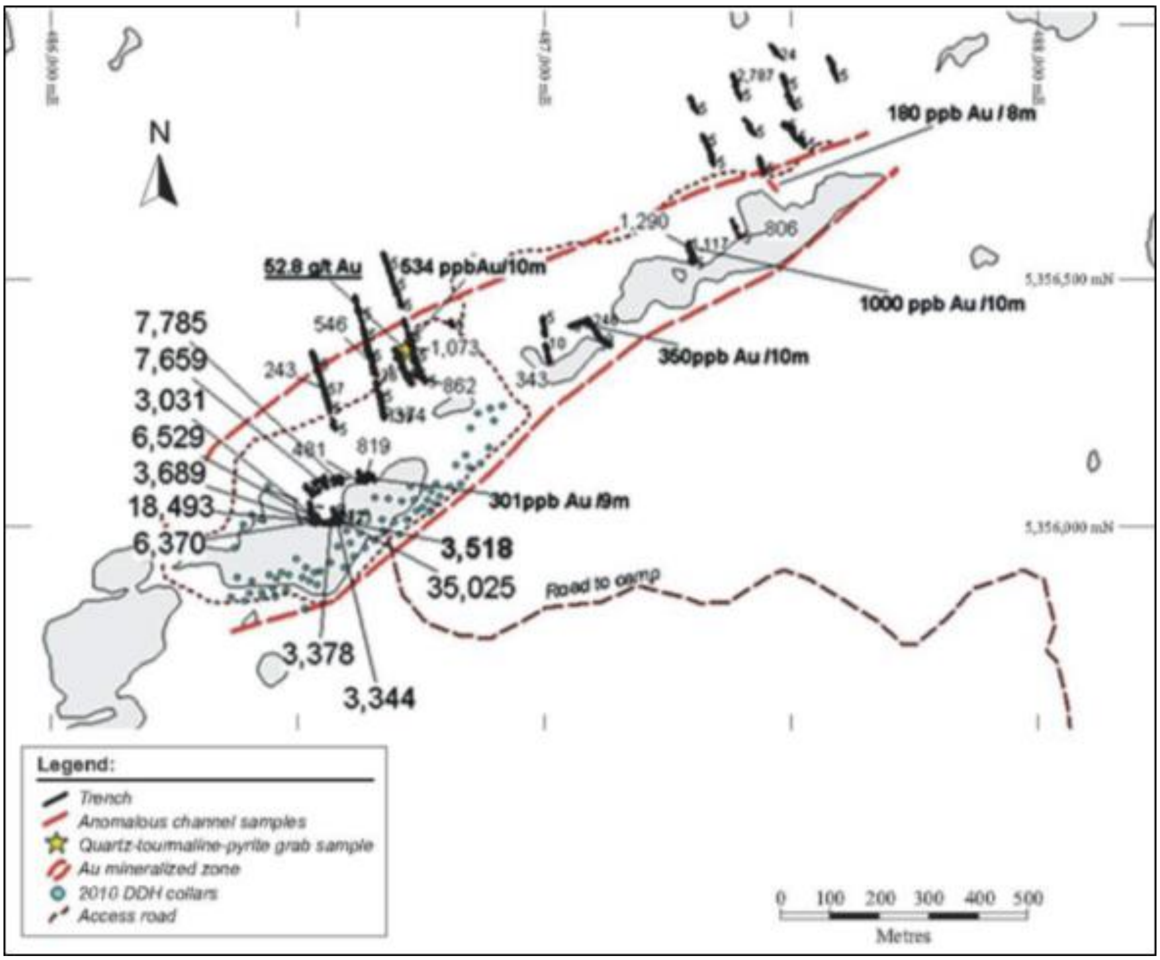
To present, Marathon Gold has channel-sawed 121 outcrops and collected 5,767 channel rock samples from throughout the property. The locations of the channel samples are shown on Figures 9-1 to 9-4 above. Channel sample sites were typically stripped of vegetation and/or glacial surficial material using a backhoe and washed with water to clear debris and leave a clean surface. The location of the channel was then marked by the geologist and was typically oriented perpendicular to the strike of mineralisation. The channel was mechanically sawn using a portable saw with a diamond blade, to create a channel approximately 5 cm wide and 10 cm deep.

The channel rock samples were taken at continuous intervals of between 1 and 2 m in length using a hammer and chisel. Samples were placed into plastic bags, tied, and labelled prior to dispatch for sample preparation and gold fire assay. The channel sample was logged like a drillhole, using the 'from' and 'to' meterage with lithological and geological descriptions recorded in an Excel datasheet.

The analytical results of the channel sampling have been used by Marathon Gold to define drill targets and are considered representative of the mineralisation with no evidence of bias. For example, the 2010 channel rock sampling results from Leprechaun and Sprite channel sampling were used to define drill targets in 2010 to 2011 (see Figure 9-5). Channel sampling was also used to successfully identify significant mineralisation at the Marathon deposit. Results from channel sampling including 16.5 m at 5.79 g/t Au, 16.5 m at 2.53 g/t Au and 9.0 m at 4.84 g/t Au were used to define the initial drill targets that led to the discovery of the Marathon deposit.

The channel rock sample data were not incorporated into the assay dataset used to prepare the mineral resource estimations presented in this report.

Figure 9-5: Channel Sample Results at the Leprechaun & Sprite Deposits (2010)



Source: Murahwi, 2017

9.5 Geophysical Surveys

Marathon Gold conducted induced polarisation (IP) surveys at Leprechaun and Victory deposits, ground magnetic surveys along the length of the main mineralised trend, and a seismic survey at the Marathon deposit. Marathon Gold also has the data acquired from an aeromagnetic survey conducted across the entire property by Richmont in 2007.

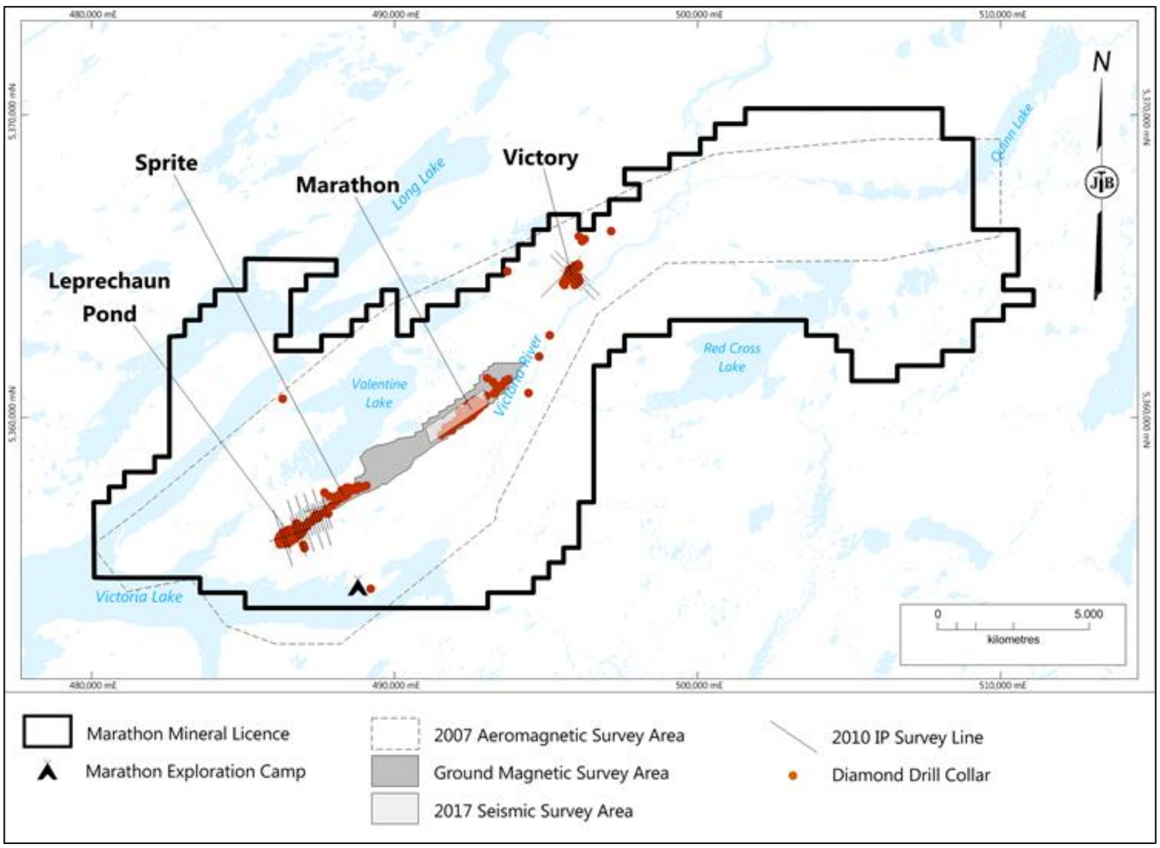
The locations of the geophysical surveys conducted at the project are shown in Figure 9-6, and the individual surveys are described below.

9.5.1 Induced Polarisation Data

9.5.1.1 Ground Induced Polarisation Survey

Insight Geophysics Inc. (IGI) of Oakville, Ontario, completed time domain IP and resistivity orientation surveys at the Leprechaun-Sprite (16.25-line km) and Victory (5-line km) deposits in July-August 2010, for a total of 21.25-line km (see Figure 9-6).

Figure 9-6: Geophysical Survey Locations at the Valentine Lake Property



Source: BOYD, 2018

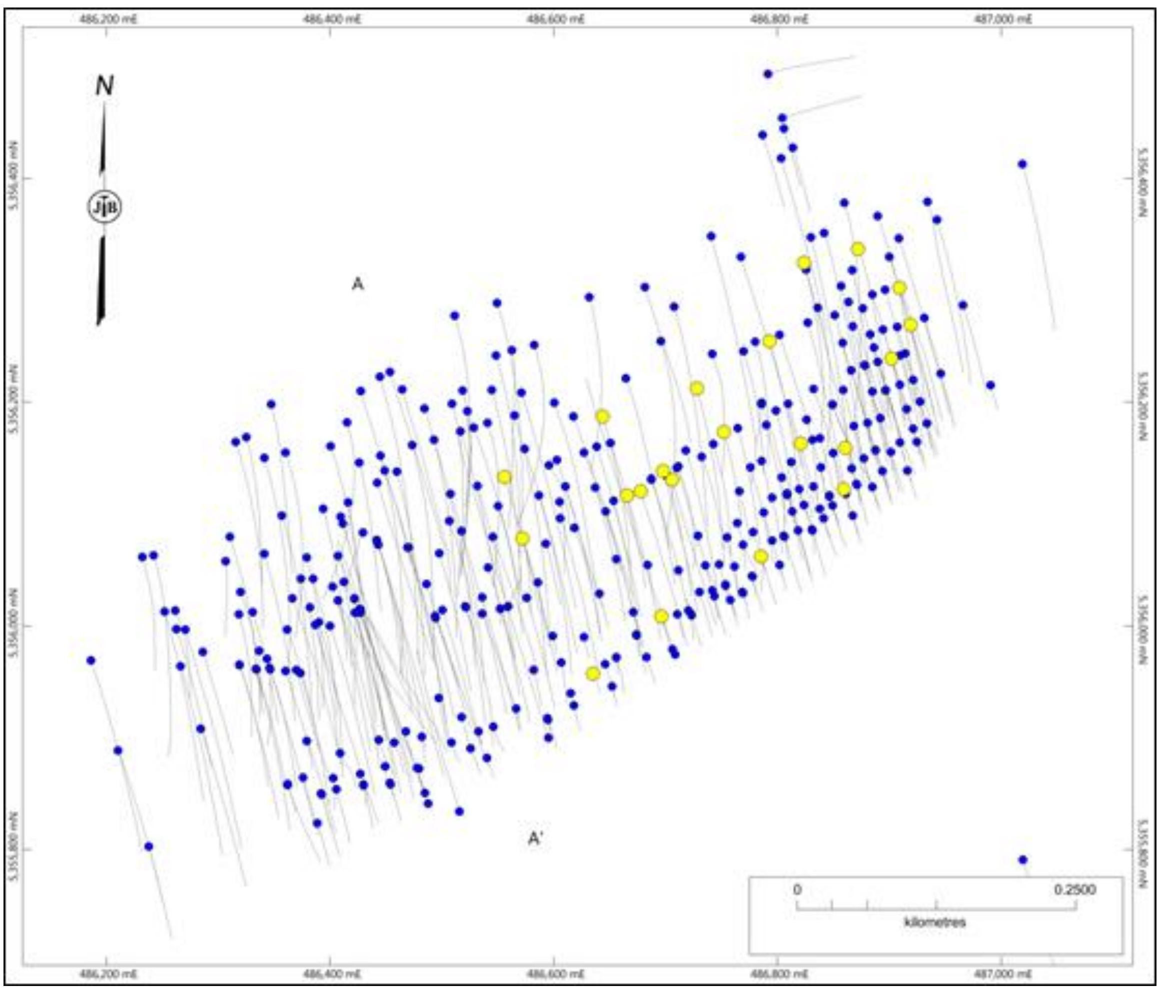
The surveys were conducted using Tx dipole spacing of 200 to 3,000 m, Rx dipole spacing of 12.5 m and 25 m, and a sampling interval of 12.5 m and 25 m (Pawluk, 2010). Survey lines were oriented perpendicular to the mapped trend of mineralisation at each area.

IGI produced a section displaying chargeability and resistivity for each line that was surveyed and Marathon Gold used the results to identify anomalies that were potentially related to QTP vein hosted mineralisation. Marathon Gold drill tested the anomalies; however, no significant results were obtained (Dunsworth, pers. comm., 2017).

9.5.1.2 Downhole Spectral Induced Polarisation Survey

Downhole Spectral IP (DSIP) surveys were conducted on 21 drillholes (see Figure 9-7) by JVX Ltd. (JVX) of Richmond Hill, Ontario, in April 2012, with the aim of mapping high-grade lenses and the overall mineralised envelope at the Leprechaun deposit (Webster and Jelenic, 2012). Apparent resistivity and chargeability were measured using pole dipole and gradient arrays to produce 2D and 3D models of chargeability and resistivity.

Figure 9-7: Leprechaun Drill Collars (blue) & Holes selected for Downhole Spectral IP Surveys (yellow)



Source: BOYD, 2018

JVX produced a set of 2D sections and 3D models with exploration targets, where anomalous zones of chargeability and resistivity were inferred to represent alteration and/or geological structures. A general trend of significant gold intercepts that correlated with fine-grained chargeable sources associated with moderate apparent resistivity was identified by JVX in 17 of the 21 drillholes surveyed (Webster and Jelenic, 2012). Two exceptions to the trend were also noted where a moderately chargeable source with moderate apparent resistivity did not correlate with significant gold mineralisation despite presenting as a valid geophysical target.

The IP survey identified two geophysical anomalies with potential for gold mineralisation (see Figures 9-8 and 9-9) and these zones have since been drilled by Marathon Gold. Overall, the survey results confirmed the presence of chargeability and resistivity anomalies coincident with known mineralisation but did not yield sufficient exploration targets to warrant more extensive use of the DSIP survey across the rest of the property.

9.5.2 Magnetic Data

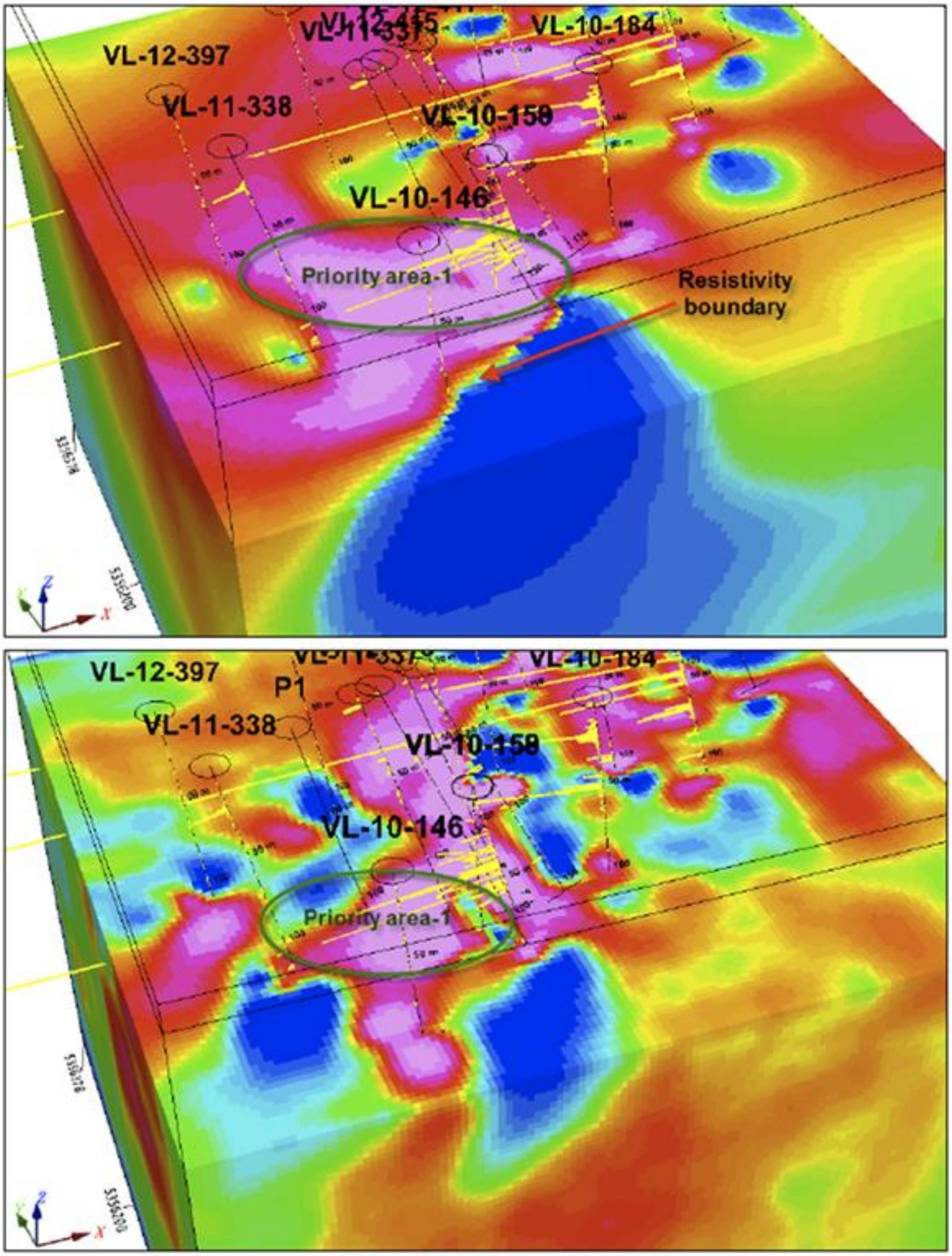
9.5.2.1 Aeromagnetic Magnetic Survey

In 2007, Richmont Mines conducted a detailed aeromagnetic survey across the entire project area (Figure 910). The results show that there is a complex structural geological history on the property, particularly at the Leprechaun, Marathon, Sprite, Victory and Berry deposits. Distinct magnetic splays off the regional structural fabric at the Leprechaun and Sprite deposits are evident (SRK, 2014; Figure 911) and represent high-potential exploration targets. Further, the detailed aeromagnetic data collected by Richmont illustrates a potential zonation to the VLIC, where multiple intrusive phases can be inferred from the magnetic response (SRK, 2014).

9.5.2.2 Ground Magnetic Surveys

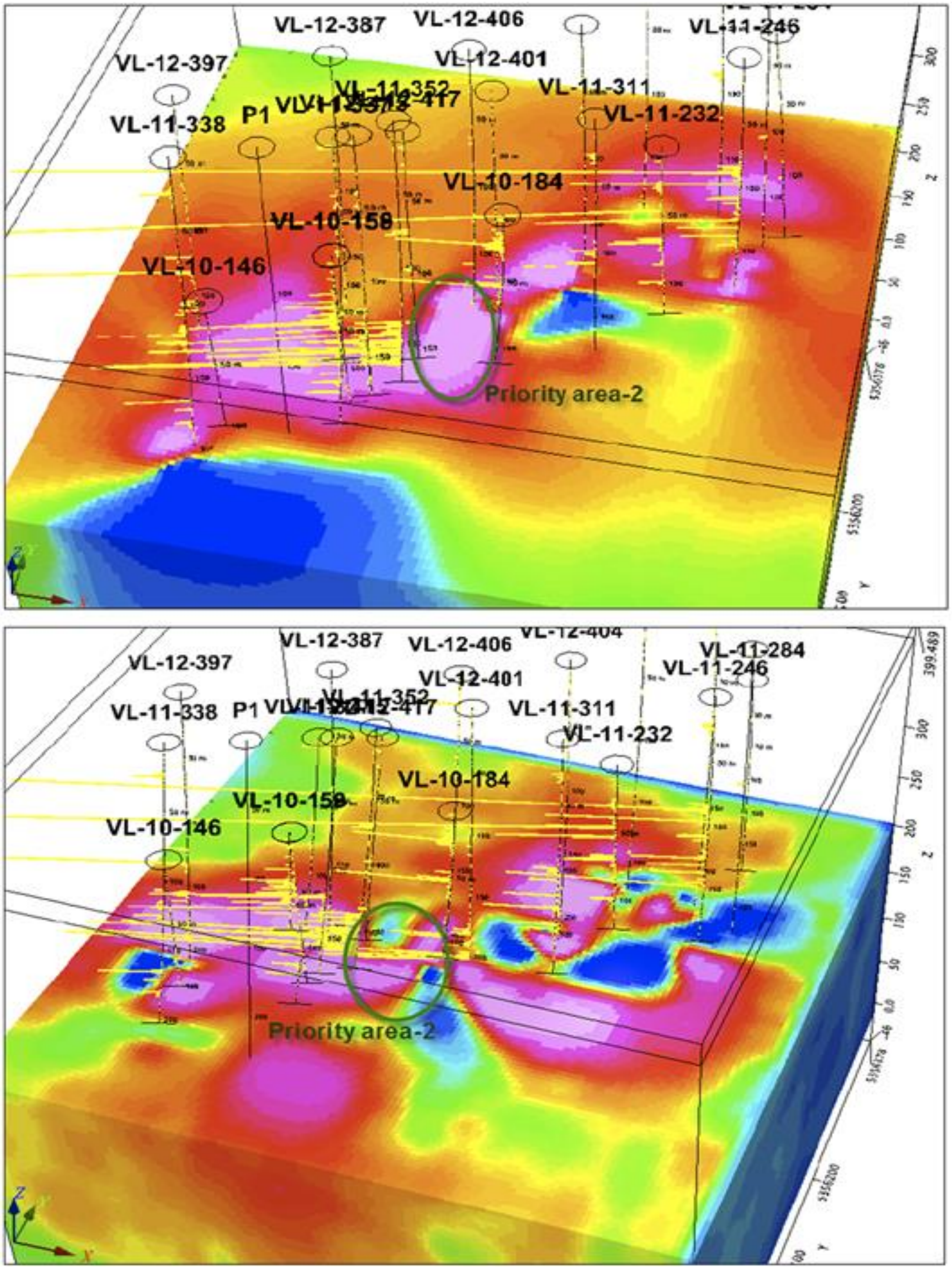
Between 2014 and 2017, Marathon Gold has conducted numerous ground magnetic geophysical surveys at the Sprite and Marathon deposits, using two Overhauser Magnetometers supplied by MTEC Geophysics Inc. The surveys were conducted using a 50 m line spacing and comprised 27-line km at Sprite and 11.9-line km at the Marathon deposit. The results indicate that mineralisation at these deposits is spatially associated with low magnetic intensity, inferred to result from the magnetite destructive sericite quartz alteration associated with the QTP vein arrays. If this hypothesis is true, then the survey results show there are several areas of low magnetic intensity that may represent exploration targets between the Sprite and Marathon deposits (see Figure 9-12).

Figure 9-8: 3D Resistivity (upper) & Chargeability (lower) Models at 90 m Depth derived from DISP Survey, Leprechaun, Showing Drillholes & Priority Area 1 Target Area



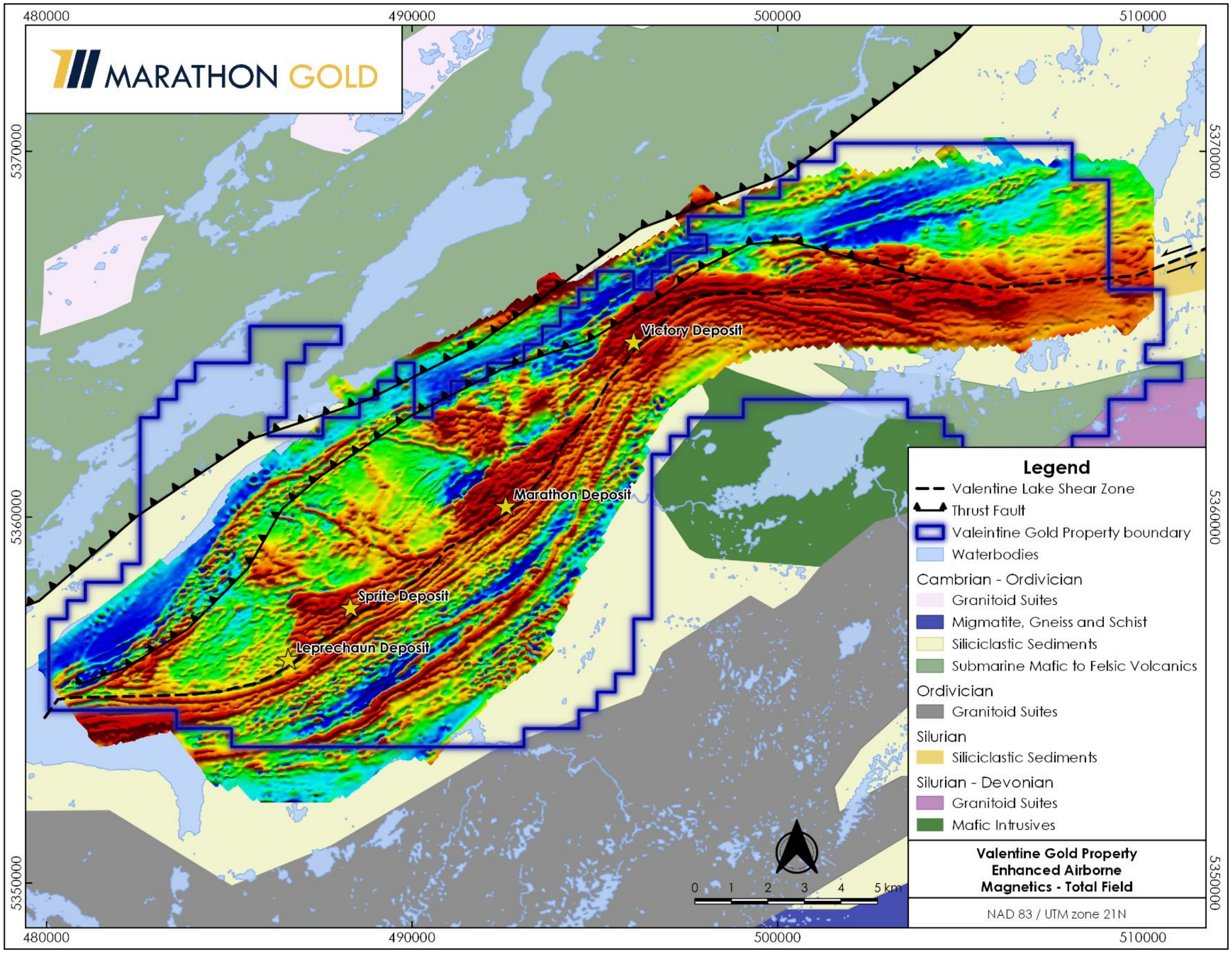
Source: Webster and Jelenic, 2012

Figure 9-9: 3D Resistivity (upper) & Chargeability (lower) Models at 183 m Depth derived from DISP Survey, Leprechaun, Showing Drillholes & Priority Area 2 Target Area



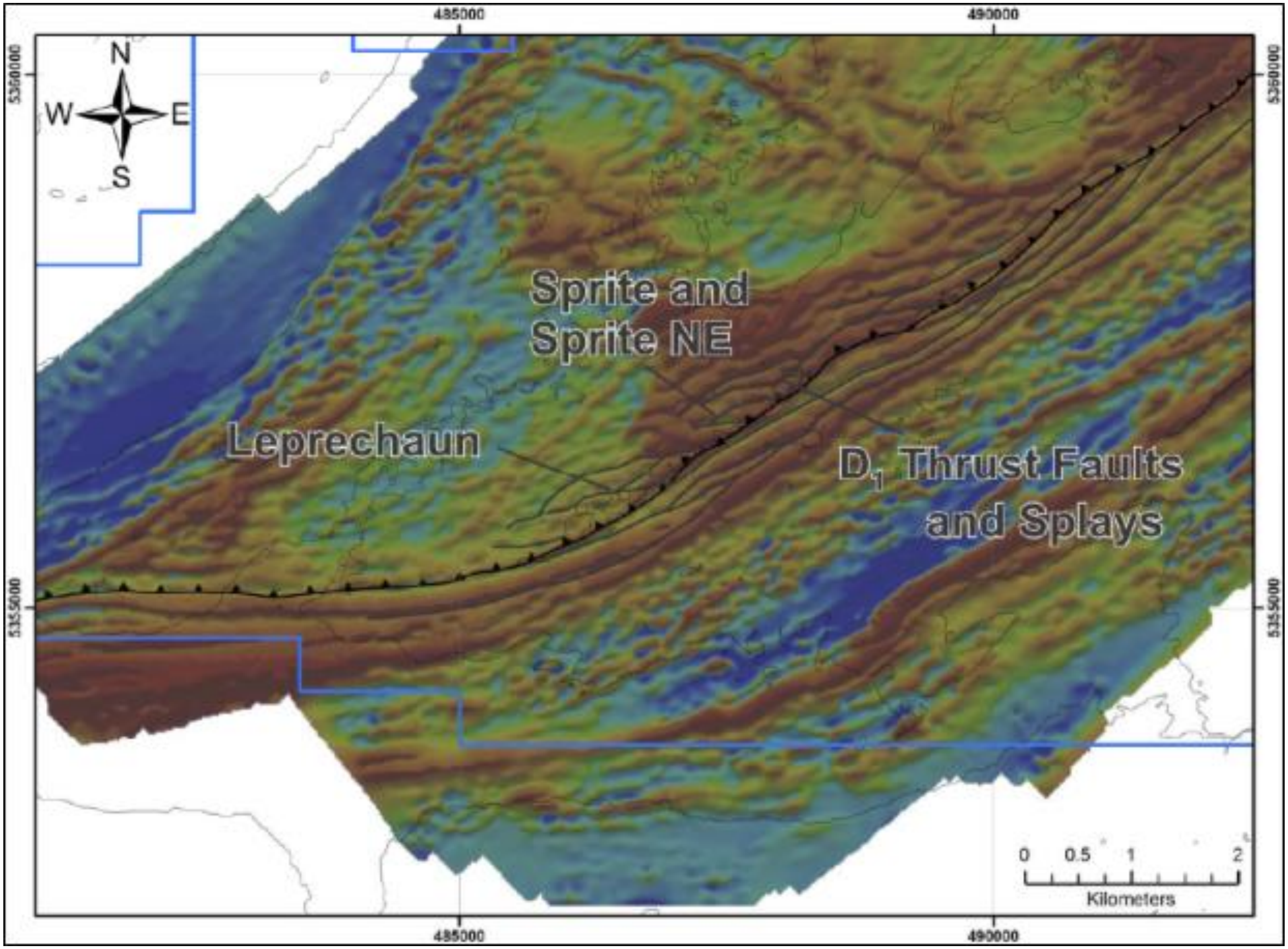
Source: Webster and Jelenic, 2012

Figure 9-10: Airborne Magnetic (reduced to pole) Data from Richmond Mines (2007)



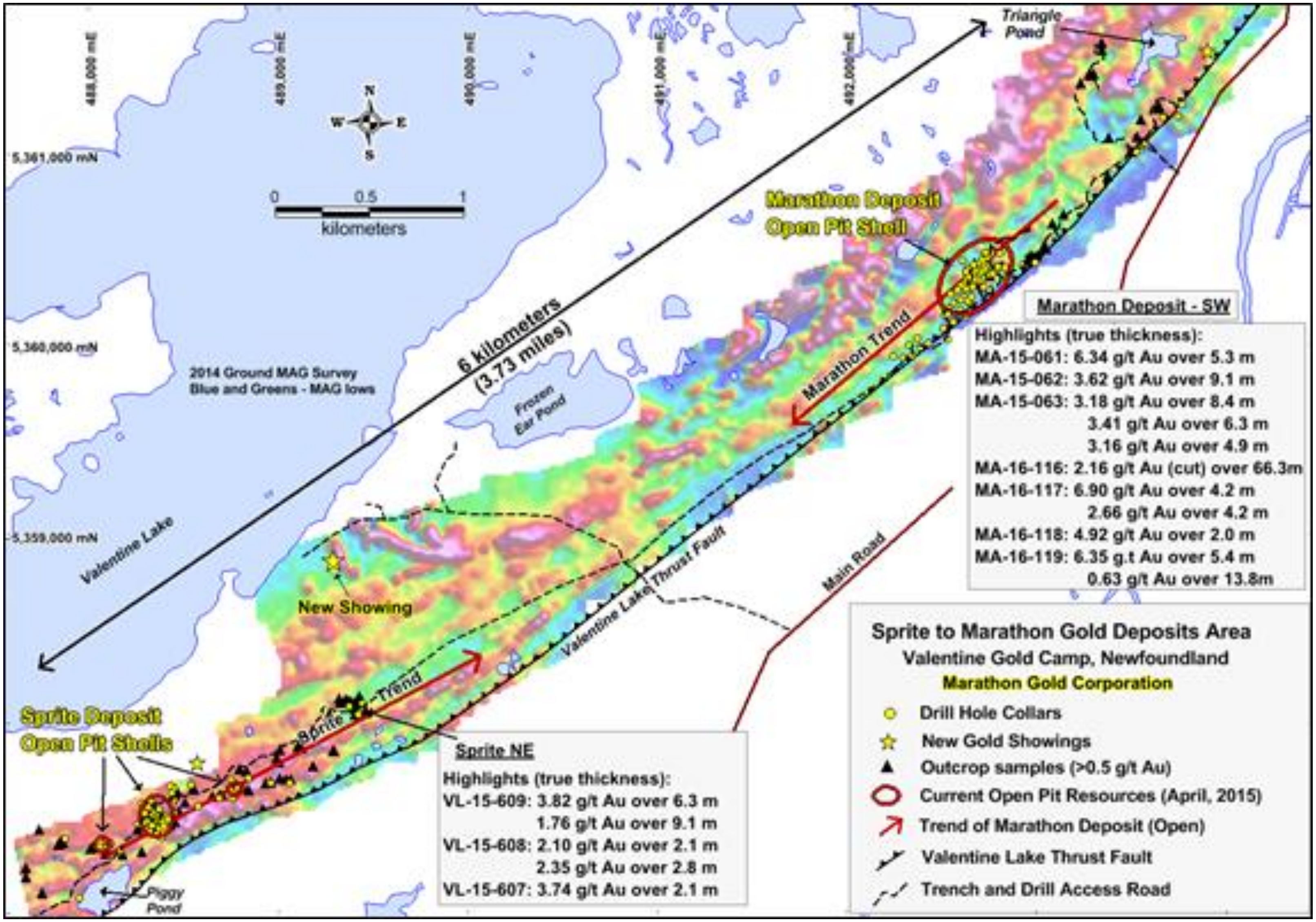
Source: Marathon Gold, 2021.

Figure 9-11: Detailed Total Magnetic Field Data at the Leprechaun & Sprite Deposits



Source: SRK, 2014

Figure 9-12: Ground Magnetic Data & Drill Highlights



Source: Marathon Gold, 2018

9.5.3 Seismic Survey

During 2017, a seismic survey was carried out by Acoustic Zoom Inc. (AZI) of Paradise, NL, across a southwest-oriented 500 m wide by 2 km long zone at the property. The aim of the survey was to define any geological structures in the area with an emphasis on quartz vein systems.

A total of 89 receiver lines were cut to lengths of approximately 500 m at 25 m spacing with 44 source lines coincident to the receiver lines but at double the spacing. Seismic data collection began on February 25 and concluded on March 6. Glacier Exploration Surveys Ltd. of Calgary, Alberta, were subcontracted by AZI to complete the survey, with supervision from AZI staff. Due to insufficient depth of frost in the ground, only 74% of the survey grid was covered by the seismic vibrator truck, which was escorted by an excavator across the wetter sections of ground.

Reprocessing and interpretation of the seismic data from this survey is ongoing and will be included in a future Marathon Gold assessment report; subsequently the results of the seismic work are not available at the effective date of this report.

Unfortunately, the seismic survey failed to provide any substantial information on geologic structures within the survey area including the VLSZ. It is believed that the survey was unable to detect the VLSZ because of its steep nature. The inability to detect the veins and vein packages is likely due in part to the small-scale nature of the veins but also from the lack of physical property contrast between the quartz veins and quartz rich granitoid. Consequently, no further emphasis is being placed on seismic methods for current or future exploration.

10 Drilling

10.1 Introduction

Historical drilling at the Valentine Lake property includes 136 drillholes totalling 25,652 m drilled prior to 2010. The historical drill information is summarised in Chapter 6. With respect to Marathon Gold controlled drill programs:

- Between 2010 and the present, Marathon Gold has drilled 1,502 diamond drillholes totalling 339,044.25 m (see Table 10.1).
- More recently and during 2019, Marathon Gold completed the company's largest drill program in the history of the Valentine Lake property (255 drillholes totalling 65,470.3 m); this drill program focused predominantly on infill drilling of the Marathon and Leprechaun deposits.
- During 2020, Marathon Gold undertook another comprehensive drill program to characterise the newly discovered Berry deposit; a total of 297 drillholes totalling 53,662.53 m have now been completed at the Berry deposit.

Between 2010 and 2020, the majority of the subsurface drillhole information was concentrated at the Marathon deposit (151,656.46 m or 44.73%), Leprechaun deposit (91,416.53 m or 26.96%) and Berry deposit (41,935.63 m or 12.37%) followed by Sprite (15,563.90 m or 4.59%), Victory (7,293.9 m; 2.15%), and other areas including the Frank, Marathon South, Narrows, Victory SW, and the Victory NE occurrences, the Scott and Steve zones, the proposed Marathon and Leprechaun waste dumps, and the tailings management facility (31,177.83 m or 9.20%; Table 10.1).

A summary of the drillhole collar locations at the Marathon, Leprechaun and Berry deposits are presented in Figures 10-1, 10-2 and 10-3, respectively. The mineral resource estimates for the Marathon, Leprechaun and Berry deposits, as presented in this report, are based on a subset of the total number of drillholes and gold assays, including those drilled prior to Marathon Gold, that were made available as of August 19, 2019 (Leprechaun deposit), November 21, 2019 (Marathon deposit), and March 8, 2021 (Berry deposit) and consist of:

- 442 diamond core drillholes totalling approximately 100,025 m with 70,302 gold assays at the Leprechaun deposit
- 487 diamond core drillholes totalling approximately 146,145 m with 105,965 gold assays at the Marathon deposit
- 209 diamond core drillholes totalling approximately 41,618 m with 29,045 gold assays at the Berry deposit (see Chapter 14, Mineral Resource Estimates)

The 2020 drill program at the Berry deposit, which was discovered in 2018 and occurs northeast of the Sprite deposit within the Sprite Corridor, is summarised in Section 10.8 along with smaller programs at the Narrows and Marathon South occurrences.

10.2 Diamond Drilling Procedures

Diamond drilling was conducted by Springdale Forestry of Springdale, NL, between 2010 and 2011, and by RNR Drilling Ltd. (Rob's Excavating and General Contracting) of Springdale from 2012 onward.

Table 10.1: Summary of Drilling Completed by Marathon Gold (2010 to 2020)

Year	Area	DDH's	DDH ID Summary	2010 (m)	2011 (m)	2012 (m)	2013 (m)	2014 (m)	2015 (m)	2016 (m)	2017 (m)	2018 (m)	2019 (m)	2020 (m)	Total
2010	LGD	95	VL-10-137 to -231	10,937.30											
2011	LGD	126	VL-11-232 to -259, -261, -263, -265, -266, -268, -269, -271, -273 to -276, -278, -280 to -365		21,753.00										
2011	FZ	12	VL-11-366 to -377		1,038.00										
2011	SZ	8	VL-11-260, -262, 264, -267, -270, -272, -277, -279		1,146.20										
2011	VGD (VE)	6	VE-11-001 to -006		1,307.40										
2012	LGD	73	VL-12-378 to -419, -421, -435 to -453, -462 to -468, -502 to -505			21,350.50									
2012	FZ	55	VL-12-420, -422 to -434, -454 to -461, -469 to -501			8,198.80									
2013	VGD (VE)	21	VE-13-007 to -027				2,032.00								
2013	SZ	13	VL-13-506 to -516, -528, -530				1,152.00								
2013	LGD	22	VL-13-517 to -527, -529, -531 to -540				7,208.00								
2014	VGD (VE)	10	VGD-14-028 to -037					1,120.00							
2014	SZ	54	VL-14-541 to -577, -589 to -605					7,308.00							
2014	MA	25	MA-14-001 to -025					4,132.60							
2014	SZ	11	VL-14-578 to -588 (Rainbow)					937.00							
2015	MA	53	MA-15-026 to -078						8,794.40						
2015	MA		**Extended** MA-14-016, MA-15-028, -044, -069						394.00						
2015	BZ	9	VL-15-606 to -614						915.00						
2015	VGD (VE)	4	VSW-15-001 to -004 (Victory SW)						383.00						
2016	MA	79	MA-16-079 to -157							18,090.20					
2016	MA		**Extended** MA-15-032, -034, -039, -047, MA-16-095, -109, -115							1,174.00					
2016	VGD (VE)	7	VGD-16-038 to -044							620.00					
2016	LGD	3	VL-16-615 to -617							291.00					
2017	MA	105	MA-17-158 to -262								44,201.90				
2017	MA		**Extended** MA-14-010, MA-15-070, -071, MA-16-134, -141, -157, MA-17-160, -161, -163, -173, -177, -178, - 185, -249								2,607.94				
2017	LGD	23	VL-17-618 to -624, -641 to -656								9,366.20				
2017	SZ	10	VL-17-625, -627, -629, -630, -632, -634, -635, -637, -638, -640 (Scott Zone)								1,190.10				
2017	SZ	6	VL-17-626, -628, -631, -633, -636, -639 (Steve Zone)								984.00				
2018	MA	85	MA-18-263 to -347									33,166.87			
2018	MA		**Extended** MA-15-065, MA-16-157, MA-17-212, MA-17-257, MA-17-258, MA-17-216, MA-18-263									1,307.00			
2018	BZ	22	VL-18-657 to -678									4,973.50			
2018	VGD (VE)	13	VGD-18-045 to -057									1,831.50			
2019	MA	140	MA-19-348 to -487										37,787.55		
2019	LGD	69	VL-19-679 to -747										20,510.53		
2019	SZ	24	VL-19-748 to -764, -766, -767, -770, -772, -775, -792, -793										2,846.60		
2019	BZ	22	VL-19-765, -768, -769, -771, -773, -774, -776 to -791										4,325.63		
2020	P-TMF	49	VS-C-20-001 to -049											6,782.33	
2020	BZ	159	VL-20-794 to -952											31,721.50	
2020	MWD	21	MA-C-20-001 to -021											2,937.00	
2020	LWD	30	VL-C-20-001 to -030											4,194.70	
2020	NA	14	NR-20-001 to -014											2,260.00	
2020	MAS	24	MAS-20-001 to -024											5,767.00	
Totals		**1502**		**10,937.30**	**25,244.60**	**29,549.30**	**10,392.00**	**13,497.60**	**10,486.40**	**20,175.20**	**58,350.14**	**41,278.87**	**65,470.31**	**53,662.53**	**339,044.25**
Historical DDH's		**136**													**25,652.00**
													Total		**364,696.25**

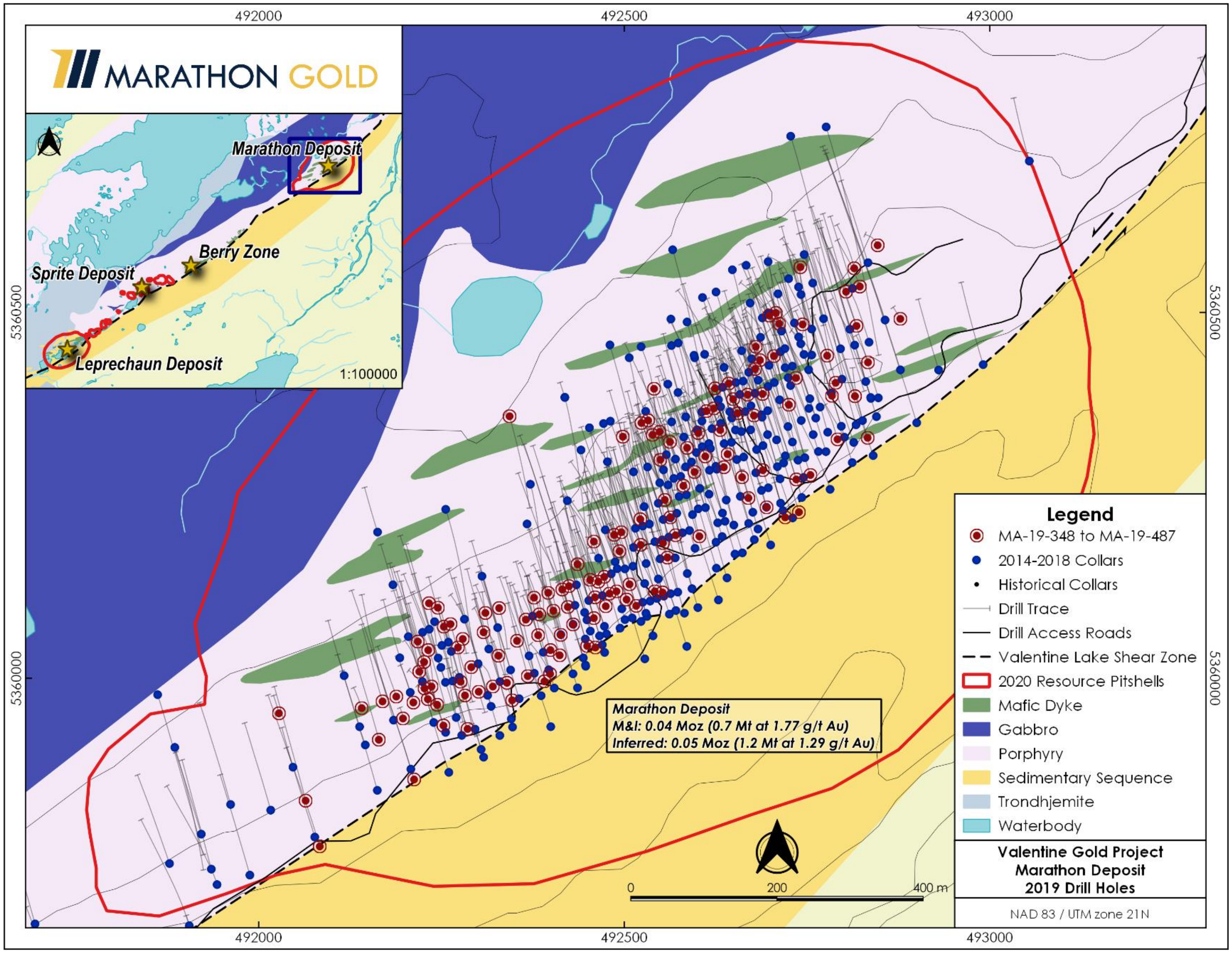
Location Legend

FZ	Frank Zone
LGD	Leprechaun Deposit
SZ	Sprite Deposit & Area (includes Rainbow, Steve and Scott showings)
BZ	Berry Zone
MAS	Marathon South
MA	Marathon Deposit
NA	Narrows
VGD (VE)	Victory Deposit & Area (includes VSW)
LWD	Leprechaun Waste Dump
P-TMF	Tailings Management Facility
MWD	Marathon Waste Dump

Marathon	Leprechaun	Berry	Victory	Sprite	Other
151,656.46	91,416.53	41,935.63	7,293.90	15,563.90	31,177.83
44.73%	26.96%	12.37%	2.15%	4.59%	9.20%

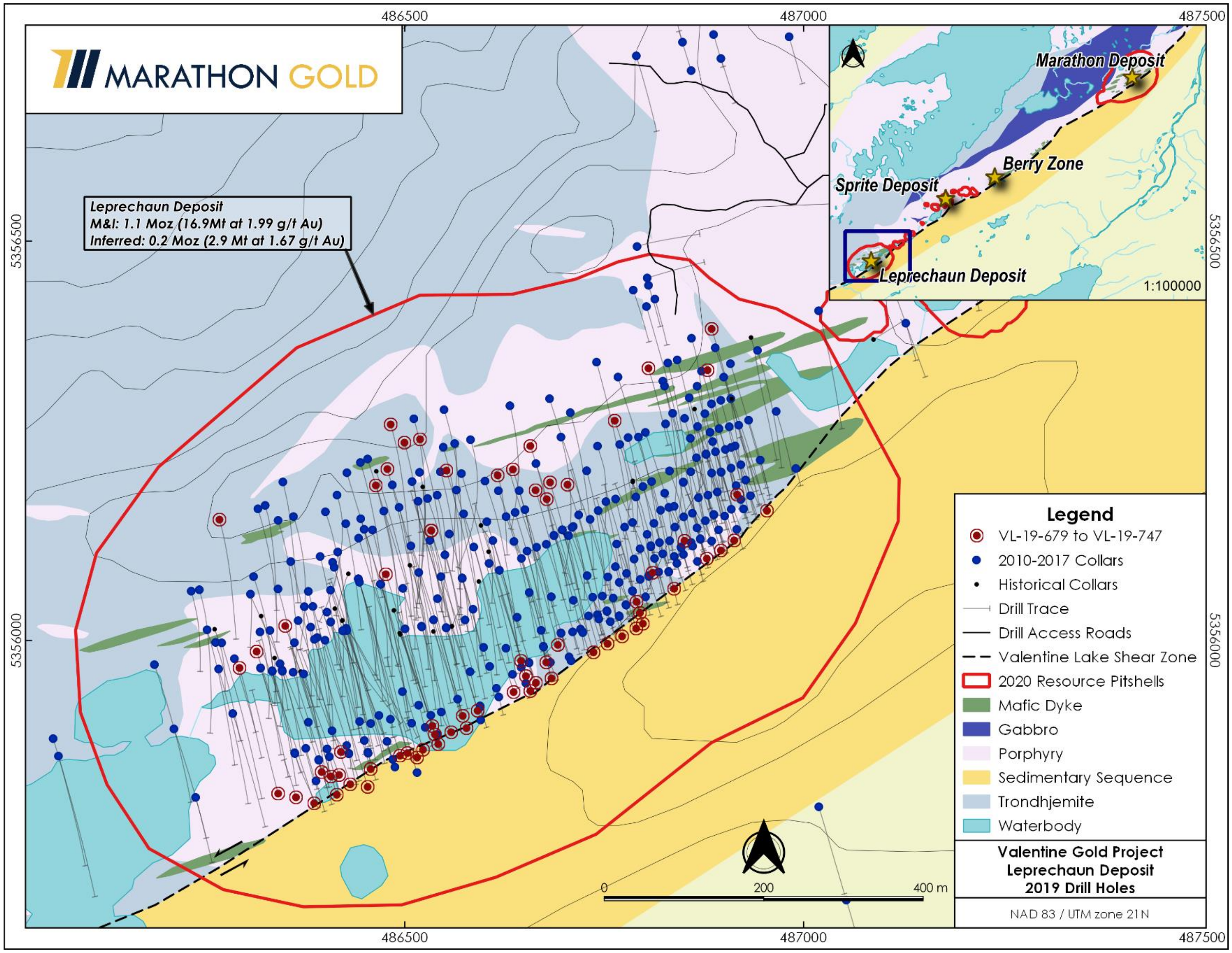
Other includes Frank, Marathon South, Narrows, Leprechaun Waste Dump, Tailings Management Facility and Marathon Waste Dump

Figure 10-1: Diamond Drillholes completed by Marathon Gold at the Marathon Deposit



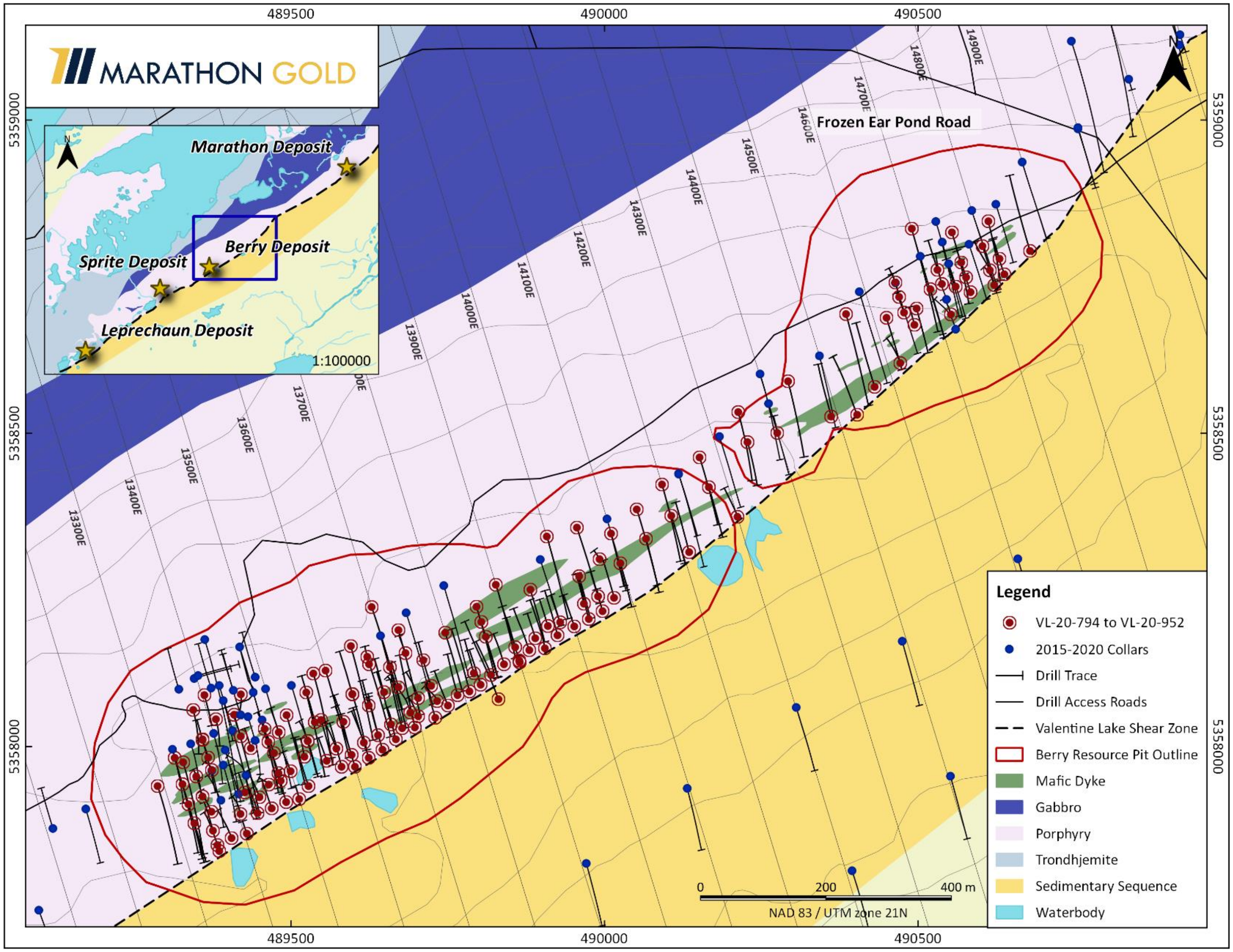
Source: Marathon Gold, 2021.

Figure 10-2: Diamond Drillholes completed by Marathon Gold at the Leprechaun Deposit



Source: Marathon Gold, 2021.

Figure 10-3: Diamond Drillholes completed by Marathon Gold at the Berry Deposit (to end of November 2020)



Source: Marathon Gold, 2021.

Collars were positioned using a TopCon Hiper HR GPS unit and were aligned to the designated azimuth using a Reflex TN-14 gyroscopic compass. This unit uses a fibre-optic gyroscope to determine the azimuth and dip of the rig. Upon completion of each drillhole, the TopCon HR was used to record the final UTM coordinates of the collar location, spatial referencing in NAD83 UTM coordinate system. All drillholes undergo downhole surveys to obtain drillhole deviation data using the Reflex Sprint-IQ instrument, since it is not affected by magnetism which is variable in some of the local rock units, particularly the mafic dikes and gabbros. This Sprint-IQ use two north-seeking gyroscopes to determine the azimuth and dip at varying intervals, typically every 2 to 5 m, during the downhole survey. Consequently, the relationship between the sample length and the true thickness of the mineralisation is well documented and all assay sample intervals are given as core length unless noted as true thickness.

Drilling was conducted using wireline NQ-size double tube barrels typically producing 3 m runs of core except in areas of poor recovery. There has been no RC drilling on the property to date and core splits are archived for future geological confirmation and QA/QC work. Drilling has been conducted as both inclined and sub-vertical holes to accommodate the variable dip of mineralised domains. Inclined holes were typically drilled at an inclination of 45° to 80° and were oriented either southeast or northwest to intercept the shallowly southeast-dipping QTP veins, the steeply northwest-dipping shear parallel QTP veins and the steeply northwest-dipping contact between the VLIC and the Rogerson Lake Conglomerate.

Exploration drilling has been conducted on nominal 100 m spaced lines with 30 m spaced holes, closing to 25 m x 25 m and up to 10-15 m drill centres at the Marathon and Leprechaun deposits.

At the end of each run, drill core was placed by the driller into core boxes which were marked with a box number. The driller inserted a block marked with the run depth in metres at the end of each run. The drill core was then transported to the core logging facility at the end of each 12-hour shift.

Following completion of the hole, collars were marked with a wooden pole, which was labelled with the hole number. Drill collar positions were surveyed after completion of the drillhole using either a Trimble or a TopCon GPS system. The Trimble is comprised of an R8 base station and rover and a hand-held Geo XM while the TopCon uses two Hiper HR units, both with base station correction. These machines yielded an accuracy of <10 cm on collar locations and have been used to survey the location of historic drill collars wherever the historic collar could be found.

At the core logging facility, each run was marked with an orientation line and geotechnically logged. The core was then photographed, geologically logged and marked for sampling by the geologist prior to cutting in half with a core saw along the orientation line. After sampling was complete, the core boxes containing half core were stacked and stored at Marathon Gold's exploration camp. Logging and sampling procedures are described in Sections 10.3 and 10.4.

10.3 Logging

Geotechnical logging by Marathon Gold geologists included a description of the fractures, such as number of fractures, fracture index, type and roughness, alteration, and core recovery. Geological logging included an initial summary log of the principal rock types and mineralised intervals, followed by a detailed geological log that described a pre-determined index of rock type, detailed lithology, alteration type and degree, mineralisation type and percentage, and structural observations in both written and graphical form. The geological log also contains the sample intervals and numbers.

10.4 Drill Core Sampling

The core cutting was done with heavy duty DeWalt 10″ wet tile saws using very thin, continuous rim, diamond porcelain blades and aluminum oxide conditioning sticks. Drill core samples were taken from half cut core, except in rare zones of intense fracturing where the core was split manually. Sample intervals were determined by the geologist based on changes in lithology, alteration, and fracture intensity, and were nominally taken at 1 m intervals in mineralised zones and 2 m intervals in barren zones. Sample locations were noted on the geological drill log. One half of the drill core was placed in a plastic sample bag, tagged with a unique sample number, tied and placed in batches for dispatch to the laboratory for preparation and analysis. Marathon Gold sampled the entire length of each hole excepting large zones of mafic dyke or conglomerate that contained no visible veining.

Specific gravity values have been systematically measured by Marathon Gold geologists using the Archimedes method. Samples were selected from half core and were chosen to represent the different lithologies, alteration types, and mineralised domains observed.

10.5 Sample Recovery

Diamond drill core recovery was routinely measured during core logging and recorded on geotechnical log sheets. Drill core recovery was excellent, averaging 95%. There is no evidence of bias or any relationship between core recovery and assayed gold grade.

10.6 Database

Geotechnical and geological logging data, as well as sample chain of custody data, were entered directly into Excel worksheets per hole and were manually updated into a master worksheet by Marathon Gold's exploration manager. More recently, Marathon Gold geologists recorded geological and geotechnical information directly into the cloud-based database, MX Deposit, which was customised to record all the same information found in the Excel workbooks.

Assay results were appended to the geological worksheets using the automatic VLookup function in Excel, with the sample number providing a unique reference. This minimised the risk of data transcription errors when receiving analytical results. Once Marathon Gold began logging using the MX deposit database, assay certificates were automatically uploaded into the program which further reduced the potential for human error.

10.7 Results of Marathon Gold's 2010-2019 Drilling Programs

Drilling by Marathon Gold has defined five gold deposits (Leprechaun, Marathon, Sprite, Victory, and Berry) at the property. The resource estimates of these deposits are based on drill data collected up to and including the results from the 2019 drill program. The 2020 drilling program focussed on new discoveries and as such no drilling was completed on the Leprechaun or Marathon deposits since the 2019 program. Example drillhole cross-sections for the five deposits are included in Chapter 14, Mineral Resource Estimates.

The Valentine Lake property hosts structurally controlled, orogenic gold deposits consisting of dominantly shallow southwest-dipping, en-echelon stacked extensional and lesser shear parallel gold-bearing quartz-tourmaline-pyrite veining. The gold-bearing QTP-veining is hosted within trondhjemite, quartz-eye porphyry and lesser aphanitic and mafic dikes of the Valentine Intrusive Suite as well as the Rogerson Lake Conglomerate. The individual characteristics of mineralisation at the Marathon and Leprechaun deposits, which are the focus of the updated mineral resource estimates, are described in this report in Section 7.5, Mineralisation.

The focus of the 2019 infill drilling campaign at the Marathon deposit was directed toward drilling the central core of the deposit, as well as drilling along the northeastern and southwestern flanks of the open pit shell (see Figure 10-1 above). Most infill drillholes were designed to drill sub-vertical to intersect the shallow southwest-dipping, en-echelon stacked gold-bearing quartz-tourmaline-pyrite veins that characterise the dominant veining of the main zone. These holes were successful in demonstrating the continuity of gold mineralisation both along strike and at depth and developing the sound geological model being used for the Marathon deposit.

A cross-section overview showing the geology and mineralised zones of quartz-tourmaline-pyrite-gold-bearing veins at the Marathon deposit with selected gold assay intervals is presented in the mineralisation section (see Chapter 7 for details).

The focus of the 2019 infill drilling campaign at the Leprechaun deposit was directed toward confirming the continuity of the geological model, gold mineralisation in the main zone and updating the Leprechaun resource estimations (see Figure 10-2 above). This was done through infill drilling at a high angle to the shallow southwest-dipping en-echelon gold-bearing QTP veining. In addition, the infill drilling verified continuity of the high-grade gold zone from surface to a depth greater than 300 m and along strike. This was particularly significant to observe in areas of previously limited drilling, such as the northeast portion of the main zone, which has helped expand the high-grade area of the main zone to a strike length of over 700 m. Overall, the drilling campaign has been successful in increasing the width of the main zone and adding confidence to the continuity of the high-grade mineralised zone.

A cross-section overview showing the geology and mineralised zones of quartz-tourmaline-pyrite-gold-bearing veins at the Leprechaun deposit with selected gold assay intervals is presented in the mineralisation section.

The infill and exploratory drilling campaigns at the Marathon and Leprechaun deposits resulted in the development of, and increase in, the substantial resources presented in Chapter 14, Mineral Resource Estimates. Drilling through the main mineralised zones at a high angle to the extensional QTP-Au veining increased the confidence in the vertical and lateral continuity of the higher-grade gold mineralisation.

Examples of best true-thickness intercepts of gold mineralisation at the Leprechaun and Marathon deposits, as reported by Capps and Dunsworth (2019) and by year, are presented in Tables 10.2 and 10.3, respectively.

10.8 Results of Marathon Gold's 2020 Drilling Program

Marathon Gold's 2020 exploration program focussed on generating new discoveries along the VLSZ, as well as infill diamond drilling of the previously discovered Berry Zone, now referred to as the Berry deposit. The Berry deposit drilling was initially centred on an area of high-intensity QTP-Au mineralisation (Main Zone) found between the Sprite Deposit and Frozen Ear Pond Road. Additional mineralisation was defined over an increasingly wide strike length during the 2020 Berry drill program.

Drilling at the Berry deposit was completed in two distinct orientations, the first oriented shallowly to the SE to define the VLSZ, the second drilling steeply down to the NW, parallel to the contact, tracing out the packages of en echelon, extensional Set 1 QTP-Au veining. By the conclusion of the

2020 drilling program, gold-bearing QTP mineralisation had been defined over a strike length of approximately 1.5 km, including a Main Zone of mineralisation similar to that found at the Leprechaun deposit. In addition to the mineralisation, several large mafic dykes were discovered running sub-parallel to the VLSZ. These mafic dykes are continuous throughout the 1.5 km long Berry Zone, apart from a 300 m section which also shows reduced mineralisation.

The relationship between high-grade gold mineralisation and the location of the dykes supports the interpretation that the mafic dykes provide a rheologic contrast that (1) promotes brittle fracturing of the granitoid unit and therefore, acts as a controlling factor of mineralised fluid flow and (2) incites the eventual emplacement of zones of gold enrichment.

The 2020 drill results, along with previous Berry deposit drilling, have now been utilised in a maiden mineral resource estimate which is described in Chapter 14, Mineral Resource Estimates. Best examples of true thickness assay intervals from Berry are presented in Table 10.4.

In addition to the drilling at Berry, smaller greenfields exploration programs were completed at the Narrows and Marathon South areas. The Narrows drilling succeeded in its primary goal of drill-defining the VLSZ and encountered sporadic QTP mineralisation proximal to the VLIC-Rogerson Conglomerate contact. Mineralisation discovered to date at Narrows is relatively minor but localised showings of VG were observed.

Drilling in 2020 at Marathon South discovered additional zones of mineralisation proximal to the current southwest boundary of the Marathon pit, with localised zones of minor mineralisation further to the southwest. While these two greenfield exploration targets did not present significant zones of high-grade mineralisation, they did illustrate the continuity and extent of fluid flow along the VLSZ in this area of the Valentine Lake property.

Table 10.2: Summary of Best Gold Assay Highlights of Drilling Completed by Marathon Gold at the Leprechaun Deposit between 2010 & 2019

2010			2011			2012			2013			2017			2019		
Drillhole	Core Interval (m)	Gold Assay (g/t)	Drillhole	Core Interval (m)	Gold Assay (g/t)	Drillhole	Core Interval (m)	Gold Assay (g/t)	Drillhole	Core Interval (m)	Gold Assay (g/t)	Drillhole	Core Interval (m)	Gold Assay (g/t)	Drillhole	Core Interval (m)	Gold Assay (g/t)
VL-10-165	9	13.4	VL-11-246	37.5	3.75	VL-12-401	30	3.93	VL-13-523	3	52.73	VL-17-653	181	3.42	VL-19-679	6	25.78
VL-10-225	19	6.53	VL-11-261	12.8	9.68	VL-12-403	22	7.23	VL-13-526	36	4.26	VL-17-654	301	2.65	VL-19-679	22	9.02
VL-10-226	17	6.94	VL-11-288	65.6	2.09	VL-12-407	15	9.19	VL-13-537	3	39.55	VL-17-655	151	2.34	VL-19-679	22	11.83
VL-10-226	13	11.81	VL-11-306	13.3	16.15	VL-12-408	19	13.81				VL-17-656	7	19.01	VL-19-680	71	2.52
			VL-11-352	26.1	13.95	VL-12-416	8	15.8				VL-17-656	33	3.72	VL-19-681	126	4.27
						VL-12-465	13	13.2							VL-19-681	42	4.11
						VL-12-504	7	45.58							VL-19-686	153	3.02
															VL-19-688	30	5.06
															VL-19-688	24	5.04
															VL-19-695	98	2.41
															VL-19-697	36	5.45
															VL-19-700	29	4.39
															VL-19-703	19	10.03
															VL-19-711	74	4.24
															VL-19-711	24	6.94
															VL-19-719	41	4.49

Table 10.3: Summary of Best Gold Assay Highlights of Drilling Completed by Marathon Gold at the Marathon Deposit between 2014 & 2019

Drillhole	Core Interval (m)	Gold Assay (g/t)	Drillhole	Core Interval (m)	Gold Assay (g/t)	Drillhole	Core Interval (m)	Gold Assay (g/t)	Drillhole	Core Interval (m)	Gold Assay (g/t)	Drillhole	Core Interval (m)	Gold Assay (g/t)	Drillhole	Core Interval (m)	Gold Assay (g/t)
MA-14-002	111	1.71	MA-15-036	47	3.02	MA-16-047	11	20.166	MA-17-159	50	3.434	MA-18-282	13	18.66	MA-19-357	13	12.49
MA-14-021	68	2.006				MA-16-101	65	2.185	MA-17-160	75	3.92	MA-18-295	59	7.97	MA-19-370	75	2.61
						MA-16-107	105	2.382	MA-17-161	60	3.835	MA-18-303	149	1.54	MA-19-372	45	3.52
						MA-16-109	47	3.012	MA-17-162	125	2.12	MA-18-305	105	1.41			
						MA-16-116	102	2.305	MA-17-162	43	4.18						
						MA-16-149	47	2.928	MA-17-163	82	1.905						
						MA-16-154	14	25.33	MA-17-165	71	2.92						
									MA-17-165	136	1.88						
									MA-17-175	101	1.766						
									MA-17-176	118	1.56						
									MA-17-178	89	1.84						
									MA-17-183	82	1.82						
									MA-17-186	191	1.61						
									MA-17-188	326	2.13						
									MA-17-213	225	1.88						
									MA-17-217	171	1.51						
									MA-17-218	209	1.36						
									MA-17-220	221	1.32						
									MA-17-225	52	2.8						
									MA-17-226	87	1.95						
									MA-17-237	99	1.43						
									MA-17-239	99	1.85						
									MA-17-242	48	3.43						

Table 10.4: Summary of Best Gold Assay Highlights of Drilling Completed by Marathon Gold at the Berry Deposit between 2018 & 2020

	2018			2019			2020	
Drillhole	Core Interval (m)	Gold Assay (g/t)	Drillhole	Core Interval (m)	Gold Assay (g/t)	Drillhole	Core Interval (m)	Gold Assay (g/t)
VL-18-676	49	6.17	VL-19-776	5	10.43	VL-20-799	55	52.30
			VL-19-778	6	9.74	VL-20-806	14	8.06
			VL-19-779	11	5.54	VL-20-813	12	8.03
			VL-19-779	13	3.82	VL-20-823	120	3.33
			VL-19-780	10	7.25	VL-20-824	4	51.52
			VL-19-786	22	7.6	VL-20-824	36	3.37
						VL-20-835	47	2.96
						VL-20-838	111	1.47
						VL-20-839	9	14.39
						VL-20-873	92	2.61
						VL-20-876	22	4.91
						VL-20-889	42	3.70
						VL-20-907	7	18.16

11 Sample Preparation, Analyses & Security

11.1 Introduction

All exploration samples that were used in the mineral resource estimate databases were prepared and analysed at Eastern Analytical located in Springdale, NL. Eastern Analytical holds ISO 17025 accreditation and is independent of Marathon Gold.

11.2 Chain of Custody

Samples were transported in batches contained in sealed rice sacks from Marathon Gold's exploration camp to Eastern Analytical by company vehicle. Upon receipt of samples, laboratory personnel checked the seals on both the rice sacks and individual sample bags to ensure that sample integrity had been maintained during transport.

11.3 Sample Preparation

At the laboratory, the samples were prepared by drying, if necessary, then the entire sample was crushed to a nominal minus 10 mesh (1.7 mm), riffle split to obtain a representative sample, and then pulverised to at least 95% minus 150 mesh (106 µm).

11.4 Analyses

Eastern Analytical analysed each sample for gold by fire assay. All samples that assayed greater than 300 ppb Au (or greater than 100 ppb Au prior to 2019) were subjected to a total pulp metallic sieve procedure. The results of metallic sieve assays override the results of standard fire assays in the drill database, as they become available.

Eastern Analytical also analysed samples by multi-element (34) inductively coupled plasmometry (ICP). Each analytical procedure is described below.

11.4.1 Fire Assay

Eastern Analytical used a 30 g crucible for rock and core samples, and a 20 g crucible for soil samples. Samples are analysed in batches of 24, including one sample blank and one internal standard. Eastern Analytical performed lead collection fire assay with atomic absorption finish.

11.4.2 Total Pulp Metallic Sieve

Eastern Analytical describe their metallic sieve (MS) procedure as follows:

- The entire sample (original pulp is approximately 250 g) was crushed to 80% passing -10 mesh and pulverised to 95% passing -150 mesh, prior to being sieved through a 150-mesh screen. The +150-mesh fraction was fire assayed as one sample.
- The -150-mesh fraction was rolled and weighed, with a 30 g sub-sample submitted for fire assay. The fire assay results of the +150 and -150 mesh fractions were calculated to produce a weighted average gold assay for the sample.

11.4.3 Inductively Coupled Plasma-34

Each analytical sample is comprised 200 mg of -150 mesh sample pulp which was placed in a test tube with nitric and hydrochloric acid prior to being heated on a hot plate. Samples were then cooled to room temperature, topped to volume with de-ionised water, stirred to homogenise, and left to settle for one hour prior to analysis by multi-element (n=34 elements) ICP. Samples were prepared and analysed in batches of 40 including two duplicates, one blank and one standard.

11.5 Quality Control & Quality Assurance

As well as reviewing the results of Eastern Analytical's internal quality control procedures, described in Sections 11.4.1 and 11.4.3, Marathon Gold conducted their own QA/QC program to monitor the performance of the laboratory. Marathon Gold inserted either a sample blank or CRM at the rate of 1 in every 20 drill core samples.

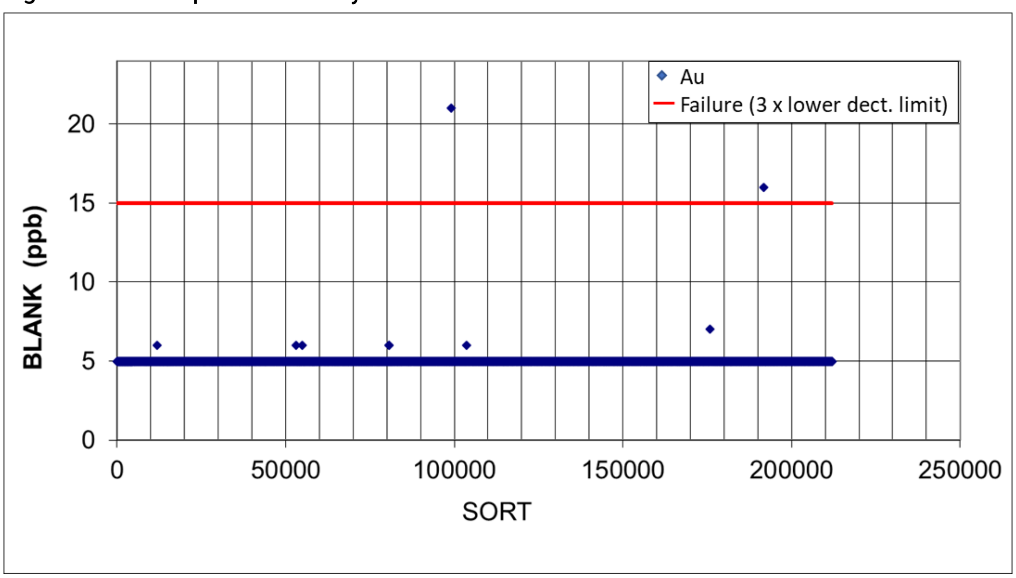
Marathon Gold routinely analysed the results of the control samples in real time against set control limits. If the assay value was outside of the control limits, the entire batch was re-assayed as a corrective measure and the results of the initial assays were rejected, assuming the control sample had returned an acceptable value within the control limits. The materials used, protocols, control limits, and results are described below.

11.5.1 Sample Blanks

Marathon Gold used a nepheline syenite sand as a sample blank that has been proven to assay below 5 ppb gold. The assay was considered a failure if the value was greater than three times the lower detection limit (5 ppb gold).

The Valentine Gold Project drill database from 2010 to 2020 contains 4,065 sample blanks. Of the 4,065 blanks analysed, four failures have been returned since 2010 (see Figure 11-1); the reason for these failures is unknown. Overall, however, the sample blanks have a good distribution and APEX considers there is no evidence of sample contamination in the dataset.

Figure 11-1: Sample Blank Assay Results



Source: APEX, 2020

11.5.2 Certified Reference Material

Since 2010, Marathon Gold has used 12 different CRMs and has analysed 9,077 CRMs as part of the company's QA/QC sampling procedures (Table 11.1). The CRMs were prepared by CDN Resource Laboratories Ltd. in Langley, BC, and include low to high mean gold grades of between 0.56 to 9.31 g/t gold. Overall, the CRM performance is good, with a few CRM assay failures generally related to high-grade CRMs being analysed by FA and/or it is evident that the early 2010-2012 QA/QC analytical results have higher negative bias; for comparison, the 2020 CRM assays have been isolated in Table 11.2.

The overall CRM assay results demonstrate a weak negative bias. For example, the mean lab assay values of the CRM samples are lower than the CDN Laboratories' certified gold concentrations by between 0.9% and 5.9% (Table 11.1). A weighted average total of 8.95% of CRMs assay outside of -2 standard deviations, ranging between 0.99% and 39.1% of CRM samples (Table 11.1). Six CRM assays fall outside of -3 standard deviations by 1.0% to 4.3% (weighted average of 0.88%). Again, this bias improves with the 2020 QA/QC analyses with CRM's assaying outside of -2 and -3 standard deviations having improved weighted averages of 0.39% and 0.18%, respectively (Table 11.2).

CRM samples with negative bias are generally continuous over the timespan the standards were used, although in some instances, the negative bias was reduced after the initial CRM analytical period. The cause of the weak negative bias is not known and is not considered material within the resource estimation process because there is no suggestion of overestimation, and importantly, Marathon Gold replaces FA analytical results with MS results within the resource assay file for any assay equal or greater than 300 ppb Au (or 100 ppb Au prior to 2019).

Table 11.1: Summary of CRM Control Sample Performance from 2010 to 2020

CRM ID	Years Used	No. of Samples	CRM Mean (Au ppb)	Dataset Mean (Au ppb)	CRM to Dataset Mean Difference (%)	>+2SD (%)	<-2SD (%)	>3SD (%)	<-3SD (%)
GS-3T	2019-2020	1189	3,050	2,985.07	2.1	0.42	2.10	0.25	0.34
GS-3Q	2017-2018	840	3,300	3,140.40	4.8	0	20.7	0	0.8
GS-P5G	2019-2020	704	562	551.62	1.8	0.43	0.99	0	0.28
GS-P5C	2016-2019	1276	571	561.00	1.8	0.55	2.27	0.78	0.08
GS-9A	2012-2017	893	9,310	9,223.30	0.9	1.12	4.03	0.11	1.01
GS-9B	2017-2020	1484	9,020	8,751.63	3.0	0.34	1.35	0	0.13
GS-3L	2015-2017	295	3,180	3,040.00	4.4	0	20.68	0	2.71
GS-3F	2010-2011	417	3,100	2,918.40	5.9	0.24	39.09	0.24	4.32
GS-8A	2010-2012	843	8,250	8,061.60	2.3	0.12	2.37	0	0.95
GS-3H	2011-2012	651	3,040	2,867.70	5.7	0.15	32.41	0.15	1.23
GS-3J	2012-2014	257	2,710	2,601.40	4.0	0.39	8.95	0	3.11
GS-3K	2014-2015	228	3,190	3,042.90	4.6	0	19.3	0	2.19
Total (all analyses)		**9,077**	**Weighted average (all data)**			**0.37**	**8.95**	**0.18**	**0.88**

Table 11.2: Summary of CRM Control Sample Performance during 2020

CRM ID	Years Used	No. of Samples	CRM Mean (Au ppb)	Dataset Mean (Au ppb)	CRM to Dataset Mean Difference (%)	>+2SD (%)	<-2SD (%)	>3SD (%)	<-3SD (%)
GS-3T	2020	429	3050	2994.009	1.8	0	0.47	0	0.23
GS-P5G	2020	359	562	550.2479	2.1	0.56	0.28	0	0.28
GS-9B	2020	312	9,020	8707.59	3.5	0	0.41	0	0
Total (all analyses):		**1,100**		**Weighted average (all data)**		**0.18**	**0.39**	**0.00**	**0.18**

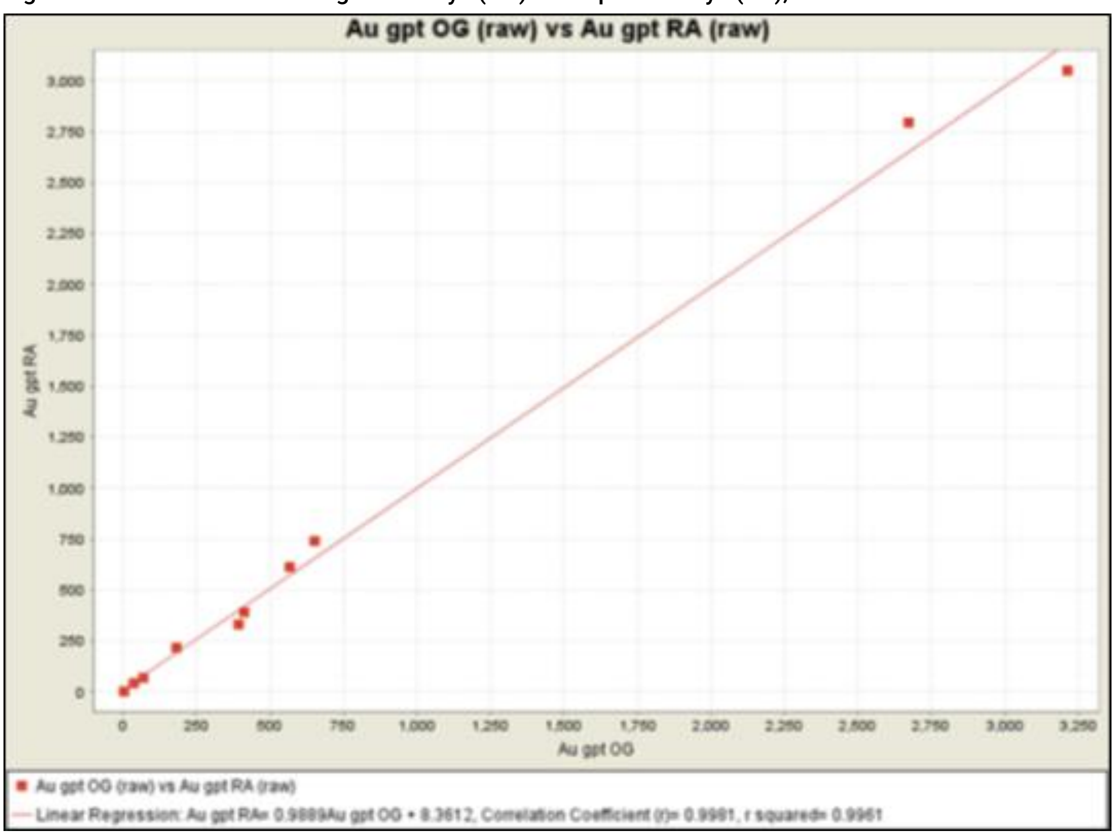
11.5.3 Duplicate Samples

Marathon Gold does not routinely analyse field or laboratory duplicate samples. As part of their data verification during independent technical reporting in 2010 and 2017, Micon submitted 47 sample pulps for re-assay at Eastern Analytical.

The sample pulps were selected from drill core samples and represented a range of gold grades, from 0.5 to >3,500 g/t gold. Results of the pulp duplicate analyses demonstrate an overall good degree of repeatability, as shown in Figures 11-2 and 11-3.

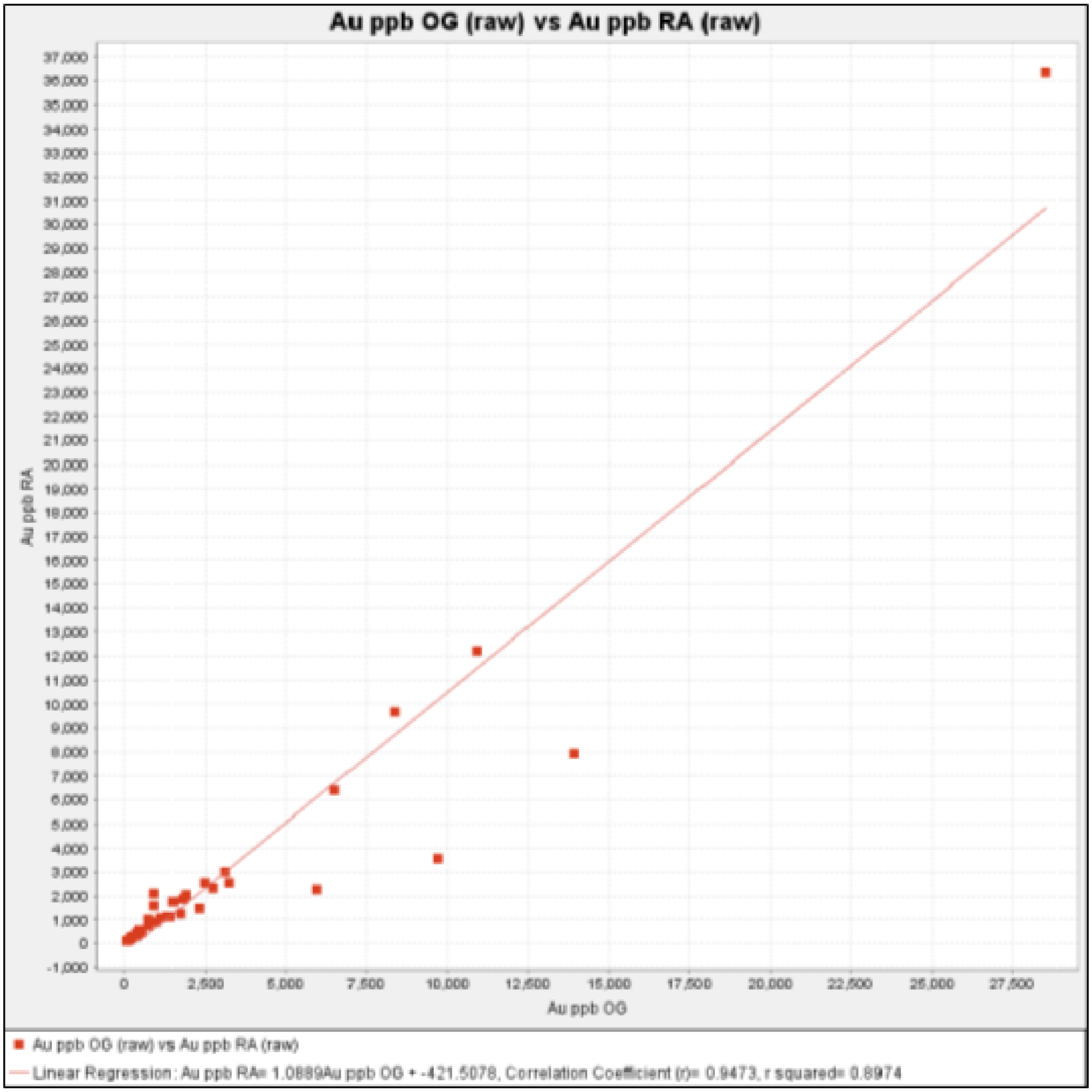
There are several outliers from higher grade samples (Figure 11-3) that demonstrate an inherent nugget effect even in the pulverised material. The use of metallic sieve analyses on any sample that assayed greater than 100 ppb gold is therefore an important analytical step in determining an accurate gold grade.

Figure 11-2: Scatter Plot of Original Assays (OG) vs. Repeat Assays (RA), 2010



Source: From Murahwi, 2017

Figure 11-3: Scatter Plot of Original Assays (OG) vs. Repeat Assays (RA), 2017



Source: From Murahwi, 2017

11.6 Qualified Person Opinion

The QP has reviewed the sample preparation, analyses and security and found no significant issues or inconsistencies that would cause one to question the validity of the data and is satisfied with the adequacy of the procedures as implemented by Marathon Gold. APEX recommends that Marathon Gold continues with the company's current QA/QC protocols and considers new strategies intended to increase the confidence level of the QA/QC work, such as umpire assaying, and collection and analysis of variability of duplicate samples.

12 Data Verification

12.1 Introduction

The authors of this chapter conducted several steps to verify the ongoing site activity; describe the visual, physical, and geological characteristics of the property; and prepare the mineral resource estimates presented in Chapter 14. A description of the site inspection, drill database verification, and independent analytical testwork is provided below.

12.2 Site Inspections

APEX conducted site inspections at the Valentine Lake property in 2017 and 2019, with the most recent visit on October 16, 2019. The purpose of these inspections was to review field exposures and outcrop, observe active 2019 drilling, observe select 2019 drill core intercepts, collect samples for independent analytical testwork, and discuss the geology and mineralisation with Marathon Gold's senior technical team. The most recent site inspection placed emphasis on field inspection and core review of the Marathon and Leprechaun deposits.

The following work was carried out:

- The author performed a visual check of assay intervals, sample numbers, downhole depths, and geological logs against selected drill core intervals laid out in core boxes for the Marathon Gold's 2019 drill programs at the Leprechaun and Marathon deposits.
- Field visits were conducted to the Frank, Leprechaun and Marathon deposits to observe outcrops and surface exposures. The authors also flew over the entire mineralised trend at the project and observed the areas stripped for future exploratory work.
- Independent coordinate readings using handheld GPS of randomly selected drillhole collars were carried out to verify the accuracy of the reported locations.

The site inspection, and subsequent review of the Marathon Gold licenses at the NL Department of Natural Resources, allowed the author to verify the location and good standing of the property, current operations, and infrastructure, and to confirm the geological interpretations made in support of mineral resource estimation. No significant errors were found in relation to the site visit.

12.3 Drillhole Database

To verify the exploration data supplied by Marathon Gold, BOYD checked the database using Vulcan software for overlapping sample intervals, duplicated data, variations in drillhole orientation, sample intervals deeper than the end of hole, and missing assay, survey, or lithological data. In concert, APEX validated the digital drillhole database by checking the digital drill collars, geology logs and sample locations versus the original hardcopy drill logs. Drillhole assay files were verified by checking the gold results in the database against the original laboratory certificates. No issues were encountered with the drillhole database verification.

12.4 Independent Analytical Testwork

APEX collected ten samples for independent analytical testwork over the two site inspections. In 2017, the author collected three samples from drill core and four from outcrop, and in 2019, three samples were collected from 2019 drill core (see Table 12.1).

Table 12.1: Analysis Results of Ten Samples Collected during 2017 & 2019 Site Inspections

					Drillhole, sample and assay detail (from Marathon Gold Corp.)						QP site visit: assay results [1]	
Sample ID	Drillhole or outcrop occurrence ID	Easting (m; Z21; Nad83)	Northing (m; Z21; Nad83)	Description	From (m)	To (m)	Marathon sample ID	Marathon FA (ppb)	Marathon MS (ppb)		APEX Au-AA26 (ppb)	APEX Au-GRA22 (ppb)
RE17-MA-001	Drillhole MA-17-176	492739	5360466	Quartz-eye porphyry and quartz-tourmaline-pyrite vein(s)	198	199	124088	1,179	1,147		780	/
RE17-MA-002	Drillhole MA-17-176	492739	5360466	Quartz-eye porphyry and quartz-tourmaline-pyrite vein(s)	225	226	124117	18,936	16,710		37,000	/
RE17-MA-003	Drillhole MA-16-149	492593	5360122	Quartz-eye porphyry and quartz-tourmaline-pyrite vein(s)	402	403	107913	25,703	28,222		51,000	/
RE17-MA-004	Marathon deposit outcrop	492708	5360454	Quartz-tourmaline-pyrite vein	/	/	/	/	/		8,960	/
RE17-MA-005	Marathon deposit outcrop	492765	5360403	Quartz-tourmaline-pyrite vein (stockwork)	/	/	/	/	/		330	/
RE17-FR-001	Frank zone (Galley) outcrop	484705	5355230	Quartz-tourmaline-pyrite vein	/	/	/	/	/		100	/
RE17-FR-002	Frank zone (Vein) outcrop	485035	5355400	Quartz-pyrite-tourmaline vein	/	/	/	/	/		>100,000	251,000
RE19-MA-001 [2]	Drillhole MA-19-442	492276	5359995	Quartz-eye porphyry and intense quartz-tourmaline-pyrite vein(s)	Grab sample (185.5-186.2)		/	/	/		10,250	/
RE19-MA-002 [2]	Drillhole MA-19-442	492276	5359995	Quartz-eye porphyry and quartz-tourmaline-pyrite vein(s)	Grab sample (190.1-190.3)		/	/	/		1,250	/
RE19-MA-003 [2]	Drillhole MA-19-442	492276	5359995	Quartz-eye porphyry	Grab sample (207.0-207.15)		/	/	/		10	/

Notes: 1. Analytical work conducted at ALS Canada Ltd.; Au-AA26 is Ore grade Au 50g FA-AA finish; Au-GRA22 is Au 50g FA-GRAV finish (finalised 2017-11-14). 2 Grab samples intended to review core logging nomenclature and not to mimic the 1 m Marathon Gold sample interval.

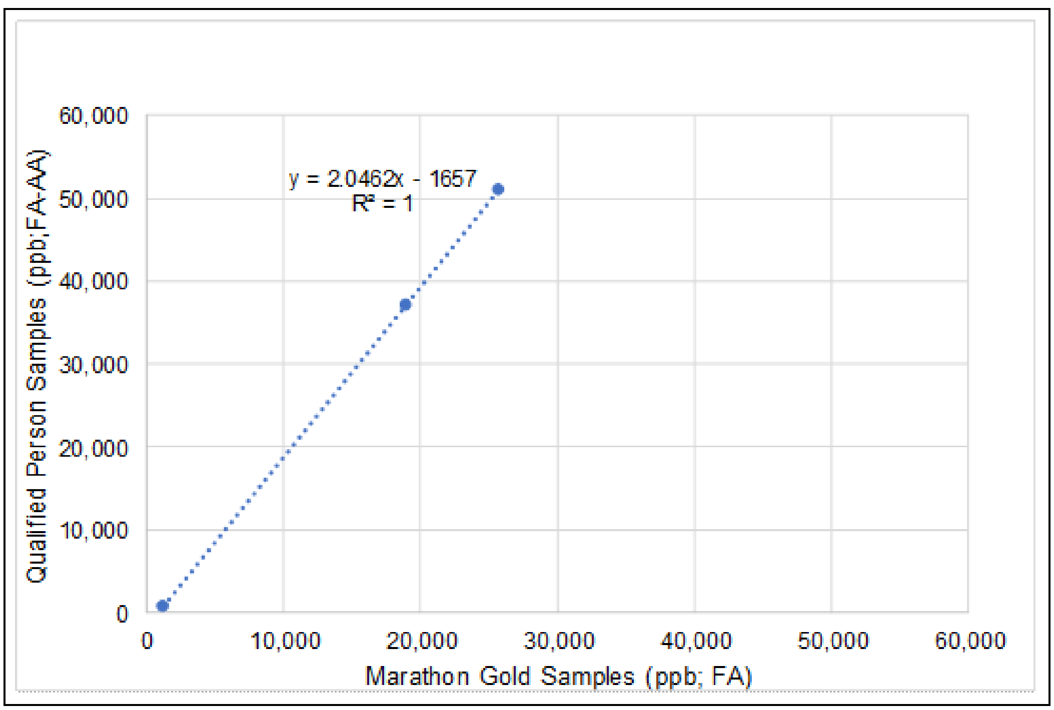
The samples were collected, bagged, sealed, and couriered by the author to an independent laboratory, ALS Canada Ltd. (ALS). At the independent laboratory, the samples were subjected to ALS's standard sample preparation and analytical practices, as follows:

- Rock preparation (Code PREP-31D) that is designed for drill core and rock that contain high-grade or coarse gold. The method is to crush to 90% less than 2 mm, riffle split off 1 kg, and then pulverise the split to better than 85% passing 75 µm.
- Fire assay and atomic absorption spectrometry (Code Au-AA26) using a 50-gram nominal sample weight. Samples that analyse over 100,000 ppb are subjected to a 50-gram analysis by fire assay with a gravimetric finish.

The author's three randomly collected 2017 core samples from the Marathon deposit yielded 780 ppb, 37,000 ppb, and 51,000 ppb Au. These samples were collected by the author at 1 m sample intervals that duplicated the original Marathon Gold samples. To clarify, the author selected and sawed the remaining core using the identical sample lengths of core that were selected by Marathon Gold (as per sample tags archived in the core boxes and Marathon Gold sample data records).

Table 12.1 above and Figure 12-1 compare the Marathon Gold assay results with the results from the QP's core samples. The author does not expect the two sample sets to have a one-to-one relationship (nearly impossible using this kind of methodology). Nevertheless, the general gold assay values are replicated in that Marathon Gold's and the author's assay results mimic the low, middle, and high core assay values from the respective assay datasets. Figure 12-1 shows the analyses conducted by the author have higher gold assays in comparison to Marathon Gold's assay work. The difference could be related to many issues including, but not limited to, sampling inconsistencies, sample preparation, sample fire assaying techniques, and/or the nuggety gold-bearing QTP mineralisation.

Figure 12-1: Comparison of Three Core Sample Assays



Source: APEX, 2020.

The author's three 2019 core grab samples from the Marathon deposit yielded 10,250 ppb, 1,250 ppb, and 10 ppb Au. The purpose of the grab sample analyses was to test Marathon Gold's core logging lithological descriptions. All three samples were of quartz-eye porphyry, but the analytical results corresponded positively with the inclusion and intensity of the gold-bearing QTP veining (see Table 12.1).

Four samples were analysed from outcrop material collected in 2017 by the author. Two samples from the Marathon deposit yielded 330 ppb and 8,960 ppb Au; the latter sample was taken near the discovery outcrop at the Marathon deposit. The remaining two samples were taken from the Frank Zone occurrence and yielded 100 ppb and >100,000 ppb Au (by fire assay). The elevated gold sample was from float material (i.e., not in place bedrock) associated with the Frank Zone vein occurrence. Because of the high gold content in sample RE17-FR-002, it was re-analysed by fire assay with a gravimetric finish at ALS; this assay result yielded 251,000 ppb Au.

In summary, the samples collected by an independent QP and the results of analytical work conducted at an independent laboratory confirm the gold mineralisation at Marathon Gold's Valentine Lake property. For example, four samples, including three random core samples and one outcrop float sample, yielded between 10,250 ppb and 251,000 ppb Au (10 to 251 g/t Au). In addition, a comparison between core assay work conducted by Marathon Gold and the author of this chapter shows that the Marathon Gold assays are not overstated and that Marathon Gold's logging protocol (i.e., identification of QVT and QVT minor zones) is sufficient and reasonable for domain resource modelling at the Valentine Gold Project.

12.5 Qualified Person's Opinion

The QP has reviewed the adequacy of the exploration information and the visual, physical, and geological characteristics of the property and has found no significant issues or inconsistencies that would cause one to question the validity of the data. The QP is satisfied to include the exploration data including the drilling, drill litho-logs, and sample assays for the purpose of resource modelling, evaluation and estimations as presented in this report.

13 Mineral Processing & Metallurgical Testing

13.1 Introduction

Metallurgical testwork programs were conducted on mineralised samples from the Valentine Gold resources between 2006 and 2021, as referenced in Section 13.2. The majority of the testwork programs were carried out for the Leprechaun and Marathon deposits. Thus far, no samples from the Sprite or Victory deposits have been tested, although all the gold occurrences for these deposits share similar general characteristics, where gold mineralisation is associated with quartz-tourmaline-pyrite (QTP).

During the 2019 pre-feasibility study, the testwork program was focused on a flotation flowsheet (gravity-flotation-leach) comprising:

- coarse primary grind (P_{80} 150 µm) to reduce capex and energy demand
- gravity and flotation to produce low mass pull concentrate
- ultra-fine grinding of flotation concentrate to liberate fine gold contained in telluride-pyrite mineralisation
- intense cyanide leach of gravity concentrate
- cyanide leach of flotation tails using tailings from concentrate leach
- cyanide destruction

During the feasibility study, the above flotation flowsheet design was progressed; however, the testwork program focussed on the simpler, lower capital cost alternative (gravity-leach) comprising:

- medium primary grind (P_{80} 75 µm)
- gravity gold recovery
- leach-CIL
- cyanide destruction

13.2 Historical Testwork Programs

A summary of the historical testwork campaigns is presented in Table 13.1. Further detail can be found in the N.I. 43-101 Technical Report & Pre-feasibility Study on the Valentine Gold Project (Ausenco, 2019).

Table 13.1: Summary of Historical Testwork

Year	Laboratory	Testwork Performed
2010	G&T Metallurgical Services KM2578	Preliminary flowsheet development – Marathon ore characterisation; gravity and cyanide leach extraction; gravity, sulphide flotation and cyanide extraction; ore hardness
2012	G&T Metallurgical Services KM3028	Preliminary flowsheet development – Leprechaun ore characterisation; gravity and cyanide leach extraction; gravity, sulphide flotation and cyanide extraction; ore hardness
2015	Thibault& Associates 6536 Phase II	Leprechaun master composite - gravity and grind size sensitivity; gravity leach and gravity-float-leach
2017	Thibault& Associates 6536 Phase I	Leprechaun and Marathon ore – grade and grind size variability; gravity-leach and gravity-float-leach
2019	SGS-Lakefield 16863	Comminution, whole ore leach, flotation-regrind-leach, heap leach, solid-liquid separation
2019	Outotec 324217	Solid-liquid separation – dynamic settling and filtration
2019	FLSmidth Rev 4	Gravity recoverable gold modelling

13.3 2021 Testwork Campaign

A feasibility study metallurgical testwork program began in 2020 at Base Met Labs (BaseMet). The program was developed and managed by Ruth Sherrit of Ausenco on behalf of Marathon Gold.

13.3.1 Sample Selection

Drill cores consisting of NQ and HQ cores, from both the Marathon and Leprechaun deposits, were delivered to BaseMet in August and September 2020, respectively. NQ core from the 2016 drilling campaign was stored as half NQ core at site in Newfoundland. HQ core from the 2020 drilling campaign was drilled and shipped directly to BaseMet.

Zone composites were selected based on spatial zone, head grade, and lithology for the metallurgical testwork campaign. Deposit composites were combined for metallurgical flowsheet development using a combination of zone composite samples. Variability samples were based on select drill core intervals to represent a range of grade and depth. Table 13.2 summarises NQ core sample compositions and Table 13.3 summarises HQ core sample compositions.

Table 13.2: Sample Composition for Metallurgical Testwork – NQ ½ Core

Composite	Resource	Name	Comprised	Tested for
Zone composites	Marathon	MAA, MAB, MAC, MAD, MAE	Select drill intervals by zone, grade & lithology	Chemical head analysis, mineralogy, BWi, preg-robbing evaluation, grind sensitivity and full metallurgical testwork program
Zone composites	Leprechaun	LPA, LPB, LPC, LPD, LPE	Select drill intervals by zone, grade & lithology	Chemical head analysis, mineralogy, BWi, preg-robbing evaluation, grind sensitivity and full metallurgical testwork program
Master composite	Marathon	MAMC	MA (A+B+C+D+E)	Gravity-leach flowsheet development; bulk test for downstream testing – detoxification, thickening, geotechnical, geochemistry
Master composite	Leprechaun	LPMC	LP (A+B+C+D+E)	
Variability – Grade	Marathon	MG1 - MG6	Select interval by grade	Gravity-leach variability
Variability – Grade	Leprechaun	LG1 - LG6	Select interval by grade	
Variability – Depth	Marathon	MD1 – MD5	Select interval by depth	
Variability – Depth	Leprechaun	LD1 – LD5	Select interval by depth	
Waste	Marathon	W1, W2, W3, W6	Select intervals by rock type	Head assay and BWi
Waste	Leprechaun	L4, L5, L7	Select intervals by rock type	

Table 13.3: Sample Composition for Metallurgical Testwork – HQ Core

Composite	Resource	Name	Comprised	Tested for
Comminution	Marathon	MHQ-1 to MHQ-17	Select intervals	Comminution – CWi, SMC, RWi, BWi, Ai
Comminution	Leprechaun	LPHQ-1 to LPHQ-17	Select intervals	
Zone Composite	Marathon	MAHQCA MAHQCB MAHQCC	Select drill intervals by zone, grade & lithology	Gravity-leach & Gravity-float-leach variability testing
Zone Composite	Leprechaun	LPHQCA LPHQCB LPHQCC	Select drill intervals by zone, grade & lithology	

13.3.2 Head Analysis

Zone composites were submitted to characterise the sample with a full suite of assays which included:

- gold by screen metallic at 106 µm
- CuCN, AgCN, Hg, Te by direct assay
- sulphur (total, sulphide sulphur S_{2-})
- carbon (C organic, C graphitic)
- ICP scan for 55 elements

Key assays for the composites tested are shown in Table 13.4 on the following page.

Observations from the zone composite head assay results:

- The samples tested had gold assays ranging from 1.31 to 3.19 g/t.
- All but one sample had silver grades of less than 1 g/t. MAA measured 3 g/t.
- All samples assayed low levels of Cu, Zn, and Ni, which contribute to cyanide consumption.
- Almost all sulphur occurs as sulphides. MAA was the exception.
- All samples had low levels of graphitic and organic carbon indicating low potential of preg-robbing.
- All samples showed low levels of mercury, less than 0.2 g/t.
- Tellurium occurred in all samples, ranging from 22 to 32 g/t.
- Mercury was measured in ppb (mg/t) and is considered low across the samples tested. All but one sample (MAB) measured <0.02 g/t.

Table 13.4: Summary of Head Assays – Zone & Master Composites NQ Core

Sample	Au (g/t)	Ag (g/t)	Cu (g/t)	CuCN (g/t)	Fe (%)	Zn (g/t)	Pb (g/t)	Ni (g/t)	As (g/t)	Sb (g/t)	Hg (mg/t)	Cg (%)	Corg (%)	S (%)	S^{2-} (%)	Se (g/t)
MAMC	4.01	<1	-	-	-	-	-	-	-	-	-	0.01	<0.01	0.74	0.68	-
MAA	1.61	3	24	6	2.17	40	9.2	20	5	< 2	23	<0.01	0.02	0.69	0.24	< 8
MAB	1.86	<1	55	4	2.07	30	20.5	20	21	2	145	<0.01	0.01	0.81	0.61	< 8
MAC	2.18	<1	39	4	2.15	< 30	7.6	20	10	< 2	9	<0.01	<0.01	0.73	0.7	< 8
MAD	1.31	<1	42	6	1.59	30	9.8	40	6	< 2	19	<0.01	<0.01	0.57	0.53	13
MAE	1.99	<1	35	2	1.9	< 30	4.7	10	< 5	< 2	6	<0.01	<0.01	0.72	0.67	< 8
LPMC	2.18	<1	-	-	-	-	-	-	-	-	-	<0.01	0.01	0.61	0.60	-
LPA	2.15	1	22	2	1.47	30	12.3	10	< 5	2	15	0.01	0.03	0.38	0.35	< 8
LPB	3.19	<1	30	2	2.04	40	7.5	10	< 5	< 2	10	<0.01	0.02	0.37	0.35	< 8
LPC	1.74	<1	27	4	2.22	40	8.6	10	< 5	< 2	13	0.01	<0.01	0.49	0.47	< 8
LPD	1.69	<1	20	2	1.97	40	8.7	30	< 5	< 2	8	0.01	<0.01	0.35	0.12	< 8
LPE	1.72	<1	27	6	2.59	40	9.4	20	< 5	2	11	0.01	<0.01	0.33	0.31	< 8

Table 13.5: Summary of Head Assays – Variability NQ Core

Sample	Au (g/t)	Ag (g/t)	Hg (mg/t)	S (%)	S^{2-} (%)	Sample	Au (g/t)	Ag (g/t)	Hg (mg/t)	S (%)	S^{2-} (%)
MG1	0.55	<1	10	0.53	0.49	LG1	1.27	<1	<5	0.39	0.38
MG2	2.1	<1	12	0.60	0.57	LG2	2.02	<1	<5	0.19	0.18
MG3	1.96	<1	7	0.64	0.36	LG3	3.03	1	<5	0.25	0.25
MG4	2.11	1	29	0.47	0.44	LG4	4.85	<1	6	0.30	0.25
MG5	1.87	<1	50	0.73	0.68	LG5	3.28	<1	<5	0.24	0.26
MG6	3.63	<1	25	0.81	0.74	LG6	4.35	<1	<5	0.24	0.23
MD1	1.7	<1	9	0.74	0.71	LD1	2.25	1	<5	0.23	0.23
MD2	1.68	1	33	0.51	0.43	LD2	1.59	<1	<5	0.24	0.22
MD3	2.17	<1	28	0.77	0.73	LD3	2.57	<1	<5	0.42	0.40
MD4	2.45	<1	9	0.80	0.75	LD4	1.20	<1	<5	0.50	0.45
MD5	2.16	<1	9	0.32	0.26	LD5	3.06	<1	<5	0.25	0.23

13.3.3 Mineralogy

13.3.3.1 Mineral Abundance

Each zone composite underwent QEMSCAN rapid mineral scan to identify the composition of minerals, as presented in Table 13.6. The distribution of sulphides is presented in Table 13.7.

Key observations are as follows:

- Feldspar, quartz and muscovite/illite make up the majority of non-sulphide gangue.
- Muscovite content ranged 2.7% to 9.1%, with the greater proportion in Leprechaun (LPA, LPB, LPE) ore. The higher levels may contribute to poorer settling characteristics.
- Kaolinite clay content ranged 0.8% to 2.8%, with the greater proportion in Marathon (MAA) ore. The higher levels may contribute to poorer settling characteristics.
- Main sulphides are pyrite and this represents typically >96% of the sulphide sulphur.
- Elevated levels of pyrrhotite observed in sample MAE and represents ~7.5% of the global sulphides in this composite.
- No arsenopyrite present. Therefore, arsenic removal in effluent treatment is likely not required.

Table 13.6: Mineral Proportions (wt%)

Element	MAA	MAB	MAC	MAD	MAE	LPA	LPB	LPC	LPD	LPE
Pyrite	1.3	1.5	1.4	0.9	1.2	0.7	0.6	0.7	0.5	0.5
Pyrrhotite	<0.1	<0.1	<0.1	<0.1	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Arsenopyrite	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Iron Oxides	0.1	0.3	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.3
Plagioclase Feldspar	36.7	35.2	42.8	42.8	41.2	47.5	48.1	58.6	58.1	48.8
Quartz	48.3	53.9	44.0	49.2	48.4	34.5	32.0	24.2	25.2	28.9
Muscovite/Illite	3.9	3.6	4.0	2.7	3.1	8.6	9.1	5.4	6.4	8.2
K-Feldspars	0.1	0.1	0.1	0.1	0.1	0.4	0.4	0.3	0.4	0.4
Chlorite	3.9	2.2	3.8	1.4	2.6	2.5	3.1	3.3	3.1	3.8
Kaolinite (Clay)	2.8	1.4	1.5	1.3	1.5	0.8	1.0	1.3	1.4	1.3
Calcite	2.0	1.1	1.5	1.0	1.1	2.4	1.9	2.4	2.1	2.9
Dolomite/Ankerite	0.3	0.1	0.1	0.2	0.1	1.6	2.8	2.6	1.6	3.0
Epidote	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.4	0.4	0.6
Rutile/Anatase	0.2	0.1	0.2	0.1	0.1	0.1	0.3	0.3	0.2	0.6
Apatite	<0.1	<0.1	<0.1	<0.1	<0.1	0.2	0.1	0.2	0.1	0.3
Ilmenite	<0.1	<0.1	<0.1	<0.1	<0.1	0.1	0.2	0.1	<0.1	0.2
Zircon	<0.1	<0.1	<0.1	<0.1	<0.1	0.1	<0.1	<0.1	<0.1	<0.1
Others	0.1	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Total	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**

Table 13.7: Sulphur-Bearing Minerals (% of total S)

Element	MAA	MAB	MAC	MAD	MAE	LPA	LPB	LPC	LPD	LPE
Pyrite	98.1	96.2	97.6	98.3	92.3	97.1	97.7	98.8	98.7	98.0
Pyrrhotite	1.4	1.8	2.0	1.3	**7.6**	2.3	2.1	0.6	1.2	1.1
Arsenopyrite	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other Sulphides	0.3	1.9	0.3	0.1	0.1	0.3	0.1	0.2	0.1	0.9
Barite	0.2	0.1	0.1	0.2	0.1	0.2	0.1	0.4	0.0	0.1
Total	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**

13.3.3.2 Gold Deportment

Master composites MAMC and LPMC were analysed for gold deportment by gravity concentration and by tailing size fraction, as follows:

- grind to P_{80} 75 µm
- Knelson gravity concentration followed by Mozley mineral separation
- produce three products: concentrate, middling and tail
- screen the tail fraction at 53 µm

Table 13.8 presents a gold distribution for the two composites. In summary:

- 76% of gold reported to Knelson concentrate for MAMC, with 24% reporting to the tail; most of the gold in tailings was in the fine fraction
- 54% of gold reported to Knelson concentrate for LPMC, with 46% reporting to the tail; most of the gold in tailings was in the fine fraction

Table 13.8: Gold Distribution

Product	% Gold Distribution	
	MAMC	LPMC
Mozley Concentrate	52.4	12.0
Mozley Middling	24.1	41.8
Knelson Tail +53 µm	3.5	8.5
Knelson Tail -53 µm	20.0	37.7
Total	**100**	**100**

QEMSCAN analysis of the combined concentrate demonstrates gold deportment based on observed visible gold occurrence. This was mostly attributed to native gold (21% and 27%) and telluride-bearing gold mineral calaverite (72% and 57%) for MAMC and LPMC, respectively, as shown in Table 13.9. Minor levels of electrum and petzite were observed with 13% sylvanite observed in LPMC.

Table 13.9: Gold Deportment

Product	% Gold Distribution	
	MAMC	LPMC
Native Gold	20.8	26.5
Calaverite	71.7	56.8
Electrum	2.9	2.1
Petzite	3.1	1.9
Sylvanite	1.6	12.7
Total	**100**	**100**

13.3.4 Comminution

The objective of the comminution testing was to characterise the variability of the ore competency and hardness/grindability from both deposits.

Testing of full HQ core crushed material comprised Bond crushing work index (CWi); while half-HQ core was used for SAG mill comminution (SMC) testing, Bond rod mill (RWi), Bond ball mill (BWi) work index tests, and Bond abrasion index (Ai) testing. In addition, five composite samples from each deposit were submitted for BWi tests.

Bond rod mill tests were conducted using a 1,180 µm closing screen size. Bond ball mill tests were conducted using a 212 µm closing screen size, aiming to achieve a grind size of P_{80} of 150 µm. Table 13.10 summarises the results for the comminution tests for the various phases of testing.

Table 13.10: Summary of Comminution Test Results

Sample	ID	Grade (g/t)	Ai (g)	CWi kWh/t	RWi kWh/t	BWi kWh/t	Axb (SMC)
Marathon	MAHQ-1	0.65	0.39	8.7	10.9	13.8	53.1
	MAHQ-2	4.50	0.42	7.2	11.0	14.7	54.4
	MAHQ-3	2.33	0.40	10.6	12.4	15.5	37.8
	MAHQ-4	2.84	0.39	9.3	11.3	15.0	43.9
	MAHQ-5	1.64	0.39	9.1	10.8	13.7	48.3
	MAHQ-6	4.25	0.38	8.3	11.0	14.3	53.5
	MAHQ-7	0.18	0.52	9.3	11.6	14.5	44.6
	MAHQ-8	2.37	0.31	13.9	13.1	14.7	32.7
	MAHQ-9	1.13	0.39	7.9	12.8	15.5	56.2
	MAHQ-10	0.30	0.46	8.2	12.8	15.0	41.3
	MAHQ-11	0.52	0.45	8.4	13.9	16.1	44.4
	MAHQ-12	4.28	0.48	8.6	9.9	14.1	59.8
	MAHQ-13	1.50	0.38	10.2	12.4	14.4	59.3
	MAHQ-14	0.55	0.40	7.2	13.8	13.9	52.8
	MAHQ-15	3.63	0.36	7.1	13.3	15.5	41.7
	MAHQ-16	1.00	0.45	9.7	12.7	15.0	52.5
	MAHQ-17	2.12	0.39	11.0	13.2	12.0	39.3
	MAHQCA	-	-	-	-	16.5	-
	MAHQCB	-	-	-	-	16.0	-
	MAHQCC	-	-	-	-	15.6	-
	MAHQCD	-	-	-	-	13.9	-
	MAHQCE	-	-	-	-	14.9	-
Leprechaun	LPHQ-1	1.96	0.39	12.8	12.6	15.5	43.1
	LPHQ-2	0.10	0.11	16.5	15.4	15.0	40.7
	LPHQ-3	4.67	0.41	13.3	13.7	16.0	46.4
	LPHQ-4	5.68	0.33	15.0	12.7	15.3	45.4
	LPHQ-5	5.32	0.33	14.5	12.4	15.9	48.9
	LPHQ-6	0.67	0.29	12.9	13.6	13.8	43.0
	LPHQ-7	1.94	0.35	11.2	14.1	15.6	40.8
	LPHQ-8	0.15	0.38	11.6	15.1	15.9	41.5
	LPHQ-9	1.88	0.30	11.1	13.5	16.7	43.8
	LPHQ-10	4.28	0.40	10.4	12.7	11.5	46.6
	LPHQ-11	0.95	0.38	15.1	14.3	16.5	34.9
	LPHQ-12	1.22	0.35	14.4	14.3	16.1	38.3
	LPHQCA	-	-	-	-	16.0	-
	LPHQCB	-	-	-	-	15.3	-
	LPHQCC	-	-	-	-	16.0	-
	LPHQCD	-	-	-	-	17.4	-
	LPHQCE	-	-	-	-	16.5	-

The results show the following:

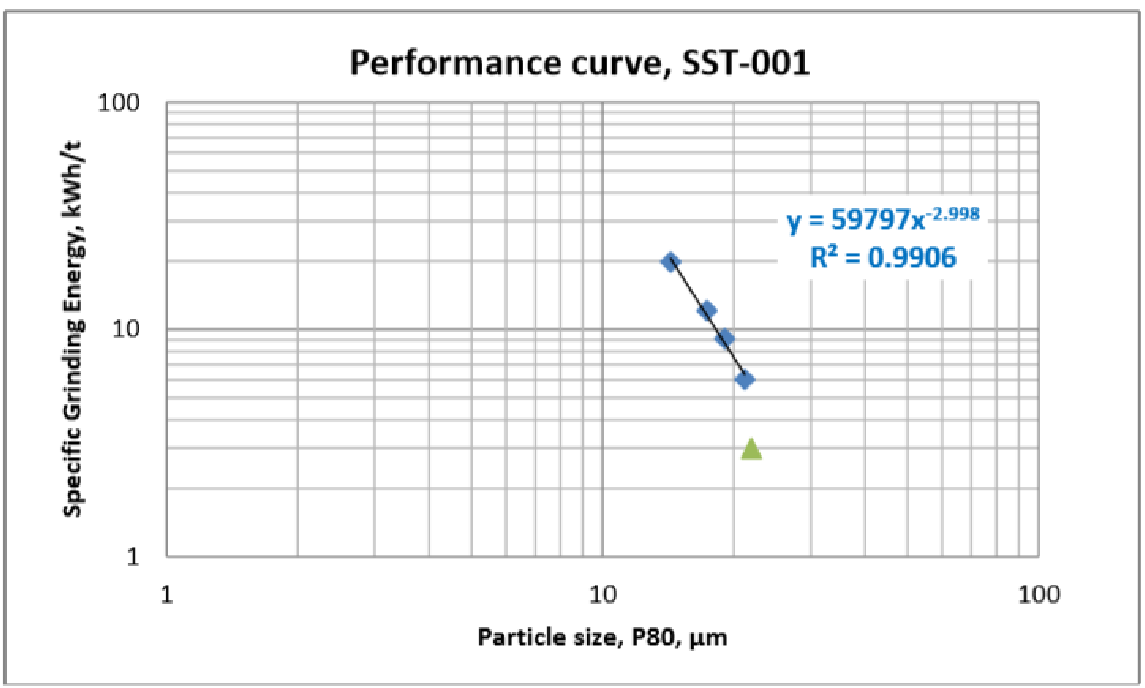
- Abrasion indices are considered moderate to high and are similar across both deposits, ranging from 0.29 to 0.63 g. One Leprechaun sample indicated a very low abrasion index of 0.11 g.
- Leprechaun ore has a higher average CWi than Marathon samples.
- Ore hardness in terms of RWi and BWi are slightly lower for Marathon ore samples, but is considered moderate for both deposits.
- Ore competency, as indicated by SMC, is considered moderately high. The average Axb values are similar for both deposits, with Marathon ores showing higher variability.

13.3.5 Flotation Concentrate Regrind

Concentrate regrind testwork was carried out using a HIG5 HIG mill. A single blended sample was submitted to the test, which consisted of a flotation concentrate comprised of material generated in a 200 kg bulk blend test representing 68% from Marathon and 32% from Leprechaun concentrate.

The test was carried out in single stage using a charge composed of 3.0 mm (60%) and 2.0 mm (40%) grinding media. The HIG mill signature plot of product P_{80} versus the energy requirement is shown in Figure 13-1. Note: the green point in the graph indicates the first pass product with F_{80} of 22 µm and the blue points are the P_{80} values on each of the following pass of the test.

Figure 13-1: Signature Plot for Concentrate Regrind Testwork



Source: SGS Canada Inc., 2020.

The results indicate that 17.8 kWh/t is required to achieve size reduction from F_{80} of 93 µm to target P_{80} of 15 µm.

13.3.6 Preg-Robbing Evaluation

Ten zone composite samples were analysed for organic carbon and graphitic carbon. Low levels (<0.03%) were measured (Table 13.4), which indicates a low probability of preg-robbing. A series of CIL tests were conducted to investigate if the ore was preg-robbing, as presented in Table 13.11. Particular attention was paid to investigate preg-robbing as the previous testwork campaign progressed with CIL.

Test conditions are as follows:

- grind to P_{80} 75 µm
- NaCN at 1 g/L
- bottle roll at 40% w/w solids with 10 g/L carbon (CIL); and with carbon addition last 6 hours (CIP)
- leach for 36 hours

The following was observed:

- In most cases, cyanide consumption was greater for CIL than CIP.
- Very little difference was observed in residue grade and recovery for CIL versus CIP.
- Calculated head grades generally compared well for both tests.

Future leach tests progressed without carbon.

Table 13.11: Preg-Robbing Test Results

Comp.	Test	NaCN Consump. (kg/t)	CaO Consump. (kg/t)	Calc. Head (g/t Au)	Residue (g/t)	Mode	Recovery %
MAA	CN1	0.29	0.95	2.04	0.16	CIP	92.1
MAA	CN2	0.32	0.89	2.05	0.12	CIL	94.1
MAB	CN3	0.28	0.48	2.32	0.16	CIP	93.3
MAB	CN4	0.39	0.83	1.93	0.15	CIL	92.5
MAC	CN5	0.34	0.89	1.60	0.13	CIP	92.2
MAC	CN6	0.48	0.82	1.78	0.10	CIL	94.4
MAD	CN7	0.70	0.87	2.05	0.09	CIP	95.9
MAD	CN8	0.45	0.78	1.68	0.09	CIL	94.9
MAE	CN21	0.15	1.04	2.40	0.17	CIP	92.9
MAE	CN22	0.30	0.93	2.35	0.17	CIL	93.0
LPA	CN11	0.21	0.76	2.93	0.22	CIP	92.7
LPA	CN12	0.36	0.76	2.93	0.19	CIL	93.5
LPB	CN13	0.26	0.75	2.07	0.20	CIP	90.6
LPB	CN14	0.35	0.75	2.70	0.21	CIL	92.2
LPC	CN15	0.28	0.77	2.11	0.18	CIP	91.5
LPC	CN16	0.39	0.76	1.63	0.11	CIL	93.2
LPD	CN17	0.27	0.77	1.68	0.12	CIP	92.9
LPD	CN18	0.38	0.77	2.39	0.16	CIL	93.3
LPE	CN19	0.27	0.77	1.62	0.14	CIP	91.7
LPE	CN20	0.36	0.77	1.67	0.13	CIL	92.5

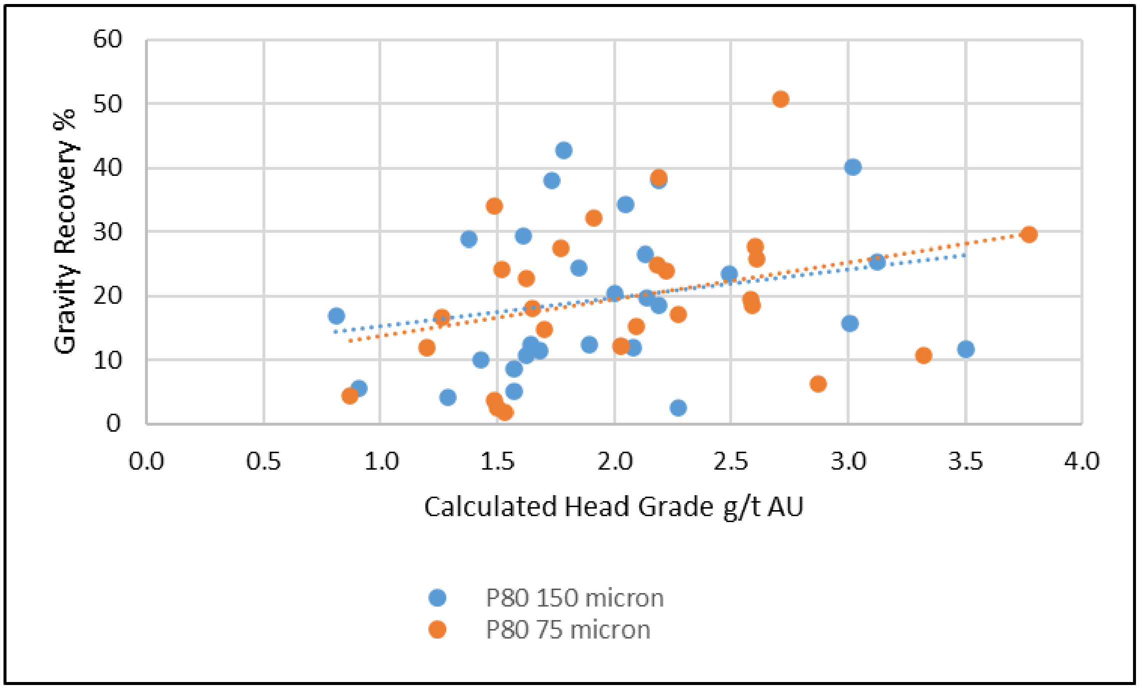
13.3.7 Gravity Concentration

Due to the high gravity recoverable gold observed in earlier testwork phases, all metallurgical tests for the feasibility study included gravity concentration prior to flotation and/or leaching. The procedure generally included grinding the ore to target grind size, single pass through a Knelson laboratory concentrator, then upgrading to a low-mass gravity concentrate on a Mozley mineral separator. Mass recovery targeted at 0.03% to 0.05% w/w to replicate plant practice. A summary of the batch gravity separation results at primary grind P_{80} of 150 µm is presented in Table 13.12 on the following page.

Observations from batch gravity tests include:

- Gravity recovery is highly variable.
- Repeat tests showed variability that is typical of coarse gold analysis.
- No relationship was observed with gravity recovery, mass pull or head grade. Figure 13-2 presents gravity recovery versus calculated head grade by grind size. No discernible relationship was observed.
- The resultant mass pull ranged from 0.02% w/w to 0.07% w/w. Mass pull in plant practice is expected to be 0.05% w/w.
- Gravity recovery ranged from 2% to 51%.
- Average gravity recovery was 20%.

Figure 13-2: Batch Gravity Recovery vs. Calculated Head Grade



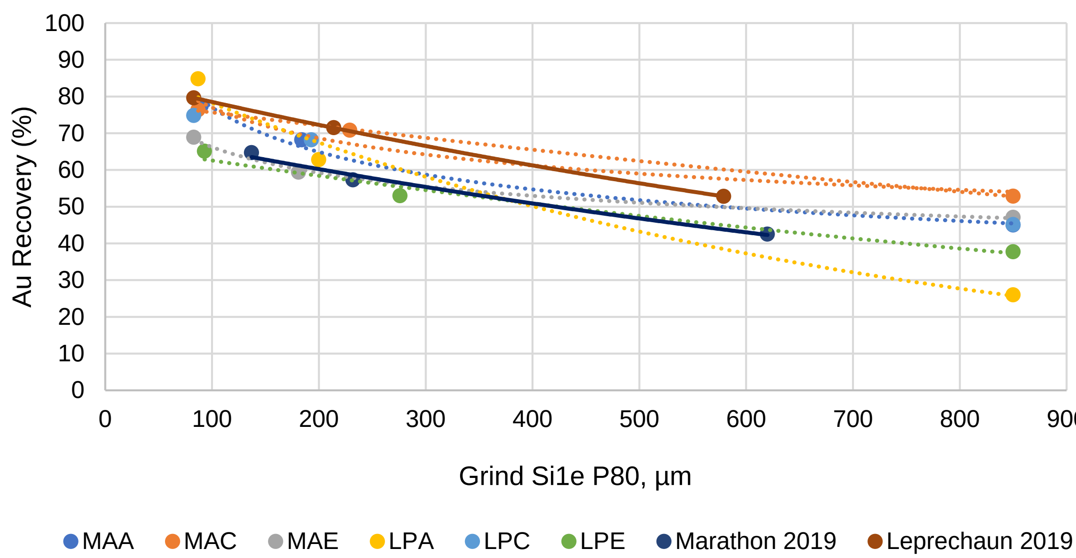
Source: Ausenco, 2021.

Table 13.12: Batch Gravity Tests P_{80} 150 µm (left) P_{80} 75 µm (right)

Sample	Test	Calc Head g/t Au	Conc. Mass %	Au Gravity Recovery %		Sample	Test	Calc Head g/t Au	Conc. Mass %	Au Gravity Recovery %
MAMC	G29	1.61	0.03	29.4		-	-	-	-	-
LPMC	G30	1.78	0.04	42.8		-	-	-	-	-
MG1	G51	0.81	0.03	16.8		MG1	G61	0.87	0.02	4.4
MG2	-		-	-		MG2	G62	2.19	0.03	38.6
MG3	G52	2.19	0.05	38.2		MG3	G63	1.77	0.04	27.6
MG4	-		-	-		MG4	G64	2.22	0.04	24.0
MG5	G53	2.49	0.05	23.4		MG5	G65	2.58	0.03	19.5
MD1	G54	2.05	0.07	34.4		MD1	G67	1.53	0.03	1.8
MD2	-		-	-		MD2	G68	1.49	0.04	3.8
MD3	G55	1.89	0.04	12.5		MD3	G69	1.70	0.04	14.9
MD4	-		-	-		MD4	G70	2.87	0.03	6.2
MD5	-		-	-		MD5	G71	2.03	0.04	12.1
LG1	G56	1.29	0.03	4.2		LG1	G72	1.26	0.03	16.7
LG2	-	-	-	-		LG2	G73	1.52	0.04	24.1
LG3	G57	3.01	0.06	15.7		LG3	G74	2.60	0.03	27.8
LG4	-	-	-	-		LG4	G75	2.61	0.04	25.8
LG5	G58	3.50	0.04	11.8		LG5	G76	3.32	0.02	10.7
LG6	-	-	-	-		LG6	G77	3.77	0.04	29.7
LD1	-	-	-	-		LD1	G78	2.27	0.03	17.1
LD2	G59	2.14	0.04	19.8		LD2	G79	2.71	0.04	50.8
LD3	-	-	-	-		LD3	G80	2.18	0.04	24.9
LD4	G60	1.57	0.07	8.7		LD4	G81	1.50	0.03	2.5
LD5	-	-	-	-		LD5	G82	2.09	0.03	15.2
MAHQCA	G93	0.91	0.03	5.6		MA-HQA	G99	1.20	0.06	12.0
MAHQCA	G100 (repeat)	-	0.04	13.7		-	-	-	-	-
MAHQCB	G94	2.13	0.03	26.5		MA-HQB	G88	2.59	0.05	18.6
MAHQCC	G95	1.64	0.03	12.5		MA-HQC	G89	1.62	0.05	22.7
MAHQCC	G101 (repeat)	-	0.04	9.5		-	-	-	-	-
LPHQCA	G96A	1.73	0.02	38.1		LP-HQA	G90	1.49	0.05	34.2
LPHQCB	G97A	1.68	0.03	11.5		LP-HQB	G91	1.65	0.06	18.0
LPHQCB	G102A (repeat)	-	0.04	5.0		-	-	-	-	-
LPHQCC	G98A	1.38	0.03	28.8		LP-HQC	G92	1.91	0.044	32.1
MAA	103	1.57	0.03	5.2		-	-	-	-	-
MAB	104	2.08	0.03	11.9		-	-	-	-	-
MAC	111	2.19	0.05	18.5		-	-	-	-	-
MAD	105	1.43	0.05	10.1		-	-	-	-	-
MAE	112	2.27	0.02	2.6		-	-	-	-	-
LPA	106	3.12	0.04	25.3		-	-	-	-	-
LPB	107	3.02	0.03	40.2		-	-	-	-	-
LPC	108	1.85	0.02	24.4		-	-	-	-	-
LPD	109	1.62	0.02	10.7		-	-	-	-	-
LPE	113	2.00	0.03	20.5		-	-	-	-	-

Extended gravity recoverable gold (e-GRG) tests were conducted on Leprechaun and Marathon zone composites to determine the maximum gravity recoverable gold and variability within the resource. This was compared with earlier e-GRG tests conducted at SGS in 2019, as presented in Figure 13-3.

Figure 13-3: E-GRG Test Results – Marathon & Leprechaun Zone compared with 2019 Data



Source: Ausenco, 2021.

The e-GRG results for the zone composites ranged 65% to 85%, with earlier SGS data lying within the zone composite data. No discernible difference between Marathon and Leprechaun ore sources was observed.

Subsequent modelling of the e-GRG tests was conducted for sizing of the concentrator circuit, as per Table 13.13. Gravity circuit modelling considers grind size, cyclone classification, gravity concentration equipment, and mass feed rate to the concentrator. Higher gravity recoverable gold is predicted at the finer grind size, by 3% to 5%.

Table 13.13: Gravity Circuit Modelling Results at P_{80} 75 & 150 µm Grind

Sample	% of Mill Discharge	Target Grind size P_{80} µm	e-GRG%	Modelled Gravity Recovery %
Marathon	23	75	66	49
Leprechaun	23	75	62	47
Marathon	28	150	66	46
Leprechaun	28	150	62	42

Marathon ore at 75 µm grind e-GRG modelling indicates 49% gravity recoverable gold will be achievable in the process plant. This is higher than batch laboratory tests which ranged 4% to 39%, some at quite low mass pull (<0.03%).

Leprechaun ore at 75 µm grind e-GRG modelling indicates 47% gravity recoverable gold will be achievable in the process plant. This is at higher end of batch laboratory tests which ranged 3% to 51%, some at quite low mass pull (<0.03).

Marathon ore at 150 µm grind e-GRG modelling indicates 46% gravity recoverable gold will be achievable in the process plant. This is higher than batch laboratory tests which ranged 4% to 38%, some at quite low mass pull (<0.03).

Leprechaun at 150 µm grind e-GRG modelling indicates 42% gravity recoverable gold will be achievable in the process plant. This is at the higher end batch laboratory tests which ranged 5% to 43%, some at quite low mass pull (<0.03).

In most cases batch laboratory tests were lower than the modelled gravity recovery. This is considered attributed to the relatively low mass pull achieved in the lab.

13.3.8 Gravity-Flotation-Leach Flowsheet

The focus of the feasibility study testwork program was to optimise the gravity-leach flowsheet conditions. The purpose of flotation testing was to confirm the test conditions established during the pre-feasibility study with additional variability samples representing a range of grade, depth and zone parameters.

The main difference to the pre-feasibility study is the use of oxygen in the leach. This provided increased recovery of approximately 2% to 3%.

Test conditions are presented in Table 13.14. In practice the concentrate leach residue will transfer to the tail leach for additional residence time. However, the testwork was conducted separately.

Table 13.14: Float-Regrind-Leach Test Parameters

Item	Parameter	Item	Parameter
Primary Grind	P_{80} 150 µm	Concentrate Leach Time	36 h
Flotation Reagents	MIBC, PAX & R208	Concentrate Leach Cyanide Concentration	10 g/L
Rougher Flotation Time	15-25 min	Flotation Tail Leach Grind	As received
Flotation pH	8 to 8.5	Tail Leach Density	50 wt% solids
Concentrate Regrind	15-17 µm	Tail Leach Dissolved Oxygen	20
Concentrate Leach Density	40 wt% solids	Tail Leach Time	22 h
Concentrate Leach Dissolved Oxygen	20 ppm	Tail Leach Cyanide Concentration	0.4 g/L

Results are summarised in Table 13.15.

Table 13.15: Summary of Gravity-Flotation-Leach Tests

Sample	Test	Grind P_{80} µm		Calc Head g/t Au	Consumption kg/t		Distribution Au%			Stage Recovery %		Overall Recovery %
		Primary	Regrind		NaCN	CaO	Gravity	Conc	Tail	Conc	Tail	
MAMC	R29	146	18	1.61	0.39	0.38	29.4	49.7	20.9	95.5	76.4	94.5
LPMC	R30	147	15	1.78	0.39	0.42	42.8	47.5	9.6	98.3	77.0	97.6
Blend	R84	150	15	2.88	0.40	0.31	43.2	47.0	9.8	96.5	68.2	95.2
MG1	R51	151	16	0.81	1.09	0.15	16.8	72.8	10.4	98.1	83.6	96.9
MG3	R52	175	17	2.19	0.57	0.22	38.2	55.3	6.4	98.2	86.5	98.1
MG5	R53	176	16	2.49	0.58	0.21	23.4	70.0	6.6	98.4	73.9	97.2
MD1	R54	140	16	2.05	0.62	0.16	34.4	62.6	3.1	98.3	70.3	98.0
MD3	R55	150	17	1.89	0.57	0.18	12.5	81.1	6.4	98.5	60.3	96.3
LG1	R56	148	15	1.29	0.81	0.17	4.2	88.2	7.6	98.7	71.3	96.7
LG3	R57	145	15	3.01	0.84	0.16	15.7	78.1	6.2	98.5	79.8	97.6
LG5	R58	136	16	3.50	0.92	0.16	11.8	82.8	5.4	99.6	67.6	97.9
LD2	R59	159	15	2.14	0.71	0.14	19.8	74.4	5.7	99.3	72.9	97.9
LD4	R60	145	15	1.57	0.97	0.15	8.7	83.3	8.1	98.5	77.8	97.0
MAHQCA	R93	175	19	0.91	0.57	0.49	5.6	77.0	17.5	95.9	69.8	91.6
MAHQCA	R100*	150	16	1.20	0.61	0.47	13.7	74.6	11.7	97.1	76.3	95.1
MAHQCB	R94	150	18	2.14	0.49	0.45	26.4	66.9	6.7	97.4	76.8	96.7
MAHQCC	R95	150	16	1.64	0.71	0.50	12.5	78.9	8.6	96.9	69.5	94.9
MAHQCC	R101*	150	16	1.41	0.64	0.36	9.5	80.1	10.4	97.1	74.0	95.0
LPHQCA	R96	150	16	1.73	0.51	0.53	38.1	55.1	6.7	97.2	67.7	96.3
LPHQCB	R97	150	18	1.68	0.53	0.49	11.5	80.9	7.7	94.8	73.8	93.8
LPHQCB	R102*	150	18	1.66	0.83	0.39	5.0	88.8	6.2	94.6	76.8	93.8
LPHQCC	R98	150	14	1.38	0.63	0.49	28.8	63.5	7.7	98.1	72.7	96.7
MAA	R103	150	17	1.57	0.26	0.42	5.2	91.2	3.6	96.8	83.3	96.4
MAB	R104	150	17	2.08	0.62	0.30	11.9	79.8	8.3	98.4	69.8	96.2
MAC	R111	150	14	2.19	0.60	0.27	18.5	75.6	5.9	98.2	70.3	96.9
MAD	R105	150	15	1.43	0.48	0.39	10.1	80.1	9.8	97.7	56.0	93.8
MAE	R112	150	16	2.27	0.52	0.27	2.6	89.2	8.2	98.1	79.4	96.6
LPA	R106	150	16	3.12	0.43	0.35	25.3	69.0	5.7	98.9	67.8	97.4
LPB	R107	150	15	3.02	0.60	0.35	40.2	53.9	5.9	97.7	67.9	96.9
LPC	R108	150	15	1.85	0.43	0.39	24.4	68.6	7.0	96.7	66.8	95.4
LPD	R109	150	14	1.62	0.39	0.38	10.7	78.9	10.5	96.2	77.5	94.6
LPE	R113	150	13	2.00	0.37	0.25	20.5	71.4	8.1	96.9	76.4	95.9
Average			16	1.94	0.60	0.32	19.42	72.4	8.20	97.5	73.1	96.1
Min			13	0.81	0.26	0.14	2.60	47.00	3.10	94.6	56.0	91.6
Max			19	3.50	1.09	0.53	43.20	91.20	20.90	99.6	86.5	98.1

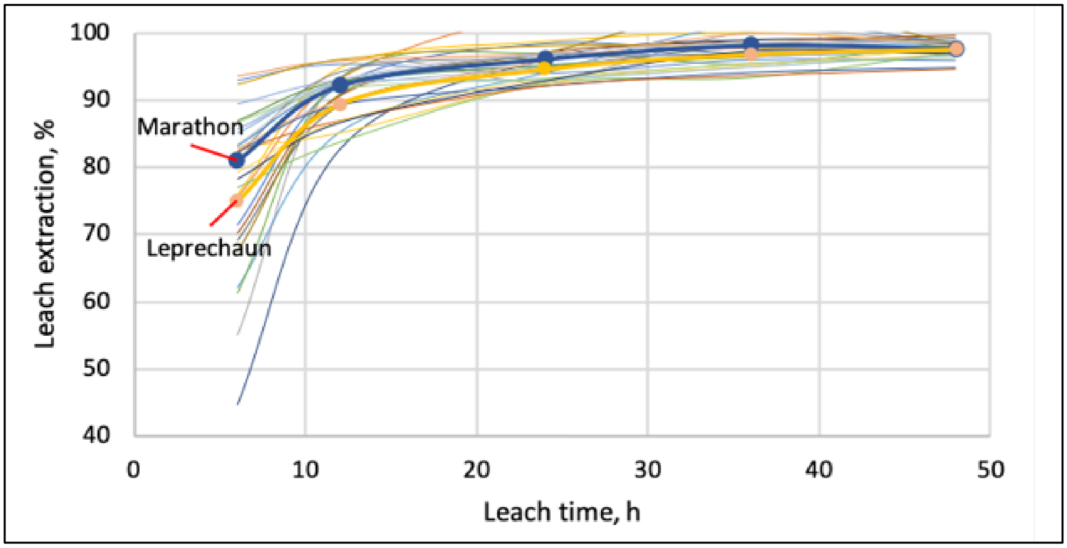
*Repeat test

The 200 kg bulk blend sample generated concentrate for HIG mill power plot/sizing. This was subsequently recovered and leached.

13.3.8.1 Cyanide Leach of Flotation Concentrate

Flotation concentrate leach kinetics were measured over a number of cyanide leach tests. In all cases flotation feed was gravity tailings. A summary of the results is presented in Figure 13-4. The majority of leaching is complete within 30 hours.

Figure 13-4: Concentrate Leach Kinetics

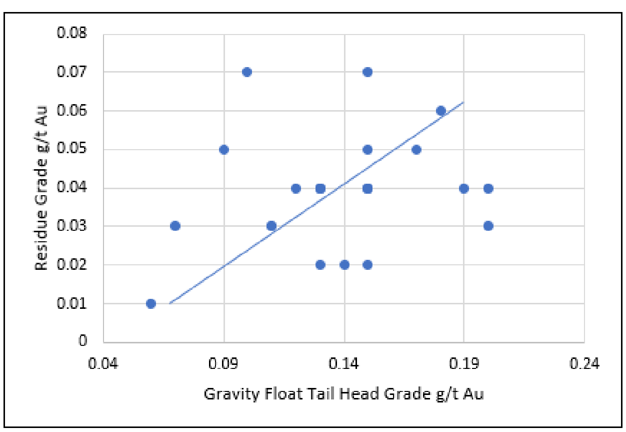


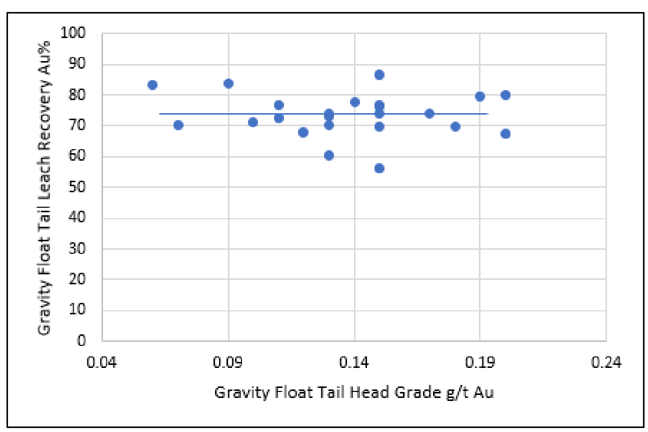
Source: John Goode, 2021.

13.3.8.2 Cyanide Leach of Gravity Flotation Tail

Gravity flotation tail leach calculated head grade by residue grade and extraction is presented in Figure 13-5. No discernible relationship was observed. The flotation tails tests were directly leached with cyanide for 22 hours, without recombining the concentrate stream.

Figure 13-5: Gravity Float Tail Head Grade vs. Residue Grade (left) & Extraction (right)





Source: Ausenco, 2021.

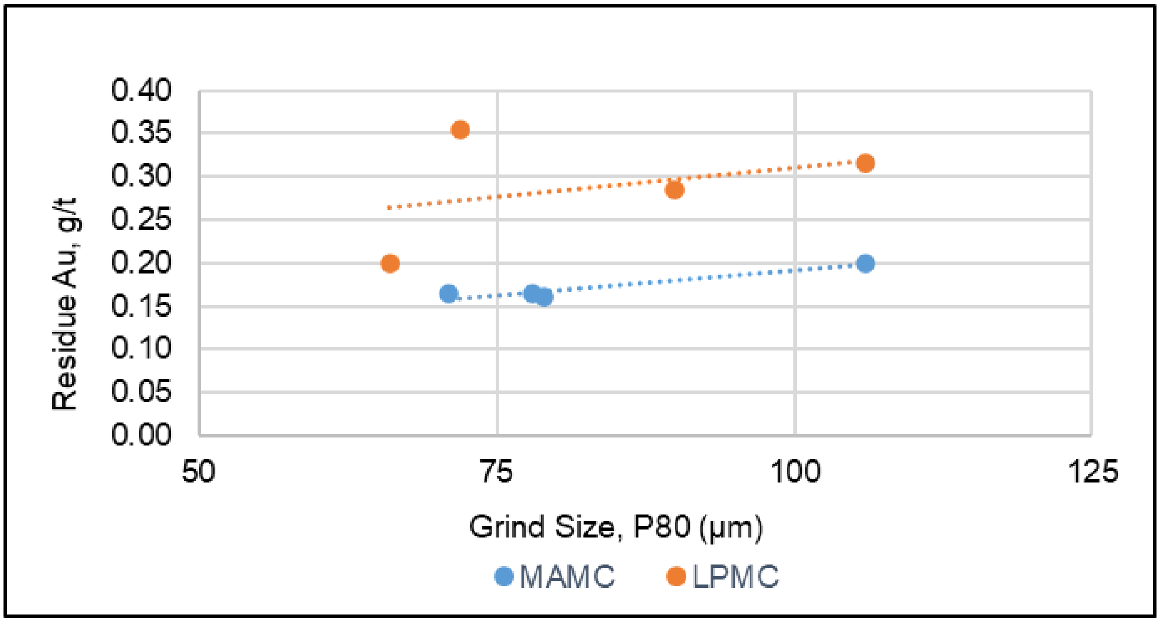
13.3.9 Gravity-Leach Flowsheet Optimisation Tests

A series of leach optimisation tests were conducted on master composites MAMC and LPMC to develop optimum parameters for variability testing and design criteria.

13.3.9.1 Grind Series

Gravity tails leach tests were conducted at varying target grind sizes ranging from 65 to 106 µm. LPMC shows a reduction in residue grade from grind size P_{80} 106 to 78 µm, and flat thereafter to 65 µm. MAMC achieved lower residue than LPMC and less reduction between grind size P_{80} 106 and 78 µm (see Figure 13-6). A grind size of 75 µm was nominated for future tests.

Figure 13-6: Effect of Grind – Master Composites MAMC & LPMC



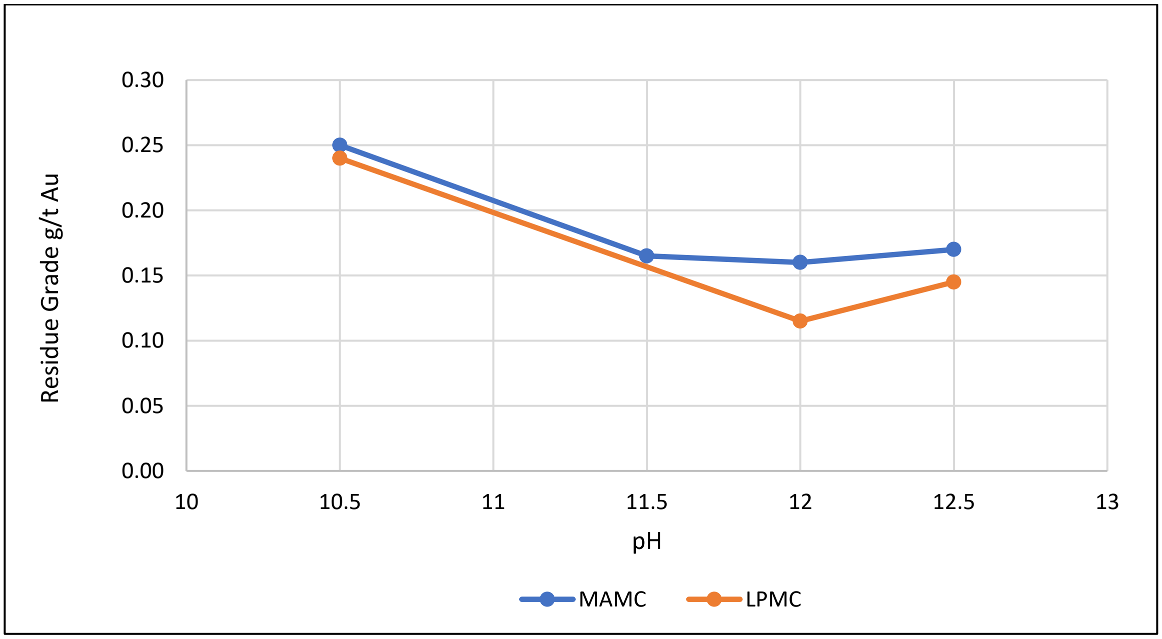
Source: Ausenco, 2021.

13.3.9.2 Free Lime (pH) Series

During the pre-feasibility study, aggressive telluride leach conditions were tested to liberate the telluride minerals. This included high pH and oxygen addition. This resulted in improved gold extraction with relatively high lime consumption; therefore, additional tests were run to investigate potential to reduce lime and operating costs.

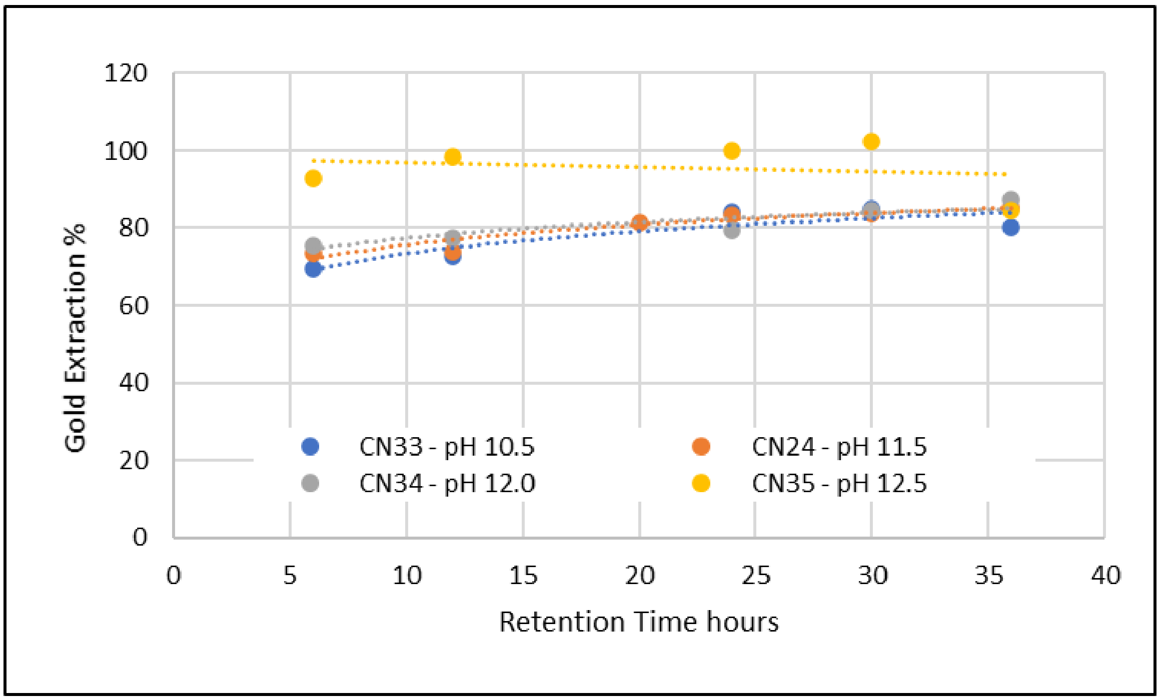
Figure 13-7 presents the pH effect on leach residue and Figures 13-8 and 13-9 present the pH effect on leach kinetics. Control of pH beyond 12 proved difficult due to the buffering effect. Comparable extractions were achieved at pH 12 with reduced lime consumption compared with the pre-feasibility study. A pH of 11.5-12.0 was nominated for future tests.

Figure 13-7: Effect of pH on Leach Extraction at P_{80} 75 µm



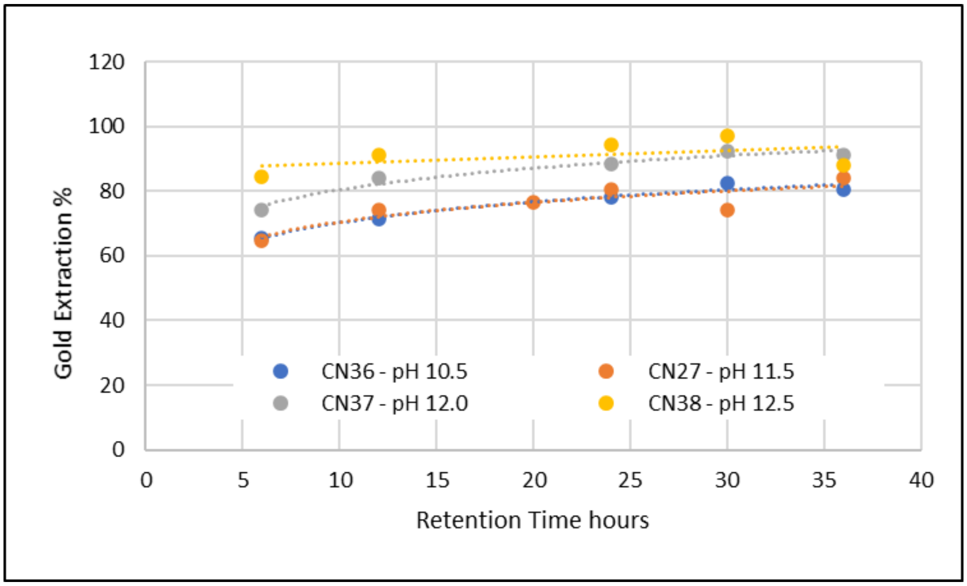
Source: Ausenco, 2021.

Figure 13-8: Effect of pH on Leach Kinetics – Marathon Composite MAMC



Source: Ausenco, 2021.

Figure 13-9: Effect of pH on Leach Kinetics – Leprechaun Composite LPMC

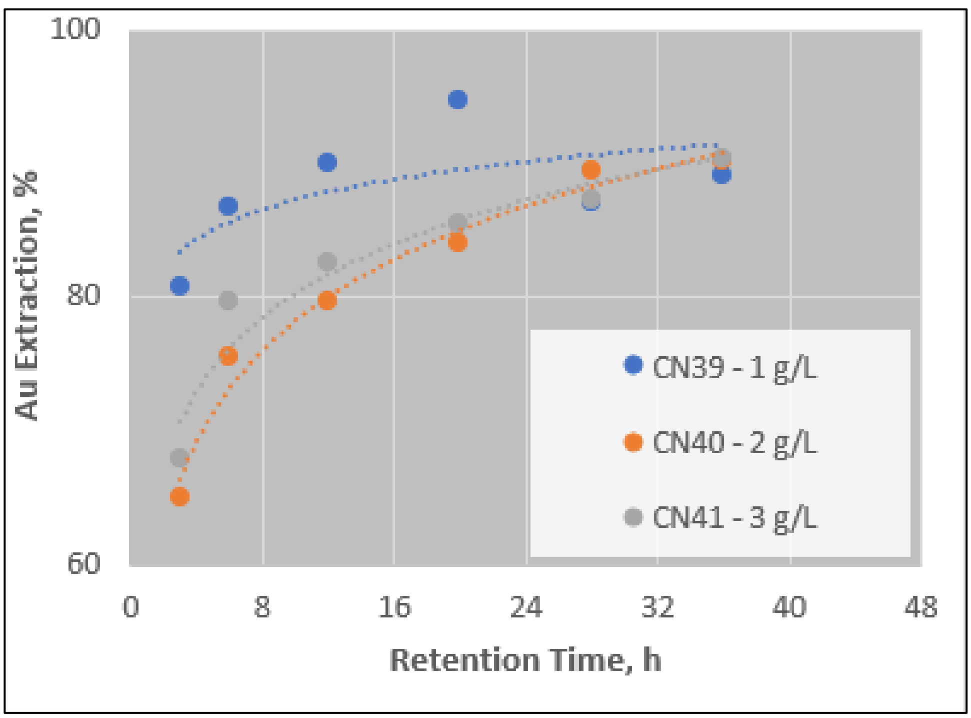


Source: Ausenco, 2021.

13.3.9.3 Cyanide Series

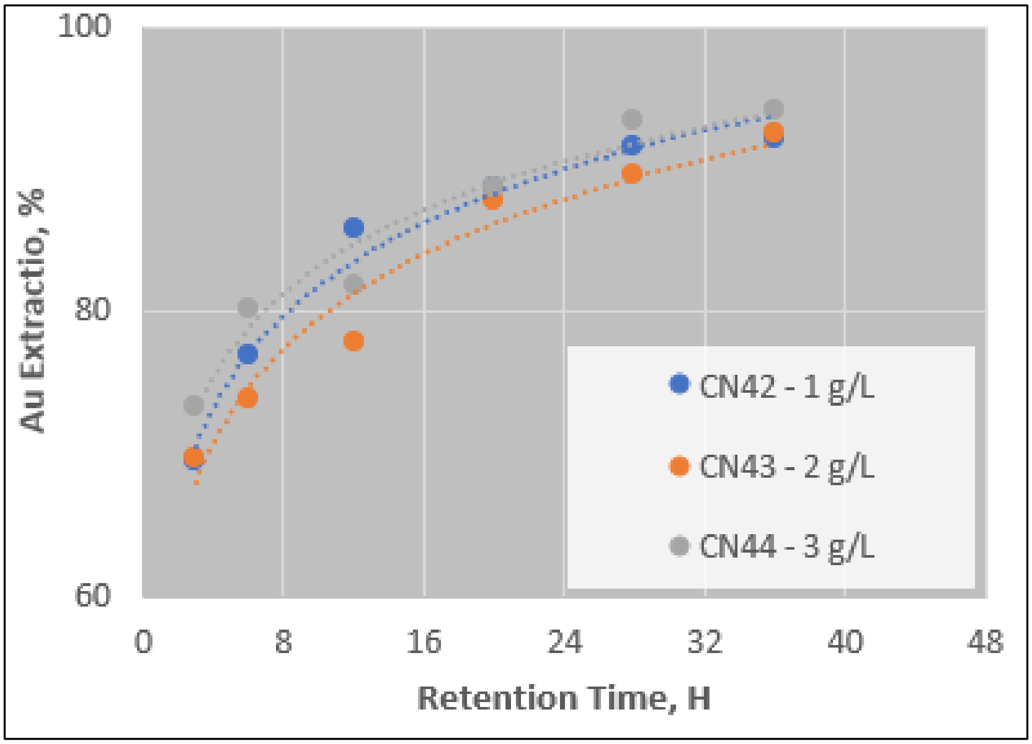
The effect of cyanide concentration was tested at three levels of 1, 2 and 3 g/L NaCN. No discernible improvement in final residue was realised to justify increasing the cyanide concentration beyond 1 g/L. See Figures 13-10 and 13-11 for results.

Figure 13-10: Effect of Cyanide Concentration – Marathon Composite MAMC



Source BaseMet, 2021.

Figure 13-11: Effect of Cyanide Concentration – Leprechaun Composite LPMC



Source BaseMet, 2021.

13.3.10 Gravity-Leach Flowsheet Variability Tests

Variability testing of NQ samples based on grade and depth plus six HQ samples was conducted at the following conditions:

Grind P_{80} .... 75 µm

Slurry density .... 40 wt% solids

Slurry pH........ 11.5-12.0

Retention time .... 32 hours

Dissolved oxygen........ 20 ppm

NaCN .... 1 g/L

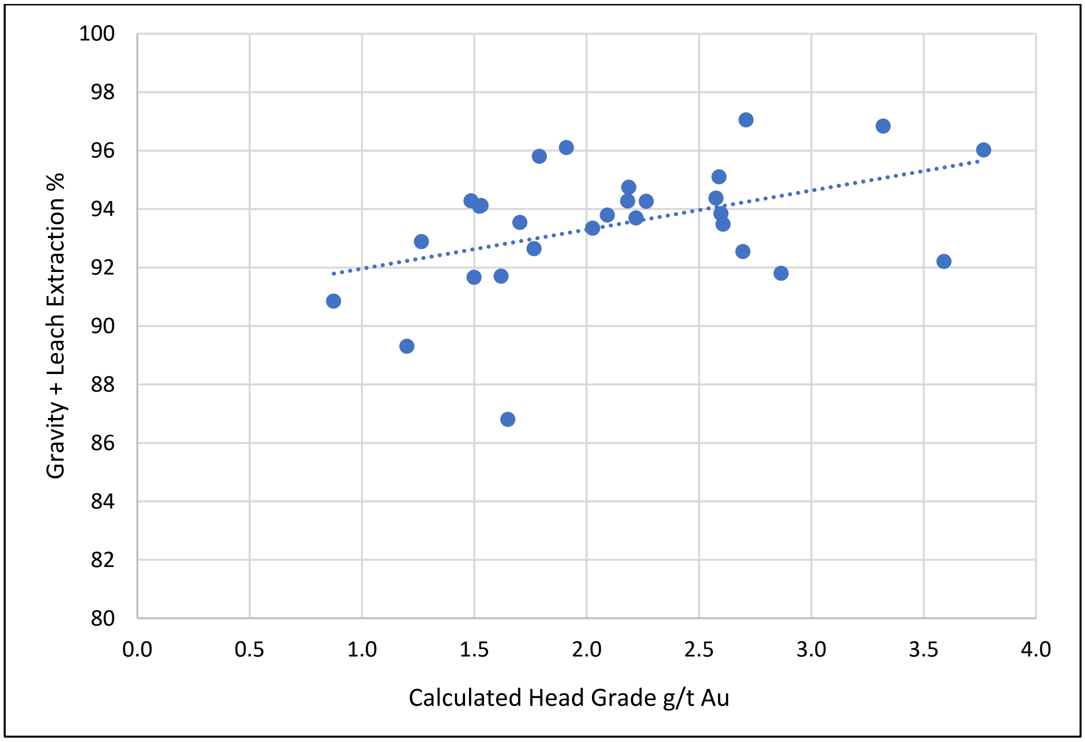
Overall recovery ranged from 87% to 97% with residue grades ranging from 0.08 to 0.28 g/t Au. Calculated and assay heads correlated well considering the amount of free gold, as presented in Table 13.16.

Figure 13-12 presents gravity leach recovery versus calculated head grade, showing a general trend with increasing head grade.

Table 13.16: Gravity-Leach Variability Tests

Sample	Test	Grind P_{80} µm	Calc. Head g/t Au	Assay Head g/t Au	Consump. kg/t		Residue Grade g/t Au	Recovery %		Overall Recovery %
					NaCN	CaO		Gravity	Leach	
CN61	MG1	68	0.87	0.55	0.27	1.91	0.08	4.4	90.4	90.8
CN62	MG2	63	2.19	2.10	0.30	2.26	0.12	38.6	91.4	94.7
CN63	MG3	63	1.77	1.96	0.37	1.72	0.13	27.6	89.8	92.6
CN64	MG4	70	2.22	2.11	0.26	1.93	0.14	24.0	91.7	93.7
CN65	MG5	66	2.58	1.87	0.24	3.18	0.15	19.5	93.0	94.4
CN85	MG6	70	3.59	3.63	0.28	3.67	0.28	23.6	89.8	92.2
CN67	MD1	67	1.53	1.70	0.23	2.46	0.09	1.8	94.0	94.1
CN68	MD2	69	1.49	1.68	0.21	2.46	0.09	3.8	94.1	94.3
CN69	MD3	69	1.70	2.17	0.24	1.46	0.11	14.9	92.4	93.5
CN86	MD4	70	2.70	2.45	0.83	1.83	0.26	22.7	90.4	92.5
CN70	MD4	69	2.87	2.45	0.30	1.67	0.24	6.2	91.3	91.8
CN71	MD5	66	2.03	2.16	0.34	1.61	0.14	12.1	92.4	93.3
CN72	LG1	68	1.26	1.27	0.22	1.86	0.09	16.7	91.5	92.9
CN73	LG2	66	1.52	2.02	0.22	1.96	0.09	24.1	92.2	94.1
CN74	LG3	68	2.60	3.03	0.18	1.68	0.16	27.8	91.5	93.8
CN75	LG4	71	2.61	4.85	0.18	1.81	0.17	25.8	91.2	93.5
CN76	LG5	75	3.32	3.28	0.21	1.81	0.11	10.7	96.5	96.8
CN77	LG6	67	3.77	4.35	0.21	1.96	0.15	29.7	94.3	96.0
CN78	LD1	69	2.27	2.25	0.24	1.90	0.13	17.1	93.1	94.3
CN79	LD2	69	2.71	1.59	0.24	1.90	0.08	50.8	94.0	97.0
CN80	LD3	69	2.18	2.57	0.21	1.88	0.13	24.9	92.4	94.3
CN81	LD4	69	1.50	1.20	0.27	1.38	0.13	2.5	91.4	91.7
CN82	LD5	65	2.09	3.06	0.13	1.92	0.13	15.2	92.7	93.8
CN99*	MAHQCA	70	1.20	1.33	0.45	5.77	0.15	12.0	87.9	89.3
CN88	MAHQCB	66	2.59	2.23	0.33	2.71	0.16	18.6	94.0	95.1
CN89	MAHQCC	69	1.62	1.35	0.28	2.85	0.18	22.7	89.2	91.7
CN90	LPHQCA	67	1.79	1.35	0.24	2.35	0.12	34.2	93.6	95.8
CN91	LPHQCB	66	1.65	1.62	0.25	2.51	0.27	18.0	84.0	86.8
CN92	LPHQCC	69	1.91	1.53	0.21	2.26	0.11	32.1	94.2	96.1
Average		68	2.14	2.20	0.27	2.23	0.14	20.1	91.9	93.5
Min		63	0.87	0.55	0.13	1.38	0.08	1.8	84.0	86.8
Max		75	3.77	4.85	0.83	5.77	0.28	50.8	96.5	97.0

Figure 13-12: Gravity-Leach Recovery vs. Head Grade – Variability Samples



Source: Ausenco, 2021.

13.3.11 Diagnostic Leaching

Diagnostic leaching was conducted on five select leach residue tails to determine the occurrence of gold losses. These samples selected showed high residue grade worthy of further investigation.

The leach residue underwent a high concentration cyanide leach. The residue was then subject to hydrochloric acid leaching to determine gold locked in carbonates, nitric acid leaching and aqua regia to determine gold locked in pyrite and other sulphides (pyrrhotite, sphalerite, chalcopyrite) and finally fire assay to determine gold locked in silicates.

A summary of the results is presented in Table 13.17. An additional 2% to 10% was extracted under intense cyanide leach conditions. All but one sample showed negligible gold locked in carbonates. However, 3% to 11% of gold was locked in sulphides and 0.4% to 2.7% locked in silicates.

Table 13.17: Diagnostic Leach

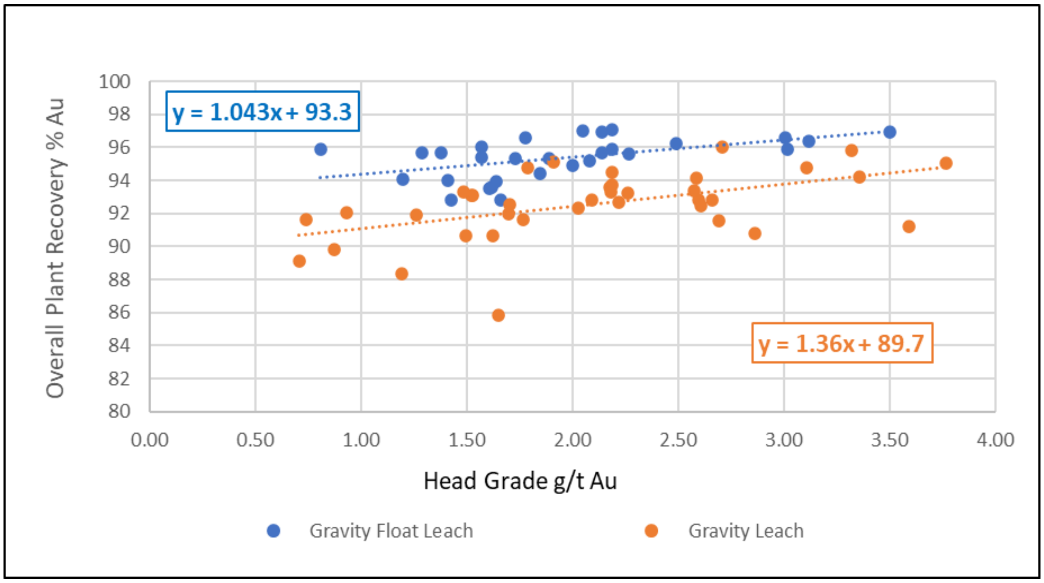
Gold Distribution as % of Feed		Original CN Leach	Intense CN Leach	Carbonates	Pyrite, Other Sulphides	Silicates
LPMC	CN27	84.2	10.5	0.3	3.2	1.8
MG6	CN66	84.4	7.9	0.3	6.8	0.6
MD4	CN70	91.3	1.9	0.4	6.1	0.4
MAHQCA	CN87	83.1	4.4	2.7	7.2	2.7
LPHQCB	CN91	84.0	3.6	0.0	10.7	1.8

13.3.12 Overall Recovery

A comparison of the overall estimated plant recovery for the two flowsheets is presented in Figure 13-13. Both trend with head grade over the range 0.7 to 3.5 g/t Au.

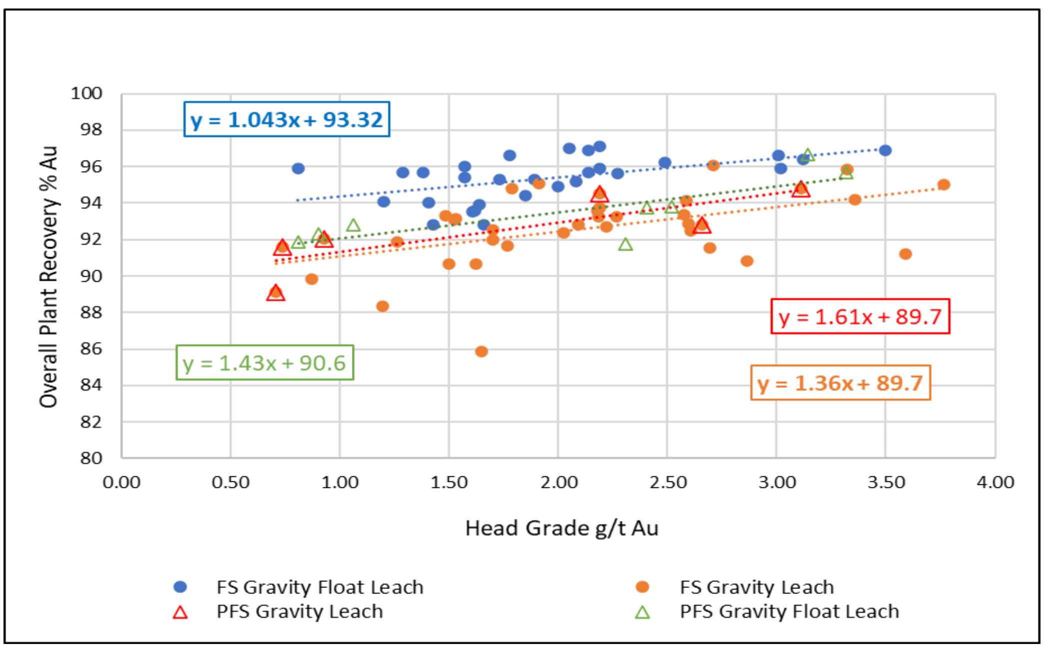
A comparison with the pre-feasibility study is presented in Figure 13-14, showing a marked improvement in the gravity float leach recovery. This is attributed to oxygen addition to the concentrate leach compared with air. This provided a 2% to 3% increase in gold recovery.

Figure 13-13: Overall Estimated Plant Recovery – Gravity Float Leach & Gravity Leach



Source: Ausenco, 2021.

Figure 13-14: Overall Recovery – Comparison with the Pre-feasibility Study



Source: Ausenco, 2021.

There were limited gravity leach recovery data points in the pre-feasibility study. With additional data points in the feasibility study including optimisation and variability samples, the overall recovery was similar, but slightly lower at the higher-grade range.

13.3.13 Cyanide Detoxification

Continuous cyanide detoxification tests using air/SO_2 method were conducted on the Master Composite which comprised MAMC (68%) and LPMC (32%) blended for both flowsheet options, as follows.

- CN83 40 kg bulk gravity leach used to generate tailings for gravity-leach flowsheet
- CN110 50 kg bulk, sequential leach to generate tailings for gravity-flotation-regrind-leach flowsheet

Cyanide detoxification feed speciation for each test is presented in Table 13.18.

Cyanide in the gravity-leach tailings was not optimised, resulting in excessively high cyanide in feed solution. The high total cyanide and low iron content indicates excessive free cyanide.

Thiocyanate and cyanate were higher for the gravity-float-leach flowsheet. This is considered attributed to a higher leach density of 50 wt% solids (CN110) compared with 40 wt% solids (CN83) and liberation of sulphides during concentrate leach at the fine grind.

Table 13.18: Cyanide Detoxification Feed Speciation (mg/L)

Species	CN83	CN110
Flowsheet	gravity-leach	gravity-float-leach
SCN	7.60	48.3
CN_{wad}	562	295
CN_{Total}	980	375
CNO	6.57	27.5
NH_3	1.42	not measured
Cu	2.1	16.1
Fe	<1	28.8
Ni	<1	0.13
Zn	<1	0.67
pH	12.3	11.3

Cyanide detoxification test results for gravity-leach flowsheet are summarised in Table 13.19. Tests were conducted at 40 wt% solids.

Table 13.19: Cyanide Detoxification Test Results for Gravity-Leach Flowsheet

Test	Objective	Time (min)	Composition (Solution)					Reagent Addition (g/g CN_{WAD})			
			pH	CN_{total} mg/L	CN_{wad} mg/L	Cu mg/L	Fe mg/L	SO_2 Equiv#	Lime	Cu# mg/L	Acid g/L
Blend Comp: CN83 - Residue Slurry			12.3	980	562	2.1	<1				
CND-C1	SO_2: 12:1	60	8.5	0.74	0.60	-	<1	12.0	0.83	50	-
CND-C2	SO_2: 10:1	60	9.5	0.59	0.45	-	<1	10.0	0.0	54	-
CND-C3	SO_2: 5:1	60	11.1	12.3	12.2	-	<1	5.0	0.0	57	-
CND-C4	5:1 | high Cu	60	10.0	1.21	1.08	-	<1	5.0	0.0	258	-
CND-C5	C4 with H_2SO_4	59	9.0	0.74	0.60	-	<1	5.0	0.0	50	10.0
CND-C6	C5 25 ppm Cu	60	9.0	0.51	0.37	-	<1	5.0	0.0	25	11.6
CND-C7	C6 12 ppm Cu	61	9.0	0.54	0.40	-	<1	5.0	0.0	12.5	12.1
CND-C8	C7: 45 min	45	9.0	0.84	0.70	-	<1	5.0	0.0	12.5	9.4
CND-C9	C8: HCl acid	45	9.0	0.95	0.81	-	<1	5.0	0.0	12.5	9.2

Notes: # Cu added as copper sulphate ($CuSO_4.5H_20$); SO_2 added as sodium metabisulphite ($Na_2S_2O_3$).

Key observations are as follows:

- The bulk leach was not optimised and resulted in excessively high pH of 12.3 and feed cyanide levels. It is intended to operate at pH 11.5 to 12.0 with WAD cyanide feed target <200 mg/L.
- WAD cyanide was effectively reduced to less than 13 ppm using 5:1 g SO_2/gCNwad in the absence of acid addition.
- WAD cyanide was effectively reduced to 1.1 ppm using 5:1 g SO_2/gCNwad and 258 mg/L Cu (as $CuSO_4.5H_20$), in the absence of acid addition.
- WAD cyanide was effectively reduced to less than 1 ppm using 5:1 g SO_2/gCNwad with acid addition to reduce initial pH to 9.
- Residence time ranged between 45 and 60 minutes.
- Further optimisation of leach pH target is recommended to optimise cyanide detoxification reagent consumption.
- SO_2 was added using sodium metabisulphite (SMBS) in all cases.

Cyanide detoxification test results for gravity-leach flowsheet are summarised in Table 13.20. Tests were conducted at 50 wt% solids.

Table 13.20: Cyanide Detoxification Test Results for Gravity-Float-Leach Flowsheet

Test	Objective	Retention Time (min)	Composition (Solution)					Reagent Addition ($g/g\ CN_{WAD}$)		
			pH	CN_{total} mg/L	CN_{wad} mg/L	Cu mg/L	Fe mg/L	SO_2 Equiv#	Lime	Cu# mg/L
Blend Comp: CN110 - Residue Slurry			11.3	375	295	16.1	28.8			
CND-C12	Cu: 100 ppm	44	8.4	0.88	0.74	0.22	<1	5.0	0.8	100
CND-C13	Cu: 50 ppm	46	9.5	0.59	0.45	-	<1	5.0	0.0	50
CND-C14	Cu: 25 ppm	45	11.1	12.3	12.2	-	<1	5.0	0.0	25
CND-C15	Cu: 12.5 ppm	45	10.0	1.21	1.08	-	<1	5.0	0.0	12.5

Notes: # Cu added as copper sulphate ($CuSO_4.5H_20$); SO_2 added as sodium metabisulphite ($Na_2S_2O_3$).

Key observations are as follows:

- WAD cyanide was effectively reduced to less than 1 ppm using 5:1 g SO_2/g CNwad in 45 minutes. No lime or acid addition was required.

13.3.14 Solid Liquid Separation

Solid/liquid separation testwork was performed on bulk samples of flotation tailings (for the gravity-flotation-leach flowsheet) and detoxified final leach tailings (for the gravity-leach flowsheet). For the detox tailings sample, both static and dynamic tests were performed. For the flotation tailings sample, only dynamic tests were conducted.

Dynamic settling tests were conducted to determine thickener sizing parameters for the project. Feed characterisation is presented in Table 13.21.

Table 13.21: Thickener Feed Sample Characterisation

Parameter	Unit	Gravity-Leach Detox Tail	Gravity-Float-Leach Rougher Tail
Solids SG	t/m^3	2.65	2.65
P_{80}	µm	75	150

13.3.14.1 Detoxification Tailings – Gravity-Leach Flowsheet

Magnafloc 10 (MF10) flocculant was selected for dynamic settling tests. These tests were all performed targeting a natural pH and using 15% w/w solids concentration for the feed slurry. Table 13.22 presents the results obtained. The highest underflow density achieved was 68 wt% solids, with a settling rate of 0.3 t/m²/h, however the resulting total suspended solids (TSS) was high. At the lowest TSS, the underflow density reached 65.5% (w/w), with a settling rate of 0.5 t/m²/h.

For process design, a settling rate of 0.50 t/h/m² and flocculant addition of 30 g/t of feed was nominated to reach an underflow density of 65% solids, w/w. This resulted in a final tailings hi-rate thickener diameter of 29 m.

Table 13.22: Dynamic Settling Test Results – Gravity-Leach Final Tailings

Parameter	Test A	Test B	Test C	Test D	Test E
Settling Rate (t/m²/h)	0.5	0.3	0.7	0.5	0.5
Rise Rate (m/h)	3.05	1.83	4.27	3.04	3.06
Flocculant Dosage (g/t)	30	30	30	20	40
Underflow Density (% solids)	65.5	68.3	65.6	65.9	65.3
TSS (mg/L)	317	645	530	860	511

13.3.14.2 Rougher Tailings – Gravity-Flotation-Leach Flowsheet

Flocculants MF10 and AN905 were selected for dynamic settling tests. These tests were all performed targeting a natural pH and using 15 wt% solids concentration for the feed slurry. Table 13.23 shows the results obtained. The highest underflow density achieved was 70% solids (w/w), with a settling rate of 0.3 t/m²/h, however the resulting TSS was high. Among the tests using flocculant AN905 and a settling rate of 1.4 t/m²/h, the underflow solids content reached 66.4% (w/w) with a much improved TSS of 58 mg/L.

For process design. a settling rate of 1.4 t/h/m² and AN905 flocculant addition of 25 g/t of feed was nominated to reach an underflow density of 65% solids, w/w. This resulted in a final tailings hi-rate thickener diameter of 22 m.

Table 13.23: Dynamic Settling Test Results – Gravity-Leach Final Tailings

Parameter	Test A	Test B	Test C	Test D	Test E	Test F	Test G	Test H	Test I
Settling Rate (t/m²/h)	0.5	0.3	0.7	0.5	0.5	1.4	1.4	1.4	1.4
Rise Rate (m/h)	3.17	1.90	4.44	3.12	3.22	8.55	8.88	8.74	9.02
Flocculant	MF10	MF10	MF10	MF10	MF10	MF10	AN905	AN905	AN905
Flocculant Dosage (g/t)	30	30	30	20	40	30	30	20	40
pH	8.6	8.6	8.6	8.6	8.6	nat	8.6	8.6	8.6
Underflow Density (% solids)	69.0	69.8	68.2	68.8	66.8	49.9	66.4	66.5	63.6
TSS (mg/L)	1117	623	426	956	401	100	58	145	78

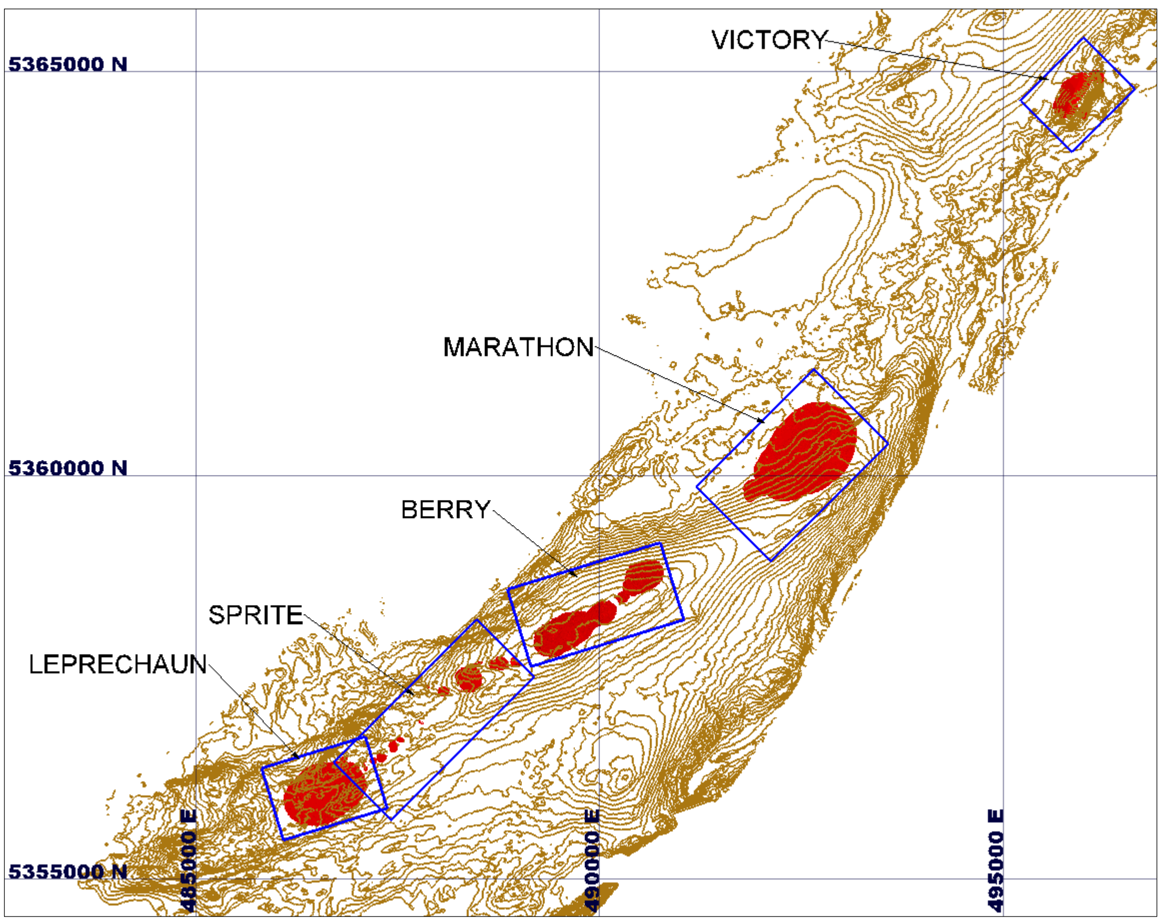
14 Mineral Resource Estimates

14.1 Overview

This chapter describes the preparation and independent estimation of mineral resources for the Valentine Gold Project. The estimates were prepared by the John T. Boyd Company (BOYD), and take into consideration the five identified gold deposits—Leprechaun, Sprite, Berry, Marathon, and Victory—that comprise the Valentine Gold Project. The mineral resource estimates reported herein were prepared under the supervision of Mr. Robert J. Farmer, P. Eng., in accordance with standards set out by National Instrument (NI) 43-101 and the Canadian Institute of Mining (CIM). Mr. Farmer is a Vice President of BOYD, and a QP as defined by N.I. 43-101 guidelines.

The general location of the five deposits, and their respective resource block models, is shown in Figure 14-1.

Figure 14-1: Valentine Resource Estimation Areas



Source: BOYD, 2021.

Mineral resource estimates for four of the deposits (Leprechaun, Sprite, Marathon, and Victory) were previously provided by BOYD in a technical report (Farmer, 2020) filed on SEDAR. The Berry mineral resource estimate is a new discovery and is first reported as part of this document. The mineral resource estimates reported herein supersede those of the previous BOYD estimates and are the result of revised technical parameters and/or new exploration work (Berry). The effective date of the revised mineral resource estimates is November 20, 2020 for the Leprechaun, Sprite, Marathon, and Victory deposits. The effective date for the Berry mineral resource estimate is April 15, 2021.

14.1.1 Mineral Resource Estimation Procedures

BOYD developed three-dimensional (3D) geological models for each of the five deposits using Maptek Pty. Ltd.'s Vulcan software. The procedures used to model and estimate the mineral resources are generally the same for all the deposits and consist of the following steps:

1. assemble and validate the exploration (drillhole) database
2. load the exploration database into Vulcan and validated the results
3. develop 3D wireframe models of the mineralised domains and surrounding rock masses for each deposit using cross-sectional interpretation and advanced implicit modelling techniques
4. examine the various sampling lengths and establish a composite length for assay composites
5. create a block model based on the resource area geology and mineralised domains developed in Step 3 above
6. determine, based on lognormal probability charts of the assay data, the threshold gold grade to limit the area of influence of high-grade gold assays
7. flag the sample composites by their intersection with the various mineralised domains as developed in Step 3 above
8. using the composites from Step 7 above, develop variograms for gold grades in each potentially mineralised domain
9. develop grade estimation parameters and interpolate block grades
10. flag the blocks located above or below topography
11. run the post-interpolation script that determines mineral resource classification, block density, and rock codes for use in pit optimisation
12. validate the block grade estimates using QQ plots and visual inspection against the underlying drillhole samples
13. export the block model into a format suitable for loading into the Geovia's Whittle pit optimiser
14. import the block model into the Whittle pit optimiser
15. determine economic pit limits to constrain the open pit mineral resource estimates using Whittle's pit optimisation tools
16. import the pit optimisation results into Vulcan
17. determine a grade shell of the Whittle pit results and flag the model for material within the Whittle pit limits and material outside of the Whittle pit limits
18. determine mineral resources inside the Whittle pit shell and underground mineral resources outside of the Whittle pit shell

For the Sprite and Victory deposits, Step 3 involved the interpretation of overburden and sediment boundaries on every cross-section through the deposit on 10 m (25 m for Victory) intervals. These boundaries were then used to develop 3D models of the overburden surfaces and sediment wireframes. Mafic dikes and quartz-tourmaline-pyrite (QTP) veins were constructed using Vulcan's implicit modelling tools. The various wireframe models were later used as boundaries for constraining the mineral resource estimates.

The same process was used at the Marathon and Leprechaun deposits; however, QTP veins could not be established with implicit modelling. Instead, a 100-ppb gold grade shell was used to limit mineralisation in the QTP veins. All orientations used in the modelling were based on field observations and numeric data.

For the Berry deposit, the procedure is the same as was used at the Leprechaun and Marathon deposits with the addition of a secondary structural orientation in the QTP veins.

14.1.2 Classification

A *measured mineral resource* is that part of a mineral resource for which quantity, grade or quality, densities, shape, and physical characteristics are estimated with confidence sufficient to allow the application of modifying factors to support detailed mine planning and final evaluation of the economic viability of the deposit. Geological evidence is derived from detailed and reliable exploration, sampling, and testing, and is sufficient to confirm geological and grade or quality continuity between points of observation.

A measured mineral resource has a higher level of confidence than that applying to either an indicated mineral resource or an inferred mineral resource. It may be converted to a proven mineral reserve or to a probable mineral reserve.

Mineralisation or other natural material of economic interest may be classified as a measured mineral resource by the Qualified Person when the nature, quality, quantity, and distribution of data are such that the tonnage and grade or quality of the mineralisation can be estimated to within close limits and that variation from the estimate would not significantly affect potential economic viability of the deposit. This category requires a high level of confidence in, and understanding of, the geology and controls of the mineral deposit.

An *indicated mineral resource* is that part of a mineral resource for which quantity, grade or quality, densities, shape, and physical characteristics are estimated with sufficient confidence to allow the application of modifying factors in sufficient detail to support mine planning and evaluation of the economic viability of the deposit. Geological evidence is derived from adequately detailed and reliable exploration, sampling, and testing, and is sufficient to assume geological and grade or quality continuity between points of observation.

An indicated mineral resource has a lower level of confidence than that applied to a measured mineral resource and may only be converted to a probable mineral reserve.

Mineralisation may be classified as an indicated mineral resource by the Qualified Person when the nature, quality, quantity, and distribution of data allow a confident interpretation of the geological framework and a reasonable assumption of the continuity of mineralisation. The Qualified Person must recognise the importance of the indicated mineral resource category to the advancement of the feasibility of the project. An indicated mineral resource estimate is of sufficient quality to support a pre-feasibility study, which can serve as the basis for major development decisions.

An *inferred mineral resource* is that part of a mineral resource for which quantity and grade or quality are estimated on the basis of limited geological evidence and sampling. Geological evidence is sufficient to imply but not verify geological and grade or quality continuity.

An inferred mineral resource has a lower level of confidence than that applying to an indicated mineral resource and must not be converted to a mineral reserve. It is reasonably expected that the majority of inferred mineral resources could be upgraded to indicated mineral resources with continued exploration.

An inferred mineral resource is based on limited information and sampling gathered through appropriate sampling techniques from locations such as outcrops, trenches, pits, workings, and drillholes. Inferred mineral resources must not be included in the economic analysis, production schedules, or estimated mine life in publicly disclosed pre-feasibility or feasibility studies, or in the life of mine plans and cash flow models of developed mines. Inferred mineral resources can only be used in economic studies as provided under N.I. 43-101.

There may be circumstances where appropriate sampling, testing, and other measurements are sufficient to demonstrate data integrity, and geological and grade/quality continuity of a measured or indicated mineral resource; however, quality assurance and quality control, or other information may not meet all industry norms for the disclosure of an indicated or measured mineral resource. Under these circumstances, it may be reasonable for the Qualified Person to report an inferred mineral resource if the Qualified Person has taken steps to verify the information meets the requirements of an inferred mineral resource.

Measured and indicated mineral resources, when combined, are also referred to as M+I in tables in this report.

14.1.3 Previous Mineral Resource Estimates

The previous mineral resource estimates were reported by BOYD in a N.I. 43-101 Technical Report (Farmer, 2020) and are provided in Table 14.1. The estimate in Table 14.1 is superseded by the mineral resource estimates presented in this report.

14.2 Leprechaun Deposit Mineral Resource Estimate

No additional exploration data were available to update the Leprechaun deposit geological model and mineral resource estimate. Changes to the mineral resource estimate for the Leprechaun deposit from those previously reported reflect revisions to the project's technical parameters (e.g., metallurgical recoveries, mining costs, etc.). *Other than the changes to the technical parameters, there are no changes from the previous April 21, 2020 Pre-feasibility Technical Report.*

A description of the previous mineral resource estimate from the BOYD Technical Report (Farmer, 2020) is duplicated below. The only changes to this report are a restating of the mineral resource using the most current feasibility study economic and technical parameters.

The Leprechaun mineral resource is contained in a series of flat-lying, gold-bearing quartz-tourmaline-pyrite (QTP) veins with an azimuth of 135°, a plunge of -10°, and a dip of -20°. The highest-grade gold mineralisation is located in the flat-lying QTP veins within a steeply dipping shear zone along the contact with the footwall sediment (SED) unit. This area of mineralisation is bounded in the hanging wall by a series of mafic dikes. To the northwest of the mafic dikes, the flat-lying, gold-bearing QTP veins continue to be mineralised and make up the hanging wall mineralisation at the Leprechaun gold deposit.

Table 14.1: Valentine Gold Project, Previous Mineral Resource Estimate (January 10, 2020)

Measured and Indicated Mineral Resource Estimate

Material/ Category	Open Pit			Underground			Total		
	Tonnes	Grade	Gold	Tonnes	Grade	Gold	Tonnes	Grade	Gold
	(t)	(g/t)	(oz)	(t)	(g/t)	(oz)	(t)	(g/t)	(oz)
Leprechaun Deposit									
Measured	8,432,000	2.211	599,500	102,000	3.877	12,700	8,534,000	2.231	612,200
Indicated	8,174,000	1.693	444,800	194,000	3.479	21,700	8,368,000	1.734	466,500
M+I	**16,606,000**	**1.956**	**1,044,300**	**296,000**	**3.616**	**34,400**	**16,902,000**	**1.985**	**1,078,700**
Sprite Deposit									
Measured	0	0	0	0	0	0	0	0	0
Indicated	675,000	1.764	38,200	7,000	2.441	500	682,000	1.771	38,700
M+I	**675,000**	**1.764**	**38,200**	**7,000**	**2.441**	**500**	**682,000**	**1.771**	**38,700**
Marathon Deposit									
Measured	22,663,000	1.667	1,214,600	488,000	4.506	70,700	23,151,000	1.727	1,285,300
Indicated	12,538,000	1.431	576,800	506,000	3.813	62,000	13,044,000	1.523	638,800
M+I	**35,201,000**	**1.583**	**1,791,400**	**994,000**	**4.153**	**132,700**	**36,195,000**	**1.653**	**1,924,100**
Victory Deposit									
Measured	0	0	0	0	0	0	0	0	0
Indicated	1,074,000	1.468	50,700	1,000	1.803	100	1,075,000	1.468	50,800
M+I	**1,074,000**	**1.468**	**50,700**	**1,000**	**1.803**	**100**	**1,075,000**	**1.468**	**50,800**
All Deposits									
Measured	31,095,000	1.814	1,814,100	590,000	4.397	83,400	31,685,000	1.863	1,897,500
Indicated	22,461,000	1.538	1,110,500	708,000	3.705	84,300	23,169,000	1.604	1,194,800
M+I	**53,556,000**	**1.698**	**2,924,600**	**1,298,000**	**4.02**	**167,700**	**54,854,000**	**1.753**	**3,092,300**

Inferred Mineral Resource Estimate

Material/ Category	Open Pit			Underground			Total		
	Tonnes	Grade	Gold	Tonnes	Grade	Gold	Tonnes	Grade	Gold
	(t)	(g/t)	(oz)	(t)	(g/t)	(oz)	(t)	(g/t)	(oz)
Leprechaun Deposit									
Inferred	2,547,000	1.441	118,100	314,000	3.478	35,100	2,861,000	1.665	153,200
Sprite Deposit									
Inferred	1,127,000	1.223	44,300	62,000	2.503	5,000	1,189,000	1.29	49,300
Marathon Deposit									
Inferred	8,791,000	1.53	432,400	1,782,000	4.069	233,100	10,573,000	1.958	665,500
Victory Deposit									
Inferred	2,019,000	1.189	77,200	124,000	3.252	13,000	2,143,000	1.309	90,200
All Deposits									
Inferred	14,484,000	1.443	672,000	2,282,000	3.901	286,200	16,766,000	1.777	958,200

Notes: **1.** The effective date for this mineral resource estimate is January 10, 2020 and is reported on a 100% ownership basis. The estimates for Leprechaun and Marathon are a new estimate using additional assays and exploration drilling (as of January 10, 2020), as well as updated economics. The estimates for Sprite and Victory are economic updates using the November 2017 mineral resources. The qualified person for the mineral resource estimate is Robert Farmer, P. Eng. **2.** Mineral resources are calculated at a gold price of US$1,300 per troy ounce. **3.** The mineral resources presented above are global and do not include a detailed pit or underground design, only an economic open pit shell was used to determine the in-pit mineral resources. The underground mineral resources are that material outside of the in-pit mineral resources above the stated underground cut-off grade. **4.** Mineral resources, which are not mineral reserves, do not have demonstrated economic viability. The estimate of mineral resources may be materially affected by environmental, permitting, legal, title, socio-political, marketing, or other relevant issues. **5.** The mineral resources presented here were estimated using a block model with a block size of 6 m x 6 m x 6 m sub-blocked to a minimum block size of 2 m x 2 m x 2 m using ID3 methods for grade estimation. All mineral resources are reported using an open pit gold cut-off of 0.300 g/t Au and an underground gold cut-off of 1.663 g/t Au. Higher gold grades were capped by mineralised domain. Material above a 0.7 g/t gold cut-off is considered high-grade while material between a 0.3 and 0.7 g/t gold cut-off is considered low-grade. **6.** The mineral resources presented here were estimated using the Canadian Institute of Mining, Metallurgy and Petroleum (CIM), CIM Standards on Mineral Resources and Reserves, Definitions and Guidelines prepared by the CIM Standing Committee on Reserve Definitions and adopted by CIM Council May 10, 2014. **7.** Figures are rounded, and totals may not add correctly. Summed average gold grades are calculated using a weighted average of tonnes and gold grade.

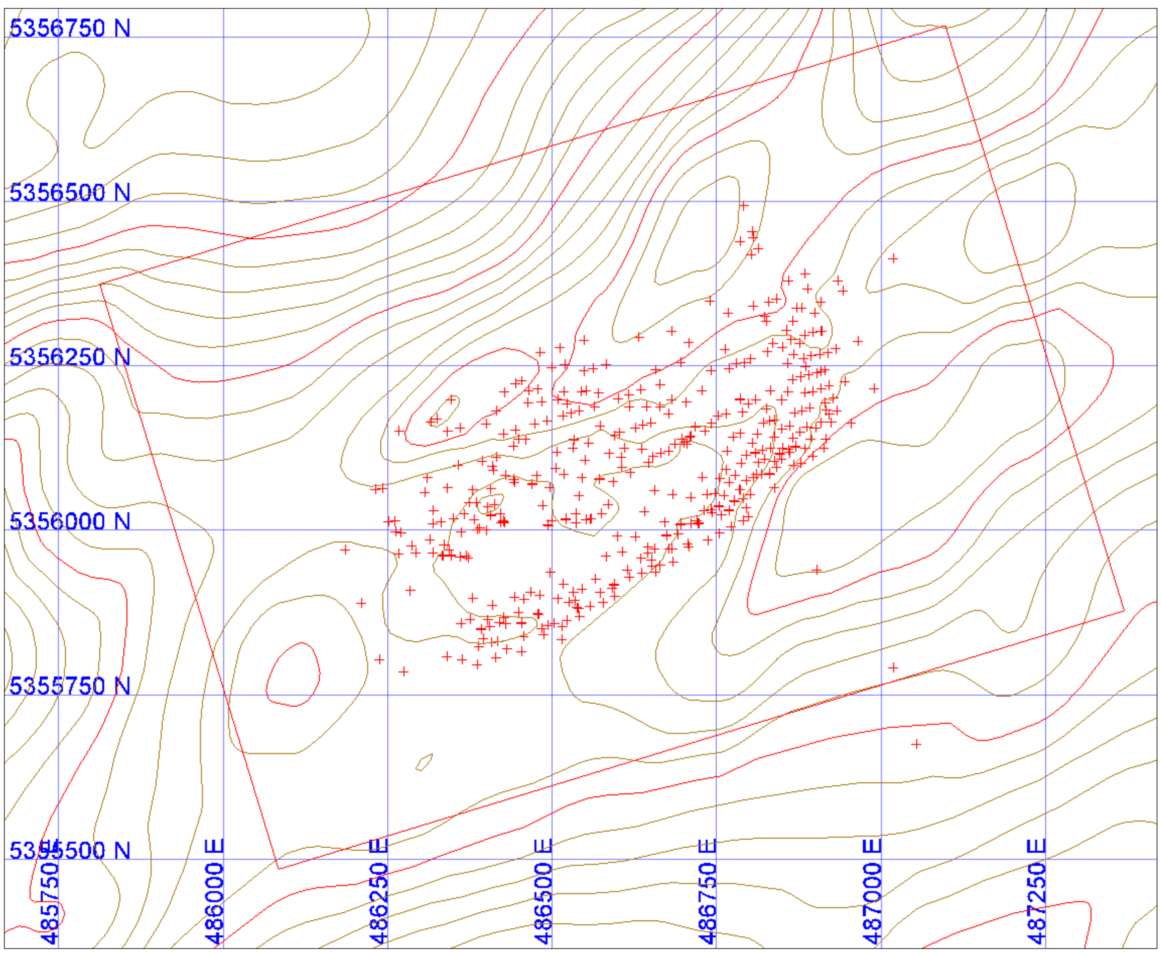
Significant gold mineralisation is encountered in all major rock units (trondhjemite, mafic dikes, and lesser sediments) and although the clear majority of the mineral resource is contained in QTP veins within these rock units, some mineralisation occurs in areas with no significantly logged QTP mineralisation. In fact, these areas probably do include QTP mineralisation in that many of the areas included very minor occurrences of QTP within the logging, but not enough to be considered a significant QTP unit.

14.2.1 Leprechaun Deposit Data

14.2.1.1 Drillholes

The mineral resource estimates for the Leprechaun deposit reported herein are based on all drillholes whose assays were available as of August 19, 2019 and consist of 442 diamond core drillholes totalling approximately 100,025 m. Figure 14-2 shows the collars of these drillholes.

Figure 14-2: Leprechaun Drillhole Locations & Topography



Source: BOYD, 2020.

14.2.1.2 Assays

Of the 70,302 gold assays available as of August 19, 2019, all were used. For unsampled intervals, gold grade values were set to zero. All gold grades were determined from fire or metallic screened assays. Total assayed sample length is 95,256 m.

14.2.1.3 Density

To date, 1,640 density measurements have been taken for the Leprechaun deposit. The results of these measurements are shown in Table 14.2. Block densities were assigned based on the block's domain of lithology type.

Table 14.2: Leprechaun Density Measurements

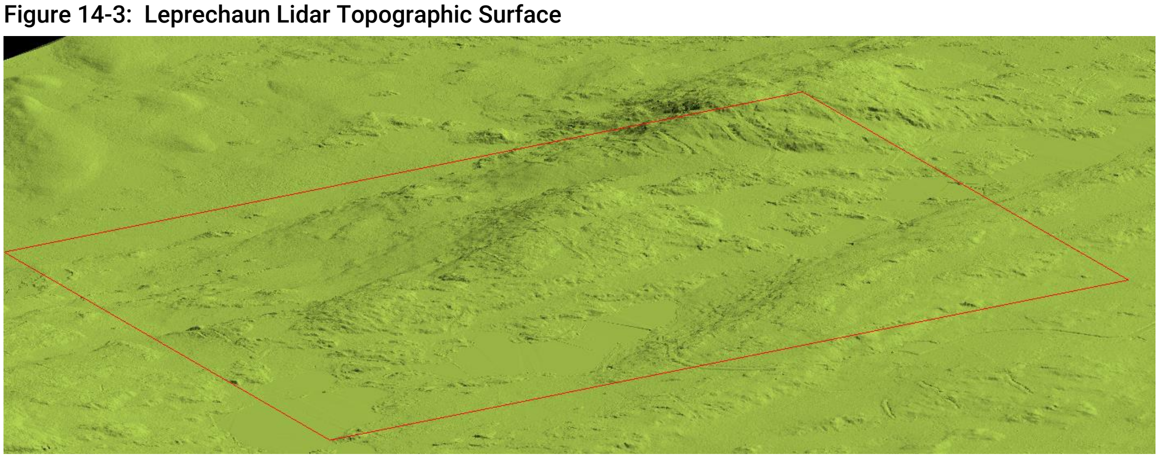
Lithology Type	Samples	Specific Gravity t/m^3
Mafic Dikes	229	2.79
Quartz-Tourmaline- Pyrite Veins	444	2.64
Sediments	140	2.75
Trondhjemite	827	2.61
Overburden	-	1.50

14.2.1.4 Topography

The topography of the area around the Leprechaun deposit is shown on Figure 14-2. All contours are expressed in metres above sea level. Contour intervals are every 5 m. The Leprechaun deposit sits on a flat-topped ridge in a shallow, water-filled depression. Towards the north, the topography falls off steeply, while towards the south, the topography slopes gently downhill.

For the previous pre-feasibility study work, a new Lidar topographic survey was completed (see Figure 14-3). This survey is the topographic basis for all mineral resource related work in the feasibility study described in this section.

Figure 14-3: Leprechaun Lidar Topographic Surface



Source: BOYD, 2020.

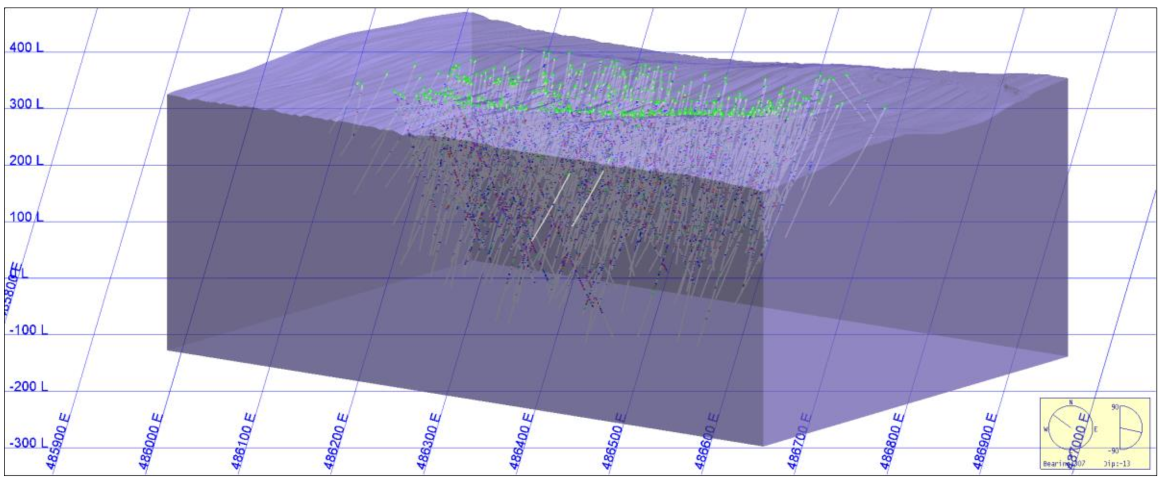
14.2.2 Leprechaun Deposit Data Analysis

14.2.2.1 Geological Modelling

The Leprechaun deposit contains four potentially mineralised domains. These domains are the SED, trondhjemite (TRJ), flat-lying, quartz-tourmaline-pyrite veins (QTPV), and mafic dikes (MD) intruding into the TRJ and QTPV domains. The QTPV domain was generated using a 100-ppb gold grade shell described below. Additionally, surface overburden was also noted in the drill logs but was not considered as a potentially mineralised host.

Geological modelling of these units is based on the logged geology as well as interpretations made by Marathon Gold staff. On every 10 m cross-section through the deposit, a line was drawn reflecting the actual or projected overburden surface below the topography. These lines were then used to construct the rock/overburden surface to constrain compositing, geological implicit models, as well as block modelling. The base of the overburden surface is shown in Figure 14-4.

Figure 14-4: Leprechaun Base of Overburden



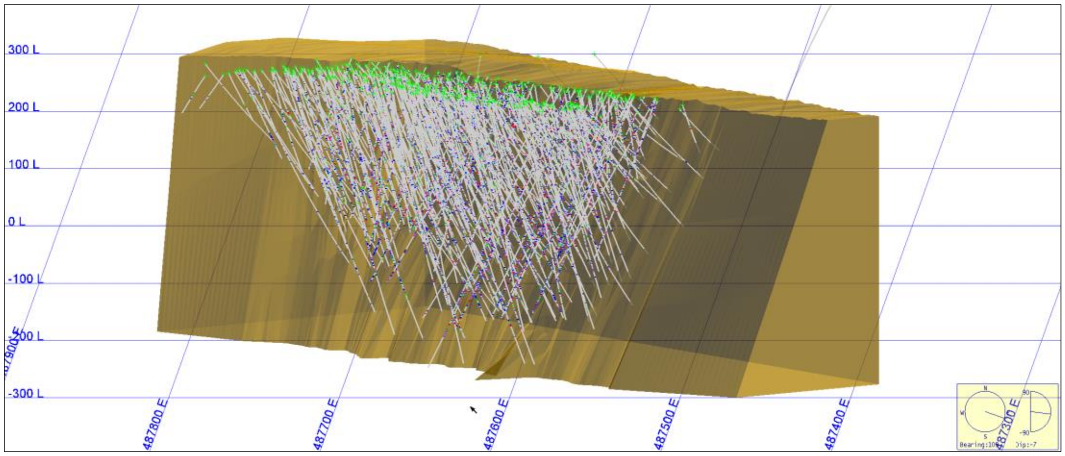
Source: BOYD, 2020.

The SED/TRJ contact was determined by drillhole intercepts or projections between intercepts and a surface constructed to represent this geologic contact. This was completed on every 10 m section through the deposit where data were available. This contact was then used to construct a solid model of the SED domain below the overburden horizon. The sediment unit is shown in Figure 14-5.

The TRJ domain is the remaining rock mass northwest of the SED solid and below the overburden horizon. The TRJ domain is shown in Figure 14-6.

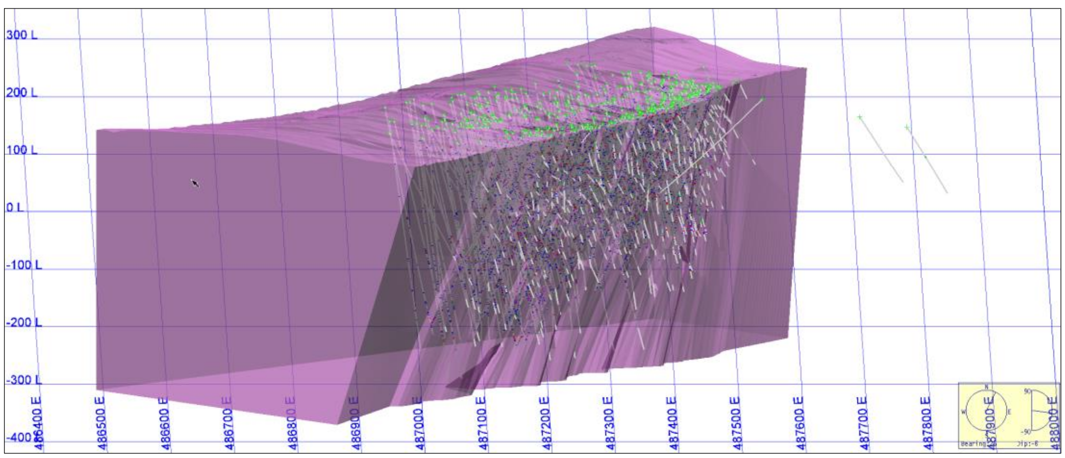
For the MD domain, Vulcan implicit modelling tools were used to develop a geologic solid based on the drillhole intercepts within the Leprechaun drillhole database. The implicit model used an azimuth of 253°, plunge of 0°, and a dip of 70° with a search distance of 75 m in the major, 75 m in the semi-major, and 5 m in the minor. Based on discussions with Marathon Gold geologic staff, the MD Domain has been truncated by the sediments and cut the QTPV zones; as such, the MD solid is clipped by the SED model. The MD domain is shown in Figure 14-7.

Figure 14-5: Leprechaun Sediment Domain



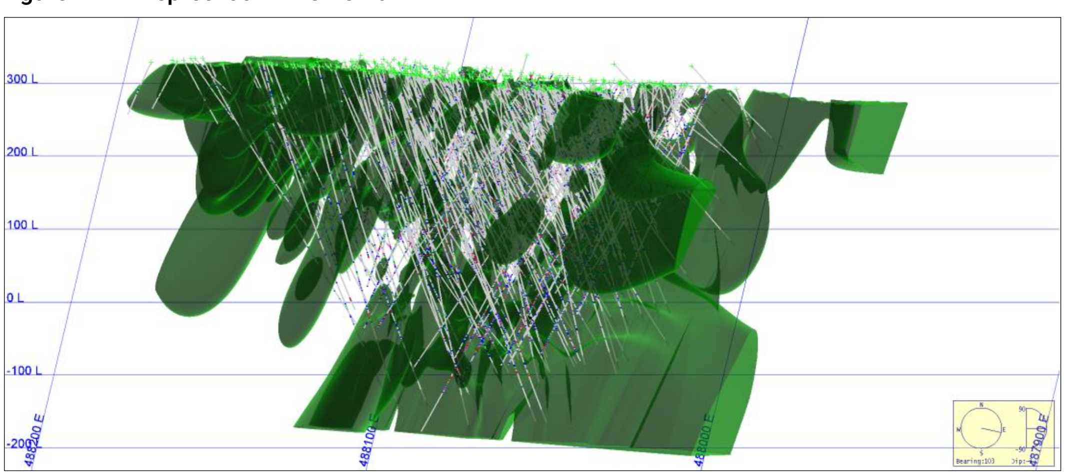
Source: BOYD, 2020.

Figure 14-6: Leprechaun Trondhjemite Domain



Source: BOYD, 2020.

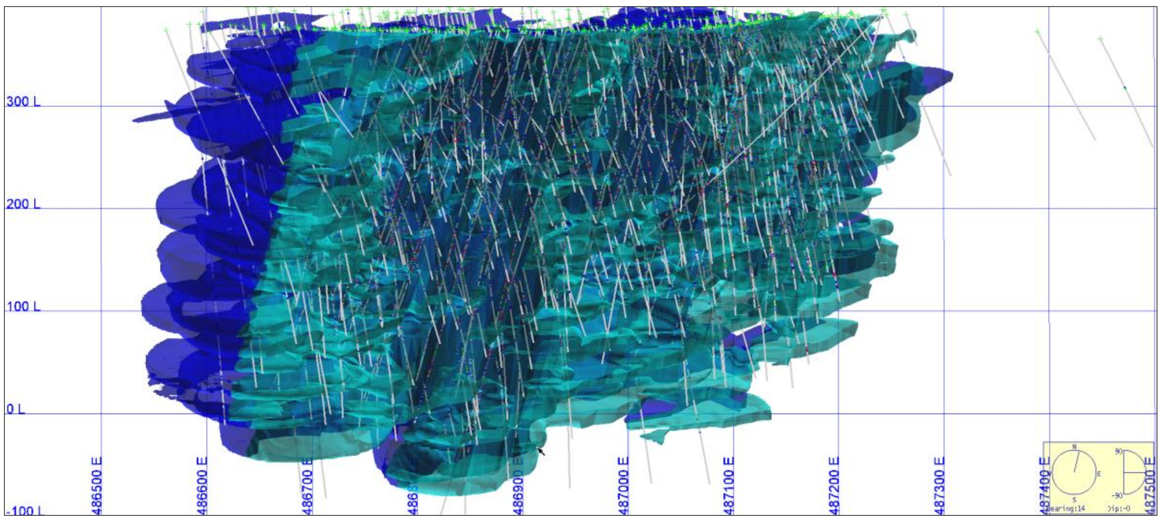
Figure 14-7: Leprechaun Dike Domain



Source: BOYD, 2020.

For the QTPV domain, the same implicit modelling approach was used to develop the mineralised solid as the MD domain. The implicit model used a 100 PPB gold grade shell with an azimuth of 135°, plunge of -10°, and a dip of -20° with a search distance of 75 m in the major, 75 m in the semi-major, and 5 m in the minor. The resulting solid was then clipped by the sediments. This zone was further divided into two sub-domains. The first represents the hanging wall QTPV domain, which sits in the hanging wall to the northwest of the SED contact. The second sub-domain is the footwall QTPV domain, which sits on the SED domain to the south and is bounded on the northwest by a series of mafic dikes and the hanging wall QTPV domain. The hanging wall and footwall QTPV domains are shown in Figure 14-8.

Figure 14-8: Leprechaun Hanging Wall (Dark Blue) & Footwall (Light Blue) QTPV Domains



Source: BOYD, 2020.

The SED, MD, TRJ, hanging wall QTPV, and footwall QTPV domains can be mineralised and were used to flag drillholes used to construct the composites for later variography and geostatistics.

14.2.2.2 Drillhole Descriptive Statistics

Descriptive statistics were generated for each individual domain, as well as the overall exploration database for gold. The results of this analysis are shown in Table 14.3.

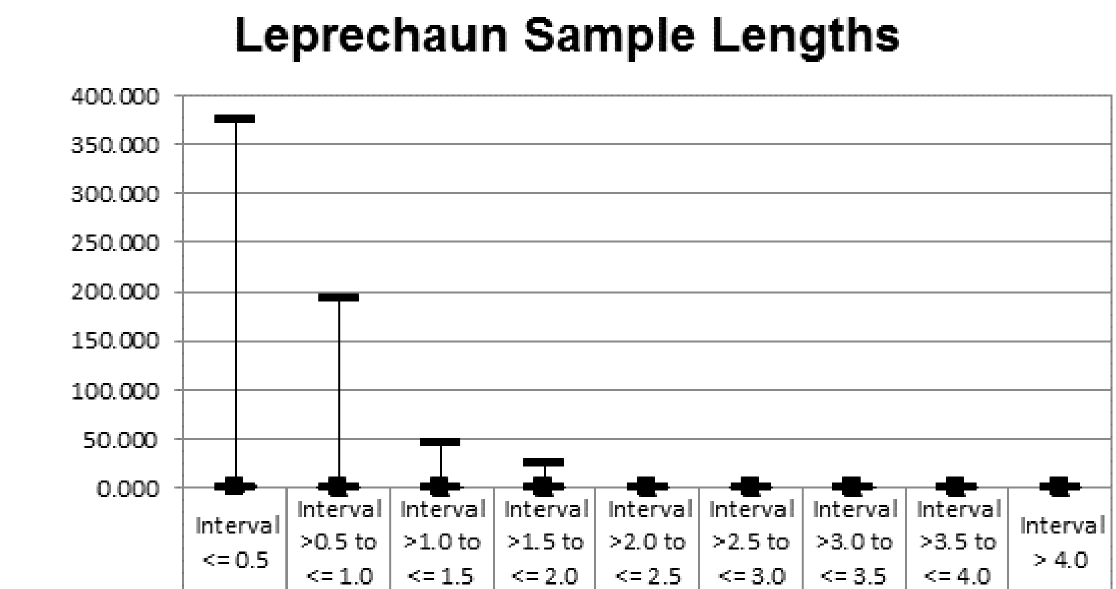
Table 14.3: Leprechaun Raw Drillhole Descriptive Statistics

Item	Domains				
	All	QTPV	Mafic Dikes	Sediment	Trondhjemite
Number of Samples	29,221	21,217	1,809	560	5,635
Minimum	0.01	0.01	0.01	0.01	0.01
Maximum	375.784	375.784	82.43	27.642	43.696
Range	375.774	375.774	82.42	27.632	43.686
Average	1.35	1.747	0.735	1.017	0.092
Standard Deviation	6.202	7.148	3.372	2.792	0.699
Variance	38.465	51.094	11.37	7.795	0.489
Coefficient. of Variance	4.594	4.092	4.588	2.745	7.598

14.2.2.3 Compositing

Sample length statistics were run on the assay database examining the number of samples for sample lengths in 0.5 m increments through a total length of 4.0 m. The purpose of this analysis is to determine what sample length was associated with the total number of samples. The boxplot in Figure 14-9 shows the results of this analysis.

Figure 14-9: Leprechaun Drillhole Sample Lengths



	Interval <=0.5	Interval >0.5 to <=1.0	Interval >1.0 to <=1.5	Interval >1.5 to <=2.0	Interval >2.0 to <=2.5	Interval >2.5 to <=3.0	Interval >3.0 to <=3.5	Interval >3.5 to <=4.0	Interval > 4.0
Q1	0.019	0.005	0.005	0.005	0.005	0.005	0.000	0.005	0.000
Min	0.005	0.002	0.005	0.004	0.005	0.005	0.000	0.005	0.000
Median	0.300	0.013	0.005	0.005	0.005	0.005	0.000	0.010	0.000
Mean	3.829	0.807	0.602	0.028	0.013	0.031	0.000	0.010	0.000
Max	375.784	192.243	45.123	25.019	0.130	0.310	0.000	0.015	0.000
Q3	1.714	0.189	0.113	0.005	0.011	0.005	0.000	0.015	0.000
NSamples	726	43846	331	25337	48	12	0	2	0

Source: BOYD, 2020.

In examining the results of this analysis, most samples with potentially economic gold mineralisation were taken at a length of 1.0 m or less. A total of 63.4% of all assays were taken at 1 metre or less containing 97.7% of the total contained metal. Based on this, a composite length of 1.0 m was selected and applied within the confines of the mineralised domains. Composites less than 1.0 m were divided by the run length (1.0 m). This composite length was selected to better reflect the actual breakdown of the mineralisation in the individual drillholes within each mineralised zone.

14.2.2.4 High Value Grade Limits

High outlier metal values can skew the resulting grade estimate if they are not accounted for with some sort of limitation or grade capping value applied to the underlying assay database. To determine this, a lognormal probability plot was generated for gold in each mineralised domain.

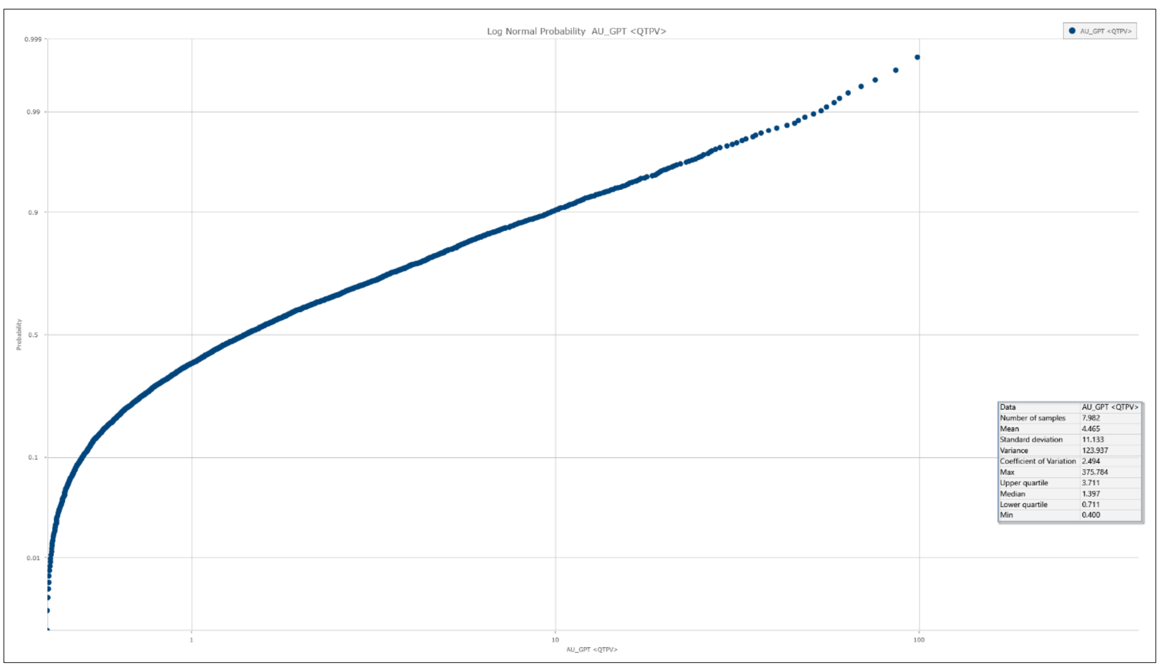
To determine high-value gold grade outliers, several methods were considered. These included a 1 troy ounce gold grade cap, the mean plus the standard deviation, four times the mean, five times the mean, lognormal, and decile analysis. All of these methods were reviewed, and the resulting potential grade caps/threshold were determined. For the Leprechaun deposit, the lognormal graph was considered the best method to establish a capping/threshold value. This is due to the very smooth lognormal results in all estimation domains.

Threshold metal grades were selected from the lognormal plot at the point where the data starts to break up or where there is a significant slope change in the plot. The lognormal probability plots for gold found in each mineralised domain are shown in Figures 14-10 through 14-13.

The lognormal probability graphs were used to determine a gold threshold grade to limit the area of influence of gold grades higher than the threshold. The area of influence was developed using indicator variograms to determine the size and extents of above threshold gold-bearing areas by producing a high gold grade search ellipsoid. This search ellipsoid was used to determine the area of influence of above threshold gold grades. This process was completed on all the potentially mineralised domains and the selected metal threshold grades are shown in Table 14.4.

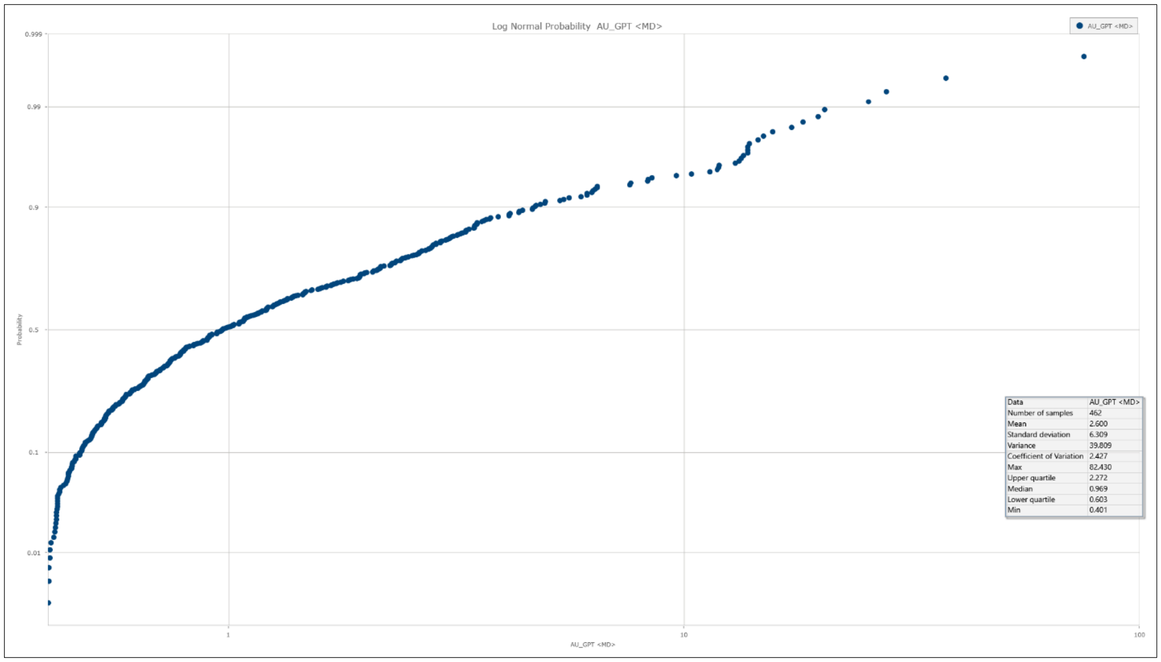
Threshold gold grades were applied during the grade estimation runs to limit the influence of the higher-grade outliers in the composites. The extreme outliers were used to hard cap gold grades at gold values that exceeded this number. This cap was determined using a lognormal graph and selecting a value where the extreme outliers appeared to lose lognormal continuity.

Figure 14-10: Leprechaun QTPV Domain Lognormal Plot



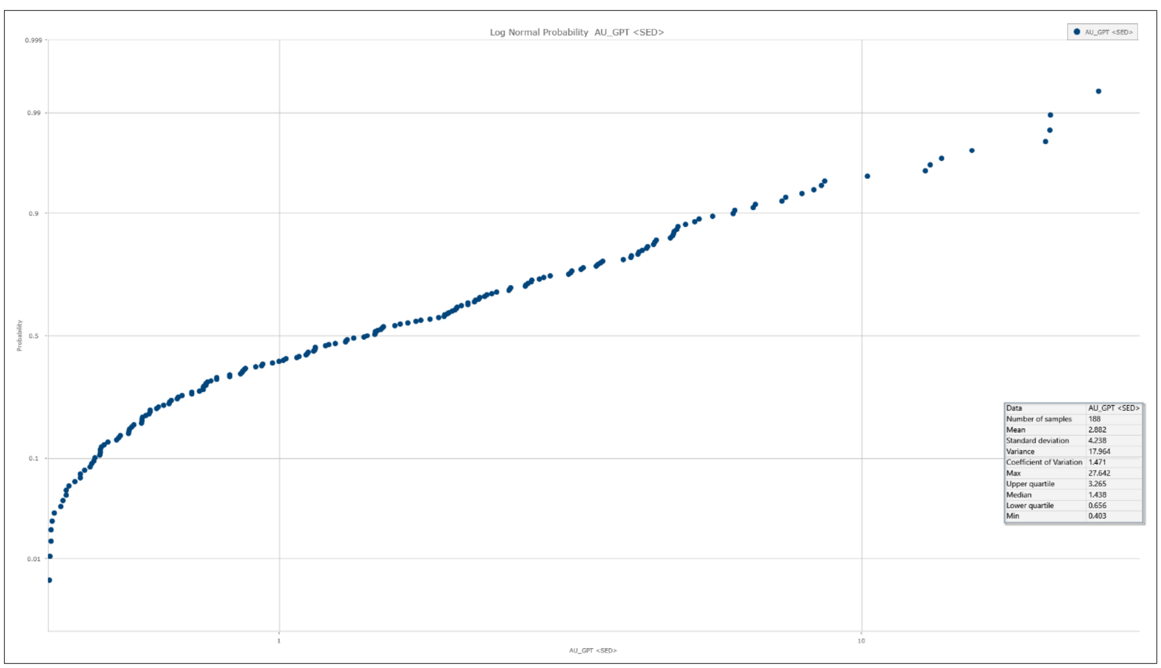
Source: BOYD, 2020.

Figure 14-11: Leprechaun MD Domain Lognormal Plot



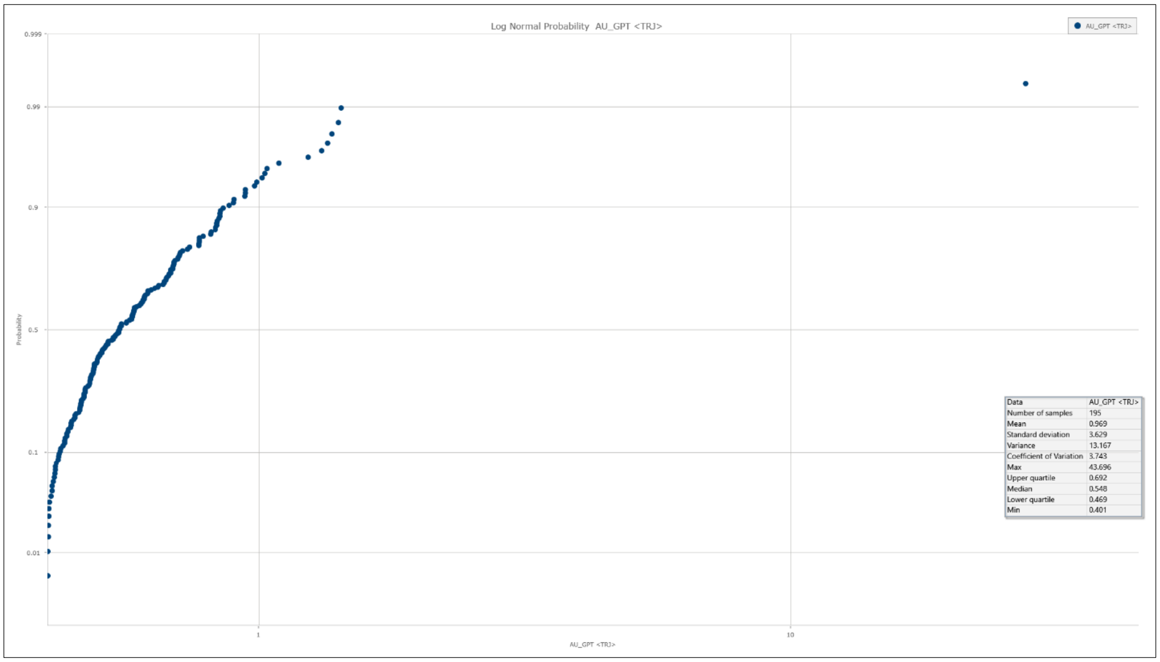
Source: BOYD, 2020.

Figure 14-12: Leprechaun SED Domain Lognormal Plot



Source: BOYD, 2020.

Figure 14-13: Leprechaun TRJ Domain Lognormal Plot



Source: BOYD, 2020.

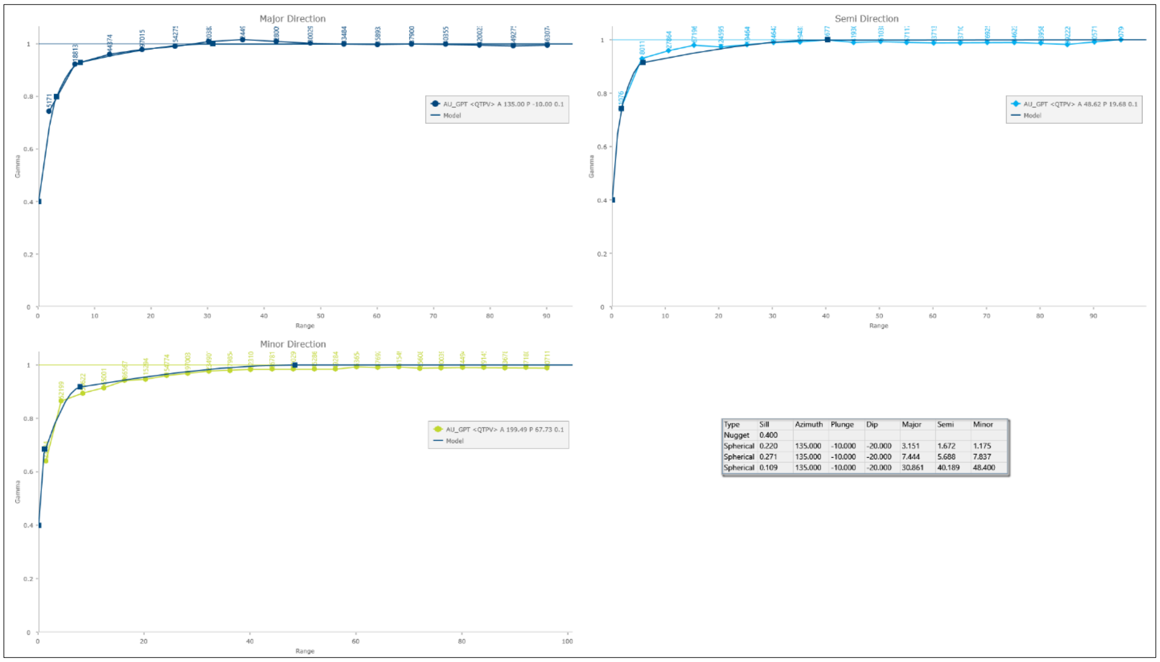
Table 14.4: Leprechaun Gold Threshold Grades

Item	QTPV	MD	SED	TRJ
Extreme Outlier Gold Cap (g/t)	115	20	13	1.5
Gold Capping Grade (Au g/t)	52	11	10	1.5
Azimuth (degrees)	135	135	135	135
Plunge (degrees)	-10	-10	-10	-10
Dip (degrees)	-20	-20	-20	-20
Major Search (m)	10	20	10	15
Semi-Major Search (m)	5	10	20	10
Minor Search (m)	5	5	5	2

14.2.3 Search Ellipsoids

The search ellipsoids for grade estimation were developed using variograms for each domain. Variograms were established in each domain for gold in the same structural orientations used to develop the mineralised solids. Gold grade variograms for each mineralised domain are shown in Figures 14-14 through 14-17.

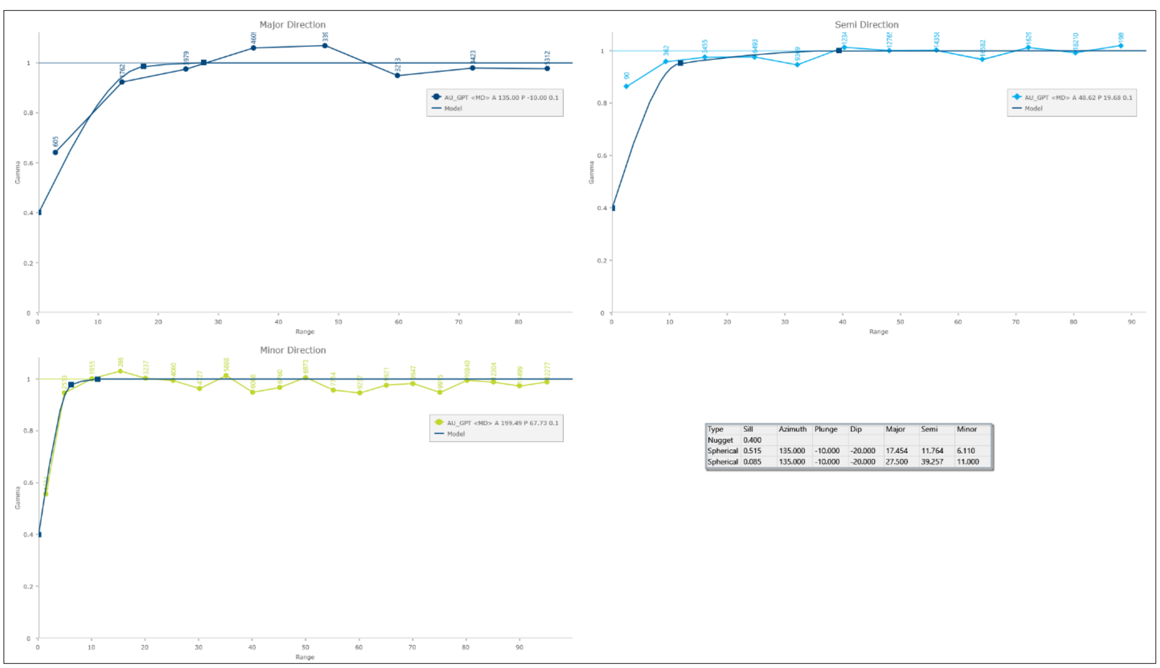
Figure 14-14: Leprechaun QTPV Variograms



Type	Sill	Azimuth	Plunge	Dip	Major	Semi	Minor
Nugget	0.400						
Spherical	0.220	135.000	-10.000	-20.000	3.151	1.672	1.175
Spherical	0.271	135.000	-10.000	-20.000	7.444	5.688	7.837
Spherical	0.109	135.000	-10.000	-20.000	30.861	40.189	48.400

Source: BOYD, 2020.

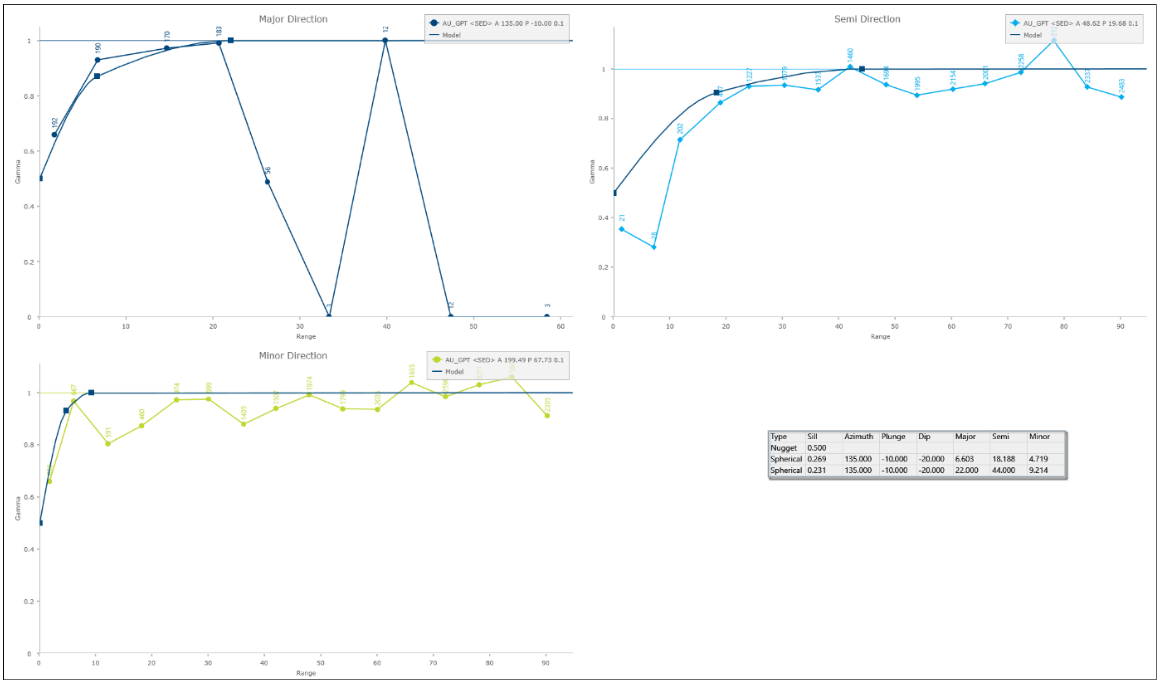
Figure 14-15: Leprechaun Mafic Dike Variograms



Type	Sill	Azimuth	Plunge	Dip	Major	Semi	Minor
Nugget	0.400						
Spherical	0.515	135.000	-10.000	-20.000	17.454	11.764	6.110
Spherical	0.085	135.000	-10.000	-20.000	27.500	39.257	11.000

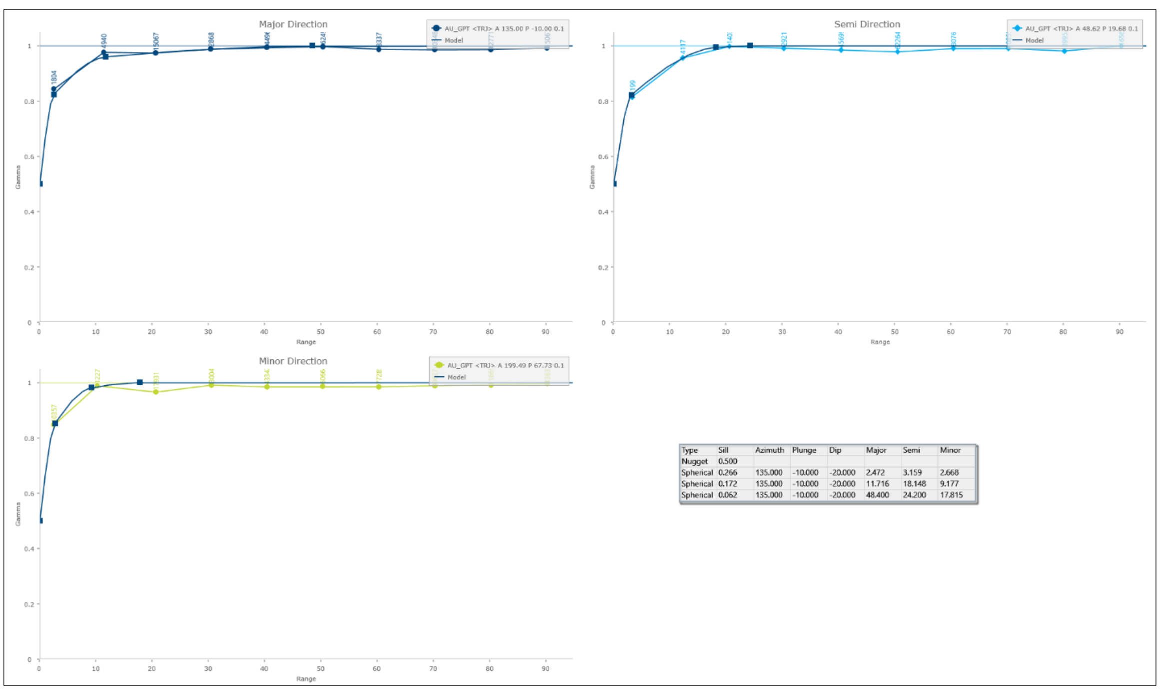
Source: BOYD, 2020.

Figure 14-16: Leprechaun Sediment Variograms



Source: BOYD, 2020.

Figure 14-17: Leprechaun Trondhjemite Variograms



Source: BOYD, 2020.

Based on these analyses, the search ellipsoid for each mineralised domain was established as shown in Tables 14.5 through 14.8.

Table 14.5: Leprechaun QTPV Search Ellipsoid

Search Parameters	Pass		
	1	2	3
Major Range (m)	30.9	30.9	30.9
Semi-Major Range (m)	40.9	40.9	40.9
Minor Range (m)	5	5	5
Azimuth (degrees)	135	135	135
Plunge (plunge of the azimuth in degrees)	-10	-10	-10
Dip (degrees)	-20	-20	-20

Table 14.6: Leprechaun Mafic Dike Search Ellipsoid

Search Parameters	Pass		
	1	2	3
Major Range (m)	27.5	27.5	27.5
Semi-Major Range (m)	39.3	39.3	39.3
Minor Range (m)	5	5	5
Azimuth (degrees)	135	135	135
Plunge (plunge of the azimuth in degrees)	-10	-10	-10
Dip (degrees)	-20	-20	-20

Table 14.7: Leprechaun Sediment Search Ellipsoid

Search Parameters	Pass		
	1	2	3
Major Range (m)	22	22	22
Semi-Major Range (m)	44	44	44
Minor Range (m)	5	5	5
Azimuth (degrees)	135	135	135
Plunge (plunge of the azimuth in degrees)	-10	-10	-10
Dip (degrees)	-20	-20	-20

Table 14.8: Leprechaun Trondhjemite Search Ellipsoid

Search Parameters	Pass		
	1	2	3
Major Range (m)	48.4	48.4	48.4
Semi-Major Range (m)	24.2	24.2	24.2
Minor Range (m)	5	5	5
Azimuth (degrees)	135	135	135
Plunge (plunge of the azimuth in degrees)	-10	-10	-10
Dip (degrees)	-20	-20	-20

These search parameters were used in the mineral resource estimate described below.

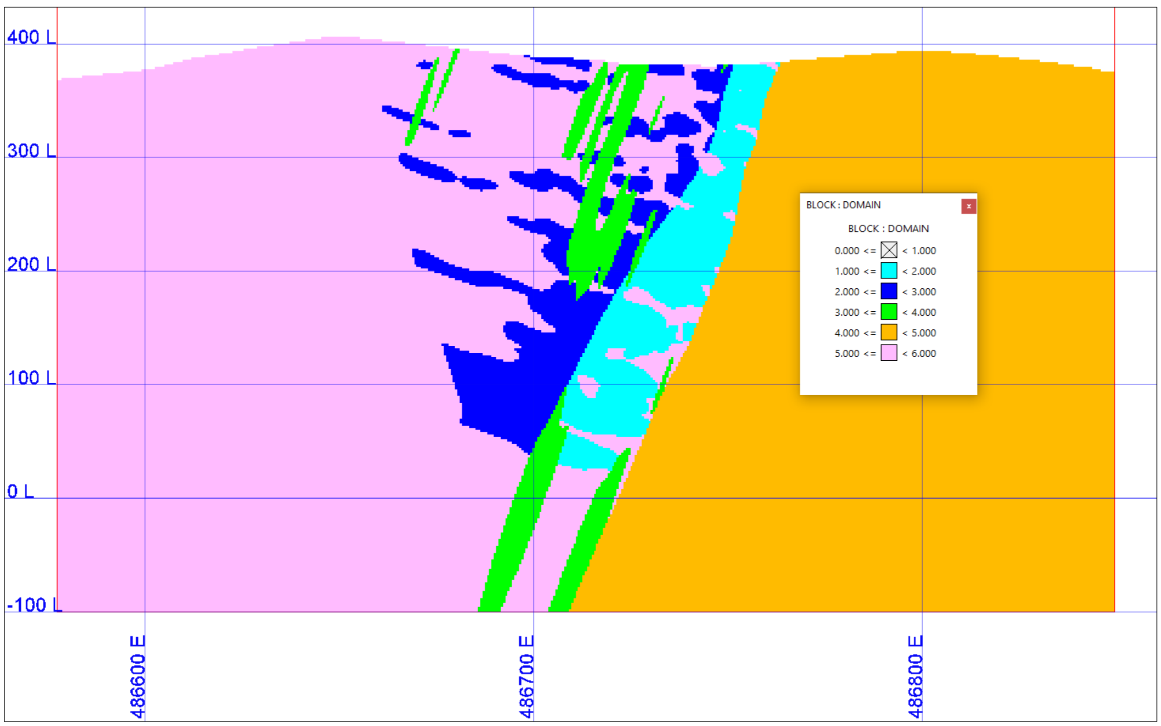
14.2.4 Leprechaun Deposit Block Model

Table 14.9 shows the Leprechaun block model extents. Figure 14-18 shows a typical block model section of the mineralised domain.

Table 14.9: Block Model Extents

Item	X	Y	Z
Origin	486,084.374	5,355,484.861	-100.000
Offset Minimum	-	-	-
Offset Maximum	1,344	930	552
Parent Block size (m)	6.00	6.00	6.00
Child Block size (m)	2.00	2.00	2.00
Bearing/Dip/Plunge	73.00	-	-

Figure 14-18: Leprechaun Typical Mineralised Domain Block Model Cross-section



Source: BOYD, 2020.

Four different block models were created for the mineral resource estimate. The purpose of these different block models was to consider the impact of gold grade capping on the total contained metal content in the block models. The four block models included:

- No Cap Model – This block model assumed that no gold grade capping was applied.
- Hard Cap Model – This block model used a fixed hard cap to minimise the impact of high-grade outliers.
- Threshold Cap Model – This block model used a gold grade cap in each domain above which a limited area of influence was applied.

- Hybrid Cap Model – This block model used both a threshold gold cap and an extreme outlier hard gold cap to limit the impact of higher gold grades. This model was used as the basis for the mineral resources reported for the Leprechaun gold deposit.

These four block models were used to examine the impact of gold grade capping on the final mineral resource estimate.

14.2.5 Leprechaun Grade Estimation

A 3D block model was constructed in Vulcan that was constrained by the mineralised domains described above. The current topographic surface was used to flag the topographic variable (vtopo). This variable is set to 100 for a block 100% below the surface and to 0% for a block 100% above the surface. A topo-adjusted density (rdensity) was assigned using the following formula:

$$rdensity = density * (vtopo/100)$$

This procedure ensures that blocks along the topographic surface have the correct density applied during pit optimisation functions.

No attempt was made to apply a block percentage (percent of the block that is mineralised material and waste). Blocks are in or out of the mineralised domain. Grade interpolation runs were set up for only that material within the mineralised domain for gold. All domains were run for gold with the exception of the overburden domain, which is assumed to not be mineralised.

Using the composited assays described above, block grade interpolations were run in each mineralised domain for gold. Runs were completed using inverse distance (ID), inverse distance squared (ID2), inverse distance cubed (ID3), inverse distance to the fifth (ID5), ordinary kriging (OK), and nearest neighbour (NN). Three passes were run to allow for use in resource classification. Only composites and blocks flagged as within the same mineralised domain were considered in the grade estimation. Grade estimation parameters are shown in Tables 14.10 through 14.13 on the following page.

14.2.6 Leprechaun Resource Classification

The resource classification used for the Leprechaun deposit is based on which pass generated a block grade estimate as well as the distance to the nearest neighbour (measured and indicated only). The resource classification used was:

- Measured – Blocks estimated in Pass 1 (minimum of four composites) with a maximum nearest neighbour distance of 15 m are classified as measured. Only QTPV blocks could be flagged as measured.
- Indicated – Blocks estimated in Pass 2 (minimum of three composites) with a maximum nearest neighbour distance of 25 m are classified as indicated. Only QTPV blocks could be flagged as indicated.
- Inferred – Blocks estimated in Pass 3 (minimum of two composites) are classified as inferred.

Table 14.10: Leprechaun QTPV Domain Grade Estimation Parameters

Item	Pass		
	1	2	3
Search Parameters			
Major Range (m)	30.9	30.9	30.9
Semi-Major Range (m)	40.9	40.9	40.9
Minor Range (m)	5.0	5.0	5.0
Azimuth (degrees)	135.0	135.0	135.0
Plunge (plunge of the azimuth in degrees)	-10.0	-10.0	-10.0
Dip (degrees)	-20.0	-20.0	-20.0
Search Ellipsoid			
Azimuth (degrees)	135.00	135.00	135.00
Plunge (plunge of the azimuth in degrees)	-10.00	-10.00	-10.00
Dip (degrees)	-20.00	-20.00	-20.00
Major (m)	30.90	30.90	30.90
Semi-Major (m)	40.90	40.90	40.90
Minor (m)	5.00	5.00	5.00
Estimation Parameters			
Minimum Number of Composites	4	3	2
Maximum Number of Composites	6	6	6
Maximum Composites Per Drillhole	2	2	2
Maximum Distance to Nearest Neighbour (m)	15.0	25.0	---
Resource Classification	Measured	Indicated	Inferred

Table 14.11: Leprechaun MD Domain Grade Estimation Parameters

Item	Pass		
	1	2	3
Search Parameters			
Major Range (m)	27.5	27.5	27.5
Semi-Major Range (m)	39.3	39.3	39.3
Minor Range (m)	5.0	5.0	5.0
Azimuth (degrees)	135.0	135.0	135.0
Plunge (plunge of the azimuth in degrees)	-10.0	-10.0	-10.0
Dip (degrees)	-20.0	-20.0	-20.0
Search Ellipsoid			
Azimuth (degrees)	135.00	135.00	135.00
Plunge (plunge of the azimuth in degrees)	-10.00	-10.00	-10.00
Dip (degrees)	-20.00	-20.00	-20.00
Major (m)	27.50	27.50	27.50
Semi-Major (m)	39.30	39.30	39.30
Minor (m)	5.00	5.00	5.00
Estimation Parameters			
Minimum Number of Composites	4	3	2
Maximum Number of Composites	6	6	6
Maximum Composites Per Drillhole	2	2	2
Maximum Distance to Nearest Neighbour (m)	15.0	25.0	---
Resource Classification	---	---	Inferred

Table 14.12: Leprechaun SED Domain Grade Estimation Parameters

Item	Pass		
	1	2	3
Search Parameters			
Major Range (m)	22.0	22.0	22.0
Semi-Major Range (m)	44.0	44.0	44.0
Minor Range (m)	5.0	5.0	5.0
Azimuth (degrees)	135.0	135.0	135.0
Plunge (plunge of the azimuth in degrees)	-10.0	-10.0	-10.0
Dip (degrees)	-20.0	-20.0	-20.0
Search Ellipsoid			
Azimuth (degrees)	135.00	135.00	135.00
Plunge (plunge of the azimuth in degrees)	-10.00	-10.00	-10.00
Dip (degrees)	-20.00	-20.00	-20.00
Major (m)	22.00	22.00	22.00
Semi-Major (m)	44.00	44.00	44.00
Minor (m)	5.00	5.00	5.00
Estimation Parameters			
Minimum Number of Composites	4	3	2
Maximum Number of Composites	6	6	6
Maximum Composites Per Drillhole	2	2	2
Maximum Distance to Nearest Neighbour (m)	15.0	25.0	---
Resource Classification	---	---	Inferred

Table 14.13: Leprechaun TRJ Domain Grade Estimation Parameters

Item	Pass		
	1	2	3
Search Parameters			
Major Range (m)	48.4	48.4	48.4
Semi-Major Range (m)	24.2	24.2	24.2
Minor Range (m)	5.0	5.0	5.0
Azimuth (degrees)	135.0	135.0	135.0
Plunge (plunge of the azimuth in degrees)	-10.0	-10.0	-10.0
Dip (degrees)	-20.0	-20.0	-20.0
Search Ellipsoid			
Azimuth (degrees)	135.00	135.00	135.00
Plunge (plunge of the azimuth in degrees)	-10.00	-10.00	-10.00
Dip (degrees)	-20.00	-20.00	-20.00
Major (m)	48.40	48.40	48.40
Semi-Major (m)	24.20	24.20	24.20
Minor (m)	5.00	5.00	5.00
Estimation Parameters			
Minimum Number of Composites	4	3	2
Maximum Number of Composites	6	6	6
Maximum Composites Per Drillhole	2	2	2
Maximum Distance to Nearest Neighbour (m)	15.0	25.0	---
Resource Classification	---	---	Inferred

14.2.7 Leprechaun Deposit Model Validation

The gold grade populated block model was reviewed to ensure reasonableness. These checks included:

- an overall review of the estimated metal values
- the impact of gold grade capping on the mineral resource
- QQ plots of the block model versus the composites
- a section-by-section comparison between the ID3 metal values and the underlying drillholes
- a statistical comparison of the raw assay values versus the composite values versus the block values

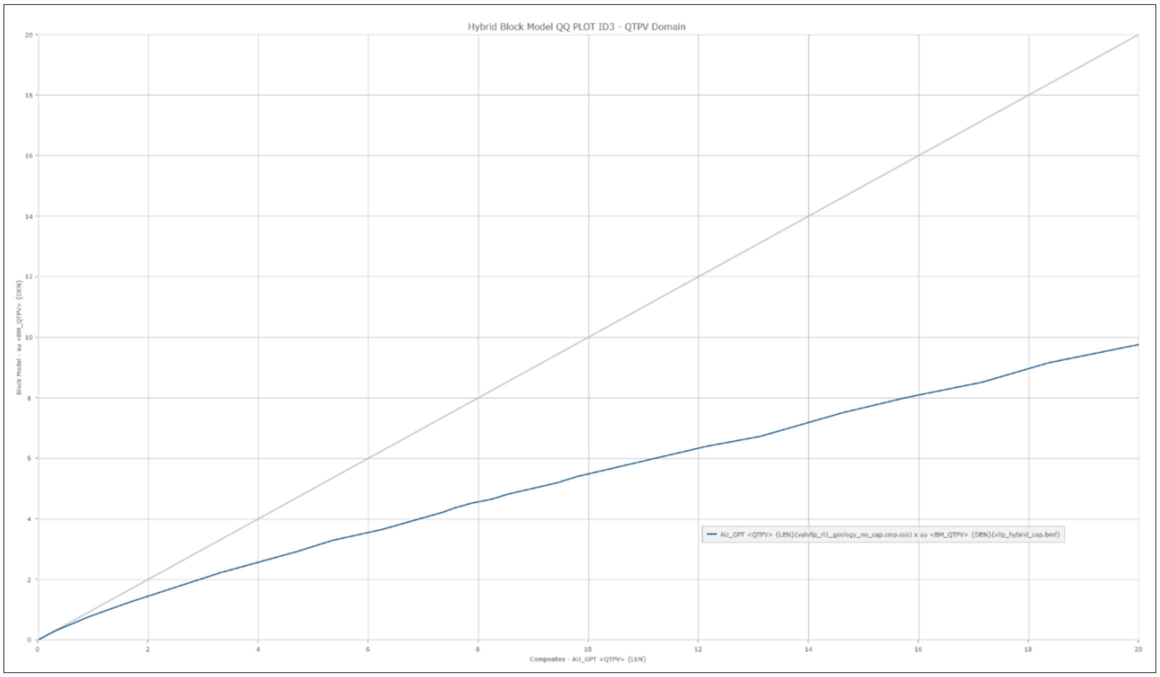
The overall block metal grades were visually examined to confirm that all the estimation parameters were honoured and kept within the individual mineralised domains. Each of the cross-sections was reviewed and the underlying drillholes were checked to determine that the original metal grade closely matched the estimated block metal grade without exceeding it. Cross-sections were examined, and assay intervals agreed with the overlying estimated block model metal grades. A statistical comparison of the raw assay values versus the composite values versus the estimated block values was run and is shown in Table 14.14.

Table 14.14: Leprechaun Mineral Resource Estimation Model Statistics (All Domains)

Item	Domains				
	All	QTPV	Mafic Dikes	Sediment	Trondhjemite
1-Metre Composite Data					
Number of samples	37,094	25,596	2,412	785	8,236
Minimum	0.010	0.010	0.010	0.010	0.010
Maximum	177.246	177.246	75.366	19.340	42.395
Range	177.236	177.236	75.356	19.330	42.385
Average	1.026	1.392	0.542	0.673	0.069
Standard deviation	4.254	4.983	2.792	1.805	0.557
Variance	18.097	24.830	7.795	3.258	0.310
Coefficient of variance	4.146	3.580	5.151	2.682	8.072
Block Model Results					
Number of blocks	2,427,542	2,324,639	25,895	8,454	68,554
Minimum	0.010	0.010	0.010	0.010	0.010
Maximum	112.162	112.162	19.995	10.451	1.132
Range	112.152	112.152	19.985	10.441	1.122
Average	0.803	0.834	0.248	0.361	0.040
Standard deviation	2.105	2.144	0.770	0.869	0.047
Variance	4.431	4.597	0.593	0.755	0.002
Coefficient of variance	2.621	2.571	3.105	2.407	1.175

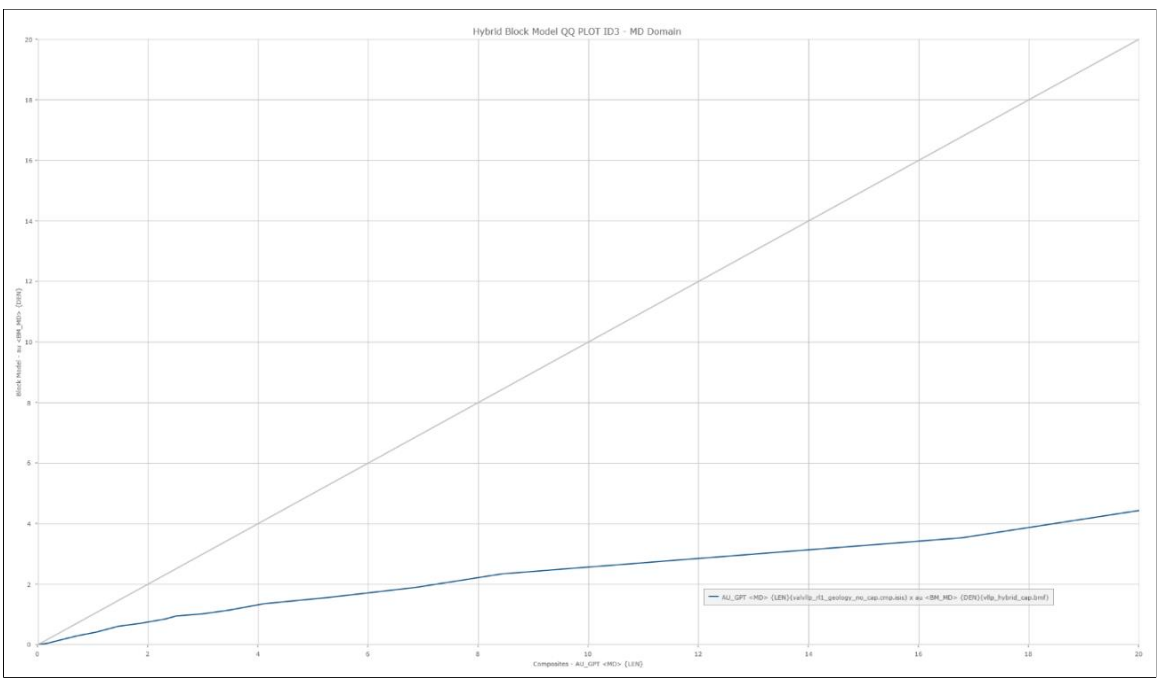
The various mineralised domain QQ plots of the block model estimated ID3 gold grades versus the composites are shown in Figures 14-19 through 14-22.

Figure 14-19: Leprechaun QTPV Domain QQ Plot



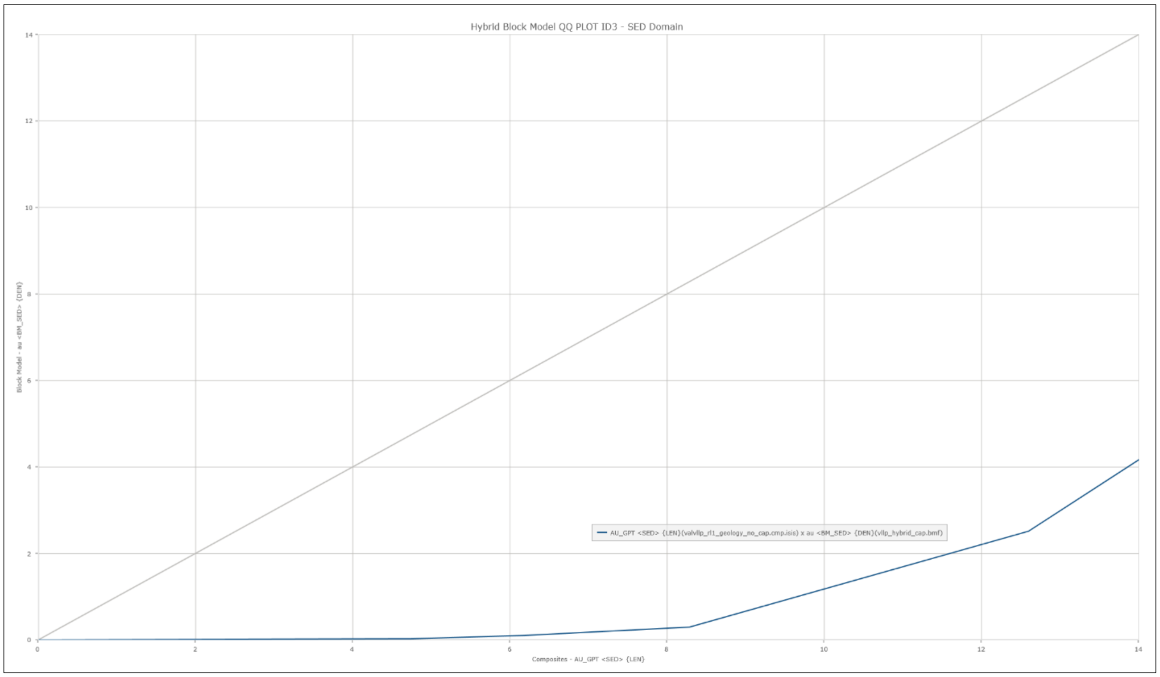
Source: BOYD, 2020.

Figure 14-20: Leprechaun MD Domain QQ Plot



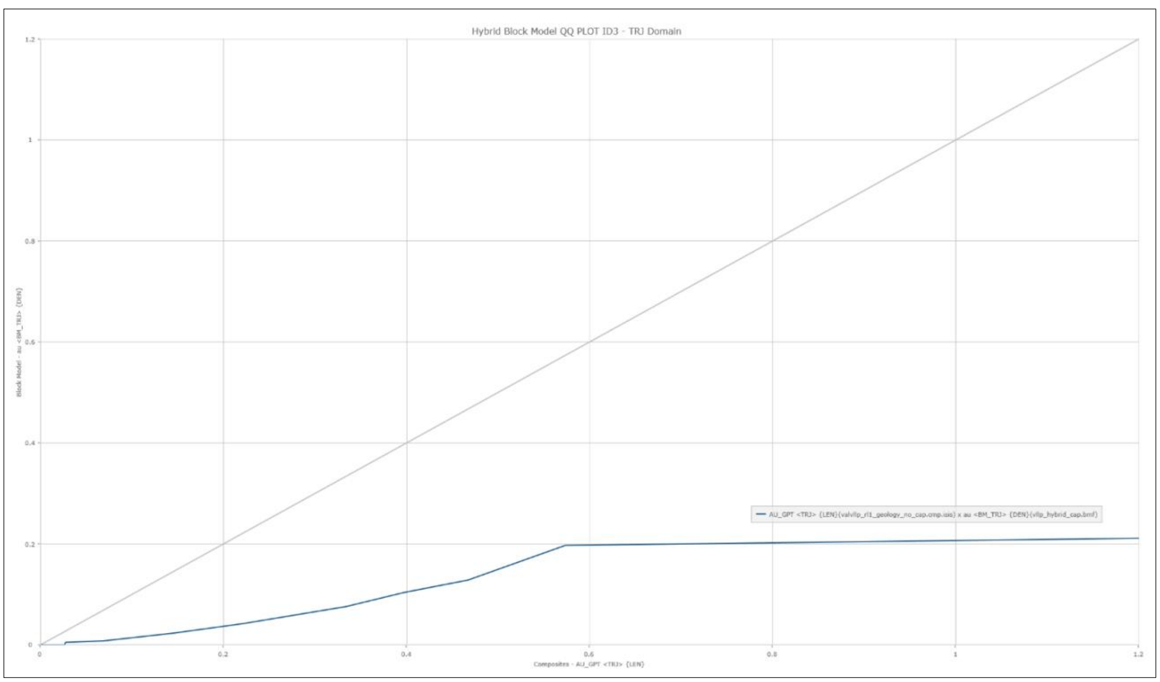
Source: BOYD, 2020.

Figure 14-21: Leprechaun SED QQ Plot



Source: BOYD, 2020.

Figure 14-22: Leprechaun TRJ QQ Plot

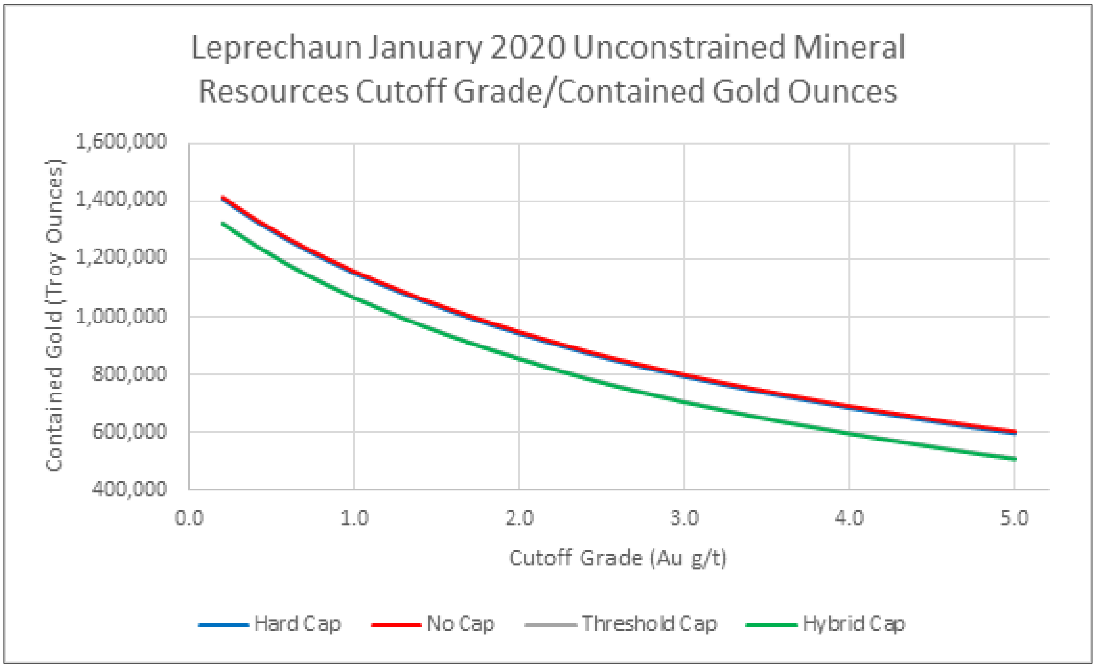


Source: BOYD, 2020.

The block model checks indicate that the mineral resource estimate matches the underlying composites at lower gold grade values. At higher gold grades, the block model gold grades are underestimated relative to the underlying composites.

The impact on total metal content of gold grade capping is shown in Figure 14-23. The impact of gold grade capping at Leprechaun showed that the hard-capped block model contained 99.5% of the no capping block model contained gold ounces. The threshold capped block model contained 93.7% of the no capping block model contained ounces. The hybrid capped model (used for the mineral resources) contained 93.5% of the no capping block model contained ounces. It is the opinion of BOYD that the hybrid capped model represents the best estimate of the in-situ mineral resource at Leprechaun and was selected for mineral resource reporting.

Figure 14-23: Leprechaun Impact of Gold Grade Capping



Source: BOYD, 2020.

14.2.8 Leprechaun Mineral Resource Estimate

The Leprechaun mineral resources may be amenable to a combination of open pit and underground mining methods. BOYD developed a conceptual pit shell (the economic open pit shell) using the Lerchs-Grossman method as provided by the Whittle software within which the portions of the block model that show "reasonable prospects for economic extraction" by open pit mining. From this shell, a conceptual open pit mine was designed and used to constrain the mineral resources. Portions of the block model which are external to the conceptual pit shell but satisfy cut-off grade criteria for an appropriate underground extraction method, are considered to show "reasonable prospects for economic extraction" by underground mining methods.

14.2.8.1 Economic Assumptions

The operating assumptions (economic and gold recovery) used for the Whittle economic open pit optimisation are shown in Table 14.15; the operating assumptions (economic and gold recovery) used for the calculation of an underground cut-off grade is shown in Table 14.16. These assumptions are based on the current feasibility study metallurgical and economic parameters.

For mineral resource estimation, a cut-off grade of 0.300 g/t gold was used for open pit, and a cut-off grade of 1.44 g/t gold was used for underground. The assumed overall pit slope in Whittle was assumed to be 42.0° in slope sectors identified by Terrane (the feasibility study geotechnical consultant) and 48.0° everywhere else. None of the slopes includes an allowance for ramps.

Using these assumptions, a Whittle economic pit optimisation was completed, and an economic open pit shell generated. This pit shell was used to design a conceptual open pit, which is shown in Figure 14-24.

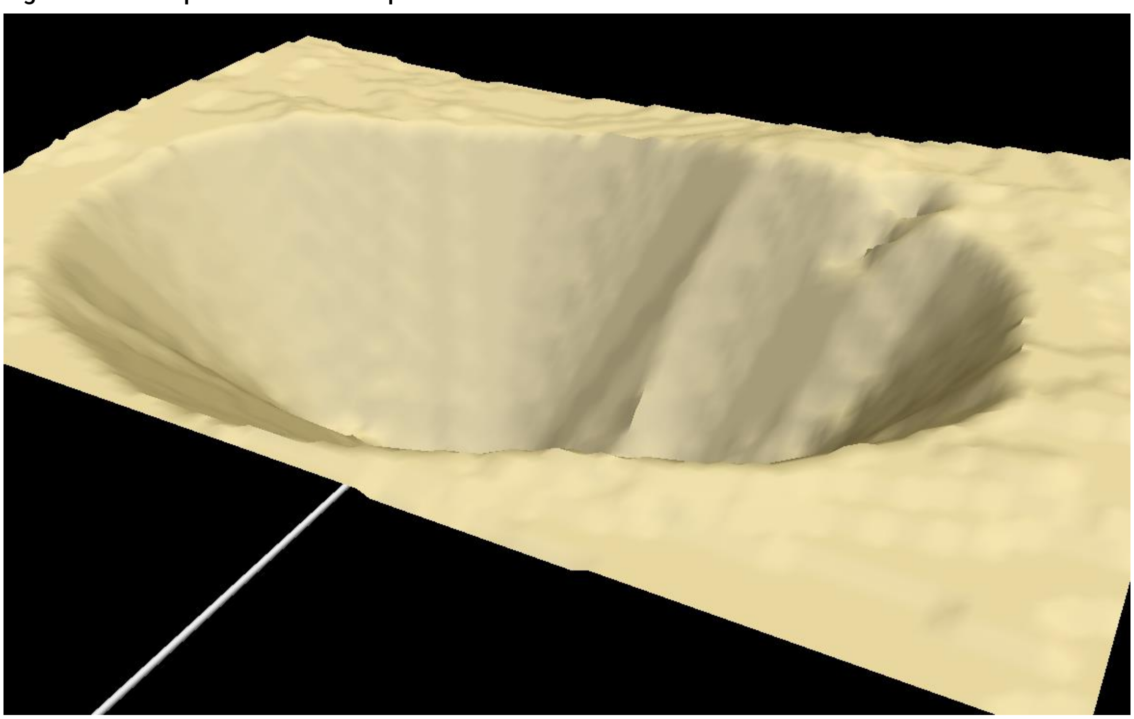
Table 14.15: Leprechaun Open Pit Economic Assumptions

Item	Value	Units
Waste Mining Cost	2.35	C$/t waste
Mill Feed Mining Cost	3.60	C$/t mill feed or heap leach
Mill Processing Cost	10.81	C$/t mill feed
G&A Cost	2.40	C$/t mill feed or heap leach
Mill Gold Recovery (at cut-off)	91.1	%
Exchange	0.76	---
Gold Price	1,500	US$/troy oz
Mill Cut-off	0.30	g/t

Table 14.16: Leprechaun Underground Economic Assumptions

Item	Value	Units
Mill Feed Mining Cost	71.00	C$/t mill feed
Processing Cost	10.81	C$/t material
G&A Cost	2.40	C$/t material
Recovery (at cut-off)	92.7	%
Exchange	0.76	---
Gold Price	1,500	US$/troy oz
Calculated Cut-off	1.44	g/t

Figure 14-24: Leprechaun Whittle Open Pit Shell



Source: BOYD, 2020.

14.2.8.2 Mineral Resource Estimate

BOYD's mineral resource estimate for the Leprechaun deposit is provided in Table 14.17.

Table 14.17: Mineral Resource Estimate for the Leprechaun Deposit

Measured and Indicated Mineral Resource Estimate

Mining Method	Resource Classification	Gold Cut-off Grade (g/t)	Tonnes	Au g/t	Au Troy (oz)
Open Pit - High-Grade	Measured	0.70	5,421,000	3.193	556,500
Open Pit - High-Grade	Indicated	0.70	4,773,000	2.593	397,900
Open Pit - High-Grade	**Measured + Indicated**	**0.70**	**10,194,000**	**2.912**	**954,400**
Open Pit - Low-Grade	Measured	0.30	3,077,000	0.469	46,400
Open Pit - Low-Grade	Indicated	0.30	3,505,000	0.463	52,200
Open Pit - Low-Grade	**Measured + Indicated**	**0.30**	**6,582,000**	**0.466**	**98,600**
Total Open Pit	Measured	0.30	8,498,000	2.207	602,900
Total Open Pit	Indicated	0.30	8,278,000	1.691	450,100
Total Open Pit	**Measured + Indicated**	**0.30**	**16,776,000**	**1.952**	**1,053,000**
Underground	Measured	1.44	98,000	3.567	11,200
Underground	Indicated	1.44	197,000	3.149	19,900
Underground	**Measured + Indicated**	**1.44**	**295,000**	**3.279**	**31,100**
Open Pit + Underground	Measured	0.30	8,596,000	2.222	614,100
Open Pit + Underground	Indicated	0.30	8,475,000	1.725	470,000
Open Pit + Underground	**Measured + Indicated**	**0.30**	**17,071,000**	**1.975**	**1,084,100**

Inferred Mineral Resource Estimate

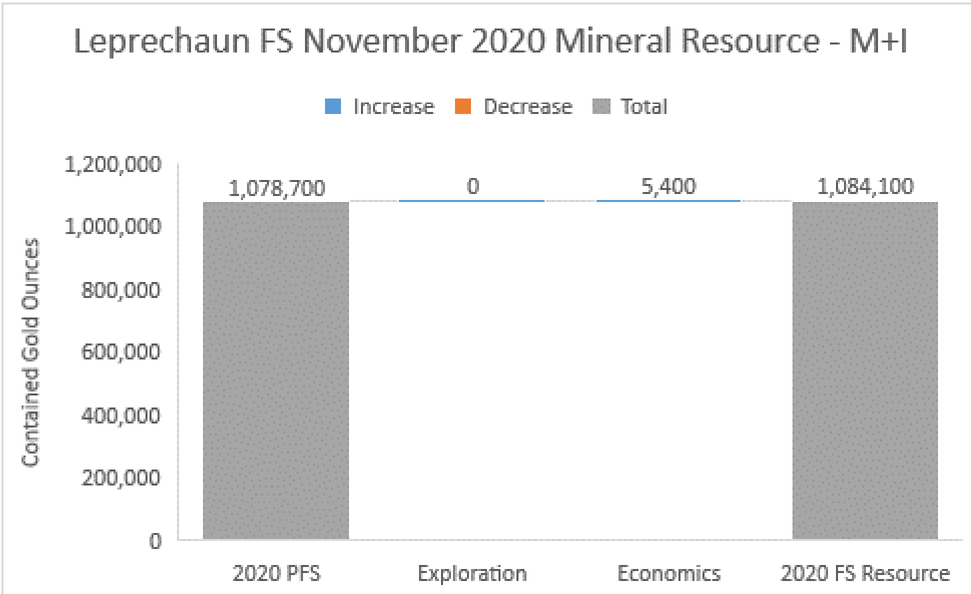
Mining Method	Resource Classification	Gold Cut-off Grade (g/t)	Tonnes	Au g/t	Au Troy (oz)
Open Pit - High-Grade	Inferred	0.70	1,379,000	2.359	104,600
Open Pit - Low-Grade	Inferred	0.30	1,288,000	0.453	18,800
Total Open Pit	Inferred	0.30	2,667,000	1.439	123,400
Underground	Inferred	1.44	325,000	3.233	33,800
Open Pit + Underground	Inferred	0.30	2,992,000	1.633	157,200

Notes: **1.** The effective date for this mineral resource estimate is November 20, 2020, and is reported on a 100% ownership basis. This estimate is an update to the previous mineral resource estimate (January10, 2020), and reflects revised economic parameters only. The qualified person for the mineral resource estimate is Robert Farmer, P. Eng. **2.** Mineral resources are calculated at a gold price of US$1,500 per troy ounce. **3.** The mineral resources presented above are global and do not include detailed pit or underground designs; only an economic open pit shell was used to determine the in-pit mineral resources. The underground mineral resources are that material outside of the in-pit mineral resources above the stated underground cut-off grade. **4.** Mineral resources, which are not mineral reserves, do not have demonstrated economic viability. The estimate of mineral resources may be materially affected by environmental, permitting, legal, title, socio-political, marketing, or other relevant issues. **5.** The mineral resources presented here were estimated using a block model with a block size of 6 m x 6 m x 6 m sub-blocked to a minimum block size of 2 m x 2 m x 2 m using ID3 methods for grade estimation. All mineral resources are reported using an open pit gold cut-off of 0.30 g/t Au and an underground gold cut-off of 1.44 g/t Au. Higher gold grades were capped by mineralised domain. Material above a 0.70 g/t gold cut-off is considered high-grade while material between a 0.30 and 0.70 g/t gold cut-off is considered low-grade. **6.** The mineral resources presented here were estimated using the Canadian Institute of Mining, Metallurgy and Petroleum (CIM), CIM Standards on Mineral Resources and Reserves, Definitions and Guidelines prepared by the CIM Standing Committee on Reserve Definitions and adopted by CIM Council May 10, 2014. **7.** Figures are rounded, and totals may not add correctly.

14.2.8.3 Changes from the Previous Mineral Resource Estimate

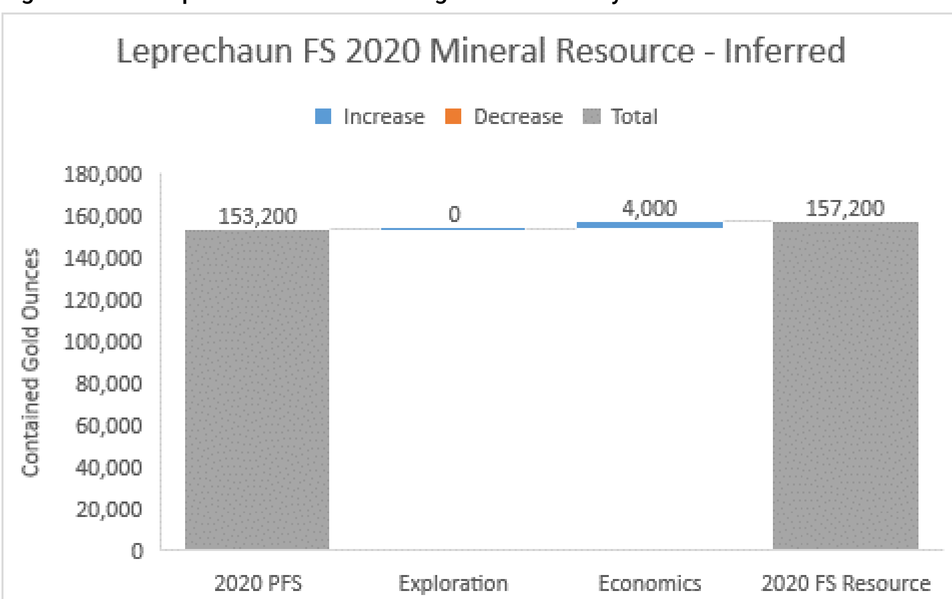
At Leprechaun, the only change since the pre-feasibility mineral resource estimate (January 10, 2020) was the addition of updated feasibility study economics. This had minimal impact on the overall mineral resource estimate. These changes are shown in Figures 14-25 and 14-26.

Figure 14-25: Leprechaun Measured & Indicated Changes from January 2020 MRE



Source: BOYD, 2020.

Figure 14-26: Leprechaun Inferred Changes from January 2020 MRE



Source: BOYD, 2020.

14.3 Victory Deposit Mineral Resource Estimate

No additional exploration data were available to update the Victory deposit geological model and mineral resource estimate. Changes to the mineral resource estimate for the Victory deposit from those previously reported reflect revisions to the project's technical parameters (e.g., metallurgical recoveries, mining costs, etc.). *Other than the changes to the technical parameters, there are no changes from the previous April 21, 2020 Pre-feasibility Technical Report.*

A description of the previous mineral resource estimate from the BOYD Technical Report (Farmer, 2018) is duplicated below. The only changes to this report are a restating of the mineral resource using the most current feasibility study economic and technical parameters.

The Victory mineral resource estimate is contained in a series of flat-lying, gold-bearing QTPV with an azimuth of 135°, a plunge of -10°, and a dip of -20°. Gold mineralisation is associated at the intersection of the QTPV zones with a steeply dipping northeast-trending shear zone.

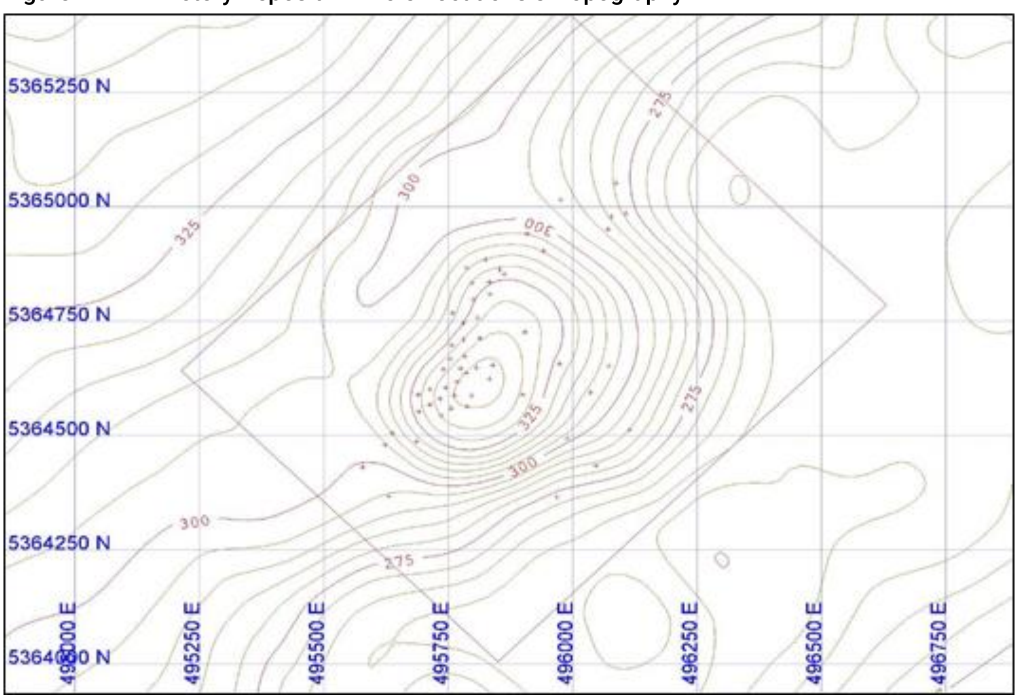
Potentially economic gold mineralisation is encountered in the QTPV and TRJ domains. There is minor mineralisation present in the other domains, but only a very limited amount of information in these areas was available and no attempt was made to make a mineral resource estimate in them.

14.3.1 Victory Deposit Data

14.3.1.1 Drillholes

The estimates of mineral resources reported herein for the Victory deposit are based on all drillholes whose assays were available by March 6, 2014 (the most recent available data), and consists of 64 diamond core drillholes totalling approximately 8,781 m. Figure 14-27 shows the collars of these drillholes.

Figure 14-27: Victory Deposit Drillhole Locations & Topography



Source: BOYD, 2018

14.3.1.2 Assays

Of the 4,169 gold assays available on March 6, 2014, all were used for the mineral resource estimation. For unsampled intervals, values were set to zero. All assays used were fire or metallic sieved assays. Total assayed sample length is 5,230 m.

14.3.1.3 Density

To date, there have been 349 density measurements taken at the Victory deposit. The results of these measurements are shown in Table 14.18. Block densities were assigned based on the block's domain of lithology type.

Table 14.18: Victory Deposit Density Measurements

Lithology Type	Samples	Specific Gravity t/m^3
Mafic Dikes	56	2.72
Quartz-Tourmaline- Pyrite Veins	97	2.59
Sediments	2	2.68
Trondhjemite	194	2.60
Overburden	-	1.50

14.3.1.4 Topography

The topography of the area around the Victory deposit is shown on Figure 14-27 above. All contours are expressed in metres above sea level. Contour intervals are every 5 m. The Victory deposit sits on a steep hilltop protruding southeast from a northeast-trending ridge. Towards the south, the ridge drops steeply downward towards a creek drainage.

14.3.2 Victory Deposit Data Analysis

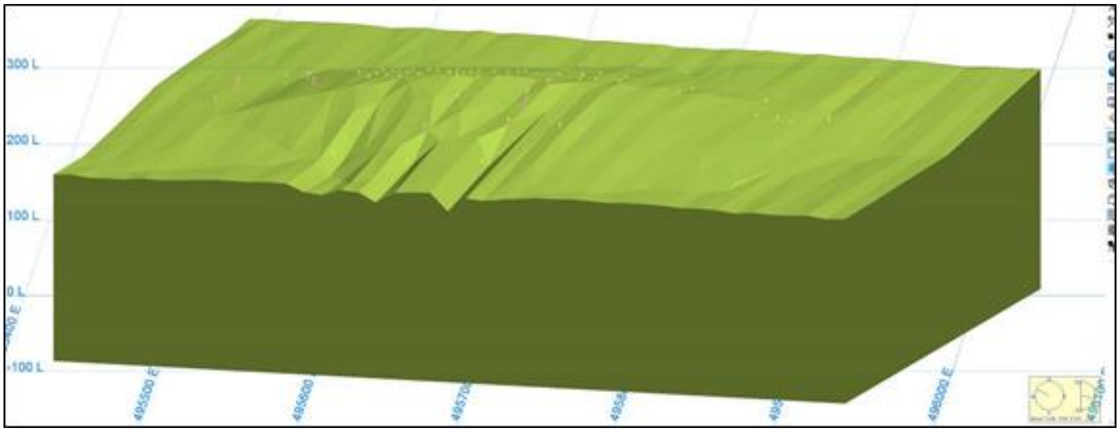
14.3.2.1 Geological Modelling

The Victory deposit contains four major potentially mineralised domains. These domains are the SED, hanging wall TRJ, flat-lying QTPV, and the MD domain intruding into the TRJ and QTPV domains. Additionally, overburden was also noted in the drill logs, but was not considered as a potentially mineralised host.

Geological modelling of these domains is based on the logged geology, as well as interpretations made by Marathon Gold geologists. On every 10 m cross-section through the deposit, a line was drawn reflecting the actual or projected overburden surface below the topography. These lines were then used to construct the rock/overburden surface to constrain compositing, geological implicit models, as well as block modelling. The overburden surface is shown in Figure 14-28.

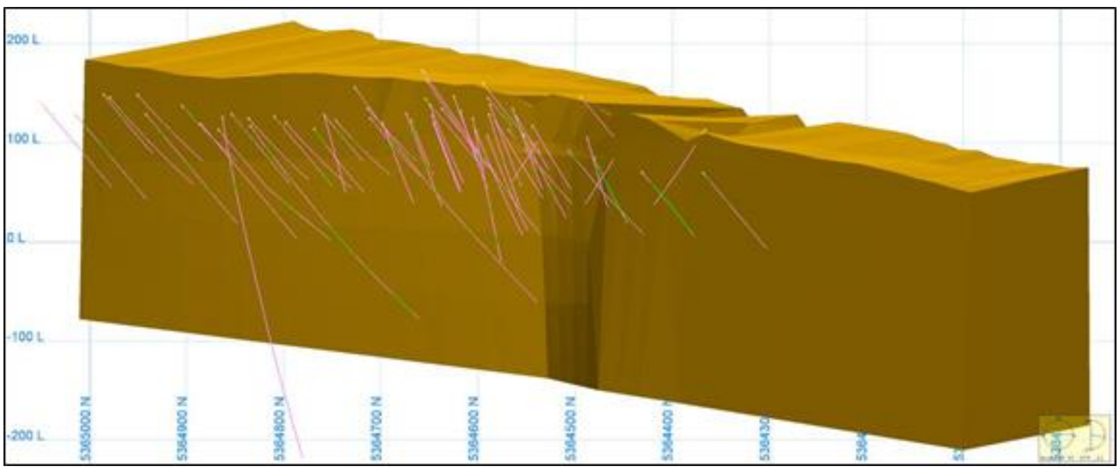
The sediment domain is shown below in Figure 14-29. The TRJ domain is the remaining rock mass northwest of the sediment solid and below the overburden horizon. The TRJ domain is shown in Figure 14-30.

Figure 14-28: Victory Deposit Base of Overburden



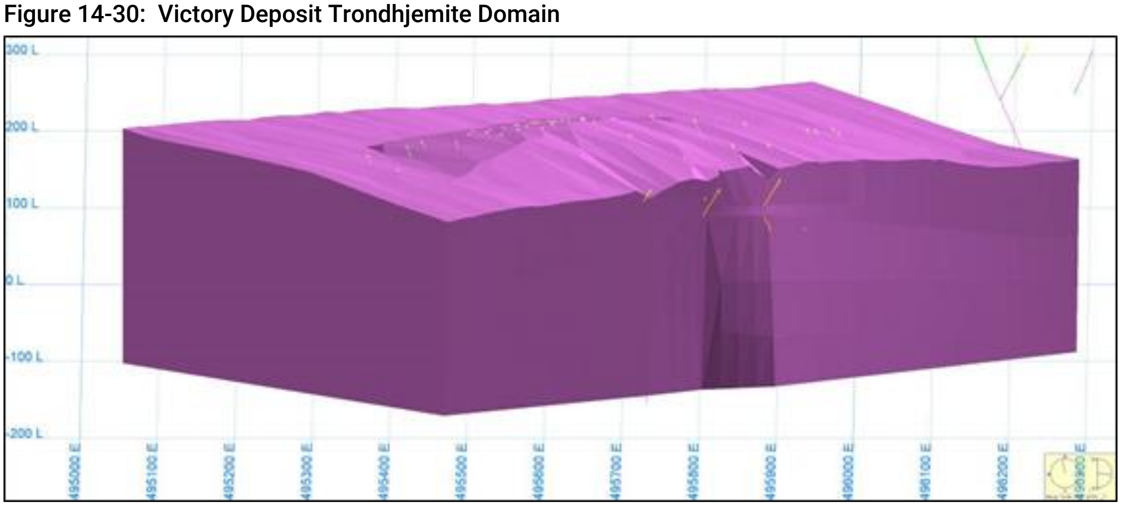
Source: BOYD, 2018

Figure 14-29: Victory Deposit Sediment Domain



Source: BOYD, 2018

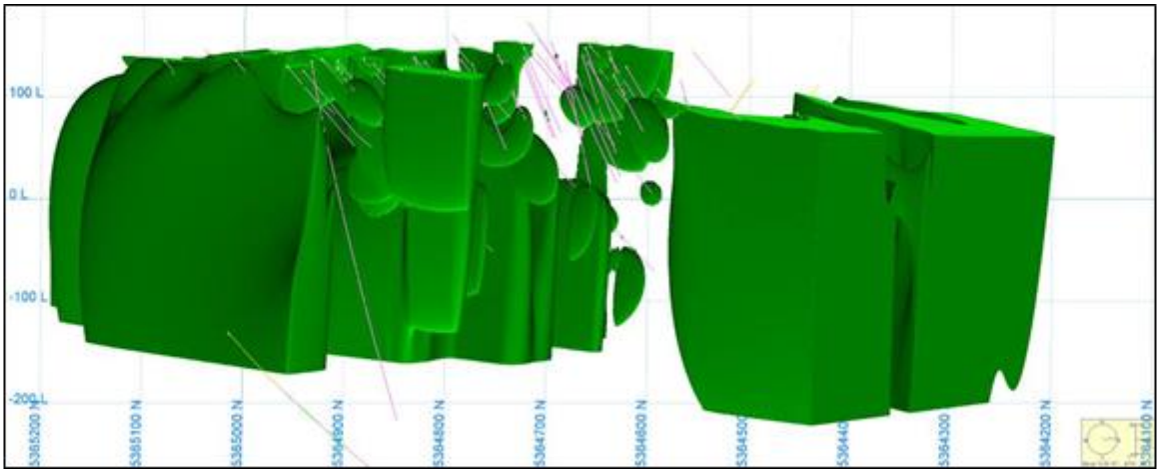
Figure 14-30: Victory Deposit Trondhjemite Domain



Source: BOYD, 2018

For the MD domain, implicit modelling was used to develop a geological solid based on the drillhole intercepts within the Victory deposit drillhole database. The implicit model used an azimuth of 218°, plunge of 0°, and a dip of -85°. Based on discussions with Marathon Gold geologic staff, the mafic dikes have been truncated by the sediments and cut the QTPV zones; as such, mafic dike solid is clipped by the sediments. The MD domain is shown in Figure 14-31.

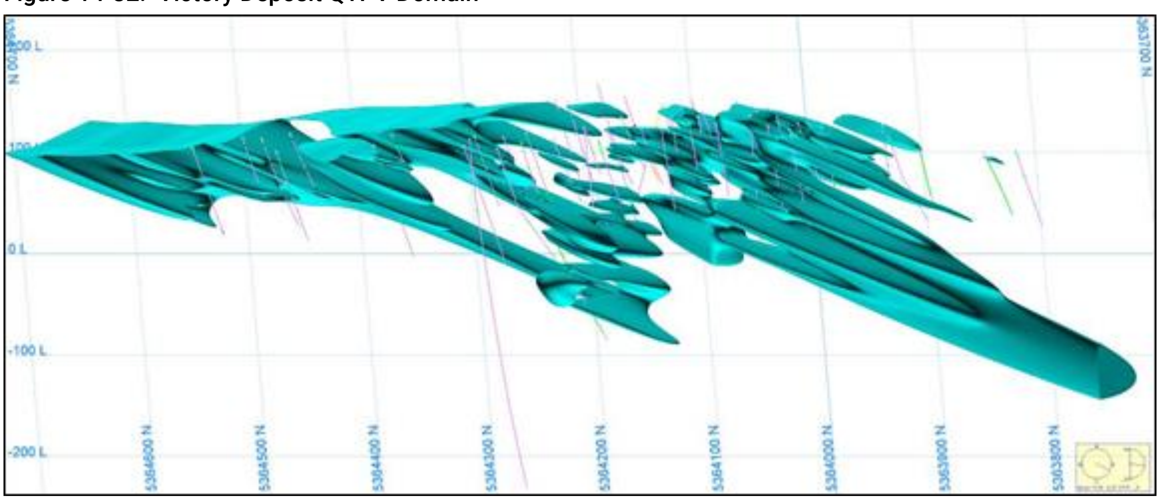
Figure 14-31: Victory Deposit Mafic Dike Domain



Source: BOYD, 2018

For the QTPV domain, the same implicit modelling approach was used to develop the mineralised solid as the mafic dikes. The implicit model used an azimuth of 135°, plunge of -10°, and a dip of -20°. The resulting solid was then clipped by the sediments. The QTPV domain is shown in Figure 14-32.

Figure 14-32: Victory Deposit QTPV Domain



Source: BOYD, 2018

The TRJ and QTPV domains can be mineralised and were used to flag drillholes used to construct the composites for later variography and statistics.

14.3.2.2 Drillhole Descriptive Statistics

Descriptive statistics were generated for each individual domain, as well as for the overall exploration database for gold. The results of this analysis are shown in Table 14.19.

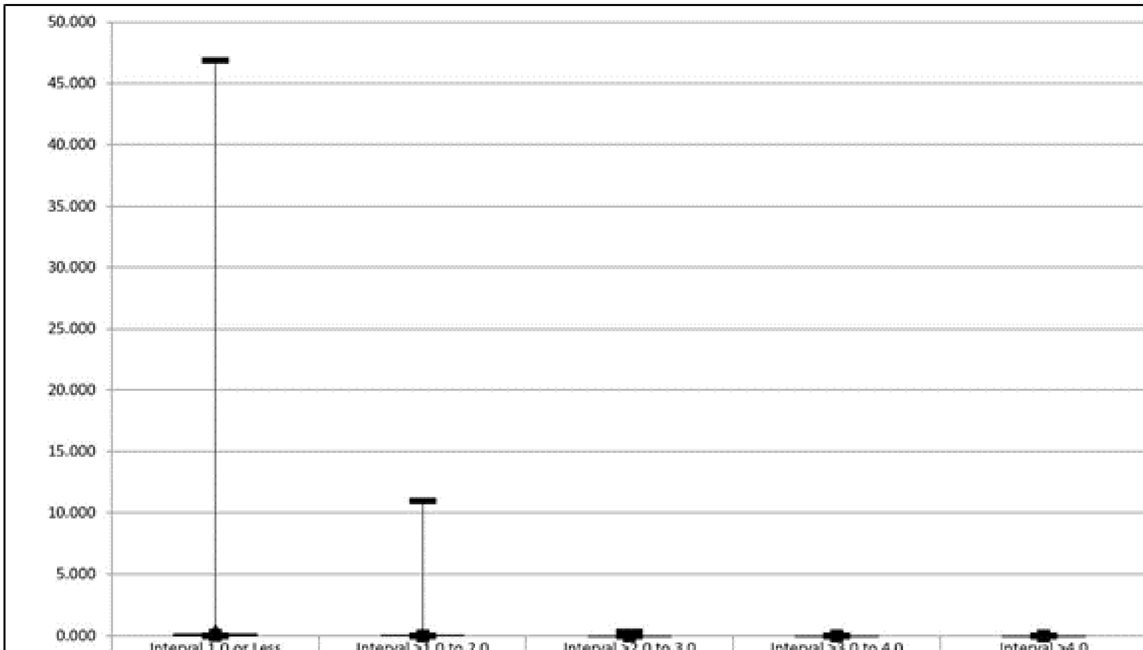
Table 14.19: Victory Deposit Descriptive Statistics

Item	All	QTPV	Trondhjemite
Number of Samples	4,169	1,655	2,688
Minimum	0.002	0.005	0.001
Maximum	46.882	46.882	28.494
Range	46.880	46.877	28.493
Average	0.331	0.588	0.154
Standard Deviation	1.834	2.606	0.905
Variance	3.364	6.791	0.819

14.3.2.3 Compositing

Sample length statistics were run on the assay database examining the number of samples for sample lengths in 1.0 m increments through a total length of 4.0 m. The purpose of this analysis is to determine what sample length was associated with the total number of samples. The boxplot in Figure 14-33 shows the results of this analysis.

Figure 14-33: Victory Deposit Drillhole Sample Lengths



	Interval 1.0 or Less	Interval >1.0 to 2.0	Interval >2.0 to 3.0	Interval >3.0 to 4.0	Interval >4.0
Q1	0.005	0.005	0.005	0.000	0.000
Min	0.005	0.002	0.005	0.000	0.000
Median	0.017	0.005	0.005	0.000	0.000
Mean	0.451	0.124	0.048	0.000	0.000
Max	46.882	10.972	0.304	0.000	0.000
Q3	0.128	0.020	0.007	0.000	0.000
NSamples	2638	1524	7	0	0

Source: BOYD, 2018

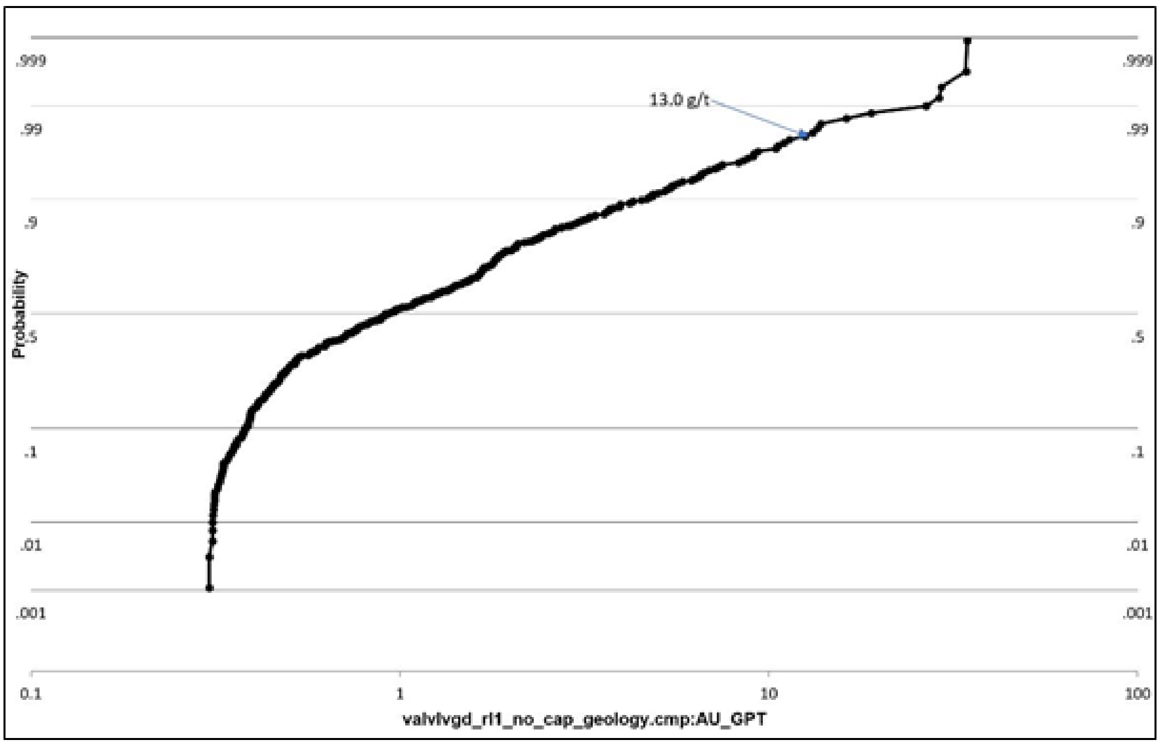
In examining the results of this analysis, it can be seen that most samples with potentially economic gold mineralisation were taken at a length of 1.0 m or less. Based on this, a composite length of 1.0 m was selected and applied within the confines of the mineralised domains. Composites less than 1.0 m were divided by the run length (1.0 m). This composite length was selected to better reflect the actual breakdown of the mineralisation in the individual drillholes within each mineralised zone.

14.3.2.4 High-Value Grade Limits

High outlier metal values can skew the resulting grade estimate if they are not accounted for with some sort of limitation or grade capping value applied to the underlying assay database. To determine this, a lognormal probability plot was generated for gold in each mineralised domain.

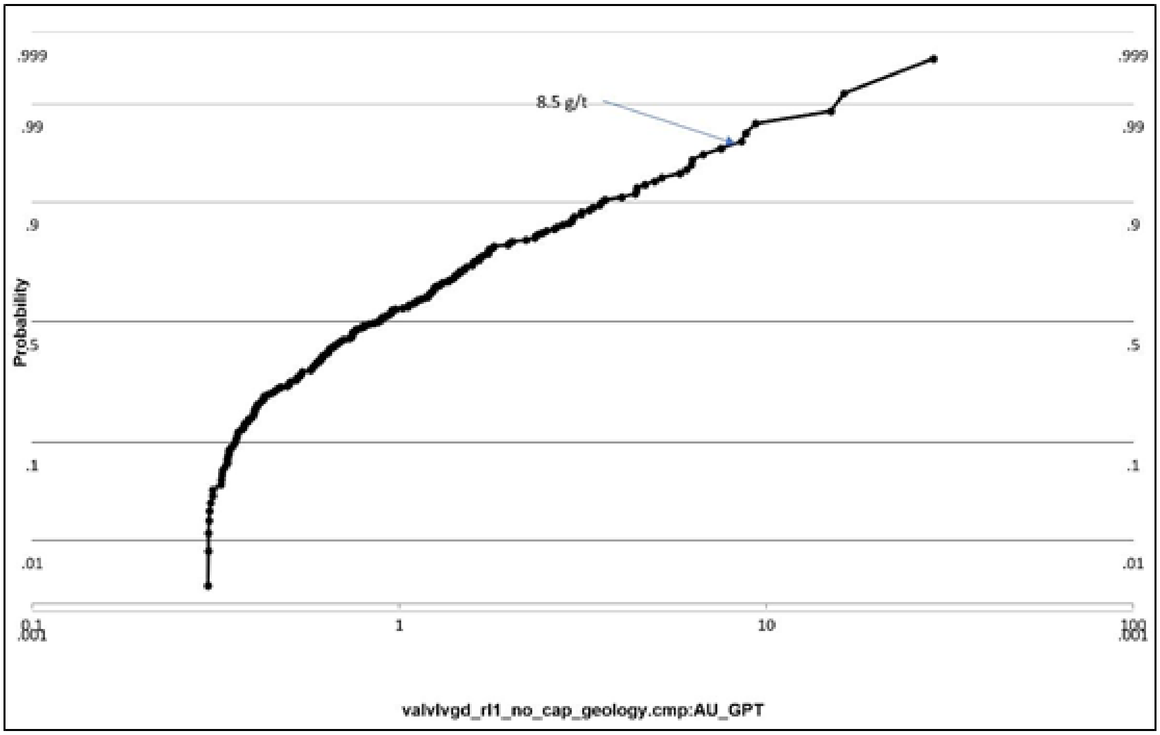
Threshold metal grades were selected at the point where the data start to break up or where there is a significant slope change in the plot. The lognormal probability plots for gold found in each mineralised domain are shown in Figures 14-34 and 14-35.

Figure 14-34: Victory Deposit QTPV Domain Lognormal Plot



Source: BOYD, 2018

Figure 14-35: Victory Deposit Trondhjemite Domain Lognormal Plot



Source: BOYD, 2018

The lognormal probability graphs above were used to determine a gold threshold grade to limit the area of influence of gold grades higher than the threshold. The area of influence was developed using the Vulcan Implicit Modeller to determine the size and extents of above threshold gold-bearing areas by producing a high gold grade wireframe. This wireframe was used to determine the area of influence of above threshold gold grades. This process was completed on all the potentially mineralised domains and the selected metal threshold grades are shown in Table 14.20.

Table 14.20: Victory Deposit Gold Threshold Grades

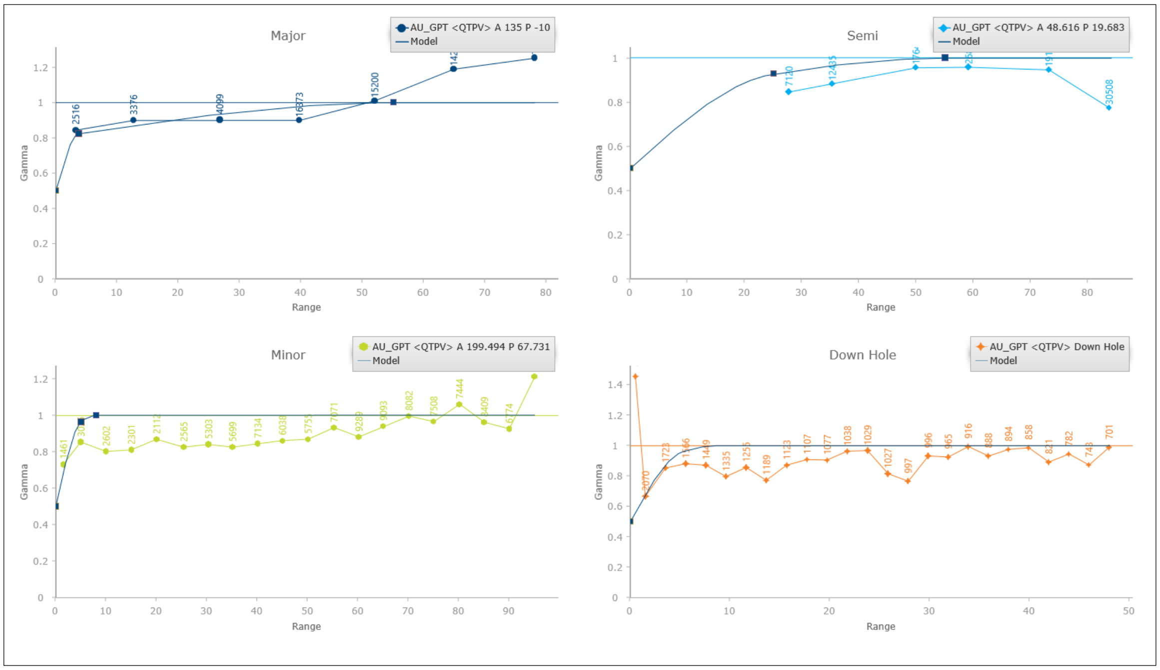
Domain	Limited Search Ellipsoid			
	Threshold Au g/t	Major (m)	Semi-Major (m)	Minor (m)
QTPV	13	20	20	8
Trondhjemite	8.5	20	20	10

Threshold gold grades were applied during the grade estimation runs to limit the influence of the higher-grade outliers in the composites.

14.3.3 Search Ellipsoids

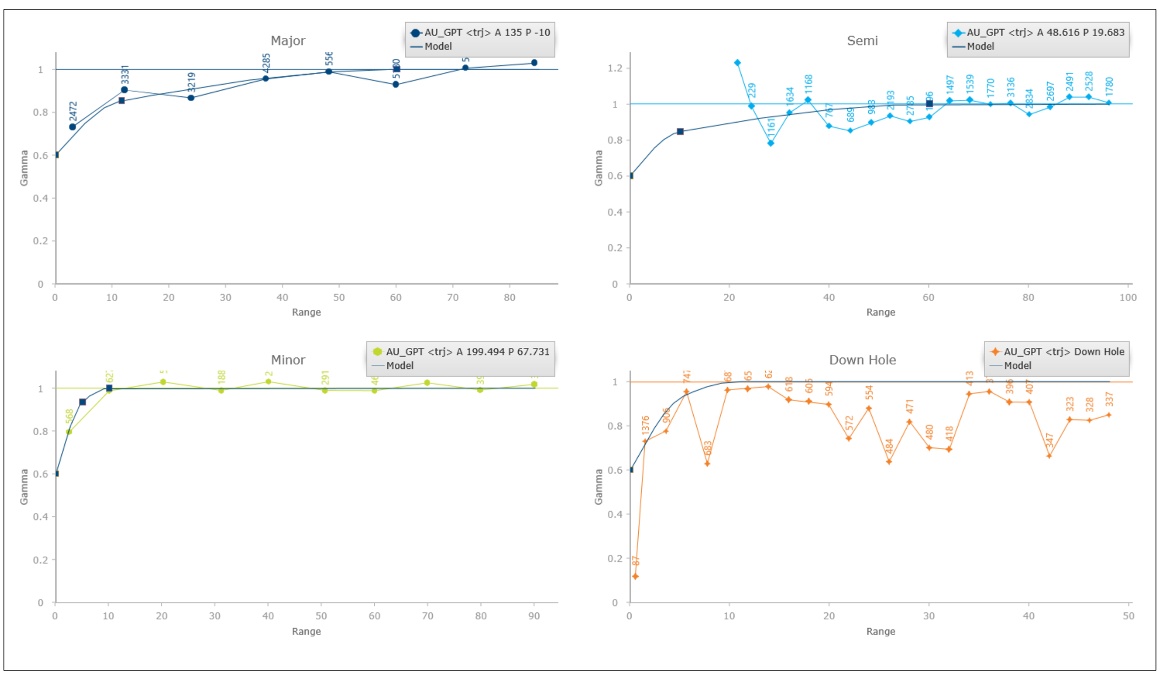
The search ellipsoids for grade estimation were developed using variograms for each domain. Variograms were run in each domain for gold in the same structural orientations used to develop the mineralised solids. Gold grade variograms for each mineralised domain are shown in Figures 14-36 and 14-37.

Figure 14-36: Victory Deposit QTPV Variograms



Source: BOYD, 2018

Figure 14-37: Victory Deposit Trondhjemite Variograms



Source: BOYD, 2018

Based on these analyses, the search ellipsoid for each mineralised domain was established as shown in Tables 14.21 and 14.22.

Table 14.21: Victory Deposit QTPV Search Ellipsoid

Grade Estimation Pass	1	2	3	4
Major Range (m)	55.0	55.0	55.0	82.5
Semi-Major Range (m)	55.0	55.0	55.0	82.5
Minor Range (m)	8.0	8.0	8.0	12.0
Azimuth (degrees)	135.0	135.0	135.0	135.0
Plunge (plunge of the azimuth in degrees)	-10.0	-10.0	-10.0	-10.0
Dip (degrees)	-20.0	-20.0	-20.0	-20.0

Table 14.22: Victory Deposit Trondhjemite Search Ellipsoid

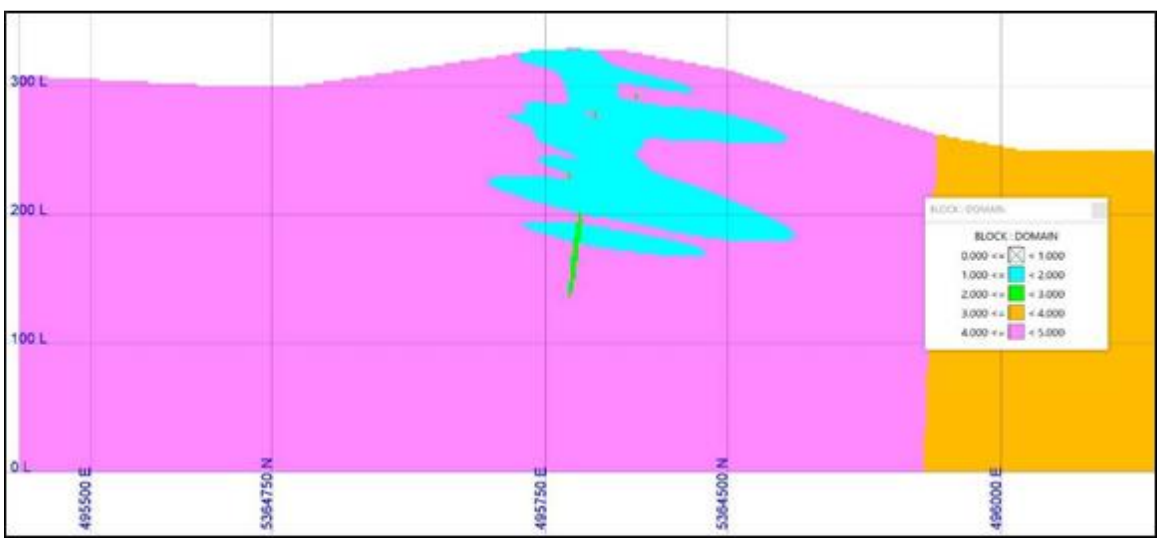
Grade Estimation Pass	1	2	3	4
Major Range (m)	60.0	60.0	60.0	90.0
Semi-Major Range (m)	60.0	60.0	60.0	90.0
Minor Range (m)	10.0	10.0	10.0	15.0
Azimuth (degrees)	135.0	135.0	135.0	135.0
Plunge (plunge of the azimuth in degrees)	-10.0	-10.0	-10.0	-10.0
Dip (degrees)	-20.0	-20.0	-20.0	-20.0

These search parameters were used in the mineral resource estimate described below.

14.3.4 Victory Deposit Block Model

Figure 14-38 shows a typical block model section of the mineralised domain. Table 14.23 shows the Victory deposit block model extents.

Figure 14-38: Victory Deposit Typical Mineralised Domain Block Model Cross-section



Source: BOYD, 2018

Table 14.23: Block Model Extents

Item	X	Y	Z
Origin	495,849.97	5,364,004.74	-
Offset Minimum	-	-	-
Offset Maximum	1,104.00	900.00	450.00
Parent Block size (m)	6.00	6.00	6.00
Child Block size (m)	2.00	2.00	2.00
Bearing/Dip/Plunge	45.00	-	-

14.3.5 Victory Deposit Grade Estimation

A 3D block model was constructed in Vulcan that was constrained by the mineralised domains (described above). The current topographic surface was used to flag the vtopo. This variable is set to 100 for a block 100% below the surface and to 0% for a block 100% above the surface. An rdensity was assigned using the following formula:

*rdensity = density * (vtopo/100)*

This procedure ensures that blocks along the topographic surface have the correct density applied during pit optimisation functions.

No attempt was made to apply a block percentage (percent of the block that is material and waste). Blocks are in or out of the mineralised domain. Grade interpolation runs were set up for only that material within the mineralised domain for gold. All domains were run for gold with the exception of the overburden domain, which is assumed to not be mineralised.

Using the composited assays (described above), block grade interpolations were run in each mineralised domain for gold. Runs were completed using ID3. Four passes were run to allow for use in resource classification. Only composites and blocks flagged as within the mineralised domain were considered in the grade estimation. The block model interpolation parameters are shown in Table 14.24 and Table 14.25 on the following page.

14.3.6 Victory Deposit Resource Classification

The mineral resource classification used for the Victory deposit is based on which pass generated a grade estimate, as well as the distance to the nearest neighbour (measured and indicated only). The resource classification used was:

- Measured – Blocks estimated in Pass 1 (minimum of four composites) with a maximum nearest neighbour distance of 15 m are classified as measured. For the Victory deposit, no blocks could be considered as measured.
- Indicated – Blocks estimated in Pass 2 (minimum of three composites) with a maximum nearest neighbour distance of 25 m are classified as indicated. Only blocks flagged as QTPV could be considered as indicated.
- Inferred – Blocks estimated in Pass 3 (minimum of two composites) are classified as inferred.

Blocks flagged during Pass 4 are not considered in the mineral resource estimate and were populated to provide future exploration guidance to Marathon Gold. Any material flagged with a classification of 4 is considered as waste material.

Table 14.24: Victory Deposit QTPV Grade Estimation Parameters

Item	Pass			
	1	2	3	4
Search Parameters	**1.00**	**1.00**	**1.00**	**1.50**
Major Range (m)	55.0	55.0	55.0	82.5
Semi-Major Range (m)	55.0	55.0	55.0	82.5
Minor Range (m)	8.0	8.0	8.0	12.0
Azimuth (degrees)	135.0	135.0	135.0	135.0
Plunge (plunge of the azimuth in degrees)	-10.0	-10.0	-10.0	-10.0
Dip (degrees)	-20.0	-20.0	-20.0	-20.0
Search Ellipsoid				
Azimuth (degrees)	135.00	135.00	135.00	135.00
Plunge (plunge of the azimuth in degrees)	-10.00	-10.00	-10.00	-10.00
Dip (degrees)	-20.00	-20.00	-20.00	-20.00
Major (m)	55.00	55.00	55.00	82.50
Semi-Major (m)	55.00	55.00	55.00	82.50
Minor (m)	8.00	8.00	8.00	12.00
Estimation Parameters				
Minimum Number of Composites	4	3	2	2
Maximum Number of Composites	6	6	6	6
Maximum Composites Per Drillhole	2	2	2	2

Table 14.25: Victory Deposit Trondhjemite Grade Estimation Parameters

Item	Pass			
	1	2	3	4
Search Parameters	**1.00**	**1.00**	**1.00**	**1.50**
Major Range (m)	60.0	60.0	60.0	90.0
Semi-Major Range (m)	60.0	60.0	60.0	90.0
Minor Range (m)	10.0	10.0	10.0	15.0
Azimuth (degrees)	135.0	135.0	135.0	135.0
Plunge (plunge of the azimuth in degrees)	-10.0	-10.0	-10.0	-10.0
Dip (degrees)	-20.0	-20.0	-20.0	-20.0
Search Ellipsoid				
Azimuth (degrees)	135.00	135.00	135.00	135.00
Plunge (plunge of the azimuth in degrees)	-10.00	-10.00	-10.00	-10.00
Dip (degrees)	-20.00	-20.00	-20.00	-20.00
Major (m)	60.00	60.00	60.00	90.00
Semi-Major (m)	60.00	60.00	60.00	90.00
Minor (m)	10.00	10.00	10.00	15.00
Estimation Parameters				
Minimum Number of Composites	4	3	2	2
Maximum Number of Composites	6	6	6	6
Maximum Composites Per Drillhole	2	2	2	2

14.3.7 Victory Deposit Model Validation

The gold grade populated block model was reviewed to ensure reasonableness. These checks included:

- an overall review of the estimated metal values
- QQ plots of the block model versus the composites
- a section-by-section comparison between the ID3 metal values and the underlying drillholes
- a statistical comparison of the raw assay values versus the composite values versus the block values

The overall block metal grades were examined to confirm that all the estimation parameters were honoured and kept within the individual mineralised domains. A visual check on a sectional basis showed this to be true with block grades being consistently below the underlying drillhole assay value. Each of the cross-sections were reviewed and the underlying drillholes were checked to determine that the original metal grade closely matched the estimated block metal grade without exceeding it. Cross-sections were examined, and assay intervals agreed with the overlying estimated block model metal grades. A statistical comparison of the raw assay values versus the composite values versus the estimated block values was run and is shown in Table 14.26.

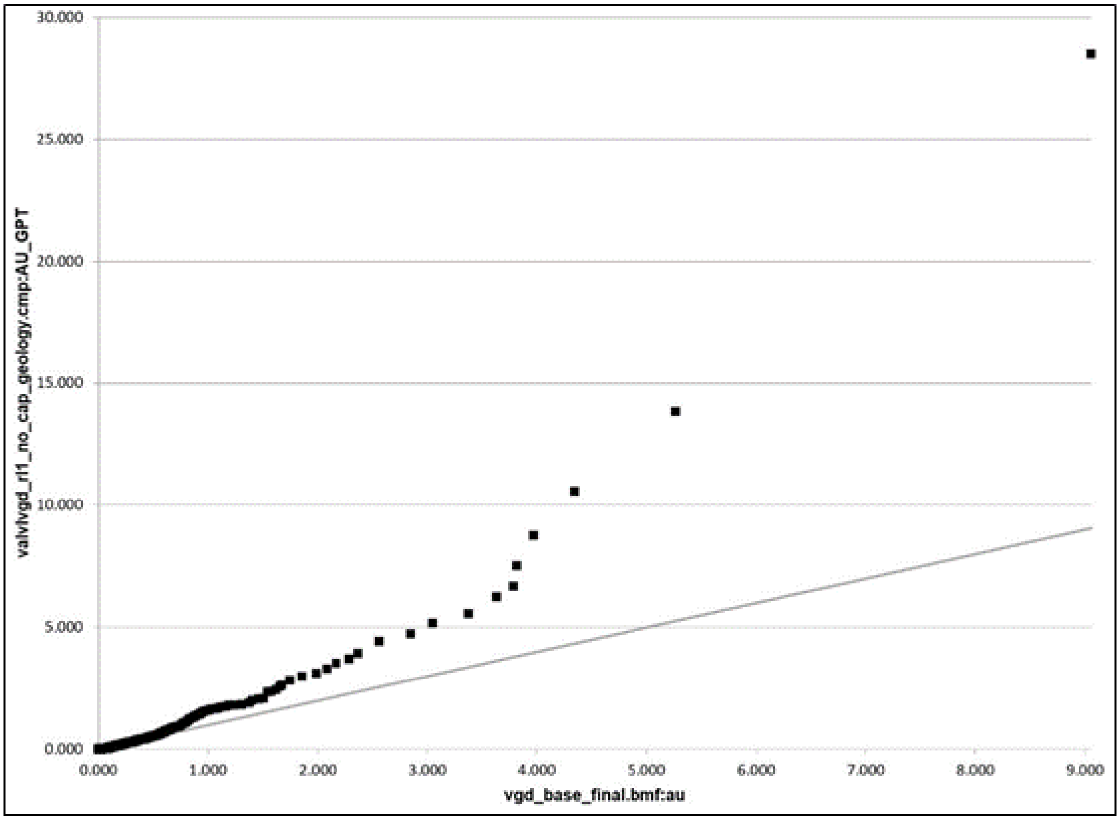
The overall QQ plot of the block model estimated gold grades versus the composites is shown in Figure 14-39.

The block model checks indicate that the mineral resource estimate slightly underestimates the underlying composites at lower gold grade values. At higher gold grades, the block model gold grades are underestimated relative to the underlying composites.

Table 14.26: Victory Deposit Mineral Resource Estimation Model Statistics

Item	Domain		
	All	QTPV	Trondhjemite
1-Metre Composites			
Number of samples	4,169	1,655	2,688
Minimum	0.002	0.005	0.001
Maximum	46.882	46.882	28.494
Range	46.880	46.877	28.493
Average	0.331	0.588	0.154
Standard deviation	1.834	2.606	0.905
Variance	3.364	6.791	0.819
Coefficient of variance	5.541	4.432	5.877
Block Model Results			
Number of blocks	122,354	47,184	75,170
Minimum	0.010	0.010	0.010
Maximum	25.677	25.677	21.953
Range	25.667	25.667	21.943
Average	0.284	0.455	0.176
Standard deviation	0.782	1.050	0.154
Variance	0.612	1.103	0.024
Coefficient of variance	2.759	2.310	0.874

Figure 14-39: Victory Deposit Overall QQ Plot



Source: BOYD, 2018

14.3.8 Victory Deposit Mineral Resource Estimate

The Victory deposit mineral resources may be amenable to a combination of open pit and underground mining methods. BOYD developed a conceptual pit shell (the economic open pit shell) using the Lerchs-Grossman method as provided by the GEOVIA Whittle software within which the portions of the block model that show reasonable prospects for economic extraction by open pit mining are defined. From this pit shell, a conceptual open pit mine was designed and used to estimate the potentially surface mineable mineral resources. Portions of the block model which are external to the conceptual pit shell but satisfy cut-off grade criteria for an appropriate underground extraction method, are considered to show “reasonable prospects for economic extraction” by underground mining methods.

14.3.8.1 Economic Assumptions

The operating assumptions (economic and gold recovery) used for the Whittle economic open pit optimisation are shown in Table 14.27; the operating assumptions (economic and gold recovery) used for the calculation of an underground cut-off grade are shown in Table 14.28. These assumptions are based on the current feasibility study metallurgical and economic parameters.

For mineral resource estimation, a cut-off grade of 0.30 g/t gold was used for open pit, and a cut-off grade of 1.44 g/t gold was used for underground. The assumed overall pit slope in Whittle was assumed to be 47.5° in non-sediment rocks and 46.0° in sediment rocks not including ramps.

Table 14.27: Victory Deposit Open Pit Economic Assumptions

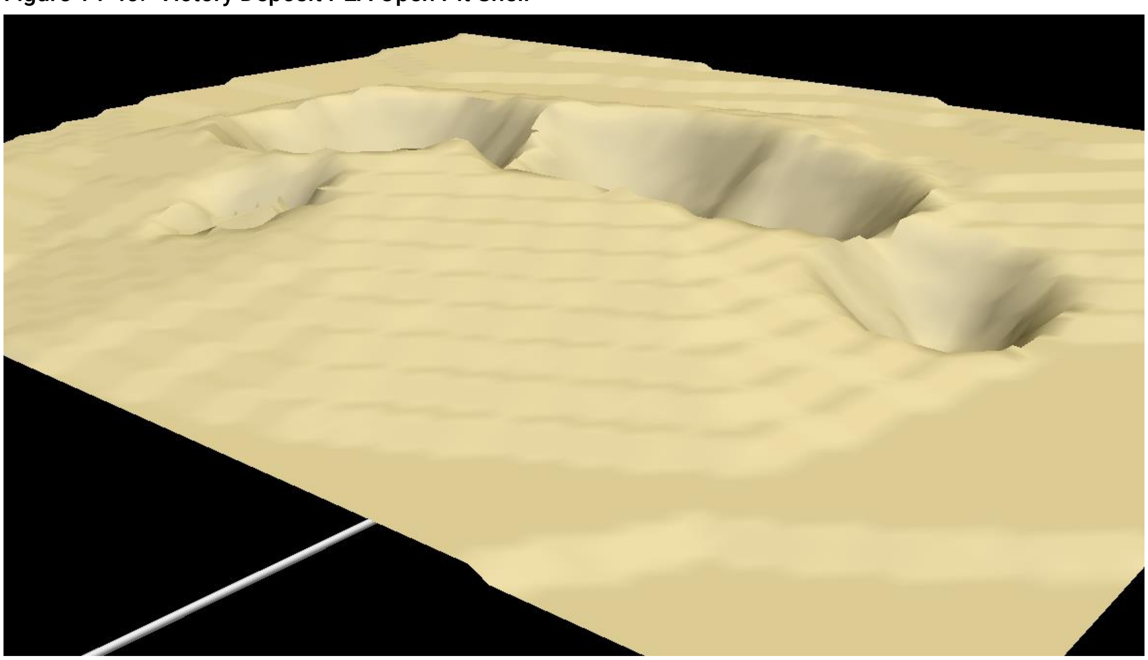
Item	Value	Units
Waste Mining Cost	2.35	C$/t waste
Mill Feed Mining Cost	3.60	C$/t mill feed or heap leach
Mill Processing Cost	10.81	C$/t mill feed
G&A Cost	2.40	C$/t mill feed or heap leach
Mill Gold Recovery (at cut-off)	91.1	%
Exchange	0.76	---
Gold Price	1,500	US$/troy oz
Mill Cut-off	0.30	g/t

Table 14.28: Victory Deposit Underground Economic Assumptions

Item	Value	Units
Mill Feed Mining Cost	71.00	C$/t mill feed
Processing Cost	10.81	C$/t material
G&A Cost	2.40	C$/t material
Recovery (at cut-off)	92.7	%
Exchange	0.76	---
Gold Price	1,500	US$/troy oz
Calculated Cut-off	1.44	g/t

Using these assumptions, a Whittle economic pit optimisation was completed, and an economic open pit shell was generated. This open pit shell was used to design the conceptual pit design shown in Figure 14-40.

Figure 14-40: Victory Deposit PEA Open Pit Shell



Source: BOYD, 2020.

14.3.8.2 Mineral Resource Estimate

BOYD's estimate of mineral resources for the Victory deposit is shown in Table 14.29.

Table 14.29: Mineral Resource Estimate for the Victory Deposit

Measured and Indicated Mineral Resource Estimate

Mining Method	Resource Classification	Gold Cut-off Grade (g/t)	Tonnes	Au g/t	Au Troy Oz
Open Pit - High-Grade	Measured	0.70	0	0	0
Open Pit - High-Grade	Indicated	0.70	621,000	2.200	43,900
Open Pit - High-Grade	**Measured + Indicated**	**0.70**	**621,000**	**2.200**	**43,900**
Open Pit - Low-Grade	Measured	0.30	0	0	0
Open Pit - Low-Grade	Indicated	0.30	463,000	0.466	6,900
Open Pit - Low-Grade	**Measured + Indicated**	**0.30**	**463,000**	**0.466**	**6,900**
Total Open Pit	Measured	0.30	0	0	0
Total Open Pit	Indicated	0.30	1,084,000	1.459	50,800
Total Open Pit	**Measured + Indicated**	**0.30**	**1,084,000**	**1.459**	**50,800**
Underground	Measured	1.44	0	0	0
Underground	Indicated	1.44	1,300	1.803	100
Underground	**Measured + Indicated**	**1.44**	**1,300**	**1.803**	**100**
Open Pit + Underground	Measured	0.30	0	0	0
Open Pit + Underground	Indicated	0.30	1,085,300	1.460	50,900
Open Pit + Underground	**Measured + Indicated**	**0.30**	**1,085,300**	**1.460**	**50,900**

Inferred Mineral Resource Estimate

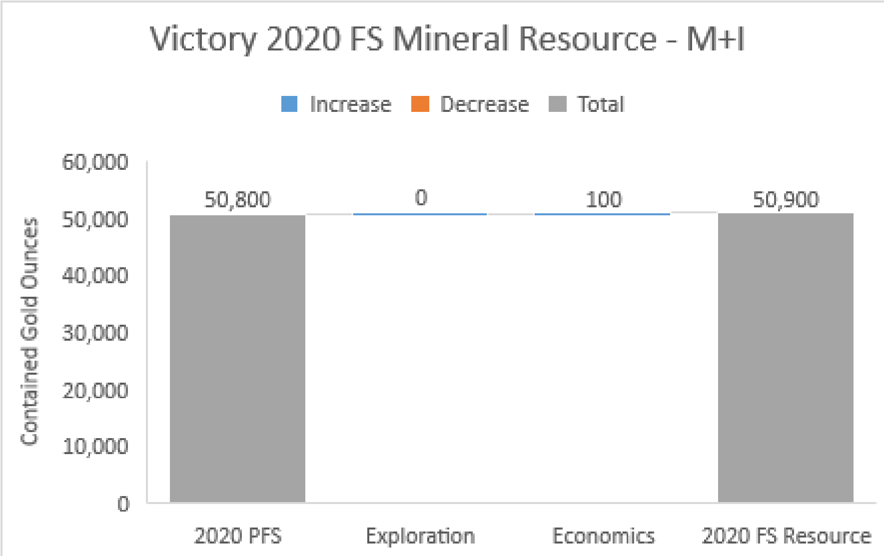
Mining Method	Resource Classification	Gold Cut-off Grade (g/t)	Tonnes	Au g/t	Au Troy Oz
Open Pit - High-Grade	Inferred	0.70	1,192,000	1.735	66,500
Open Pit - Low-Grade	Inferred	0.30	1,008,000	0.473	15,300
Total Open Pit	Inferred	0.30	2,200,000	1.157	81,800
Underground	Inferred	1.44	130,000	3.050	12,700
Open Pit + Underground	Inferred	0.30	2,330,000	1.262	94,500

Notes: **1.** The effective date for this mineral resource estimate is November 20, 2020 and is reported on a 100% ownership basis. This estimate is an update to the previous mineral resource estimate (January10, 2020) and reflects revised economic parameters only. The qualified person for the mineral resource estimate is Robert Farmer, P. Eng. **2.** Mineral resources are calculated at a gold price of US$1,500 per troy ounce. **3.** The mineral resources presented above are global and do not include detailed pit or underground designs; only an economic open pit shell was used to determine the in-pit mineral resources. The underground mineral resources are that material outside of the in-pit mineral resources above the stated underground cut-off grade. **4.** Mineral resources, which are not mineral reserves, do not have demonstrated economic viability. The estimate of mineral resources may be materially affected by environmental, permitting, legal, title, socio-political, marketing, or other relevant issues. **5.** The mineral resources presented here were estimated using a block model with a block size of 6 m x 6 m x 6 m sub-blocked to a minimum block size of 2 m x 2 m x 2 m using ID3 methods for grade estimation. All mineral resources are reported using an open pit gold cut-off of 0.30 g/t Au and an underground gold cut-off of 1.44 g/t Au. Higher gold grades were capped by mineralised domain. Material above a 0.70 g/t gold cut-off is considered high-grade while material between a 0.30 and 0.70 g/t gold cut-off is considered low-grade. **6.** The mineral resources presented here were estimated using the Canadian Institute of Mining, Metallurgy and Petroleum (CIM), CIM Standards on Mineral Resources and Reserves, Definitions and Guidelines prepared by the CIM Standing Committee on Reserve Definitions and adopted by CIM Council May 10, 2014. **7.** Figures are rounded, and totals may not add correctly.

14.3.8.3 Changes from the Previous Mineral Resource Estimate

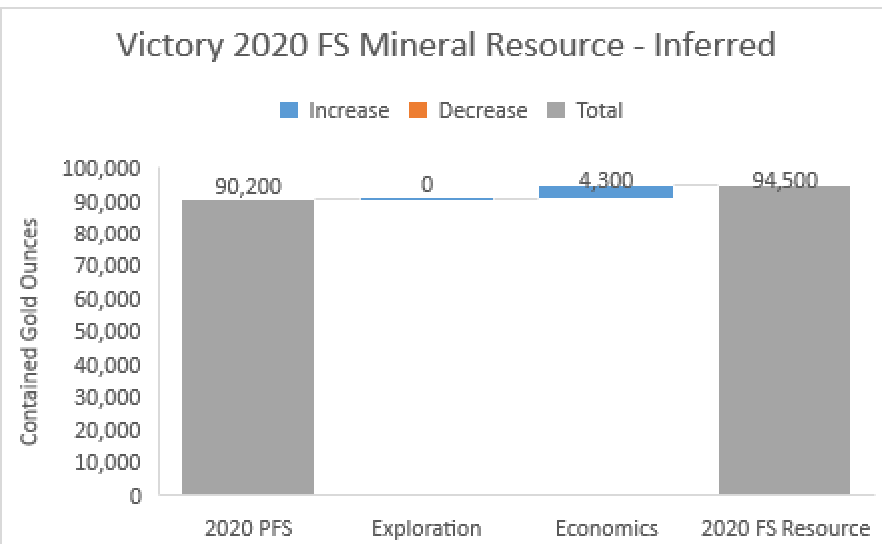
At Victory, the only change since the pre-feasibility mineral resource estimate (January 10, 2020) was the addition of updated feasibility study economics. This had minimal impact of the overall mineral resource estimate. This is illustrated in Figures 14-41 and 14-42.

Figure 14-41: Victory Measured & Indicated Changes from the Previous MRE



Source: BOYD, 2020.

Figure 14-42: Victory Inferred Changes from the Previous MRE



Source: BOYD, 2020.

At Victory, the only change since the October 2018 Mineral Resource Estimate was the addition of updated feasibility study economics. This had minimal impact of the overall mineral resource estimate.

14.4 Sprite Deposit Mineral Resource Estimate

No additional exploration data were available to update the Sprite deposit geological model and mineral resource estimate. Changes to the mineral resource estimate for the Sprite deposit from those previously reported reflect revisions to the project's technical parameters (e.g., metallurgical recoveries, mining costs, etc.). *Other than the changes to the technical parameters, there are no changes from the previous April 21, 2020 Pre-feasibility Technical Report.*

A description of the previous mineral resource estimate from the BOYD Technical Report (Farmer, 2020) is duplicated below. The only changes to this report are a restating of the mineral resource using the most current feasibility study economic and technical parameters.

The Sprite deposit mineral resource is contained in a series of flat-lying, gold-bearing QTPV with an azimuth of 135°, a plunge of -10°, and a dip of -20°. Gold mineralisation is associated at the intersection of the QTPV zones with a steeply dipping northeast-trending shear zone.

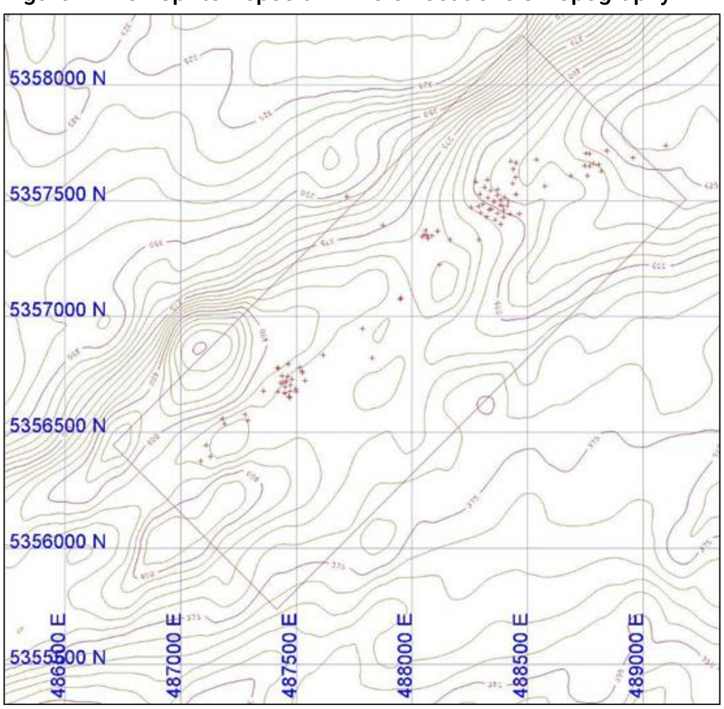
Potentially economic gold mineralisation is encountered in the QTPV and TRJ domains. There is minor mineralisation present in the other domains, but only a very limited amount of information in these areas was available and no attempt was made to complete a mineral resource estimate in them.

14.4.1 Sprite Deposit Data

14.4.1.1 Drillholes

Geologic modelling of the Sprite deposit is based on all drillholes whose assays were available by March 12, 2015 (the most recent available data) and consists of 97 diamond core drillholes totalling approximately 13,134 m. Figure 14-43 shows the collars of these drillholes.

Figure 14-43: Sprite Deposit Drillhole Locations & Topography



Source: BOYD, 2018

14.4.1.2 Assays

Of the 6,635 gold assays available on March 12, 2015, all were used for the mineral resource estimation. For unsampled intervals, values were set to zero. All assays used were fire or metallic sieved assays. Total assayed sample length is 9,463 m.

14.4.1.3 Density

To date, there have been 552 density measurements completed for the Sprite deposit. The results of these measurements are shown in Table 14.30. Block densities were assigned based on the block's domain of lithology type.

Table 14.30: Sprite Density Measurements

Lithology Code	Samples	Specific Gravity t/m^3
Mafic Dikes (MD)	77	2.73
Quartz-Tourmaline- Pyrite Veins	120	2.64
Sediments (SED)	17	2.73
Trondhjemite (TRJ)	338	2.63
Overburden (OB)	---	1.50

14.4.1.4 Topography

The topography of the area around the Sprite deposit is shown on Figure 14-43 above. All contours are expressed in metres above sea level. Contour intervals are every 5 m. The Sprite deposit sits on a flat-topped ridge extending northeast from the Leprechaun area. Towards the north, the topography falls off steeply, while towards the south, the topography slopes gently downhill.

14.4.2 Sprite Deposit Data Analysis

14.4.2.1 Geological Modelling

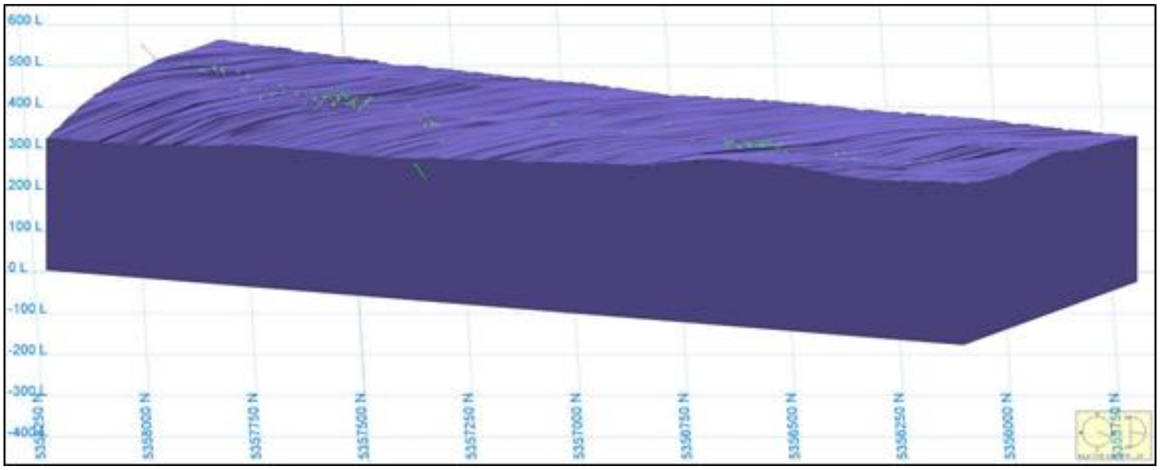
The Sprite deposit contains four major potentially mineralised domains. These domains are the SED, hanging wall TRJ, flat-lying QTPV, and the MD domain intruding into the TRJ and QTPV domains. Additionally, surface overburden was also noted in the drill logs, but was not considered as a potentially mineralised host.

Geological modelling of these units is based on the logged geology as well as interpretations made by Marathon Gold staff. On every 10 m cross-section through the deposit, a line was drawn reflecting the actual or projected overburden surface below the topography. These lines were then used to construct the rock/overburden surface to constrain compositing, geological implicit models, as well as block modelling. The overburden surface is shown in Figure 14-44.

The SED/TRJ contact was determined by drillhole intercepts or projections between intercepts and a surface constructed to represent this geologic contact. This was completed on every 10 m section through the deposit where data were available. This contact was then used to construct a solid model of the SED domain below the overburden horizon. The SED unit is shown in Figure 14-45.

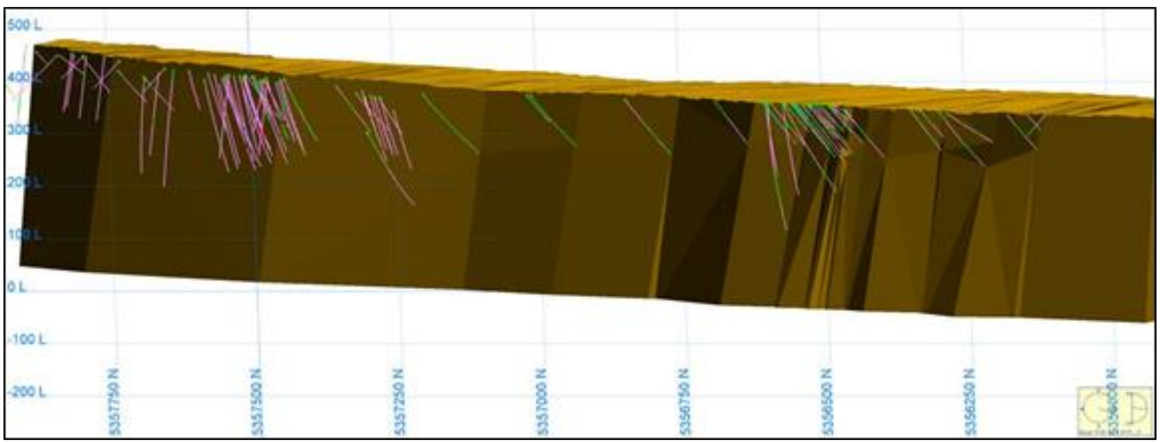
The TRJ domain is the remaining rock mass northwest of the sediment solid and below the overburden horizon. The TRJ domain is shown in Figure 14-46.

Figure 14-44: Sprite Deposit Sediment Domain



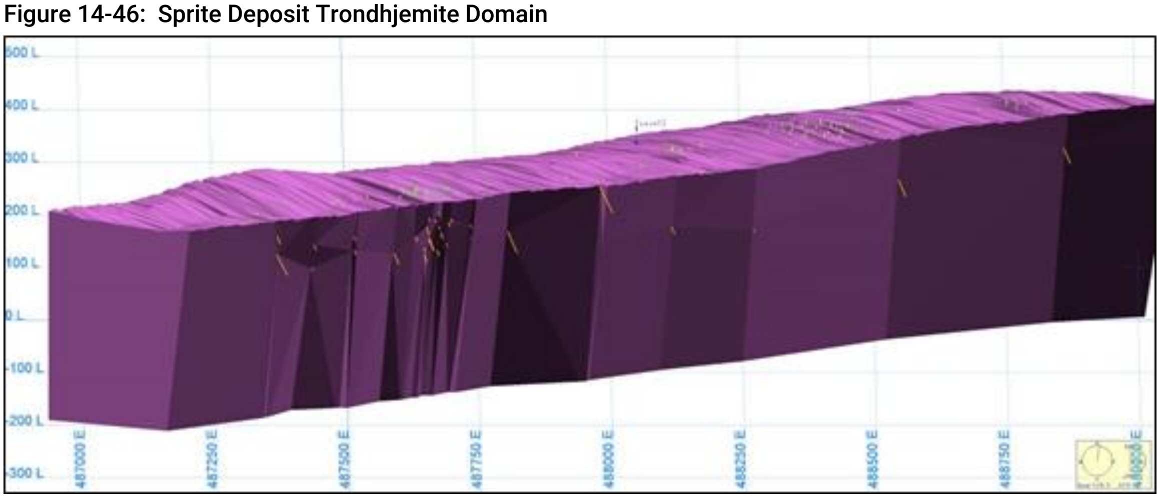
Source: BOYD, 2018

Figure 14-45: Sprite Deposit Trondhjemite Domain



Source: BOYD, 2018

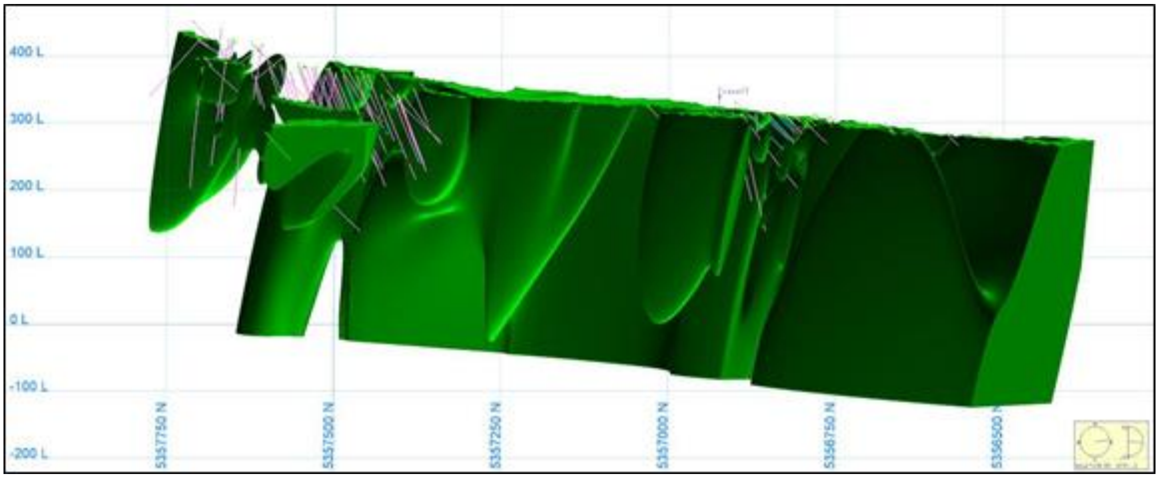
Figure 14-46: Sprite Deposit Trondhjemite Domain



Source: BOYD, 2018

For the MD domain, implicit modelling was used to develop a geological solid based on the drillhole intercepts within the Sprite gold deposit drillhole database. The implicit model used an azimuth of 235°, plunge of 0°, and a dip of -75°. Based on discussions with Marathon Gold geologic staff, the mafic dikes have been truncated by the sediments and cut the QTPV zones; as such, mafic dike solid is clipped by the sediments. The MD domain is shown in Figure 14-47.

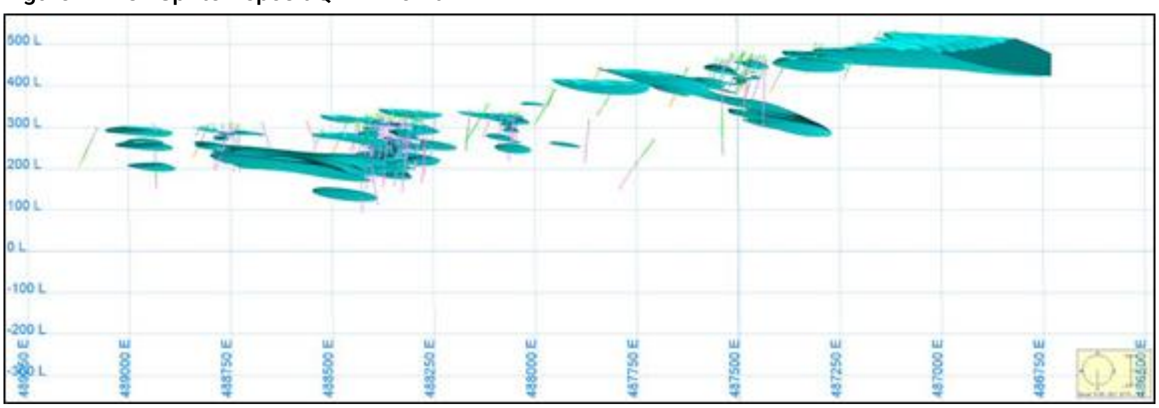
Figure 14-47: Sprite Deposit Mafic Dike Domain



Source: BOYD, 2018

For the QTPV domain, the same implicit modelling approach was used to develop the mineralised solid as the mafic dikes. The implicit model used an azimuth of 135°, plunge of -10°, and a dip of -20°. The resulting solid was then clipped by the sediments. The QTPV domain is shown in Figure 14-48.

Figure 14-48: Sprite Deposit QTPV Domain



Source: BOYD, 2018

The TRJ and QTPV domains can be mineralised and were used to flag the drillholes used to construct the composites for later variography as well as statistics.

14.4.2.2 Drillhole Descriptive Statistics

Descriptive statistics were generated for each domain as well as the overall exploration database for gold grades. The results of this analysis are shown in Table 14.31.

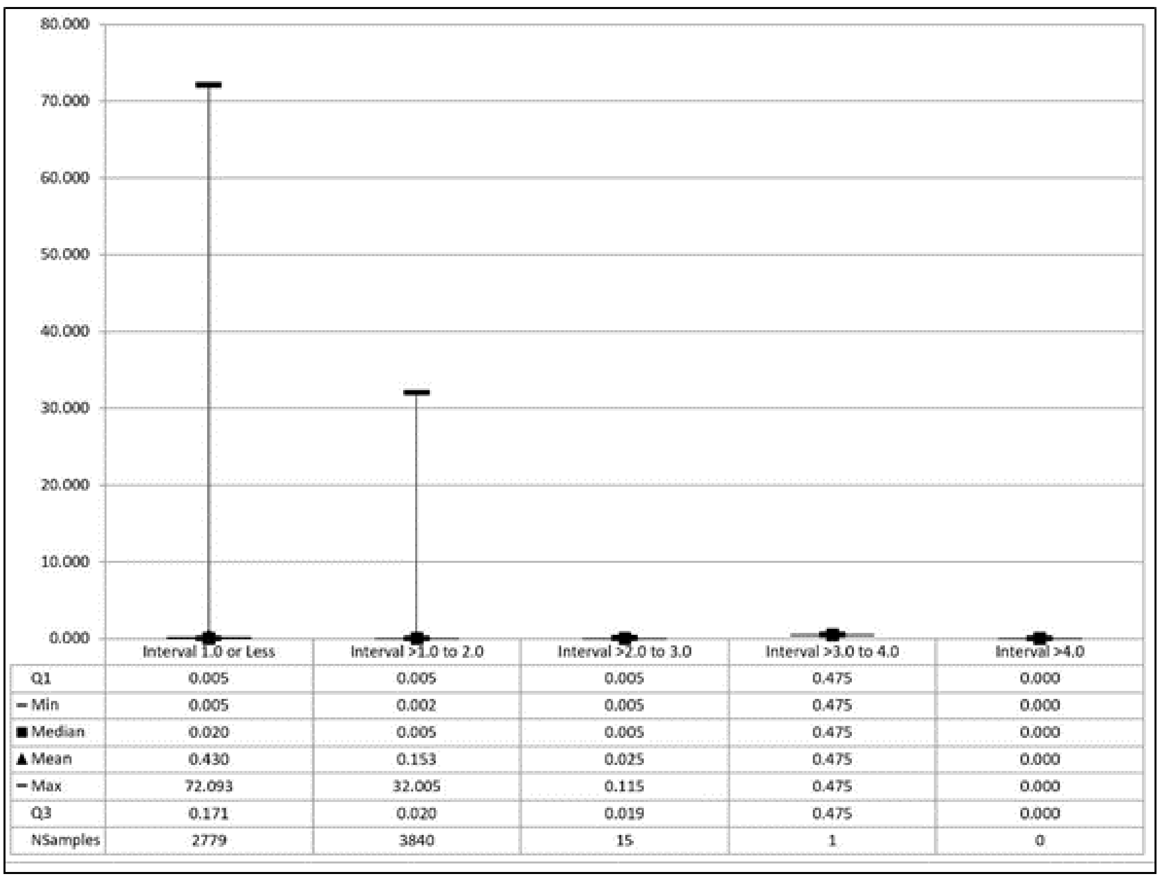
Table 14.31: Sprite Deposit Descriptive Statistics

Item	All	QTPV	Trondhjemite
Number of Samples	6,635	1,308	4,683
Minimum	0.002	0.005	0.002
Maximum	72.093	72.093	29.167
Range	72.091	72.088	29.165
Average	0.269	0.838	0.150
Standard Deviation	1.836	3.619	0.995
Variance	3.371	13.097	0.990

14.4.2.3 Compositing

Sample length statistics were run on the assay database examining the number of samples for sample lengths in 1.0 m increments through a total length of 4.0 m. The purpose of this analysis is to determine what sample length was associated with the total number of samples. The boxplot in Figure 14-49 shows the results of this analysis.

Figure 14-49: Sprite Deposit Drillhole Sample Lengths



Source: BOYD, 2018

In examining the results of this analysis, it can be seen that most samples with potentially economic gold mineralisation were taken at a length of 1.0 m or less. Based on this, a composite length of 1.0 m was selected and applied within the confines of the mineralised domains.

Composites less than 1.0 m were divided by the run length (1.0 m). This composite length was selected to better reflect the actual breakdown of the mineralisation in the individual drillholes within each mineralised zone.

14.4.2.4 High Value Grade Limits

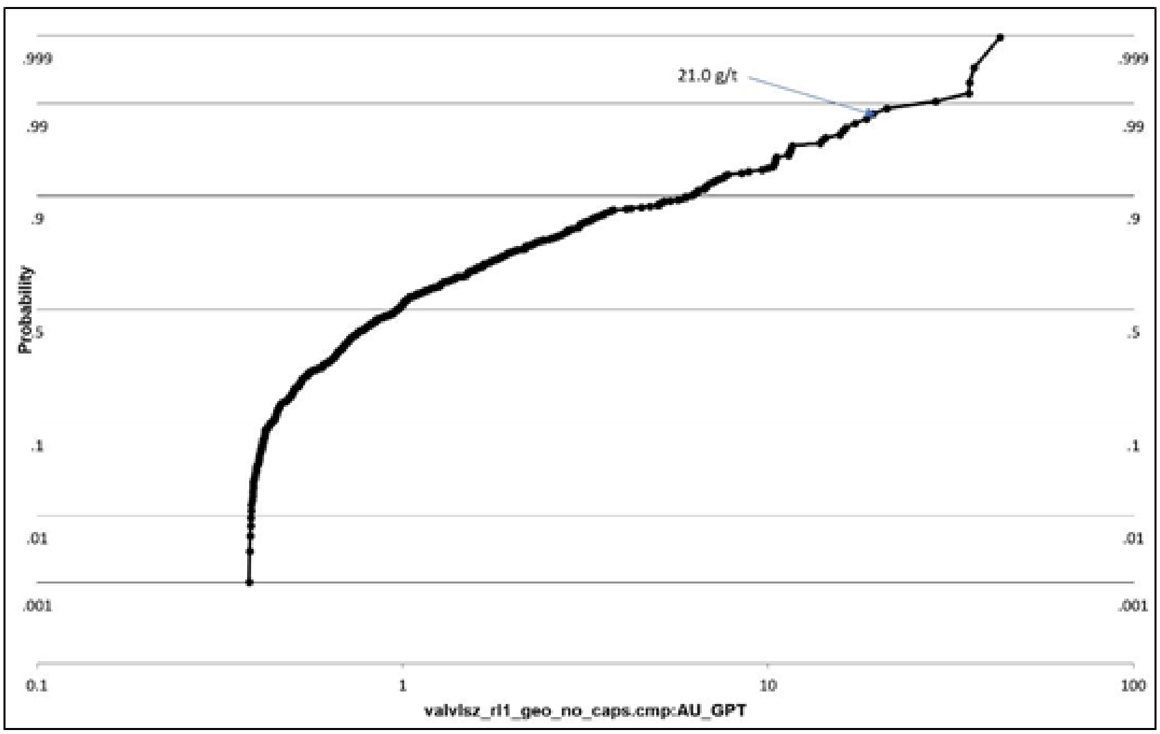
High outlier metal values can skew the resulting grade estimate if they are not accounted for with some sort of limitation or grade capping value applied to the underlying assay database. To determine this, a lognormal probability plot was generated for gold in each mineralised domain.

Threshold metal grades were selected at the point where the data start to break up or where there is a significant slope change in the plot. The lognormal probability plots for gold found in each mineralised domain are shown in Figures 14-50 and 14-51.

The lognormal probability graphs above were used to determine a gold threshold grade to limit the area of influence of gold grades higher than the threshold. The area of influence was developed using the Vulcan Implicit Modeller to determine the size and extents of above threshold gold-bearing areas by producing a high gold grade wireframe. This wireframe was used to determine the area of influence of above threshold gold grades. This process was completed on all the potentially mineralised domains and the selected metal threshold grades are shown in Table 14.32.

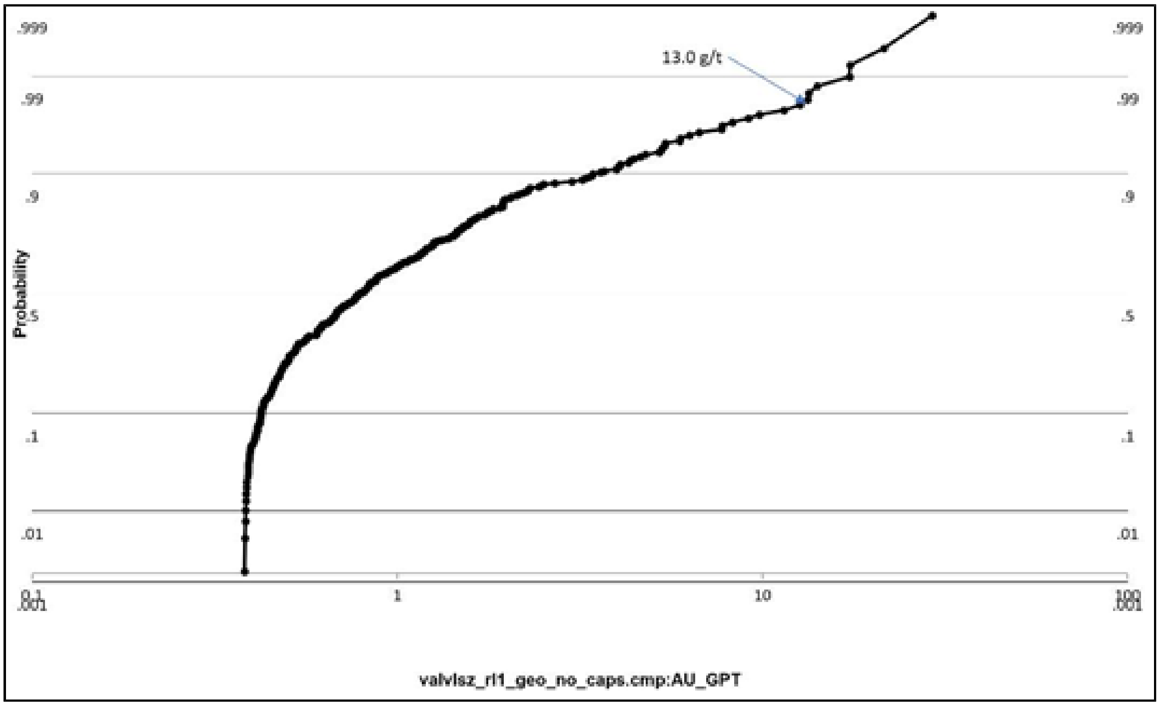
Threshold gold grades were applied during the grade estimation runs to limit the influence of the higher-grade outliers in the composites.

Figure 14-50: Sprite QTPV Domain Lognormal Plot



Source: BOYD, 2018

Figure 14-51: Sprite Trondhjemite Domain Lognormal Plot



Source: BOYD, 2018

Table 14.32: Sprite Deposit Gold Threshold Grades

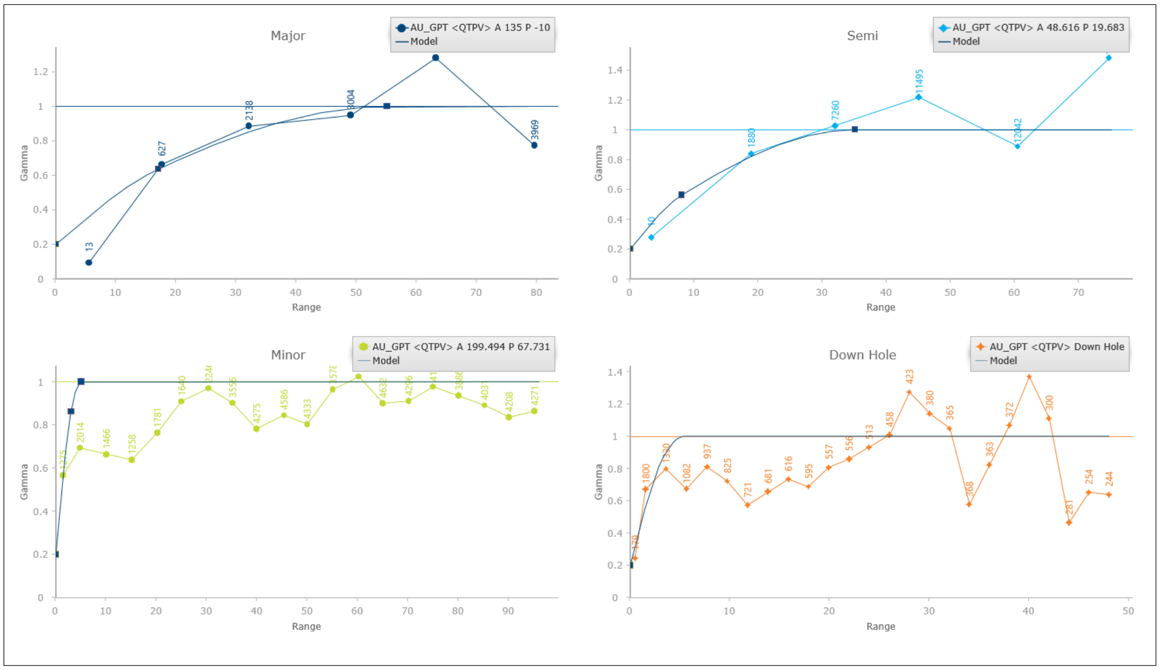
Domain	Limited Search Ellipsoid			
	Threshold Au g/t	Major (m)	Semi-Major (m)	Minor (m)
QTPV	21.0	10.0	10.0	5.0
Trondhjemite	13.0	10.0	10.0	5.0

14.4.3 Search Ellipsoids

The search ellipsoids for grade estimation were developed using variograms for each domain. Variograms were established for each domain for gold grades in the same structural orientations used to develop the mineralised solids. Gold grade variograms for each mineralised domain are shown in Figure 14-52 and 14-53.

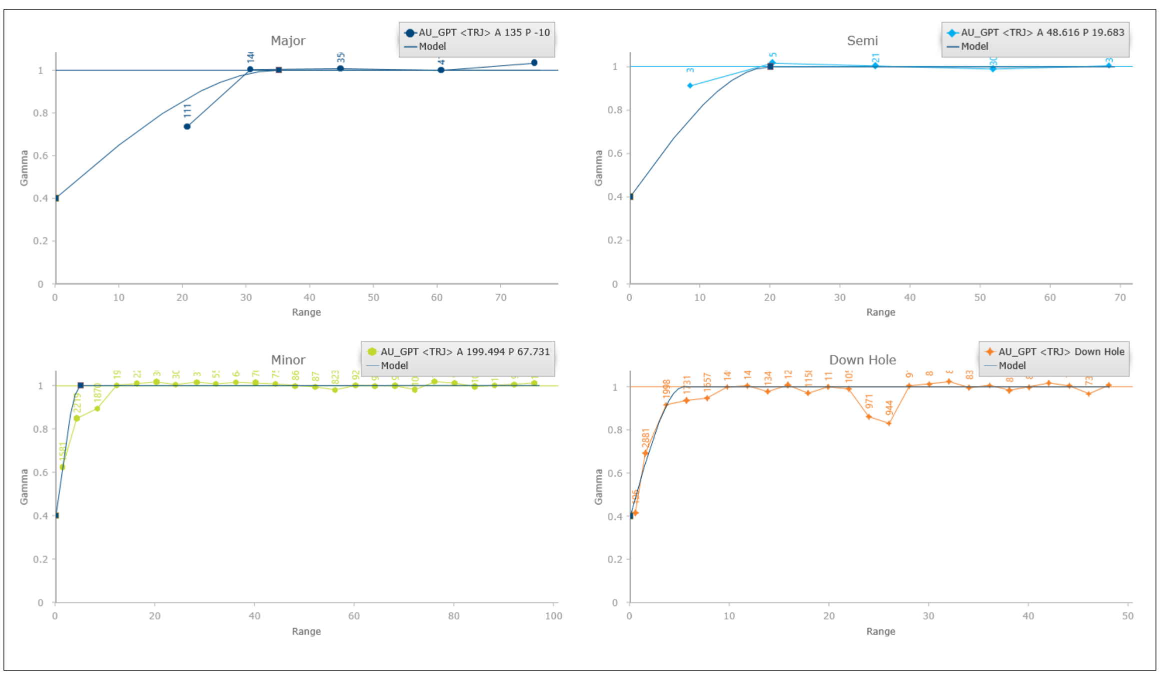
Based on these analyses, the search ellipsoid for each mineralised domain was established as shown in Table 14.33 and 14.34.

Figure 14-52: Sprite Deposit QTPV Variograms



Source: BOYD, 2018

Figure 14-53: Sprite Deposit Trondhjemite Variograms



Source: BOYD, 2018

Table 14.33: Sprite Deposit QTPV Search Ellipsoid

Grade Estimation Pass	1	2	3	4
Major Range (m)	55.0	55.0	55.0	82.5
Semi-Major Range (m)	35.0	35.0	35.0	52.5
Minor Range (m)	5.0	5.0	5.0	7.5
Azimuth (degrees)	135.0	135.0	135.0	135.0
Plunge (plunge of the azimuth in degrees)	-10.0	-10.0	-10.0	-10.0
Dip (degrees	-20.0	-20.0	-20.0	-20.0

Table 14.34: Sprite Deposit Trondhjemite Search Ellipsoid

Grade Estimation Pass	1	2	3	4
Major Range (m)	35.0	35.0	35.0	52.5
Semi-Major Range (m)	20.0	20.0	20.0	30.0
Minor Range (m)	5.0	5.0	5.0	7.5
Azimuth (degrees)	135.0	135.0	135.0	135.0
Plunge (plunge of the azimuth in degrees)	-10.0	-10.0	-10.0	-10.0
Dip (degrees	-20.0	-20.0	-20.0	-20.0

These search parameters were used in the block grade estimation described below.

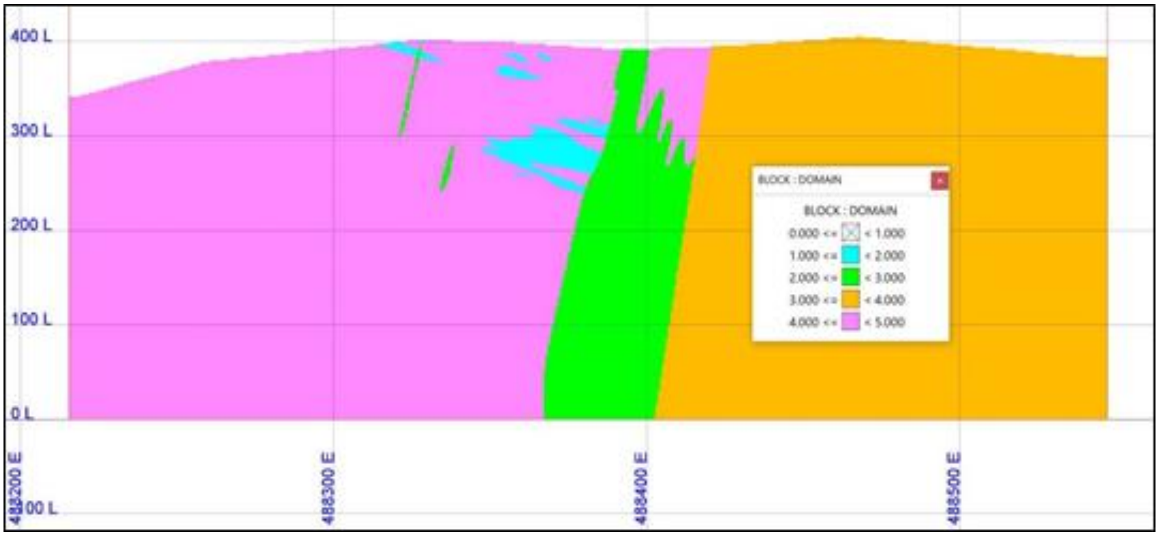
14.4.4 Sprite Deposit Block Model

Table 14.35 shows the Sprite block model extents. Figure 14-54 shows a typical block model section of the mineralised domain.

Table 14.35: Block Model Extents

Item	X	Y	Z
Origin	487,415.320	5,355,737.199	-
Offset Minimum	-	-	-
Offset Maximum	2,502	1,002	450
Parent Block size (m)	6.00	6.00	6.00
Child Block size (m)	2.00	2.00	2.00
Bearing/Dip/Plunge	45.00	-	-

Figure 14-54: Sprite Deposit Typical Mineralised Domain Block Model Cross-section



Source: BOYD, 2018

14.4.5 Sprite Grade Estimation

A 3D block model was constructed in Vulcan that was constrained by the mineralised domains (described above). The current topographic surface was used to flag the vtopo. This variable is set to 100 for a block 100% below the surface and to 0% for a block 100% above the surface. An rdensity was assigned using the following formula:

*rdensity = density * (vtopo/100)*

This procedure ensures that blocks along the topographic surface have the correct density applied during pit optimisation functions.

No attempt was made to apply a block percentage (percent of the block that is material and waste). Blocks are in or out of the mineralised domain. Grade interpolation runs were set up for only that material within the mineralised domain for gold. All domains were run for gold with the exception of the overburden domain, which is assumed to not be mineralised.

Using the composited assays (described above), block grade interpolations were run in each mineralised domain for gold. Runs were completed using ID3. Four passes were run to allow for use in resource classification. Only composites and blocks flagged as within the mineralised domain were considered in the grade estimation.

The block model interpolation parameters are shown in Table 14.36 and Table 14.37.

Table 14.36: Sprite Deposit QTPV Grade Estimation Parameters

Item	Pass			
	1	2	3	4
Search Parameters	**1.00**	**1.00**	**1.00**	**1.50**
Major Range (m)	55.0	55.0	55.0	82.5
Semi-Major Range (m)	35.0	35.0	35.0	52.5
Minor Range (m)	5.0	5.0	5.0	7.5
Azimuth (degrees)	135.0	135.0	135.0	135.0
Plunge (plunge of the azimuth in degrees)	-10.0	-10.0	-10.0	-10.0
Dip (degrees)	-20.0	-20.0	-20.0	-20.0
Search Ellipsoid				
Azimuth (degrees)	135.00	135.00	135.00	135.00
Plunge (plunge of the azimuth in degrees)	-10.00	-10.00	-10.00	-10.00
Dip (degrees)	-20.00	-20.00	-20.00	-20.00
Major (m)	55.00	55.00	55.00	82.50
Semi-Major (m)	35.00	35.00	35.00	52.50
Minor (m)	5.00	5.00	5.00	7.50
Estimation Parameters				
Minimum Number of Composites	4	3	2	2
Maximum Number of Composites	6	6	6	6
Maximum Composites Per Drillhole	2	2	2	2

Table 14.37: Sprite Deposit Trondhjemite Grade Estimation Parameters

Item	Pass			
	1	2	3	4
Search Parameters	**1.00**	**1.00**	**1.00**	**1.50**
Major Range (m)	35.0	35.0	35.0	52.5
Semi-Major Range (m)	20.0	20.0	20.0	30.0
Minor Range (m)	5.0	5.0	5.0	7.5
Azimuth (degrees)	135.0	135.0	135.0	135.0
Plunge (plunge of the azimuth in degrees)	-10.0	-10.0	-10.0	-10.0
Dip (degrees)	-20.0	-20.0	-20.0	-20.0
Search Ellipsoid				
Azimuth (degrees)	135.00	135.00	135.00	135.00
Plunge (plunge of the azimuth in degrees)	-10.00	-10.00	-10.00	-10.00
Dip (degrees)	-20.00	-20.00	-20.00	-20.00
Major (m)	35.00	35.00	35.00	52.50
Semi-Major (m)	20.00	20.00	20.00	30.00
Minor (m)	5.00	5.00	5.00	7.50
Estimation Parameters				
Minimum Number of Composites	4	3	2	2
Maximum Number of Composites	6	6	6	6
Maximum Composites Per Drillhole	2	2	2	2

14.4.6 Sprite Deposit Resource Classification

The mineral resource classification used on the Sprite deposit is based on which pass generated a grade estimate as well as the distance to the nearest neighbour (measured and indicated only). The resource classification used was:

- Measured – Blocks estimated in Pass 1 (minimum of four composites) with a maximum nearest neighbour distance of 15 m are classified as measured. For the Sprite deposit, no blocks could be considered as measured.
- Indicated – Blocks estimated in Pass 2 (minimum of three composites) with a maximum nearest neighbour distance of 25 m are classified as indicated. Only blocks flagged as QTPV could be considered as indicated.
- Inferred – Blocks estimated in Pass 3 (minimum of two composites) are classified as inferred.

Blocks flagged during Pass 4 are not considered in the mineral resource estimate and were populated to provide future exploration guidance to Marathon Gold. Any material flagged with a classification of 4 is considered as waste material.

14.4.7 Sprite Deposit Model Validation

The grade populated block model was reviewed to ensure reasonableness. This review included:

- an overall review of the estimated metal values
- QQ plots of the block model versus the composites
- a section-by-section comparison between the ID3 metal values and the underlying drillholes
- a statistical comparison of the raw assay values versus the composite values versus the block values

The block metal grades were examined to confirm that all the estimation parameters were honoured and kept within the individual mineralised domains. A visual check on a sectional basis showed this to be true with block grades being consistently below the underlying drillhole assay value. Each of the cross-sections was also reviewed and the underlying drillholes were checked to determine that the original metal grade closely matched the estimated block metal grade without exceeding it. Cross-sections were examined, and assay intervals agreed with the overlying estimated block model metal grades. A statistical comparison of the raw assay values versus the composite values versus the estimated block values was run and is shown in Table 14.38.

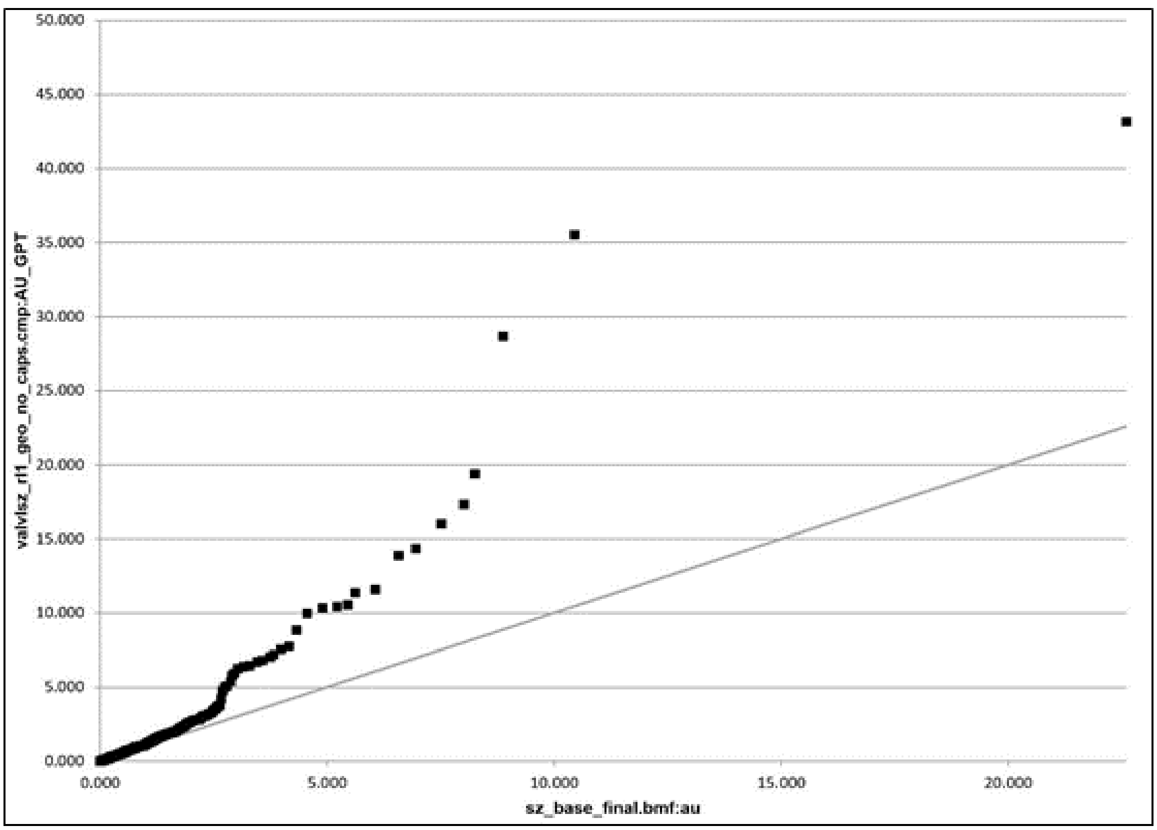
The overall QQ plot of the block model estimated gold grades versus the composites are shown in Figure 14-55.

The block model checks indicate that the mineral resource estimate slightly underestimates the underlying composites at lower gold grade values. At higher gold grades, the block model gold grades are underestimated relative to the underlying composites.

Table 14.38: Sprite Deposit Mineral Resource Estimation Model Statistics

Item	Domain		
	All	QTPV	Trondhjemite
1-Metre Composites			
Number of samples	6,635	1,308	4,683
Minimum	0.002	0.005	0.002
Maximum	72.093	72.093	29.167
Range	72.091	72.088	29.165
Average	0.269	0.838	0.150
Standard deviation	1.836	3.619	0.995
Variance	3.371	13.097	0.990
Coefficient of variance	6.825	4.319	6.633
Block Model Results			
Number of blocks	137,949	41,863	96,083
Minimum	0.000	0.000	0.000
Maximum	39.285	39.285	17.320
Range	39.285	39.285	17.320
Average	0.232	0.492	0.110
Standard deviation	0.839	1.258	0.150
Variance	0.704	1.583	0.023
Coefficient of variance	3.620	2.557	1.364

Figure 14-55: Sprite Deposit Overall QQ Plot



Source: BOYD, 2018

14.4.8 Sprite Deposit Mineral Resource Estimate

The Sprite mineral resource estimate may be amenable to a combination of open pit and underground mining methods. BOYD developed a conceptual pit shell (the economic pit shell) using the Lerchs-Grossman method as provided by the Whittle within which the portions of the block model that show reasonable prospects for economic extraction by open pit mining are defined. Portions of the block model which are external to the conceptual pit shell, but satisfy cut-off grade criteria for an appropriate underground extraction method, are considered to show “reasonable prospects for economic extraction” by underground mining methods.

14.4.8.1 Economic Assumptions

The operating assumptions (economic and gold recovery) used for the Whittle economic open pit optimisation are shown in Table 14.39; the operating assumptions (economic and gold recovery) used for the calculation of an underground cut-off grade are shown in Table 14.40. These assumptions are based on the current feasibility study metallurgical and economic parameters.

Table 14.39: Sprite Open Pit Economic Assumptions

Item	Value	Units
Waste Mining Cost	2.35	C$/t waste
Mill Feed Mining Cost	3.60	C$/t mill feed or heap leach
Mill Processing Cost	10.81	C$/t mill feed
G&A Cost	2.40	C$/t mill feed or heap leach
Mill Gold Recovery (at cut-off)	91.1	%
Exchange	0.76	---
Gold Price	1,500	US$/troy oz
Mill Cut-off	0.30	g/t

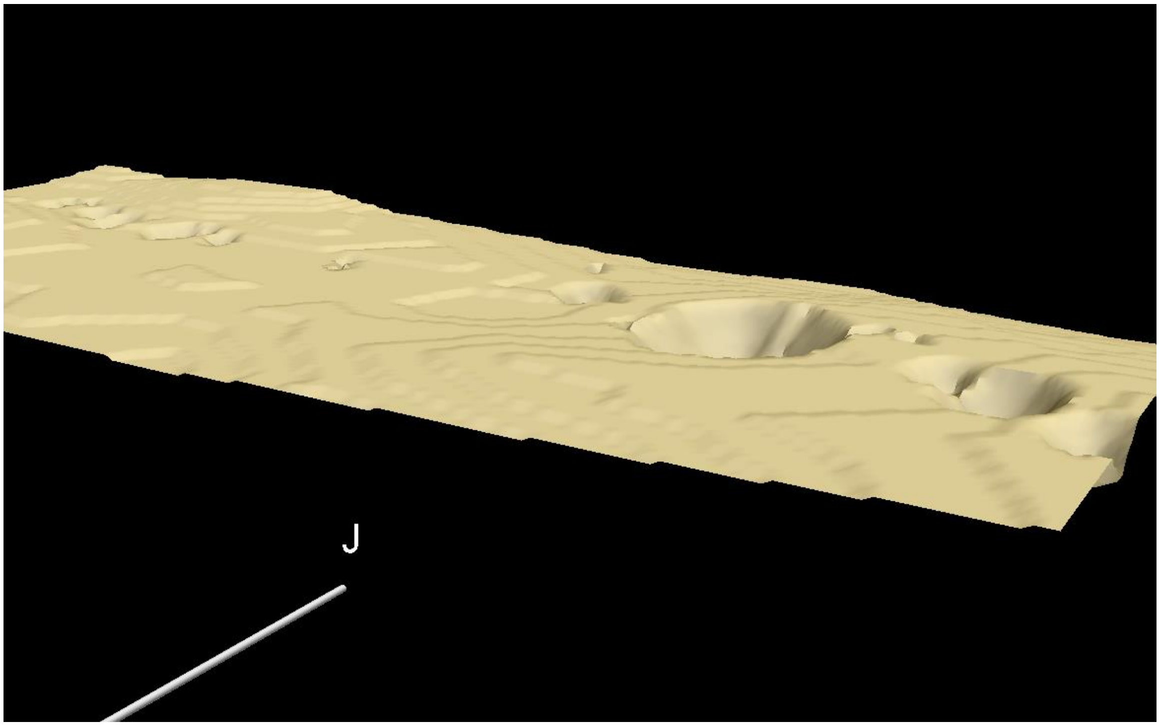
Table 14.40: Sprite Underground Economic Assumptions

Item	Value	Units
Mill Feed Mining Cost	71.00	C$/t mill feed
Processing Cost	10.81	C$/t material
G&A Cost	2.40	C$/t material
Recovery (at cut-off)	92.7	%
Exchange	0.76	---
Gold Price	1,500	US$/troy oz
Calculated Cut-off	1.44	g/t

For mineral resources estimation, a cut-off grade of 0.30 g/t gold was used for open pit, and a cut-off grade of 1.44 g/t gold was used for underground. The assumed overall pit slope in Whittle was assumed to be 48.0° in non-sediment rocks and 42.0° in sediment rocks not including ramps.

Using these assumptions, a Whittle economic pit optimisation was completed, and an economic open pit shell generated. This pit shell was used to design a final PEA pit which is shown in Figure 14-56.

Figure 14-56: Sprite Deposit Whittle Pit Shell



Source: BOYD, 2020.

14.4.8.2 Mineral Resource Estimate

BOYD's estimated mineral resources for the Sprite deposit are shown in Table 14.41.

Table 14.41: Sprite Deposit Mineral Resources

Measured and Indicated Mineral Resource Estimate

Mining Method	Resource Classification	Gold Cut-off Grade (g/t)	Tonnes	Au g/t	Au Troy Ozs
Open Pit - High Grade	Measured	0.70	0	0.000	0
Open Pit - High Grade	Indicated	0.70	408,000	2.630	34,500
Open Pit - High Grade	**Measured + Indicated**	**0.70**	**408,000**	**2.630**	**34,500**
Open Pit - Low Grade	Measured	0.30	0	0.000	0
Open Pit - Low Grade	Indicated	0.30	287,000	0.467	4,300
Open Pit - Low Grade	**Measured + Indicated**	**0.30**	**287,000**	**0.467**	**4,300**
Total Open Pit	Measured	0.30	0	0.000	0
Total Open Pit	Indicated	0.30	695,000	1.737	38,800
Total Open Pit	**Measured + Indicated**	**0.30**	**695,000**	**1.737**	**38,800**
Underground	Measured	1.44	0	0.000	0
Underground	Indicated	1.44	6,000	2.196	400
Underground	**Measured + Indicated**	**1.44**	**6,000**	**2.196**	**400**
Open Pit + Underground	Measured	0.30	0	0.000	0
Open Pit + Underground	Indicated	0.30	701,000	1.741	39,200
Open Pit + Underground	**Measured + Indicated**	**0.30**	**701,000**	**1.741**	**39,200**

Inferred Mineral Resource Estimate

Mining Method	Resource Classification	Gold Cut-off Grade (g/t)	Tonnes	Au g/t	Au Troy Ozs
Open Pit - High Grade	Inferred	0.70	585,000	1.960	36,900
Open Pit - Low Grade	Inferred	0.30	604,000	0.462	9,000
Total Open Pit	Inferred	0.30	1,189,000	1.199	45,900
Underground	Inferred	1.44	61,000	2.468	4,800
Open Pit + Underground	Inferred	0.30	1,250,000	1.261	50,700

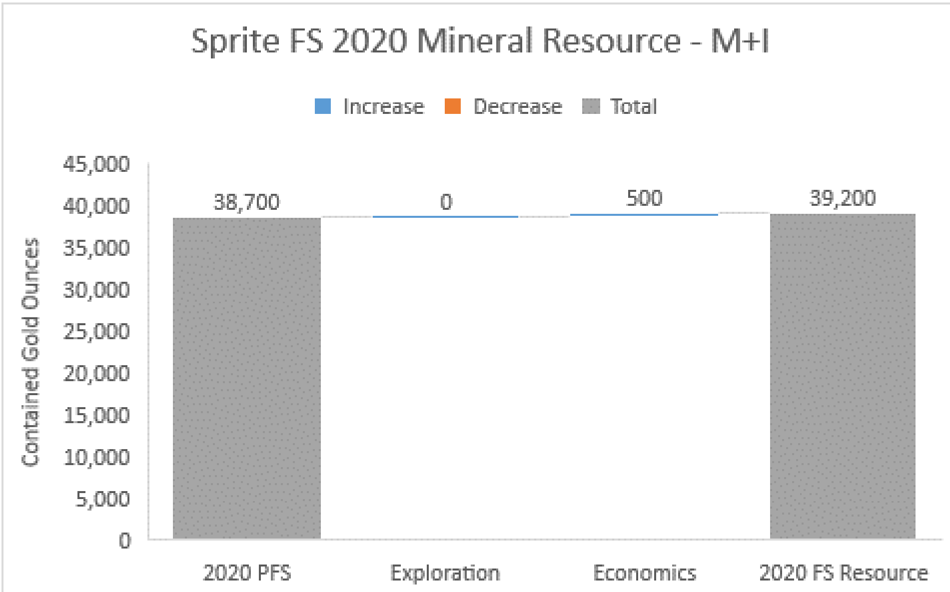
Notes: **1.** The effective date for this mineral resource estimate is November 20, 2020 and is reported on a 100% ownership basis. This estimate is an update to the previous mineral resource estimate (January10, 2020) and reflects revised economic parameters only. The qualified person for the mineral resource estimate is Robert Farmer, P. Eng. **2.** Mineral resources are calculated at a gold price of US$1,500 per troy ounce. **3.** The mineral resources presented above are global and do not include detailed pit or underground designs; only an economic open pit shell was used to determine the in-pit mineral resources. The underground mineral resources are that material outside of the in-pit mineral resources above the stated underground cut-off grade. **4.** Mineral resources, which are not mineral reserves, do not have demonstrated economic viability. The estimate of mineral resources may be materially affected by environmental, permitting, legal, title, socio-political, marketing, or other relevant issues. **5.** The mineral resources presented here were estimated using a block model with a block size of 6 m x 6 m x 6 m sub-blocked to a minimum block size of 2 m x 2 m x 2 m using ID3 methods for grade estimation. All mineral resources are reported using an open pit gold cut-off of 0.30 g/t Au and an underground gold cut-off of 1.44 g/t Au. Higher gold grades were capped by mineralised domain. Material above a 0.70 g/t gold cut-off is considered high-grade while material between a 0.30 and 0.70 g/t gold cut-off is considered low-grade. **6.** The mineral resources presented here were estimated using the Canadian Institute of Mining, Metallurgy and Petroleum (CIM), CIM Standards on Mineral Resources and Reserves, Definitions and Guidelines prepared by the CIM Standing Committee on Reserve Definitions and adopted by CIM Council May 10, 2014. **7.** Figures are rounded, and totals may not add correctly.

14.4.8.3 Changes from the Previous Mineral Resource Estimate

Changes from the previous pre-feasibility study mineral resource estimate (January 10, 2020) are shown in Figures 14-57 and 14-58.

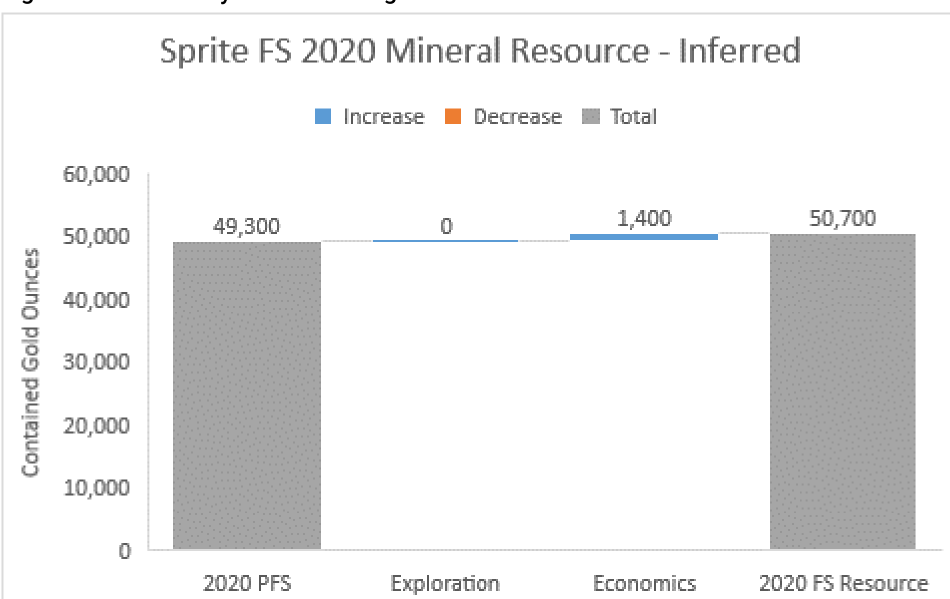
At Sprite, the only change since the pre-feasibility mineral resource estimate (January 10, 2020) was the addition of updated feasibility study economics. This had minimal impact of the overall mineral resource estimate.

Figure 14-57: Victory Measured & Indicated Changes from the Previous MRE



Source: BOYD, 2020.

Figure 14-58: Victory Inferred Changes from the Previous MRE



Source: BOYD, 2020.

14.5 Marathon Deposit Mineral Resource Estimate

No additional exploration data were available to update the Marathon deposit geological model and mineral resource estimate. Changes to the mineral resource estimate for the Marathon deposit from those previously reported reflect revisions to the project's technical parameters (e.g., metallurgical recoveries, mining costs, etc.). *Other than the changes to the technical parameters, there are no changes from the previous April 21, 2020 Pre-feasibility Technical Report.*

The Marathon mineral resource is contained in a series of flat-lying, gold-bearing QTPV with an azimuth of 125°, a plunge of -10°, and a dip of -30°. The highest-grade gold mineralisation is located in the flat QTPV zones within a steeply dipping shear zone northwest of the contact with the sediment unit. Mineralisation extends from this corridor within the QTPV zones towards the northwest and southeast along strike as well as along dip. Gold mineralisation has been shown by exploration drilling to extend up to 1,000 m below the surface and remains unexplored below this depth as well as along the trend of the shear zone to the northeast and southwest.

Potentially economic gold mineralisation is encountered in all major rock units (sediments, mafic dikes, quartz-eye porphyry, and gabbro) and although the clear majority of the mineral resource is contained in QTPV zones within these rock units, some mineralisation occurs in areas with no significantly logged QTPV mineralisation. In fact, these areas probably do include QTPV mineralisation in that many of the areas included very minor occurrences of QTPV within the logging, but not enough to be considered significant to note in the logging.

14.5.1 Marathon Deposit Data

14.5.1.1 Drillholes

The estimate of mineral resources reported herein for the Marathon deposit is based on all drillholes whose assays were available by November 21, 2019 and consists of 487 diamond core drillholes totalling approximately 146,145 m. Figure 14-59 on the following page shows the collars of these drillholes.

14.5.1.2 Assays

Of the 105,965 gold assays available as of November 21, 2019, all were used. For unsampled intervals, gold grade values were set to zero. All gold grades were determined from fire or metallic screened assays. Total assayed sample length is 146,145 m.

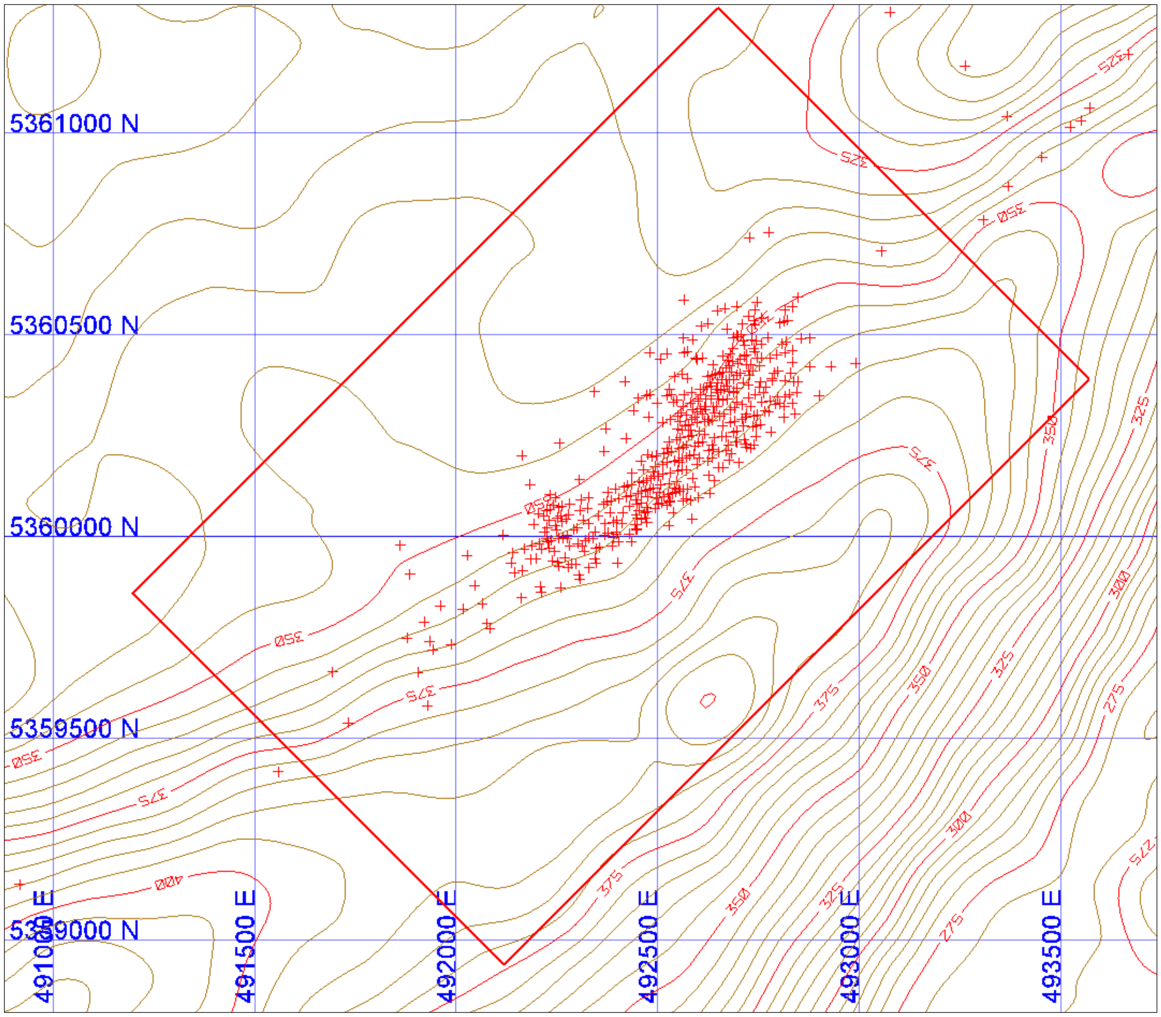
14.5.1.3 Density

To date, there have been 1,755 density measurements taken at the Marathon deposit. The results of these measurements are shown in Table 14.42. Block densities were assigned based on the block's domain of lithology type.

Table 14.42: Marathon Density Measurements

Lithology Type	Samples	Specific Gravity t/m
Mafic Dikes	292	2.72
Quartz-Tourmaline- Pyrite Veins	388	2.60
Sediments	14	2.64
Quartz-Eye Porphyry	1,061	2.61
Trondhjemite	---	2.61
Overburden	---	1.50

Figure 14-59: Marathon Drillhole Locations & Topography



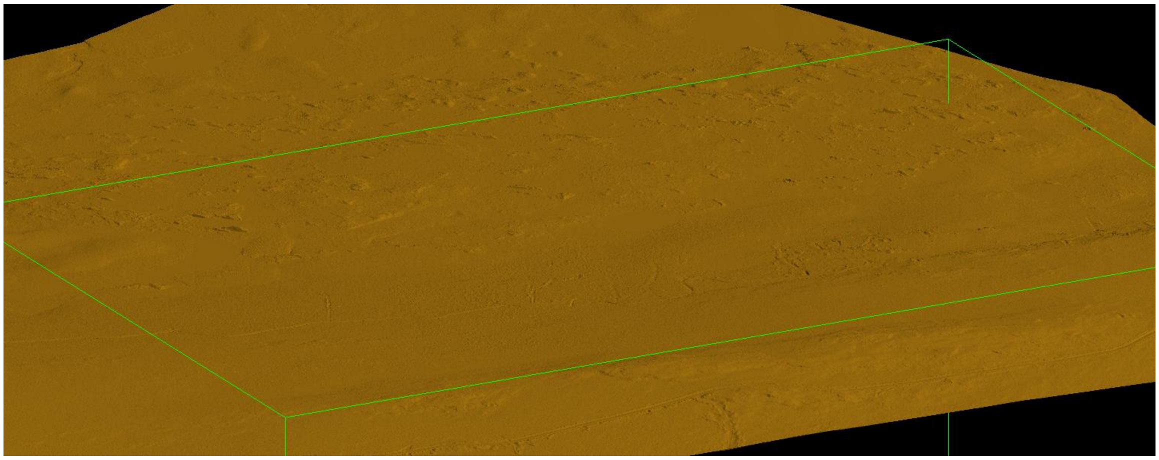
Source: BOYD, 2020.

14.5.1.4 Topography

The topography of the area around the Marathon deposit is shown on Figure 14-60. All contours are expressed in metres above sea level. Contour intervals are every 5 m. The Marathon deposit sits along the north edge of a northeast-trending ridge. The deposit area sits on the downward (towards the northwest) side of the ridge and is somewhat steep towards the top of the ridge while being fairly flat towards the base of the ridge.

For the pre-feasibility study work, a new Lidar topographic survey was completed. This survey is the topographic basis for all mineral resource related work described in this section for the feasibility study and is shown in Figure 14-60.

Figure 14-60: Marathon Lidar Topographic Surface



Source: BOYD, 2020.

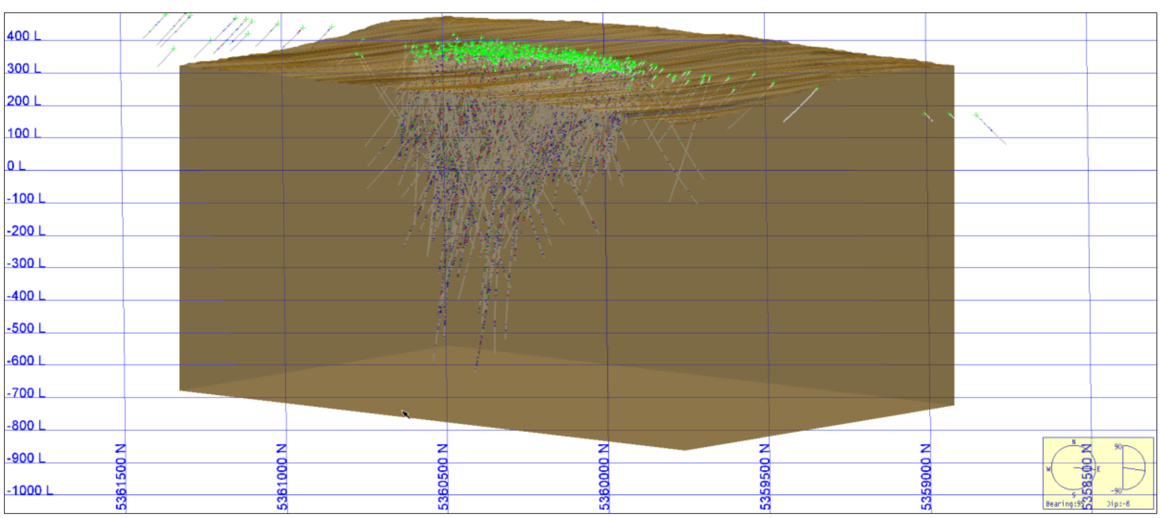
14.5.2 Marathon Deposit Data Analysis

14.5.2.1 Geological Modelling

The Marathon deposit contains five major potentially mineralised domains. These domains are the sediment (SED), quartz-eye porphyry (QEPOR), gabbro (GAB), quartz-tourmaline-pyrite veins (QTPV), and mafic dike (MD) intruding into the QEPOR, GAB, and QTPV domains. Additionally, surface overburden was also noted in the drill logs, but was not considered as a potentially mineralised host.

Geological modelling of these units is based on the logged geology, as well as interpretations made by Marathon Gold staff. On every 10 m cross-section through the deposit, a line was drawn reflecting the actual or projected overburden surface below the topography. These lines were then used to construct the rock/overburden surface to constrain compositing, geologic implicit models, as well as block modelling. The overburden surface is shown in Figure 14-61.

Figure 14-61: Marathon Base of Overburden

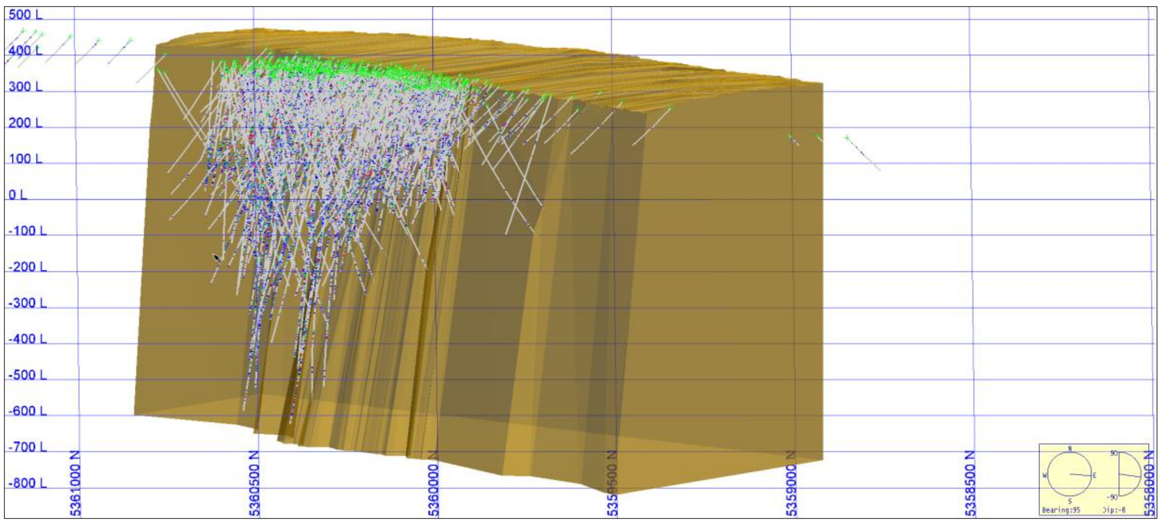


Source: BOYD, 2020.

The SED/QEPOR contact was determined by drillhole intercepts or projections between intercepts and a surface constructed to represent this geologic contact. This was completed on every 10 m section through the deposit where data were available. This contact was then used to construct a solid model of the SED domain below the overburden horizon. The SED unit is shown in Figure 14-62.

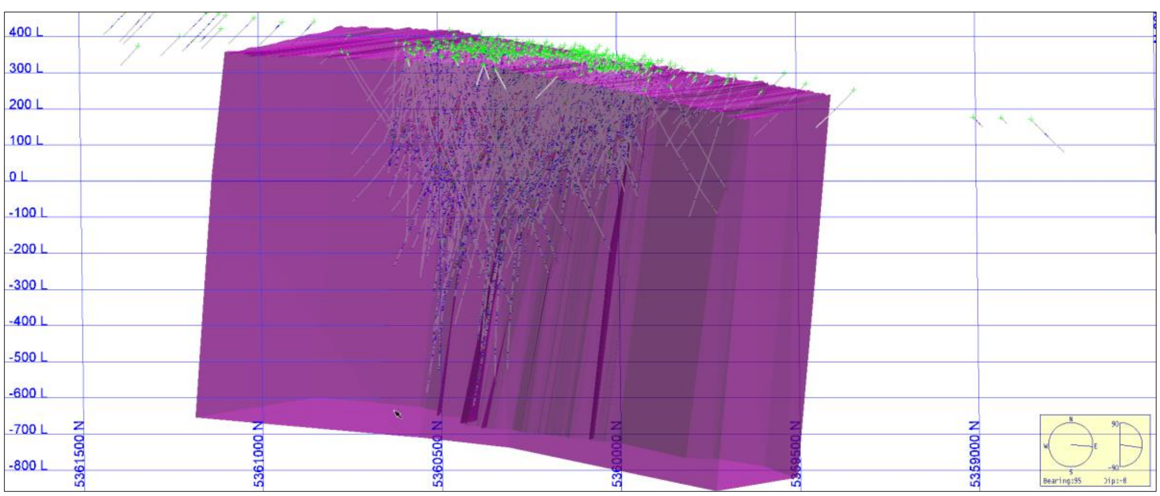
The QEPOR domain is the rock mass northwest of the sediment solid and southeast of the GAB contact and below the overburden horizon. The QEPOR domain is shown in Figure 14-63. The GAB domain is located northwest of the QEPOR and is shown in Figure 14-64.

Figure 14-62: Marathon Sediment Domain



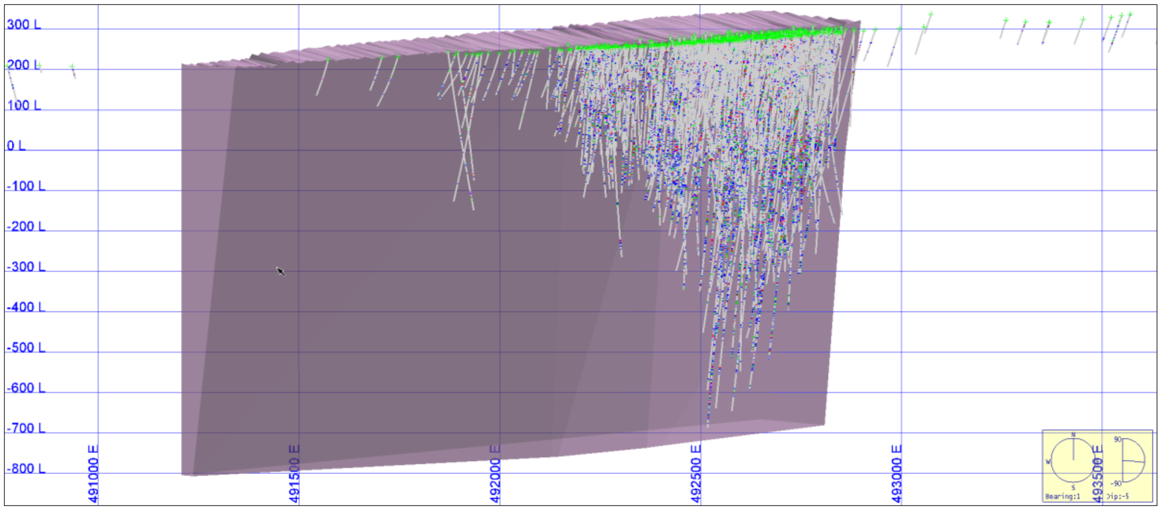
Source: BOYD, 2020.

Figure 14-63: Marathon Quartz-Eye Porphyry Domain



Source: BOYD, 2020.

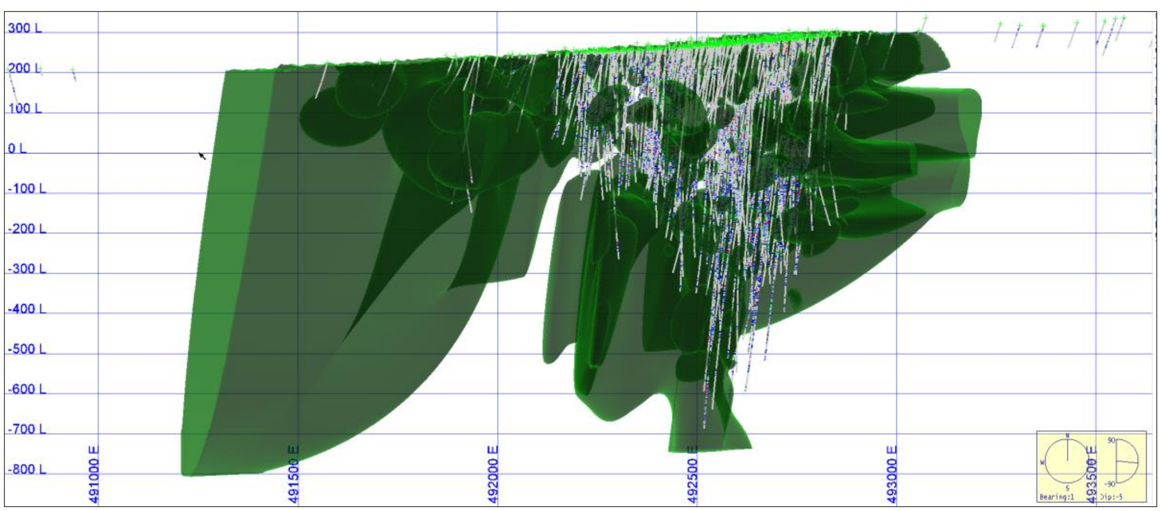
Figure 14-64: Marathon Gabbro Domain



Source: BOYD, 2020.

For the MD domain, implicit modelling was used to develop a geological solid based on the intercepts within the Marathon Gold drillhole database. The implicit model used an azimuth of 250°, plunge of 0°, and a dip of -80° with search of 100 m in the major axis, 100 m in the semi-major axis, and 5 m in the minor axis. Based on discussions with Marathon Gold geologic staff, the mafic dikes have been truncated by the sediments and cut the QTPV zones; as such, MD solid is clipped by the sediments. The mafic dike domain is shown in Figure 14-65.

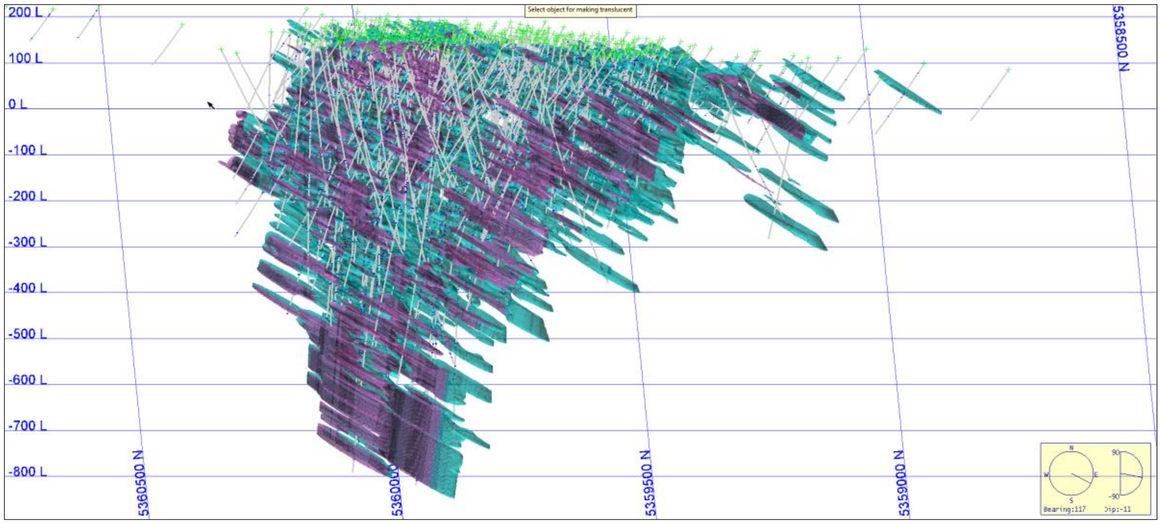
Figure 14-65: Marathon Mafic Dike Domain



Source: BOYD, 2020.

Attempts to model the QTPV zones at Marathon resulted in less than satisfactory results so a different approach using the implicit modelling was used to define the mineralised zone. Instead of using the logged QTPV zones, a 100-ppb gold grade threshold was used to generate a grade shell to limit mineralisation. This threshold approximates the QTPV zones at Marathon. The implicit model used an azimuth of 125°, plunge of -10°, and a dip of -30° with search of 100 m in the major axis, 100 m in the semi-major axis, and 5 m in the minor axis. The resulting solid was then clipped by the sediments. The zone is considered the QTPV domain for Marathon. The QTPV domains are shown in Figure 14-66.

Figure 14-66: Marathon QTPV Domains (light blue = footwall, purple = hanging wall)



Source: BOYD, 2020.

The SED, MD, QEPOR, GAB, and QTPV domains can be potentially mineralised and were used to flag drillholes used to construct the composites for later variography and geostatistics. For the mineral resource estimate, only the QTPV, MD, and QEPOR domains could be considered for estimation. The other domains did not have enough data to support a mineral resource estimate.

14.5.2.2 Drillhole Descriptive Statistics

Descriptive statistics were generated for individual domains as well as the overall exploration database for gold grades. The results of this analysis are shown in Table 14.43.

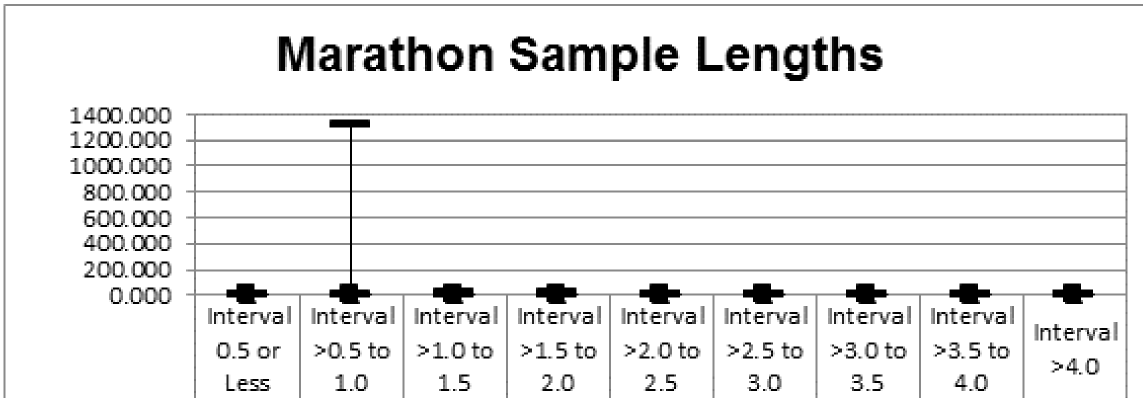
Table 14.43: Marathon Descriptive Statistics

Item	All	QTPV	Mafic Dikes	Quartz-Eye Porphyry
Number of Samples	64,342	37,221	2,213	19,367
Minimum	0.010	0.010	0.010	0.010
Maximum	1,313.714	43.092	63.569	3.515
Range	1,313.704	43.082	63.559	3.505
Average	0.880	0.647	0.379	0.064
Standard Deviation	8.610	1.408	2.118	0.109
Variance:	74.132	1.982	4.486	0.012
Coefficient of Variance	9.784	2.176	5.588	1.691

14.5.2.3 Compositing

Sample length statistics were run on the assay database examining the number of samples for sample lengths in 0.5 m increments through a total length of 4.0 m. The purpose of this analysis is to determine what sample length was associated with the total number of samples. The boxplot in Figure 14-67 shows the results of this analysis.

Figure 14-67: Marathon Drillhole Sample Lengths



	Interval 0.5 or Less	Interval >0.5 to 1.0	Interval >1.0 to 1.5	Interval >1.5 to 2.0	Interval >2.0 to 2.5	Interval >2.5 to 3.0	Interval >3.0 to 3.5	Interval >3.5 to 4.0	Interval >4.0
Q1	0.007	0.008	0.005	0.005	0.005	0.008	0.000	0.030	0.626
Min	0.005	0.001	0.005	0.005	0.005	0.005	0.000	0.030	0.626
Median	0.021	0.065	0.005	0.005	0.005	0.036	0.000	0.031	0.626
Mean	0.170	0.794	0.266	0.037	0.016	0.199	0.000	0.031	0.626
Max	1.164	1313.71	19.211	18.514	0.476	2.158	0.000	0.031	0.626
Q3	0.115	0.349	0.022	0.009	0.006	0.089	0.000	0.031	0.626
NSamples	9	65590	203	40080	61	14	0	2	1

Source: BOYD, 2020.

In examining the results of this analysis, most samples with potentially economic gold mineralisation were taken at a length of 1.0 m or less. A total of 61.9% of all assays were taken at 1 metre or less containing 97.1% of the total contained metal. Based on this, a composite length of 1.0 m was selected and applied within the confines of the mineralised domains. Composites less than 1.0 m were divided by the run length (1.0 m). This composite length was selected to better reflect the actual breakdown of the mineralisation in the individual drillholes within each mineralised zone.

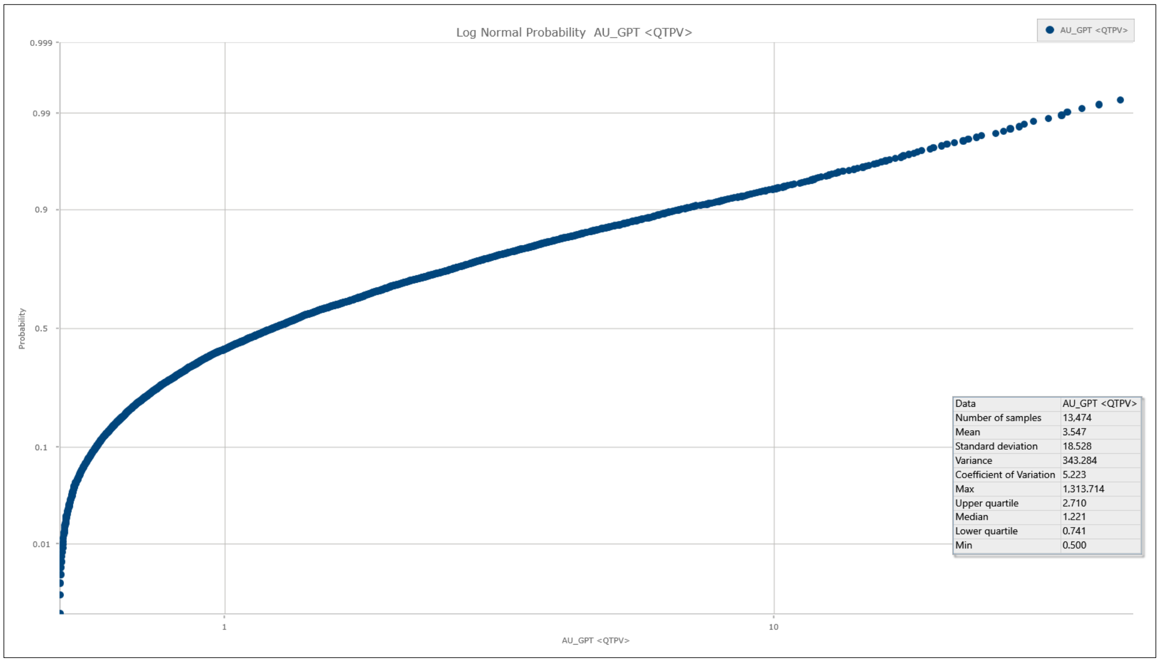
14.5.2.4 High Value Grade Limits

High outlier metal values can skew the resulting grade estimate if they are not accounted for with some sort of limitation or grade capping value applied to the underlying assay database. To determine this, a lognormal probability plot was generated for gold in each mineralised domain.

To determine high value gold grade outliers, several methods were considered. These included a 1 troy ounce gold grade cap, the mean plus the standard deviation, four times the mean, five times the mean, lognormal, and decile analysis. All of these methods were reviewed, and the resulting potential grade caps/threshold were determined. For the Marathon deposit, the lognormal graph was considered the best method to establish a capping/threshold value. This is due to the very smooth lognormal results in all estimation domains.

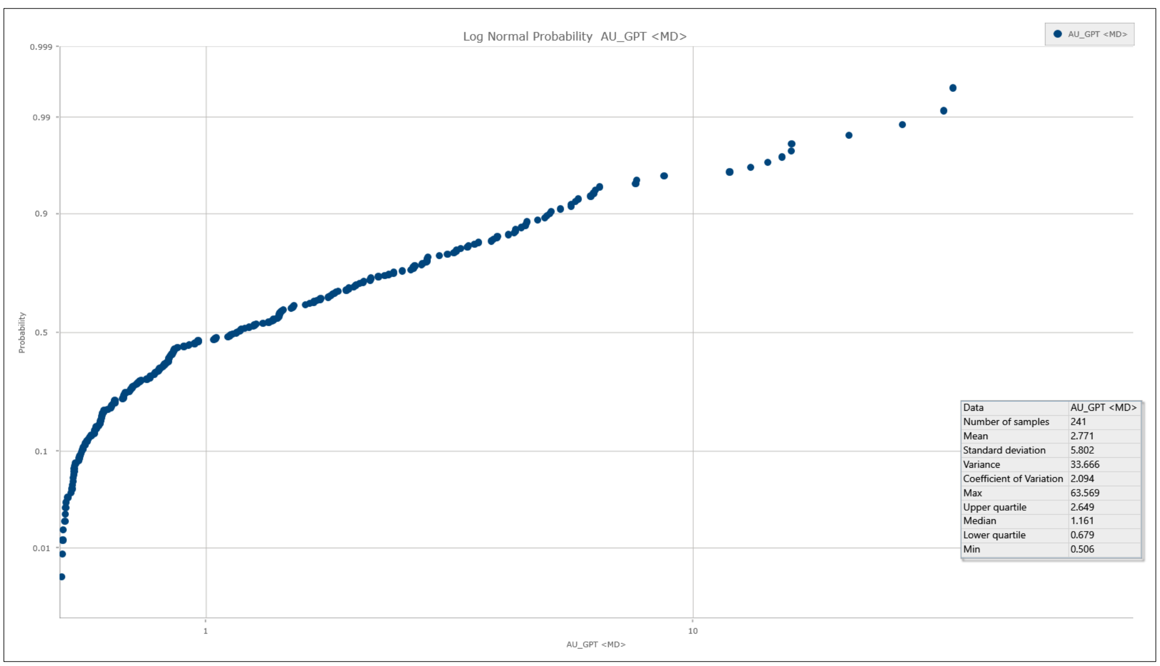
Threshold metal grades were selected from the lognormal plot at the point where the data starts to break up or where there is a significant slope change in the plot. The lognormal probability plots for gold found in each mineralised domain are shown in Figures 14-68 through 14-70.

Figure 14-68: Log Normal Probability for the QTPV Domain



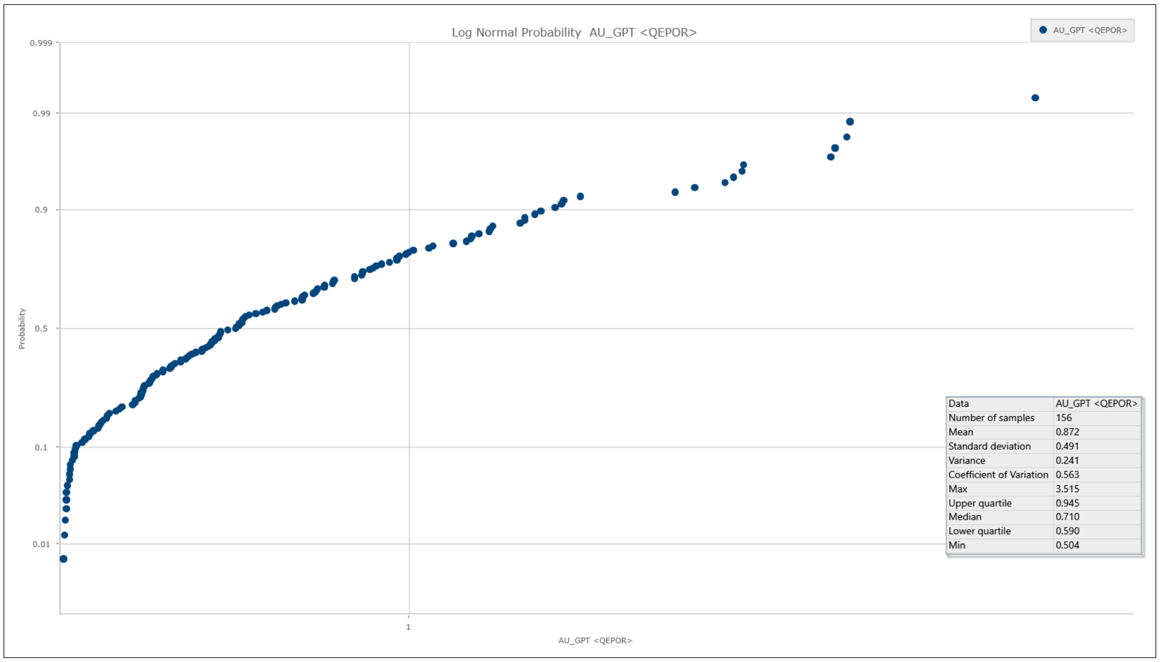
Source: BOYD, 2020.

Figure 14-69: Log Normal Probability for the MD Domain



Source: BOYD, 2020.

Figure 14-70: Log Normal Probability for the QEPOR Domain



Source: BOYD, 2020.

The lognormal probability graphs above were used to determine a gold threshold grade to limit the area of influence of gold grades higher than the threshold. The area of influence was developed using indicator variograms to determine the size and extents of above threshold gold-bearing areas by producing a high gold grade search ellipsoid. This search ellipsoid was used to determine the area of influence of above threshold gold grades. This process was completed on all the potentially mineralised domains and the selected metal threshold grades are shown in Table 14.44.

Table 14.44: Marathon Threshold Grades

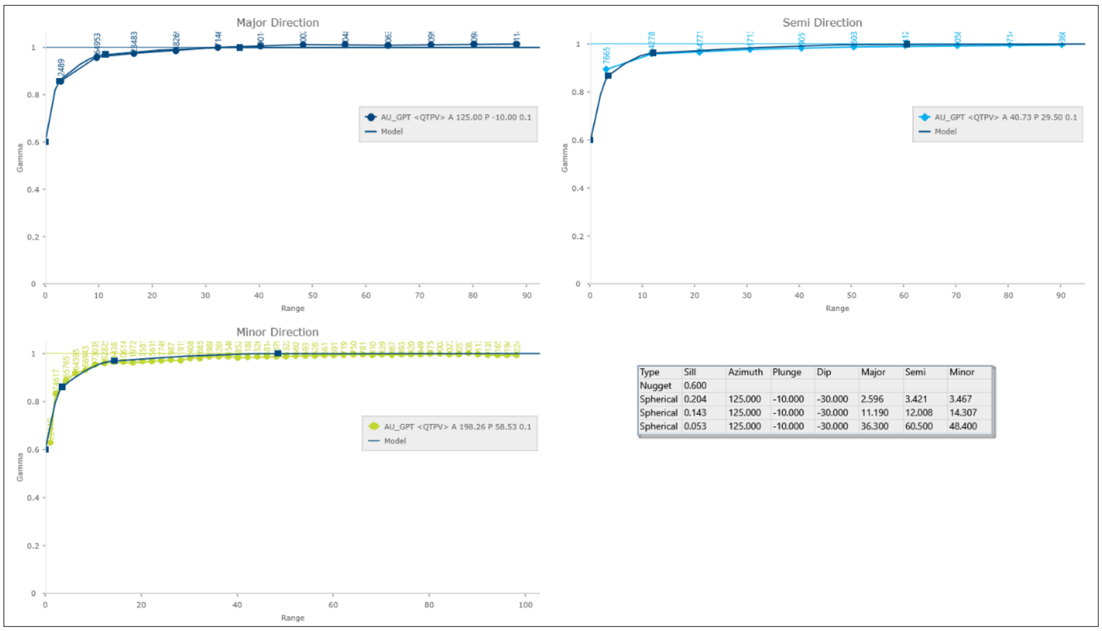
Item	QTPV	MD	QEPOR
Extreme Outlier Gold Cap (g/t)	150.0	17.0	2.1
Gold Capping Grade (Au g/t)	45.0	5.5	1.5
Azimuth (degrees)	125.0	125.0	125.0
Plunge (degrees)	-10.0	-10.0	-10.0
Dip (degrees)	-30.0	-30.0	-30.0
Major Search (m)	13.0	10.0	24.6
Semi-Major Search (m)	15.0	5.0	21.3
Minor Search (m)	2.7	5.0	2.0

Threshold gold grades were applied during the grade estimation runs to limit the influence of the higher-grade outliers in the composites. The extreme outliers were used to hard cap gold grades at gold values that exceeded this number. This cap was determined using a lognormal graph and selecting a value where the extreme outliers appeared to lose lognormal continuity.

14.5.3 Search Ellipsoids

The search ellipsoids for grade estimation were developed using variograms for each domain. Variograms were established in each domain for gold grades in the same structural orientations used to develop the mineralised solids. Gold grade variograms for each mineralised domain are shown in Figures 14-71 through 14-73.

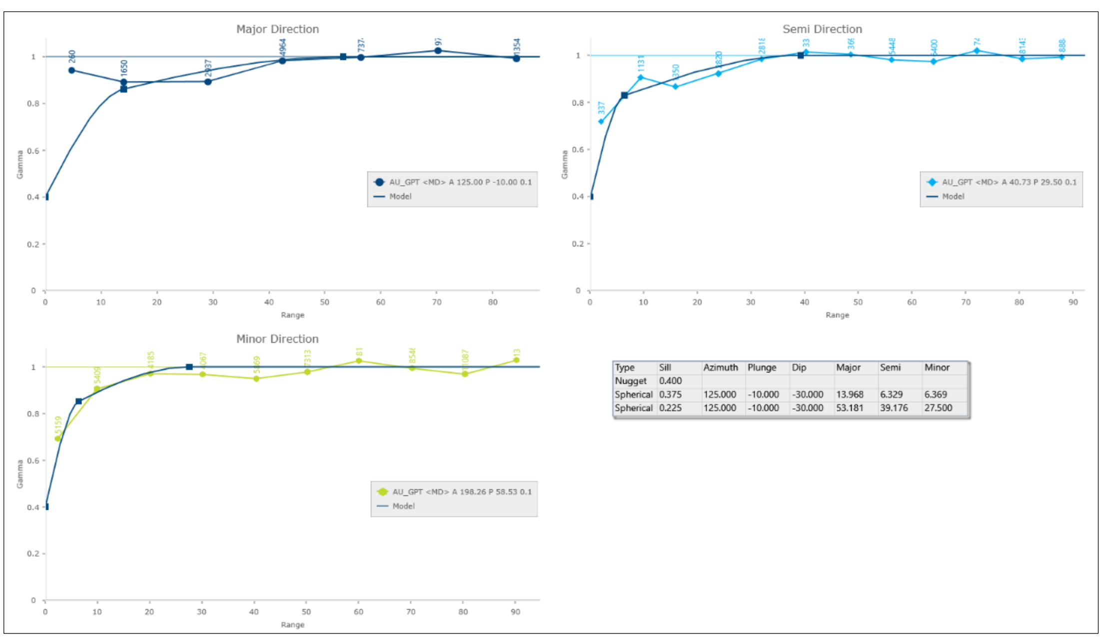
Figure 14-71: Marathon QTPV Variograms



Type	Sill	Azimuth	Plunge	Dip	Major	Semi	Minor
Nugget	0.600						
Spherical	0.204	125.000	-10.000	-30.000	2.596	3.421	3.467
Spherical	0.143	125.000	-10.000	-30.000	11.190	12.008	14.307
Spherical	0.053	125.000	-10.000	-30.000	36.300	60.500	48.400

Source: BOYD, 2020.

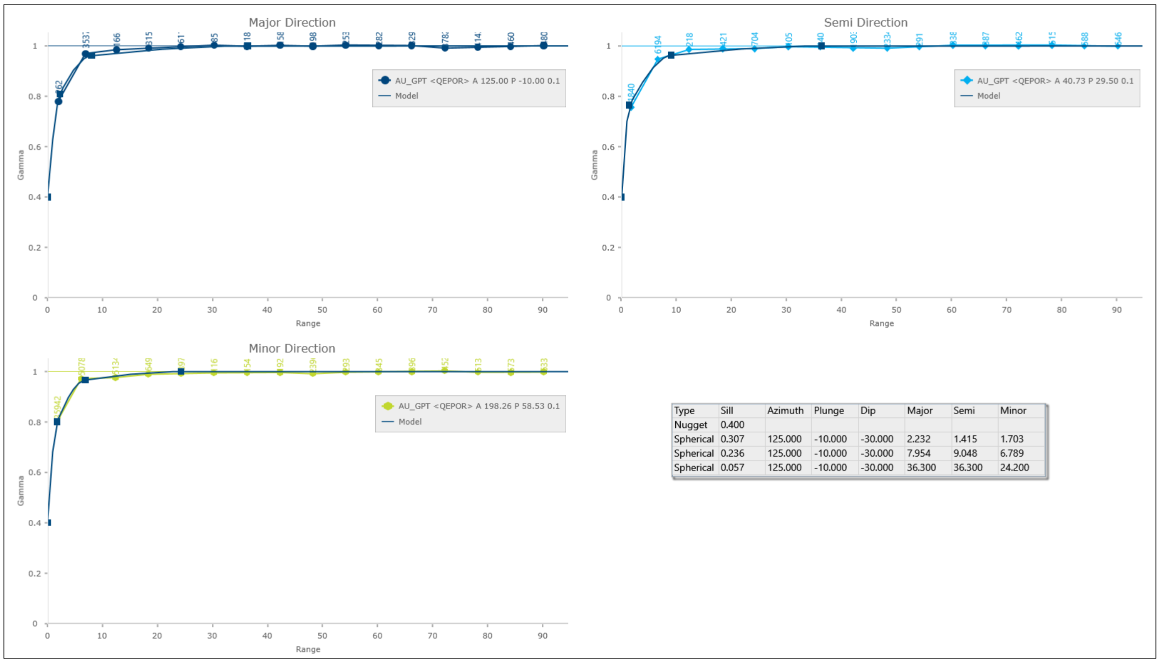
Figure 14-72: Marathon Mafic Dike Variograms



Type	Sill	Azimuth	Plunge	Dip	Major	Semi	Minor
Nugget	0.400						
Spherical	0.375	125.000	-10.000	-30.000	13.968	6.329	6.369
Spherical	0.225	125.000	-10.000	-30.000	53.181	39.176	27.500

Source: BOYD, 2020.

Figure 14-73: Marathon Quartz-Eye Porphyry Variograms



Source: BOYD, 2020.

Based on these analyses, the search ellipsoid for each mineralised domain was established as shown in Tables 14.45 through 14.47. These search parameters were used in the block grade estimation described below.

Table 14.45: Marathon QTPV Search Ellipsoid

Search Parameters	Pass		
	1	2	3
Major Range (m)	36.3	36.3	36.3
Semi-Major Range (m)	60.5	60.5	60.5
Minor Range (m)	5.0	5.0	5.0
Azimuth (degrees)	125.0	125.0	125.0
Plunge (plunge of the azimuth in degrees)	-10.0	-10.0	-10.0
Dip (degrees)	-30.0	-30.0	-30.0

Table 14.46: Marathon Mafic Dike Search Ellipsoid

Search Parameters	Pass		
	1	2	3
Major Range (m)	53.2	53.2	53.2
Semi-Major Range (m)	39.2	39.2	39.2
Minor Range (m)	5.0	5.0	5.0
Azimuth (degrees)	125.0	125.0	125.0
Plunge (plunge of the azimuth in degrees)	-10.0	-10.0	-10.0
Dip (degrees)	-30.0	-30.0	-30.0

Table 14.47: Marathon Quartz-Eye Porphyry Search Ellipsoid

Search Parameters	Pass		
	1	2	3
Major Range (m)	36.3	36.3	36.3
Semi-Major Range (m)	36.3	36.3	36.3
Minor Range (m)	5.0	5.0	5.0
Azimuth (degrees)	125.0	125.0	125.0
Plunge (plunge of the azimuth in degrees)	-10.0	-10.0	-10.0
Dip (degrees)	-30.0	-30.0	-30.0

14.5.4 Marathon Deposit Block Model

Table 14.48 shows the Marathon block model extents. Figure 14-74 on the following page shows a typical block model section of the mineralised domain.

Table 14.48: Block Model Extents

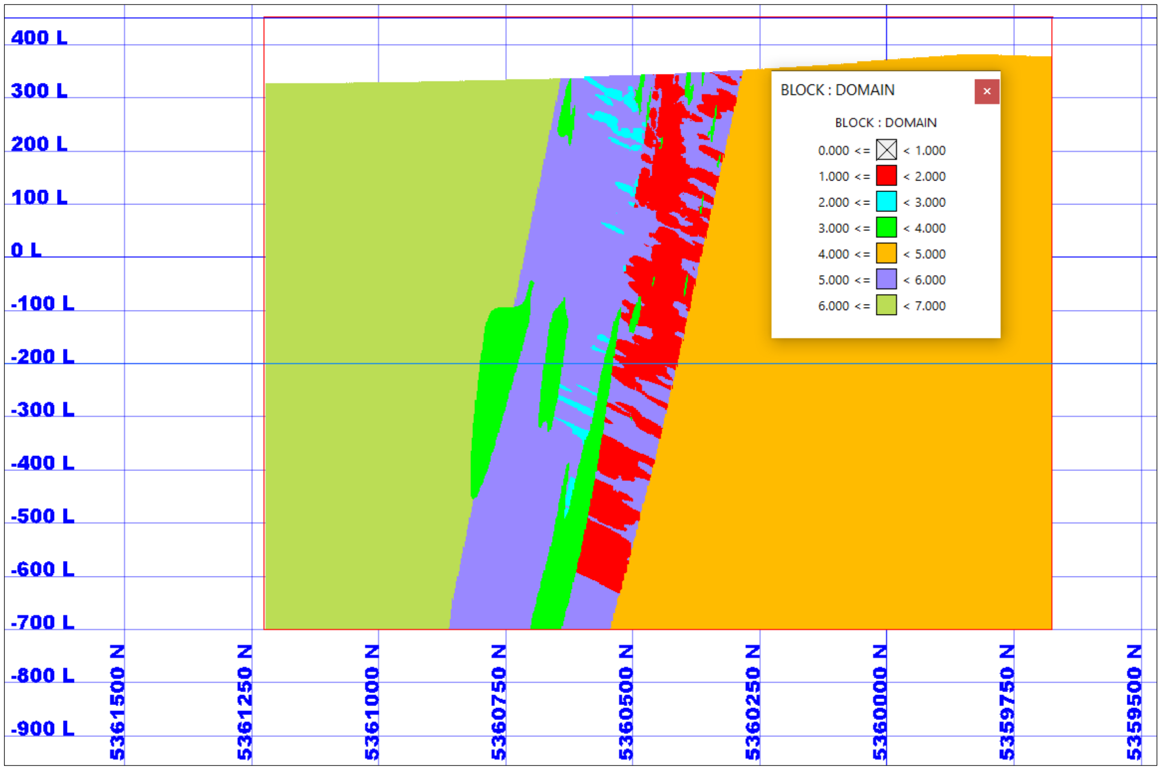
Item	X	Y	Z
Origin	492,119.311	5,358,937.879	-700.000
Offset Minimum	-	-	-
Offset Maximum	2,064	1,308	1,152
Parent Block size (m)	6.00	6.00	6.00
Child Block size (m)	2.00	2.00	2.00
Bearing/Dip/Plunge	45.00	-	-

Four different block models were created for the mineral resource estimate. The purpose of these different block models was to consider the impact of gold grade capping on the total contained metal content in the block models. The four block models included:

- No Cap Model – This block model assumed that no gold grade capping was applied.
- Hard Cap Model – This block model used a fixed hard cap to minimise the impact of high-grade outliers.
- Threshold Cap Model – This block model used a gold grade cap in each domain above which a limited area of influence was applied.
- Hybrid Cap Model – This block model used both a threshold gold cap and an extreme outlier hard gold cap to limit the impact of higher gold grades. This model was used as the basis for the mineral resources reported for the Leprechaun gold deposit.

These four block models were used to examine the impact of gold grade capping on the final mineral resource estimate.

Figure 14-74: Typical Marathon Mineralised Domain Block Model Cross-section



Source: BOYD, 2020.

14.5.5 Marathon Deposit Grade Estimation

A 3D block model was constructed in Vulcan that was constrained by the mineralised domains (described above). The current topographic surface was used to flag the vtopo. This variable is set to 100 for a block 100% below the surface and to 0% for a block 100% above the surface. An rdensity was assigned using the following formula:

rdensity = density * (vtopo/100)

This procedure ensures that blocks along the topographic surface have the correct density applied during pit optimisation functions.

No attempt was made to apply a block percentage (percent of the block that is material and waste). Blocks are in or out of the mineralised domain. Grade interpolation runs were set up for only that material within the mineralised domain for gold. All domains were run for gold with the exception of the overburden domain, which is assumed to not be mineralised.

Using the composited assays (described above), block grade interpolations were run in each mineralised domain for gold. Runs were completed using inverse distance (ID), inverse distance squared (ID2), inverse distance cubed (ID3), inverse distance to the fifth (ID5), ordinary kriging (OK), and nearest neighbour (NN). Three passes were run to allow for use in resource classification. Only composites and blocks flagged as within the same mineralised domain were considered in the grade estimation. Grade estimation parameters are shown in Tables 14.49 through 14.51.

Table 14.49: Marathon QTPV Grade Estimation Parameters

Item	Pass		
	1	2	3
Search Parameters			
Major Range (m)	36.3	36.3	36.3
Semi-Major Range (m)	60.5	60.5	60.5
Minor Range (m)	5.0	5.0	5.0
Azimuth (degrees)	125.0	125.0	125.0
Plunge (plunge of the azimuth in degrees)	-10.0	-10.0	-10.0
Dip (degrees)	-30.0	-30.0	-30.0
Search Ellipsoid			
Azimuth (degrees)	125.0	125.0	125.0
Plunge (plunge of the azimuth in degrees)	-10.0	-10.0	-10.0
Dip (degrees)	-30.0	-30.0	-30.0
Major (m)	36.3	36.3	36.3
Semi-Major (m)	60.5	60.5	60.5
Minor (m)	5.0	5.0	5.0
Estimation Parameters			
Minimum Number of Composites	4	3	2
Maximum Number of Composites	6	6	6
Maximum Composites Per Drillhole	2	2	2
Maximum Distance to Nearest Neighbour (m)	15	25	---
Resource Classification	Measured	Indicated	Inferred

Table 14.50: Marathon Mafic Dikes Grade Estimation Parameters

Item	Pass		
	1	2	3
Search Parameters			
Major Range (m)	53.2	53.2	53.2
Semi-Major Range (m)	39.2	39.2	39.2
Minor Range (m)	5.0	5.0	5.0
Azimuth (degrees)	125.0	125.0	125.0
Plunge (plunge of the azimuth in degrees)	-10.0	-10.0	-10.0
Dip (degrees)	-30.0	-30.0	-30.0
Search Ellipsoid			
Azimuth (degrees)	125.0	125.0	125.0
Plunge (plunge of the azimuth in degrees)	-10.0	-10.0	-10.0
Dip (degrees)	-30.0	-30.0	-30.0
Major (m)	53.2	53.2	53.2
Semi-Major (m)	39.2	39.2	39.2
Minor (m)	5.0	5.0	5.0
Estimation Parameters			
Minimum Number of Composites	4	3	2
Maximum Number of Composites	6	6	6
Maximum Composites Per Drillhole	2	2	2
Maximum Distance to Nearest Neighbour (m)	15	25	---
Resource Classification	---	---	Inferred

Table 14.51: Marathon Quartz-Eye Porphyry Grade Estimation Parameters

Item	Pass		
	1	2	3
Search Parameters			
Major Range (m)	36.3	36.3	36.3
Semi-Major Range (m)	36.3	36.3	36.3
Minor Range (m)	5.0	5.0	5.0
Azimuth (degrees)	125.0	125.0	125.0
Plunge (plunge of the azimuth in degrees)	-10.0	-10.0	-10.0
Dip (degrees)	-30.0	-30.0	-30.0
Search Ellipsoid			
Azimuth (degrees)	125.0	125.0	125.0
Plunge (plunge of the azimuth in degrees)	-10.0	-10.0	-10.0
Dip (degrees)	-30.0	-30.0	-30.0
Major (m)	36.3	36.3	36.3
Semi-Major (m)	36.3	36.3	36.3
Minor (m)	5.0	5.0	5.0
Estimation Parameters			
Minimum Number of Composites	4	3	2
Maximum Number of Composites	6	6	6
Maximum Composites Per Drillhole	2	2	2
Maximum Distance to Nearest Neighbour (m)	15	25	---
Resource Classification	---	---	Inferred

14.5.6 Marathon Deposit Resource Classification

The mineral resource classification used on the Marathon deposit is based on which pass generated a grade estimate as well as the distance to the nearest neighbour (measured and indicated only). The resource classification used was:

- Measured – Blocks estimated in Pass 1 (minimum of four composites) with a maximum nearest neighbour distance of 15 m are classified as measured. Only QTPV blocks in the QTPV footwall domain could be flagged as measured.
- Indicated – Blocks estimated in Pass 2 (minimum of three composites) with a maximum nearest neighbour distance of 25 m are classified as indicated. Only QTPV blocks could be flagged as indicated.
- Inferred – Blocks estimated in Pass 3 (minimum of two composites) are classified as inferred.

14.5.7 Model Validation

The gold grade populated block model was reviewed to ensure reasonableness. These checks included:

- an overall review of the estimated metal values
- the impact of gold grade capping on the mineral resource
- QQ plots of the block model versus the composites

- a section-by-section comparison between the ID3 metal values and the underlying drillholes
- a statistical comparison of the raw assay values versus the composite values versus the block values

The overall block metal grades were visually examined to confirm that all the estimation parameters were honoured and kept within the individual mineralised domains. Each of the cross-sections was reviewed and the underlying drillholes were checked to determine that the original metal grade closely matched the estimated block metal grade without exceeding it. Cross-sections were examined, and assay intervals agreed with the overlying estimated block model metal grades. A statistical comparison of the raw assay values versus the composite values versus the estimated block values was run and is shown in Table 14.52.

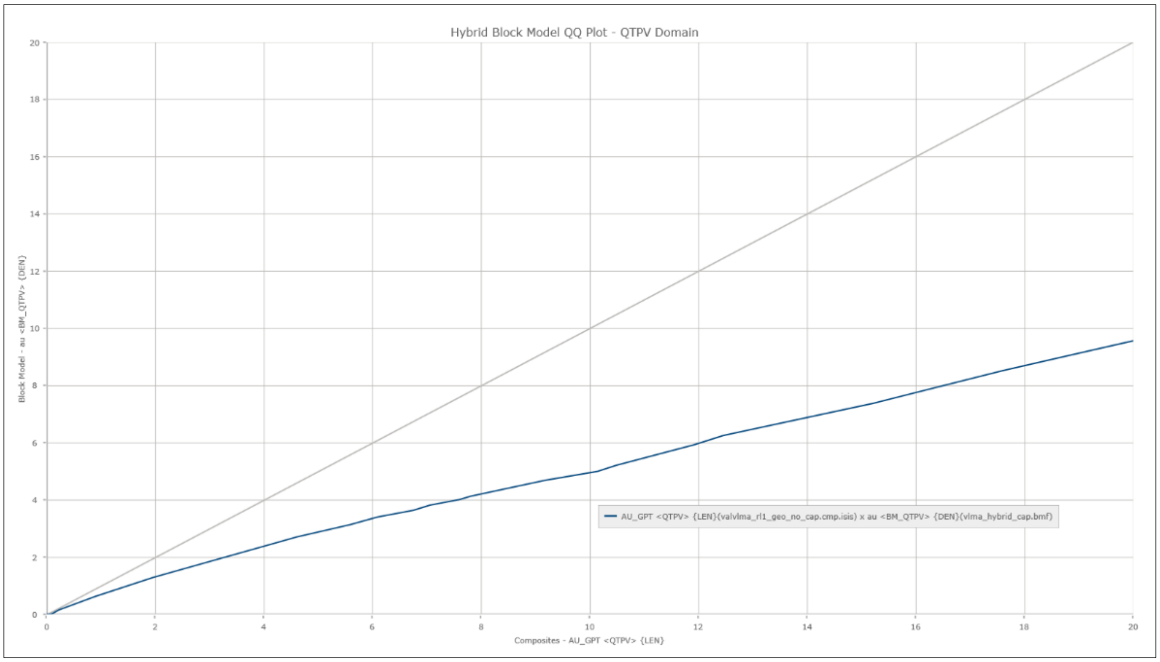
Table 14.52: Marathon Composite & Mineral Resource Estimation Model Statistics

Item	Domain			
	All	QTPV	Mafic Dikes	Quartz-Eye Porphyry
1-Metre Composites				
Number of samples	75,123	44,689	2,908	26,871
Minimum	0.010	0.010	0.010	0.010
Maximum	851.999	851.999	61.868	2.865
Range	851.989	851.989	61.858	2.855
Average	0.734	1.184	0.277	0.050
Standard deviation	6.326	8.160	1.619	0.076
Variance	40.018	66.586	2.621	0.006
Coefficient of variance	8.619	6.892	5.845	1.520
Block Model Results				
Number of blocks	5,973,818	5,656,482	39,974	277,362
Minimum	0.010	0.010	0.010	0.010
Maximum	149.900	149.900	16.909	2.033
Range	149.890	149.890	16.899	2.023
Average	0.790	0.832	0.128	0.036
Standard deviation	2.028	2.076	0.418	0.037
Variance	4.113	4.310	0.175	0.001
Coefficient of variance	2.567	2.495	3.266	1.028

The various mineralised domain QQ plots of the block model estimated ID3 gold grades versus the composites are shown in Figure 14-75 through 14-77.

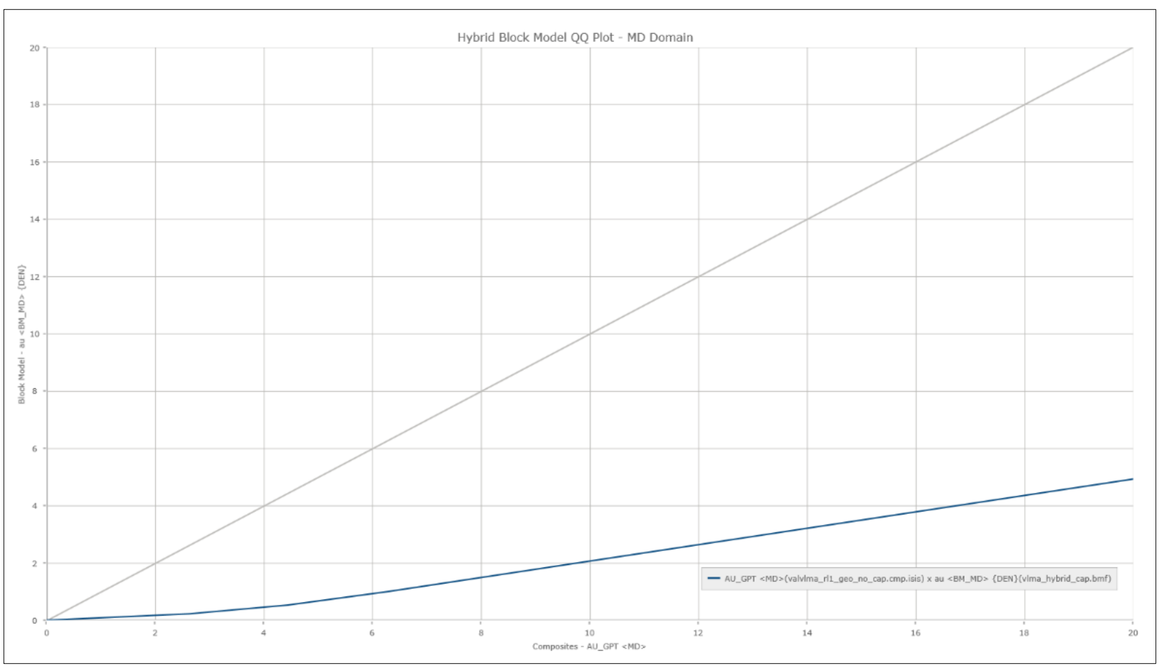
The block model checks indicate that the mineral resource estimate matches the underlying composites at lower gold grade values. At higher gold grades, the block model gold grades are underestimated relative to the underlying composites.

Figure 14-75: Marathon QTPV Domain QQ Plot



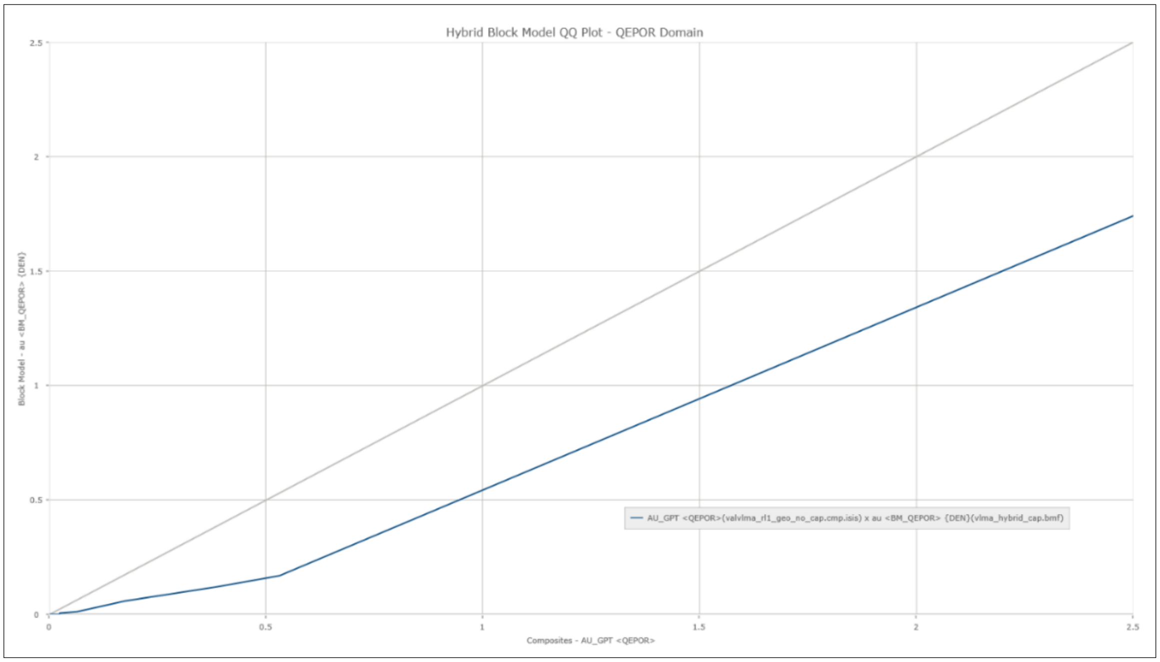
Source: BOYD, 2020.

Figure 14-76: Marathon MD Domain QQ Plot



Source: BOYD, 2020.

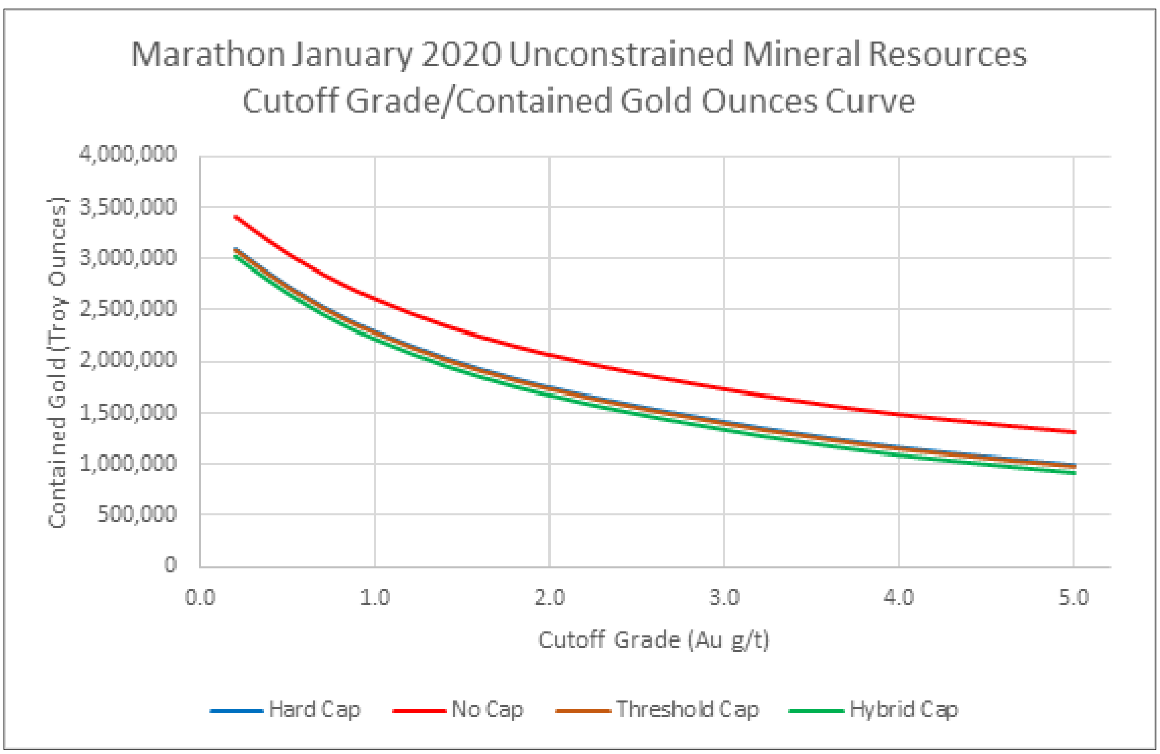
Figure 14-77: Marathon QEPOR Domain QQ Plot



Source: BOYD, 2020.

The impact on total metal content of gold grade capping is shown in Figure 14-78.

Figure 14-78: Marathon Impact of Gold Grade Capping



Source: BOYD, 2020.

The impact of gold grade capping at Marathon showed that the hard-capped block model contained 90.7% of the no capping block model contained gold ounces. The threshold capped block model contained 90.4% of the no capping block model contained ounces. The hybrid capped model (used for the mineral resources) contained 88.6% of the no capping block model contained ounces. It is the opinion of BOYD that the hybrid capped model represents the best estimate of the in-situ mineral resource at Leprechaun and was selected for mineral resource reporting.

14.5.8 Marathon Deposit Mineral Resource Estimate

The Marathon mineral resources may be amenable to a combination of open pit and underground mining methods. BOYD developed a conceptual pit shell (the "economic open pit shell") using the Lerchs-Grossman method as provided by the GEOVIA Whittle software within which the portions of the block model that show reasonable prospects for economic extraction by open pit mining are defined. From this shell, a conceptual open pit was designed and used to constrain the potentially surface mineable mineral resources. Portions of the block model which are external to the conceptual pit shell but satisfy cut-off grade criteria for an appropriate underground extraction method, are considered to show "reasonable prospects for economic extraction" by underground mining methods.

14.5.8.1 Economic Assumptions

The operating assumptions (economic and gold recovery) used for the Whittle economic open pit optimisation are shown in Table 14.53; the operating assumptions (economic and gold recovery) used for the calculation of an underground cut-off grade is also shown in Table 14.54. These assumptions are based on the current feasibility study metallurgical and economic parameters.

Table 14.53: Marathon Open Pit Economic Assumptions

Item	Value	Units
Waste Mining Cost	2.35	C$/t waste
Mill Feed Mining Cost	3.60	C$/t mill feed or heap leach
Mill Processing Cost	10.81	C$/t mill feed
G&A Cost	2.40	C$/t mill feed or heap leach
Mill Gold Recovery (at cut-off)	91.1	%
Exchange	0.76	---
Gold Price	1,500	US$/troy oz
Mill Cut-off	0.30	g/t

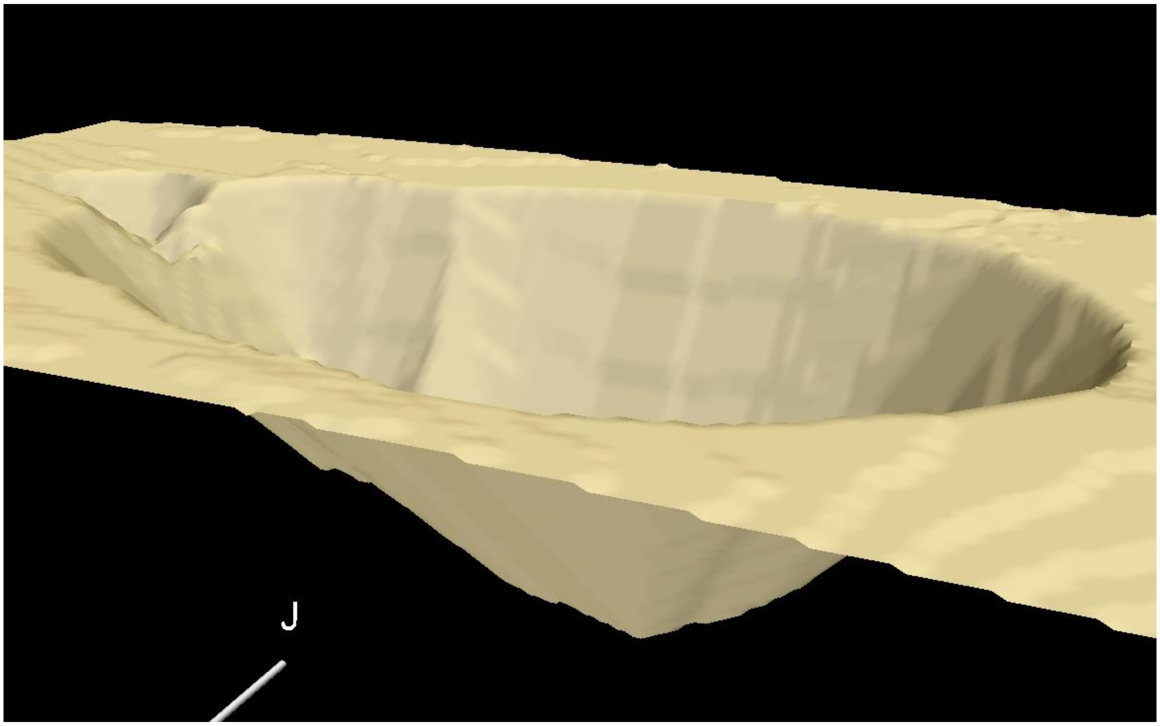
Table 14.54: Marathon Underground Economic Assumptions

Item	Value	Units
Mill Feed Mining Cost	71.00	C$/t mill feed
Processing Cost	10.81	C$/t material
G&A Cost	2.40	C$/t material
Recovery (at cut-off)	92.7	%
Exchange	0.76	---
Gold Price	1,500	US$/troy oz
Calculated Cut-off	1.44	g/t

For mineral resources estimation, a cut-off grade of 0.30 g/t gold was used for open pit, and a cut-off grade of 1.44 g/t gold was used for underground. The assumed overall pit slope in Whittle was assumed to be 46.0° in slope sectors identified by Terrane (the feasibility study geotechnical consultant) and 47.5° everywhere else. None of the slopes includes an allowance for ramps.

Using these assumptions, a Whittle economic pit optimisation was completed, and an economic open pit shell generated. This pit shell was used to design a conceptual open pit, which is shown in Figure 14-79.

Figure 14-79: Marathon Feasibility Study Open Pit Shell



Source: BOYD, 2020.

14.5.8.2 Mineral Resource Estimate

BOYD's mineral resource estimates for the Marathon deposit are provided in Table 14.55.

14.5.8.3 Changes from the Previous Mineral Resource Estimate

Changes from the previous pre-feasibility study MRE (January 10, 2020) are shown in Figures 14-80 and 14-81.

At Marathon, the only change since the pre-feasibility mineral resource estimate (January 10, 2020) was the addition of updated feasibility study economics. This had minimal impact of the overall mineral resource estimate.

Table 14.55: Marathon Mineral Resources

Measured and Indicated Mineral Resource Estimate

Mining Method	Resource Classification	Gold Cut-off Grade (g/t)	Tonnes	Au g/t	Au Troy Ozs
Open Pit - High Grade	Measured	0.70	13,092,000	2.597	1,093,100
Open Pit - High Grade	Indicated	0.70	7,238,000	2.225	517,800
Open Pit - High Grade	**Measured + Indicated**	**0.70**	**20,330,000**	**2.465**	**1,610,900**
Open Pit - Low Grade	Measured	0.30	10,486,000	0.467	157,400
Open Pit - Low Grade	Indicated	0.30	6,116,000	0.465	91,400
Open Pit - Low Grade	**Measured + Indicated**	**0.30**	**16,602,000**	**0.466**	**248,800**
Total Open Pit	Measured	0.30	23,578,000	1.650	1,250,500
Total Open Pit	Indicated	0.30	13,354,000	1.419	609,200
Total Open Pit	**Measured + Indicated**	**0.30**	**36,932,000**	**1.566**	**1,859,700**
Underground	Measured	1.44	413,000	4.169	55,400
Underground	Indicated	1.44	454,000	3.351	48,900
Underground	**Measured + Indicated**	**1.44**	**867,000**	**3.741**	**104,300**
Total Open Pit + Underground	Measured	0.30	23,991,000	1.693	1,305,900
Total Open Pit + Underground	Indicated	0.30	13,808,000	1.482	658,100
Total Open Pit + Underground	**Measured + Indicated**	**0.30**	**37,799,000**	**1.616**	**1,964,000**

Inferred Mineral Resource Estimate

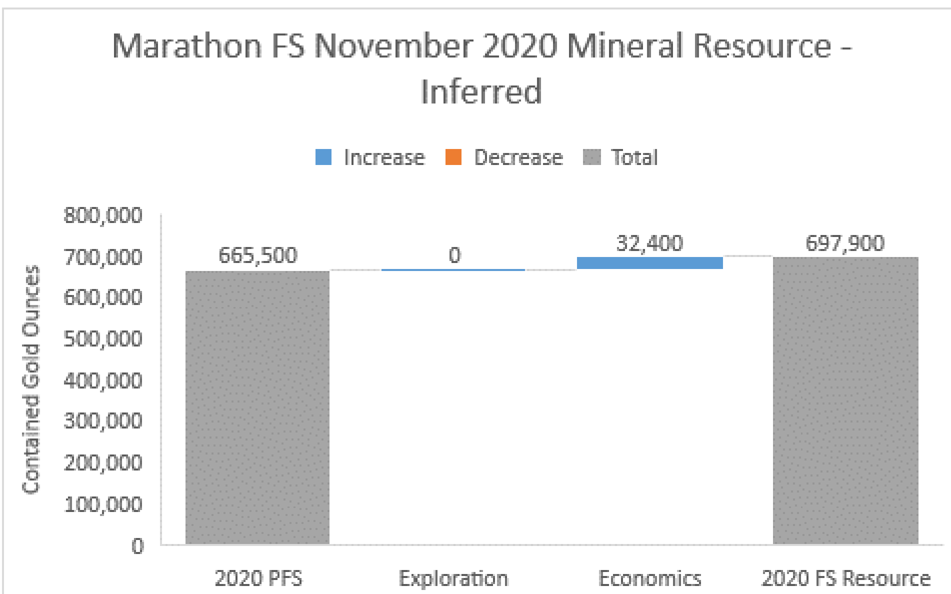
Mining Method	Resource Classification	Gold Cut-off Grade (g/t)	Tonnes	Au g/t	Au Troy Ozs
Open Pit - High Grade	Inferred	0.70	5,140,000	2.498	412,800
Open Pit - Low Grade	Inferred	0.30	4,630,000	0.463	68,900
Total Open Pit	Inferred	0.30	9,770,000	1.534	481,700
Underground	Inferred	1.44	1,910,000	3.521	216,200
Open Pit + Underground	Inferred	0.30	11,680,000	1.859	697,900

Notes: **1.** The effective date for this mineral resource estimate is November 20, 2020 and is reported on a 100% ownership basis. This estimate is an update to the previous mineral resource estimate (January 10, 2020) and reflects revised economic parameters only. The qualified person for the mineral resource estimate is Robert Farmer, P. Eng. **2.** Mineral resources are calculated at a gold price of US$1,500 per troy ounce. **3.** The mineral resources presented above are global and do not include detailed pit or underground designs; only an economic open pit shell was used to determine the in-pit mineral resources. The underground mineral resources are that material outside of the in-pit mineral resources above the stated underground cut-off grade. **4.** Mineral resources, which are not mineral reserves, do not have demonstrated economic viability. The estimate of mineral resources may be materially affected by environmental, permitting, legal, title, socio-political, marketing, or other relevant issues. **5.** The mineral resources presented here were estimated using a block model with a block size of 6 m x 6 m x 6 m sub-blocked to a minimum block size of 2 m x 2 m x 2 m using ID3 methods for grade estimation. All mineral resources are reported using an open pit gold cut-off of 0.30 g/t Au and an underground gold cut-off of 1.44 g/t Au. Higher gold grades were capped by mineralised domain. Material above a 0.70 g/t gold cut-off is considered high-grade while material between a 0.30 and 0.70 g/t gold cut-off is considered low-grade. **6.** The mineral resources presented here were estimated using the Canadian Institute of Mining, Metallurgy and Petroleum (CIM), CIM Standards on Mineral Resources and Reserves, Definitions and Guidelines prepared by the CIM Standing Committee on Reserve Definitions and adopted by CIM Council May 10, 2014. **7.** Figures are rounded, and totals may not add correctly.

Figure 14-80: Marathon Measured & Indicated Changes from the Previous MRE

Source: BOYD, 2020.

Figure 14-81: Marathon Inferred Changes from the Previous MRE



Source: BOYD, 2020.

14.6 Berry Zone Deposit Mineral Resource Estimate

The Berry deposit is a new discovery since the pre-feasibility technical report was published in April 2020. This deposit sits northeast of the Sprite deposit and southwest of the Marathon deposit (see Figure 14-1). The deposit shares many of the same characteristics as the Leprechaun deposit including a mineralised zone sandwiched between the sediment contact and mafic dikes contained within the quartz-eye porphyry (QEPOR) in the hanging wall.

The Berry mineral resource is contained in two sets of relatively flat-lying, gold-bearing quartz-tourmaline-pyrite (QTP) veins. Set 1 (S1) is orientated with an azimuth of 108°, a plunge of 0°, and a dip of -40°. A minor secondary orientation, Set 3 (S3), occurs within these mineralised zones with an azimuth of 246°, a plunge of 0°, and a dip of -7°. The highest-grade gold mineralisation is in the flat-lying QTP veins within a steeply dipping shear zone along the contact with the footwall sediment (SED) unit. This area of mineralisation is bounded in the hanging wall by a series of mafic dikes. To the northwest of the mafic dikes, the flat-lying, gold-bearing QTP veins continue to be mineralised and make up the hanging wall mineralisation at the Berry gold deposit.

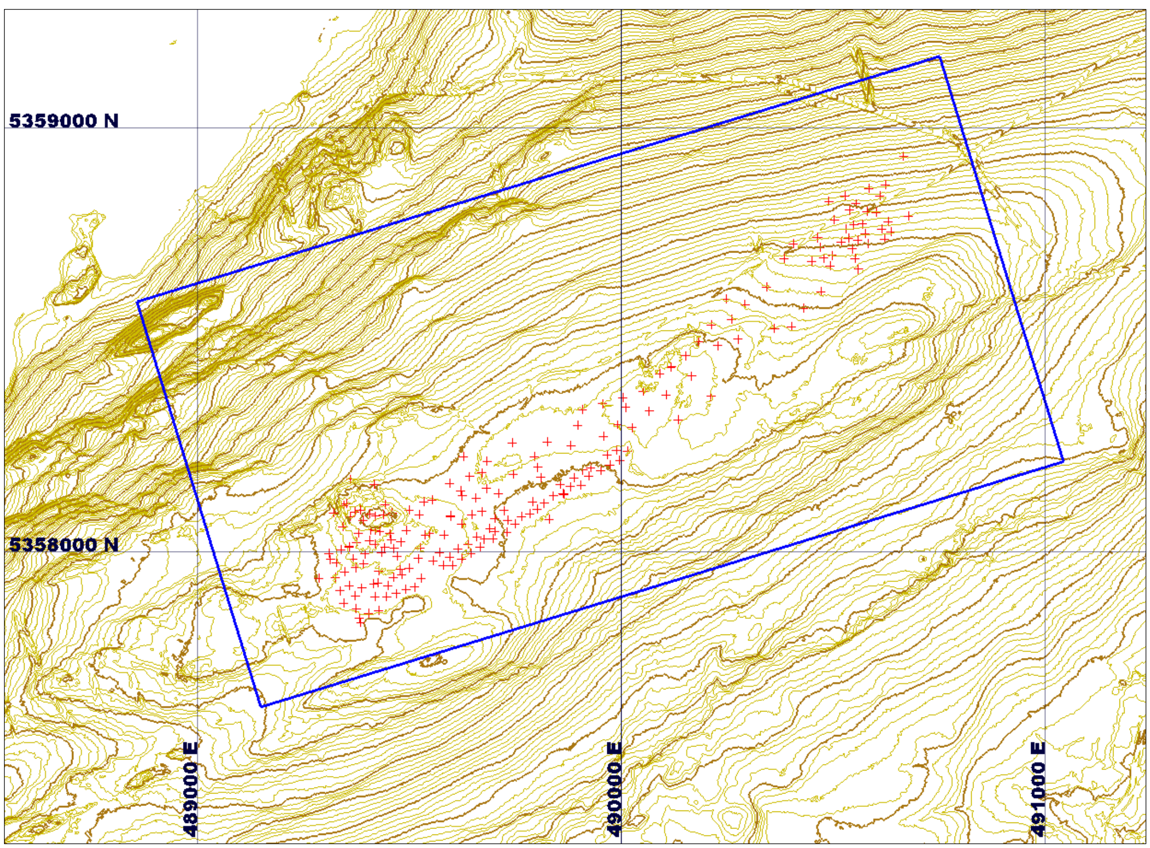
Significant gold mineralisation is encountered in all major rock units (quartz-eye porphyry, mafic dikes, and lesser sediments) and although most of the mineral resource is contained in QTP veins, some mineralisation occurs in areas with no significantly logged QTP mineralisation. In fact, these areas probably do include QTP mineralisation in that many of the areas included very minor occurrences of QTP within the logging, but not enough to be considered significant QTP units.

14.6.1 Berry Deposit Data

14.6.1.1 Drillholes

The mineral resource estimates for the Berry deposit reported herein are based on all drillholes whose assays were available as of March 8, 2021 and consist of 209 diamond core drillholes totalling approximately 41,618 m. Figure 14-82 shows the collars of these drillholes.

Figure 14-82: Berry Drillhole Locations & Topography



Source: BOYD, 2021

14.6.1.2 Assays

Of the 29,045 gold assays available as of March 8, 2021, all were used. For unsampled intervals, gold grade values were set to zero. All gold grades were determined from fire or metallic screened assays. Total assayed sample length is 39,576 m.

14.6.1.3 Density

Bulk density for the Berry deposit was derived from the 1,640 measurements taken for the Leprechaun deposit. The results of these measurements are shown in Table 14.56 and are assumed to be representative of those found within the Berry deposit. Block densities were assigned based on the block's domain or lithology type.

Table 14.56: Berry Density Measurements

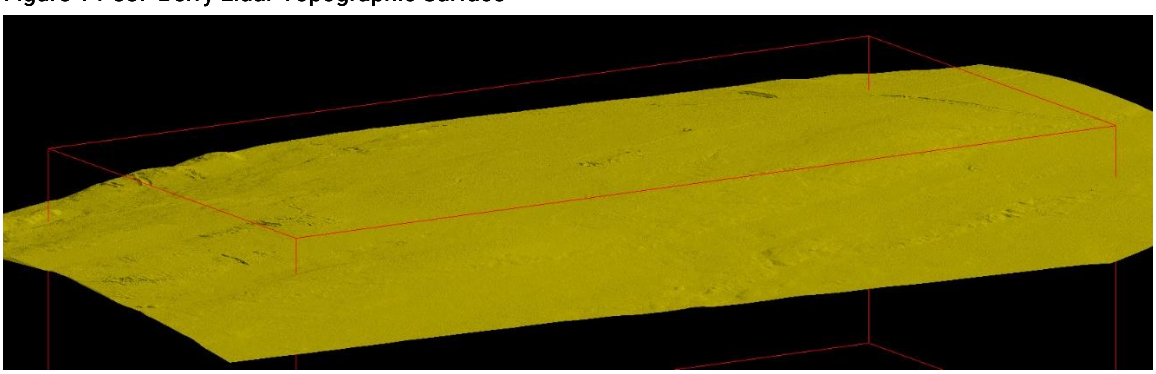
Lithology Type	Specific Gravity (t/m^3)
Mafic Dikes	2.79
Quartz-Tourmaline- Pyrite Veins	2.64
Sediments	2.75
Quartz-Eye Porphyry	2.61
Overburden	1.50

14.6.1.4 Topography

The topography of the area around the Berry deposit is shown on Figure 14-82. All contours are expressed in metres above sea level. Major contour intervals are every 5 m with minor contour levels expressed in 1 m increments. The Berry deposit sits on a sloped ridge top. Towards the north, the topography falls off steeply, while towards the south, the topography slopes gently downhill.

For the previous pre-feasibility study work, a new Lidar topographic survey was completed over the entire Valentine Project property area. This survey is the topographic basis for all the mineral resource related work described in this section and is shown in Figure 14-83.

Figure 14-83: Berry Lidar Topographic Surface



Source: BOYD, 2021

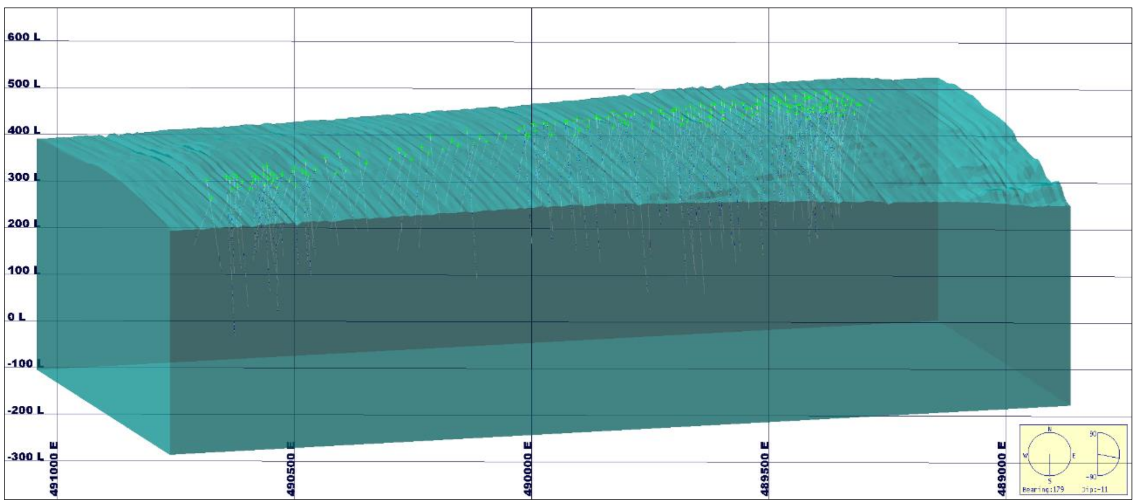
14.6.2 Berry Deposit Data Analysis

14.6.2.1 Geological Modelling

The Berry deposit contains four potentially mineralised domains. These domains are the sediments (SED), quartz-eye porphyry (QEPOR), flat-lying, quartz-tourmaline-pyrite veins (QTPV), and mafic dikes (MD) intruding into the QEPOR and QTPV domains. The QTPV domain was generated using a 100-ppb gold grade shell described below. Additionally, surface overburden was also noted in the drill logs but was not considered as a potentially mineralised host.

Geological modelling of these units is based on the logged geology as well as interpretations made by Marathon Gold staff. On every 10 m cross-section through the deposit, a line was drawn reflecting the actual or projected overburden surface below the topography. These lines were then used to construct the rock/overburden surface to constrain compositing, geological implicit models, as well as block modelling. The base of the overburden surface is shown in Figure 14-84.

Figure 14-84: Berry Base of Overburden



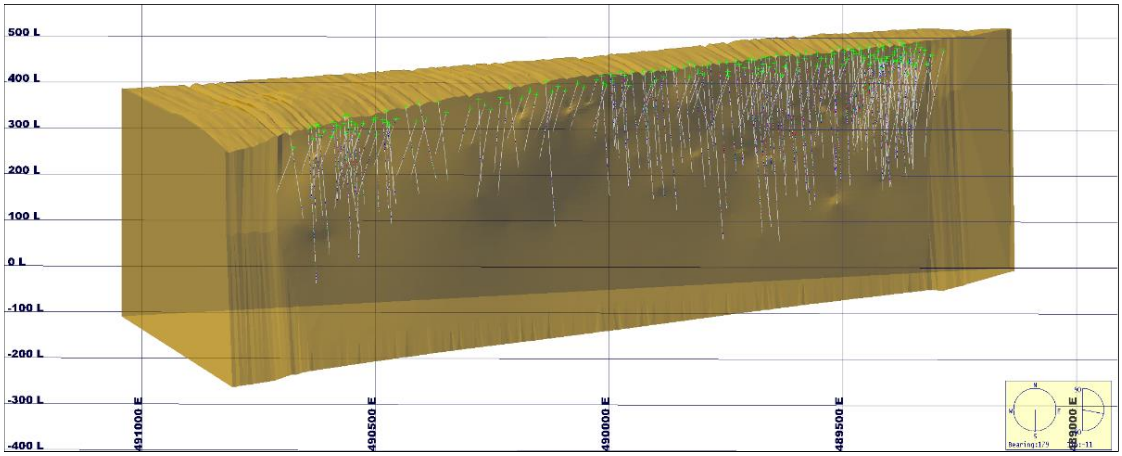
Source: BOYD, 2021

The SED/QEPOR contact was determined by drillhole intercepts or projections between intercepts and a surface constructed to represent this geologic contact. This was completed on every 10 m section through the deposit where data was available. This contact was then used to construct a solid model of the SED domain below the overburden horizon. The sediment unit is shown in Figure 14-85.

The QEPOR domain is the remaining rock mass northwest of the SED solid and below the overburden horizon. The QEPOR domain is shown in Figure 14-86.

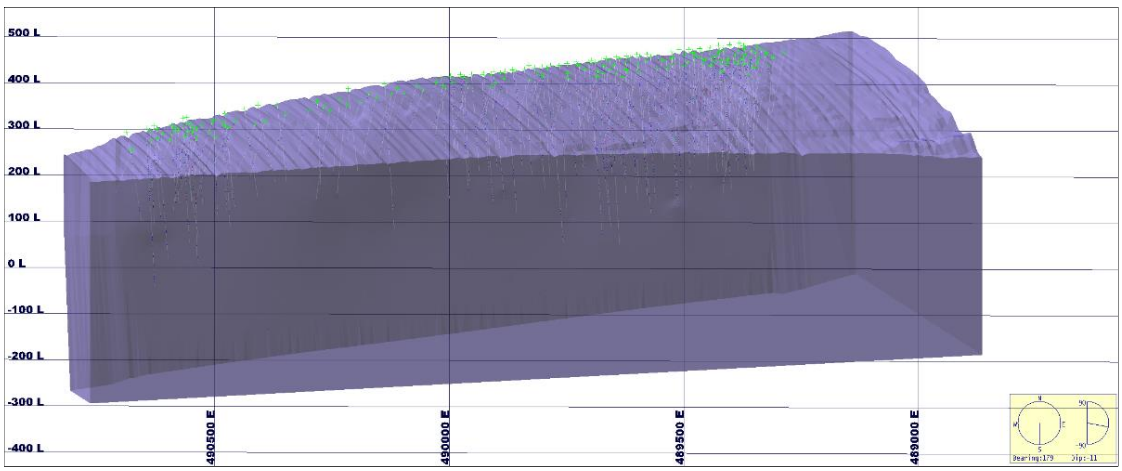
For the MD domain, a geologic solid was provided by Marathon staff. BOYD also ran a Vulcan implicit model of the mafic dikes and found that that both models closely matched, and the hand generated model provided by Marathon was used to define this domain. As was the case for the Leprechaun and Marathon deposits, the MD Domain has been truncated by the sediments and cuts the QTPV zones; as such, the MD solid is clipped by the SED model. The MD domain is shown in Figure 14-87.

Figure 14-85: Berry Sediment Domain



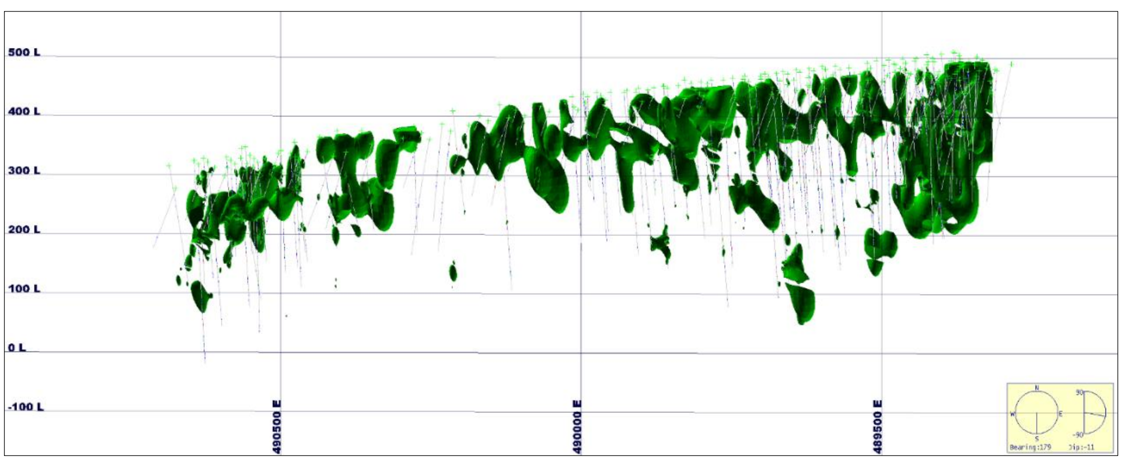
Source: BOYD, 2020

Figure 14-86: Berry Quartz-Eye Porphyry Domain



Source: BOYD, 2021

Figure 14-87: Berry Mafic Dike Domain

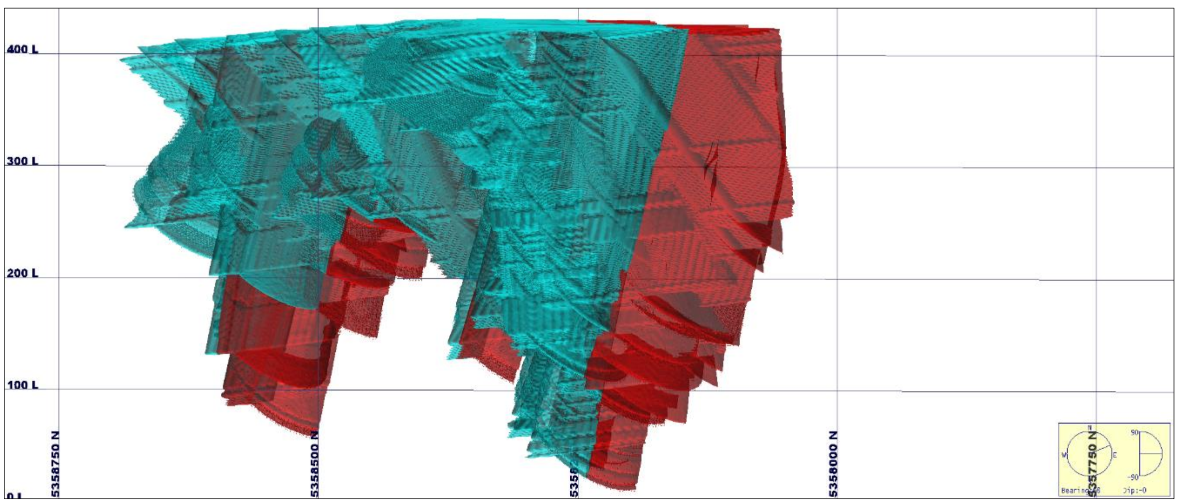


Source: BOYD, 2021

For the QTPV domain, Vulcan implicit modelling was used to develop the mineralised solid in two structural orientations, S1 and S3. A study completed by Terrane Geoscience Inc. (Kruse and Bartsch, 2021) determined that there were four structural orientations—S1, S2, S3, and S4—at the Berry deposit. S2 and S4 were found to be only weakly mineralised and are not considered in this estimate. The principal structural orientation, S1, and a minor structural orientation, S3, both contain more significant gold mineralisation. The S1 is orientated with an azimuth of 108°, plunge of 0°, and a dip of -40°. The S3 is orientated with an azimuth of 246°, plunge of 0°, and a dip of -7°. These two structural orientations were used to develop a constraining model of the QTPV.

Implicit modelling of the S1 and S3 utilized a 100 PPB gold grade shell with orientations described above and a search distance of 60 m in the major, 60 m in the semi-major, and 3 m in the minor axes. The resulting solids were clipped by the sediment domain. This zone was further divided into two sub-domains. The first represents the hanging wall QTPV domain, which sits in the hanging wall to the northwest of the SED contact. The second sub-domain is the footwall QTPV domain, which sits on the SED domain to the south and is bounded on the northwest by a series of mafic dikes and the hanging wall QTPV domain. The resulting hanging wall and footwall QTPV domains are shown in Figure 14-88.

Figure 14-88: Berry Hanging Wall (Light Blue) & Footwall (Red) QTPV Domains



Source: BOYD, 2021

The SED, MD, hanging wall QTPV, and footwall QTPV domains can be mineralised and were used to flag drillholes used to construct the composites for later variography and geostatistics. The QEPOR domain had no drilling information and was not estimated.

14.6.2.2 Drillhole Descriptive Statistics

Descriptive statistics were generated for each individual domain, as well as the overall exploration database for gold. Note that the QTPV domains include all values from the S1 and S3 structural orientations. The results of this analysis are shown in Table 14.57.

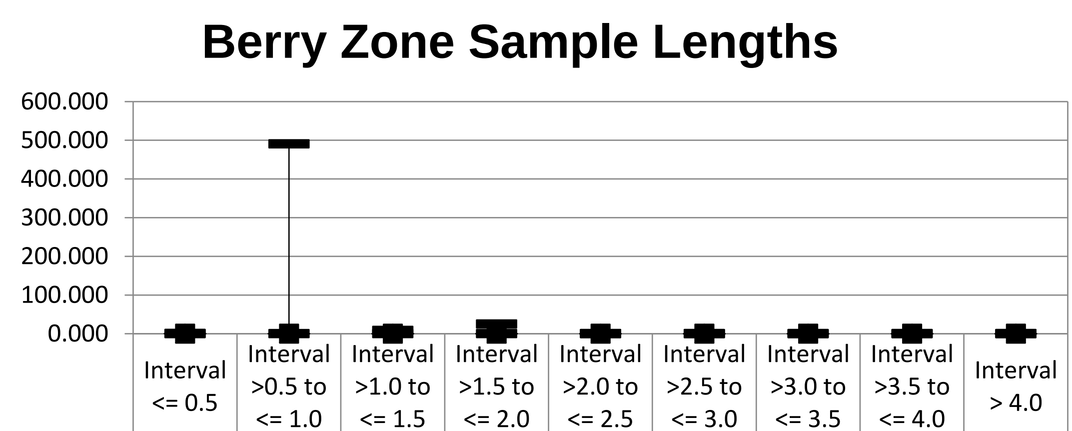
Table 14.57: Berry Raw Drillhole Descriptive Statistics

Item	Domains				
	All	QTPV FW	QTPV HW	Mafic Dikes	Sediment
Number of Samples	16,405	10,627	4,417	1,184	176
Minimum	0.01	0.01	0.01	0.01	0.01
Maximum	490.613	490.613	136.912	28.503	38.016
Range	490.603	490.603	136.902	28.493	38.006
Average	0.985	1.269	0.525	0.251	0.380
Standard Deviation	6.480	7.599	3.967	1.208	2.889
Variance	41.990	57.745	15.737	1.459	8.346
Coefficient. of Variance	6.579	5.988	7.556	4.813	7.603

14.6.2.3 Compositing

Sample length statistics were run on the assay database examining the number of samples for sample lengths in 0.5 m increments through a total length of 4.0 m. The purpose of this analysis is to determine what sample length was associated with the total number of samples. The boxplot in Figure 14-89 shows the results of this analysis.

Figure 14-89: Berry Drillhole Sample Lengths



	Interval <= 0.5	Interval >0.5 to <= 1.0	Interval >1.0 to <= 1.5	Interval >1.5 to <= 2.0	Interval >2.0 to <= 2.5	Interval >2.5 to <= 3.0	Interval >3.0 to <= 3.5	Interval >3.5 to <= 4.0	Interval > 4.0
Q1	0.018	0.006	0.003	0.003	0.004	0.000	0.000	0.000	0.000
Min	0.018	0.003	0.003	0.003	0.003	0.000	0.000	0.000	0.000
Median	0.228	0.042	0.008	0.005	0.006	0.000	0.000	0.000	0.000
Mean	0.228	0.847	0.201	0.035	0.007	0.000	0.000	0.000	0.000
Max	0.438	490.613	8.278	25.089	0.016	0.000	0.000	0.000	0.000
Q3	0.438	0.236	0.051	0.011	0.009	0.000	0.000	0.000	0.000
NSamples	2	18411	102	10516	13	0	0	0	0

Source: BOYD, 2021

In examining the results of this analysis, most samples with potentially economic gold mineralisation were taken at a length of 1.0 m or less. A total of 63.4% of all assays were taken at 1 metre or less containing 97.6% of the total contained metal. Based on this, a composite length of 1.0 m was selected and applied within the confines of the mineralised domains. Composites less than 1.0 m were divided by the run length (1.0 m). This composite length was selected to better reflect the actual breakdown of the mineralisation in the individual drillholes within each mineralised zone.

14.6.2.4 High Value Grade Limits

High outlier metal values can skew the resulting grade estimate if they are not accounted for with some sort of limitation or grade capping value applied to the underlying assay database. To determine this, a lognormal probability plot was generated for gold in each mineralised domain.

To determine high-value gold grade outliers, several methods were considered. These included a 1 troy ounce gold grade cap, the mean plus the standard deviation, four times the mean, five times the mean, lognormal, and decile analysis. These methods were reviewed, and the resulting potential grade caps/threshold were determined. For the Berry deposit, the lognormal graph was considered the best method to establish a capping/threshold value. This is due to the very smooth lognormal results in all estimation domains.

Threshold metal grades were selected from the lognormal plot at the point where the data starts to break up or where there is a significant slope change in the plot. The lognormal probability plots for gold found in each mineralised domain are shown in Figures 14-90 through 14-93 on the following pages.

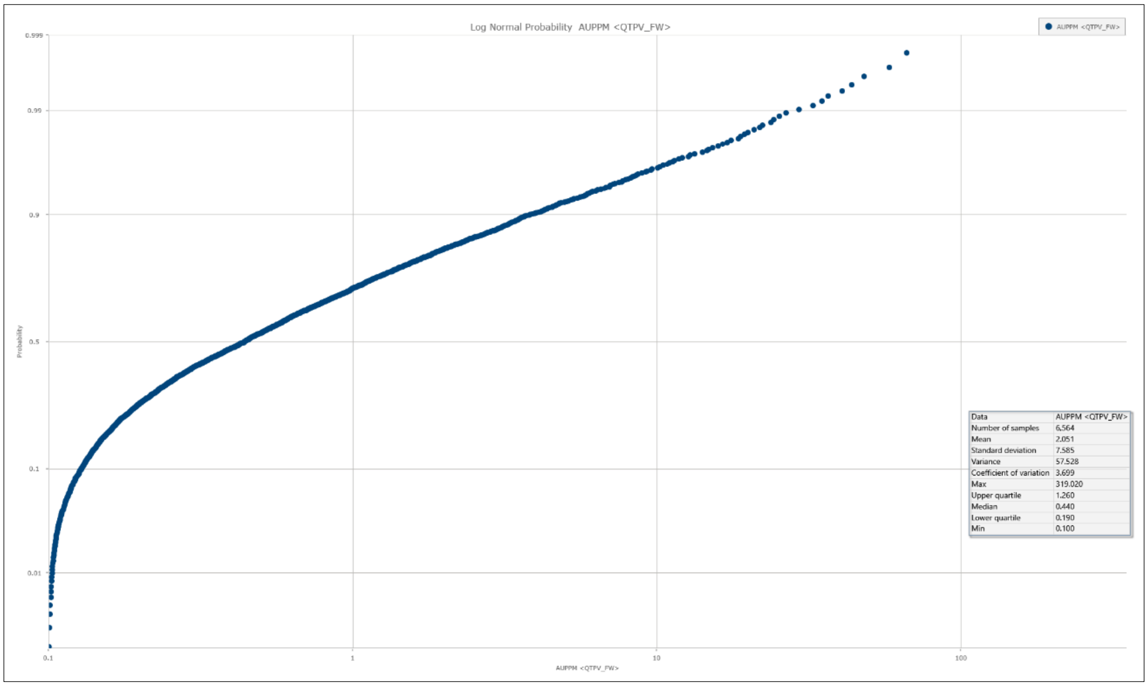
The lognormal probability graphs were used to determine a gold threshold grade to limit the area of influence of gold grades higher than the threshold. The area of influence was developed using indicator variograms to determine the size and extents of above threshold gold-bearing areas by producing a high gold grade search ellipsoid. This search ellipsoid was used to determine the area of influence of above threshold gold grades. This process was completed on all the potentially mineralised domains and the selected metal threshold grades are shown in Table 14.58 below.

Threshold gold grades were applied during the grade estimation runs to limit the influence of the higher-grade outliers in the composites. The extreme outliers were used to hard cap gold grades at gold values that exceeded this number. This cap was determined using a lognormal graph and selecting a value where the extreme outliers appeared to lose lognormal continuity.

Table 14.58: Berry Gold Threshold Grades

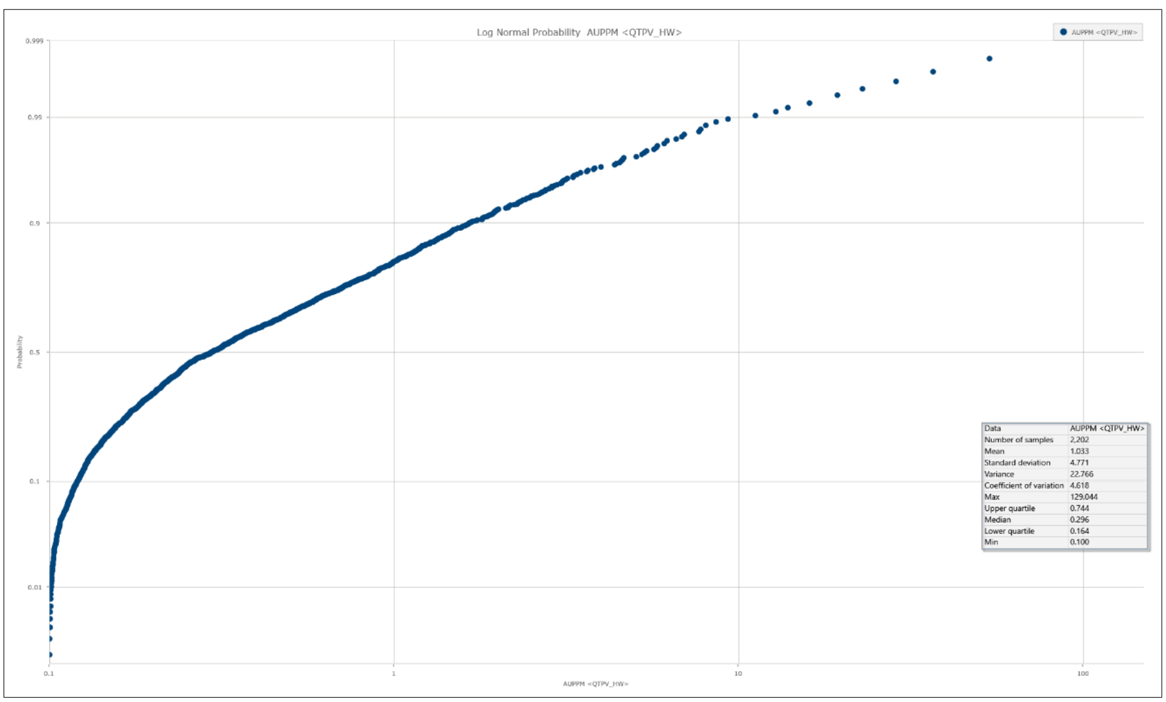
Item	QTPV_FW		QTPV_HW		Mafic Dikes	Sediments
	S1	S3	S1	S3		
Extreme Outliers (g/t)	100.0	100.0	50.0	50.0	5.0	2.0
Threshold Cap (g/t)	30.0	30.0	6.0	6.0	3.5	2.0
Azimuth (degrees)	108.0	246.0	108.0	246.0	108.0	108.0
Plunge (degrees)	0.0	0.0	0.0	0.0	0.0	0.0
Dip (degrees)	-40.0	-7.0	-40.0	-7.0	-40.0	-40.0
Range - Major (m)	8.9	13.2	10.0	6.3	25.0	---
Range - Semi-Major (m)	14.0	10.1	4.6	10.0	7.2	---
Range - Minor (m)	3.0	3.0	3.0	3.0	3.0	---

Figure 14-90: Berry QTPV Footwall Domain (both S1 & S3) Lognormal Plot



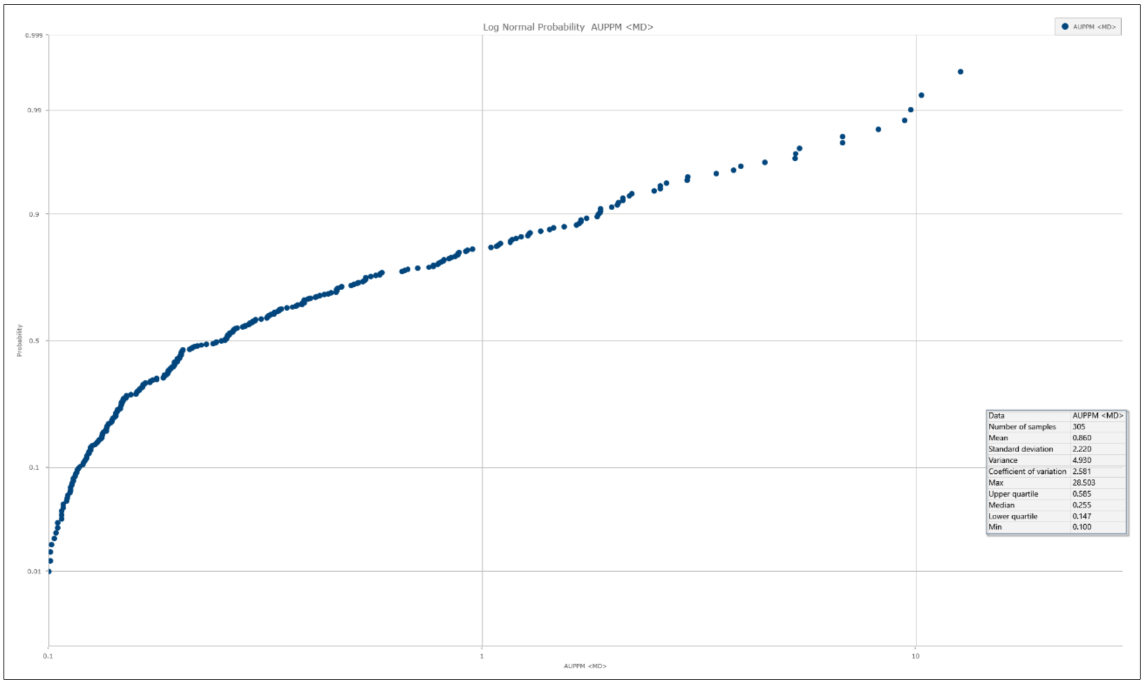
Source: BOYD, 2021

Figure 14-91: Berry QTPV Hanging Wall Domain (both S1 & S3) Lognormal Plot



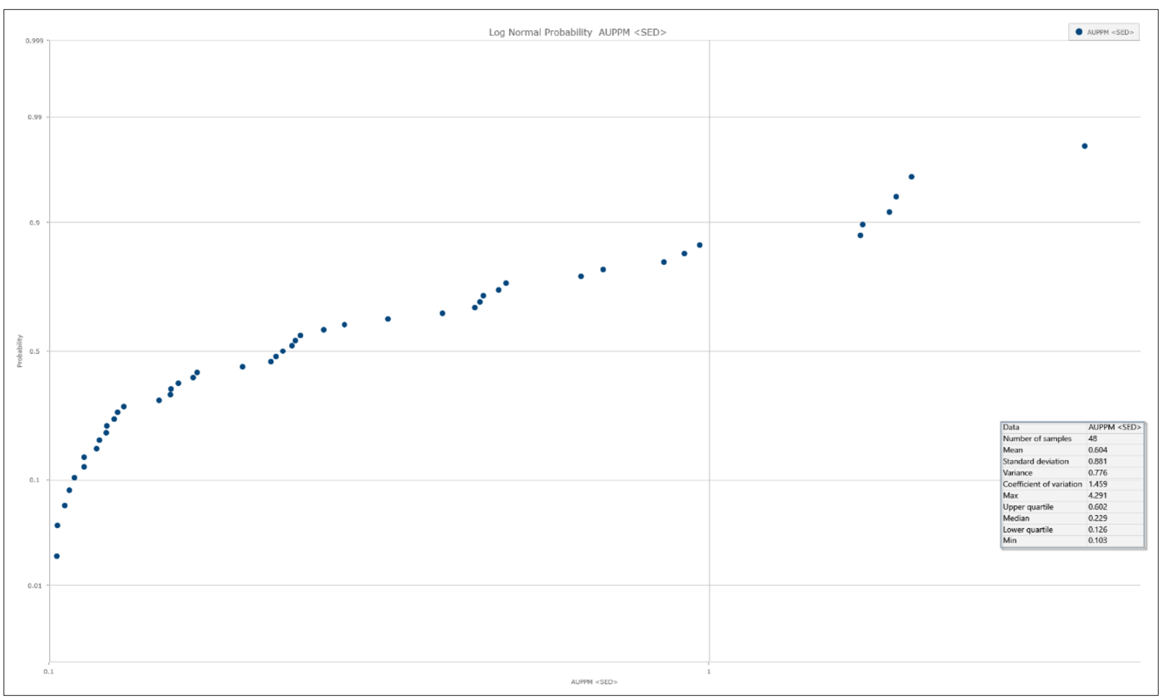
Source: BOYD, 2021

Figure 14-92: Berry Mafic Dike Domain Lognormal Plot



Source: BOYD, 2021

Figure 14-93: Berry Sediment Domain Lognormal Plot

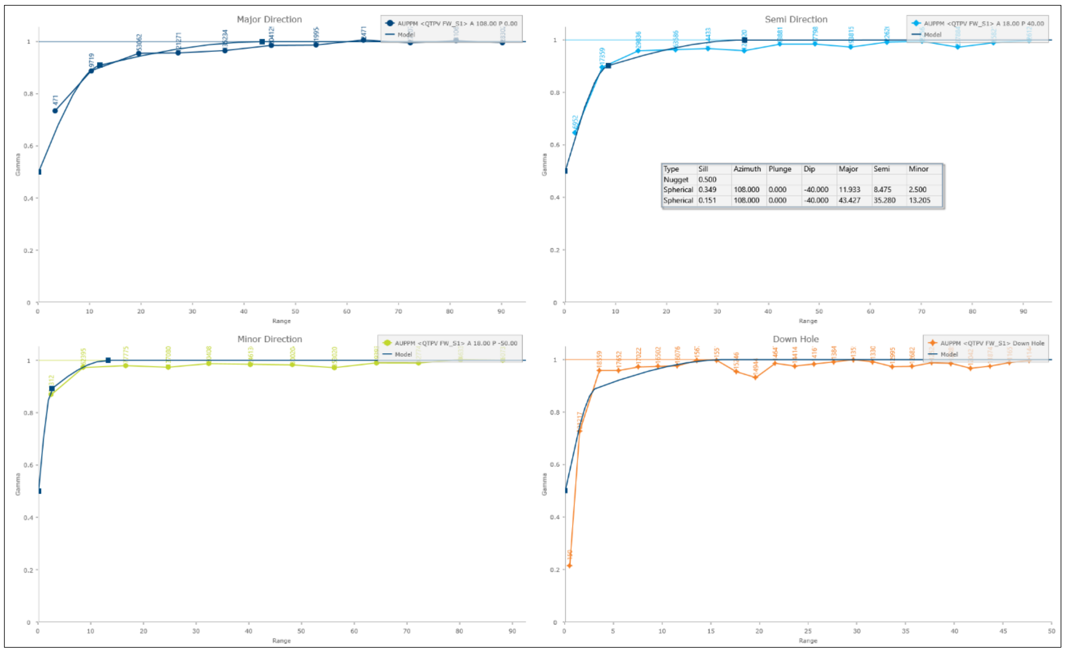


Source: BOYD, 2021

14.6.3 Search Ellipsoids

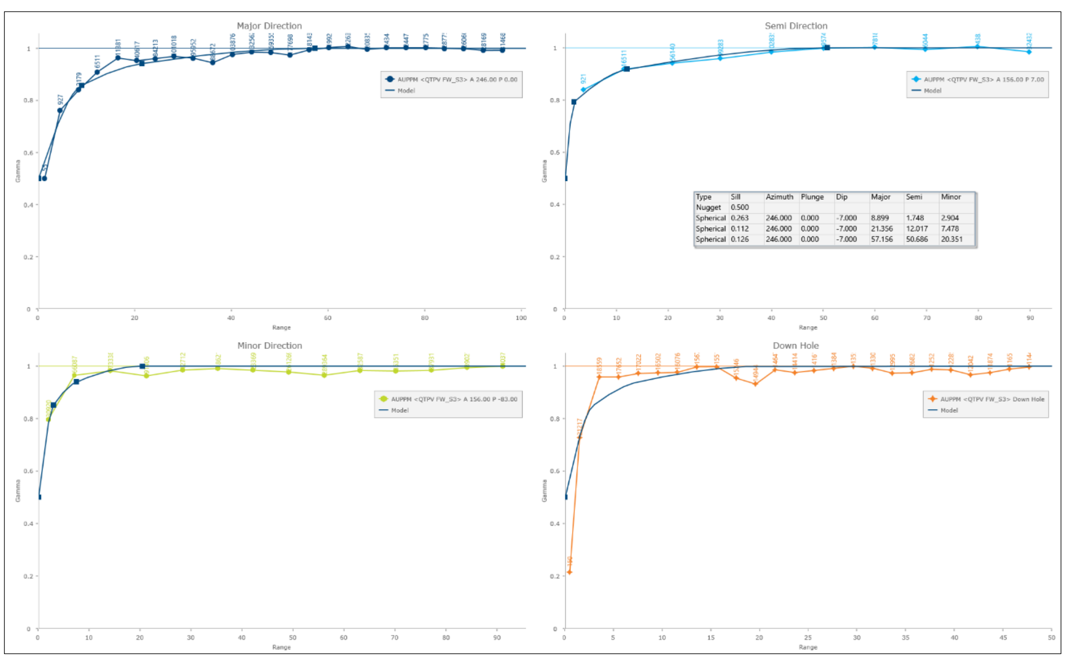
The search ellipsoids for grade estimation were developed using variograms for each domain. Variograms were established in each domain for gold in the same structural orientations used to develop the mineralised solids. Gold grade variograms for each mineralised domain are shown in Figures 14-94 through 14-99.

Figure 14-94: Berry QTPV Footwall S1 Variograms



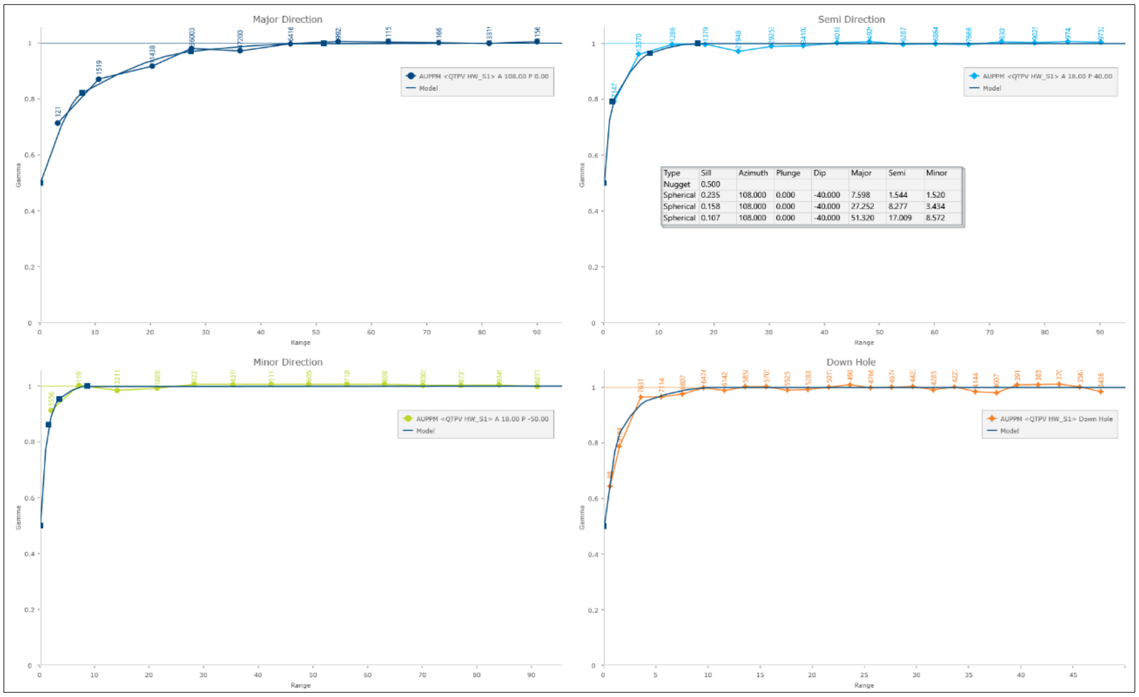
Source: BOYD, 2021

Figure 14-95: Berry QTPV Footwall S3 Variograms



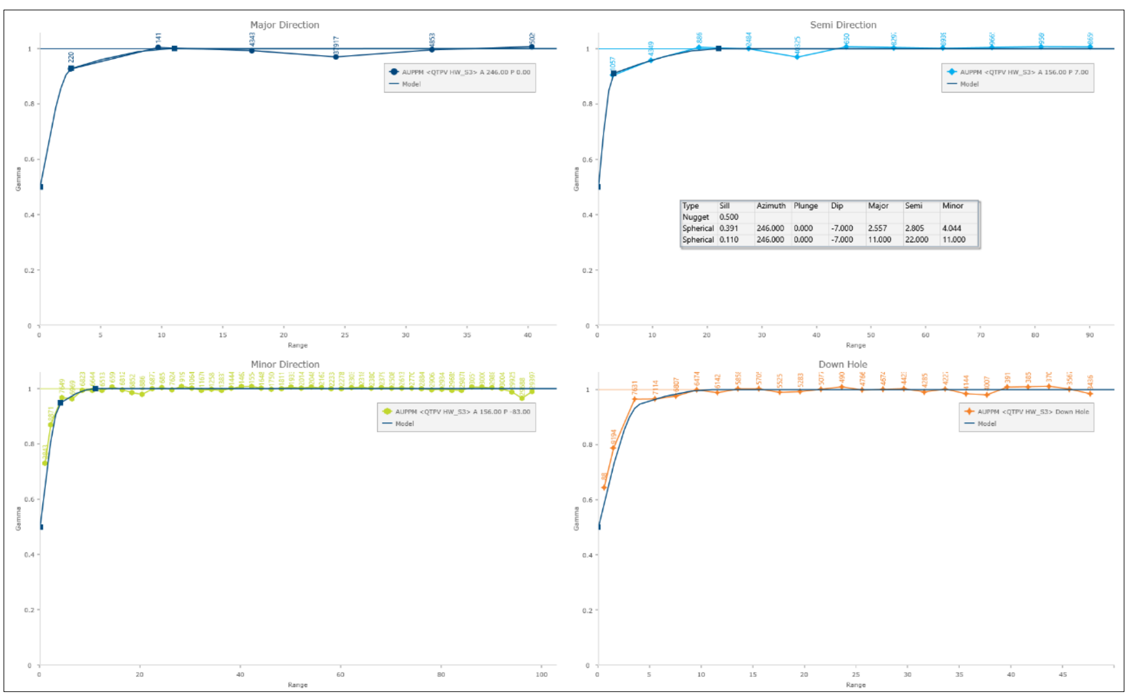
Source: BOYD, 2021

Figure 14-96: Berry QTPV Hanging Wall S1Variograms



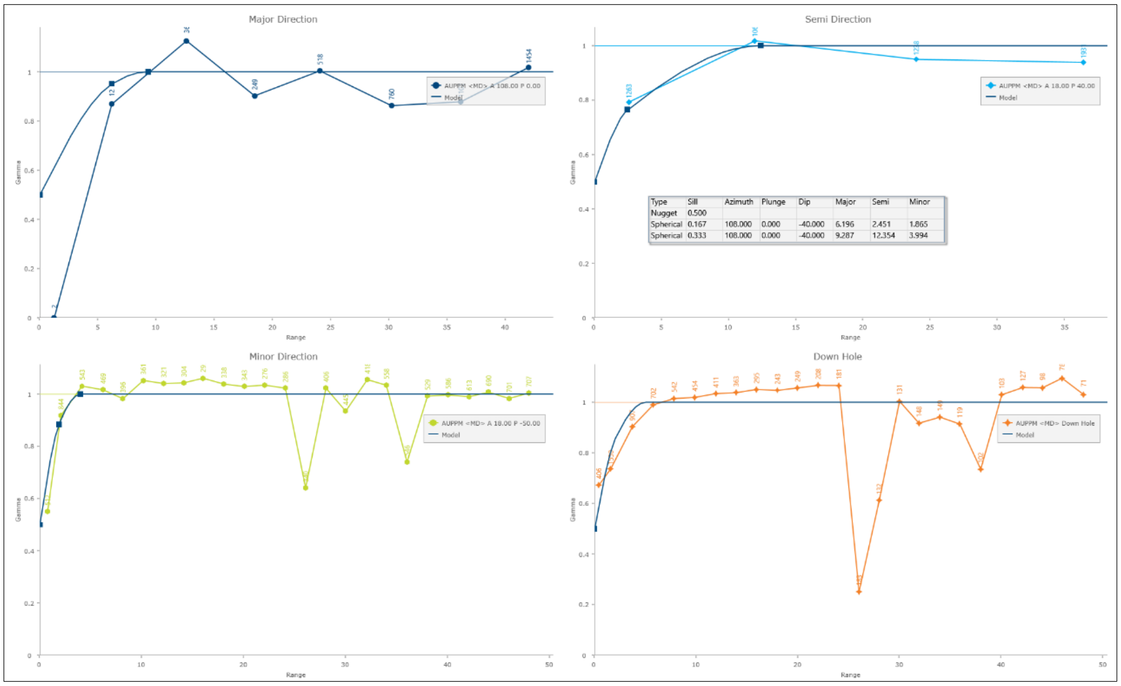
Source: BOYD, 2021

Figure 14-97: Berry QTPV Hanging Wall S3 Variograms



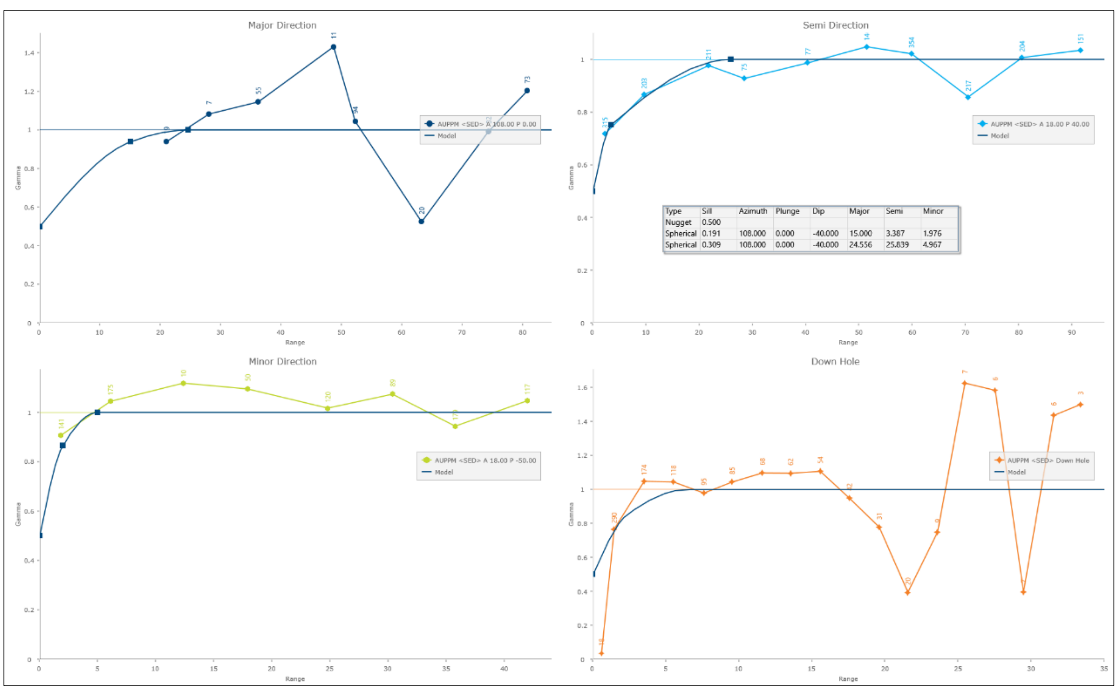
Source: BOYD, 2021

Figure 14-98: Berry Mafic Dike Variograms



Source: BOYD, 2021

Figure 14-99: Berry Sediment Variograms



Source: BOYD, 2021

Based on these analyses, search ellipsoids for each mineralised domain were established as shown in Tables 14.59 through 14.64.

Table 14.59: Berry QTPV Footwall S1 Search Ellipsoid

Search Parameters	Pass		
	1	2	3
Major Range (m)	43.4	43.4	43.4
Semi-Major Range (m)	35.3	35.3	35.3
Minor Range (m)	5.0	5.0	5.0
Azimuth (degrees)	108.0	108.0	108.0
Plunge (plunge of the azimuth in degrees)	0.0	0.0	0.0
Dip (degrees)	-40.0	-40.0	-40.0

Table 14.60: Berry QTPV Footwall S3 Search Ellipsoid

Search Parameters	Pass		
	1	2	3
Major Range (m)	57.2	57.2	57.2
Semi-Major Range (m)	50.7	50.7	50.7
Minor Range (m)	5.0	5.0	5.0
Azimuth (degrees)	246.0	246.0	246.0
Plunge (plunge of the azimuth in degrees)	0.0	0.0	0.0
Dip (degrees)	-7.0	-7.0	-7.0

Table 14.61: Berry QTPV Hanging Wall S1 Search Ellipsoid

Search Parameters	Pass		
	1	2	3
Major Range (m)	51.3	51.3	51.3
Semi-Major Range (m)	17.0	17.0	17.0
Minor Range (m)	5.0	5.0	5.0
Azimuth (degrees)	108.0	108.0	108.0
Plunge (plunge of the azimuth in degrees)	0.0	0.0	0.0
Dip (degrees)	-40.0	-40.0	-40.0

Table 14.62: Berry QTPV Hanging Wall S3 Search Ellipsoid

Search Parameters	Pass		
	1	2	3
Major Range (m)	11.0	11.0	11.0
Semi-Major Range (m)	22.0	22.0	22.0
Minor Range (m)	5.0	5.0	5.0
Azimuth (degrees)	246.0	246.0	246.0
Plunge (plunge of the azimuth in degrees)	0.0	0.0	0.0
Dip (degrees)	-7.0	-7.0	-7.0

Table 14.63: Berry Mafic Dike Search Ellipsoid

Search Parameters	Pass		
	1	2	3
Major Range (m)	9.3	9.3	9.3
Semi-Major Range (m)	12.4	12.4	12.4
Minor Range (m)	4.0	4.0	4.0
Azimuth (degrees)	108.0	108.0	108.0
Plunge (plunge of the azimuth in degrees)	0.0	0.0	0.0
Dip (degrees)	-40.0	-40.0	-40.0

Table 14.64: Berry Sediment Search Ellipsoid

Search Parameters	Pass		
	1	2	3
Major Range (m)	24.6	24.6	24.6
Semi-Major Range (m)	25.8	25.8	25.8
Minor Range (m)	5.0	5.0	5.0
Azimuth (degrees)	108.0	108.0	108.0
Plunge (plunge of the azimuth in degrees)	0.0	0.0	0.0
Dip (degrees)	-40.0	-40.0	-40.0

These search parameters were used in the mineral resource estimate described below.

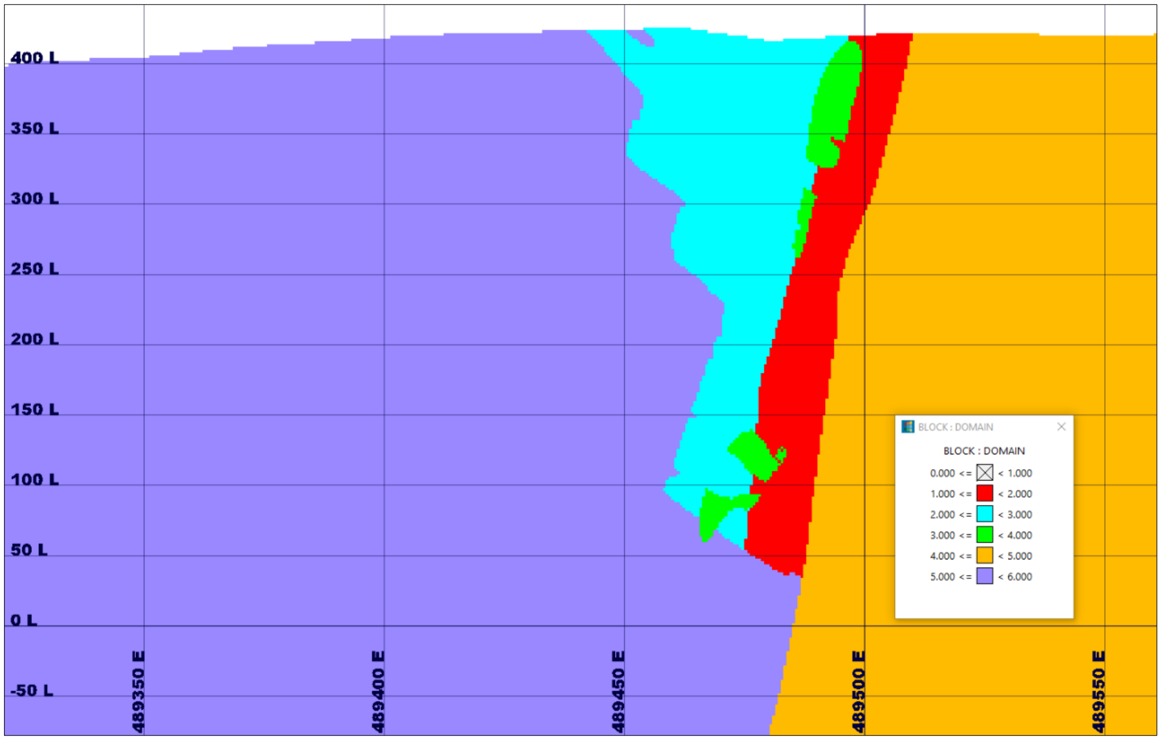
14.6.4 Berry Deposit Block Model

Table 14.65 shows the Berry block model extents. Figure 14-100 shows a typical block model section of the mineralised domain.

Table 14.65: Block Model Extents

Item	X	Y	Z
Origin	489,150.102	5,357,633.584	-100.000
Offset Minimum	-	-	-
Offset Maximum	1,980	996	600
Parent Block size (m)	6.00	6.00	6.00
Child Block size (m)	2.00	2.00	2.00
Bearing/Dip/Plunge	73.00	-	-

Figure 14-100: Berry Typical Mineralised Domain Block Model Cross-section



Source: BOYD, 2021

Four different block models were created for the mineral resource estimate. The purpose of these different block models was to consider the impact of gold grade capping on the total contained metal content in the block models. The four block models included:

- No Cap Model – This block model assumed that no gold grade capping was applied.
- Hard Cap Model – This block model used a fixed hard cap to minimise the impact of high-grade outliers.
- Threshold Cap Model – This block model used a gold grade cap in each domain above which a limited area of influence was applied.
- Hybrid Cap Model – This block model used both a threshold gold cap and an extreme outlier hard gold cap to limit the impact of higher gold grades. This model was used as the basis for the mineral resources reported for the Berry gold deposit.

These four block models were used to examine the impact of gold grade capping on the final mineral resource estimate.

14.6.5 Berry Grade Estimation

A 3D block model was constructed in Vulcan that was constrained by the mineralised domains described above. The current topographic surface was used to flag the topographic variable (vtopo). This variable is set to 100 for a block 100% below the surface and to 0% for a block 100% above the surface. A topo-adjusted density (rdensity) was assigned using the following formula:

$$rdensity = density * (vtopo/100)$$

This procedure ensures that blocks along the topographic surface have the correct density applied during pit optimisation functions.

No attempt was made to determine the percentages of the block that is mineralised material and waste; as such, blocks are considered entirely in or out of their respective domain. Block grades were determined for every domain except for the overburden and quartz-eye porphyry domains, which are assumed to not contain gold mineralisation.

Gold grades were interpolated from the composited assays described above using inverse distance (ID), inverse distance squared (ID2), inverse distance cubed (ID3), inverse distance to the fifth (ID5), ordinary kriging (OK), and nearest neighbour (NN) methods. Three passes were run to assist in resource classification. Only composites flagged as within the same mineralisation were considered in the grade estimation for each domain. Grade estimation parameters are shown in Tables 14.66 through 14.71 on the following pages.

Within the QTPV_FW and QTPV_HW domains, the block grades were first estimated in the S1 orientation and then in the S3 orientation. Results for each estimate were stored in separate block variables. During post estimation procedures, the gold grade of a block was determined using the following:

- If the block has only a S1 gold value, then the block gold value is the S1 gold estimate.
- If the block has a S1 and S3 gold value, then the block gold value is the S1 estimate.
- If the block does not have a S1 gold value but has a S3 gold value, then the block gold value is the S3 estimate.
- If the block does not have a gold estimate in either the S1 or the S3 variables, then the block gold value is not estimated and considered to have a zero gold grade.

14.6.6 Berry Resource Classification

The resource classification used for the Berry deposit is generally based on which interpolation pass generated a block grade estimate as well as the distance to the nearest sample(s) (measured and indicated only). The resource classification used was:

- Measured – Blocks estimated in Pass 1 (minimum of four composites) with a maximum nearest neighbour distance of 15 m are classified as measured. No blocks for the Berry deposit are considered measured.
- Indicated – Blocks estimated in Pass 2 (minimum of three composites) with a maximum nearest neighbour distance of 25 m are classified as indicated. Only QTPV Footwall blocks could be flagged as indicated.
- Inferred – Blocks estimated in Pass 3 (minimum of two composites) are classified as inferred.

Table 14.66: Berry QTPV Footwall S1 Domain Grade Estimation Parameters

Item	Pass		
	1	2	3
Search Parameters			
Major Range (m)	43.4	43.4	43.4
Semi-Major Range (m)	35.3	35.3	35.3
Minor Range (m)	5.0	5.0	5.0
Azimuth (degrees)	108.0	108.0	108.0
Plunge (plunge of the azimuth in degrees)	0.0	0.0	0.0
Dip (degrees)	-40.0	-40.0	-40.0
Search Ellipsoid			
Azimuth (degrees)	108.00	108.00	108.00
Plunge (plunge of the azimuth in degrees)	0.00	0.00	0.00
Dip (degrees)	-40.00	-40.00	-40.00
Major (m)	43.40	43.40	43.40
Semi-Major (m)	35.30	35.30	35.30
Minor (m)	5.00	5.00	5.00
Estimation Parameters			
Minimum Number of Composites	4	3	2
Maximum Number of Composites	6	6	6
Maximum Composites Per Drillhole	2	2	2
Maximum Distance to Nearest Neighbour (m)	15	25	---
Resource Classification	---	Indicated	Inferred

Table 14.67: Berry QTPV Footwall S3 Grade Estimation Parameters

Item	Pass		
	1	2	3
Search Parameters			
Major Range (m)	57.2	57.2	57.2
Semi-Major Range (m)	50.7	50.7	50.7
Minor Range (m)	5.0	5.0	5.0
Azimuth (degrees)	246.0	246.0	246.0
Plunge (plunge of the azimuth in degrees)	0.0	0.0	0.0
Dip (degrees)	-7.0	-7.0	-7.0
Search Ellipsoid			
Azimuth (degrees)	246.00	246.00	246.00
Plunge (plunge of the azimuth in degrees)	0.00	0.00	0.00
Dip (degrees)	-7.00	-7.00	-7.00
Major (m)	57.20	57.20	57.20
Semi-Major (m)	50.70	50.70	50.70
Minor (m)	5.00	5.00	5.00
Estimation Parameters			
Minimum Number of Composites	4	3	2
Maximum Number of Composites	6	6	6
Maximum Composites Per Drillhole	2	2	2
Maximum Distance to Nearest Neighbour (m)	15	25	---
Resource Classification	---	Indicated	Inferred

Table 14.68: Berry QTPV Hanging Wall S1 Domain Grade Estimation Parameters

Item	Pass		
	1	2	3
Search Parameters			
Major Range (m)	51.3	51.3	51.3
Semi-Major Range (m)	17.0	17.0	17.0
Minor Range (m)	5.0	5.0	5.0
Azimuth (degrees)	108.0	108.0	108.0
Plunge (plunge of the azimuth in degrees)	0.0	0.0	0.0
Dip (degrees)	-40.0	-40.0	-40.0
Search Ellipsoid			
Azimuth (degrees)	108.00	108.00	108.00
Plunge (plunge of the azimuth in degrees)	0.00	0.00	0.00
Dip (degrees)	-40.00	-40.00	-40.00
Major (m)	51.30	51.30	51.30
Semi-Major (m)	17.00	17.00	17.00
Minor (m)	5.00	5.00	5.00
Estimation Parameters			
Minimum Number of Composites	4	3	2
Maximum Number of Composites	6	6	6
Maximum Composites Per Drillhole	2	2	2
Maximum Distance to Nearest Neighbour (m)	15	25	---
Resource Classification	---	---	Inferred

Table 14.69: Berry QTPV Hanging Wall S3 Domain Grade Estimation Parameters

Item	Pass		
	1	2	3
Search Parameters			
Major Range (m)	11.0	11.0	11.0
Semi-Major Range (m)	22.0	22.0	22.0
Minor Range (m)	5.0	5.0	5.0
Azimuth (degrees)	246.0	246.0	246.0
Plunge (plunge of the azimuth in degrees)	0.0	0.0	0.0
Dip (degrees)	-7.0	-7.0	-7.0
Search Ellipsoid			
Azimuth (degrees)	246.00	246.00	246.00
Plunge (plunge of the azimuth in degrees)	0.00	0.00	0.00
Dip (degrees)	-7.00	-7.00	-7.00
Major (m)	11.00	11.00	11.00
Semi-Major (m)	22.00	22.00	22.00
Minor (m)	5.00	5.00	5.00
Estimation Parameters			
Minimum Number of Composites	4	3	2
Maximum Number of Composites	6	6	6
Maximum Composites Per Drillhole	2	2	2
Maximum Distance to Nearest Neighbour (m)	15	25	---
Resource Classification	---	---	Inferred

Table 14.70: Berry Mafic Dike Domain Grade Estimation Parameters

Item	Pass		
	1	2	3
Search Parameters			
Major Range (m)	9.3	9.3	9.3
Semi-Major Range (m)	12.4	12.4	12.4
Minor Range (m)	4.0	4.0	4.0
Azimuth (degrees)	108.0	108.0	108.0
Plunge (plunge of the azimuth in degrees)	0.0	0.0	0.0
Dip (degrees)	-40.0	-40.0	-40.0
Search Ellipsoid			
Azimuth (degrees)	108.00	108.00	108.00
Plunge (plunge of the azimuth in degrees)	0.00	0.00	0.00
Dip (degrees)	-40.00	-40.00	-40.00
Major (m)	9.30	9.30	9.30
Semi-Major (m)	12.40	12.40	12.40
Minor (m)	4.00	4.00	4.00
Estimation Parameters			
Minimum Number of Composites	4	3	2
Maximum Number of Composites	6	6	6
Maximum Composites Per Drillhole	2	2	2
Maximum Distance to Nearest Neighbour (m)	15	25	---
Resource Classification	---	---	Inferred

Table 14.71: Berry Sediment Domain Grade Estimation Parameters

Item	Pass		
	1	2	3
Search Parameters			
Major Range (m)	24.6	24.6	24.6
Semi-Major Range (m)	25.8	25.8	25.8
Minor Range (m)	5.0	5.0	5.0
Azimuth (degrees)	108.0	108.0	108.0
Plunge (plunge of the azimuth in degrees)	0.0	0.0	0.0
Dip (degrees)	-40.0	-40.0	-40.0
Search Ellipsoid			
Azimuth (degrees)	108.00	108.00	108.00
Plunge (plunge of the azimuth in degrees)	0.00	0.00	0.00
Dip (degrees)	-40.00	-40.00	-40.00
Major (m)	24.60	24.60	24.60
Semi-Major (m)	25.80	25.80	25.80
Minor (m)	5.00	5.00	5.00
Estimation Parameters			
Minimum Number of Composites	4	3	2
Maximum Number of Composites	6	6	6
Maximum Composites Per Drillhole	2	2	2
Maximum Distance to Nearest Neighbour (m)	15	25	---
Resource Classification	---	---	Inferred

14.6.7 Berry Deposit Model Validation

The gold grade populated block model was reviewed to ensure reasonableness. These checks included:

- an overall review of the estimated metal values
- the impact of gold grade capping on the mineral resource
- QQ plots of the block model versus the composites
- a section-by-section comparison between the ID3 metal values and the underlying drillholes
- a statistical comparison of the raw assay values versus the composite values versus the block values

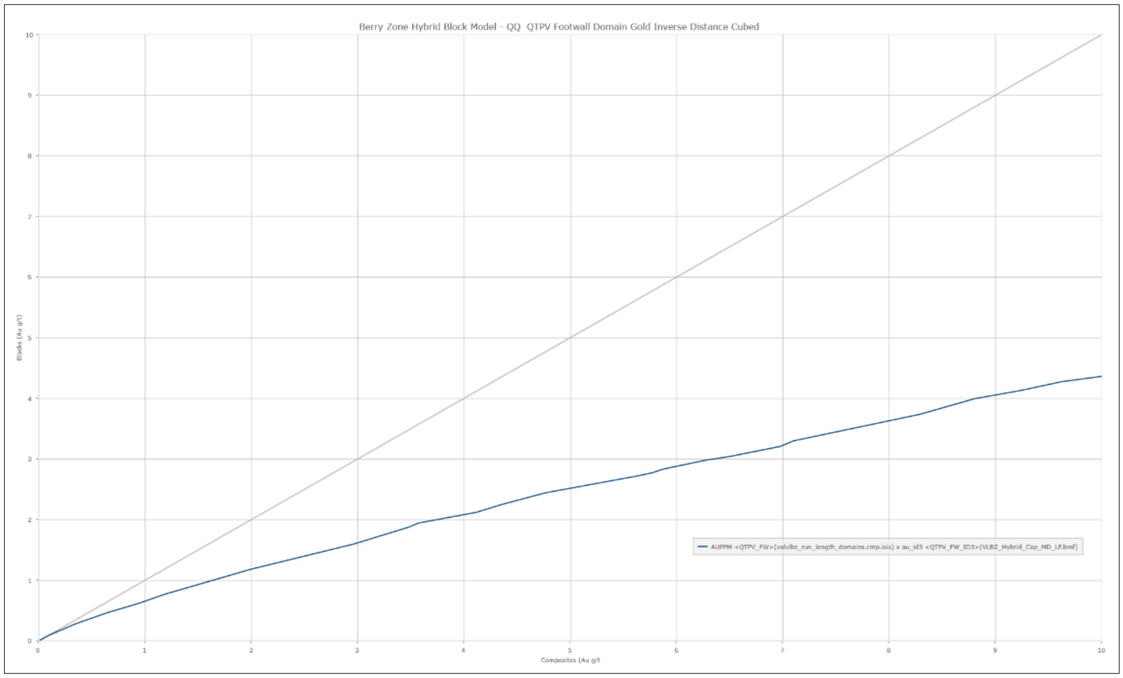
The overall block metal grades were visually examined to confirm that all the estimation parameters were honoured and kept within the individual mineralised domains. Each of the cross-sections was reviewed and the underlying drillholes were checked to determine that the original metal grade closely matched the estimated block metal grade without exceeding it. Cross-sections were examined, and assay intervals agreed with the overlying estimated block model metal grades. A statistical comparison of the raw assay values versus the composite values versus the estimated block values was run and is shown in Table 14.72.

Table 14.72: Berry Mineral Resource Estimation Model Statistics (All Domains)

Item	Domains				
	All	QTPV_FW (S1 & S3)	QTPV_HW (S1 & S3)	Mafic Dikes	Sediments
1-Meter Composite Data					
Number of Blocks	20,863	13,211	5,963	1,422	266
Minimum	0.010	0.010	0.010	0.010	0.010
Maximum	319.020	319.020	129.044	28.503	4.291
Range	319.010	319.010	129.034	28.493	4.281
Average	0.788	1.038	0.404	0.207	0.133
Standard Deviation	4.626	5.440	2.939	1.084	0.435
Variance	21.400	29.594	8.638	1.175	0.189
Coefficient of Variance	5.871	5.241	7.275	5.237	3.271
Block Model Results					
Number of Blocks	2,929,032	2,066,470	857,309	3,357	1,896
Minimum	0.010	0.010	0.010	0.010	0.010
Maximum	100.000	100.000	49.100	5.000	1.856
Range	99.990	99.990	49.090	4.990	1.846
Average	0.413	0.495	0.217	0.112	0.108
Standard Deviation	1.553	1.801	0.611	0.318	0.247
Variance	2.413	3.242	0.374	0.101	0.061
Coefficient of Variance	3.760	3.637	2.811	2.824	2.281

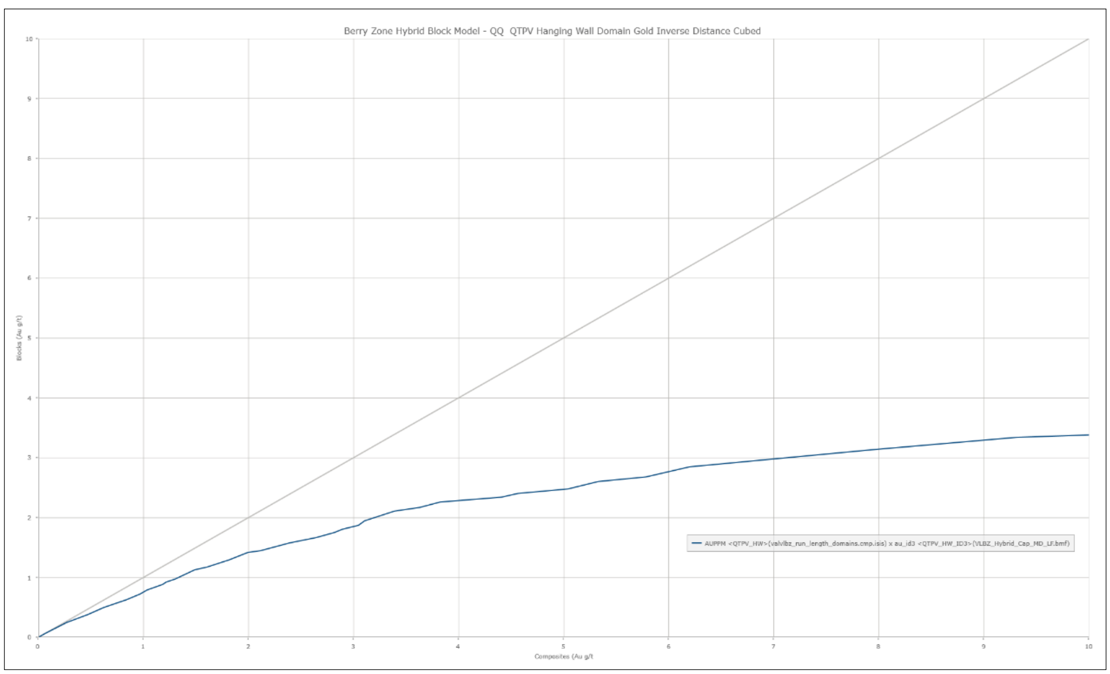
The various mineralised domain QQ plots of the block model estimated ID3 gold grades versus the composites are shown in Figures 14-101 through 14-104.

Figure 14-101: Berry QTPV_FW (S1 & S3) Domain QQ Plot



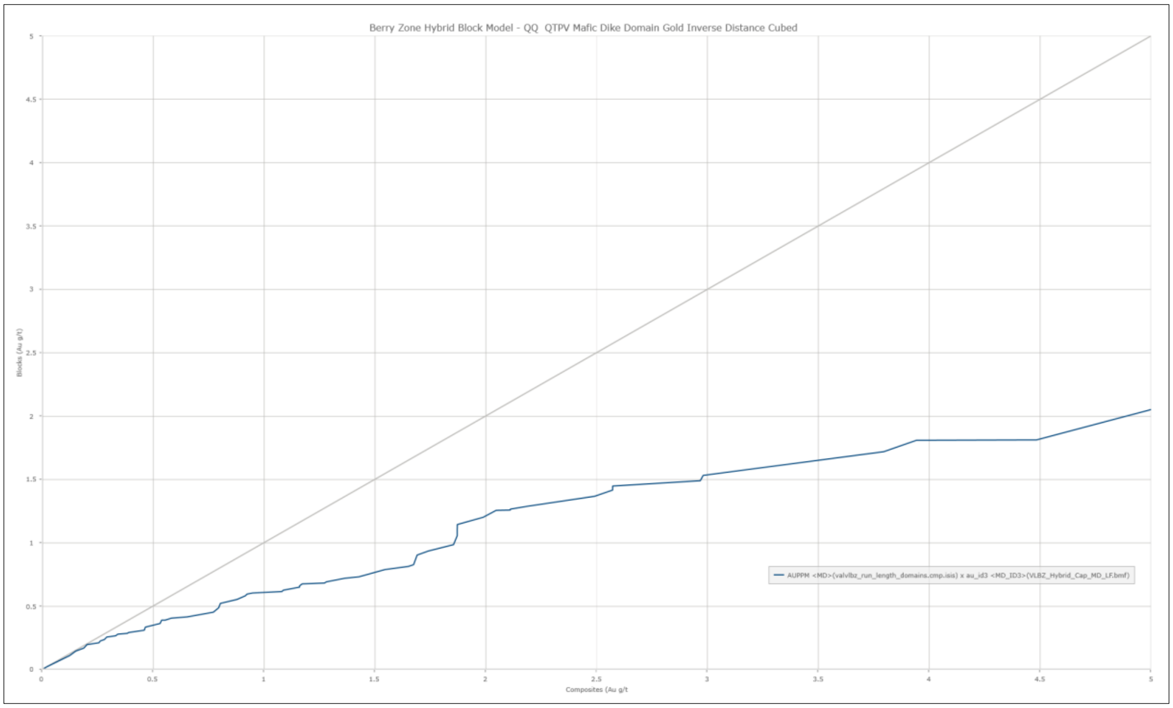
Source: BOYD, 2021

Figure 14-102: Berry QTPV_HW (S1 & S3) Domain QQ Plot



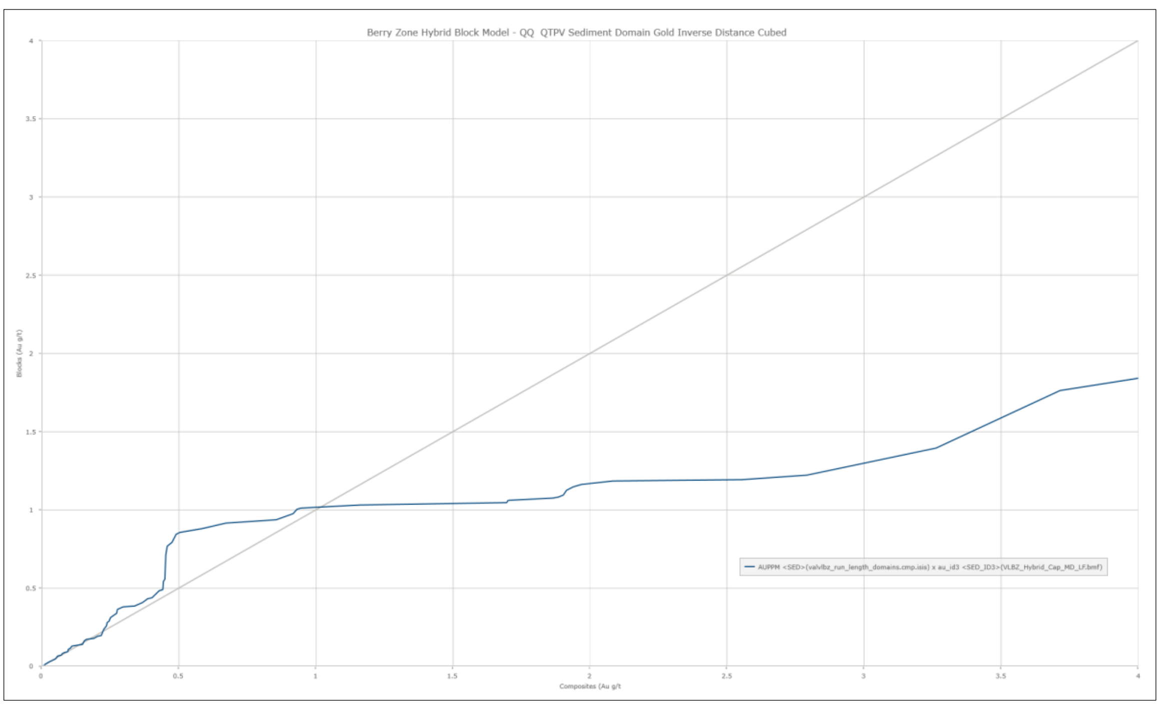
Source: BOYD, 2021

Figure 14-103: Berry Mafic Dike QQ Plot



Source: BOYD, 2021

Figure 14-104: Berry Sediment QQ Plot



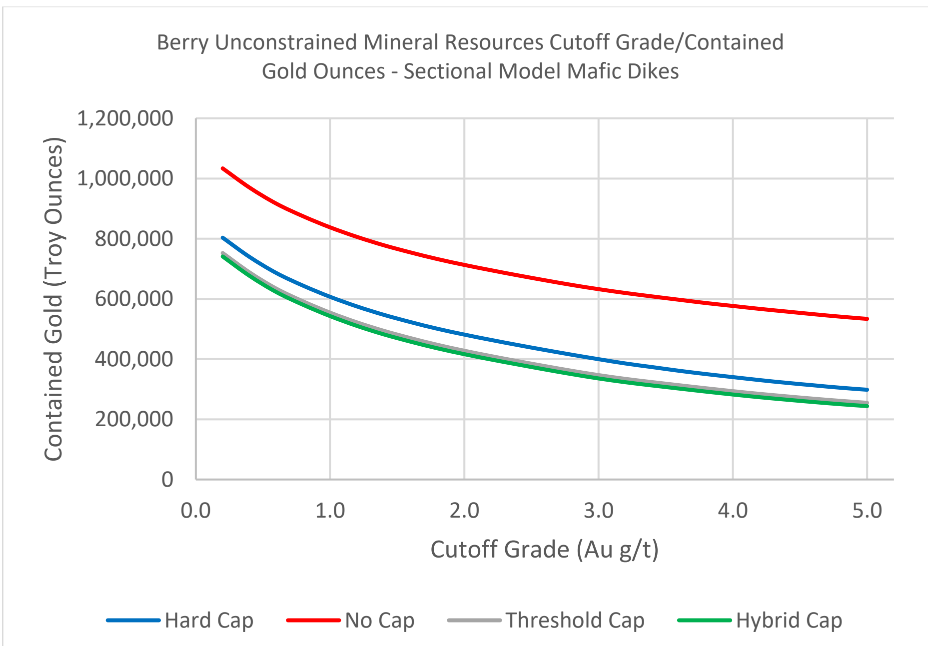
Source: BOYD, 2021

The block model checks indicate that the mineral resource estimate matches the underlying composites at lower gold grade values. At higher gold grades, the block model gold grades are underestimated relative to the underlying composites.

A review of the classification in the mineral resource model indicated that much of the indicated mineral resource occurred in isolated blocks. This issue, also known as “spotted dog”, is likely due to relative sparseness of the exploration data for the Berry deposit. As such, it is BOYD’s opinion that until further infill drilling is completed the mineral resource should be classified as inferred only.

The impact on total metal content of gold grade capping is shown in Figure 14-105. The impact of gold grade capping at Berry showed that the hard-capped block model contained 77.4% of the no capping block model contained gold ounces. The threshold capped block model contained 72.6% of the no capping block model contained ounces. The hybrid capped model (used for the mineral resources) contained 71.5% of the no capping block model contained ounces. It is the opinion of BOYD that the hybrid capped model represents the best estimate of the in-situ mineral resource at Berry and was selected for mineral resource reporting.

Figure 14-105: Berry Impact of Gold Grade Capping



Source: BOYD, 2021

14.6.8 Berry Mineral Resource Estimate

The Berry mineral resources may be amenable to a combination of open pit and underground mining methods. BOYD developed a conceptual pit shell (the economic open pit shell) using the Lerchs-Grossman method as provided by the Whittle software within which the portions of the block model that show “reasonable prospects for economic extraction” by open pit mining. From this shell, a conceptual open pit mine was designed and used to constrain the mineral resources. Portions of the block model which are external to the conceptual pit shell but satisfy cut-off grade criteria for an appropriate underground extraction method, are considered to show “reasonable prospects for economic extraction” by underground mining methods.

14.6.8.1 Economic Assumptions

The operating assumptions (economic and gold recovery) used for the Whittle economic open pit optimisation are shown in Table 14.73; the operating assumptions (economic and gold recovery) used for the calculation of an underground cut-off grade is shown in Table 14.74. These assumptions are based on the current feasibility study metallurgical and economic parameters.

For mineral resource estimation, a cut-off grade of 0.300 g/t gold was used for open pit, and a cut-off grade of 1.44 g/t gold was used for underground. The assumed overall pit slope in Whittle was assumed to be 42.0° in slope sectors identified by Terrane (the feasibility study geotechnical consultant) and 48.0° elsewhere. None of the slopes includes an allowance for ramps.

Using these assumptions, a Whittle economic pit optimisation was completed, and an economic open pit shell generated. This pit shell was used to design a conceptual open pit, which is shown in Figure 14-106.

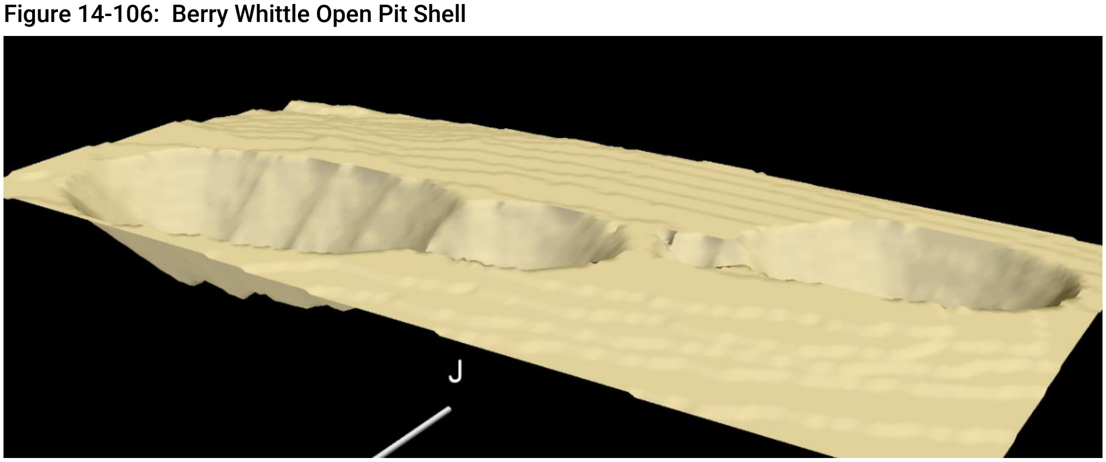
Table 14.73: Berry Open Pit Economic Assumptions

Item	Value	Units
Waste Mining Cost	2.35	C$/t waste
Mill Feed Mining Cost	3.60	C$/t mill feed or heap leach
Mill Processing Cost	10.81	C$/t mill feed
G&A Cost	2.40	C$/t mill feed or heap leach
Mill Gold Recovery (at cut-off)	91.1	%
Exchange	0.76	---
Gold Price	1,500	US$/troy oz
Mill Cut-off	0.30	g/t

Table 14.74: Berry Underground Economic Assumptions

Item	Value	Units
Mill Feed Mining Cost	71.50	C$/t mill feed
Processing Cost	10.81	C$/t material
G&A Cost	2.40	C$/t material
Recovery (at cut-off)	92.7	%
Exchange	0.76	---
Gold Price	1,500	US$/troy oz
Calculated Cut-off	1.44	g/t

Figure 14-106: Berry Whittle Open Pit Shell



Source: BOYD, 2021

14.6.8.2 Mineral Resource Estimate

BOYD's mineral resource estimate for the Berry deposit is provided in Table 14.75.

Table 14.75: Mineral Resource Estimate for the Berry Deposit

Inferred Mineral Resource Estimate

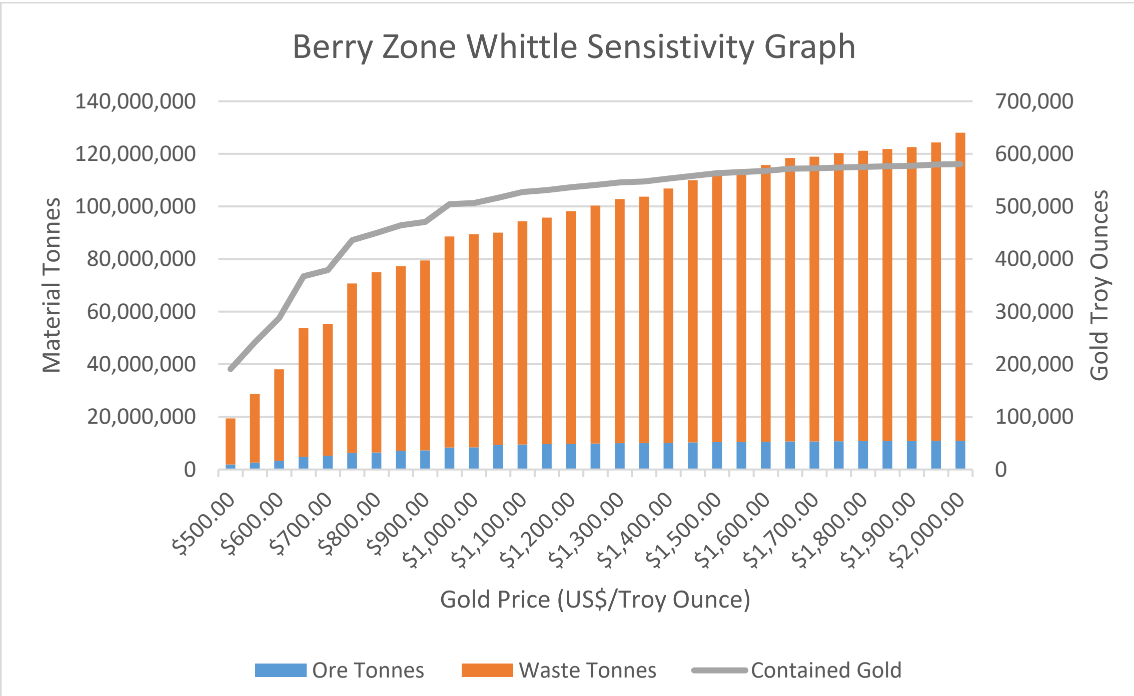
Mining Method	Resource Classification	Gold Cut-off Grade (g/t)	Tonnes	Au (g/t)	Au Troy (oz)
Open Pit – High Grade	Inferred	0.70	5,816,000	2.640	493,700
Open Pit – Low Grade	Inferred	0.30	4,895,000	0.462	72,700
Total Open Pit	Inferred	0.30	10,711,000	1.645	566,400
Underground	Inferred	1.44	622,000	3.616	72,300
Open Pit + Underground	Inferred	0.30	11,333,000	1.753	638,700

Notes: **1.** The effective date for this mineral resource estimate is April 15, 2021 and is reported on a 100% ownership basis. The effective date for this mineral resource estimate is April 15, 2021 and is reported on a 100% ownership basis. This estimate is a new estimate using additional assays and exploration drilling as well as updated economics. The qualified person for the mineral resource estimate is Robert Farmer, P. Eng. **2.** Mineral resources are calculated at a gold price of US$1,500 per troy ounce. **3.** The mineral resources presented above are global and do not include detailed pit or underground designs; only an economic open pit shell was used to determine the in-pit mineral resources. The underground mineral resources are that material outside of the in-pit mineral resources above the stated underground cut-off grade. **4.** Mineral resources, which are not mineral reserves, do not have demonstrated economic viability. The estimate of mineral resources may be materially affected by environmental, permitting, legal, title, socio-political, marketing, or other relevant issues. **5.** The mineral resources presented here were estimated using a block model with a block size of 6 m x 6 m x 6 m sub-blocked to a minimum block size of 2 m x 2 m x 2 m using ID3 methods for grade estimation. All mineral resources are reported using an open pit gold cut-off of 0.30 g/t Au and an underground gold cut-off of 1.44 g/t Au. Higher gold grades were capped by mineralised domain. Material above a 0.70 g/t gold cut-off is considered high-grade while material between a 0.30 and 0.70 g/t gold cut-off is considered low-grade. **6.** The mineral resources presented here were estimated using the Canadian Institute of Mining, Metallurgy and Petroleum (CIM), CIM Standards on Mineral Resources and Reserves, Definitions and Guidelines prepared by the CIM Standing Committee on Reserve Definitions and adopted by CIM Council May 10, 2014. **7.** Figures are rounded, and totals may not add correctly.

14.6.8.3 Sensitivity Analysis

During the Whittle optimization, pit shells were run at $50 increments from US$500 to US$2,000 per ounce. The results of this analysis shows that the current mineral resource remains substantially unchanged at gold prices higher than US$1,000 per ounce. The analysis is shown below in Figure 14-107.

Figure 14-107: Berry Gold Price Sensitivity Analysis



Source: BOYD, 2021

14.7 Consolidated Mineral Resource Statement for the Valentine Gold Project

The overall consolidated mineral resources for the Valentine Gold Project are shown in Table 14.76.

Table 14.76: Consolidated Valentine Gold Project Mineral Resources

Measured & Indicated Mineral Resource Estimate

Material/ Category	Open Pit			Underground			Total		
	Tonnes	Grade	Gold	Tonnes	Grade	Gold	Tonnes	Grade	Gold
	(t)	(g/t)	(oz)	(t)	(g/t)	(oz)	(t)	(g/t)	(oz)
Leprechaun Deposit									
Measured	8,498,000	2.207	602,900	98,000	3.567	11,200	8,596,000	2.222	614,100
Indicated	8,278,000	1.691	450,100	197,000	3.149	19,900	8,475,000	1.725	470,000
M+I	**16,776,000**	**1.952**	**1,053,000**	**295,000**	**3.279**	**31,100**	**17,071,000**	**1.975**	**1,084,100**
Sprite Deposit									
Measured	0	0.000	0	0	0.000	0	0	0.000	0
Indicated	695,000	1.737	38,800	6,000	2.196	400	701,000	1.741	39,200
M+I	**695,000**	**1.737**	**38,800**	**6,000**	**2.196**	**400**	**701,000**	**1.741**	**39,200**
Marathon Deposit									
Measured	23,578,000	1.650	1,250,500	413,000	4.169	55,400	23,991,000	1.693	1,305,900
Indicated	13,354,000	1.419	609,200	454,000	3.351	48,900	13,808,000	1.482	658,100
M+I	**36,932,000**	**1.566**	**1,859,700**	**867,000**	**3.741**	**104,300**	**37,799,000**	**1.616**	**1,964,000**
Victory Deposit									
Measured	0	0.000	0	0	0.000	0	0	0.000	0
Indicated	1,084,000	1.459	50,800	1,300	1.803	100	1,085,300	1.460	50,900
M+I	**1,084,000**	**1.459**	**50,800**	**1,300**	**1.803**	**100**	**1,085,300**	**1.460**	**50,900**
All Deposits									
Measured	32,076,000	1.797	1,853,400	511,000	4.054	66,600	32,587,000	1.833	1,920,000
Indicated	23,411,000	1.526	1,148,900	658,300	3.277	69,300	24,069,300	1.574	1,218,200
M+I	**55,487,000**	**1.683**	**3,002,300**	**1,169,300**	**3.616**	**135,900**	**56,656,300**	**1.723**	**3,138,200**

Inferred Mineral Resource Estimate

Material/ Category	Open Pit			Underground			Total		
	Tonnes	Grade	Gold	Tonnes	Grade	Gold	Tonnes	Grade	Gold
	(t)	(g/t)	(oz)	(t)	(g/t)	(oz)	(t)	(g/t)	(oz)
Leprechaun Deposit									
Inferred	2,667,000	1.439	123,400	325,000	3.233	33,800	2,992,000	1.633	157,200
Sprite Deposit									
Inferred	1,189,000	1.199	45,900	61,000	2.468	4,800	1,250,000	1.261	50,700
Marathon Deposit									
Inferred	9,770,000	1.534	481,700	1,910,000	3.521	216,200	11,680,000	1.859	697,900
Victory Deposit									
Inferred	2,200,000	1.157	81,800	130,000	3.050	12,700	2,330,000	1.262	94,500
Berry Deposit									
Inferred	10,711,000	1.645	566,400	622,000	3.616	72,300	11,333,000	1.753	638,700
All Deposits									
Inferred	26,537,000	1.523	1,299,200	3,048,000	3.469	339,800	29,585,000	1.723	1,639,000

Notes: **1.** The effective date for this mineral resource estimate is November 20, 2020 for the Leprechaun, Sprite, Marathon, and Victory deposits, and April 15, 2021 for the Berry deposit, and is reported on a 100% ownership basis. This estimate is an update to the previous mineral resource estimate (1/2020) and is an update to economics only while the Berry deposit is a new discovery. The qualified person for the mineral resource estimate is Robert Farmer, P. Eng. **2.** Mineral resources are calculated at a gold price of US$1,500 per troy ounce. **3.** The mineral resources presented above are global and do not include detailed pit or underground designs; only an economic open pit shell was used to determine the in-pit mineral resources. The underground mineral resources are that material outside of the in-pit mineral resources above the stated underground cut-off grade. **4.** Mineral resources, which are not mineral reserves, do not have demonstrated economic viability. The estimate of mineral resources may be materially affected by environmental, permitting, legal, title, socio-political, marketing, or other relevant issues. **5.** The mineral resources presented here were estimated using a block model with a block size of 6 m x 6 m x 6 m sub-blocked to a minimum block size of 2 m x 2 m x 2 m using ID3 methods for grade estimation. All mineral resources are reported using an open pit gold cut-off of 0.30 g/t Au and an underground gold cut-off of 1.44 g/t Au. Higher gold grades were capped by mineralised domain. Material above a 0.70 g/t gold cut-off is considered high-grade while material between a 0.30 and 0.70 g/t gold cut-off is considered low-grade. **6.** The mineral resources presented here were estimated using the Canadian Institute of Mining, Metallurgy and Petroleum (CIM), CIM Standards on Mineral Resources and Reserves, Definitions and Guidelines prepared by the CIM Standing Committee on Reserve Definitions and adopted by CIM Council May 10, 2014. **7.** Figures are rounded, and totals may not add correctly.

15 Mineral Reserve Estimates

15.1 Introduction

The mineral reserves for the Valentine Gold Project are a subset of the measured and indicated mineral resources, described in Chapter 14, and supported by feasibility study engineering described in subsequent sections of this report, including the mine engineering summarised in Chapter 16.

15.2 Mineral Reserves Statement

Proven and probable mineral reserves have been modified from measured and indicated mineral resources and are summarised in Table 15.1. Inferred class mineral resources are set to waste. Mineral reserves have been estimated using the CIM 2019 Best Practices Guidelines (CIM, 2019) and are classified using the 2014 CIM Definition Standards (CIM, 2014). Mill feed tonnes and gold grades are based re-blocking the original resource model blocks to a selective mining unit (SMU) block size of 6 m x 6 m x 6 m. Further mining recovery parameters have been introduced, treating the following SMU blocks as waste:

- all isolated, mineralised blocks (blocks bounded by waste on all sides)
- all blocks below 0.50 g/t gold grade that are bounded by waste on all but one side

15.3 Mineral Reserves within Pit Phases

Open pits are based on the results of Pseudoflow sensitivity analysis, and then designed into detailed pit phases to develop contents for mine production scheduling. The mineral reserves by designed pit phase are shown in Table 15.2. Table 15.3 summarises the inferred mineral resources within the designed pits that have been set to waste; these are included in the waste tonnage totals in Table 15.2.

15.4 Factors that May Affect the Mineral Reserve Estimates

Mineral reserves are based on the engineering and economic analysis described in Chapters 16 to 22 of this report. Changes in the following factors and assumptions may affect the mineral reserve estimate:

- metal prices
- interpretations of mineralisation geometry and continuity of mineralisation zones
- geotechnical and hydrogeological assumptions
- ability of the mining operation to meet the targeted annual production rate
- operating cost assumptions
- mining and process plant recoveries
- ability to meet and maintain permitting and environmental license conditions, and the ability to maintain the social license to operate

Table 15.1: Proven & Probable Mineral Reserves

Mine Area	Reserve Class	Mill Feed (Mt)	Diluted Gold Grade (g/t Au)	Contained Metal (Moz)
Marathon	Proven	20.6	1.36	0.9
	Probable	9.1	1.15	0.3
	Marathon Total	**29.7**	**1.30**	**1.2**
Leprechaun	Proven	9.1	1.69	0.5
	Probable	8.3	1.19	0.3
	Leprechaun Total	**17.4**	**1.45**	**0.8**
Subtotal	Proven	29.7	1.46	1.4
	Probable	17.4	1.17	0.7
Grand Total	**Total Proven & Probable**	**47.1**	**1.36**	**2.1**

Notes: **1.** The mineral reserve estimates were prepared by Marc Schulte, P.Eng. (who is also an independent Qualified Person), reported using the 2014 CIM Definition Standards, and have an effective date of March 13, 2021. **2.** Mineral Reserves are mined tonnes and grade; the reference point is the mill feed at the primary crusher. **3.** Mineral reserves are reported at a cut-off grade of 0.30 g/t Au. **4.** Cut-off grade assumes US$1,500/oz Au at a currency exchange rate of US$0.75 per C$1.00; 99.8% payable gold; US$5.00/oz off-site costs (refining and transport); and uses an 87% metallurgical recovery. The cut off-grade covers processing costs of $12.00/t, administrative (G&A) costs of $3.00/t, and a stockpile rehandle cost of $1.50/t. **5.** Mined tonnes and grade are based on an SMU of 6 m x 6 m x 6 m, including additional mining losses estimated for the removal of isolated blocks (surrounded by waste) and low-grade (<0.5 g/t Au) blocks bounded by waste on three sides. **6.** Numbers have been rounded as required by reporting guidelines.

Table 15.2: Proven & Probable Mineral Reserves within Designed Pit Phases

Pit Phase	Pit Name	Mill Feed (Mt)	Waste (Mt)	Strip Ratio (t/t)	Diluted Gold Grade (g/t Au)
Marathon Phase 1	M631	9.3	30.8	3.3	1.37
Marathon Phase 2	M632i	7.7	39.2	5.1	1.23
Marathon Phase 3	M633i	12.7	115.4	9.1	1.28
Total Marathon	**M633**	**29.7**	**185.5**	**6.3**	**1.30**
Leprechaun Phase 1	L641	5.4	24.8	4.6	1.47
Leprechaun Phase 2	L642i	4.5	58.8	13.1	1.36
Leprechaun Phase 3	L643i	7.5	70.7	9.4	1.49
Total Leprechaun	**L643**	**17.4**	**154.3**	**8.9**	**1.45**
Grand Total		**47.1**	**339.8**	**7.2**	**1.36**

Notes: **1.** A cut-off grade of 0.30 g/t Au is applied. **2.** Mined tonnes and grade are based on an SMU of 6 m x 6 m x 6 m, including additional mining losses estimated for the removal of isolated blocks (surrounded by waste) and low-grade (<0.5 g/t Au) blocks bounded by waste on 3 sides. **3.** Mineral reserves in this table are not additive to the mineral reserves in Table 15.1. Footnotes to Table 15.1 apply to this table.

Table 15.3: Diluted Inferred Mineral Resources within the Designed Pits

Mine Area	Resources (Mt)	Gold Grade (g/t Au)
Marathon	5.6	1.05
Leprechaun	2.4	1.15
Total	**8.0**	**1.08**

Notes: **1.** A cut-off gold grade of 0.30 g/t Au is applied to the inferred mineral resources. **2.** These mineral resources are not additive to the mineral resources in Table 14.56; they are a subset of these mineral resources.

16 Mining Methods

The mineral reserves stated in Chapter 15 are supported by the open pit mine plan summarised in this chapter.

Open pit mine designs, mine production schedules and mine capital and operating costs have been developed for the Marathon and Leprechaun deposits at a feasibility level of engineering.

16.1 Key Design Criteria

The following mine planning design inputs were used:

- topography is based on a LiDAR survey of the region
- re-blocked resource block model on 6 m spacing in all three dimensions, with diluted gold grades, weight averaged specific gravities and majority coded resource classifications
- inferred mineral resources are treated as waste rock with no economic value
- a grade dependant gold process recovery is used for the pit optimisation and cut-off grade estimations:
  - process recovery = 1.43 * gold head grade + 90.64, capped at 97%
- a breakeven economic cut-off grade of 0.30 g/t Au is used
- stockpiles and haul roads are planned to minimise wetland, waterbody, and watercourse disturbance

16.1.1 Ore Loss & Dilution

The mineral resources are based on a 2 m x 2 m x 2 m resource model block size. For mine planning and mineral reserve estimation, these blocks have been diluted to a mining unit size of 6 m x 6 m x 6 m, which accounts for planned open pit mine operating conditions. This re-blocking to 6 m blocks introduces ~21% dilution and ~2% loss to the Marathon resource model and ~25% dilution and ~6% loss to the Leprechaun resource model, when measured at a 0.30 g/t gold cut-off grade.

This approach to calculating dilution and loss is considered appropriate for the current mine plan. The calculated 6 m re-blocked mill feed gold grades will be representative of the diluted run-of-mine material that the operator will be able to achieve when pursuing the throughputs targeted in this mine plan.

Further mining recovery parameters have been introduced, removing from the mineral reserves the following:

- all isolated mineralised blocks (blocks bounded by waste on all sides)
- all blocks below 0.50 g/t gold grade that are bounded by waste on all but one side

These additional parameters introduce a further 2% mining loss (on a gold ounce basis).

16.1.2 Bulk Mining & Selective Mining

A "selective" method of mining will be employed in certain areas of the Marathon and Leprechaun deposits to enhance grade control.

Flitch mining along the ore/waste boundary is proposed to reduce the ore loss and dilution (Hunt and La Rosa, 2019) and follow the boundary with greater precision. The digging face angle of a small flitch (1 to 2 m) is much steeper than the digging face angle of a full bench (6 or 12 m). As well, successive flitches can be adjusted (in plan view) to follow the ore/waste boundary as it changes with depth.

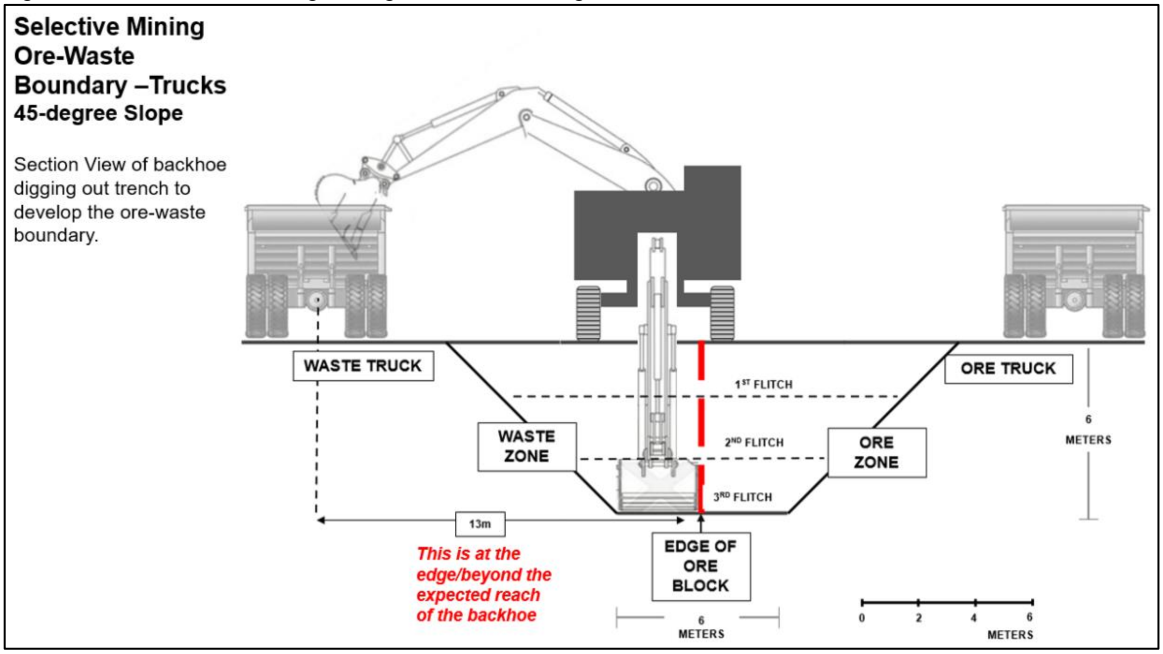
Figure 16-1 shows the proposed flitch mining process along the ore/waste boundary (the "selective" mining zone). It should be noted that flitch mining is less productive than full bench mining and therefore more costly on a unit cost basis. Therefore, flitch mining is only proposed along the ore/waste boundary. In straight waste or straight ore, digging can be done on a full bench height and utilise larger, more efficient mining equipment (the "bulk" mining zones).

The following assumptions are made for the selective mining process:

- 6 m bench height
- 2 m flitches
- 12 m^3 loader in a backhoe configuration (3 m wide bucket)
- effective reach of backhoe is 12 m
- vertical dig face angles for 2 m flitches
- 72° dig face angle for 6 m bench with a 45° zone of influence
- the ore/waste boundary has been defined using the results of the grade control sampling, and the ore/waste boundary will be further defined in the blasted rock using material movement measurements or modelling

The proposed method relies on containment on each side of the selective mining zone during flitch mining. Therefore, selective mining along the ore/waste boundary should be done ahead of full bench digging in straight ore or straight waste zones.

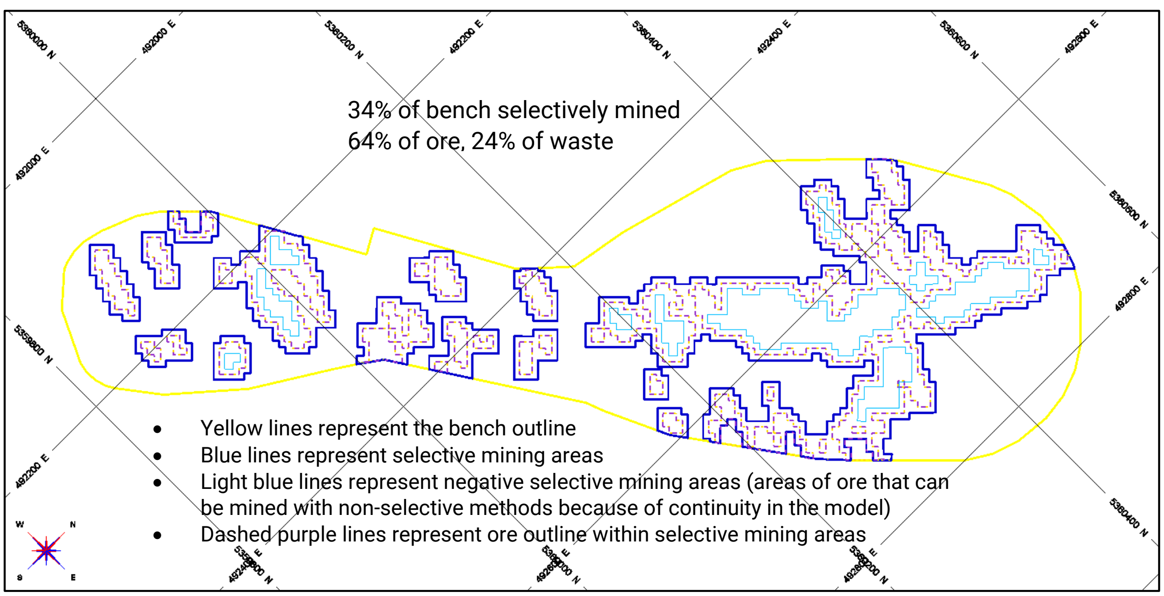
Figure 16-1: Selective Mining Configuration – Loading Trucks



Source: Moose Mountain, 2021.

Measurements of “selective” mined and “bulk” mined areas on each bench in each of the Marathon and Leprechaun deposits has been completed, with percentages of each methods back coded into the mine planning block model. Figure 16-2 shows an example of these measurements on the 326 m bench of the Phase 1 Marathon pit, one of the most “selective” benches in the entire mine plan.

Figure 16-2: Selective Mining Measurements



Source: Moose Mountain, 2021.

Global averages of selective mining measurements are 19% in the Marathon deposit, comprised of 54% of ore and 12% of waste, and 16% in the Leprechaun deposit, comprised of 65% of ore and 10% of waste.

Bench by bench percentages of each mining type are used in the pit optimisation routine, with higher costs applied to selectively mined quantities. Quantities of each method are also tracked through the mine production schedule and equipment fleet plans for the project.

16.1.3 Pit Slopes

The pit slope criteria are based on a 2021 geotechnical report by Terrane Geoscience Inc. (Gilman et al., 2021). Field data collection consisted of detailed geotechnical drillhole logging, index strength tests, packer testing, geomechanical sample collection, and optical/acoustic televiewer surveying. Geomechanical lab testing included unconfined compressive strength, triaxial compressive strength, direct shear, and Brazilian tensile testing.

Geotechnical models of the Marathon and Leprechaun deposit areas are built off the bases of geological models, structural models (fabrics and major structures), rock mass models and hydrogeological models.

Slope design takes into consideration an analysis of the overall slope stability of a pit wall (i.e., all the benches, berms, and ramps from the pit floor to the surface) and the bench design (i.e., bench width, bench face angle, and bench height). The overall slope angle, inter-ramp angle, and the bench face angles are then designed based on an acceptance criterion for probability of failure (PoF) and factor of safety (FOS).

Pit designs are configured on 6 m bench heights, with 8.1 m wide berms placed every three benches, or triple benching. Bench face angles, and subsequent inter-ramp angles, are varied based on prescribed geotechnical design sectors.

Bench face and inter-ramp slopes in the defined design sectors are listed in Table 16.1 for Marathon and Table 16.2 for Leprechaun. Defined geotechnical zones are illustrated in Figure 16-3 for Marathon and Figure 16-4 for Leprechaun on the following pages.

Table 16.1: Marathon Bench Face & Inter-Ramp Angle Inputs

Domain	Design Sector (Figure 16-1)	Bench Face Angle (°)	Inter-Ramp Angle (°)	Overall Slope* (°)
Overburden	All	25	25	25
Southeast	6	77	56	46
NW, NE and SW	1 to 5, 7 to 9	80	58	47.5

*Overall slope angles are inputs for pit optimisations only.

Table 16.2: Leprechaun Bench Face Inter-Ramp Angle Inputs

Domain	Design Sector (Figure 16-2)	Bench Face Angle (°)	Inter-Ramp Angle (°)	Overall Slope * (°)
Overburden	All	25	25	25
South	5	57	42	36
Southeast	4	70	51	42
NW and End Walls	1 to 3, 6 to 7	80	58	48

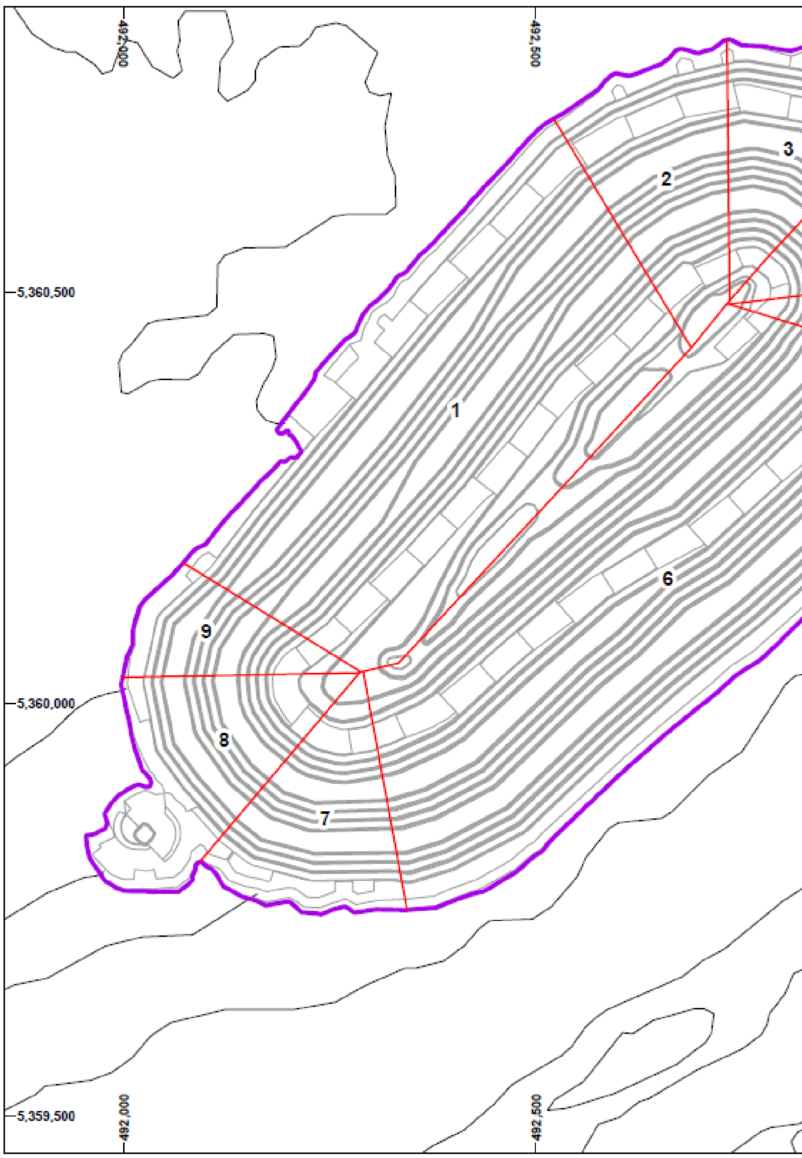
*Overall slope angles are inputs for pit optimisations only.

In-pit haul roads and geotechnical berms (25 m wide) are added to the pit designs and flatten the inter-ramp slopes out to shallower overall slopes. Geotechnical berms are placed on 90 m vertical spacing, wherever in-pit ramps are not present.

A 12 m wide berm is left at the bedrock contact with overburden. Groundwater flow is estimated to be higher along this bedrock contact. This berm is added to catch potential sloughing from the overburden above, as well as to allow sufficient room for water management features to be constructed.

Designs assume that controlled blasting (pre-split and/or trim blasting), slope dewatering and slope depressurisation, routine bench face maintenance, geotechnical monitoring, and on-going data collection will be completed throughout the life of the mine.

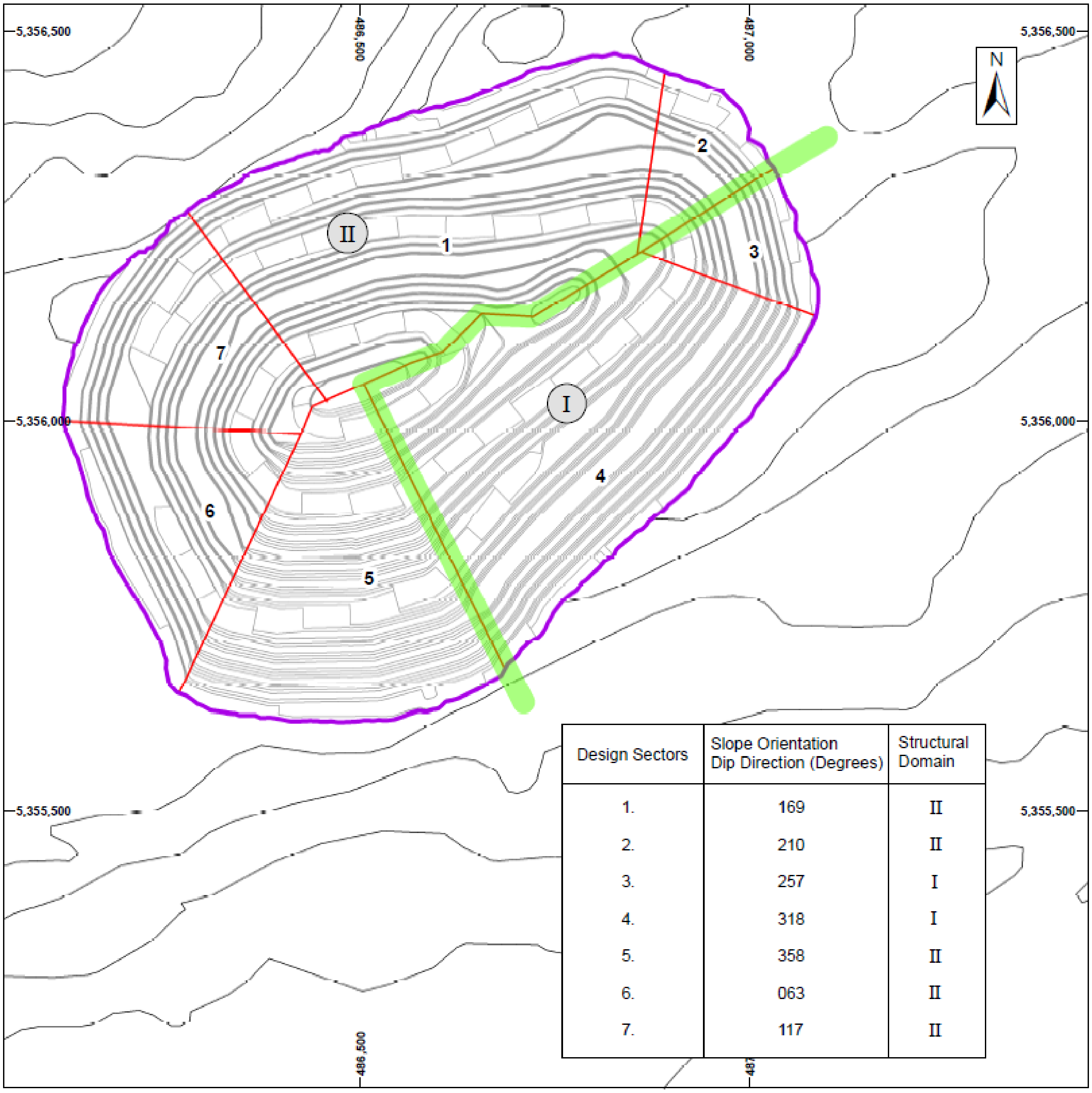
Figure 16-3: Marathon Pit Slope Design Sectors



Design Sector	Slope Orientation Dip Direction (Degrees)
1.	134
2.	157
3.	197
4.	245
5.	278
6.	320
7.	012
8.	070
9.	105

Source: Terrane Geoscience, Gilman et al., 2021.

Figure 16-4: Leprechaun Pit Slope Design Sectors



Design Sectors	Slope Orientation Dip Direction (Degrees)	Structural Domain
1.	169	II
2.	210	II
3.	257	I
4.	318	I
5.	358	II
6.	063	II
7.	117	II

Source: Terrane Geoscience, Gilman et al., 2021.

16.2 Pit Optimisation

The economic pit limits are determined using the Pseudoflow algorithm. This algorithm uses the ore grades and specific gravity (SG) for each block of the re-blocked mine planning 3D block model and evaluates the costs and revenues of the blocks within potential pit shells. The algorithm uses input economic and engineering parameters and expands downwards and outwards until the last increment is at break-even economics.

Additional cases are included in the analysis to evaluate the sensitivities of resources to strip ratio/topography and high-grade/low-grade areas of the deposit. In this study, the various cases or pit shells are generated by varying the input gold price and comparing the resultant waste and mill feed tonnages and gold grades for each pit shell.

By varying the economic parameters while keeping inputs for metallurgical recoveries and pit slopes constant, various generated pit cases are evaluated to determine where incremental pit shells produce marginal or negative economic returns. This drop-off is due to increasing strip ratios, decreasing gold grades, increased mining costs associated with the larger or deeper pit shells, and the value of discounting costs before revenues. The economic margins from the expanded cases are evaluated on a relative basis to provide payback on capital and produce a return for the project. At some point, further expansion does not provide significant added value. A pit limit can then be chosen that has suitable economic return for the deposit.

For each pit shell, an undiscounted cash flow (UCF) is generated based on the shell contents and the economic parameters listed in Table 16.3. The UCFs for each case are compared to reinforce the selected point at which increased pit expansions do not increase the project value. Note that the economics are only applied for comparative purposes to assist in the selection of an optimum pit shell for further mine planning; they do not reflect the actual financial results of the mine plan.

The chosen pit shell is then used as the basis for more detailed design and economic modelling.

Price and operating cost assumptions for the Pseudoflow runs are provided in Table 16.3. Note that the pit optimisation analysis was re-run with final study costs and process recoveries, which yielded identical selected pit shells as described below.

Table 16.3: Price & Operating Cost Inputs into Pseudoflow Shell Runs

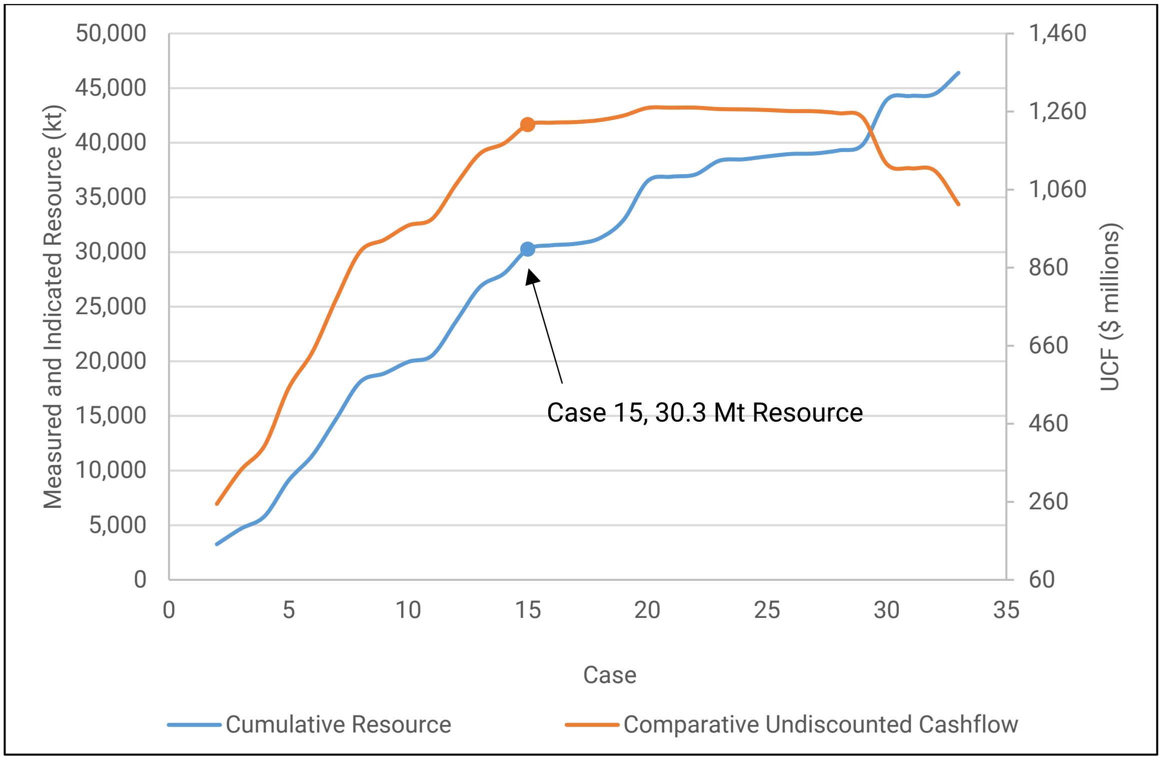
<table>
<tr><th>Item</th><th>Unit</th></tr>
<tr><td>Gold price</td><td>US$1,500</td></tr>
<tr><td>Foreign exchange USD:CAD</td><td>0.75:1.00</td></tr>
<tr><td>Payable gold</td><td>99.8%</td></tr>
<tr><td>Off-site costs</td><td>US$5.00/oz Au (refining and doré transport)</td></tr>
<tr><td>Royalties</td><td>0%</td></tr>
<tr><td rowspan="4">Pit rim mining cost
Pit rim 350 m at Marathon
Pit rim 386 m a Leprechaun</td><td>$3.13/t for bulk mining ore</td></tr>
<tr><td>$3.60/t for selective mining ore</td></tr>
<tr><td>$2.35/t for bulk mining waste</td></tr>
<tr><td>$2.70/t for selective mining waste</td></tr>
<tr><td>Incremental haulage cost</td><td>$0.015 per every 6 m bench below pit rim</td></tr>
<tr><td>Processing cost</td><td>$10.81/t</td></tr>
<tr><td>General/Administration cost</td><td>$2.40/t</td></tr>
</table>

16.2.1 Marathon Pit Limit

Figure 16-5 shows the contents of the generated Pseudoflow pit shells for Marathon. An inflection point to a flatter curve can be seen in the curve of cumulative resources and UCF by pit case. This point indicates Case 15 as a point at which larger pit shells will not produce significant increases to project value.

The pit shell generated from Case 15 is selected as the ultimate pit limits for Marathon and is used for further mine planning as a target for detailed open pit designs with berms and ramps.

Figure 16-5: Marathon Pseudoflow Pit Shell Resource Contents by Case



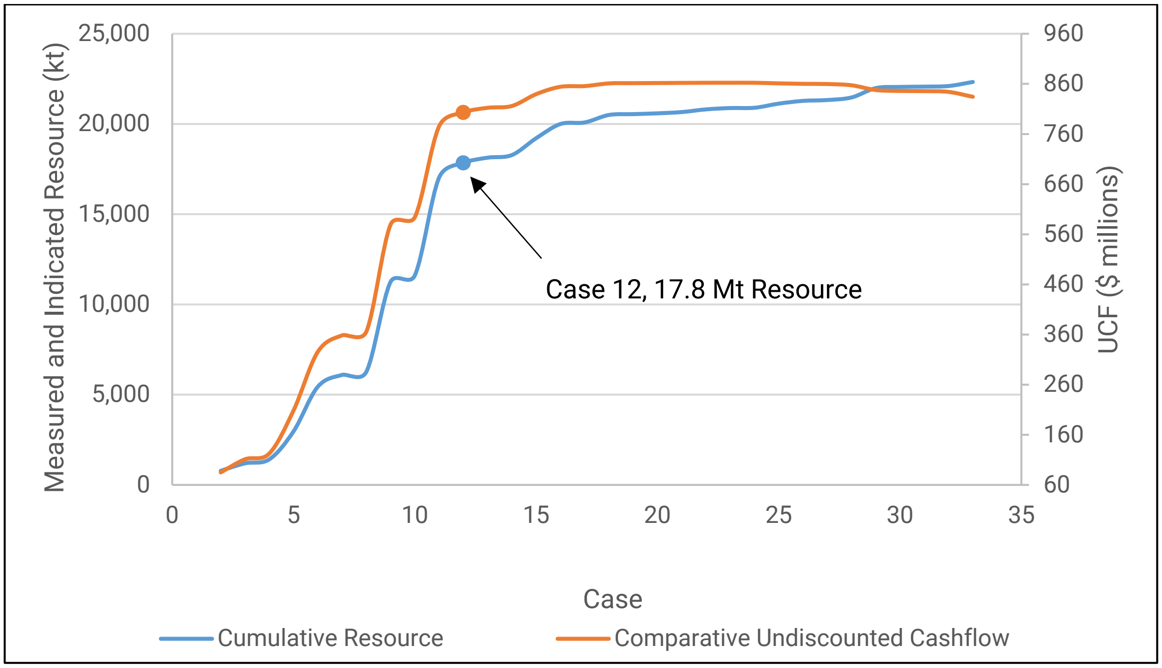
Source: Moose Mountain, 2021.

16.2.2 Leprechaun Pit Limit

Figure 16-6 shows the contents of the generated Pseudoflow pit shells for Leprechaun. An inflection point can be seen in the curve of cumulative resources and UCF by pit case. This point indicates Case 12 as a point at which larger pit shells will not produce significant increases to the project value.

The pit shell generated from Case 12 is selected as the ultimate pit limits for Leprechaun and is used for further mine planning as a target for detailed open pit designs with berms and ramps.

Figure 16-6: Leprechaun Pseudoflow Pit Shell Resource Contents by Case

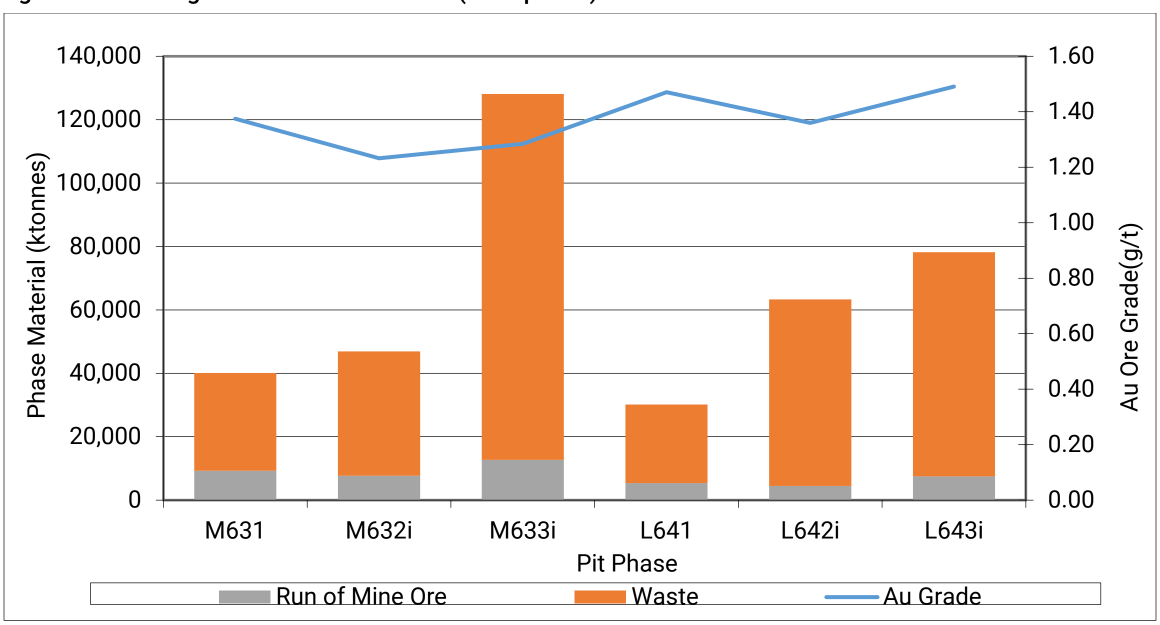


Source: Moose Mountain, 2021.

16.3 Pit Designs

Contents of the designed open pits are presented in Table 15.2 and discussed in Section 15.3. The contents for each designed pit phase are presented graphically in Figure 16-7.

Figure 16-7: Designed Phase Pit Contents (all deposits)



Source: Moose Mountain, 2021.

16.3.1 In-Pit Haul Roads

Two-way haul roads of 28 m width are sized to handle 140-tonne payload rigid frame haul trucks. Haul road grades are limited to a maximum of 10%. Access ramps are not designed for the last two benches of the pit bottom, on the assumption that the bottom ramp segment will be removed using some form of retreat mining. The bottom two ramped benches of the pit use one-way haul roads of 21 m width and 12% grade since bench volumes and traffic flow are reduced.

16.3.2 Pit Phases

Ultimate pit limits are generally split up into phases or pushbacks to target higher economic margin material earlier in the mine life. Minimum pushback distances of 60 m are honoured to maintain productive headings. The Marathon pit is split into three phases with the higher-grade, lower-strip-ratio first phase mined ahead of the two pushbacks to the north, east, and south. Targets for the first two phases use Case 6 and Case 8 of the optimisation runs described in Section 16.2.1.

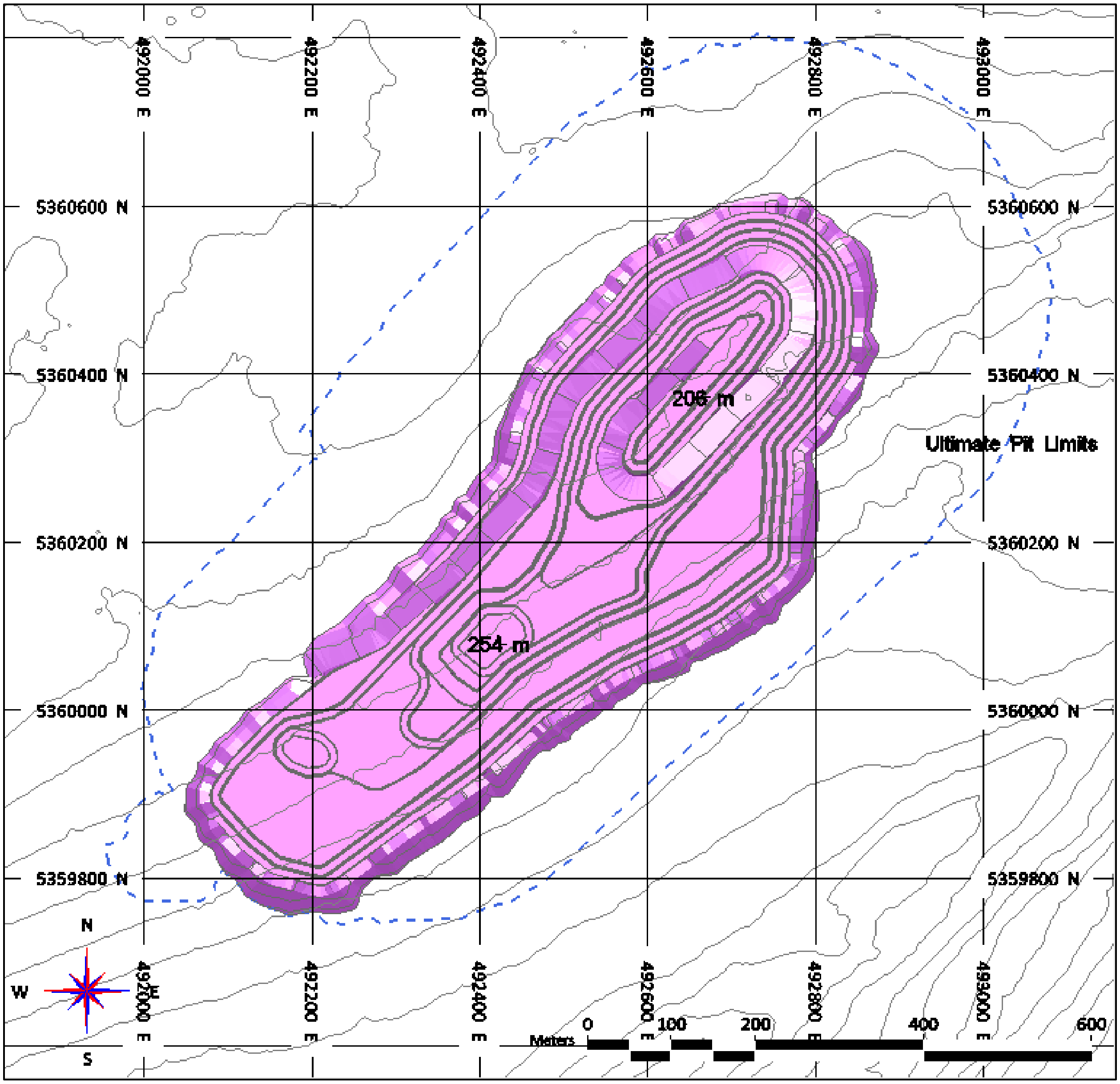
The Leprechaun pit is split into three phases with the higher grade, lower strip ratio first phase mined ahead of west, north, and south pushback second phase and an east and north pushback third phase. Targets for the first two phases use Case 6 and Case 9 of the optimisation runs described in Section 16.2.2.

16.3.3 Marathon Pit Designs

The phased Marathon pit designs are discussed below and shown in Figure 16-8 to Figure 16-12. Sections through the deposit showing the 6 m re-blocked model grades are illustrated in Figure 16-11 and Figure 16-12.

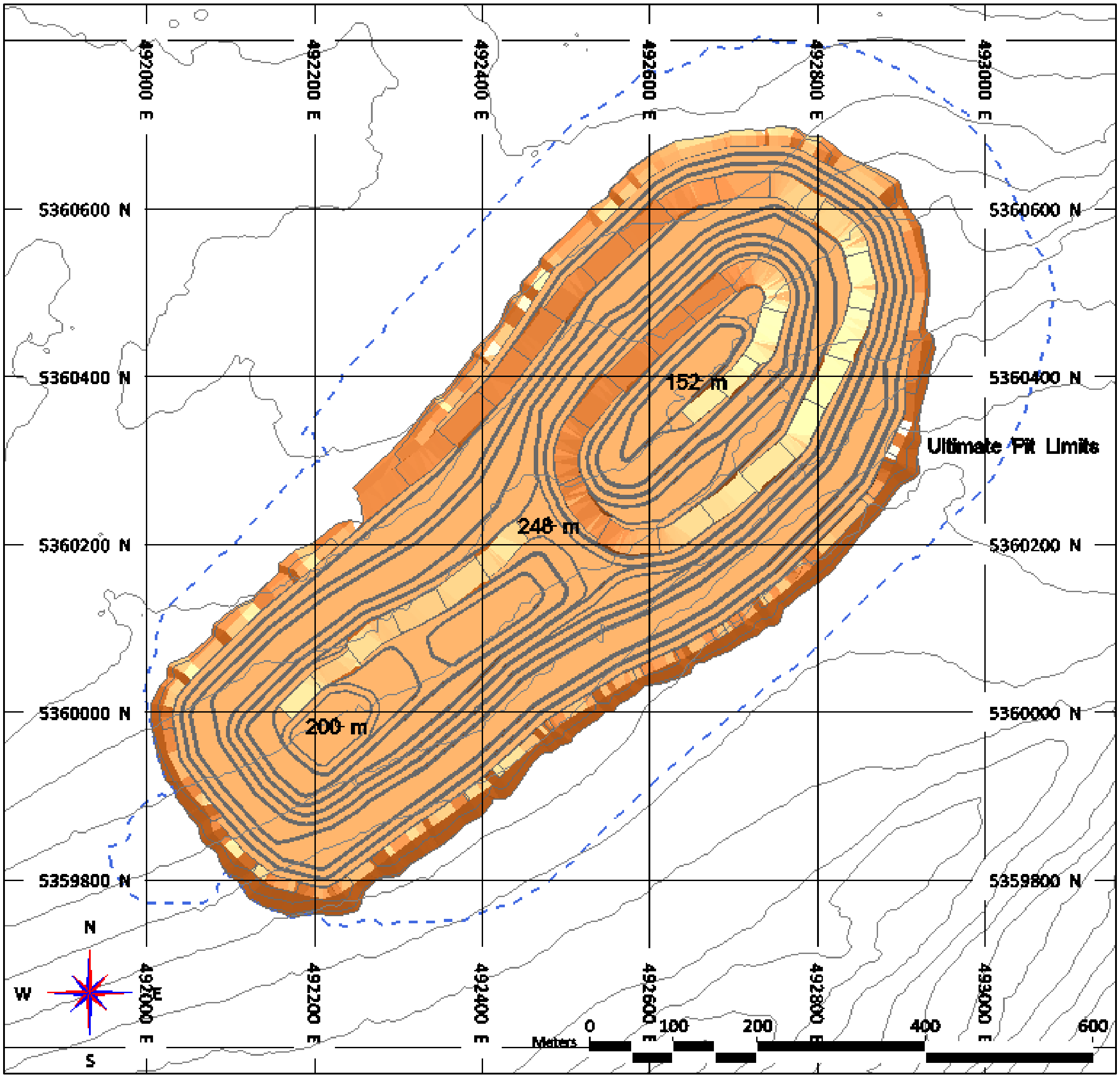
- Marathon Phase 1, M631 – This phase targets the high-grade, low-strip-ratio central portion of the deposit. This phase contains about three years' worth of mill feed and mines from the pit exit at the 350 m elevation, down to the pit bottom at the 206 m elevation. The main ramp runs clockwise down from the pit exit in the northwest.
- Marathon Phase 2, M632 – This phase targets deeper, higher-strip-ratio mineralisation below phase 1, pushing out in the north and east directions, while leaving enough room for a final pushback to the phase 3 pit. This phase contains about three years' worth of mill feed and mines from the pit exit at the 342 m elevation, down to the pit bottom at the 152 m elevation. The main ramp runs clockwise from the pit exit in the north of the pit. Geotechnical berms are left behind at the 314 m and 278 m elevations. The southwest portion of the pit is accessed from the 248 m elevation down to a pit bottom at the 200 m elevation from a secondary ramp. This pit bottom will be mined out before the remainder of the pit progresses below the 248 m elevation.
- Marathon Phase 3, M633 – This phase is the final phase and pushes out in the north, east, and south directions, targeted the remaining deep mineralisation. This phase contains about three years' worth of mill feed and mines from the pit exit at the 338 m elevation, down to the pit bottom at the 44 m elevation. The main ramp runs clockwise down from the pit exit in the north of the pit. Geotechnical berms are left behind various elevations.

Figure 16-8: Marathon Phase 1 Pit, M631



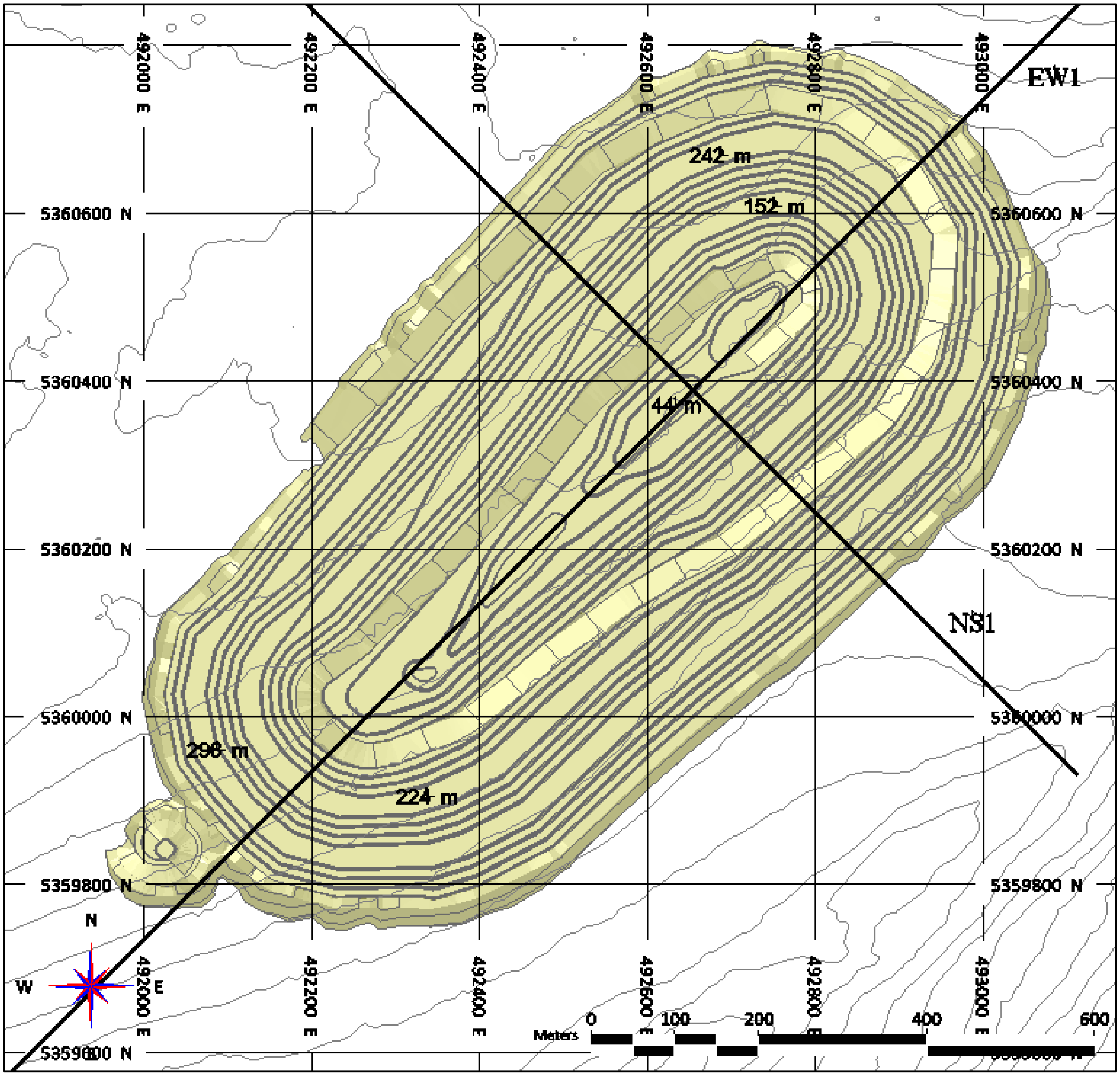
Source: Moose Mountain, 2021.

Figure 16-9: Marathon Phase 2 Pit, M632



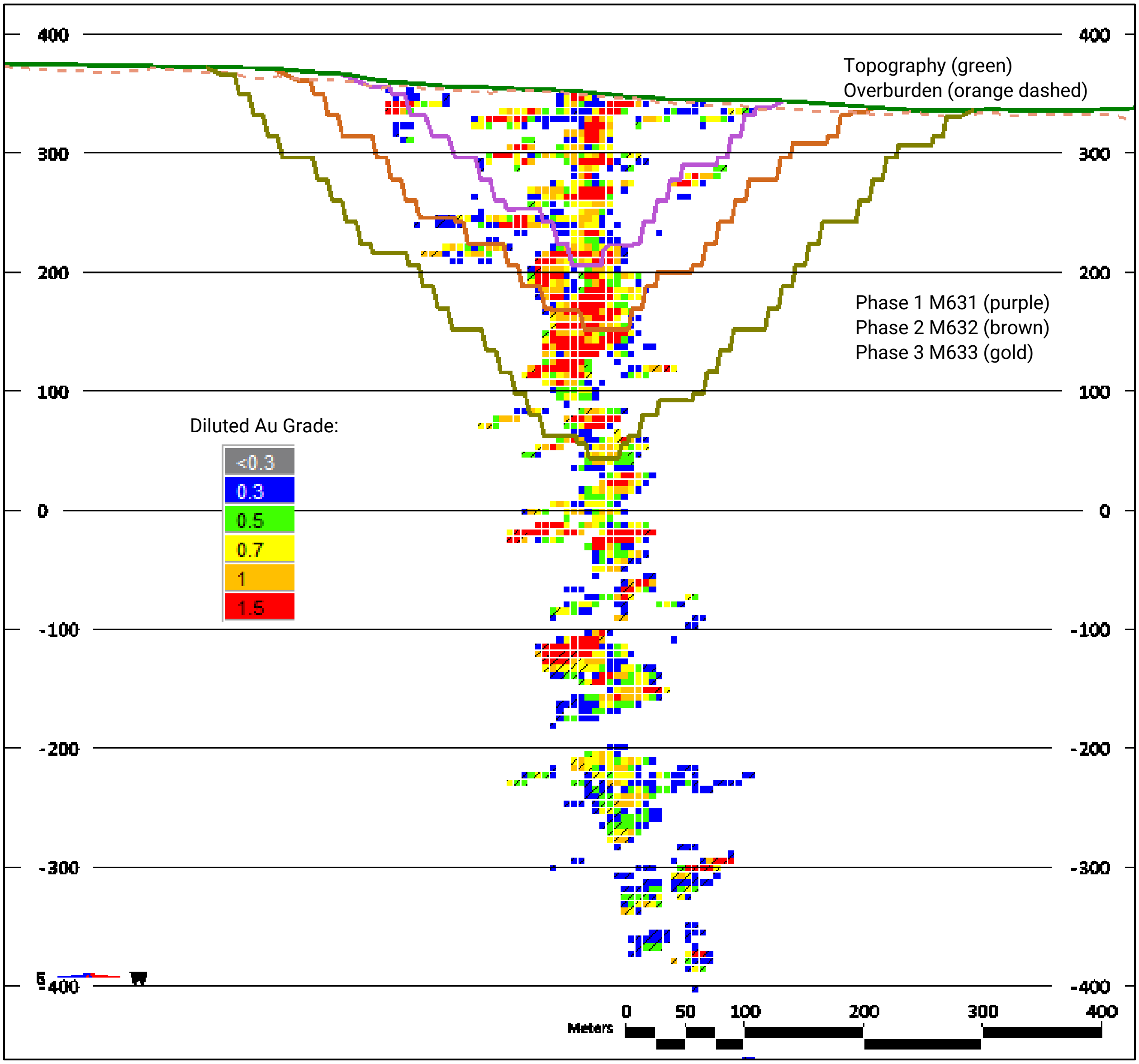
Source: Moose Mountain, 2021.

Figure 16-10: Marathon Phase 3 Pit, M633



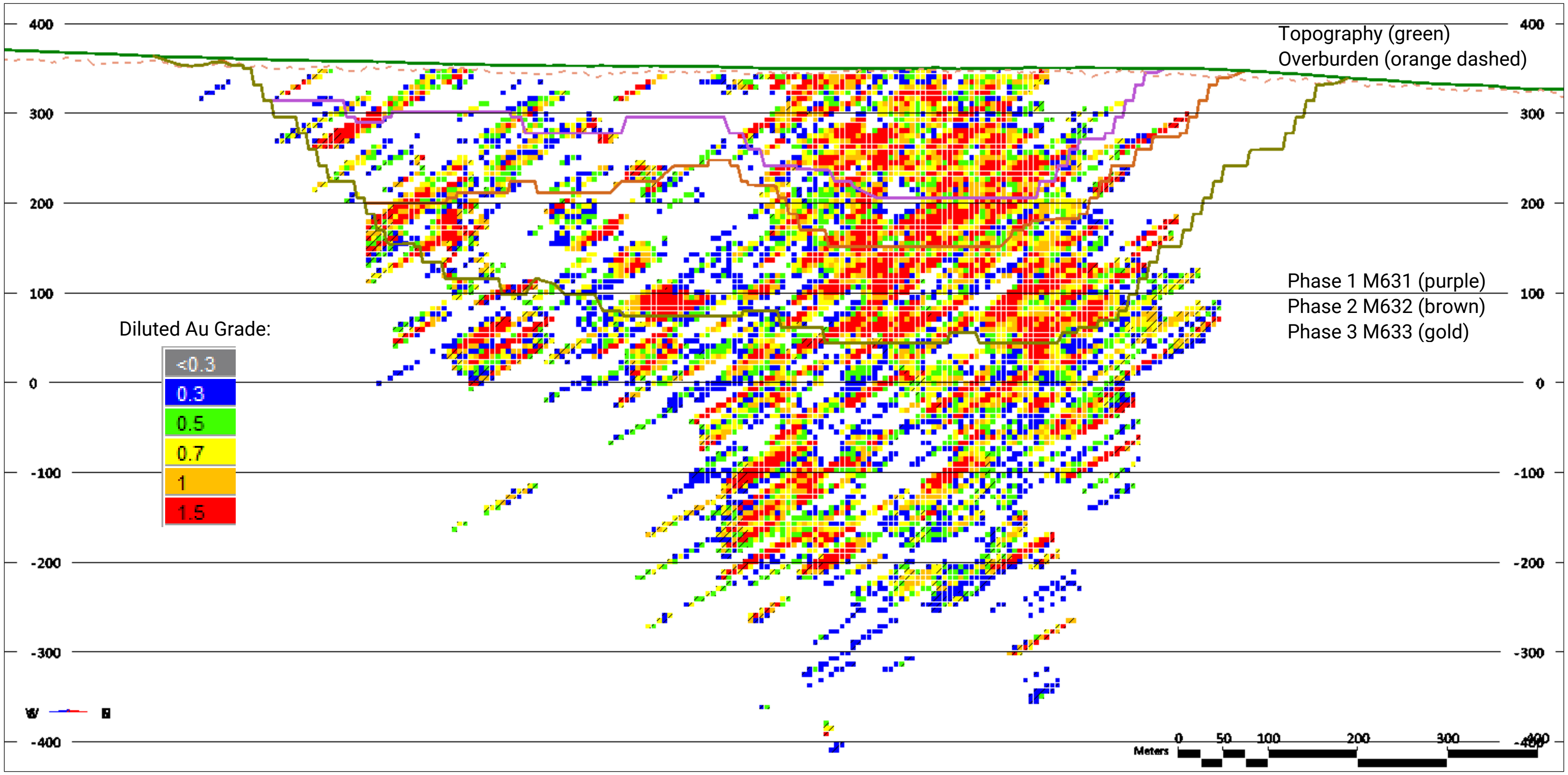
Source: Moose Mountain, 2021.

Figure 16-11: Marathon Pit Designs, North-South Section



Note: NS1 as shown in Figure 16-10. Source: Moose Mountain, 2021.

Figure 16-12: Marathon Pit Designs, East-West Section



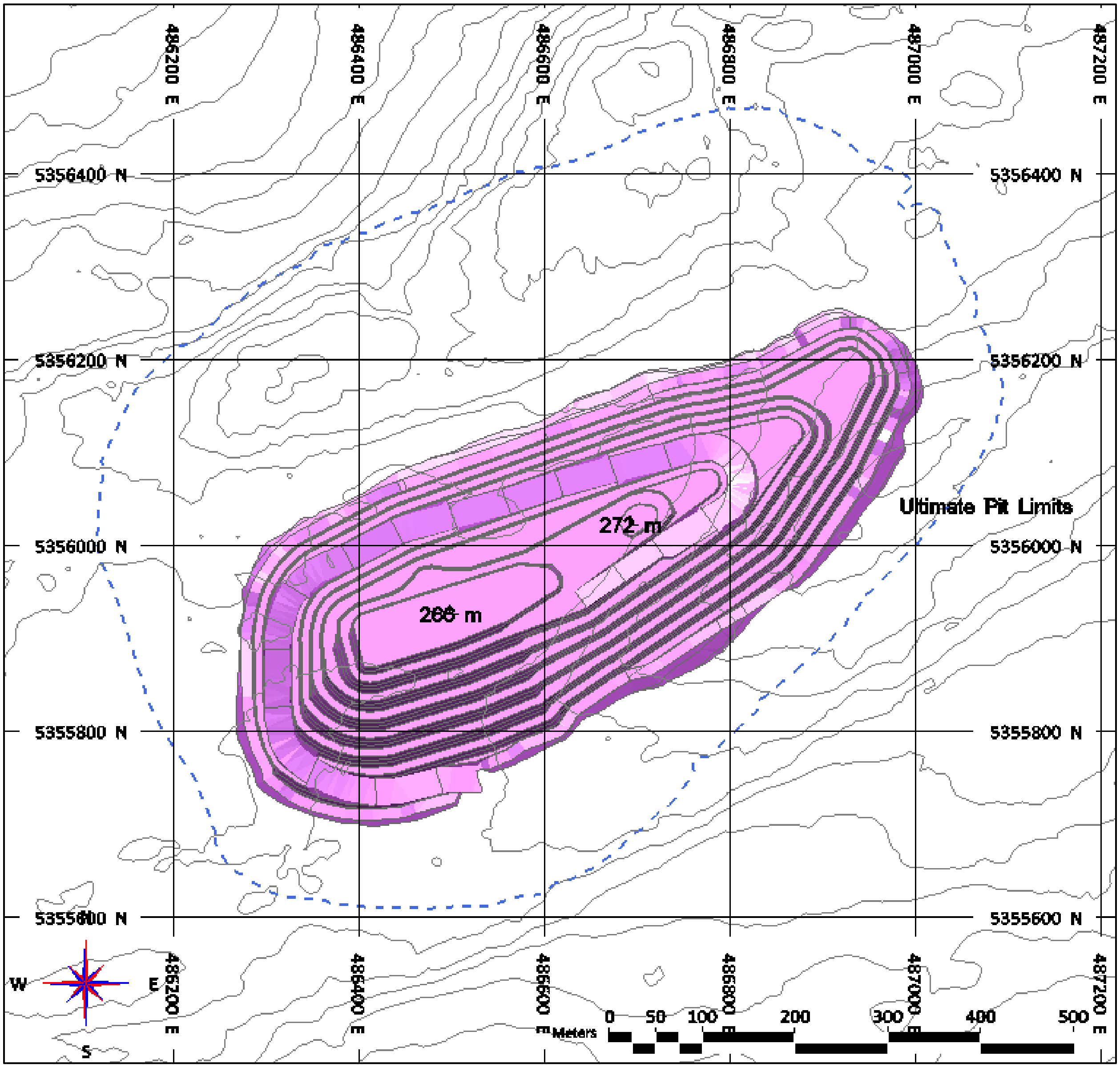
Note: EW1 as shown in Figure 16-10. Source: Moose Mountain, 2021.

16.3.4 Leprechaun Pit Designs

The phased Leprechaun pit designs are shown in Figure 16-13 to Figure 16-17 on the following pages. Sections through the deposit showing the 6 m re-blocked model grades are illustrated in Figure 16-16 and Figure 16-17.

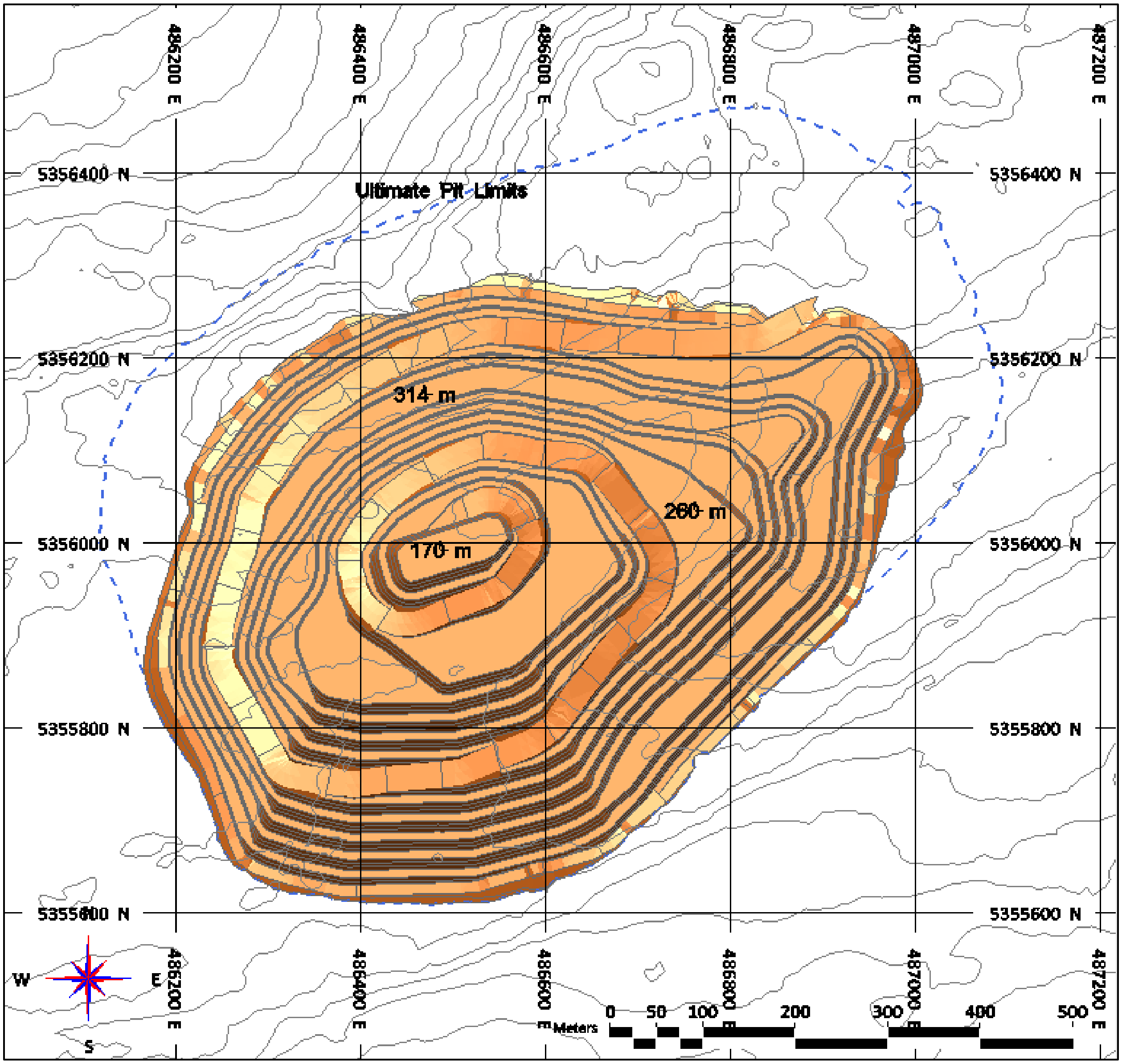
- Leprechaun Phase 1, L641 – This phase targets the high-grade, low-strip-ratio central portion of the deposit. This phase contains about three years' worth of mill feed and mines from the pit exit at the 386 m elevation, down to the pit bottom at the 266 m elevation. The main ramp runs clockwise down from the pit exit in the south.
- Leprechaun Phase 2, L642 – This phase targets deeper, higher-strip-ratio mineralisation below phase 1, pushing out in the north, south and west directions, while leaving enough room for a final pushback to the phase 3 pit. This phase contains about two years' worth of mill feed and mines from the pit exit at the 398 m elevation, down to the pit bottom at the 170 m elevation. The main ramp runs counter-clockwise down from the pit exit in the northeast. Geotechnical berms are left behind at the 350 m and 314 m elevations
- Leprechaun Phase 3, L643 – This phase is the final phase and pushes out in the north and east directions, targeting the remaining deep mineralisation. This phase contains about three years' worth of mill feed and mines from the pit exit at the 398 m elevation, down to the pit bottom at the 98 m elevation. The main ramp runs counter-clockwise down from the pit exit in the east of the pit switchbacks at the 308 m elevation, then clockwise down to the bottom of the pit. Geotechnical berms are left behind at 314 m and 224 m elevations.

Figure 16-13: Leprechaun Phase 1 Pit, L641



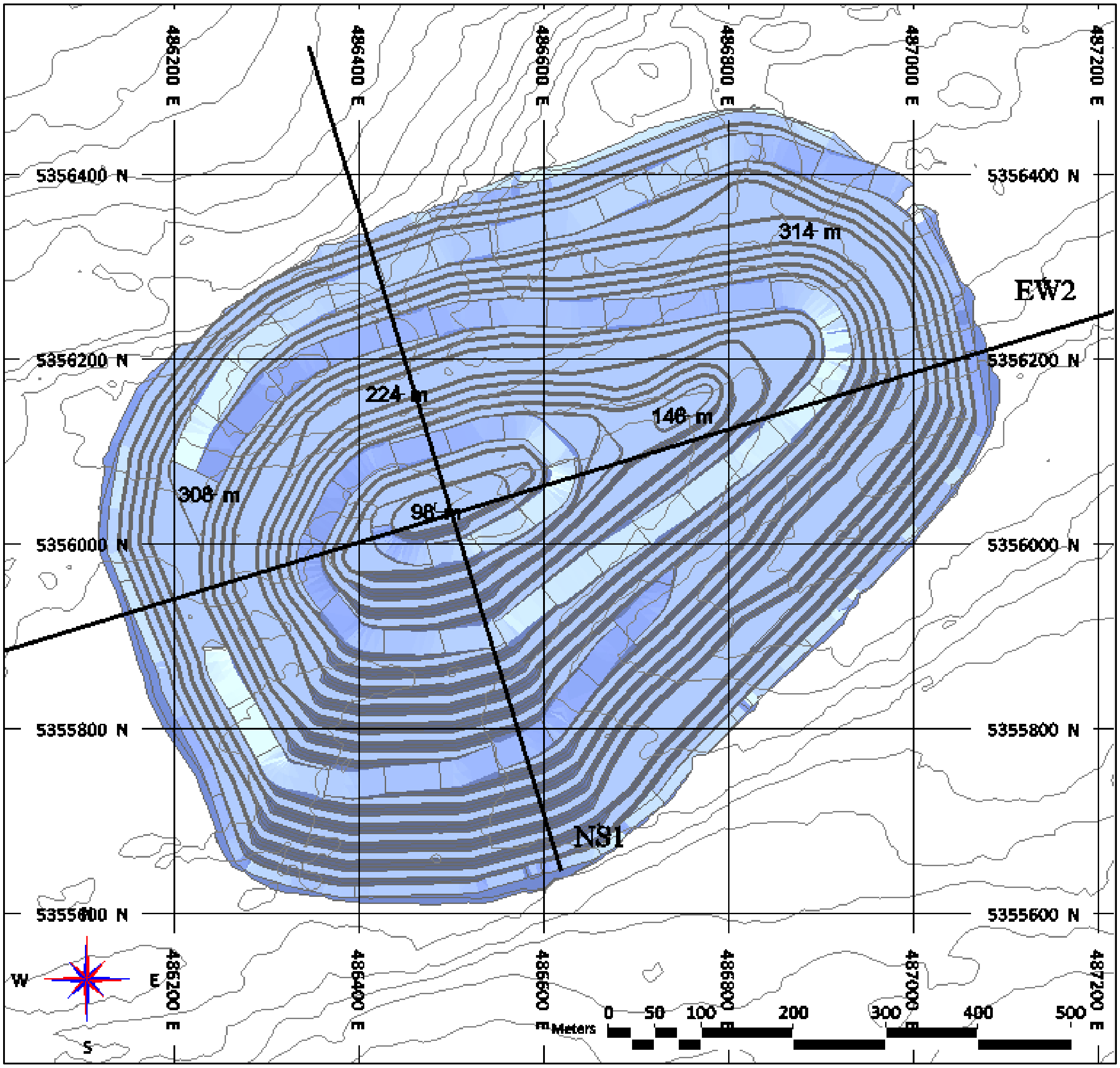
Source: Moose Mountain, 2021.

Figure 16-14: Leprechaun Phase 2 Pit, L642



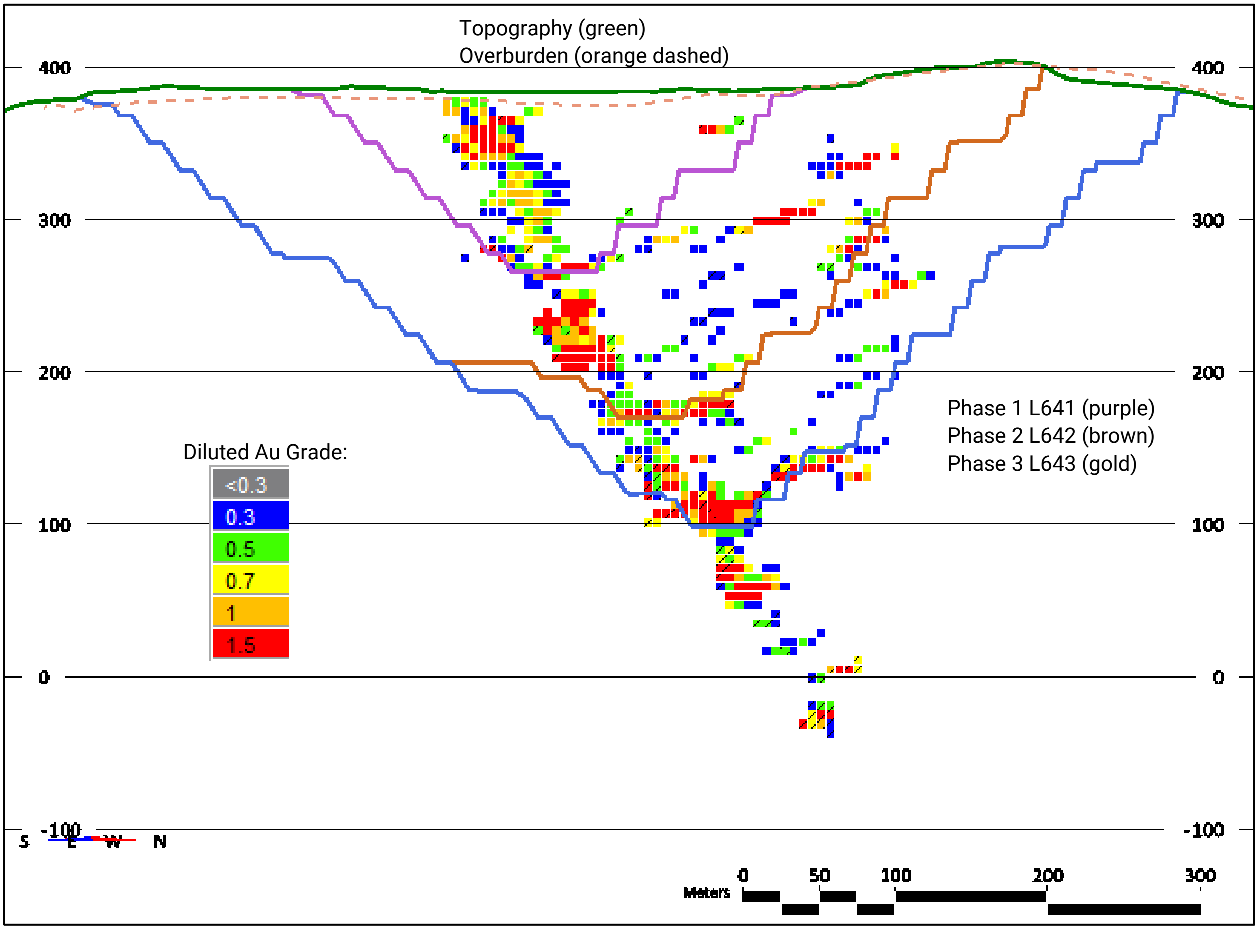
Source: Moose Mountain, 2021.

Figure 16-15: Leprechaun Phase 3 Pit, L643



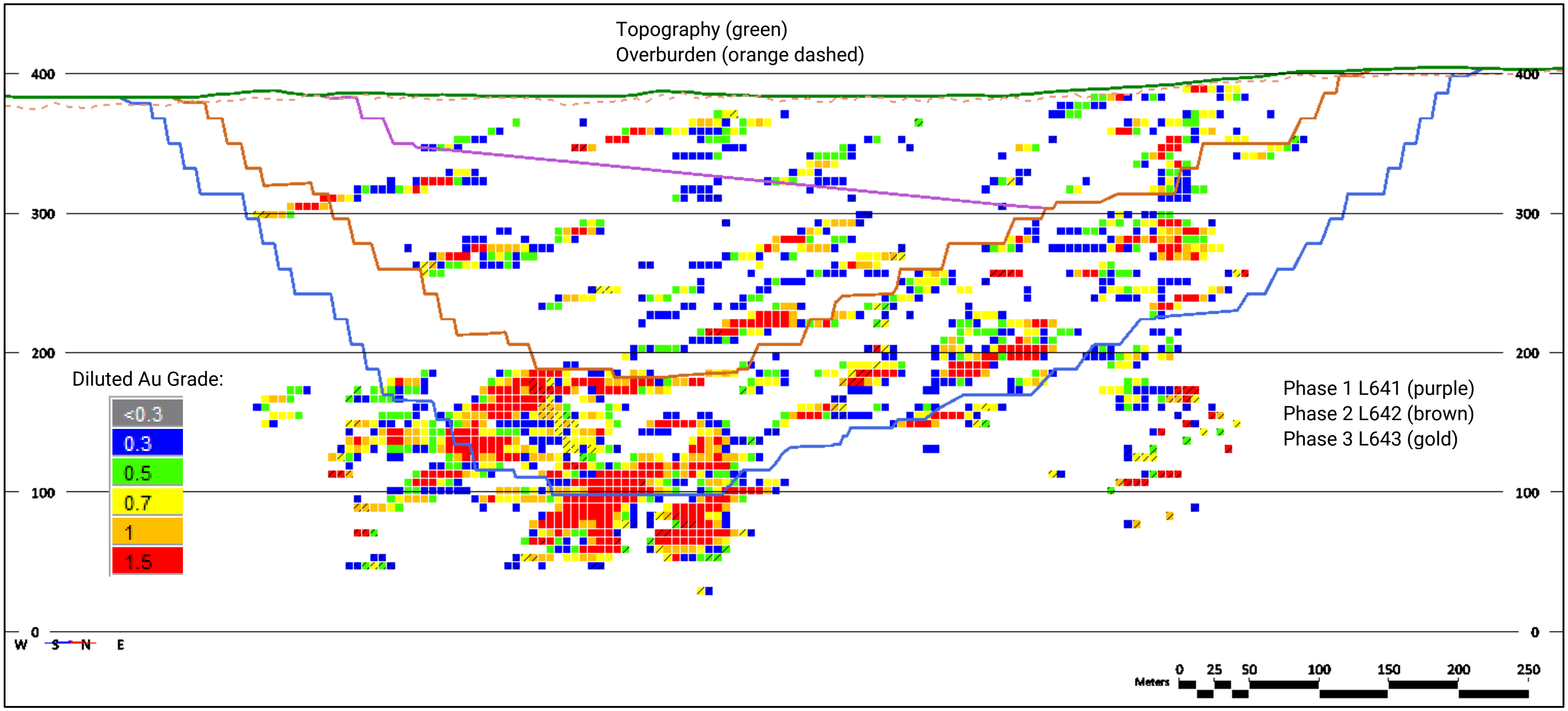
Source: Moose Mountain, 2021.

Figure 16-16: Leprechaun Pit Designs, North-South Section



Note: NS1 as shown in Figure 16-15. Source: Moose Mountain, 2021.

Figure 16-17: Leprechaun Pit Designs, East-West Section



Note: EW2 as shown in Figure 16-15. Source: Moose Mountain, 2021.

16.4 Ex-Pit Haul Roads

Mine haul roads external to the open pits are designed to haul ore and waste materials from the open pits to the scheduled destinations. The mine haul roads are designed with the following key inputs:

- 35 m wide ex-pit haul roads that incorporate a dual-lane running width and berms on both edges of the haul road
- sized to handle 140-tonne payload rigid-frame haul trucks
- 8% maximum grade

The ex-pit haul roads are shown in the project layout drawing Figure 16-18.

16.5 Ore Storage Facilities

When ore is mined from the pit, it will either be delivered to the crusher, the ROM stockpile located next to the crusher, or the ore stockpiles.

The crusher and ROM stockpiles are located 3.5 km southwest of the Marathon pit limits and 3.0 km northeast of the Leprechaun pit limits.

Throughout the life of operations, ore grading between 0.30 and 0.80 g/t Au will be stockpiled in low-grade ore stockpiles just outside the pit, based on an optimised cut-off grade strategy applied to the mine production schedule. At Marathon, this low-grade ore will be stockpiled just southwest of the pit limits; at Leprechaun, it will be stockpiled 2.0 km east of the pit limits.

Ore above 0.80 g/t Au mined in excess of the mill feed targets in certain planned periods will be sent to a high-grade ore stockpile located just northeast of the crusher and ROM stockpile.

The stockpiled ore is planned to be re-handled back to the crusher during the mine life. The high grade will be re-handled during pit operations and the low grade once the pits are exhausted.

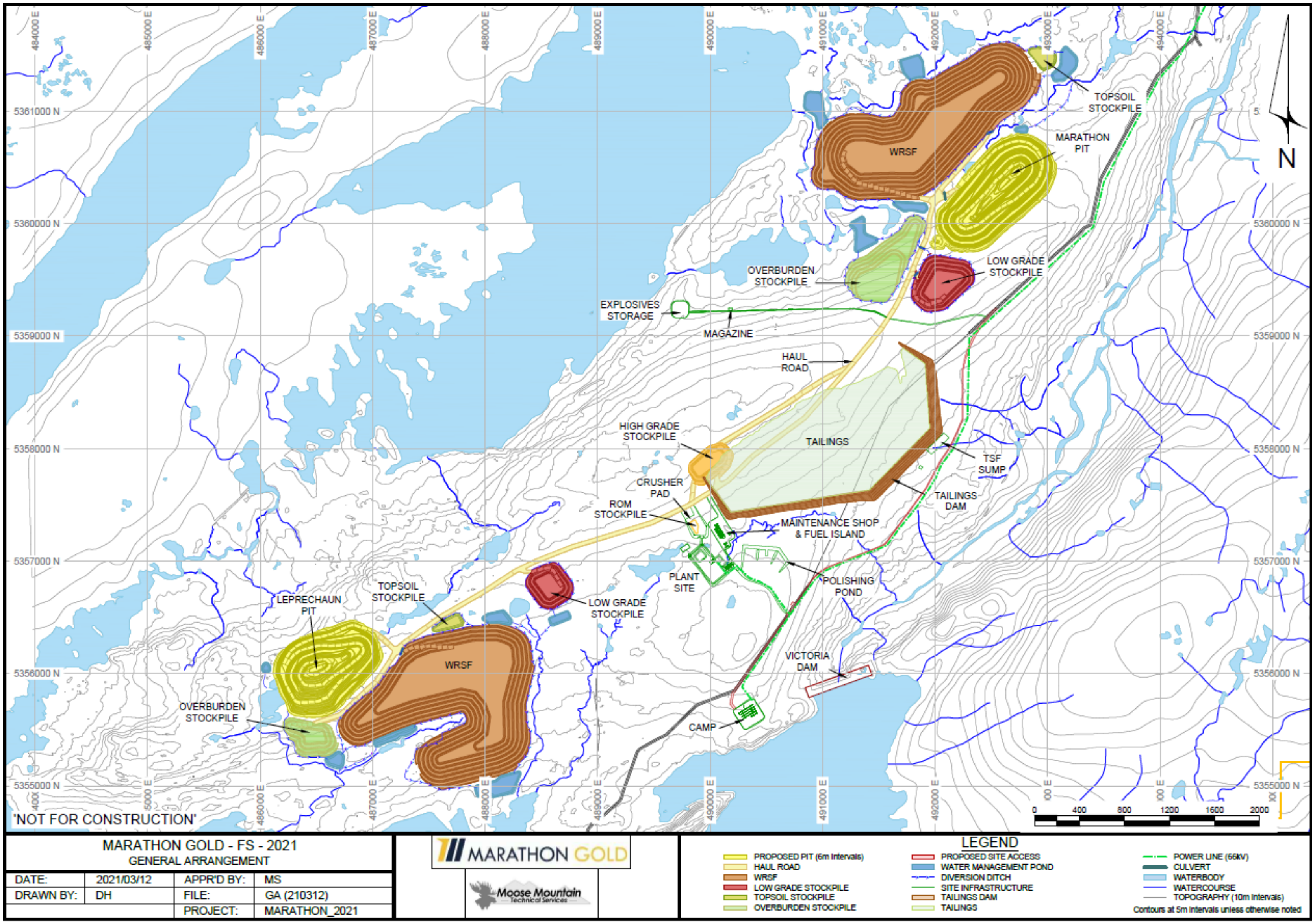
The ore stockpiles are shown in the project layout drawing Figure 16-18.

16.6 Waste Rock Storage Facilities

Waste rock and overburden/topsoil storage facilities are planned at each site for waste materials from the open pit. In general, design considerations assumed:

- bottom-up construction
- 10 m lift heights for overburden/topsoil
- 15 m lift heights for waste rock
- 1.5:1 active slopes of overburden/topsoil lifts
- 1.3:1 active slopes on waste rock lifts
- berm allowances push slopes out to ~2.7:1
- target achievable reclamation slopes of 3.0:1

Figure 16-18: Overall Site Layout Plan



Source: Moose Mountain, 2021.

Testwork suggests that the waste rock from both deposits is net acid neutralising and there has been no consideration for segregation of different rock types in the planned stockpiles.

All stockpiles are planned to avoid existing waterbodies and watercourses.

Waste rock from the Marathon pit will be stored directly northwest of the pit limits and built up to a crest elevation of 430 m. Topsoil from the pit will be stored in a pile 0.5 km north of the pit limits and overburden will be stored a pile directly southwest of the pit limits.

Waste rock from the Leprechaun pit will be stored directly southeast of the pit limits and built up to a crest elevation of 445 m. Topsoil from the pit will be stored in a pile directly west of the pit limits and overburden will be stored in a pile directly southwest of the pit limits.

The waste rock storage facilities (WRSFs), overburden, and topsoil stockpiles are shown in the project layout drawing in Figure 16-18 above.

16.7 Production Schedule

16.7.1 Overview

Production requirements by scheduled period, mine operating considerations, product prices, recoveries, destination capacities, haul cycle times, equipment performance and operating costs are used to determine the optimal production schedule from the pit phase mineral reserves.

The production schedule is based on the following parameters:

- The mineral reserve estimate quantities are split by phase and bench.
  - including details within each split of lithologies and percentages selectively mined
- Start of mine operations construction will be in February 2022; milling will start in October 2023.
- Monthly periods are scheduled for the construction period through to the end of 2024, followed by scheduling on quarterly periods from 2025 to 2027; the remaining operations are scheduled on annual periods.
  - Production at the Marathon deposit is planned to be shut down for three weeks in April and two weeks in November, in consideration of estimated caribou migration through that area of the mine operations. The Leprechaun deposit is assumed to be unaffected.
- An annual mill feed rate of 2,500 kt/a is targeted for the first three years of operation, increasing to 4,000 kt/a thereafter until the end of mine life.
- Target mill throughput rates ramp up in the first year of milling, as follows:
  - October 2023 targets 125 kt (60% nameplate)
  - November 2023 targets 165 kt (80% nameplate)
  - December 2023 targets 175 kt (85% nameplate)
  - January 2024 targets 185 kt (90% nameplate)
  - February 2024 targets 195 kt (95% nameplate)
  - March 2024 at 100% nameplate capacity

- Similarly, mill throughput rates for the expansion to 4,000 kt/a ramp up over the expansion period:
  - Q1 2027 targets 725 kt (73% nameplate)
  - Q2 2027 targets 900 kt (90% nameplate)
  - Q3 2027 at 100% nameplate capacity.
- Within a given phase, each bench is fully mined before progressing to the next bench.
- Pit phases are mined in sequence, where the second pit phase does not mine below the first pit phase.
- Pit phase vertical progression is limited to no more than 54 m in each year; average annual phase progression is 42 m.
- Pre-production mining requirements are as follows:
  - rock waste requirements of 4.1 Mt for tailings dam construction, and 0.5 Mt for ex-pit haul road and explosive pad construction, and 1.0 Mt for ROM/truck pad construction
  - any in-situ topsoil, overburden, and ore that must be moved to access this construction rock is stockpiled
- Ore tonnes released in excess of the mill capacity are stockpiled.
- Low-grade ore (0.3 to 0.7 g/t Au) is stockpiled and re-handled to the primary crushers at the end of mine life.

The open pit mine production schedule showing production tonnages and grade forecasts is included as Table 16.4 and shown graphically as Figure 16-19; Figure 16-20 provides an illustration of the projected material mined and strip ratio. This is illustrated for each individual deposit in Figures 16-21 to 16-24.

16.7.2 Mining Sequence

The pit operations will run from 2022 to 2033. The capitalised construction period runs from 2022 to September 2023, with quantities for this period listed in Table 16.4 as “Pre-Prod”. Following pit operations in 2033, stockpile re-handling operations will continue for three years to 2036. LOM activities are summarised in Table 16.5.

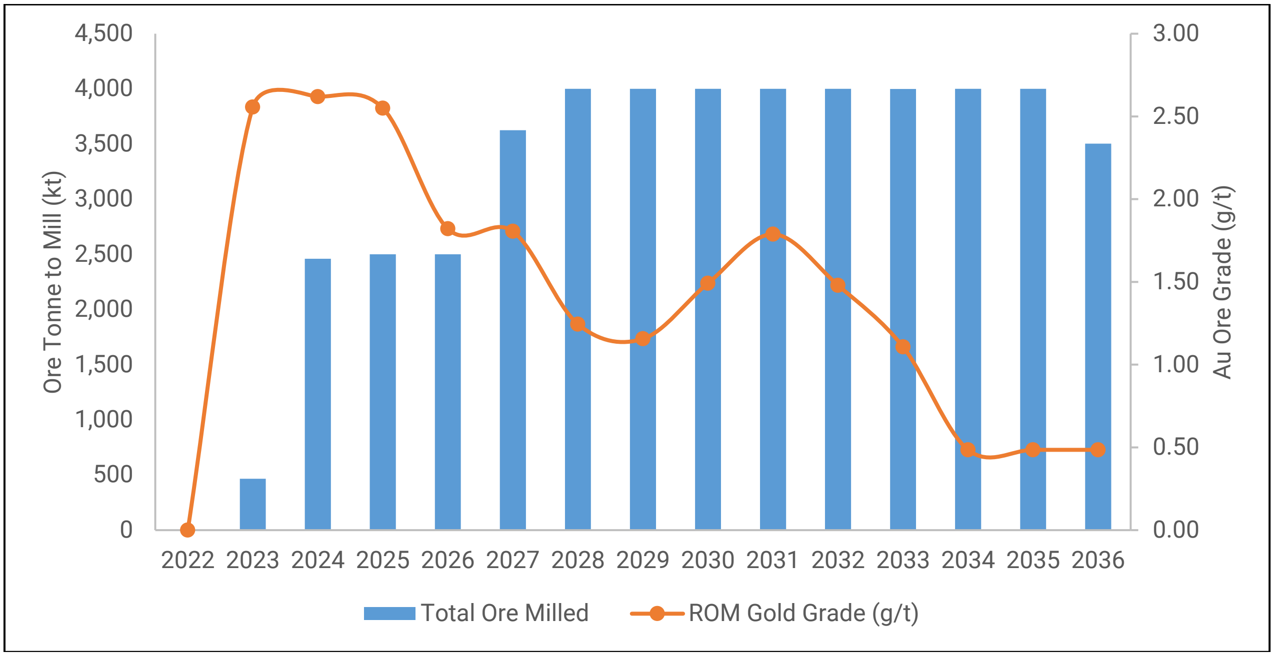
The final layout plans for Marathon and Leprechaun are illustrated in Figures 16-25 and 16-26, respectively. End-of-period drawings representing the end of Q3 2023 (start of milling), 2024, 2025, 2027, and 2036 are shown for Marathon and Leprechaun in Figures 16-27 to 16-36, respectively.

Table 16.4: Mine Production Schedule

Total Mine Production	Year	LOM	Pre-Prod*	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036
Mill Feed Tonnes	**kt**	**47,055**	**0**	**–**	**465**	**2,461**	**2,500**	**2,500**	**3,625**	**4,000**	**4,000**	**4,000**	**4,000**	**4,000**	**4,000**	**4,000**	**4,000**	**3,503**
Mill Feed Grade, Au	**g/t**	**1.36**	**0.00**	**–**	**2.56**	**2.62**	**2.55**	**1.82**	**1.81**	**1.24**	**1.16**	**1.49**	**1.79**	**1.48**	**1.11**	**0.49**	**0.49**	**0.49**
Mill Feed Contained Metal	koz	2,050	0	–	38	207	205	146	210	160	149	192	230	190	142	62	62	55
Ore Tonnes from Pit	kt	47,055	504	57	1,527	7,024	5,746	4,475	5,620	3,000	3,000	5,180	5,097	4,000	2,328	0	0	0
Ore Grade from Pit, Au	g/t	1.36	1.09	0.90	1.27	1.32	1.46	1.21	1.33	1.32	1.23	1.24	1.49	1.48	1.55	0.00	0.00	0.00
Stockpile Tonnes to Mill	kt	15,849	0	–	55	119	0	250	0	1,000	1,000	250	0	0	1,672	4,000	4,000	3,503
Stockpile Grade to Mill, Au	g/t	0.57	0.00	–	2.51	1.12	0.00	1.01	0.00	1.01	0.94	0.51	0.00	0.00	0.49	0.49	0.49	0.49
Waste Tonnes from Pit	kt	339,816	9,957	5,203	12,096	39,620	41,101	54,383	49,696	48,630	39,816	30,896	11,931	5,006	1,436	0	0	0
Total Mined from Pits	kt	386,871	10,461	5,261	13,623	46,644	46,847	58,858	55,316	51,630	42,816	36,076	17,029	9,007	3,764	0	0	0
Total Moved	kt	402,720	10,461	5,261	13,678	46,764	46,847	59,108	55,316	52,630	43,816	36,326	17,029	9,007	5,436	4,000	4,000	3,503
Marathon																		
Ore Tonnes Direct to Mill	kt	29,665	0	–	186	1,286	1,873	2,008	2,232	1,928	1,958	2,301	2,429	2,807	3,385	2,529	2,529	2,214
Ore Grade Direct to Mill, Au	g/t	1.30	0.00	–	2.18	2.66	2.30	1.88	1.74	1.24	1.02	1.44	1.54	1.28	1.22	0.49	0.49	0.49
Ore Tonnes from Pit	kt	29,665	0	0	658	3,728	4,431	3,515	3,349	1,322	1,348	3,008	3,172	2,807	2,328	0	0	0
Ore Grade from Pit, Au	g/t	1.30	0.00	0.00	1.13	1.32	1.33	1.27	1.32	1.36	1.07	1.19	1.27	1.28	1.55	0.00	0.00	0.00
Stockpile Tonnes to Mill	kt	9,941	0	–	25	61	0	152	0	607	610	158	0	0	1,057	2,529	2,529	2,214
Stockpile Grade to Mill, Au	g/t	0.56	0.00	–	1.92	1.08	0.00	0.99	0.00	0.99	0.92	0.51	0.00	0.00	0.49	0.49	0.49	0.49
Waste Tonnes from Pit	kt	185,472	2,196	2,196	5,876	21,134	18,447	25,440	23,770	28,324	26,411	20,434	8,059	3,945	1,436	0	0	0
Leprechaun																		
Ore Tonnes Direct to Mill	Kt	17,390	0	–	279	1,175	628	492	1,394	2,072	2,042	1,699	1,571	1,193	615	1,471	1,471	1,289
Ore Grade Direct to Mill, Au	g/t	1.45	0.00	–	2.81	2.57	3.29	1.59	1.91	1.25	1.29	1.56	2.17	1.94	0.48	0.48	0.48	0.48
Ore Tonnes from Pit	kt	17,390	57	57	869	3,296	1,316	961	2,271	1,678	1,652	2,172	1,926	1,193	0	0	0	0
Ore Grade from Pit, Au	g/t	1.45	0.90	0.90	1.38	1.31	1.90	1.00	1.35	1.30	1.36	1.30	1.84	1.94	0.00	0.00	0.00	0.00
Stockpile Tonnes to Mill	kt	5,909	0	–	30	58	0	98	0	393	390	92	0	0	615	1,471	1,471	1,289
Stockpile Grade to Mill, Au	g/t	0.58	0.00	–	3.00	1.16	0.00	1.04	0.00	1.04	0.97	0.50	0.00	0.00	0.48	0.48	0.48	0.48
Waste Tonnes from Pit	kt	154,343	3,007	3,007	6,220	18,486	22,654	28,943	25,927	20,306	13,405	10,462	3,873	1,061	0	0	0	0

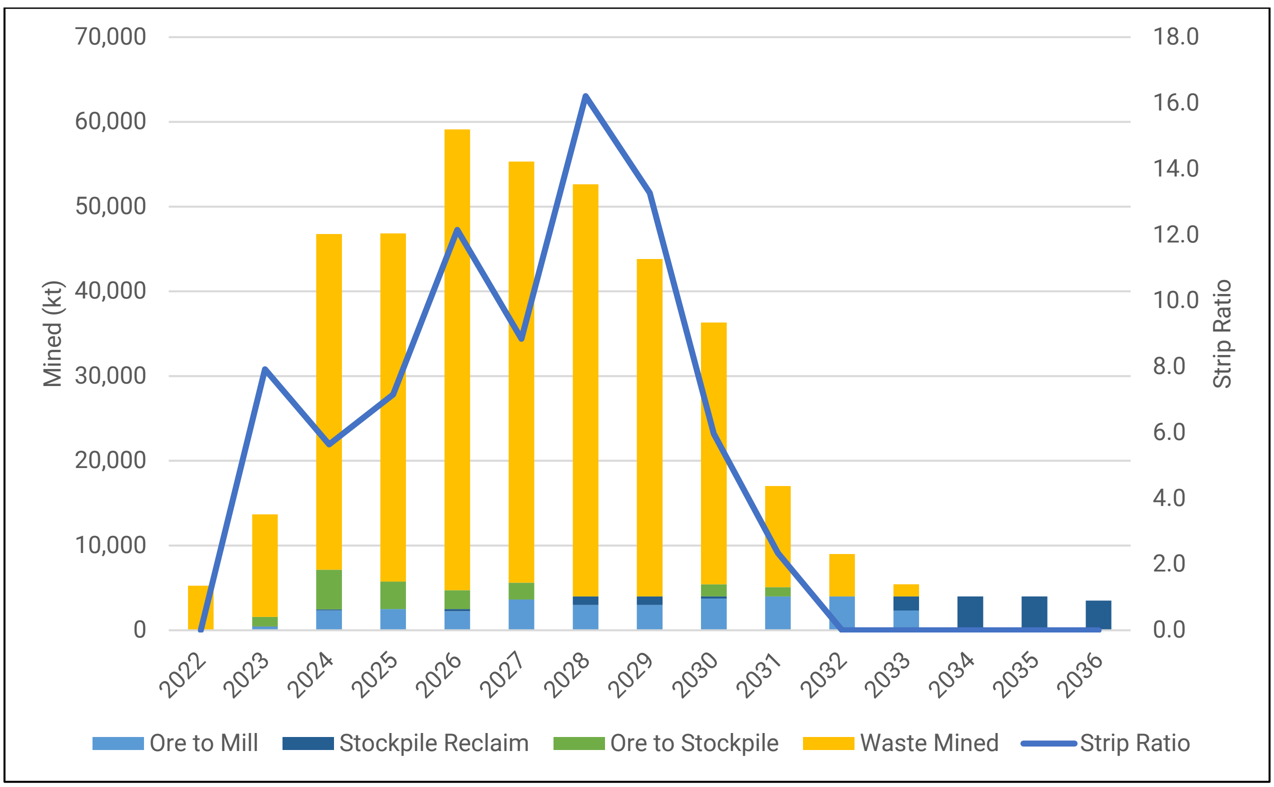
Note: Pre-production runs from 2022 to September 2023.

Figure 16-19: Production Schedule, Mill Feed Tonnes & Grade (All Deposits)



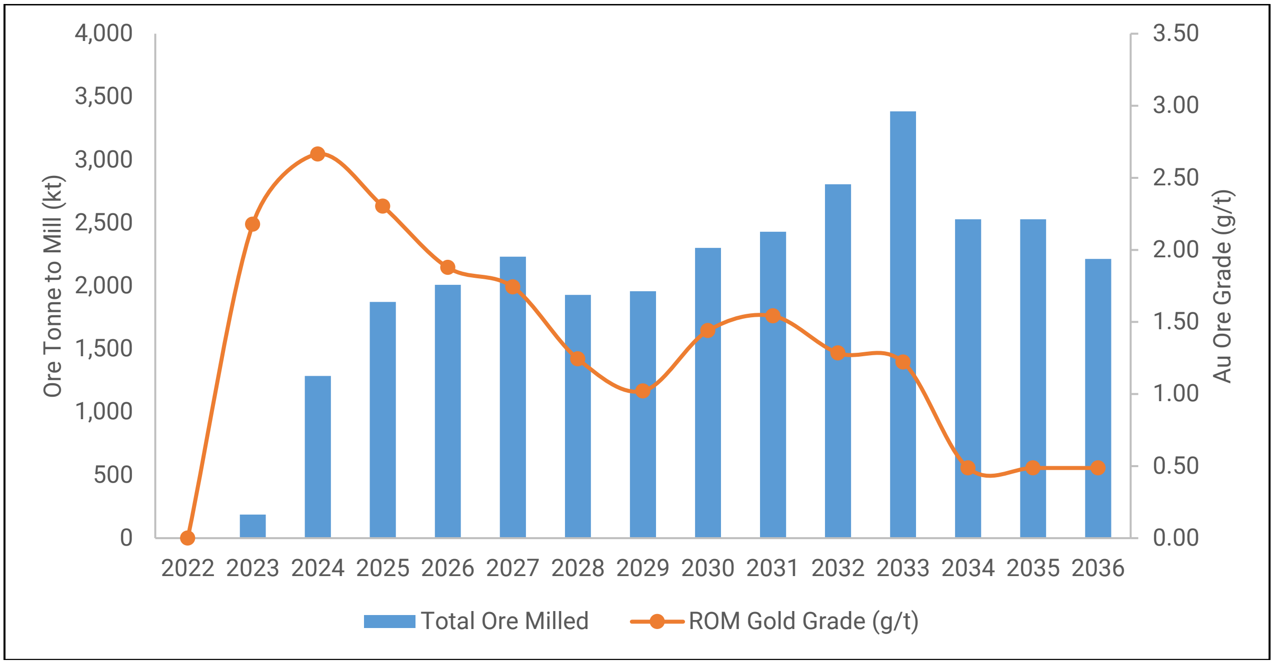
Source: Moose Mountain, 2021.

Figure 16-20: Mine Production Schedule, Material Mined & Strip Ratio (All Deposits)



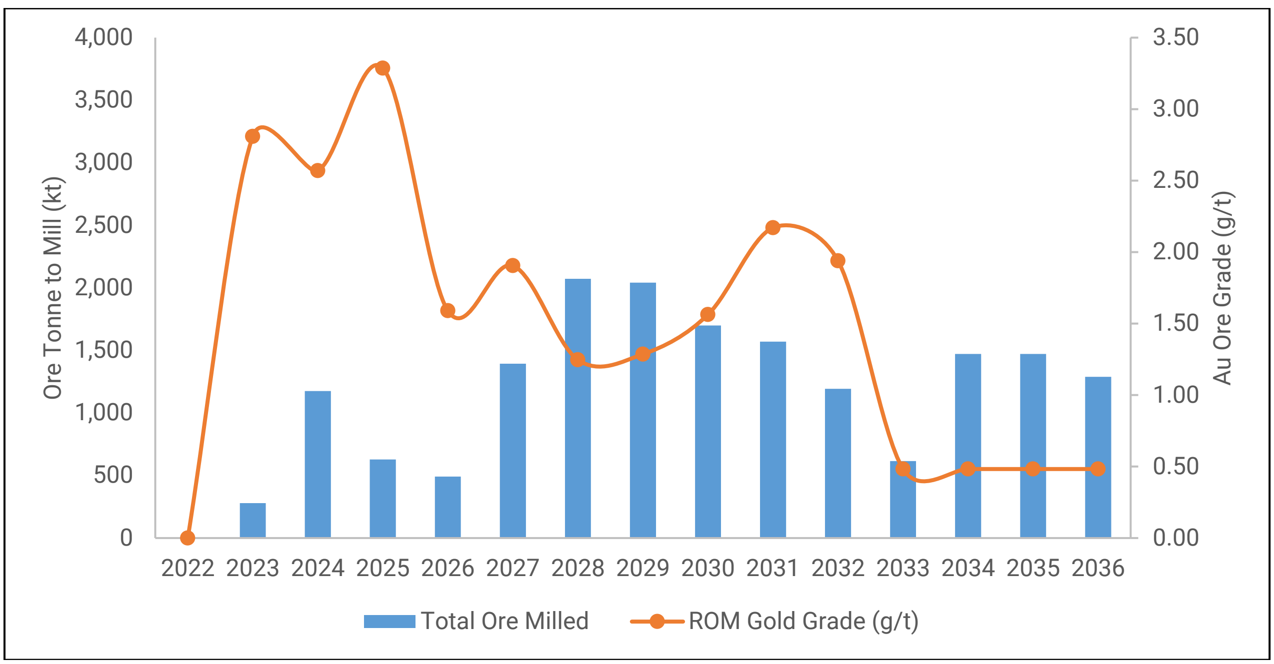
Source: Moose Mountain, 2021.

Figure 16-21: Marathon Production Schedule, Mill Feed Tonnes & Grade



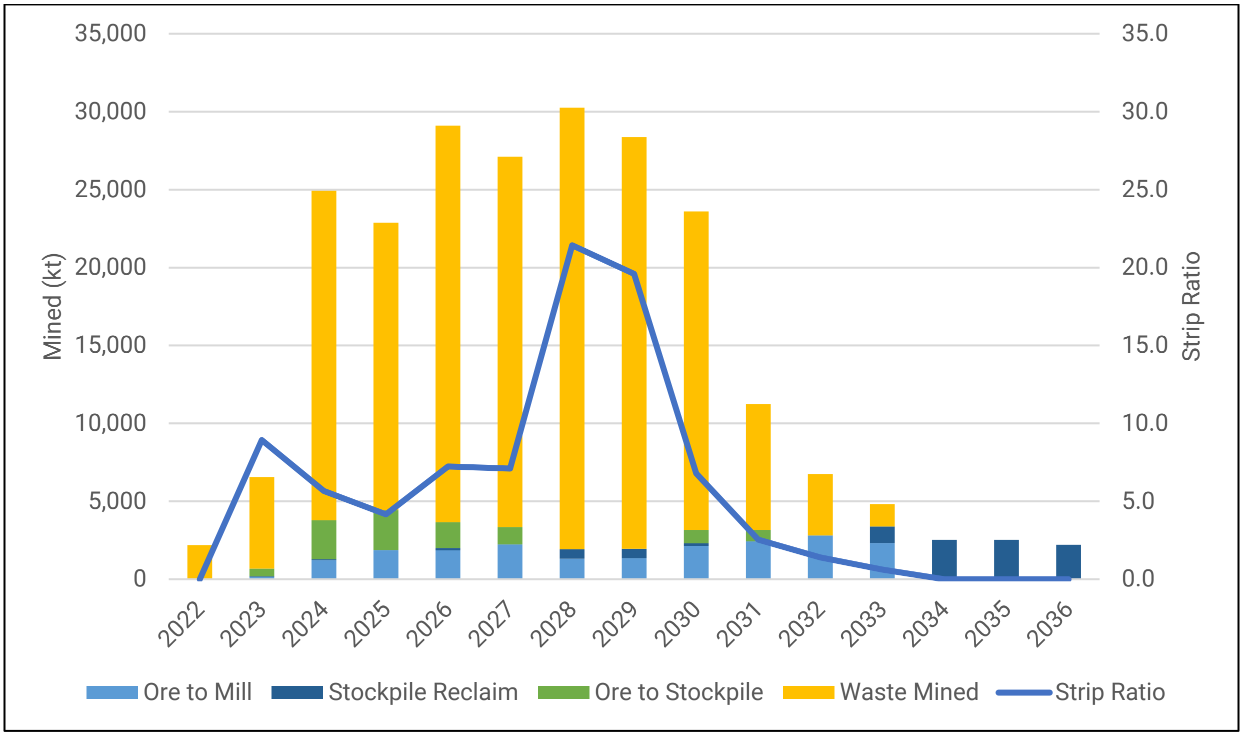
Source: Moose Mountain, 2021.

Figure 16-22: Leprechaun Production Schedule, Mill Feed Tonnes & Grade



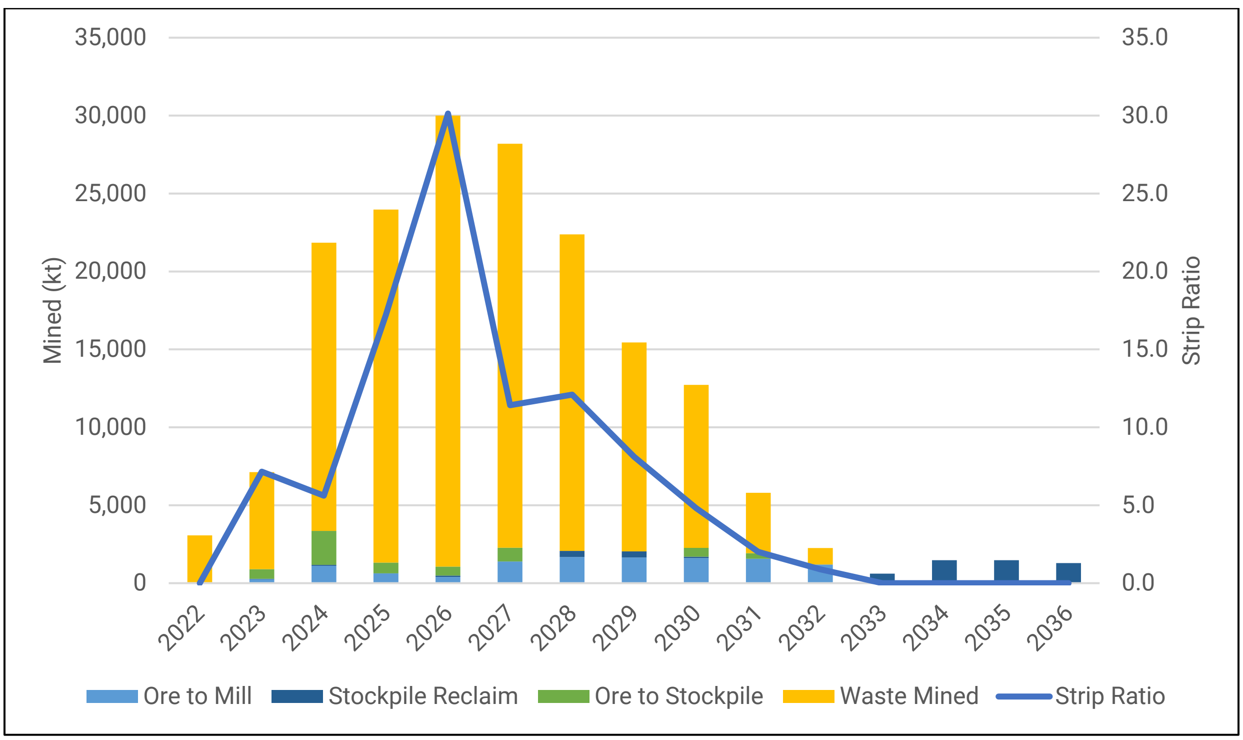
Source: Moose Mountain, 2021.

Figure 16-23: Marathon Mine Production Schedule, Material Mined & Strip Ratio



Source: Moose Mountain, 2021.

Figure 16-24: Leprechaun Mine Production Schedule, Material Mined & Strip Ratio

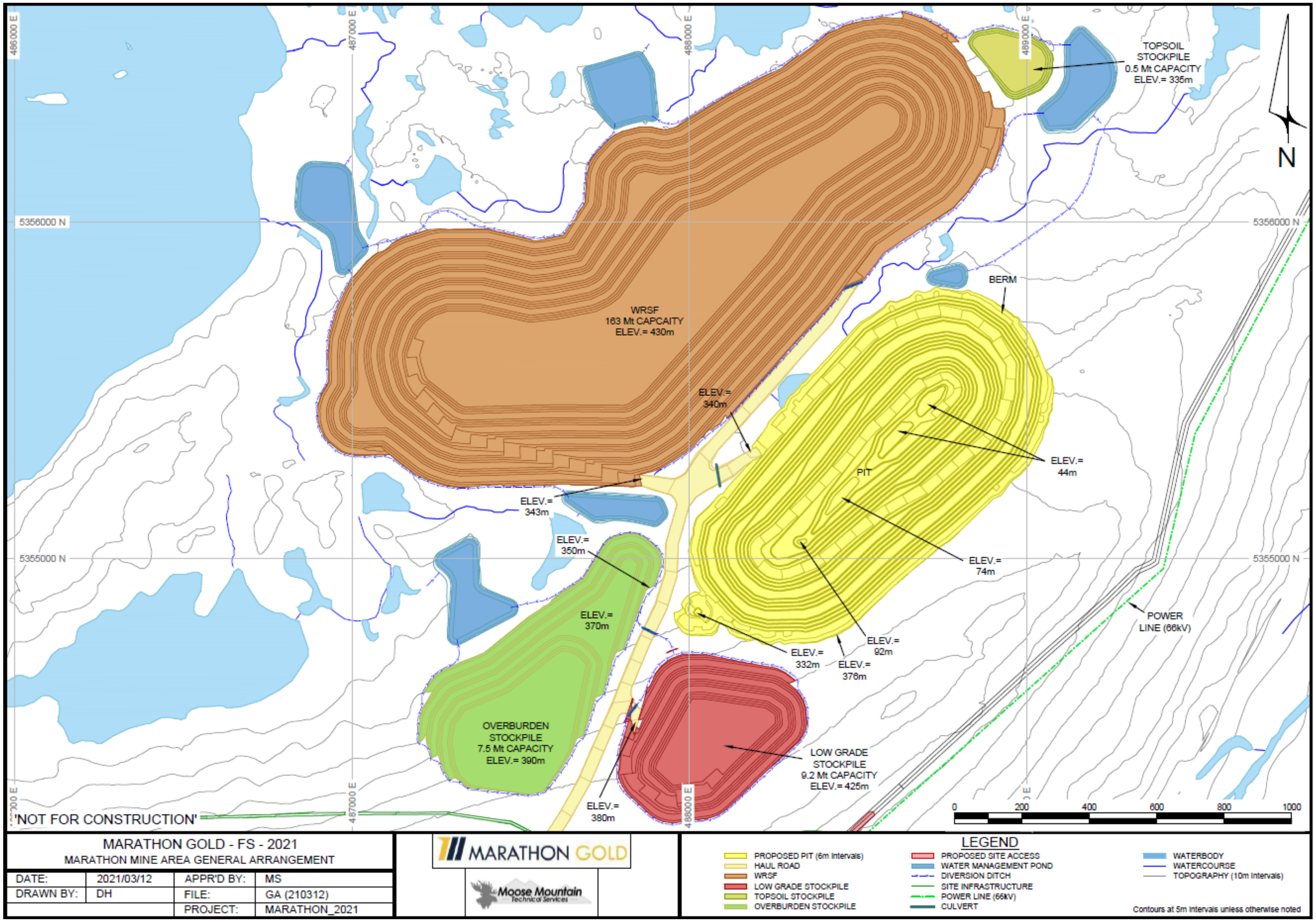


Source: Moose Mountain, 2021.

Table 16.5: Annual Mine Operations

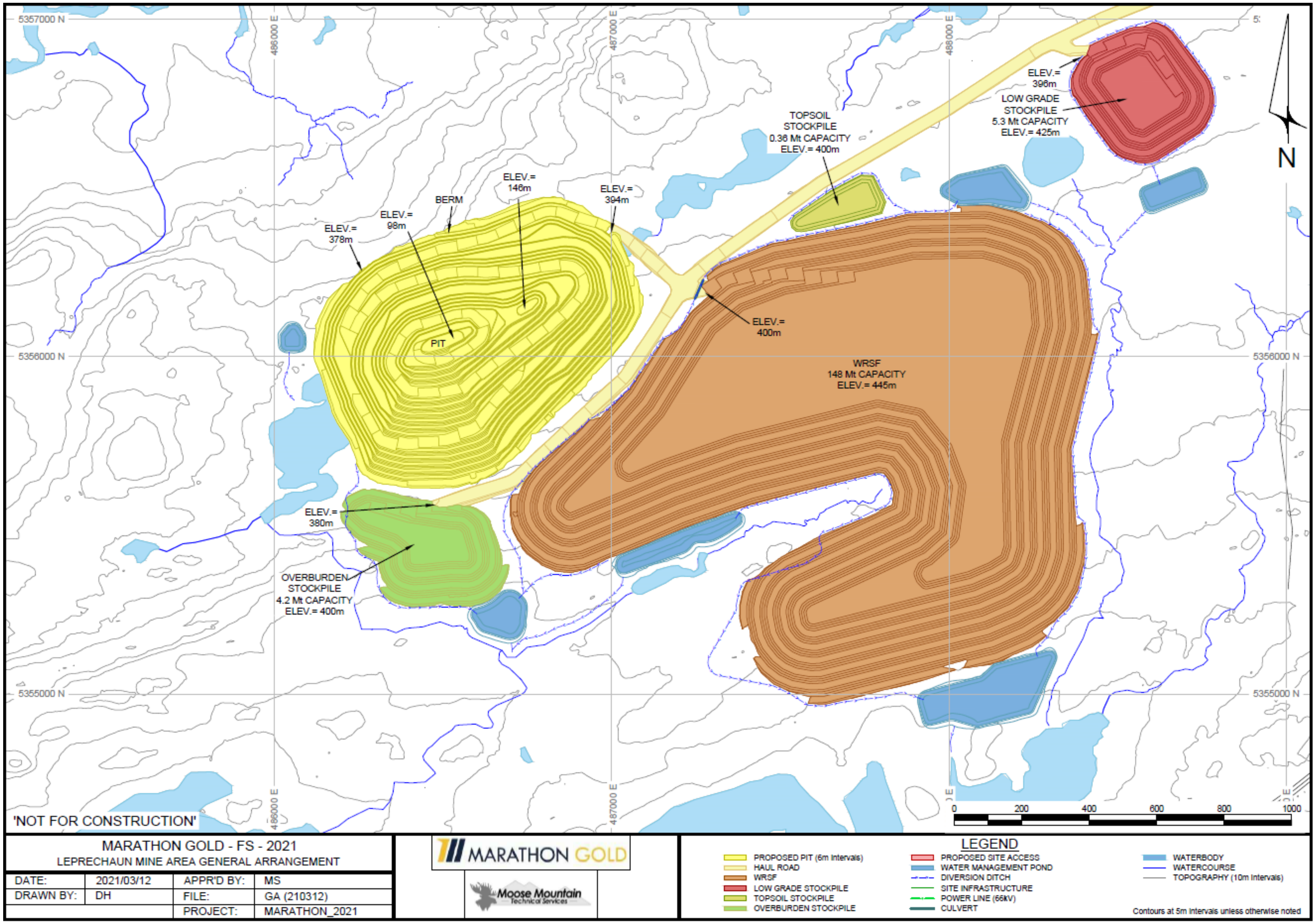
Year	Activity
Construction (2022 to Sept 2023)	Clearing and grubbing the phase 1 and phase 2 Marathon and Leprechaun pits. Clearing and grubbing of ex-pit haul road, ore stockpile and overburden stockpile footprints. Removal and stockpiling of topsoil from pit areas cleared and grubbed. Removal and stockpiling of topsoil from the ore stockpile areas. Removal and stockpiling of overburden from the pit areas cleared and grubbed. Haul road construction from the pits to the stockpiles, crusher and tailings dam. Initial grade control delineation drilling to the 308 bench of the Marathon phase 1 pit and the 350 bench of the Leprechaun phase 1 pit. Mining of the Marathon phase 1 pit down to 344 bench. Mining of the Leprechaun phase 1 pit down to the 374 bench. Delivery of construction rock to the facilities area, for use in the ROM, truck shop and explosives storage pads. Delivery of construction rockfill to stage 1 and stage 2 of the tailings dam. Stockpiling high-grade ore on the ROM pad and high-grade ore stockpile for use in mill commissioning.
Q4 2023 and 2024	Clearing and grubbing of the east side of the Marathon waste rock stockpile footprint. Clearing and grubbing of the south side of the Leprechaun waste rock stockpile footprint. Removal and stockpiling of topsoil from the waste rock stockpile footprints. Marathon phase 1 pit mined down to 296 bench, phase 2 mined down to 326 bench. Leprechaun phase 1 pit mined down to 302 bench, phase 2 mined down to 380 bench. Re-handle of stockpiled high-grade ore. Delivery of construction rockfill to stage 3 of the tailings dam.
2025	Clearing and grubbing phase 3 Marathon and Leprechaun pits. Clearing and grubbing the remaining waste rock stockpile footprints Removal and stockpiling of topsoil from cleared pit and waste rock stockpile footprints. Marathon phase 1 pit mined down to the 242 bench, phase 2 mined down to the 290 bench. Leprechaun phase 1 pit mined down to the pit bottom on the 266 bench Leprechaun phase 2 mined down to the 332 bench. Delivery of construction rockfill to stage 4 of the tailings dam.
2026	Marathon phase 1 pit mined down to the pit bottom on the 206 bench. Marathon phase 2 pit mined down to the 236 bench, phase 3 mined down to the 332 bench. Leprechaun phase 2 pit mined down to 284 bench, phase 3 mined down to the 368 bench. Re-handle of stockpiled high-grade ore. Delivery of construction rockfill to stage 5 of the tailings dam.
2027	Marathon phase 2 pit mined down to the 188 bench, phase 3 mined down to the 302 bench. Leprechaun phase 2 pit mined down to 230 bench, phase 3 mined down to the 332 bench. Delivery of construction rockfill to stage 5 of the tailings dam.
2028	Marathon phase 2 pit mined down to the pit bottom on the 152 bench. Marathon phase 3 mined down to the 254 bench. Leprechaun phase 2 pit mined down to 188 bench, phase 3 mined down to the 284 bench. Re-handle of stockpiled high-grade ore. Delivery of construction rockfill to stage 6 of the tailings dam.
2029	Leprechaun phase 2 pit mined down to the pit bottom on the 170 bench. Marathon phase 3 mined down to the 200 bench. Leprechaun phase 3 mined down to the 236 bench. Re-handle of remaining stockpiled high-grade ore (stockpile depleted). Re-handle of stockpiled low-grade ore. Delivery of construction rockfill to stage 6 of the tailings dam.
2030 to 2033	Marathon phase 3 pit mined down to the pit bottom on the 44 bench. Leprechaun phase 3 pit mined down to the pit bottom on the 98 bench (2032). Re-handle of stockpiled low-grade ore.
2034 to 2036	Re-handle of remaining stockpiled low-grade ore (stockpiles depleted).

Figure 16-25: Marathon Layout Plan



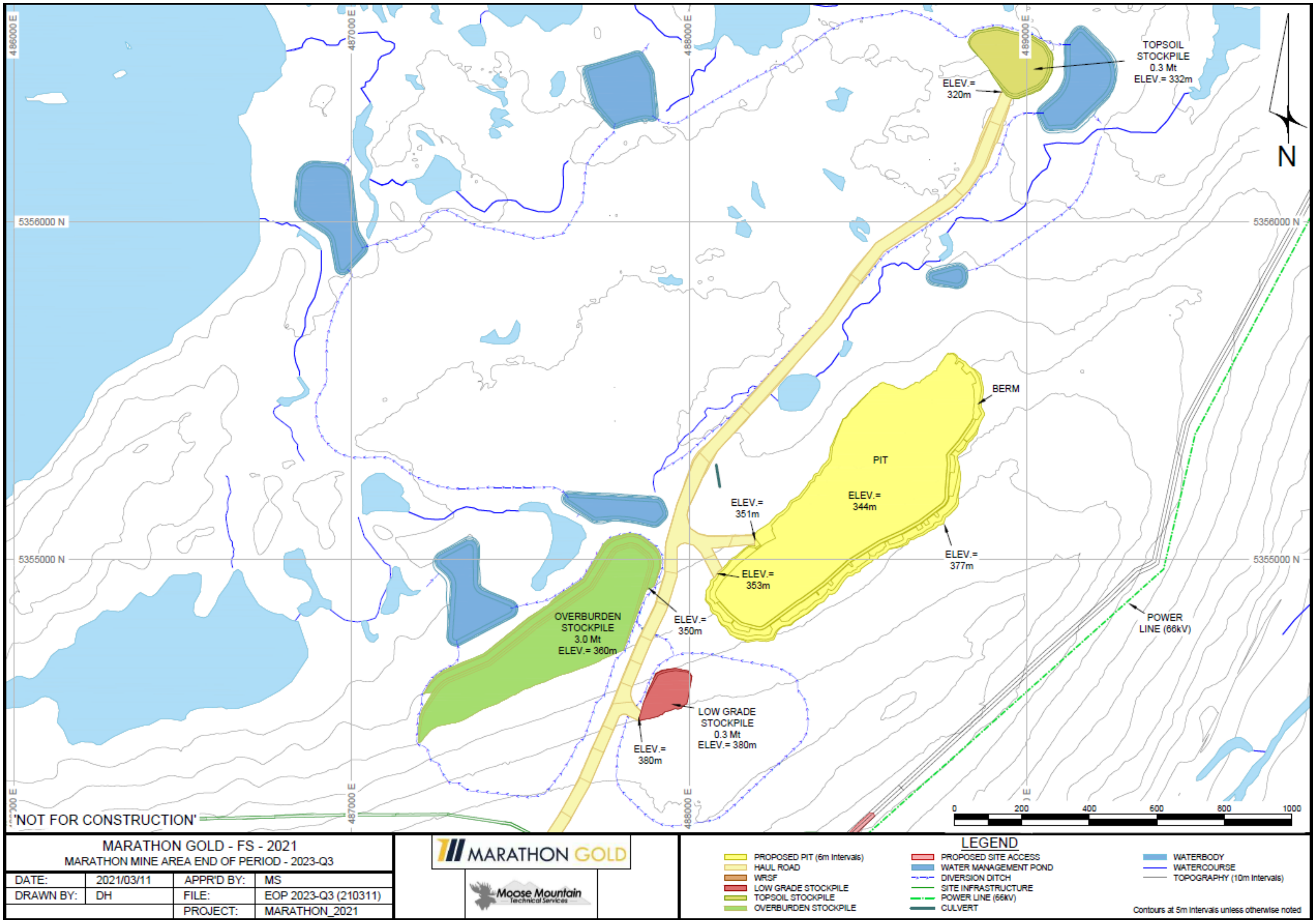
Source: Moose Mountain, 2021.

Figure 16-26: Leprechaun Layout Plan



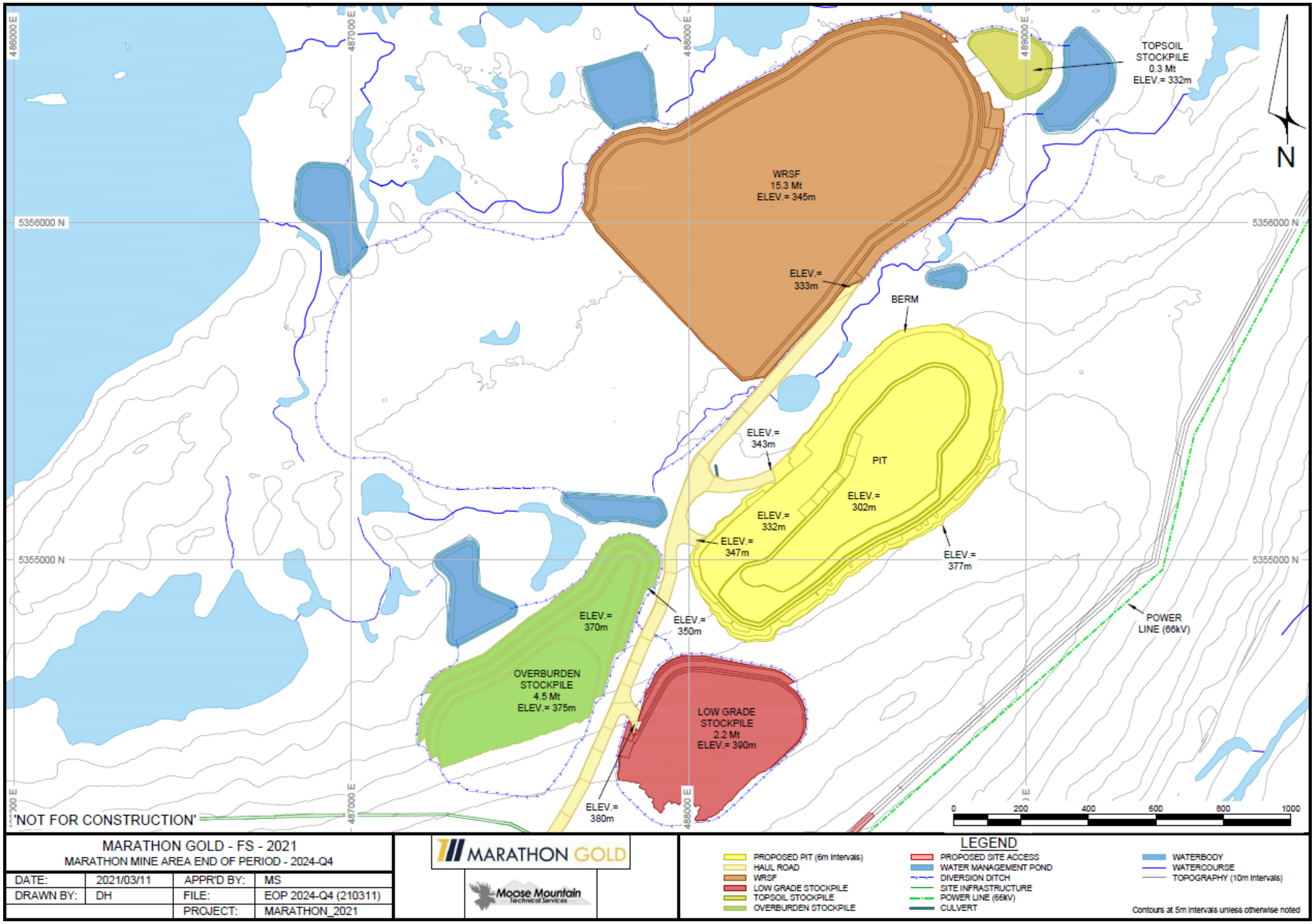
Source: Moose Mountain, 2021.

Figure 16-27: Marathon End of Period – Q3 2023



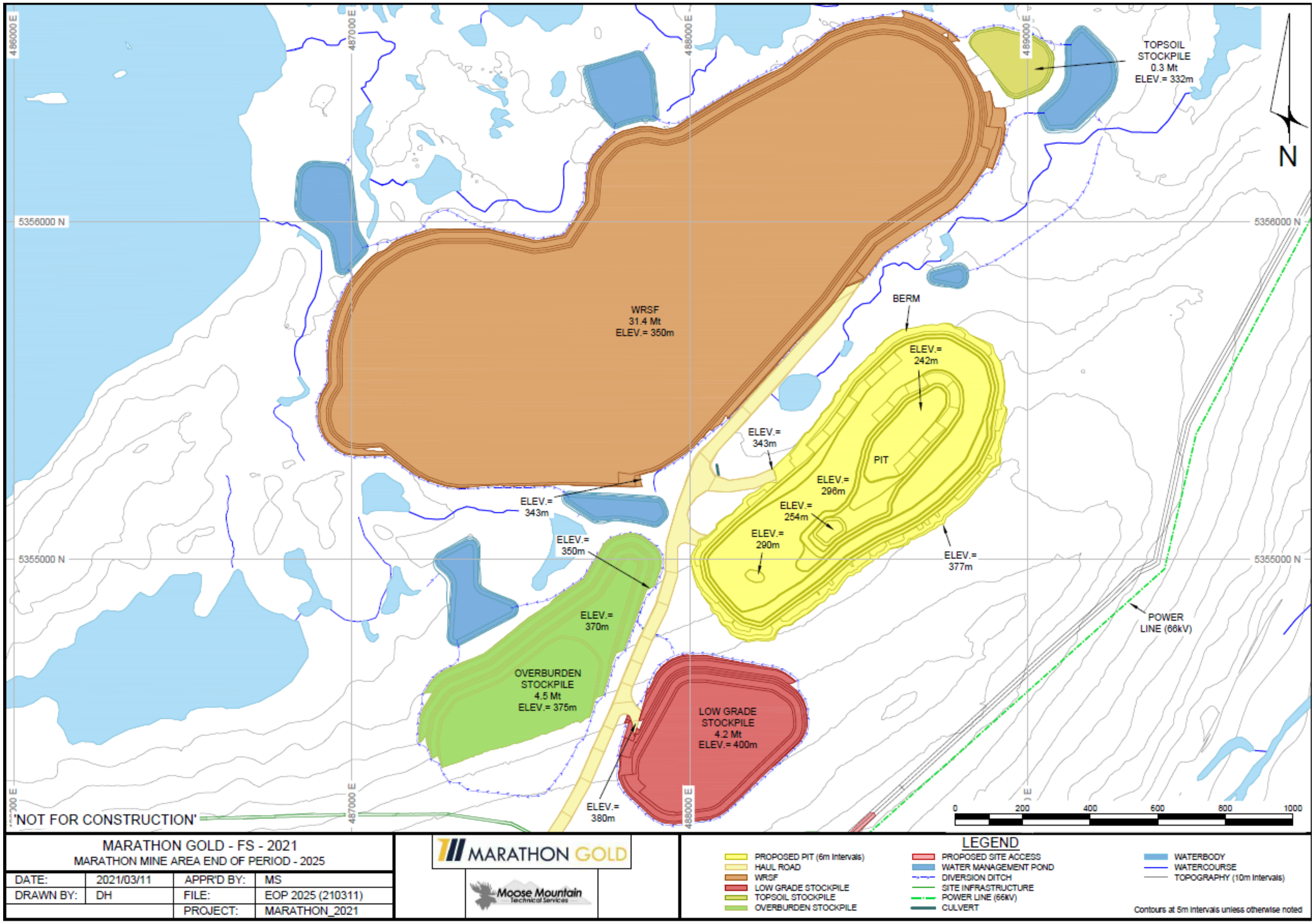
Source: Moose Mountain, 2021.

Figure 16-28: Marathon End of Period – 2024



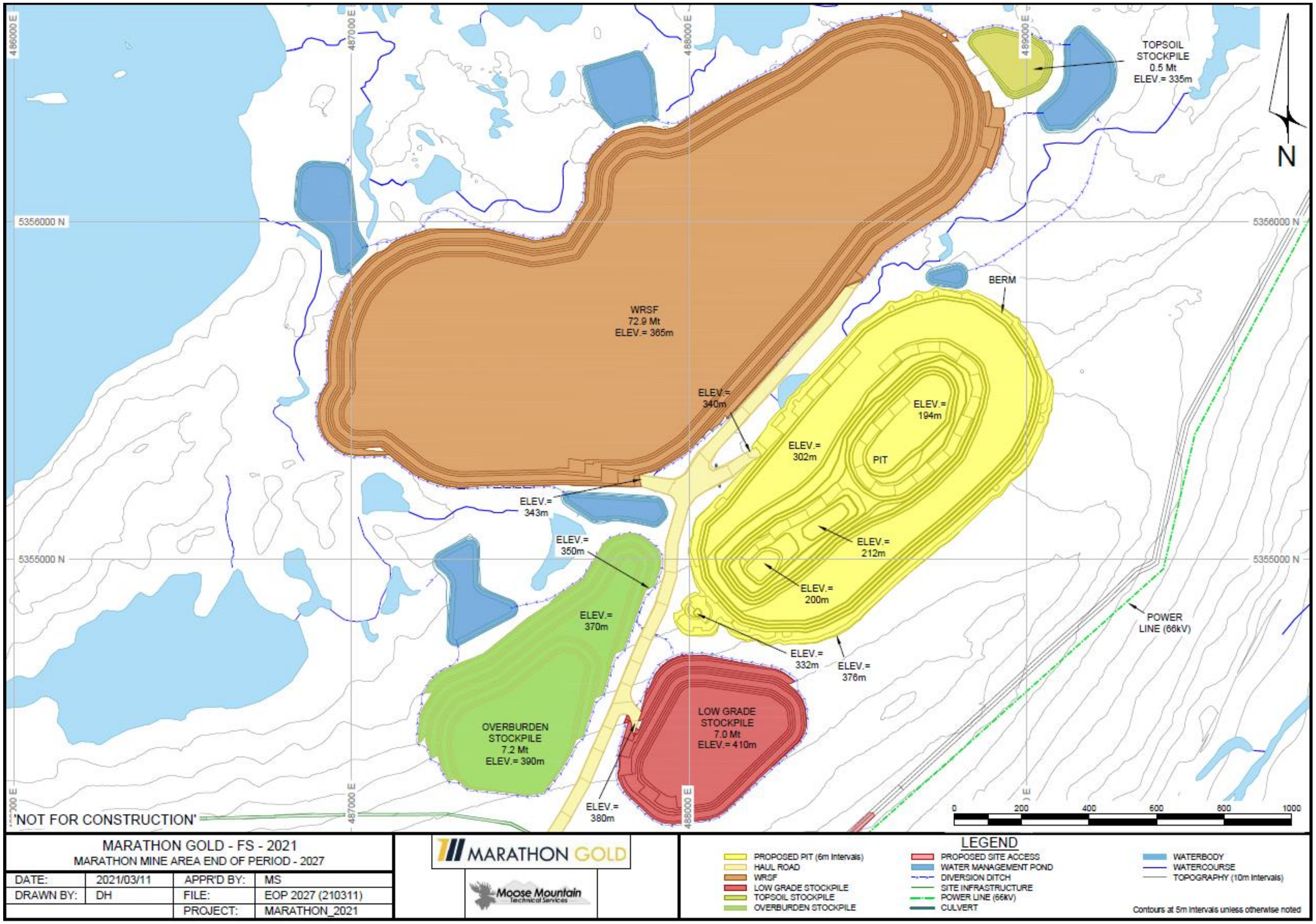
Source: Moose Mountain, 2021.

Figure 16-29: Marathon End of Period – 2025



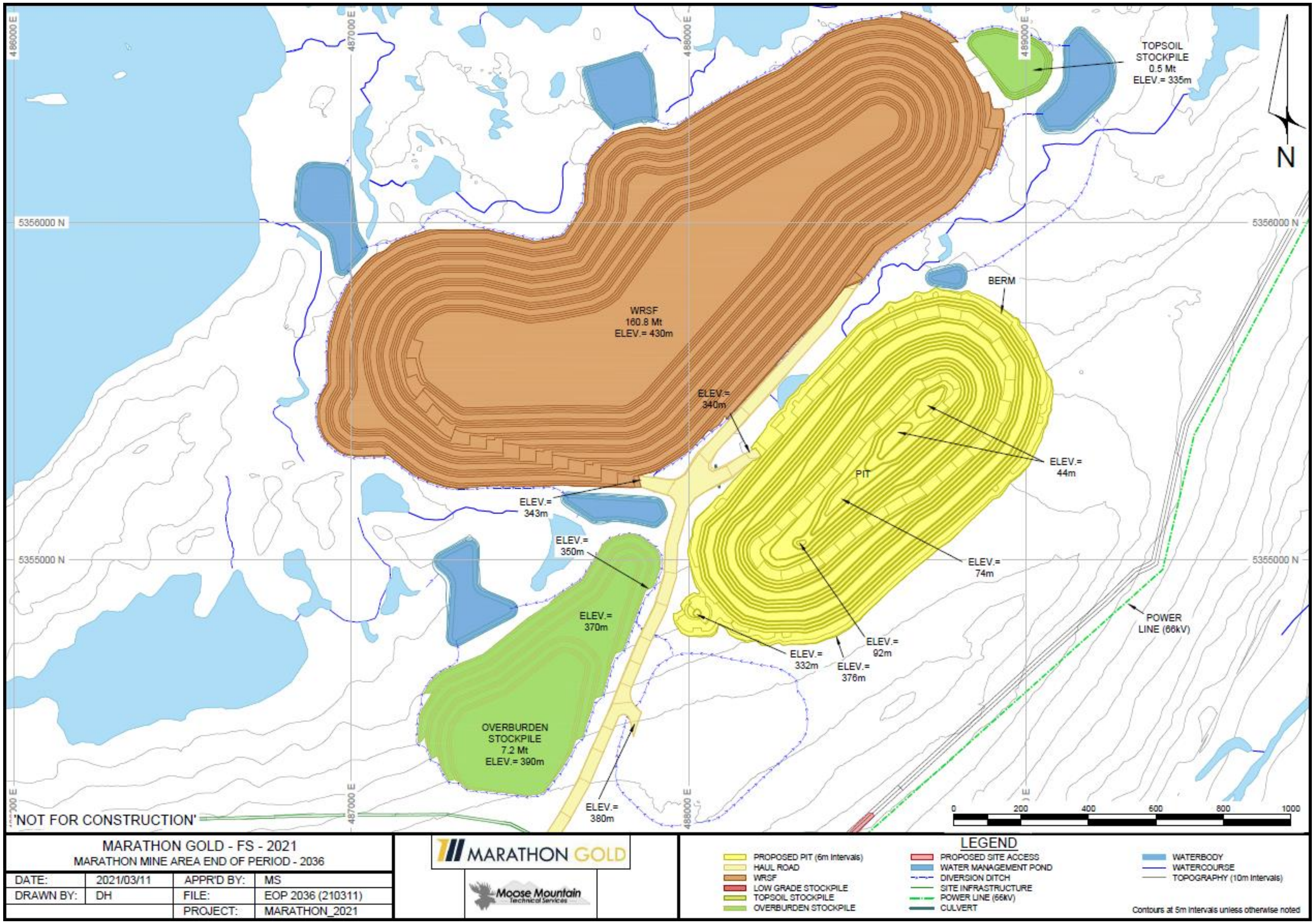
Source: Moose Mountain, 2021.

Figure 16-30: Marathon End of Period – 2027



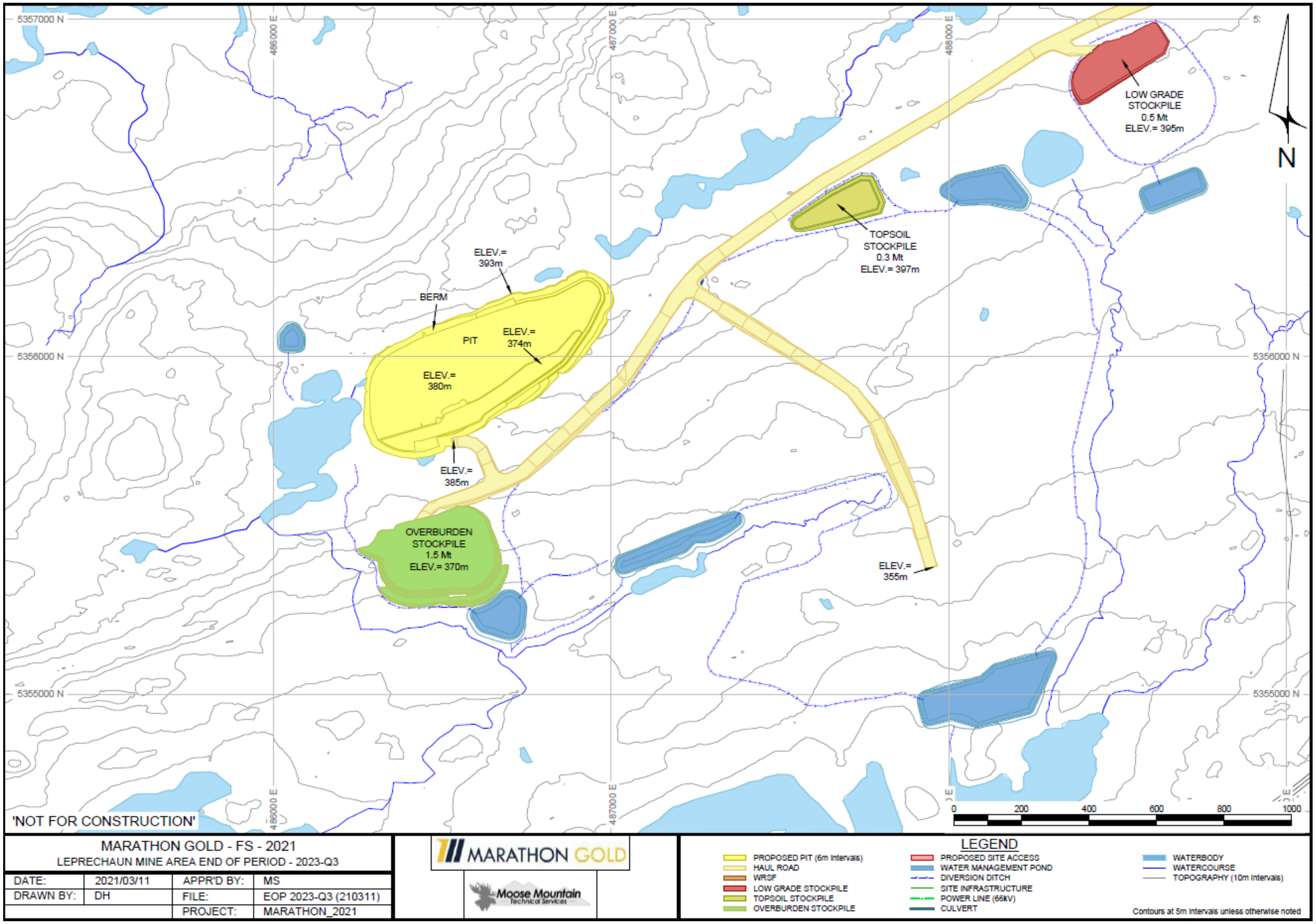
Source: Moose Mountain, 2021.

Figure 16-31: Marathon End of Period – 2036



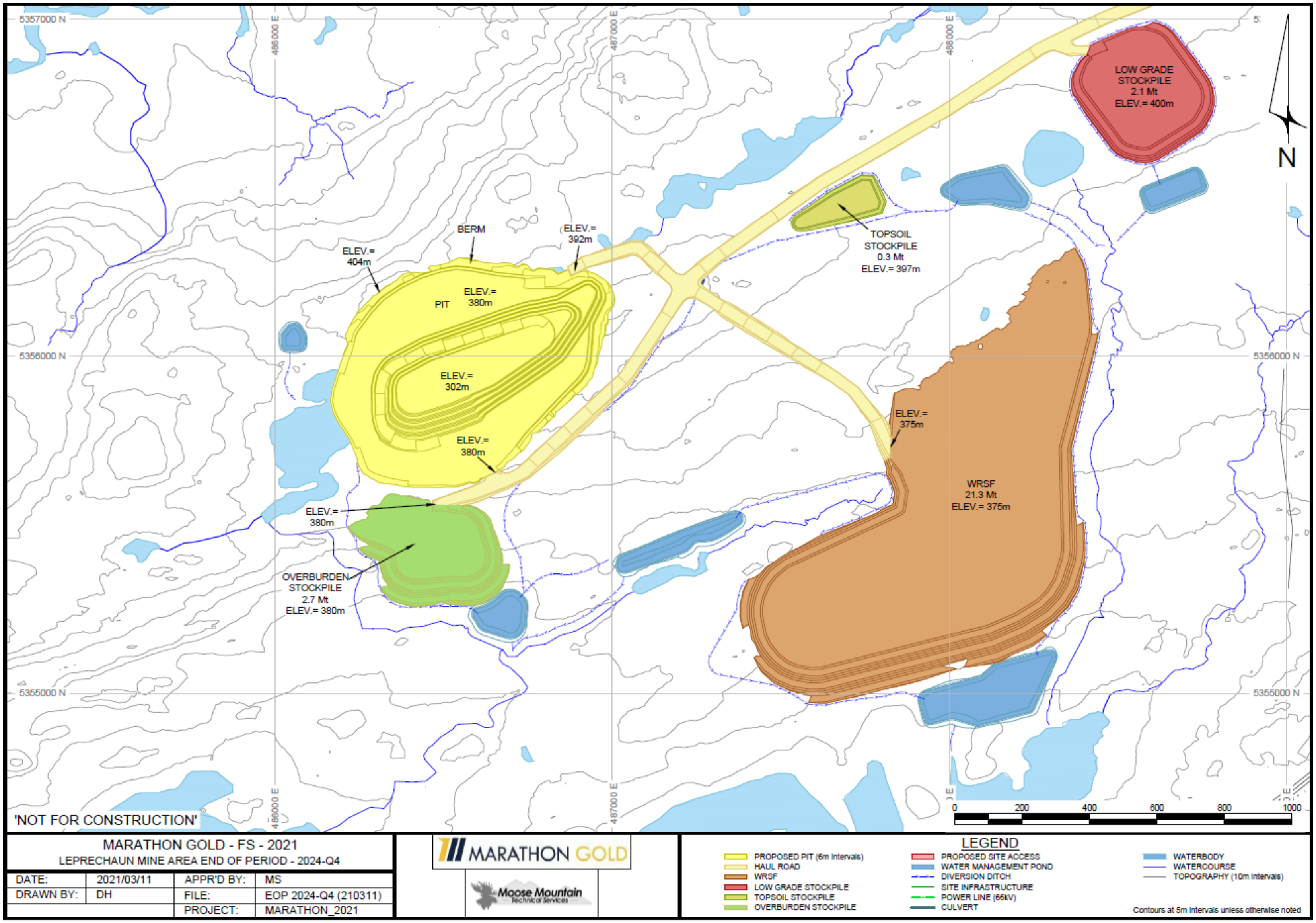
Source: Moose Mountain, 2021.

Figure 16-32: Leprechaun End of Period – Q3 2023



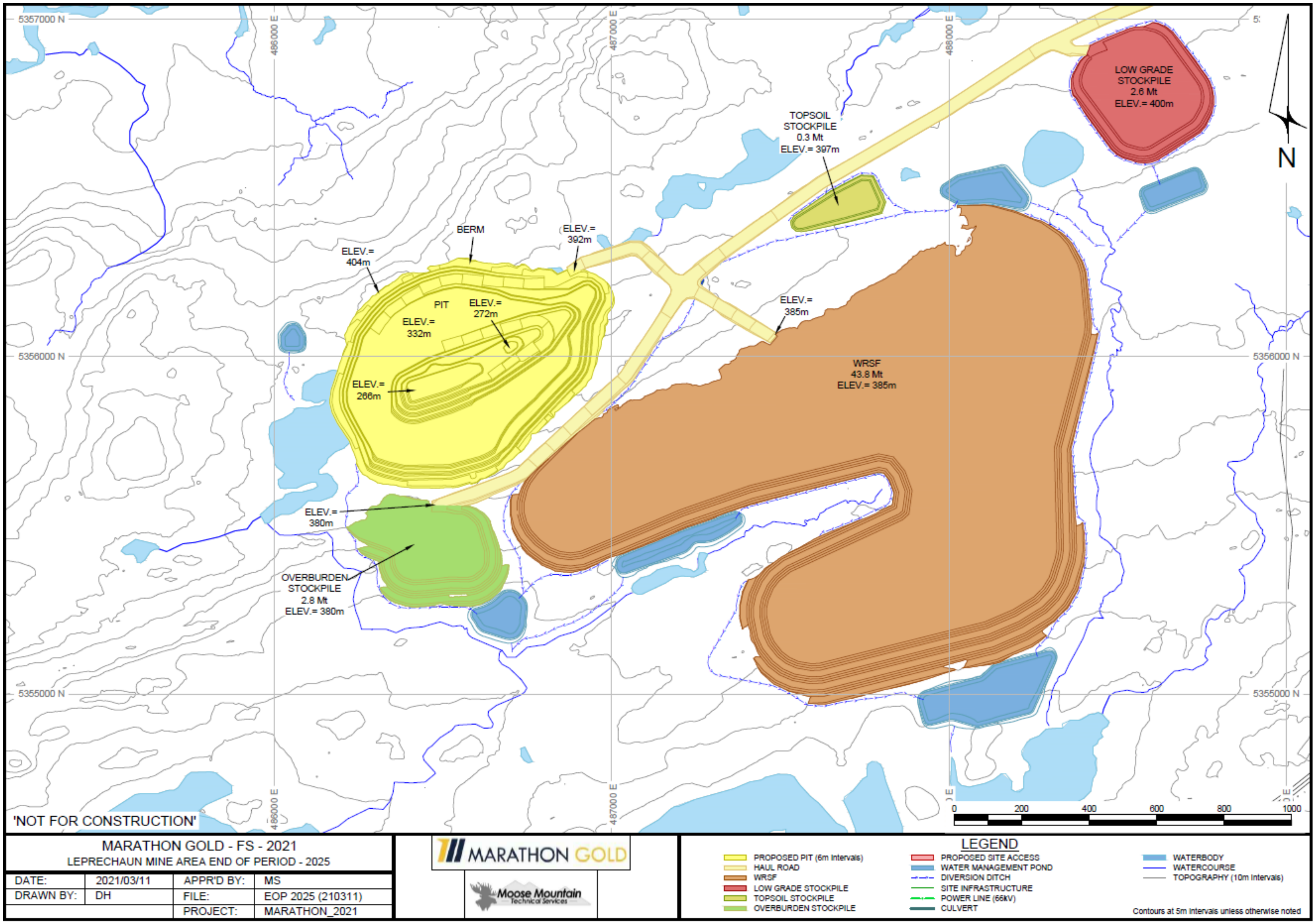
Source: Moose Mountain, 2021.

Figure 16-33: Leprechaun End of Period – 2024



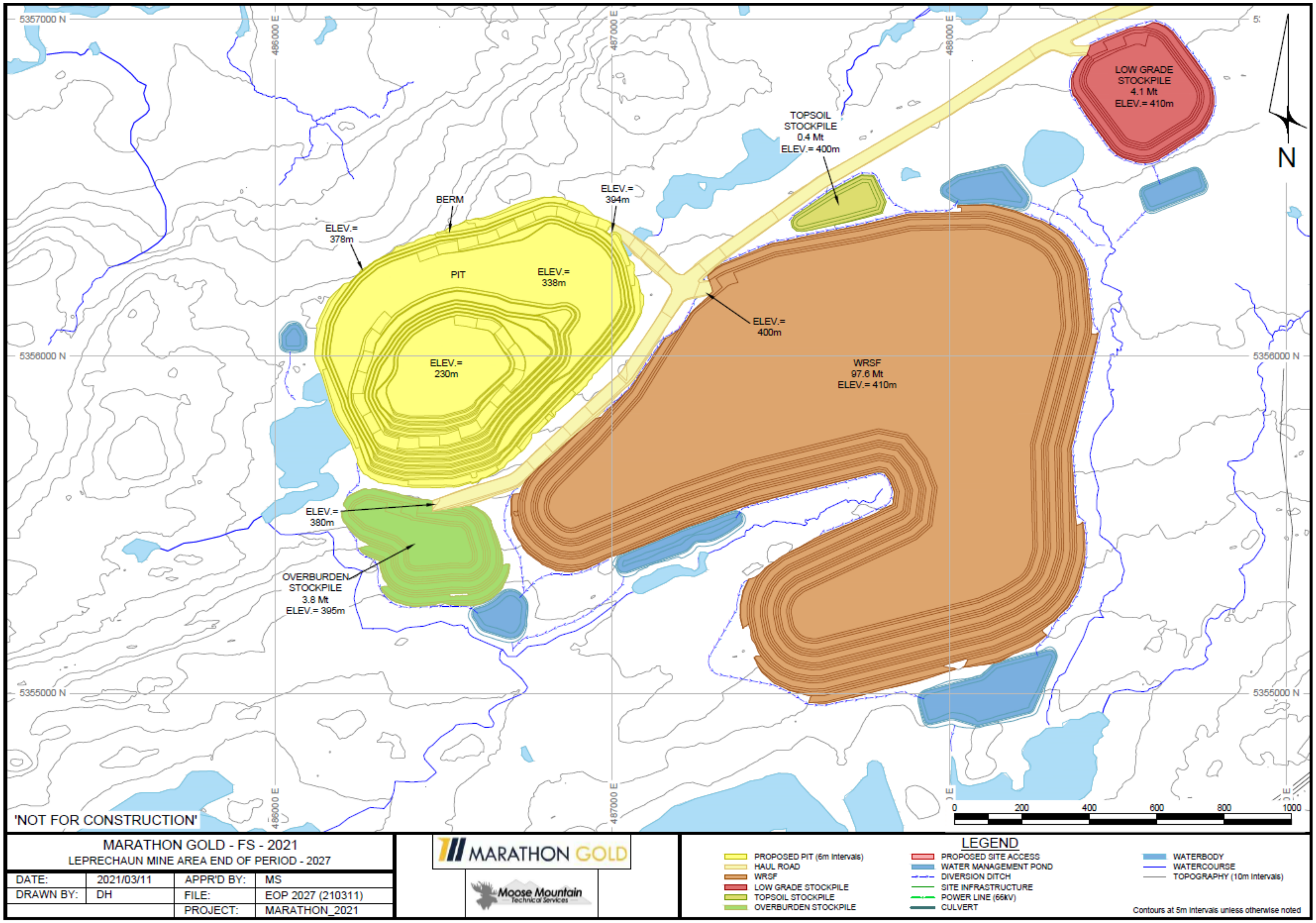
Source: Moose Mountain, 2021.

Figure 16-34: Leprechaun End of Period – 2025



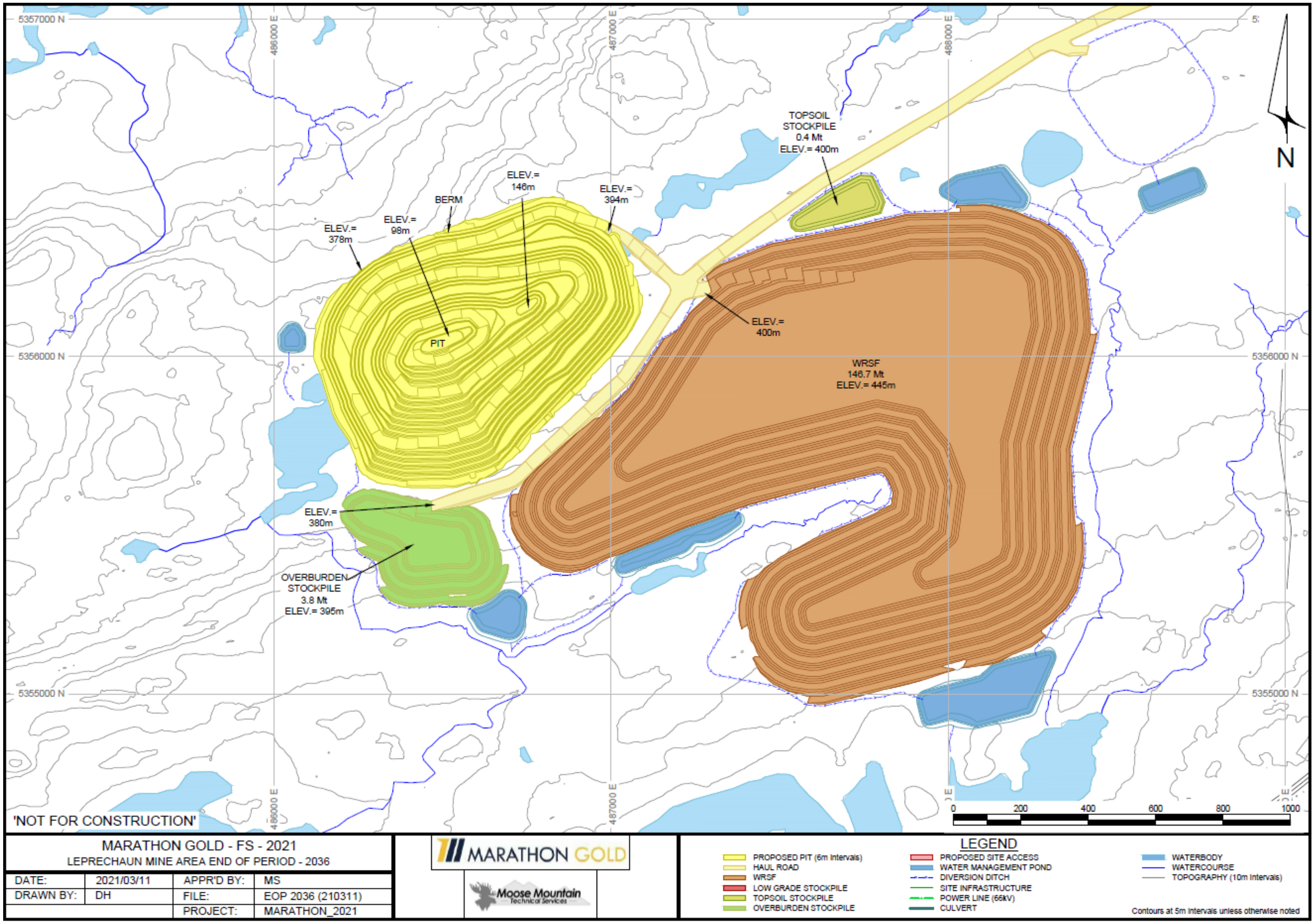
Source: Moose Mountain, 2021.

Figure 16-35: Leprechaun End of Period – 2027



Source: Moose Mountain, 2021.

Figure 16-36: Leprechaun End of Period – 2036



Source: Moose Mountain, 2021.

16.8 Operations

Planned mining operations are typical of similar open pit operations in flat terrain.

Grade control drilling is carried out to better delineate the resource in upcoming benches. An ore control system is planned to provide field control for the loading equipment to selectively mine ore-grade material separately from the waste.

In-situ rock is drilled and blasted to create suitable fragmentation for efficient loading and hauling of both ore and waste rock. Drilling and blasting are planned on 6 m benches in selectively mined areas, and 12 m benches in bulk mined areas. Topsoil and overburden material will not require blasting. Variable powder factors are estimated for the various encountered lithologies and range from 0.22 to 0.27 kg/t. The blasting activities are planned to fall under a contract service agreement with the explosive supplier.

Loading in selective mined areas will be completed with hydraulic excavators on 6 m benches, on multiple flitches or sub-benches, and in bulk mining zones with hydraulic excavators and wheel loaders on 12 m benches. For selectively mined tonnages, 50% is planned to be direct loaded into haulers, and the other 50% placed in piles on the bench and rehandle loaded into haulers via the wheel loader.

Ore and waste materials will be hauled out of the pit and to scheduled destinations with off-highway rigid-frame haul trucks.

Mine pit services include:

- haul road maintenance
- pit floor and ramp maintenance
- stockpile maintenance
- ditching
- dewatering
- mobile fleet fuel and lube support
- topsoil excavation
- secondary blasting and rock breaking
- snow removal
- reclamation and environmental control
- lighting
- transporting personnel and operating supplies
- mine safety and rescue

Direct mining operations and mine fleet maintenance are planned as an Owner's fleet; equipment ownership and labour are undercharged to mine operations.

Mining operations are based on 365 operating days per year with two 12-hour shifts per day. An allowance of 15 days of no production has been built into the mine schedule to allow for adverse weather conditions.

The number of hourly mine operations personnel, including maintenance staff, peaks at 300 persons. Due to the shift rotation, only one-quarter of full personnel complement will be on shift at a given time. Salaried personnel of approximately 45 persons will be required for mine operations, including the mine and maintenance supervision, mine engineering and geology.

16.8.1 Open Pit Dewatering

Pits will be dewatered with conventional dewatering equipment (pit bottom submersible pumps). Daily pit inflow rates have been estimated based on direct precipitation over the pit areas and groundwater inflow rates via host rock hydraulic conductivity (Gilman et al., 2021).

Field hydraulic testing included packer testing in deep geotechnical drillholes, installation of vibrating wire piezometers in geotechnical drillholes, hydraulic response (slug) testing in monitoring wells, and short-term constant rate testing in exploration drillholes. Results of these programs defined a generally low permeability rock mass and a trend of decreasing hydraulic conductivity with depth.

Current estimates of pit hydrogeology suggest inflow from direct precipitation and groundwater to average 5,295 m^3/d for Marathon and 3,080 m^3/d for Leprechaun. Maximum daily inflow is estimated to be 119,158 m^3/d for Marathon and 102,545 m^3/d for Leprechaun.

It is possible that inflow rates higher than estimated may occur as the radius of influence reaches out to various surface water features within and surrounding the pit footprints and these water bodies become additional sources of recharge. In particular, the calculated radius of influence for the Leprechaun pit appears to extend out to Victoria Lake, and the calculated radius of influence for the Marathon pit appears to extend out to Victoria River. Depending on the hydraulic connectively of these two pits with these surface water bodies through various structural features (i.e., faults, fractures, and shear zones), it is possible that these could provide significant sources of recharge and result in higher pit inflow rates than that estimated.

Dewatering of the pits by way of natural seepage should have a direct effect on the bulk pore pressure regime developed behind the pit walls and allow pressures to dissipate passively. No additional active depressurisation regimes have been planned.

Pit water will be pumped from in pit sumps to collection ponds adjacent to the pits, where it will be managed as per the overall site water management plan (see Section 18.9 for details).

16.8.2 Planned Grade Control Measures

The aim of grade control is to accurately model ore/waste boundaries and the goal of selective mining along the ore/waste boundary is to minimise mining dilution.

For short-term mine planning on the scale of three months, a smaller and specific ore control model will be built using closer spaced drilling and conditional simulation for gold grade interpolation. This model will be suitable for mining selectivity on 6 m widths and 6 m heights. The resource model will only be useful for medium- to long-term planning.

A conceptual ore control system (OCS) is planned to provide field control for the loading equipment to selectively mine ore grade material separately from the waste. The OCS will consist of:

- angled reverse circulation (RC) bench drilling on 36 m vertical intervals throughout all ore/waste boundary areas of the designed open pit, on a 6 m x 6 m pattern

- sampling of RC drillholes for gold grades on 3.0 m intervals, 500 g charge
- assaying samples based on PAL (pulverise and leach) process at an on-site laboratory
- conditional simulation of gold grade assayed results into a 2 m x 2 m x 2 m block model
- generation of dig limits at a 0.30 g/t gold cut-off grade within block model
- loading dig limits into guidance systems on excavators
- additional field mark-up of dig limits by the technical services department
- sampling of mined gold grades at the crusher
- reconciliation of planned versus mined gold grade

Blasts along the ore/waste boundary will use straight emulsion, rather than a blended emulsion or ANFO product, to reduce heave and minimise movement along the ore/waste boundary. This will minimise the dilution along the ore/waste contact, or the dig limits for operations. However, the fragmentation that will result from using straight emulsion product is lower, due to the reduced heave during blasting. This has an impact on the expected loader productivity in the selective mining zone (ore/waste boundary).

The combination of powder factor and blast designs (timing and sequencing) to minimise dilution should be optimised in the detailed design phase of the project and will require field measurements and adjustments during operations. Post-blast material movement in operations is an area that has been studied, modelled, and attempts have been made to measure this movement (La Rosa, 2019; Thornton 2009).

Selective loading along the ore/waste boundary is described in 16.1.2, utilising hydraulic excavators on 2 m flitches dynamically separating ore from waste along modelled boundaries and with additional direction of ore control geologists.

An automated hauler dispatch or fleet management system is planned for the loading and hauling tools to minimise the occurrence of misdirected loads. The mine plan direction for excavated materials can be uploaded to the loading tools, which can then dynamically impart this information onto the haulers as it is loading. The hauler operators are then informed of where to deliver the load and which loading tool to return to keep the operation running smoothly.

16.9 Mining Equipment

Grade control drilling will be carried out with 144 mm (5.5″) diesel hydraulic RC drills. Production drilling will be carried out with 200 mm (8”) diesel rotary drills in bulk mining zones and 165 mm (6.5″) diesel down-the-hole (DTH) drills in selective mining zones.

Reliable mining equipment commonly found in the open pit mining industry has been selected and sized for the loading and hauling fleet. A larger hydraulic excavator or possibly front shovel configuration (15.5 m^3 bucket) is proposed to handle large bulk waste headings planned over the mine life. Smaller hydraulic excavators (12.0 m^3 bucket) are proposed based on their ability to minimise losses and dilution for the ore control operations. Front end wheel loaders (13.0 m^3 bucket) are proposed based on their ability to load the haulers in three to four passes, and their ability to load the crusher when required. Rigid-frame haulers (140-tonne and 90-tonne payload) are proposed to be flexible enough to use on the smaller pit benches and in selective mining scenarios but are not so small that the fleet size is excessive. Two articulated haulers (40-tonne payload) are proposed to supplement the fleet and provide additional flexibility for construction of the pits, haul roads, and tailings dam.

Graders will be used to maintain the haul routes for the haul trucks and other equipment within the pits and on all routes to the various waste storage locations and the crusher. Articulated trucks (40-tonne payload) that are outfitted with a water tank and gravel body are included for haul road maintenance. Track dozers (447 kW and 325 kW) are included to handle waste rock, ore, overburden, and topsoil at the various stockpile locations. Front-end wheel loaders (4.5 m^3 bucket) and hydraulic excavators (3.8 m^3 and 3.0 m^3 bucket) are included as pit support, loading tools for the articulated haulers, topsoil and gravel loading, and back-up loaders for the main fleet. Custom articulated fuel/lube trucks are included for mobile fuel/lube support. Various small mobile equipment pieces are proposed to handle all other pit service and mobile equipment maintenance functions.

Mine fleet maintenance activities are generally performed in the maintenance facilities located near the plant site.

Primary mining equipment requirements are shown in Table 16.7 on the following page. A list of support units is shown in Table 16.6 below.

Table 16.6: Support Units

Unit	Function	Maximum Number
Diesel RC tracked drill (144 mm)	Grade control drilling	3
Articulated haul truck (40 t payload)	Haul support, topsoil hauling, construction support	2
Motor grader (4.9 m blade)	Haul road maintenance, snow clearing	6
Water/gravel truck	Haul road maintenance, gravel hauling	4
Track dozer (447 kW)	Stockpile maintenance	2
Track dozer (325 kW)	Pit support, construction, snow clearing	2
Wheel loader (4.5 m^3)	Pit support, gravel loading, and construction	2
Hydraulic excavator (3.8 m^3)	Ore cleaning, preparation for ore loading, topsoil load	2
Hydraulic excavator (3.0 m^3)	Pit support, ditching, construction activities	2
Fuel and lube truck	Mobile fuel/lube service	3
Shuttle bus	Employee transportation	4
Pickup trucks (1/4 ton)	Staff transportation	10
Light plants (20 kW)	Pit lighting	12
Water pumps (150 m^3/h)	Pit sump dewatering	6
On-highway dump truck	Utility material movement	2
Flatbed picker truck	Material transport, pump crew support	2
Emergency response vehicle	First aid and mine rescue	1
Maintenance trucks	Mobile maintenance crew and tool transport	3
Mobile crane (36 t capacity)	Mobile maintenance material handling	1
Float trailer (150-ton capacity)	Equipment and material transport	1
Shovel Float (300-ton capacity)	Shovel transport	1
Forklift (3 t capacity)	Shop material and tire handling	1
Mobile steam cleaner	Mobile maintenance equipment cleaning	1
Scissor Lift / mobile personnel lift	Mobile maintenance support	2

Table 16.7: Primary Mining Fleet Schedule

Unit	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034-2036
Drilling													
Diesel Rotary tracked drill - 200 mm (8”) holes	0	2	2	3	3	3	3	3	2	1	1	0	0
Diesel DTH tracked drill - 165 mm (6.5”) holes	2	3	4	4	4	4	4	4	4	3	3	2	0
Loading													
Hydraulic excavator - 15.5 m^3 bucket	0	1	1	1	1	1	1	1	1	0	0	0	0
Hydraulic excavator - 12.0 m^3 bucket	1	3	3	3	4	4	4	4	4	2	2	1	0
Wheel loader - 13.0 m^3 bucket	0	2	2	2	2	2	2	2	2	2	2	1	1
Hauling													
Rigid frame haul truck - 140 t payload	0	11	11	12	17	17	17	17	17	7	3	0	0
Rigid frame haul truck - 90 t payload	3	8	8	8	11	11	11	11	11	10	9	7	3

17 Recovery Methods

17.1 Overall Process Design

The provided testwork was analysed and several process route options were addressed in the initial stages of the feasibility study. Based on the analysis, a process route was chosen as the best suited for the testwork results and subsequent economic analysis for the material. The unit operations selected are typical for this industry.

Per the mining production schedule, as the high-grade ore is fed to the mill in the first three years, the project will utilise a more capital cost-effective mill design, including a primary grind size P_{80} of 75 µm, gravity recovery of gold and gravity tails cyanidation.

As the mill feed grade decreases, and plant capacity is required to increase to maintain gold production, the project will use the existing grinding mills, and coarsen the primary grind size P_{80} to 150 µm. Flotation equipment will then be employed to recover the majority of the gold to a low mass concentrate stream, at 5% mass pull (of mill feed), and ultra-fine grinding and cyanidation will be applied. Using this approach, initial capital costs will be reduced where possible, and when the mill is required to expand to maintain a steady gold production profile, the flowsheet will be modified to again reduce the expansion capital costs and the operating costs.

In essence, the project will be constructed in two distinct phases, as follows:

- Phase 1 (2.5 Mt/a) – Comprises a semi-autogenous grinding (SAG) mill, ball mill, gravity concentration, and gravity tails leaching, carbon elution, and gold recovery. Leach-adsorption tails will be treated for cyanide destruction, thickened, and deposited in the TMF.
- Phase 2 (expansion to 4.0 Mt/a) – Includes Phase 1 equipment with the addition of pebble crushing, gravity tails flotation, flotation concentrate regrind, float concentrate leaching, and thickening of both the float concentrate and tailings streams

Key process design criteria are listed below:

- Phase 1 nominal throughput of 6,850 t/d or 2.5 Mt/a
- Phase 2 nominal throughput of 10,960 t/d or 4.0 Mt/a
- crushing plant availability of 75%
- plant availability of 92% for grinding, gravity concentration, flotation, and leach plant and gold recovery operations

17.2 Phase 1 – Mill Process Plant Description

The Phase 1 process design is comprised of the following circuits:

- primary crushing of run-of-mine (ROM) material
- a covered, crushed material stockpile to provide buffer capacity ahead of the grinding circuit
- SAG mill with trommel screen followed by a ball mill with cyclone classification
- gravity recovery of the cyclone feed slurry by one semi-batch centrifugal gravity concentrator, followed by intensive cyanidation of the gravity concentrate and electrowinning of the pregnant leach solution in a dedicated cell located in the gold room

- trash screening
- leach + adsorption (L/CIL hybrid)
- acid washing of loaded carbon and pressure Zadra-type elution followed by electrowinning and smelting to produce doré
- carbon regeneration by rotary kiln
- cyanide destruction of tailings using O_2/SO_2
- carbon screening, tailings thickening and tailings management facility
- effluent water treatment followed by a polishing pond before discharging into Victoria Lake

17.2.1 Plant Design Criteria

Key process design criteria for the mill during Phase 1 are listed in Table 17.1 on the following page.

17.2.2 Primary Crushing & Stockpiling

The crushing circuit is designed for an annual operating time of 6,570 h/a or 75% availability at the Phase 2 capacity of 10,960 t/d from the outset.

Material is hauled from the mine or stockpiles and direct tipped into to the ROM hopper. Provision for dumping on the ROM pad for blending and re-handling into the ROM hopper is provided. Material from the ROM hopper is crushed by a primary jaw crusher. ROM hopper material is reclaimed by a vibrating grizzly at 381 t/h to feed the jaw crusher.

A fixed rock breaker is utilised to break oversize rocks at the feed to the jaw crusher. The crushed material is conveyed to a covered stockpile that provides approximately 19 hours of live storage at the Phase 1 processing rate. Given the milling operation is designed for an annual operating time of 8,059 h/a or 92% availability, this will result in excess crushed material production when the crusher is operational. The excess crushed material will allow routine crusher maintenance to be carried out without interrupting feed to the mill.

The mill feed stockpile is equipped with apron feeders to regulate feed at 310 t/h into the SAG mill. Crushed material is drawn from the stockpile by two apron feeders and feeds the grinding circuit via the SAG mill feed conveyor. Pebble lime is added to the SAG mill feed conveyor for pH control in leaching as required. SAG mill pebble production is recycled via a series of conveyors back to the SAG mill feed conveyor.

The material handling and crushing circuit includes the following key equipment:

- ROM hopper
- vibrating grizzly
- fixed rock breaker
- primary jaw crusher
- mill feed apron feeders (equipped with VFDs)
- material handling equipment

Table 17.1: Key Milling Plant Process Design Criteria for Phase 1

Design Parameter	Units	Value
Plant Throughput	t/d	6,850
Gold Head Grade – Design	g/t Au	3.0
Crushing Plant Availability	%	75
Mill Availability	%	92
Bond Crusher Work Index (CWi)	kWh/t	16.5
Bond Rod Mill Work Index (BWi)	kWh/t	13.9
Bond Ball Mill Work Index (BWi)	kWh/t	16.0
JK Axb Parameter – (75th percentile)	Axb	41.5
Bond Abrasion Index (Ai)	g	0.41
Primary Crusher		C150 or Equivalent
Material Specific Gravity	t/m^3	2.68
Angle of Repose	degrees	37
Moisture Content	%	3.0
Pebble Lime Addition	kg/t material	5.0
SAG Mill Dimensions		7.3 m dia. X 4.9 m EGL
SAG Mill Installed Power	MW	4.6, with VFD
SAG Mill Discharge Density	% w/w	70
SAG Mill Ball Charge	% v/v	9
Ball Mill Dimensions		5.5 m dia. X 8.5 m EGL
Ball Mill Installed Power	MW	4.6, with VFD
Ball Mill Discharge Density	% w/w	72
Ball Mill Ball Charge	% v/v	28
Primary Grind size (P_{80})	µm	75
Gravity Circuit Feed Source		Cyclone feed slurry
Gravity Circuit Feed Rate	% cyclone recirculation	21.8
Gravity Circuit Recovery	%Au	45
L-CIL Residence Time	h	32
L-CIL Extraction	%Au	93
L-CIL Operating Density	% w/w	42.5
L-CIL DO Target	ppm	20
L-CIL pH Target		12
L-CIL Carbon Concentration	g/L	12
L-CIL Sodium Cyanide Addition	kg/t material	1.5
L-CIL Hydrated Lime Addition	kg $Ca(OH)_2$/t material	1.0
Leach & CIL Tanks	#	2 + 6
Tonnes of Carbon per Column	t	7.0
Detox Residence Time	min	60
Detox Oxygen Addition Rate	g O_2/g SO_2	3.0
Detox WAD Cyanide Feed to Circuit	mg/L CN_{WAD}	200
Detox WAD Cyanide Discharge Target	mg/L CN_{WAD}	<2.0
Detox Copper Sulphate Addition	ppm Cu^{+2}	25
Detox SMBS Addition	g SO_2/g CN_{WAD}	5.0
Detox Hydrated Lime Addition	g CaO/g SO_2	0.75
Final Tails Thickener Underflow Density	% w/w	65
Flocculant – Final Tails Thickener	g/t material	30

17.2.3 Grinding Circuit

The grinding circuit consists of a SAG mill followed by a ball mill in closed circuit with hydrocyclones. The circuit is sized based on a SAG F_{80} of 111 mm and a ball mill product P_{80} of 75 µm. The SAG mill slurry discharges through a trommel where the pebbles are screened and recycled to the SAG mill via conveyors. Trommel undersize discharges into the cyclone feed pumpbox.

The ball mill is fed by cyclone underflow and gravity circuit tails. The ball mill discharges through a trommel and the oversize is screened out and discharged to a scats bunker. Trommel undersize discharges into the cyclone feed pumpbox.

Water is added to the cyclone feed pumpbox to obtain the appropriate density prior to pumping to the cyclones. This hopper also has a dedicated pump to feed the gravity circuit scalping screen. Cyclone overflow gravitates to the leach-adsorption circuit via a trash screen.

The grinding circuit includes the following key equipment:

- 4,600 kW SAG mill (shared VFD with ball mill)
- 4,600 kW ball mill
- cyclone feed pumpbox
- classification cyclones

17.2.4 Gravity Concentrate Recovery Circuit

The gravity circuit comprises one centrifugal concentrator complete with a feed scalping screen. Feed to the circuit is directed from the cyclone feed pumpbox via a dedicated pump to the scalping screen. Gravity scalping screen oversize at +2 mm reports to the gravity tails pumpbox, from where the gravity tails pump directs the material back to feed the ball mill.

Scalping screen undersize is fed to the centrifugal concentrator. Operation of the gravity concentrator is semi-batch and the gravity concentrate is collected in the concentrate storage cone and subsequently leached by the intensive cyanidation reactor circuit. The tails from the gravity concentrator also report to the gravity tails pumpbox.

The gravity recovery circuit includes the following key equipment:

- gravity feed scalping screen
- gravity concentrator
- gravity tails pumpbox

17.2.5 Intensive Cyanidation Reactor

Concentrate from the gravity circuit reports to the intensive cyanidation reactor (ICR) to extract the contained gold by intensive cyanidation. The concentrate from the gravity concentrator is directed to the ICR gravity concentrate storage cone and de-slimed before transfer to the ICR.

ICR leach solution (mixture of NaCN, NaOH and LeachAid® - an oxidant) is made up within the heated ICR reactor vessel feed tank. From the feed tank, the leach solution is circulated though the reaction vessel, then drained back into the feed tank. The leached residue within the reaction vessel is washed, with wash water recovered to the reaction vessel feed tank, and then the solid gravity leach tailings are pumped to the CIL circuit.

The ICR pregnant leach solution is pumped from the reaction vessel feed tank to the ICR pregnant solution tank located in the gold room.

ICR pregnant solution is treated in the gold room for gold recovery as gold sludge using a dedicated electrowinning cell. The sludge is combined with the sludge from the carbon elution electrowinning cells and smelted. It can also be smelted separately for metallurgical accounting purposes.

The ICR circuit includes the following key equipment:

- gravity concentrate storage cone
- intensive cyanidation reactor
- ICR pregnant solution tank
- ICR electrowinning cell

17.2.6 Leach & Adsorption Circuit

The leach-adsorption circuit consists of two leach tanks and six CIL tanks. The circuit is fed by trash screen undersize together with barren solution from electrowinning cells. The leach and CIL tanks are identical in size, with a total circuit residence time of 32 hours at 42.5% w/w density.

Oxygen is sparged to each tank to maintain adequate dissolved oxygen levels for leaching at 20 ppm. Hydrated lime is added to further refine the operating pH to the desired set point of 12. Cyanide solution is added to the first leach tank. Fresh/regenerated carbon from the carbon regeneration circuit is returned to the last tank of the CIL circuit and is advanced counter-currently to the slurry flow by pumping slurry and carbon. Slurry from the last CIL tank gravitates to the cyanide detoxification tanks.

The inter-tank screen in each CIL tank retains the carbon whilst allowing the slurry to flow by gravity to the downstream tank. This counter-current process is repeated until the loaded carbon reaches the first CIL tank. Recessed impeller pumps are used to transfer slurry between the CIL tanks and from the lead tank to the loaded carbon screen mounted above the acid wash column in the elution circuit.

The leach and carbon adsorption circuit includes the following key equipment:

- trash screen
- leach/CIL tanks and agitators
- loaded carbon screen
- intertank carbon screens
- carbon sizing screen

17.2.7 Cyanide Destruction

Leach-adsorption tails at 42.5% w/w solids flow by gravity to the cyanide destruction tank. The water used for acid rinse and carbon transfer is also included in the feed to detoxification circuit. As a result, the percentage solids in the feed to the detoxification circuit is estimated to be closer to 40% w/w solids.

The tank operates with a total residence time of approximately 60 mins to reduce weak acid dissociable cyanide (CN_{WAD}) concentration from 200 ppm to less than 2.0 ppm.

Cyanide destruction is undertaken using the SO_2/O_2 method. The reagents required are oxygen, lime, copper sulphate, and sodium metabisulphite (SMBS). The cyanide destruction tank is equipped with oxygen addition points and an agitator to ensure that the oxygen and reagents are thoroughly mixed with the tailings slurry.

From the detoxification tank, the tailings report to the carbon safety screen. Screen undersize feeds the tailings thickener, whilst screen oversize (recovered carbon) is collected in a fine carbon bin for potential return to the CIL circuit.

The main equipment in this area includes:

- cyanide destruction tank and agitator
- oxygen supply system
- carbon safety screen

17.2.8 Tailings Thickening

Detoxified tailings are thickened before discharge to the TMF. The overflow of the thickener is reused as process water in the plant. Flocculant is combined with the feed to the thickener to improve the settling rate of the material. The underflow is pumped to the TMF for final deposition with decant water from the TMF returned for use as process water.

The main equipment in this area includes:

- high-rate thickener
- overflow tank for process water storage
- underflow / final tailings pumps (two-stage)

17.2.9 Carbon Acid Wash, Elution & Regeneration Circuit

17.2.9.1 Carbon Acid Wash

Prior to gold stripping stage, loaded carbon is treated with a weak hydrochloric acid solution to remove calcium, magnesium, and other salt deposits that could render the elution less efficient or become baked on in subsequent steps and ultimately foul the carbon.

Loaded carbon from the loaded carbon recovery screen flows by gravity to the acid wash column. Entrained water is drained from the column and the column is refilled from the bottom up with the hydrochloric acid solution. Once the column is filled with acid, it is left to soak, after which the spent acid is rinsed from the carbon and discarded to the cyanide destruction tank.

The acid-washed carbon is then hydraulically transferred to the elution column for gold stripping.

The main equipment in this area includes:

- acid wash carbon column –7- tonne capacity
- hydrochloric acid feed pump

- spent solution discharge sump pump

17.2.9.2 Gold Stripping (Elution)

The gold stripping (elution) circuit uses the pressure Zadra process.

The elution sequence commences with the injection of a set volume of water into the bottom of the elution column, along with the simultaneous injection of cyanide and sodium hydroxide solution to achieve a weak NaOH (2.0% w/w) and weak NaCN (0.2% w/w) solution. Once the prescribed volume has been added, the pre-soak period commences. During the pre-soak, the caustic/cyanide solution is circulated through the column and the elution heater until a temperature of 95°C is achieved.

Upon completion of the pre-soak period, additional water is pumped through the trim heat exchanger and elution heater, then through the elution column to the pregnant eluate tank at a rate of 2.0 bed volumes (BV)/h. At this stage, the temperature of the strip solution passing through the column is increased to 130°C at a pressure of 650 kPa and the gold is stripped off the loaded carbon.

Strip solution flows up and out of the top of the column, passing through the heat exchanger via the elution discharge strainers and to the pregnant solution tank.

Upon completion of the cool down sequence, the carbon is hydraulically transferred to the carbon regeneration kiln feed hopper via a dewatering screen.

The stripping circuit includes the following key equipment:

- elution carbon column – 7-tonne capacity
- strip solution heater (electric) with heat exchangers
- strip eluate, and pregnant solution tanks

17.2.9.3 Carbon Reactivation

Carbon is reactivated in an electric rotary kiln. Dewatered barren carbon from the stripping circuit is held in a 7-tonne kiln feed hopper. A screw feeder metres the carbon into the reactivation kiln, where it is heated to 650° to 750°C in an atmosphere of superheated steam to restore the activity of the carbon.

Carbon discharging from the kiln is quenched in water and screened on a carbon sizing screen located on top of the CIL tanks to remove undersized carbon fragments. The undersize fine carbon gravitates to the carbon safety screen, whilst carbon screen oversize is directed to the CIL circuit.

As carbon is lost by attrition, new carbon is added to the circuit using the carbon quench tank. The new carbon is then transferred along with the regenerated carbon to feed the carbon sizing screen.

The carbon reactivation circuit includes the following key equipment:

- carbon dewatering screen
- regeneration kiln (electric) including feed hopper and screw feeder
- carbon quench tank

17.2.10 Electrowinning & Gold Room

Gold is recovered from the pregnant solution by electrowinning and smelted to produce doré bars. The pregnant solution is pumped through one electrowinning cell with stainless steel mesh cathodes. Gold is deposited on the cathodes and the resulting barren solution is pumped to the leach circuit. One additional electrowinning cell is dedicated to process ICR pregnant solution.

The gold-rich sludge is washed off the steel cathodes in the electrowinning cells using high-pressure spray water and gravitates to the sludge hopper. The sludge is filtered, dried, mixed with fluxes, and smelted in an electrical induction furnace to produce gold doré. The electrowinning and smelting process takes place within a secure and supervised gold room equipped with access control, intruder detection, and closed-circuit television equipment.

The electrowinning circuit and gold room include the following key equipment:

- electrowinning cells with rectifiers
- sludge pressure filter
- drying oven
- flux mixer
- induction smelting furnace with bullion moulds and slag handling system
- bullion vault and safe
- dust and fume collection system
- gold room security system

17.2.11 Effluent Treatment Plant

Excess water from the TMF is fed to an effluent water treatment plant followed by a polishing pond before discharging into Victoria Lake. Excess water in the TMF will be treated according to the Metal and Diamond Mining Effluent Regulations (MDMER) 2021 discharge regulations. The effluent treatment plant (ETP) will be operated year-round, with water only being released during non-winter months, seven months of the year.

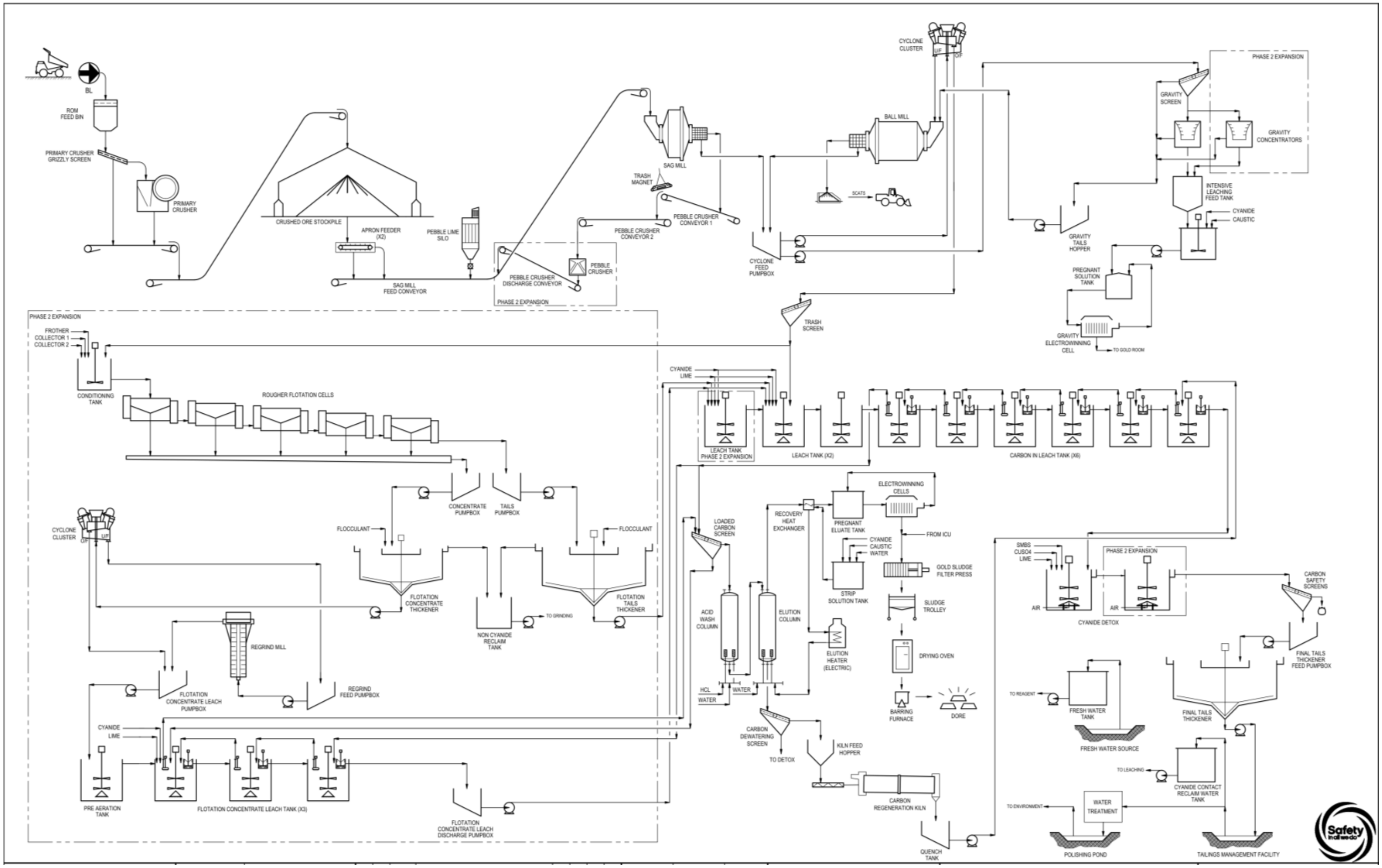
Heavy metals removal by precipitation will reduce contained copper in solution. The precipitate sludge will report to the TMF. A biological treatment method using submerged attached growth reactor (SAGR) will subsequently reduce ammonia and cyanide contained in the TMF. SAGR is a porous graded rock bed with nitrifying bacteria. Blowers provide the required aeration to complete the nitrification process. Residual cyanide and ammonia will meet MDMER 2021 guidelines for discharged water into the environment.

17.2.12 Flowsheet & Layout Drawings

An overall process flow diagram showing the unit operations in the selected process flowsheet is presented in Figure 17-1. Plans and sections of the proposed plant are provided in Figures 17-2 to 17-6.

In the process plant general arrangement drawing (Figure 17-2), the process areas shaded in grey (such as flotation, thickeners, and concentrate leach tanks) represent the equipment that is required for Phase 2, and thus will be constructed in parallel to the Phase 1 operation during production year 3.

Figure 17-1: Overall Process Flow Diagram

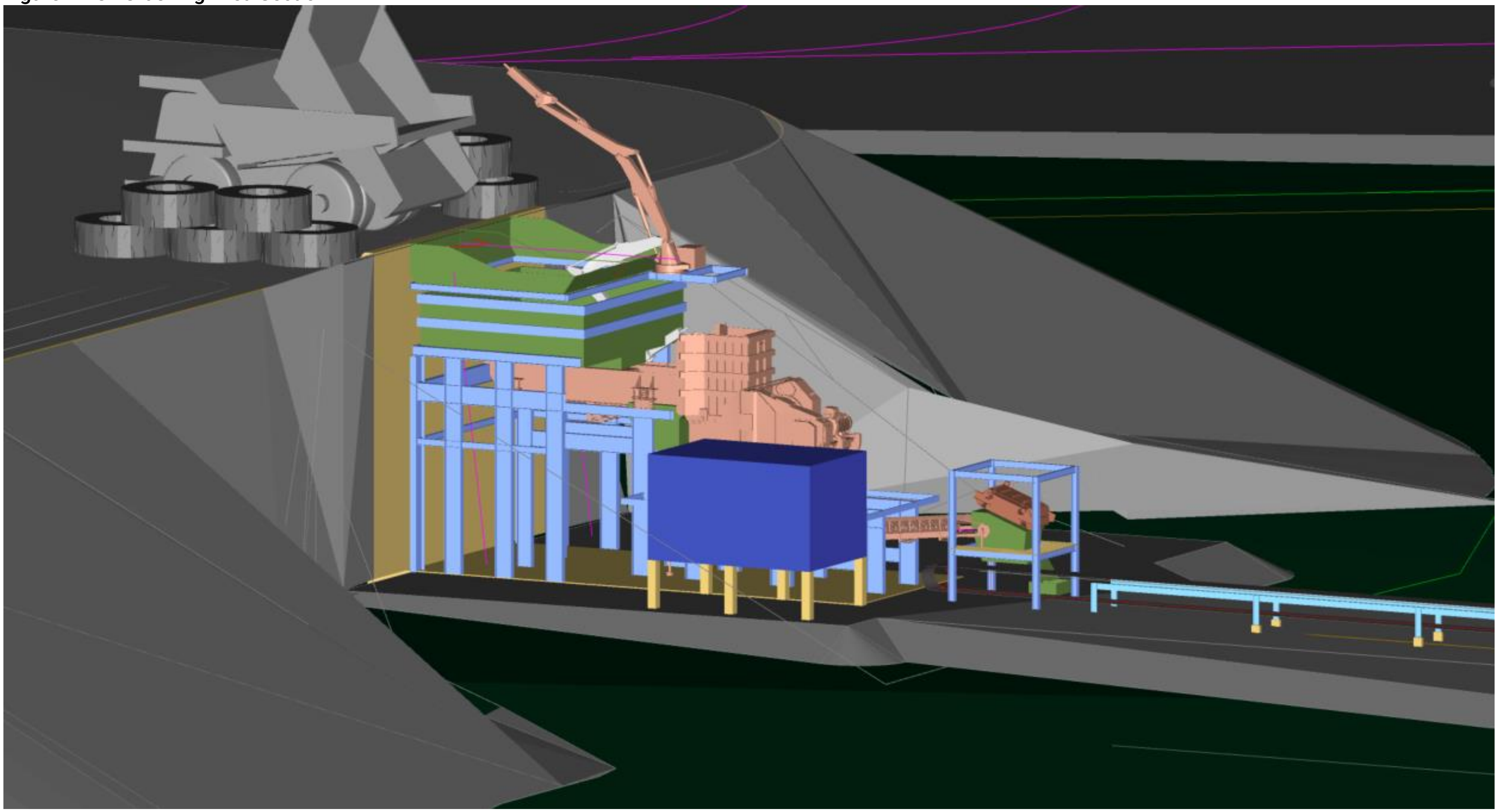


Source: Ausenco, 2020.

Figure 17-2: Overall Plant Layout

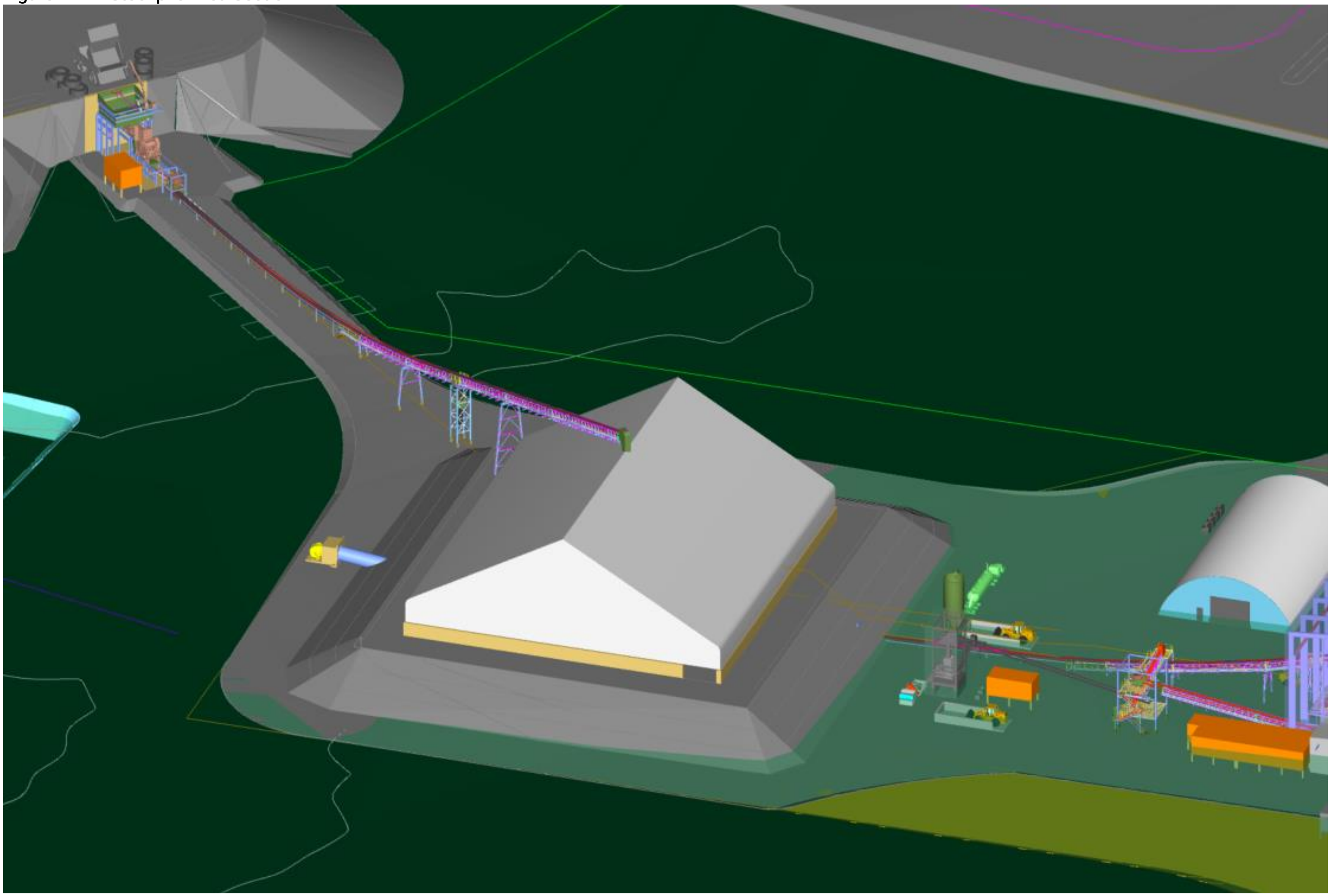
Source: Ausenco, 2021.

Figure 17-3: Crushing Area Section



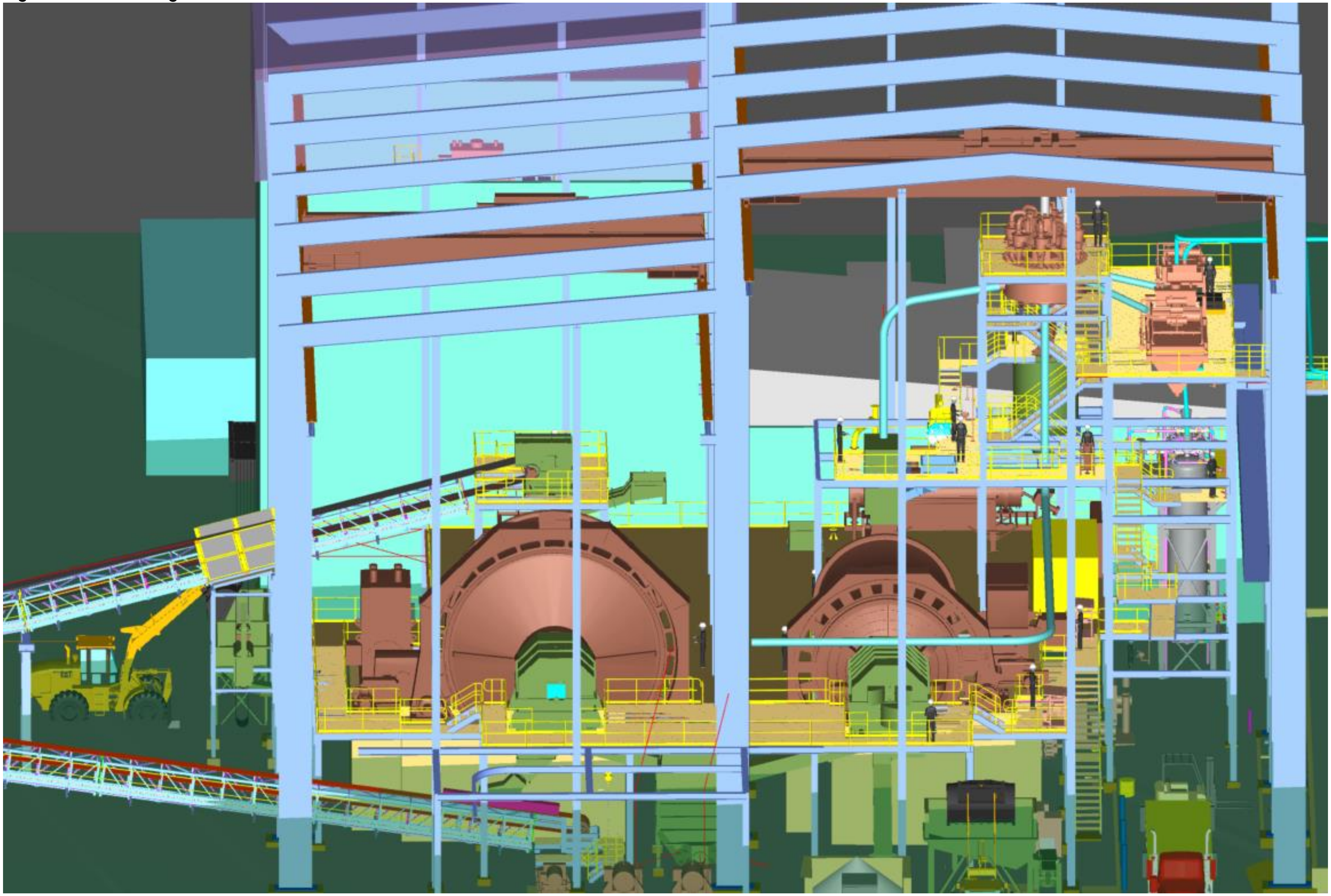
Source: Ausenco, 2021.

Figure 17-4: Stockpile Area Section



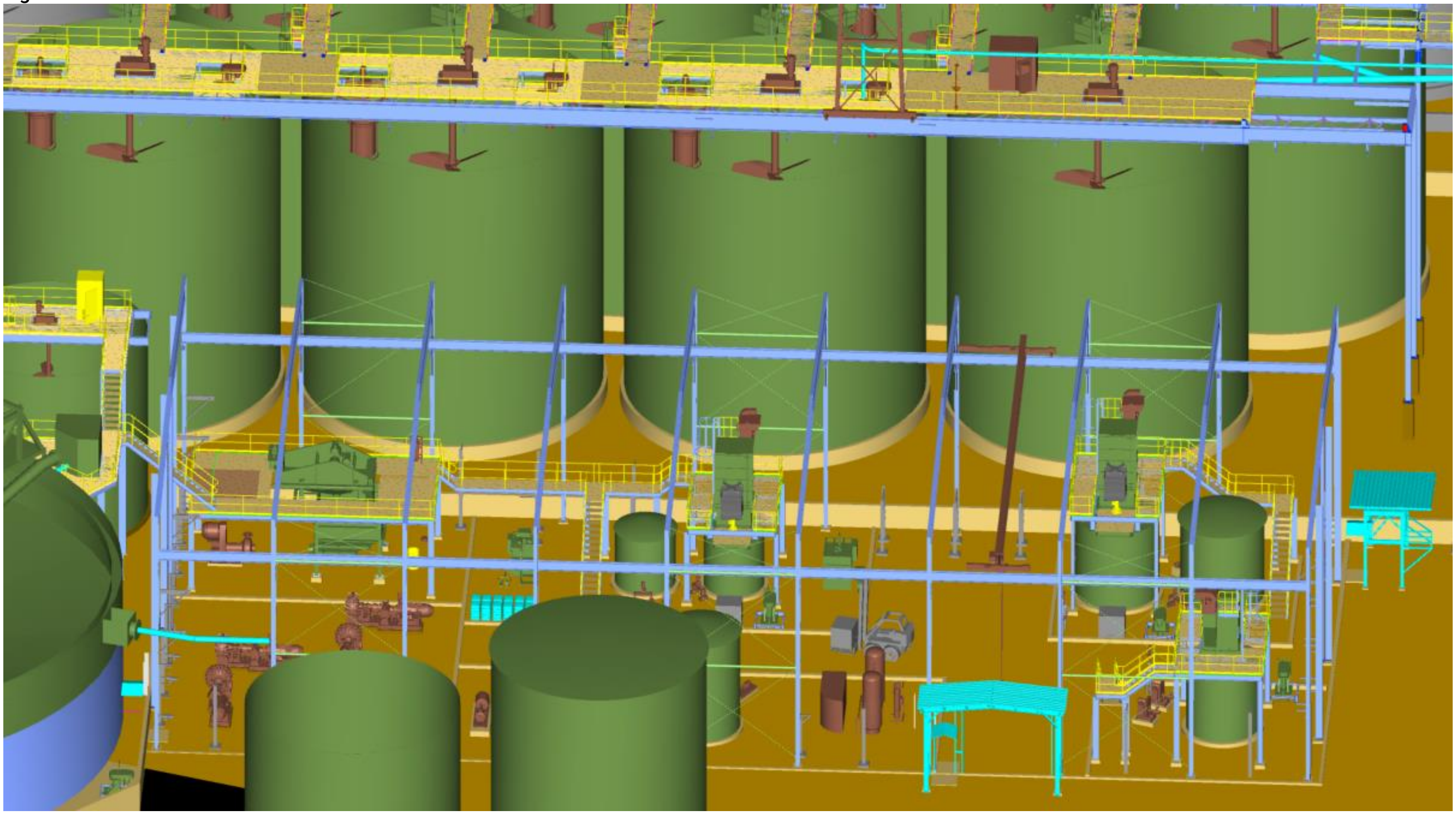
Source: Ausenco, 2021.

Figure 17-5: Grinding & Tank Area Section



Source: Ausenco, 2021.

Figure 17-6: Plant Services Area Section



Source: Ausenco, 2021.

17.3 Phase 2 – Mill Process Plant Description

The proposed process design is comprised of the following circuits:

- primary crushing of ROM material
- covered crushed material stockpile to provide buffer capacity ahead of the grinding circuit
- grinding circuit: SAG mill with trommel screen followed by a ball mill with cyclone classification
- pebble crushing
- gravity gold recovery from the cyclone feed slurry by two semi-batch centrifugal gravity concentrators (one original, one added for Phase 2), followed by intensive cyanidation of the gravity concentrate and electrowinning of the pregnant leach solution in a dedicated cell located in the gold room as for Phase 1
- trash screening
- rougher flotation
- flotation concentrate thickening
- flotation concentrate regrind
- flotation concentrate pre-aeration and CIL
- flotation tails thickening
- flotation tails leach + adsorption (L/CIL hybrid)
- acid washing of loaded carbon and Zadra-type elution followed by electrowinning and smelting to produce doré
- carbon regeneration by rotary kiln
- cyanide destruction of tailings using O_2/SO_2 process
- carbon screening, tailings thickening and tailings management facility
- effluent water treatment followed by a polishing pond before discharging into Victoria Lake

17.3.1 Plant Design Criteria

The key process design criteria for the mill during Phase 2 are listed in Table 17.2. Any repeated comminution characteristics identical to Phase 1 have been omitted.

17.3.2 Primary Crushing & Stockpiling

This area is identical to the equivalent area in Phase 1 (see Section 17.2.2), except for the addition of a pebble crusher in the pebble recycle circuit. As in Phase 1, The SAG mill slurry discharges through a trommel where the pebbles are screened and recycled to the SAG mill via conveyors, but in this phase, the addition of a pebble crusher in the recycle circuit will avoid build-up in the SAG mill. The conveyor recycle circuit has an installed tramp magnet and the following conveyor has a metal detector installed, to protect the pebble crusher from ball parts or other metal scraps that may cause it damage. The pebble crusher may be bypassed for maintenance using a diverter chute.

Table 17.2: Key Milling Plant Process Design Criteria for Phase 2

Design Parameter	Units	Value
Plant Throughput	t/d	10,960
Gold Head Grade – Design	g/t Au	1.81
Availability & Comminution Characteristics		See Phase 1
Pebble Lime Addition	kg/t	0.9
SAG Mill Dimensions		7.3 m dia. x 4.9 m EGL
SAG Mill Installed Power	MW	4.6 (with VFD)
SAG Mill Discharge Density	% w/w	70
SAG Mill Ball Charge	% v/v	16
Ball Mill Dimensions		5.5 m dia. x 8.5 m EGL
Ball Mill Installed Power	MW	4.6 (with VFD)
Ball Mill Discharge Density	% w/w	72
Ball Mill Ball Charge	% v/v	30
Primary Grind size (P_{80})	µm	150
Gravity Circuit Feed Source		cyclone feed slurry
Gravity Circuit Feed Rate	% cyclone recirculation	27.5
Gravity Circuit Recovery	%Au	45
Flotation Conditioning Tank Residence Time	min	10
Flotation Concentrate Mass Pull	%	5.0
Flotation Residence Time	min	30
Flotation Circuit Recovery	%Au	90
Regrind Product size (P_{80})	µm	15
Flotation Concentrate Thickener Underflow Density	% w/w	60
Flotation Tails Thickener Underflow Density	% w/w	65
Flotation Concentrate Pre-aeration Residence Time	h	6.0
Flotation Concentrate CIL Residence Time	h	48
Flotation Concentrate CIL Extraction	%Au	95
Flotation Concentrate CIL Operating Density	% w/w	42
Flotation Concentrate CIL DO Target	ppm	20
Flotation Concentrate CIL pH Target		11
Flotation Concentrate CIL Carbon Concentration	g/L	18
Flotation Concentrate CIL Sodium Cyanide Addition	kg/t	1.0
Flotation Concentrate CIL Hydrated Lime Addition	kg $Ca(OH)_2$/t	1.0
Flotation Concentrate Pre-aeration & CIL Tanks	#	1+3
Flotation Tails CIL Residence Time	h	26
Flotation Tails CIL Extraction	%Au	91
Flotation Tails CIL Operating Density	% w/w	50
Flotation Tails CIL DO Target	ppm	20
Flotation Tails CIL pH Target		11
Flotation Tails CIL Carbon Concentration	g/L	12
Flotation Tails CIL Sodium Cyanide Addition	kg/t	1.0
Flotation Tails CIL Hydrated Lime Addition	kg $Ca(OH)_2$/t	0.5
Flotation Tails Leach & CIL Tanks	#	3 + 6
Tonnes of Carbon per Column	t	7.0
Detox Characteristics		See Phase 1

17.3.3 Grinding Circuit

This area is identical to the equivalent area in Phase 1 (see Section 17.2.3), except for an increase in the primary grind P_{80} to 150 µm.

17.3.4 Gravity Recovery Circuit

This area is identical to the equivalent area in Phase 1 (see Section 17.2.4), with the addition of one gravity concentrator.

17.3.5 Intensive Cyanidation Reactor

This area is identical to the equivalent area in Phase 1 (see Section 17.2.5).

17.3.6 Flotation, Thickening & Concentrate Regrind Circuit

Cyclone overflow gravitates over a trash screen to remove foreign material prior to flotation. Trash reports to the trash bin, which is periodically removed for emptying. Screen undersize gravitates to the rougher conditioner tank. Reagents are dosed into the rougher conditioner tank and mixed thoroughly.

The rougher flotation circuit consists of five 130 m^3 forced-air tank cells in series. Rougher concentrate is pumped into the flotation concentrate thickener. The rougher tailings are pumped to flotation tailings thickener. Flocculant is combined with the feed to each thickener to improve the settling rate of the material. Flotation tails thickener underflow reports to the leach-CIL tanks. The overflow from both thickeners is recovered in a process water tank, and re-used specifically in the grinding circuit to ensure the non-cyanide contact water is used pre-flotation.

Flotation concentrate thickener underflow reports to the concentrate regrind mill. The target product size from the regrind mill is P_{80} of 15 µm. Fine grinding is achieved via attrition and abrasion of the particles in a horizontal fine grinding mill containing small ceramic beads as the grinding medium in an open-circuit configuration with a hydrocyclone.

Cyclone overflow feeds the flotation concentrate leach circuit pre-aeration tank, which overflows to the five flotation concentrate CIL tanks. Loaded carbon from the flotation tailings CIL circuit is returned to the last tank of the flotation concentrate CIL circuit. As for the leach and adsorption circuit described in Section 17.2.6, the carbon is advanced counter-currently to the slurry flow by pumping slurry and carbon. Slurry from the last flotation concentrate CIL tank is pumped to the flotation tails CIL circuit.

The intertank screen in each flotation concentrate CIL tank retains the carbon whilst allowing the slurry to flow by gravity to the downstream tank. This counter-current process is repeated until the loaded carbon reaches the first flotation concentrate CIL tank. Recessed impeller pumps are used to transfer slurry between the flotation concentrate CIL tanks and from the lead tank to the loaded carbon screen mounted above the acid wash column in the elution circuit.

The flotation, thickening, concentrate regrinding and leaching circuit includes the following key equipment:

- trash screening
- rougher flotation feed conditioning tank and agitator
- rougher flotation tank cells
- flotation concentrate thickener
- regrind mill and cyclone
- flotation concentrate leach tanks and agitators
- flotation tails thickener
- flotation tails

17.3.7 Flotation Tailings Leach & Adsorption Circuit

This area is identical to the equivalent area in Phase 1 (see Section 17.2.6), with the addition of one more leach tank in series and operating at 50% w/w solids concentration, receiving the underflow from the flotation tails thickener and the discharge from the flotation concentrate CIL circuit. At the head CIL tank, instead of the carbon advance slurry reporting to the loaded carbon screen, the carbon advances to the flotation concentrate CIL circuit for further loading.

17.3.8 Cyanide Destruction

This area is identical to the equivalent area in Phase 1 (see Section 17.2.7), with the addition of one more cyanide destruction tank, one more carbon safety screen, and operating at 50% w/w solids concentration.

17.3.9 Tailings Thickening

This area is identical to the equivalent area in Phase 1 (see Section 17.2.8).

17.3.10 Carbon Acid Wash, Elution & Regeneration Circuit

This area is identical to the equivalent area in Phase 1 (see Section 17.2.9).

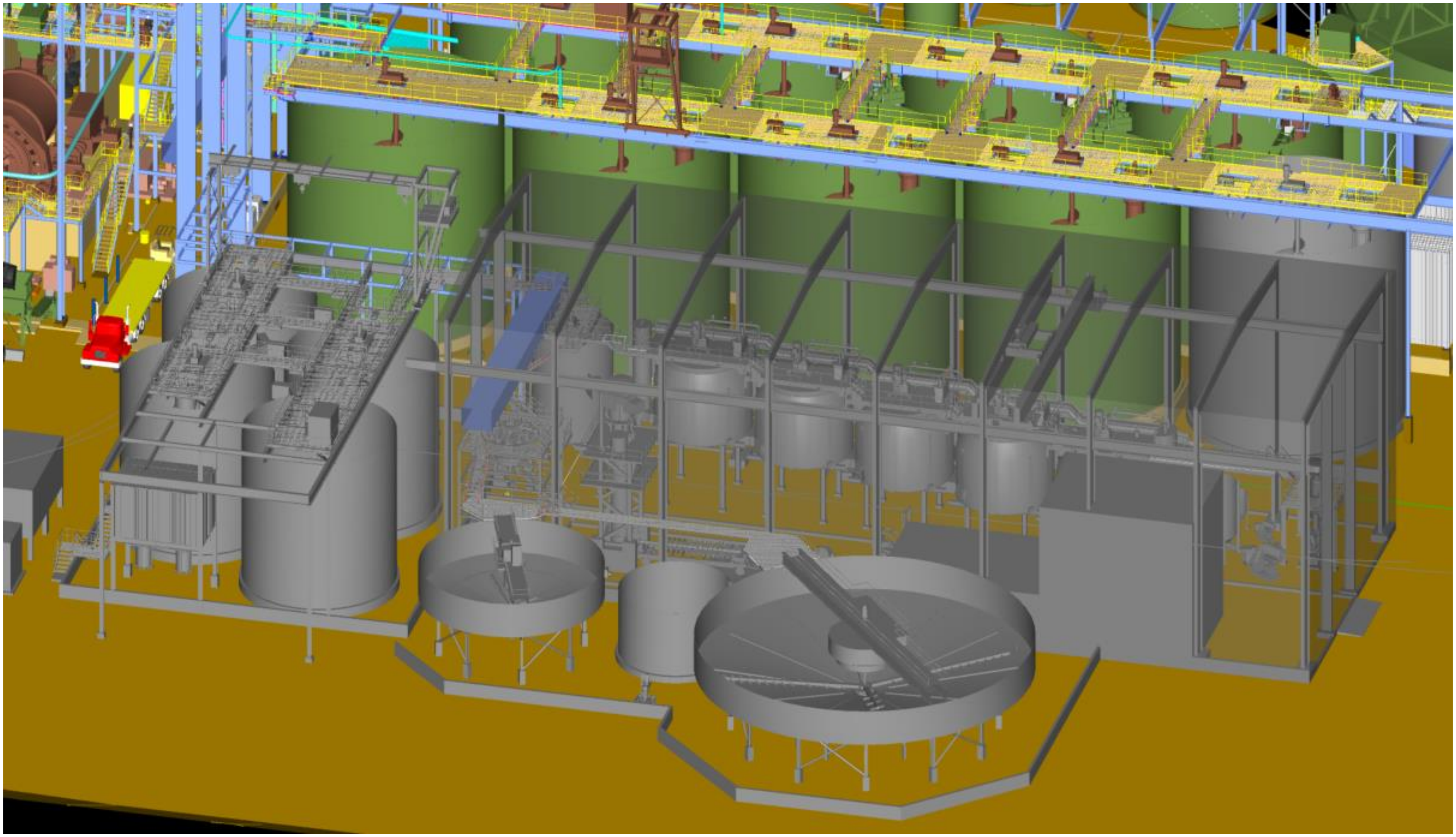
17.3.11 Electrowinning & Gold Room

This area is identical to the equivalent area in Phase 1 (see Section 17.2.10).

17.3.12 Layout Drawings

Plans and sections of the proposed plant expansions are provided in Figure 17-7.

Figure 17-7: Flotation Area Section



Source: Ausenco, 2021.

17.4 Reagent Handling & Storage

Each set of compatible reagents mixing and storage systems are located within curbed containment areas to prevent incompatible reagents from mixing. Storage tanks are equipped with level indicators, instrumentation, and alarms to ensure spills do not occur during normal operation. Appropriate ventilation, fire and safety protection, eyewash stations, and Material Safety Data Sheet (MSDS) stations are located throughout the facilities. Sumps and sump pumps are provided for spillage control.

The following reagent systems are required for the process:

- pebble lime
- hydrated lime
- sodium cyanide
- hydrochloric acid
- copper sulphate pentahydrate
- sodium metabisulphite
- sodium hydroxide
- flocculant
- activated carbon
- smelting fluxes
- frother, collector 1 and collector 2 for Phase 2
- liquid oxygen

17.4.1 Pebble Lime

Pebble lime is delivered in bulk and is pneumatically conveyed from the tanker to the pebble lime silo located in the crushing circuit adjacent to the crusher ore stockpile. Pebble lime is extracted from the lime silo and fed onto the SAG mill feed conveyor in a solid form for pH control in leaching as required.

17.4.2 Hydrated Lime

Hydrated lime is delivered in bags, which are lifted using a frame and hoist into the hydrated lime bag breaker on top of the mixing/storage tank. The solid reagent discharges into the tank and is slurried in process water to achieve the required dosing concentration. The slurried hydrated lime is pumped through a ring main with distribution points in leaching and cyanide destruction. An extraction fan is provided over the lime bag breaker/mixing tank to remove reagent dust that may be generated during reagent addition/mixing.

17.4.3 Sodium Cyanide (NaCN)

Sodium cyanide is delivered to site in secured boxes containing the reagent bags. Bags are lifted using a frame and hoist into the sodium cyanide bag breaker on top of the tank. The solid reagent discharges into the tank and is dissolved in water to achieve the required dosing concentration.

After the mixing period is complete, cyanide solution is transferred to the cyanide storage tank using a transfer pump. Sodium cyanide is delivered to the flotation concentrate leach circuit, flotation tailings leach circuit, intensive leach circuit and elution circuit with dedicated dosing pumps. An extraction fan is provided over the sodium cyanide bag breaker/mixing tank to remove reagent dust that may be generated during reagent addition/mixing.

17.4.4 Copper Sulphate

Copper sulphate pentahydrate is delivered in solid crystal form in small bags and stored in the warehouse. Process water is added to the agitated copper sulphate mixing tank. A pallet of bags is lifted using a frame and hoist, and periodically a single bag is placed on the copper sulphate bag breaker on top of the tank. The solid reagent falls into the tank and is dissolved in water to achieve the required dosing concentration.

Copper sulphate solution is transferred by gravity to the copper sulphate storage tank, which has a stacked arrangement with the mixing tank. Copper sulphate is delivered to cyanide destruction circuits using the copper sulphate dosing pump. An extraction fan is provided over the copper sulphate bag breaker/mixing tank to remove reagent dust that may be generated during reagent addition/mixing.

17.4.5 Sodium Metabisulphite (SMBS)

SMBS is delivered in the form of solid flakes in bulk bags and stored in the warehouse. Process water is added to the agitated SMBS mixing tank. Bags are lifted using a frame and hoist into the SMBS bag breaker on top of the tank. The solid reagent falls into the tank and is dissolved in water to achieve the required concentration. After the mixing period is complete, SMBS solution is transferred to the SMBS storage tank using the SMBS transfer pump. SMBS is delivered to the cyanide destruction circuit using the SMBS dosing pump. An extraction fan is provided over the SMBS mixing tank to remove SO_2 gas that may be generated during mixing. The SMBS mixing area is ventilated using the SMBS area roof fan.

17.4.6 Sodium Hydroxide (NaOH)

Sodium hydroxide (caustic soda) is delivered in intermediate bulk containers (IBCs) as a solution and stored adjacent to the elution circuit until required. During winter months, the reagent concentration may be adjusted to prevent it from freezing in the IBCs. Dosing pumps automatically deliver the reagent to the required locations—gravity concentrate leach circuit, elution circuit, electrowinning and cyanide mixing—to ensure the dosing requirements are met.

17.4.7 Hydrochloric Acid (HCl)

Hydrochloric acid is delivered in intermediate bulk containers (IBCs) as a solution and stored adjacent to the elution circuit until required. Hydrochloric acid is mixed with raw water (inline) to achieve the required 3% w/v concentration. Hydrochloric acid is delivered to the acid wash circuit using the hydrochloric acid dosing pump.

17.4.8 Flocculant

Powdered flocculant is delivered to site in bulk bags and stored in the warehouse. A self-contained mixing and dosing system is installed, including a flocculant storage hopper, flocculant blower, flocculant wetting head, flocculant mixing tank, and flocculant transfer pump. Powdered flocculant is loaded into the flocculant storage hopper using the flocculant hoist. Dry flocculant is pneumatically transferred into the wetting head, where it is contacted with water.

Flocculant solution, at 0.50% w/v, is agitated in the flocculant mixing tank for a pre-set period. After a pre-set time, the flocculant is transferred to the flocculant storage tank using the flocculant transfer pump. Flocculant is dosed to the various high-rate thickeners using variable speed helical rotor style pumps. Flocculant is further diluted just prior to the addition point.

17.4.9 Frother (MIBC)

MIBC is delivered as a liquid in IBCs and stored in the warehouse until required. A permanent bulk box is installed to provide storage capacity local to the flotation area. MIBC is used as-received and without dilution. Diaphragm-style dosing pumps deliver the reagent to the required locations within the flotation circuit. A top-up of the permanent bulk boxes is carried out manually as required.

17.4.10 Collector 1 (PAX)

PAX is delivered in granular powder form in bags and stored in the warehouse. Raw water is added to the agitated PAX mixing tank. Bags are lifted using a frame and hoist into the PAX bag breaker on top of the tank. The solid reagent falls into the tank and is dissolved in water to achieve the required dosing concentration. PAX solution is transferred by gravity to the PAX storage tank, which has a stacked arrangement with the mixing tank.

The mixing tank is ventilated using the PAX tank fan to remove any carbon disulphide gas. PAX is delivered to the flotation circuit using the PAX dosing pump. Actuated control valves provide the required PAX flowrates at a number of locations around the flotation circuit.

17.4.11 Collector 2 (R208)

R208 is delivered as a liquid in IBCs and stored in the warehouse. It is used as-received and without dilution. Diaphragm-style dosing pumps deliver the reagent to the required locations within the flotation circuit. A top-up of the permanent bulk boxes is carried out manually as required.

17.4.12 Activated Carbon

Activated carbon is delivered in solid granular form in bulk bags. When required, the fresh carbon is introduced to the carbon quench tank, or directly to the final CIL tank.

17.4.13 Anti-Scalant

Anti-scalant is delivered as a solution in IBCs and stored in the warehouse until required. Anti-scalant is dosed neat, without dilution. Positive displacement-style dosing pumps deliver the anti-scalant to the strip solution tank as needed.

17.4.14 Oxygen

Oxygen is injected into the Phase 1 leach tanks to achieve a dissolved oxygen level of >20 ppm. For this purpose, oxygen is produced in a vacuum swing adsorption (VSA) plant at site to meet requirements of both Phase 1 and Phase 2 consumptions.

17.4.15 Gold Room Smelting Fluxes

Borax, silica sand, sodium nitrate, and soda ash are delivered as solid crystals/pellets in bags or plastic containers and stored in the warehouse until required.

17.5 Services & Utilities

17.5.1 Process / Instrument Air

High-pressure air at 700 kPag is produced by compressors to meet plant requirements. The high-pressure air supply is dried and used to satisfy both plant air and instrument air demand. Dried air is distributed via the air receivers located throughout the plant.

17.5.2 Low-Pressure Air

Compressed air is injected into the Phase 2 flotation concentrate and flotation tails leach tanks to achieve a dissolved oxygen of >8 ppm. Low-pressure air for flotation is supplied by air blowers.

17.6 Water Supply

17.6.1 Raw Water Supply System

Raw water is supplied to a raw water storage tank. Raw water is used for all purposes requiring clean water with low dissolved solids and low salt content, primarily as follows:

- gland water for pumps
- reagent make-up
- elution circuit make-up
- raw water is treated and stored in the potable water storage tank for use in safety showers and other similar applications
- fire water for use in the sprinkler and hydrant system
- cooling water for mill motors and mill lubrication systems (closed loop)

17.6.2 Process Water Supply System

Overflow from the final tailings' thickener and TMF decant water meet the main process water requirements for Phase 1. Raw water provides any additional make-up water requirements.

For Phase 2, flotation concentrate, and flotation tails thickener overflow feed a non-cyanide contact process water tank that is recycled to the grinding circuit to ensure the flotation performance is not impacted by recycling cyanide.

17.6.3 Gland Water

One dedicated gland water pump is fed from the fresh water tank to supply gland water to all slurry pump applications in the plant.

17.7 Reagent & Consumable Requirements

Reagent consumptions are based on testwork results or standard industry practices. A summary of the estimated reagent and consumable rates is shown in Table 17.3.

Table 17.3: Estimated Reagent Consumptions

Reagent	Form	Unit	Phase 1 Consumption	Phase 2 Consumption
Activated Carbon	Coconut shell, grade 6 x 12 mesh	g/t feed	40	25
Collector 1 (PAX)	Pellets, 90% minimum purity	kg/t feed	NR	0.04
Collector 2 (R208)	Liquid, 97.5% minimum purity	kg/t feed	NR	0.02
Copper Sulphate	Blue crystal, pentahydrate, 99.5% minimum purity	kg/t feed	0.14	0.10
Flocculant	Powder, 97.5% minimum purity	kg/t feed	0.03	0.05
Frother	Liquid, 97.5% minimum purity	kg/t feed	NR	0.038
Hydrochloric Acid	Liquid, 33% w/w	m^3/strip	1.2	1.2
Pebble Lime	Granules, 90% minimum available CaO	kg/t feed	1.71	0.13
Hydrated Lime	Powder, 90% minimum available CaO	kg/t feed	1.12	0.82
Sodium Cyanide	Powder, 98% minimum purity	kg/t feed	0.63	0.78
Sodium Hydroxide	Liquid, 50% w/w	kg/t feed	0.15	0.09
SMBS	Powder, 97.5% minimum purity	kg/t feed	1.03	0.95
Oxygen	Produced in situ	kg/t feed	0.87	0.86
Anti-scalant	Liquid	kg/t feed	0.015	0.011
Sulphamic Acid	Powder	g/t feed	5.0	3.1
Borax	Powder	kg/100 kg concentrate	60	60
Silica	Powder	kg/100 kg concentrate	30	30
Sodium Nitrate	Powder	kg/100 kg concentrate	5	5
Sodium Carbonate	Powder	kg/100 kg concentrate	5	5
SAG Mill Media	125 mm balls	kg/t feed	0.74	0.58
Ball Mill Media	50-75 mm balls	kg/t feed	0.87	0.57
Regrind Media	6 mm beads	kg/t feed	NR	0.01

Reagents will require storage capacity on site for sufficient inventory to be held to mitigate the risk of process disruptions. In Table 17.4, the projected lead time of reagents and consumables has been listed upon receiving feedback from key suppliers during the feasibility study phase.

Table 17.4: Reagent Order Expected Lead Time

Reagent	Maximum Expected Lead Time (weeks)
Activated Carbon	14
Anti-scalant	2
Ball Mill Media (2-3 inches)	2
Borax	3
Collector 1 (PAX)	14
Collector 2 (R208)	5
Copper Sulphate	10
Flocculant	2
Frother	5
HCl	3
Hydrated Lime	3
NaCN	3
NaOH	3
Nitre	3
Pebble Lime	2
Regrind Mill Media (6 mm)	14
SAG Mill Media (5 inches)	2
Silica	2
SMBS	10
Sodium Carbonate	3
Sulphamic Acid	3

Recommended operational inventory and facility sizing guidelines were calculated per the lead time projections and mill consumption (see Table 17.5). Area requirements include space for movement of personnel and equipment.

Operational requirements necessitate a storage warehouse of approximately 28.7 m x 28.7 m of climate-controlled space, and 4.8 m x 4.8 m of non-climate-controlled space. Bulk bags and totes will be stacked two units high; small bags will be stacked four units high. Frother and Collector 1 (PAX) are considered to have separate dedicated storage space.

Table 17.5: Reagent Operational Inventory Recommendations

Reagent	Bulk Unit Type / Stacking Configuration	Recommended Inventory (t)	Bulk Units	Area Required (m^2)
Indoor (Climate Controlled)				
NaCN	1 tonne bag / 2 unit stacking	492	492	367
Hydrated Lime	1 tonne bag / 2 unit stacking	131	131	98
Copper Sulphate	25 kg bag / 4 unit stacking	275	275	103
SMBS	1 tonne bag / 2 unit stacking	264	264	197
Flocculant	1 m^3 / 2 unit stacking	8	8	6.0
NaOH	1 m^3 / 2 unit stacking	24	24	18
Collector 2 (R208)	1 m^3 / 2 unit stacking	11	11	8.2
Anti-scalant	1 m^3 / 2 unit stacking	2	2	1.0
Borax	25 kg bag / 4 unit stacking	1	40	5.0
Nitre	25 kg bag / 4 unit stacking	1	40	5.0
Sodium Carbonate	25 kg bag / 4 unit stacking	1	40	5.0
Silica	25 kg bag / 4 unit stacking	1	40	5.0
Sulphamic Acid	25 kg bag / 4 unit stacking	1	40	5.0
Total Area			**823 (28.7m x 28.7m)**	
Indoor (Non-Climate Controlled)				
HCl	1 m^3 IBC / 2 unit stacking	16	16	12
Activated Carbon	500kg bag / 2 unit stacking	2	4	3.0
Total Area			**25 (4.8m x 4.8m)**	
Outdoor				
SAG Mill Media (5 inch)	Truck	30	-	5.2
Ball Mill Media (2-3 inch)	Truck	50	-	7.3
Regrind Mill Media (6 mm)	Truck	23		4.3
Total Area				**16.8**
Dedicated Frother Storage (Phase 2 only, Climate Controlled)				
Frother	1 m^3 IBC / 2 unit stacking	22	22	11
Dedicated Collector 1 (PAX) Storage (Phase 2 only, Climate Controlled)				
Collector 1 (PAX)	1 tonne bag / 2 unit stacking	24	24	18

18 Project Infrastructure

18.1 Overall Site

The overall site plan (see Figure 18-1) shows the major project facilities, including the open pit mines, tailings management facility (TMF), waste rock facilities, polishing pond, mine services, access road, accommodations camp, and effluent treatment plant. Access to the facility is from the northeast side of the property from the existing public access road. Process plant access will be via the security gate at the public road intersection.

The site will not be fenced due to local legislation, which requires open access to all waterbodies in the area. However, there will be gatehouses to clearly delineate the mining and processing areas to deter access by unauthorised people. The process plant is located south of Valentine Lake, between the Marathon and Leprechaun deposits, largely dictated by the location of the TMF, in a position that avoids the impact to the natural waterbodies.

Site selection and location took into consideration the following factors:

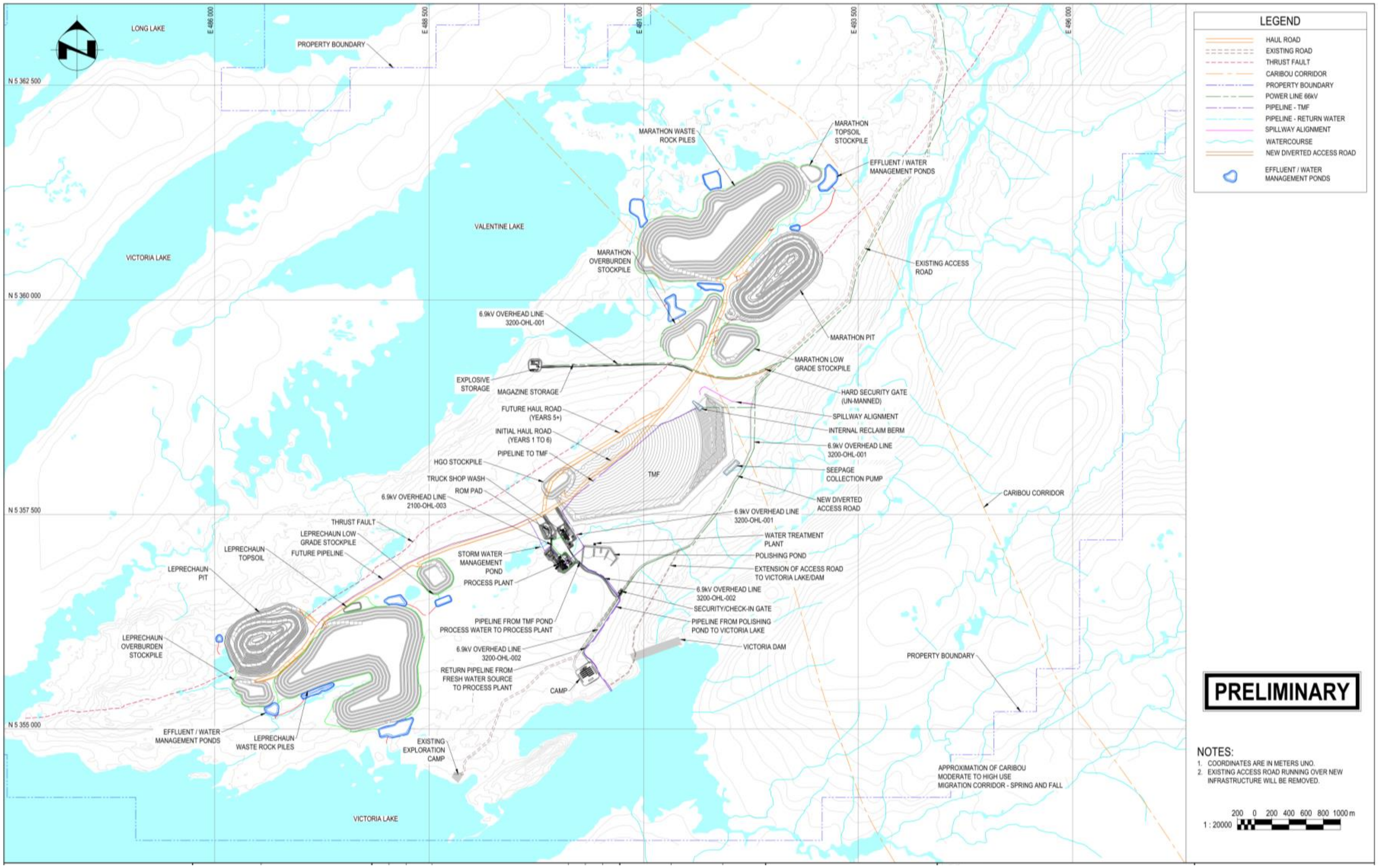
- locate the ROM pad between the two open pits, to minimise haul distance
- ensure the location of the process plant and mining truck area are outside the flyrock exclusion zone from the Berry Zone resource
- utilise the natural high ground for the ROM pad as much as possible
- separate heavy mine vehicle traffic from non-mining, light-vehicle traffic
- locate the process plant in an area safe from flooding
- locate the heavy equipment foundation on competent bedrock and utilise rock anchors for foundations design
- place mining, administration and processing plant staff offices close together to limit walking distances between them
- locate the ready line close to the mining admin/office area and changehouse
- avoid known fish habitation areas

18.2 Process Plant Pad & Stormwater Management

The process plant site and stormwater design approach is aimed at intercepting and diverting non-contact water outside of process plant area to reduce the amount of contact water to be managed at the process plant site. The process plant site pad will be graded to allow surface runoff water to drain naturally to the internal network of collection swells and ditches that are sized to handle peak flow resulting from the 1:25-year rainfall storm event. The collection ditches will convey the water to a 6,000 m^3 live capacity stormwater pond.

The storm pond is sized based on 1:25-year storm event and overflow slipway designed for a 1:50-year storm event. The pond design considered minimum pond depth for operational purposes, maximum pond depth based on maximum operating volume, maximum storage required in combination with a discharge pumping rate, and retention time to promote settling of solids. The water in the storm management pond water will be released to the environment by gravity via perforated riser after required retention time is achieved.

Figure 18-1: Overall Site Plan



Source: Ausenco, 2021.

18.3 Roads

18.3.1 Access to Site

The access to the process plant site, camp site and explosive storage area are through new 0.86 km, 0.21 km, and 0.30 km gravel roads, respectively. The access roads connect these facilities to an existing 84 km public gravel road which will be upgraded. The road upgrade includes re-surfacing gravel pavement, improving surface drainage, and installing new culverts at stream crossings.

Granular fill material for road base and sub-base construction and upgrade will be sourced from permitted borrow pits along the route and established quarries. The public road upgrade will also include replacing existing wooden bridges and rehabilitating/repairing the existing steel bridges. The construction of the new TMF dam will overprint approximately 2.2 km of existing road on the site property. A new 3.1 km detour road will be constructed to replace that section of road.

18.3.2 Plant Site Roads

The roads within the process plant area will be generally 6 m wide, integrated with process plant pad earthworks, and designed with adequate drainage. The roads will allow access between the administration building, warehouses, mill building, crushing buildings, stockpile, mining truck shop, and top of ROM Pad.

18.4 Power Supply

18.4.1 Electrical Power Source

Newfoundland-Labrador Hydro (NL Hydro) will supply power to the Valentine Gold Project as per conditions outlined in a Power Supply Agreement with Marathon Gold. The system supply point will be the Star Lake Terminal Station which is located approximately 20 km to the northwest of the Valentine Gold Project.

To facilitate the connection, the following infrastructure will be required:

- Upgrade of the existing Star Lake Terminal Station to support the addition of electrical, protection and control, and communications equipment required to provide power to the Valentine Terminal Station; communications equipment will also be installed at NL Hydro’s Buchans Terminal Station and at Valentine Terminal Station for remote monitoring and protection.
- Construction of a 40 km 69 kV wood pole transmission line (TL 271) from Star Lake Terminal Station to Valentine Terminal Station.

The Valentine Gold Project has the following load (maximum demand) requirements:

- Phase 1: Initial start-up requirement between 2023 and 2027 – 17 MW
- Phase 2: Full load requirement in 2028 to end of life – 20 MW

As agreed with Marathon Gold, NL Hydro will develop, own, and operate the Star Lake Terminal Station extension and TL 271. Marathon Gold will develop, own, and operate the Valentine Terminal Station with consideration for NL Hydro standards and operating procedures to ensure safety and reliability. The project will be subject to approvals under the provincial *Environmental Assessment*

Act and the Public Utilities Board. Expected completion is tentatively planned for February 3, 2023 with first power available to meet Marathon's requirement of March 31, 2023, assuming there is no delay experienced with the Environmental Assessment.

18.4.2 Electrical Distribution

The plant electrical system is based on 6.9 kV distribution. The 66 kV feed from NL Hydro will be stepped down to 6.9 kV at the Valentine Lake Terminal Substation and will supply the plant main 6.9 kV switchgear housed in the main process plant electrical room.

The larger variable frequency drives (VFDs) will have 6.9 kV input, fed by plant main 6.9 kV switchgear. Separate 6.9 kV / 600 V distribution transformers at the various electrical rooms will be fed from the plant main 6.9 kV switchgear. Electrical rooms will be provided at the following locations:

- process plant main
- primary crusher area
- stockpile and reclaim
- grinding areas
- gold room / leaching / reagents
- flotation areas

The main process plant electrical room will house the 6.9 kV switchgear. The other electrical rooms will consist of 6.9 kV / 600 V transformers close coupled to the 600 V motor control centres (MCCs), LV VFDs, LV soft starters, plant control system cabinets, lighting and services transformers, distribution boards, and uninterrupted power supply (UPS) power distribution.

To reduce installation time, the electrical rooms were considered prefabricated modular buildings, installed on structural framework 2 m above ground level for bottom entry of cables. The electrical rooms will be installed with HVAC units and suitably sealed to prevent ingress of dust. They will be in the process plant area and as close as possible to the main load points to minimise costs.

18.4.3 Power Reticulation

Overhead power lines of 6.9 kV will provide power to various remote facilities. Pole-mounted or pad-mounted transformers will step down the voltage at each location and supply the low voltage distribution system to respective facilities.

18.4.4 Star Lake Substation

The tie in of 66 KV overhead line to NL Hydro's equipment at Star Lake Terminal Station will be required to be carried out.

18.4.5 66 kV Overhead Line

A 66 KV overhead line using monopole structures is proposed to be installed between NL Hydro's Star Lake Terminal Station up to Marathon Gold's Valentine Lake Terminal Station.

18.4.6 Valentine Substation

The main terminal substation (Valentine Lake) is located near the process plant. This terminal substation will be with 100% redundancy in transformer capacity. Two 20/26.7 MVA oil-filled with forced air-cooled type substation transformers are proposed to be installed to carry the maximum power required by the site.

This includes future growth and redundancy in the event a single transformer is temporarily out of service. This terminal substation will also include wave trap for the power line communication between Star Lake and Valentine lake substations.

18.4.7 Standby / Emergency Power Supply

Three standby diesel generators in weatherproof enclosures will be provided to supply critical process loads and life safety systems. Each standby diesel generator is located close to the MCCs feeding the critical loads. The generators have been sized based on the assumption that in case of power failure, the power to the tank agitators and rougher flotation cells will be toggled between each of the agitators (i.e., keep two running for 10 minutes and cycle through each).

18.4.8 SAG & Ball Mill Drives

The SAG and ball mills are the largest electrical loads in the plant. Both motors are squirrel cage induction motors, with single VFD and bypass switchgear arrangement to minimise voltage drop impact on the utility supply system during motor start-up. The VFD will be used to start the ball mill and once the ball mill is running on fixed speed, the same VFD will be used to run the SAG mill at variable speed.

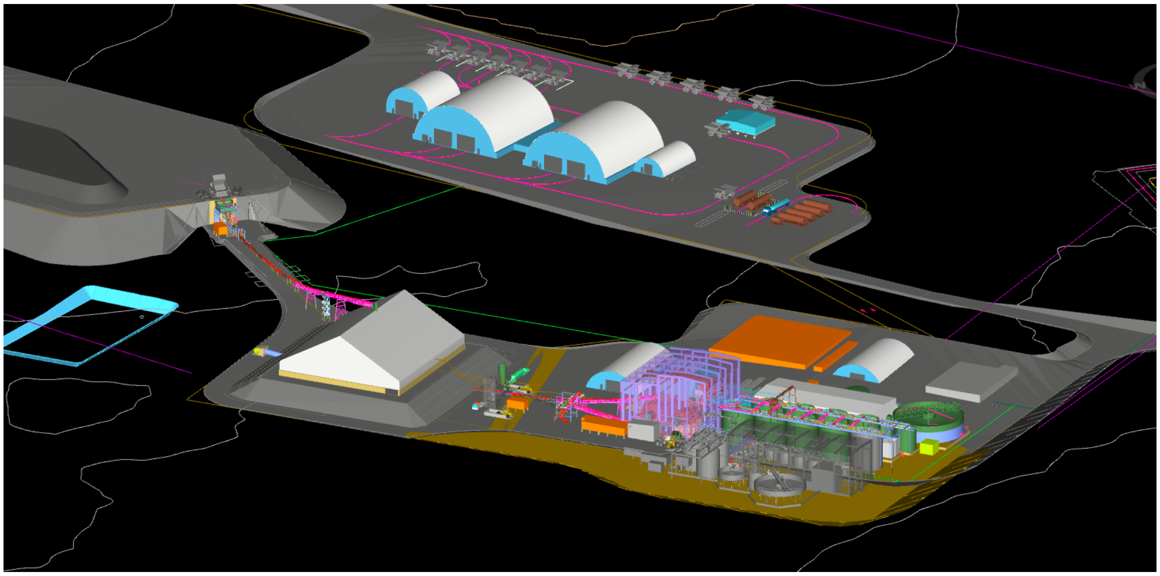
18.4.9 Construction Power

Initial power for construction will be provided by diesel generators, as is the current approach for the exploration camp at the Valentine site.

18.5 Support Buildings

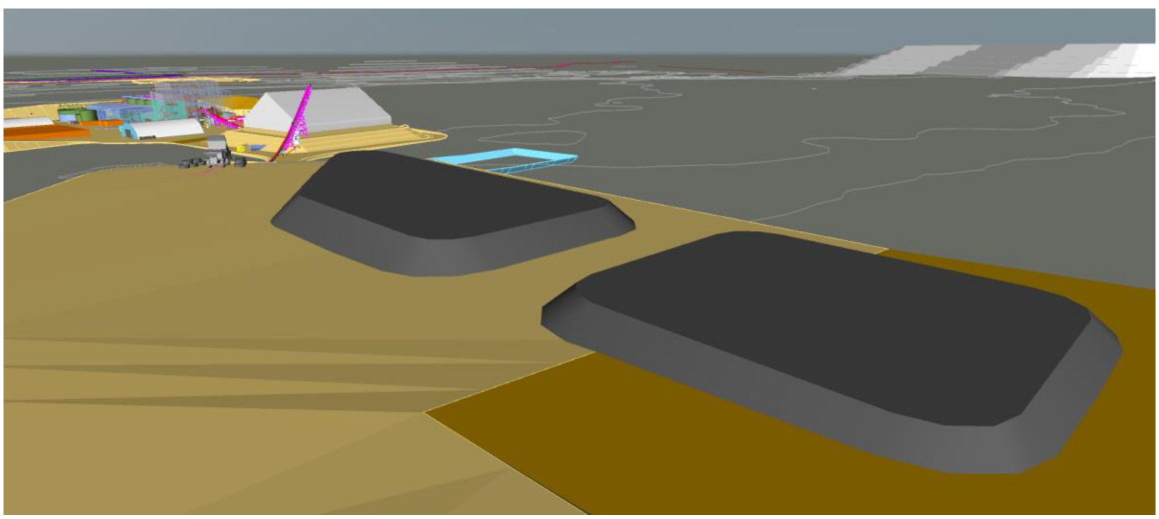
Figure 18-2 shows a 3D model image of the process plant and process infrastructure for Phase 1, with the Phase 2 expansion represented in grey. A 3D model of the ROM pad is illustrated in Figure 18-3.

Figure 18-2: Process Plant & Process Infrastructure – Phase 1



Source: Ausenco, 2021.

Figure 18-3: ROM Pad



Source: Ausenco, 2021.

18.5.1 Process Plant Building

The process plant consists of three main process buildings located southeast of the primary crusher building and east of the coarse ore storage stockpile/reclaim: the mill building (grinding/elution, gold room, gravity), reagent building, and flotation/regrind building (Phase 2 only). All buildings will be supported on reinforced concrete footings with concrete slabs and pedestals.

The mill building will be a 46 m (long) x 40 m (wide) pre-engineered steel building with a ground floor and multiple equipment access platforms. The building will house the SAG mill, ball mill, cyclone feed hopper/pumps, cyclones, trash screen, and liner handler, and will have dedicated areas for the acid wash column, elution column and regeneration equipment. The process equipment will be serviced by a 40-tonne overhead crane. The gravity circuit will be adjacent to the SAG mill area and the gold room in the same pre-engineered metal building as the SAG mill, but with a partition wall. The gold room will be a lean-to attached to the mill building separated by a partition wall for security. The gold room will house the electrowinning cells, sludge hopper/filter, drying oven, furnace, vault and security room, complete with a monorail.

The reagent building will be a 54 m (long) x 24 m (wide) fabric building, complete with a five-tonne bridge crane, that will house the reagent mixing tanks, reagents totes including cyanide, activated carbon, copper sulphate, flocculants, anti-scalant, and SMBS, in addition to the tailings pumping hopper and pumps. Outdoor storage adjacent to the reagent storage area is reserved for additional storage as required.

All pre-engineered and fabric buildings will be fully enclosed with metal cladding and fabric cover respectively, complete with fiberglass blanket insulation.

18.5.2 External Process Areas

The design includes some process areas that will not be inside building infrastructures.

The primary crushing area will be located northwest of the process plant. The equipment in this area includes the vibrating grizzly feeder, primary jaw crusher, chutes and platework. It will compose a modular open structure (no cladding) crushing system package along with the stockpile and mill feed conveyors.

The primary crusher module will be located on the ground complete with equipment platforms. The process equipment will be serviced by mobile cranes as required. The primary crusher will be supported on reinforced concrete raft slab. The stockpile will be covered by a fabric building.

In Phase 2, the flotation/regrind area will be added, with a 57 m (long) x 22 m (wide) area, complete with a 10-tonne bridge crane, and will house five 130 m^3 flotation tank cells, including tank platforms and flotation reagents. This area will also house the regrind mill, and its associated cyclone cluster and pumps. The concentrate and tailings thickeners will be located outside, adjacent to the building.

18.5.3 Truck Shop / Truck Wash / Storage

The truck shop building at the site will be a 44 m (wide) x 40 m (long) fabric building located north of the ROM pad. The building each equipped with four bays, will be used to maintain haul trucks and highway trucks, and for spare parts storage. The haul truck maintenance bays will be serviced mobile crane. The building will be supported on a reinforced Seacan containers.

The truck shop offices, lunchroom and washrooms will be inside one prefabricated, modular building located immediately east of the truck shop. Additional storage will be available inside shipping containers placed adjacent to the truck shop.

The truck wash building at the site will be a 25 m (wide) x 18 m (long) fabric building also located north of the ROM pad, and east of the truck shop. The building will be used for washing haul trucks, and will be supported on a concrete foundation.

The truck shop storage warehouse will be an 18 m wide x 24 m long fabric building with a gravel floor supported on concrete foundations.

18.5.4 Plant Maintenance Shops & Storage Buildings

The plant maintenance shops / storage area will be a fabric building 18 m wide x 30 m long. The shop area will be separated with interior partition wall.

The reagent storage area will be a fabric building 18 m wide x 24 m long.

18.5.5 Explosives Storage & Handling

A 6 m wide access road and 150 m x 150 m pad will be constructed to deliver and store explosives required for mine operations. A design buffer of 1.1 km to all other site facilities and operations is assumed. The pad area will be gated and contain bulk storage facilities, a garage for mobile equipment, and trailers for personnel. A separate 30 m x 20 m pad will be constructed along the access road to store the explosive magazine. Explosives and accessories will be prepared and transported to the mine pits as needed.

18.5.6 Fuel Station

The fuel station will consist of a 50 m (long) x 70 m (wide) open-air area including truck manoeuvring space. There will be a central area, with reinforced concrete containment. The fuel station will be located adjacent to the truck shop. The fuel station will service the on-site mine equipment and mobile fleet.

Diesel fuel storage and supply will be provided by a fuel supplier and will include a total volume of 450 m^3 of fuel storage, offloading pumps, dispensing pumps, associated piping and electronic fuel control/tracking.

18.5.7 Plant Administration Building / Mill Muster Building

The administration office will be an 18 m (wide) x 26 m (long), single-storey building located south of the process plant. The building will include offices, meeting rooms, a lunchroom, and washrooms. The buildings will be of prefabricated modular construction, placed on precast concrete block footings.

Muster building will be a 7 (wide) x 18 m (long), single-storey building located south of the process plant. The building will include offices, meeting rooms, a lunchroom, and washrooms. The buildings will be of prefabricated modular construction placed on precast concrete block footings.

18.5.8 Laboratory

The laboratory will be an assortment of prefabricated, single-storey, modular buildings on precast concrete blocks, totalling 260 m^2 of area, and housing the equipment for typical mine and plant assays.

18.5.9 Security Gate

The security gatehouse will have one boom gate for vehicle access and another for personnel. There will be a shack where the gate security personnel will be allocated, with a section where induction training can be performed for visitors and new employees, as well as first aid, which will also be the parking location for the ambulance.

18.6 Site-wide Investigations

18.6.1 Overview

Marathon Gold retained GEMTEC Consulting Engineers and Scientists Limited (GEMTEC) to conduct a site-wide geotechnical and hydrogeological field investigation and prepare a factual and interpretive report. GEMTEC carried out the field program from September 4 to October 30, 2020. Following the field program, GEMTEC submitted the findings and its recommendations in a project report (GEMTEC, 2020). Prior to the submittal of its report, GEMTEC also issued preliminary geotechnical design parameters and recommendations in three (3) technical design memos and one (1) follow up clarification email correspondence.

GEMTEC's 2020 feasibility study site-wide investigation included the excavation of test pits, drilling of geotechnical boreholes, geotechnical logging, soil and bedrock geotechnical testing/analysis, installation of monitoring wells, in-situ hydraulic conductivity testing of soil and bedrock (packer testing and slug testing), groundwater quality sampling, and outcrop mapping in the following mine site infrastructure areas (site areas):

- Marathon area – including the waste rock pile, overburden stockpile, low-grade ore stockpile, topsoil stockpile, and the Marathon pit
- TMF area – including the embankment, basin, and polishing pond
- high-grade ore stockpile
- plant site
- Leprechaun area – including the waste rock pile, the overburden stockpile, the Marathon low-grade ore stockpile, and the Leprechaun pit
- camp pad
- explosives pad
- roads including haul roads and site access roads

The following sections summarise the key findings and recommendations from GEMTEC's feasibility-level 2020 site-wide geotechnical/hydrogeological investigation report.

18.6.2 Geotechnical

Based on the subsurface investigation carried out across the site as part of the 2020 feasibility study investigation, the site was found to consist of a surficial layer of organic material (rootmat, topsoil, and/or varying thicknesses of peat), overlying till, overlying bedrock. This is in general agreement with the subsurface conditions observed during the GEMTEC's 2019 pre-feasibility study geotechnical program.

The characteristics of the bedrock encountered in each site development area are summarised as follows:

- Marathon Areas – Fair quality weak to strong mafic dyke (waste rock pile), fair quality weak to strong felsic porphyry (pit/overburden stockpile), fair to good quality weak to strong conglomerate (pit/low-grade ore stockpile) and fair to good quality weak to very strong gabbro (waste rock pile).
- TMF Area – Good quality strong to very strong sandstone, good quality medium strong to strong siltstone, fair quality, weak to strong mudstone, fair quality very strong mafic dyke, good quality very strong felsic porphyry and poor to fair quality weak phyllite.

- High-Grade Ore Stockpile Area – Fair quality weak conglomerate.
- Plant Site Area – Fair to good quality, weak to very strong mudstone/sandstone.
- Leprechaun Areas – Fair to good quality strong to very strong mafic dyke (low-grade ore stockpile/waste rock pile), fair quality, weak to very strong conglomerate and poor to fair quality weak phyllite (waste rock pile/overburden stockpile).

Structural measurements of the main foliation (S1) collected from outcrops showed the orientation of the strike ranging from 240° to 255° and the dip ranging from 65° to 85°.

The mean freezing index for Buchans, NL, about 80 km north of the site, according to published Canadian Climate Normal values, is 890°C-days, recorded from 1981 to 2010. The estimated frost penetration depth for the site is 1.8 m below finished ground surface elevations using a design freezing index of 1,250°C-days.

According to Table 4.1.8.4.-A of the National Building Code of Canada (NBCC, 2015) Site Class C can be used for an average Standard Penetration Resistance value of N60 >50 within the upper 30 m provided that there is no more than 3 m of overburden soil between the underside of the footings and the bedrock. In cases where there will be more than 3 m of overburden soil between the underside of the footings and the bedrock, Site Class D should be used.

The potential for soil liquefaction during a significant earthquake is considered to be negligible at this site.

Concrete in contact with the native soil or groundwater could be batched with general use (GU) Portland cement.

Waste rock piles and overburden and ore stockpiles can be constructed at a maximum overall permanent slope angle of 2.5H:1V and topsoil stockpiles can be constructed at a maximum overall permanent slope angle of 4H:1V to a maximum total height of 20 m minimum. This is to achieve stability factors of safety of 1.5 under static conditions and 1.0 under pseudo-static (seismic) loading conditions.

Per GEMTEC's recommendations, the design of concrete pad footings in the plant site area will proceed with complete removal of organic layer of soil. The undisturbed in-situ glacial till over-burden layer can provide a maximum of 200 kPa serviceability limit state bearing reaction and a factored Ultimate limit state bearing resistance of 300 kPa. These bearing are values are deemed to be sufficient to support most shallow foundations proposed within the plant site including the raft foundation, slab-on-grade (SOG), and pad footings.

18.6.3 Hydrogeology

The findings of the hydrogeological field investigation for each site area are detailed in GEMTEC (2020). Overall, groundwater levels in the project area are shallow, ranging from 2.7 metres below ground surface (mbgs) to -0.57 mbgs (artesian). Shallow groundwater flow follows topography and the direction of surface runoff at horizontal hydraulic gradients ranging from 1% (0.01 m/m) in the northern portion of the Plant Site to 7% (0.07 m/m) in the area of the Marathon overburden stockpile and low-grade ore stockpile. Estimated vertical hydraulic gradients determined using paired well systems in the TMF, Plant Site, and Marathon and Leprechaun waste rock pile areas indicate slight vertical gradients ranging from less than 1% (< 0.01 m/m) in the Marathon waste rock pile and TMF areas to 3% (0.03 m/m) in the Plant Site and Leprechaun waste rock pile areas; both downwards and upwards components of flow are identified.

Estimates of hydraulic conductivity for the soil (till) range from 3.31E-07 m/s in the TMF to 4.58E-04 m/s in the plant site, with an overall geometric mean of 6.44E-06 m/s for the project site. The hydraulic conductivity of shallow bedrock (down to the tested depth of about 30 m) ranged from 1.68E-07 m/s in the TMF to 9.91E-05 m/s in the Marathon pit area, with an overall geometric mean of 4.02E-06 m/s for the project site. These estimates of soil and bedrock hydraulic conductivity are in close agreement with values determined during previous investigations at the project site, and are within the typical range of literature values for similar soil and bedrock types. The results of the 2020 feasibility study investigation indicate soil and bedrock down to a tested depth of approximately 30 m have a moderately low permeability and show no significant trends in hydraulic conductivity based on lithology or depth.

The groundwater table is shallow at the site, and some dewatering will be required for service trenches and excavations. The anticipated rate of groundwater inflow into excavations is expected to be moderate and should be able to be handled by typical sump pump systems and drainage ditches, depending on the actual depth and location of the excavation work. Groundwater is classified as either calcium-bicarbonate or sodium bicarbonate water, with a principally meteoric signature and no significant inorganic water quality environmental issues.

The groundwater collected from the 10 monitoring wells were analysed for subsurface corrosion potential to support concrete mix design requirements. The results of the analysis are presented in Table 18.1.

Table 18.1: Laboratory Analysis Results – Corrosion Potential

Site Area	Test Hole ID	pH	Chloride mg/L	Sulphate mg/L	Resistivity (Ohm.cm)
Marathon Waste Rock Pile	20BH-15B	6.96	2	<2	3290
	20BH-16	7.86	3	8	3720
Marathon Pit	20BH-20	7.72	2	3	5380
TMF	20BH-26B	7.82	3	3	3290
	20BH-28	7.86	2	3	3890
Plant Site	20BH-01	7.06	2	<2	5680
	20BH-05B	7.37	2	3	6250
	20BH-09	6.96	2	4	12700
Leprechaun Waste Rock Pile	20BH-35B	7.37	2	<2	4180
	20BH-36	7.39	2	12	6540

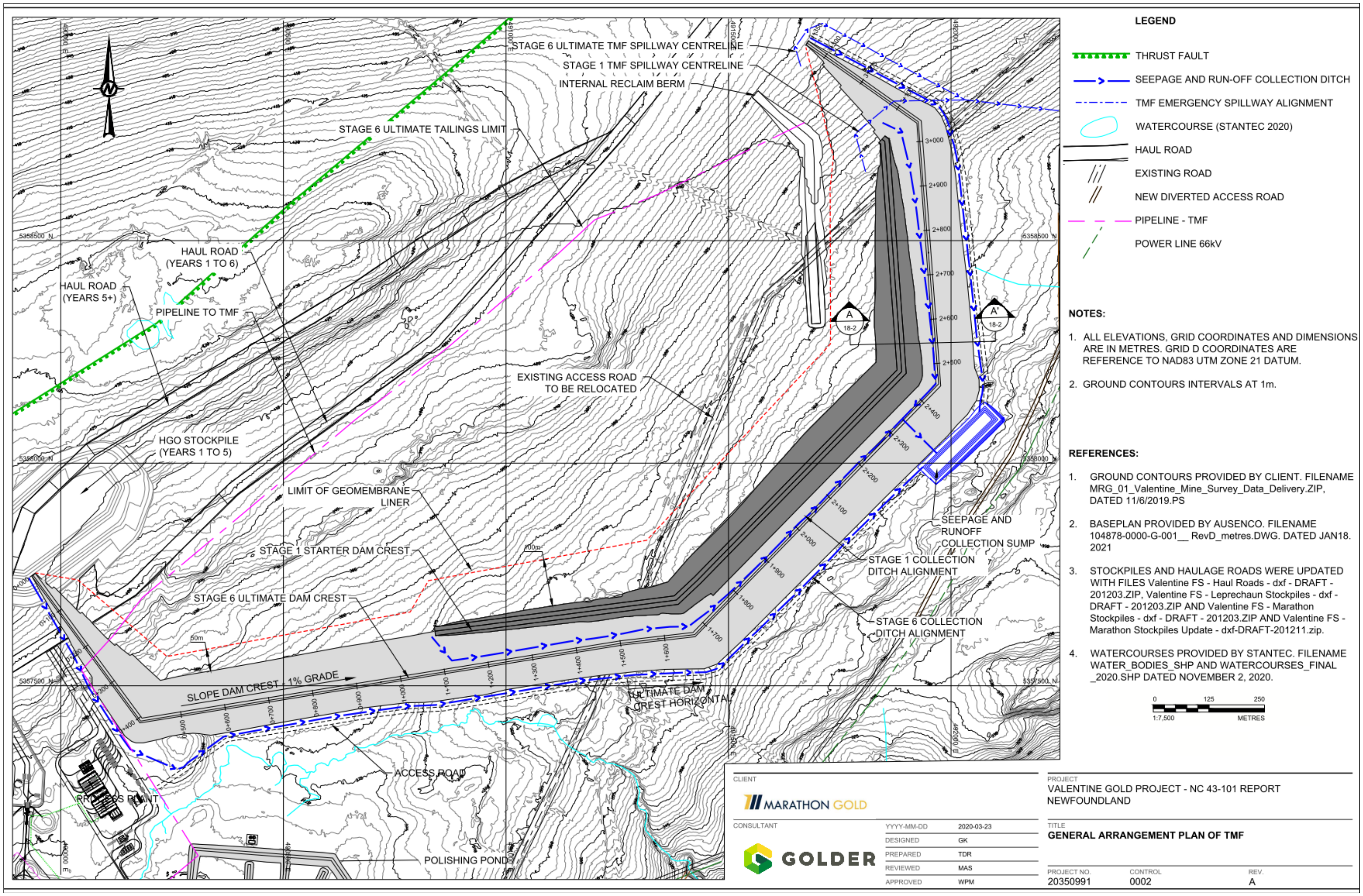
Source: GEMTEC, 2021.

18.7 Tailings Management Facility

18.7.1 Background

The design of the TMF was developed to a preliminary level as part of the April 2020 Pre-feasibility Study. The feasibility design has built upon the same TMF location selected as part of a site selection options analysis carried out during the pre-feasibility study. The site was selected based on consideration for a balance of environmental, social, economic and operational parameters. The alignment of the TMF was optimised for this study with the dam alignment adjusted to ensure the footprint avoids known fish habitat. The general arrangement of the TMF, as represented in its ultimate configuration, is shown on Figure 18-4.

Figure 18-4: Tailings Management Facility – General Arrangement



Source: Golder, 2021.

The TMF is formed by constructing perimeter zoned rockfill embankment dams, which are raised in stages. The waste rockfill is sourced from Leprechaun and Marathon open pits. The upstream face of the dam is lined with geomembrane which is anchored into relatively low permeability foundation soils. As an added level of robustness in the design, the geomembrane liner also extends upstream of the dam toe to protect the dam against piping of fine foundation soils into the rockfill due to seepage forces.

Thickened tailings slurry has been adopted for the project. This dewatering technology provides opportunity for a denser, more stable, non-segregated mass when deposited. The selection of thickened tailings is premised on taking advantage of the topography at the TMF location, with deposition from the natural hillside upstream of the dams and providing a steeper beach slope over conventional slurry deposition.

18.7.2 Design Criteria

The TMF has a feasibility design to accommodate 30.1 Mt (approximately 21.4 Mm^3) of tailings material that will be produced over the initial 9 to 10 years of the mine life. Tailings will subsequently be deposited in the mined-out Leprechaun open pit beginning in Year 10 and for the remainder of the mine life (approximately 16.9 Mt of tailings stored in the pit). The design is based on the annual mill throughput which ramps up from 1.875 Mt/a in Year 1 to 4.0 Mt/a in Year 6 and does not include the Berry Zone.

The overall design objective of the TMF is to safely contain tailings while protecting groundwater and surface water resources during both operations and long term (post-closure). The design of the TMF has taken into account the criteria in Table 18.2, as well as the following:

- reducing the impact and risks on the surrounding environment
- safe, long-term containment of all solid mine waste materials
- collection and management of water released from the tailings during operations for reuse as process water in the mill, to the extent practical
- avoid development of mine waste infrastructure on fish habitat
- staged development of the TMF over the life of the project to defer capital cost and allow for efficient use of waste materials from pit stripping as construction materials

Table 18.2: TMF Design Criteria

Parameter	Value
Material Specific Gravity	2.68
Thickened Tailings Discharge Solids Content	65% (by mass)
Assumed Void Ratio of the Deposited Tailings	0.9
Calculated Average Dry Density of the Deposited Tailings	1.41 t/m^3
Calculated Maximum Volume of Tailings for Storage at the TMF	21.4 Mm^3
Assumed Tailings Beach Slope	3%

The TMF will safely store the environmental design flood (EDF), resulting from a 1:100-year return hydrologic event, with no discharge through the spillway.

A spillway designed to safely pass the inflow design flood (IDF), resulting from the probable maximum flood (PMF) event.

The dam safety program established in NL requires that dams must be designed, operated and maintained to meet the requirements of Canadian Dam Association (CDA) Dam Safety Guidelines. In accordance with the dam classification methodology presented in the CDA Dam Safety Guidelines, the proposed TMF dams have been classified as a "Very High" consequence of failure, based on the potential environmental impact and population at risk. Golder carried out a dam breach assessment in August 2020 to inform the consequence classification. The results of the assessment confirmed that the consequence classification is appropriate.

The design of the TMF was carried out to meet minimum allowable factors of safety under static and pseudo-static loading conditions recommended in the current CDA Dam Safety Guidelines.

18.7.3 Tailings & Waste Rock Characteristics

Particle size distribution tests for two tailings samples representative of Phase 1 and Phase 2 grind sizes were provided by Ausenco. The Phase 1 tailings are predominantly silt sized with approximately 81% of the particles by mass finer than 0.075 mm diameter (silt and clay sized), out of which 37% by mass are clay sized. The Phase 2 tailings are predominantly sand and silt sized with approximately 48% of the particles by mass finer than 0.075 mm diameter (silt and clay sized), out of which 21% by mass are clay sized. Settling and slurry consolidation tests are currently being undertaken by Golder's Burnaby laboratory. The results will be available for the next stage of design to better understand the settlement, permeability and deposition characteristics of the tailings in the TMF.

Tailings will be produced from both high-grade and low-grade ore with about 38% originating from the Leprechaun pit and the remainder from the Marathon pit. Tailings geochemistry has been evaluated by Stantec. The testing carried out to date indicates that composite samples of tailings from both deposits are classified as non-potentially acid generating and are not expected to generate acid rock drainage. In addition, high leaching potential is also determined for total ammonia, CN_{WAD} (surrogate for free CN), F, Hg, P, and Fe. After closure, covered tailings beaches are not expected to produce acidic runoff and/or have high or moderate leaching except for P. Seepage from the TMF has been conservatively predicted to exceed MDMER limits for CN_T, un-ionised ammonia and copper after closure and may require treatment (Stantec, 2020a). During the operating period, seepage collection ditches and a sump at the downstream toe of the TMF will collect local runoff and shallow seepage, which will be pumped back into the TMF.

Overall, Leprechaun pit waste rock is classified as non-PAG and is not expected to generate ARD due to the small amount of PAG material (less than five percent of waste rock volume) and significant excess of NP. Fourteen percent of the waste rock from Marathon pit is conservatively estimated to be PAG and blending and/or encapsulation with non-PAG is recommended to neutralise ARD potential. Waste rock for the tailings dam construction will undergo necessary testwork to prevent PAG materials from being used (Stantec, 2020a).

Blast fragmentation modelling carried out by Moose Mountain has predicted that the particle size distribution for the Marathon and Leprechaun waste rock will comprise primarily 1000 mm minus material and be suitable rockfill for construction of the TMF dam.

18.7.4 Geotechnical Subsurface Conditions

To support the feasibility design, geotechnical and hydrogeological site investigations at the proposed TMF were carried out by GEMTEC in 2020, which included 32 test pits excavated and 11 boreholes advanced (GEMTEC, 2021).

The subsurface conditions encountered at the investigation locations comprise a surficial layer of organics up to approximately 2.2 m thick underlain by a non-cohesive glacial till deposit described as silty sand and gravel to sandy silt containing cobbles and boulders. The till extends to the bedrock surface and ranges in thickness from 0.7 m to 7.5 m. Based on standard penetration testing, the till was found to be in a 'compact' to 'very dense' state. The bedrock surface was encountered at an average depth of 2.9 m at the investigation locations. Bedrock outcrops were mapped at 26 locations within the TMF footprint, although more outcrops are expected to exist. Bedrock lithology was described as mudstone, sandstone, siltstone and mafic intrusive.

Groundwater levels measured in monitoring wells installed in the boreholes indicate levels are shallow measuring on average 0.2 m below ground surface. Overburden in-situ hydraulic conductivity values were estimated using rising and falling head hydraulic response (slug) testing methods. Bedrock hydraulic conductivity was estimated using Lugeon packer testing methods during drilling and slug testing in monitoring wells with screened intervals in bedrock. The average (geometric mean) hydraulic conductivity of the till overburden and bedrock was estimated to be 5.89×10^{-6} m/s and 4.49×10^{-6} m/s, respectively.

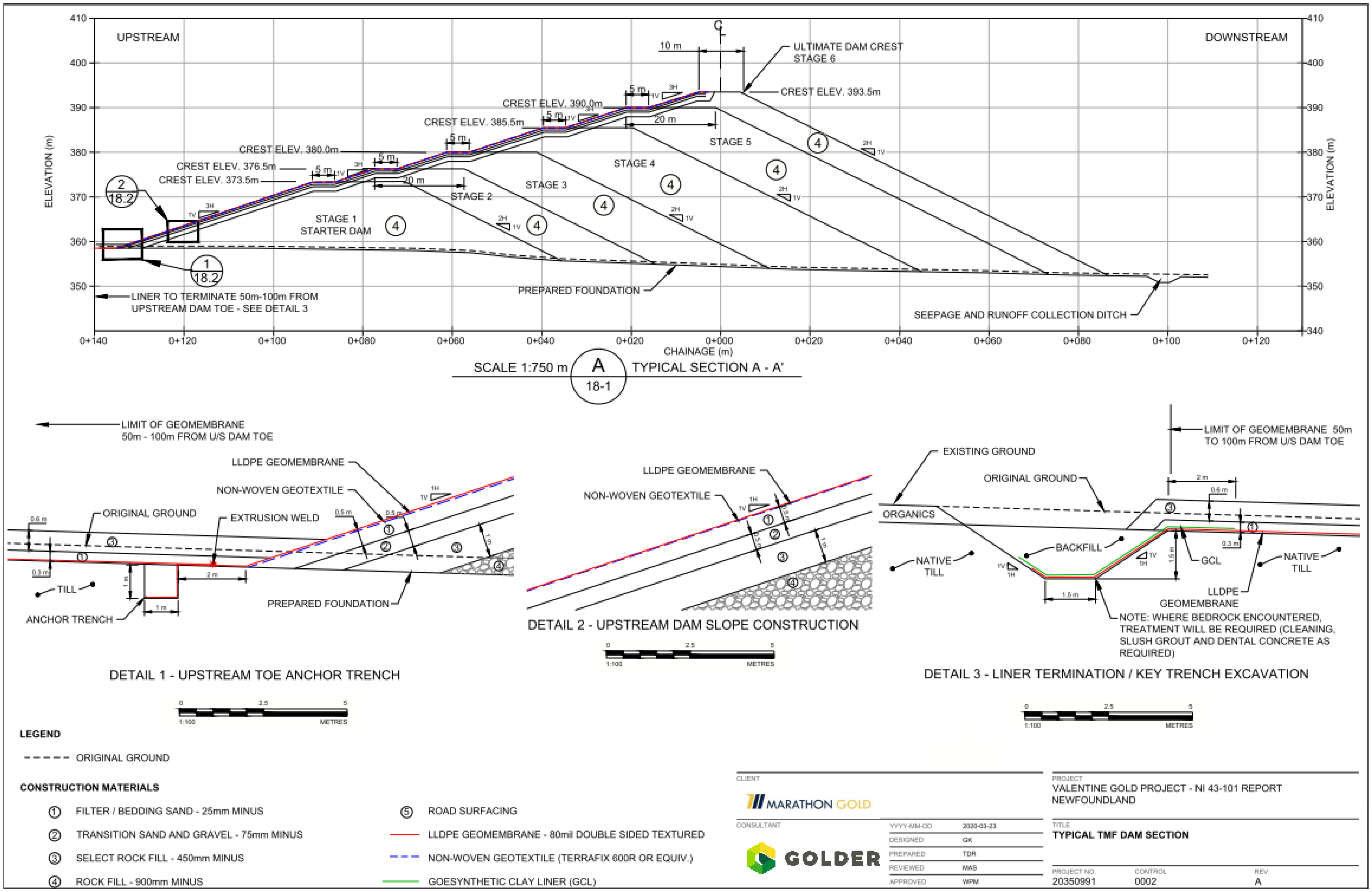
18.7.5 Dam Design

A downstream raised embankment concept was maintained for the feasibility design of the TMF perimeter dams. Mine waste rock from the pit developments will be the primary embankment construction material based on the availability of waste rock indicated in the proposed mine plan. The upstream face of the dam will be lined with a linear low-density polyethylene (LLDPE) geomembrane liner to reduce seepage through the dam. The upstream face of the dam will be composed of a select fine rock fill, sand and gravel transition, and a filter / bedding sand zone. The respective zones will be filter compatible to protect against internal erosion of dam fill and provide the necessary bedding for liner protection. The embankment has a flatter overall upstream slope of 3.5H:1V (including 5 m interim benches) to allow for placement of the filter and transition zones and installation of the liner. The downstream slope is designed at 2.0H:1V for stability considerations. For the intermediate stages of the dam, a crest width of 20 m was selected to allow for mine vehicle and equipment access during construction.

All dam fill will be constructed upon a prepared foundation to ensure stability of the dams. For dam safety, the design also includes an LLDPE geomembrane extended 50 to 100 m beyond the upstream dam toe as a seepage mitigation measure to reduce the critical hydraulic gradient at the toe of the dam and seal any bedrock outcrops and permeable zones. The upstream limit of the liner will be terminated in a key trench with a section of geosynthetic clay liner (GCL) to ensure an adequate cut-off.

Figure 18-5 shows the dam typical cross-section and pertinent construction details.

Figure 18-5: Tailings Management Facility – Typical Dam Section & Details



Source: Golder, 2021.

The non-PAG waste rock fill will be placed in lifts and compacted by the mine fleet while the foundation preparation, sand and transition zones, and liner installation will be carried out by a civil contractor. The sand and transition materials are required to be produced from crushing and screening waste rock, as no viable local borrow sources have been identified to date.

Settlement plates, inclinometers and vibrating wire piezometers will be installed in the dam at various stages of construction to provide information to support long-term performance monitoring.

18.7.6 Tailings Deposition Plan

The tailings deposition plan for the TMF involves subaerial spigotting of thickened tailings both from the crest of the perimeter of the embankment dams at approximately 100 m spacing and the natural high ground on the northwest side of the basin. Initial spigotting from the perimeter dam following starter dam construction and each subsequent stage raise will promote the development of a beach over the liner. The tailings beach will enhance dam safety, protect the liner from ice damage, and reduce seepage potential through the liner. During winter months, deposition will occur by end-pipe discharge to prevent freezing of lines, with the tailings lines and discharge points being actively managed to ensure optimal filling of the basin.

The combination of discharging from the dam and the natural ground will allow the TMF decant pond to form at the east side of the basin. A portion of the decant pond will be against natural ground where the emergency and closure spillways will be located. An internal reclaim berm constructed of waste rock will extend into the decant pond such that a barge may be accessed and floated or fixed at a location with suitable pond depth.

The TMF dams are designed to be raised based on storage requirements. Table 18.3 summarises the dam stage sequencing and storage availability. Stage 1 and 2 will be built first, with Stage 1 being a lower interim crest elevation to facilitate wet commissioning of the mill and capturing freshwater for start-up in October 2023. Stage 2 is to be completed later in 2023, before the onset of winter 2024 and will provide storage until the end of 2024.

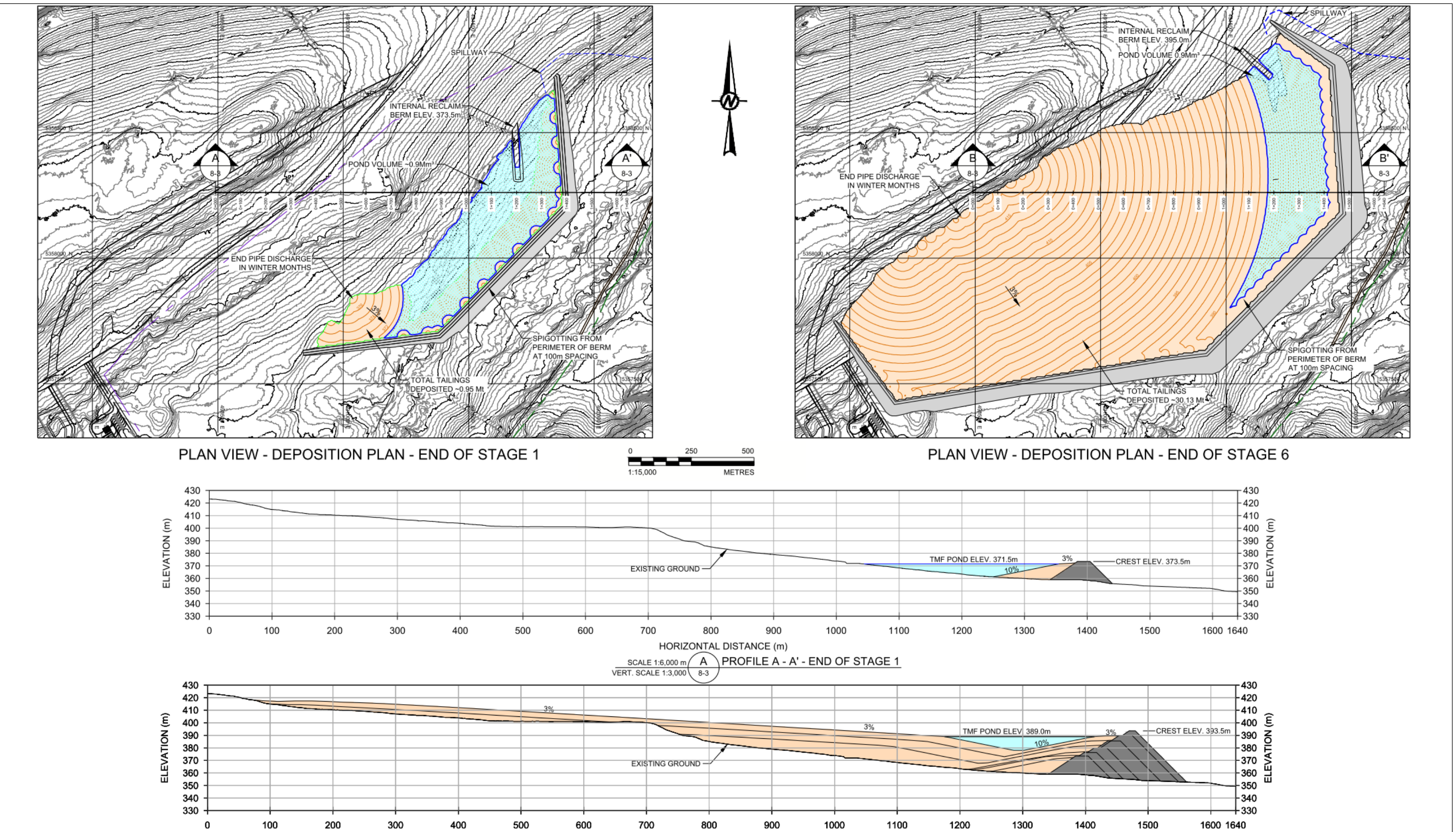
Table 18.3: TMF Staged Raising Details

TMF Stage	Year of Construction	Tailings Storage Availability (Mt)	Operational Period (End of Year)	Dam Crest Elevation		Bulk Dam Fill Requirements (Mm^3)
				Maximum (masl)	Minimum (masl)	
1	2022 and 2023	3.125	2024	373.5	373.5	1.09
2	2023			390.1	376.3	0.90
3	2024	6.875	2025	393.3	380	1.13
4	2025	14.125	2027	399.6	385.5	2.16
5	2027	22.125	2029	404.4	390	2.35
6	2029	30.125	2032	408.7	393.5	1.34

With the exception of Stage 1, the crest of the dam slopes down from the west abutment at a 1% grade for about half the alignment length and is then horizontal up to the east abutment. This sloping crest, in conjunction with the strategy of deposition from the natural ground towards the dam, reduces the dam fill requirements while maintaining suitable pond storage on the east side of the TMF.

The tailings deposition plan configurations at the end of Stage 1 and Stage 6 are illustrated in Figure 18.6.

Figure 18-6: Tailings Deposition Plan – Starter & Ultimate Configurations (Stage 1 & 6)



NOTE:

1. TYPICAL TMF POND VOLUMES WERE SELECTED FOR THE DEPOSITION MODELLING. TMF POND VOLUMES WILL FLUCTUATE SEASONALLY DEPENDING ON THE OPERATIONAL MONTH.

REFERENCE

1. GROUND CONTOURS WERE PROVIDED BY CLIENT. FILENAME MRG_01_Valentine_Mine_Survey_Data_ Delievery.ZIP, DATED 11/6/2019.

CLIENT	MARATHON GOLD
CONSULTANT	GOLDER
YYYY-MM-DD	2020-03-23
DESIGNED	GK
PREPARED	TDR
REVIEWED	MAS
APPROVED	WPM
PROJECT	VALENTINE GOLD PROJECT - NI 43-101 REPORT NEWFOUNDLAND
TITLE	TAILINGS DEPOSITION PLAN - STARTER AND ULTIMATE CONFIGURATIONS (STAGES 1 AND 6)
PROJECT NO.	20350991
CONTROL	0002
REV.	A

Source: Golder, 2021.

The TMF will be monitored to demonstrate performance goals are achieved and design criteria and assumptions are met. The perimeter embankment will be raised in stages to provide the necessary storage during the first 9 to 10 years of operation.

Tailings will subsequently be deposited subaqueously in the mined-out Leprechaun open pit starting in fall 2032 (Year 9.5) and for the remainder of the mine life. Site investigation at the Leprechaun pit location was carried out by Terrane (2021). In-situ testing results across a variety of depths in bedrock indicate that the permeability of the rock is low (mean of 3.3 $x10^{-8}$ m/s) and there are slight upward groundwater flow gradients into the pit. Faults tested in the pit area had similar hydraulic conductivities and are not distinct from the surrounding rock mass (GEMTEC, 2021).

Furthermore, based on recent hydrogeological and water quality modelling carried out by Stantec (2020b), discharge from the pit is not predicted to exceed MDMER limits. Based on these findings, lining of the pit prior to deposition is not included in the design. Refinement of the groundwater modelling to evaluate the impacts of the TMF on the local environment may be required. A specific model should also address the impacts of in-pit disposal of tailings in the mined-out Leprechaun pit. Golder understands Stantec is evaluating the site-wide hydrogeology and contaminant transport in consideration of the TMF and open pit.

18.7.7 TMF Water Management

The site-wide water balance was completed by Stantec, while Golder completed the TMF water balance. The TMF water balance was updated from the pre-feasibility study and considered monthly flows for average as well as 25-year wet and dry annual precipitation scenarios. The water balance model was run from start-up (Year -1) to the end of operations (Year 14).

The TMF receives runoff from hydrological conditions and process water discharged with the tailings stream. Excess water from the overall mine site (e.g., from open pit dewatering and waste rock stockpile runoff) is managed separately and does not report to the TMF. The water balance concludes that the TMF has a positive water balance.

Excess water within the TMF will be collected and recycled to the process plant to the maximum practical extent. A water treatment plant and polishing pond allow for the treatment and discharge of surplus TMF water to Victoria Lake. Treatment and discharge are assumed to occur for seven to eight months per year during the ice-free period. The TMF pond has been sized to temporarily store the critical EDF above the maximum operating water level (MOWL). The maximum operating pond volume ranges from approximately 0.8 Mm^3 to 1.4 Mm^3 depending on the year of operation. Reclaim water is pumped to the process plant from a barge in the TMF, which is located at the end of the internal reclaim berm extending into the pond. Assuming no inflow to the pond in winter months (i.e., runoff and process water remain frozen on the tailings beach), a pre-winter minimum pond volume is required to ensure a mill reclaim inventory during the freeze up period, which ranges from approximately 0.4 Mm^3 to 1.0 Mm^3, depending on the year of operation.

An emergency spillway and discharge channel are included in the design on the east abutment of the TMF dam for each TMF stage to provide safe passage of the IDF. Rip-rap lined runoff and seepage collection ditches are provided along the toe of the dam which report to a single downstream collection sump. Seepage and runoff gathered in the collection sump is recycled back to the TMF during the operating period via a pumping system designed by Ausenco.

18.7.8 Closure Considerations

The tailings are considered to be non-PAG and therefor require no special measures for long-term chemical stability (e.g., permanent water or geomembrane liner cover). Closure of the TMF will include lowering of the spillway to allow for passive drainage and elimination of supernatant pond water, regrading of tailings to ensure positive drainage to the lowered spillway, and a vegetated overburden cover over the exposed tailings beaches for physical stability and reduced infiltration. The polishing pond dams and seepage runoff collection sump perimeter berms will be breached and regraded. The Leprechaun pit will be flooded and provided with a permanent passive discharge channel.

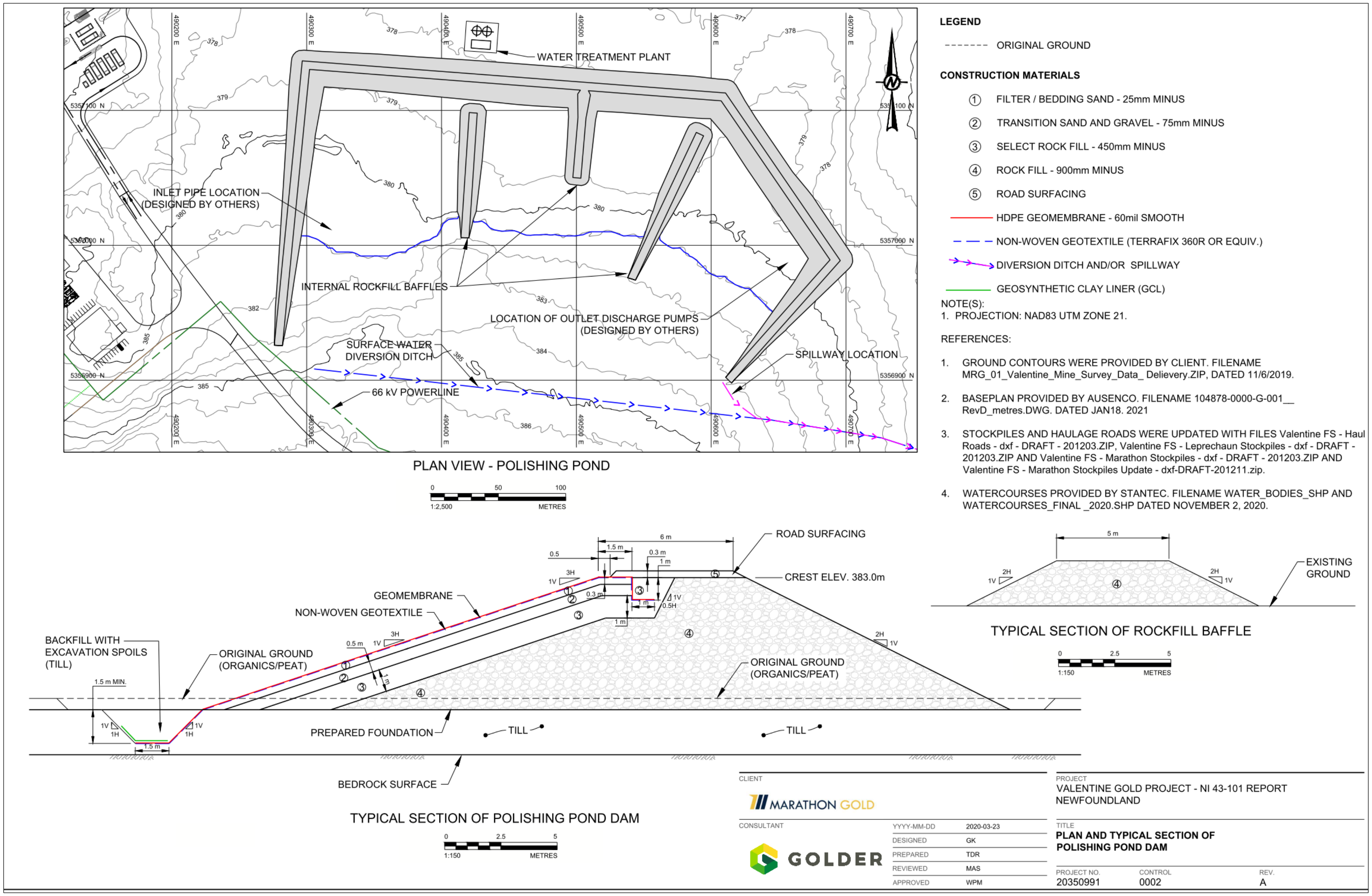
18.8 Polishing Pond

The polishing pond is located east of the process plant site and has a footprint area of 8 ha. The general arrangement of the polishing pond is shown on Figure 18-7. The pond will be constructed during construction of the TMF starter dam with an operational capacity of about 60,000 m^3 based on a maximum flow through rate of 350 m^3/h, which is sufficient to treat runoff, precipitation, and process flows for up to a 25-year wet precipitation year. A retention time of seven days was specified by Ausenco.

Containment for the pond will be provided by perimeter dams lined with a geomembrane, similar to the upstream slope of the TMF dam. The pond is designed to provide sufficient residence time for the settlement of solids. To promote settling and flow distribution, the pond includes internal rockfill baffles designed to reduce short-circuiting. The design also allows for a dead storage depth of up to 1.5 m for solids accumulation and has a minimum freeboard of 1.3 m above the MOWL to the polishing pond crest.

An emergency spillway and discharge channel will be constructed in natural ground for the polishing pond to safely pass the IDF.

Figure 18-7: Polishing Pond – General Arrangement



Source: Golder, 2021.

18.9 Water Systems

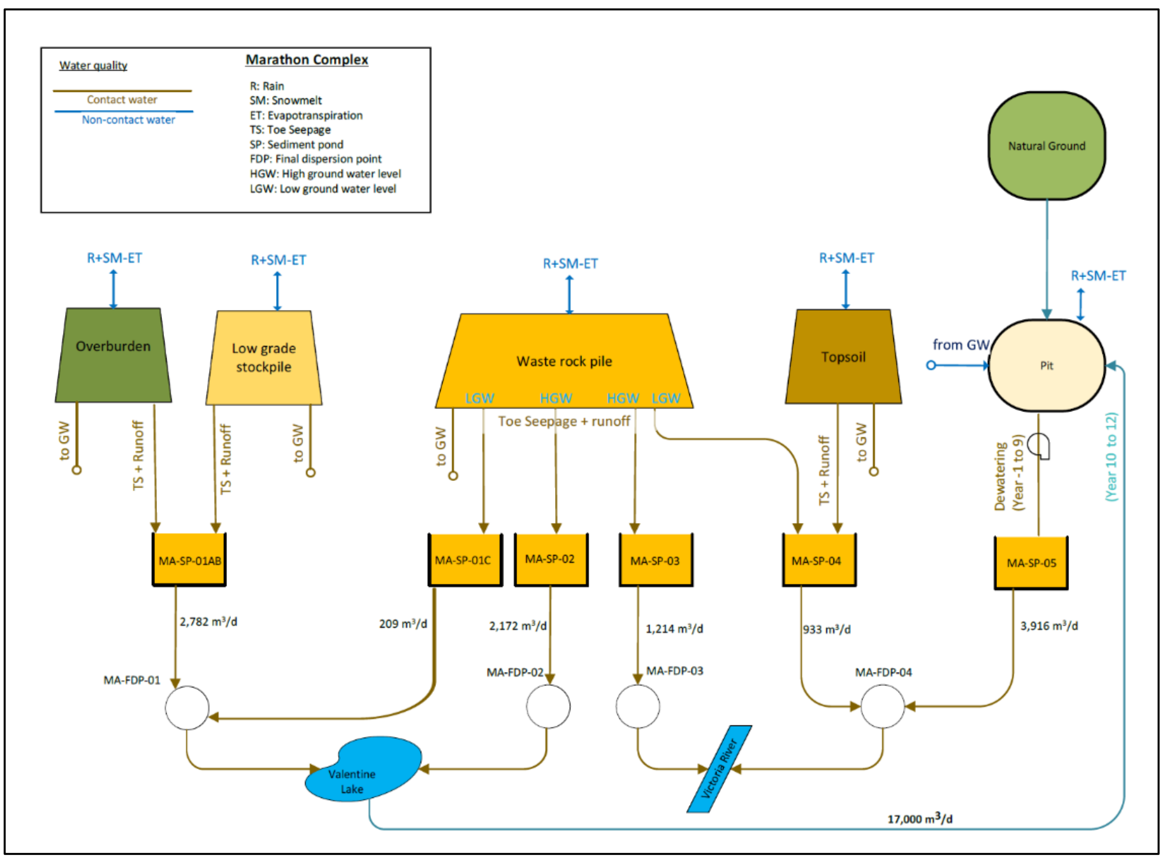
18.9.1 Site Water Balance

A site-wide water balance was completed to estimate the quantity of mine site contact water expected to be managed during the operational phase of the project to support the Environmental Impact Statement and feasibility design.

The mine site is divided into three complexes. From north to south, they are the Marathon Complex, the Process Plant Complex, and the Leprechaun Complex. Water management functions independently with decentralised treatment and control in each complex. To reduce the mine water inventory, non-contact runoff is proposed to be diverted using perimeter berms to allow runoff to naturally flow off site.

As shown in Figure 18-8, the Marathon Complex drains and discharges ultimately to Valentine Lake or Valentine River. As shown in Figure 18-9, the Leprechaun Complex drains and discharges ultimately to Victoria Lake Reservoir through direct lake tributaries. During operation Years 1 to 9, the process plant area and TMF will drain and discharge to Victoria Lake Reservoir as well; however, during Years 10 to 12, excess TMF water will be reclaimed to the process plant with no discharge to Victoria Lake Reservoir.

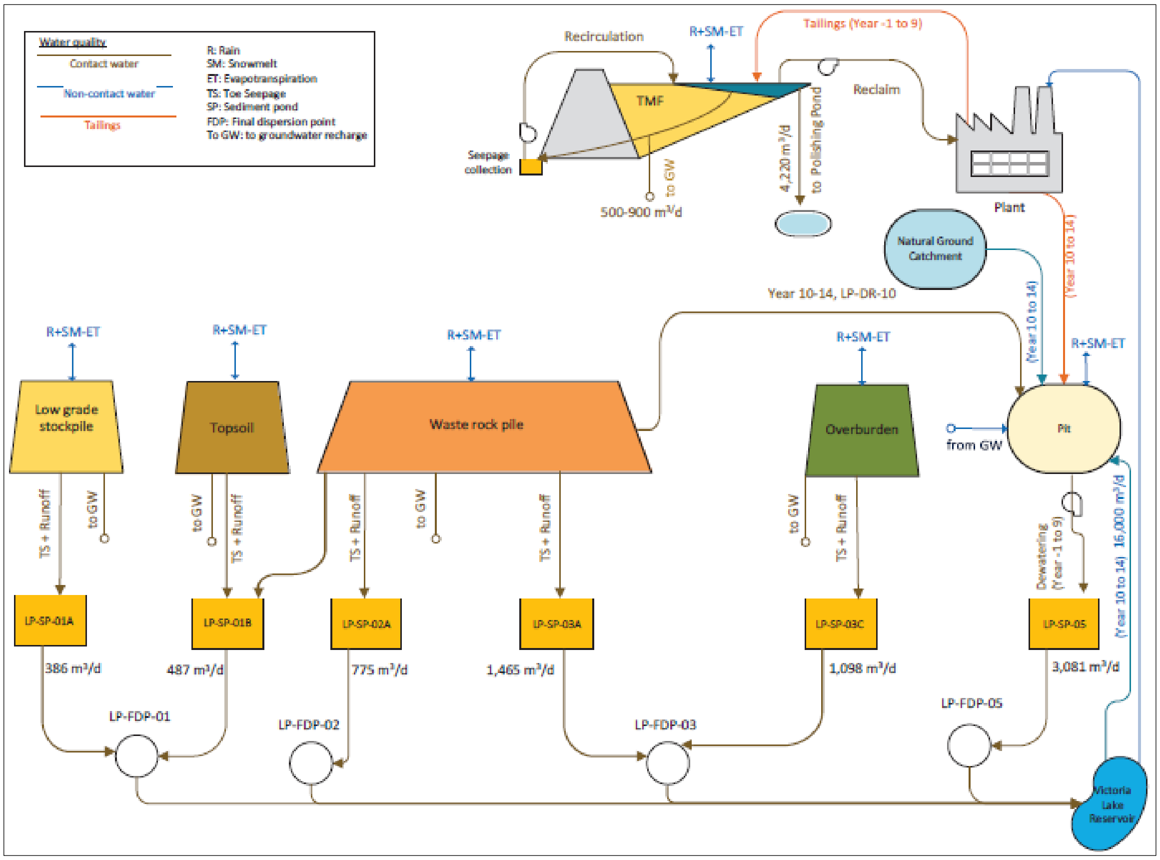
Figure 18-8: Marathon Operational Water Balance – Climate Normal Condition



Source: Stantec, 2020.

Accelerated pit filling from waste rock pile water management pond excess, natural ground runoff, and Victoria Lake Reservoir will commence in Year 10 as part of progressive reclamation. Similarly, the Marathon pit filling will commence in Year 10 from Valentine Lake and excess from waste rock pile water management ponds. The flow arrows in Figures 18-8 and 18-9 show the direction of flow accounted for in the water quantity model to or away from the project facility. Key design updates to water management infrastructure from a pre-feasibility to feasibility study design are presented in Section 18.9.6.

Figure 18-9: Leprechaun Operational Water Balance – Climate Normal Condition



Source: Stantec, 2020b (with feasibility study updates).

18.9.1.1 Water Balance Methods

The water balance accounted for the precipitation, groundwater, and toe seepage captures from beneath the piles gains and evaporation, transpiration, and infiltration losses of each identified mine site component. The water balance represents the mine site components at full development during operation. The proportion of infiltration that becomes part of deeper regional groundwater flow and that does not report to seepage collection ditches was not included in the model. Average precipitation at the mine site was represented by the Climate Normals precipitation (1981-2010) for the Environment and Climate Change Canada (ECCC) climate station Buchans (Station ID 8400698). Building from this base case, a probabilistic Monte Carlo analysis was conducted to extend the analysis to include extreme wet and dry climatic conditions. This allows for the prediction of runoff, seepage, and water quality behaviour and characteristics over this range of climatic conditions.

A proportion of precipitation in the cold months of December through March was assumed to be stored as snow with melt occurring in the months of March through June. Groundwater and surface water inflows to the pits were based on a hydrogeological model developed by others (Terrane, 2019 & 2020). Evaporation from ponds at the site was represented by the average evaporation rate (mm/month) reported at the Stephenville and Gander ECCC climate stations (Station IDs 8401700 and 8403800). Actual evapotranspiration (AET) at the site was based on a USGS Thornthwaite model (Thornthwaite 1948). Inputs to the USGS Thornthwaite model included average climate precipitation and temperature data at Buchans, local soil conditions, and recommended values provided by the USGS (McCabe and Markstrom 2007). The amount of AET was adjusted in the model based on project facility and project phase. These adjustments were applied to account for the characteristics of stockpile slope, soil storage, and infiltration of each project facility.

The percentage of precipitation that results in runoff from the pile areas was accounted for in the water quantity model by a water balance approach. The accounting was the balance of rainfall plus snowmelt runoff less evapotranspiration and net infiltration that falls on the catchment. Net infiltration is the sum of groundwater infiltration and toe seepage less any soil losses. The proportion of net infiltration that reports as seepage to perimeter ditching and is collected in the seepage collection system is carried through the model to the water management ponds. Different from the waste rock and LGO piles, the topsoil and overburden stockpiles are fine-grained, which limits infiltration into the pile and increases runoff. As a result of the soil material combined with the steep pile slopes, the net infiltration through the piles was assumed to be negligible.

Runoff from the tailings and polishing pond was estimated in the model based on the proportion of total precipitation (rainfall plus snowmelt runoff) on the catchment multiplied by a seasonally adjusted runoff coefficient. Seepage was modelled as shallow seepage, collected and recirculated to the TMF and deep basal seepage lost to the system.

The modelled project facilities, including the processing plant, TMF, open pit and stockpiles will have drainage and diversion controls that prevent external natural drainage from coming into contact with project facilities and becoming contact water.

18.9.1.2 Water Balance Results

Figures 18-8 and 18-9 show the water balance gains and losses for each mine component identified in the three complexes, in cubic metres per hour, under normal climate conditions. Actual instantaneous flows will vary significantly by month and by varying annual climate conditions.

The Marathon Complex consists of the Marathon pit, Marathon northwest waste rock pile, Marathon topsoil stockpile, Marathon overburden stockpile, and Marathon low-grade stockpile. The Leprechaun Complex consists of a rock pile, Leprechaun topsoil pile, Leprechaun overburden stockpile, and stormwater ponds. Runoff from these project components will be collected in drainage ditches and directed to sedimentation ponds. Pond discharges will be directed locally to unnamed tributary streams to Victoria River (70%), and directly to Valentine Lake (30%) for Marathon.

Drainage from the Marathon Complex reporting to Valentine Lake ultimately discharges to the Victoria River, which flows north to Red Indian Lake and the Exploits River system. The Leprechaun Complex will discharge locally to unnamed tributary streams to Victoria Lake, as well as directly to Victoria Lake. Victoria Lake was diverted during the Bay d'Espoir hydroelectric project to the east and the lake now drains via the Victoria Canal, Granite Canal, and Meelpaeg Reservoir to the Bay d'Espoir generating facility on the south coast of the Island.

The water management ponds are influenced by climate inputs, and collect runoff, toe seepage, and shallow groundwater flow from the waste rock pile and low-grade ore, overburden, and topsoil stockpiles through seepage collection ditches around these facilities. The water quantity model simulated the function of the water management ponds. The water management ponds will discharge to the final dispersion points when the pond water level rises above the low-level outlet.

The Processing Plant Complex consists of the TMF, polishing pond, water treatment plant, process plant, truck shop wash-ROM pad, and high-grade ore stockpile. The processing plant and TMF will operate as a circuit with tailings being deposited in the TMF as a thickened slurry (60% to 65%) and process water being reclaimed via a pump and pipeline from a point downstream of the polishing pond back to the process plant. Generally, the simulation flow results on the water management ponds and the final dispersion points, from 5th to 95th percentile results, range from approximately -25% to +25% of the mean results within each mine phase. This is consistent with the range of precipitation and approximately represents the 1:25 return period wet year to the 1:5 dry year.

Fresh water for elution, reagents and potable water requirements will be pumped from Victoria Lake to the process plant at a rate of 34.4 m^3/h (2.5 Mt/a scenario) and 60.2 m^3/h (4.0 Mt/a scenario). Surplus water from the TMF will be discharged to a treatment plant, from which treated water will be sent to a polishing pond prior to discharge via a pipeline to Victoria Lake. Ore rock will be stored on the run-of-mine stockpile and in the high-grade ore stockpile prior to processing.

The primary source of water to meet the plant water demand is the reclaim from tailings pond; the secondary source is fresh water from Victoria Lake Reservoir to balance plant water demand deficit (i.e., difference between the demand and the reclaim). A deficit of reclaim water to meet process plant demand only occurs for three months during the first year of operation.

The water balance model was run iteratively to analyse the volume of excess water from the TMF requiring treatment prior to discharge to the environment. In the model TMF runoff was pumped to the treatment plant when the tailings pond level reaches 70% of its volume capacity. The capacity of the water treatment plant will not be exceeded for the 95th percentile corresponding to a 1:25 return period wet year. Results from the probabilistic analysis indicate no release of untreated water during operation (before Year 13) for the 95th percentile. This condition could change depending on future operation management philosophy between the tailings pond and the water treatment plant.

18.9.2 Fresh Water Supply System

Design considered that fresh water will be captured from Lake Victoria. It will be directed to the fresh / fire water tank, from where it will be distributed to required points in the plant, and feed the potable water treatment system, elution circuit and reagent systems. During the first year of operation, fresh water will be required to supplement process water demand, typically recovered from the TMF. The bottom section of the fresh / fire water tank will be dedicated for the fire water system.

18.9.3 Potable Water Supply

The quality requirement for the potable water treatment plant will match the local drinking water guidelines. Fresh water will be sourced from the fresh water intake pump (at Lake Victoria) and processed through the potable water treatment skid before being stored in the potable water tank.

Prior to further use, the potable water is heated by the tepid water heating skids before being distributed to safety showers and other points in the plant facilities. The distribution piping will either be buried below the frost line or heat traced and insulated wherever it is not inside a heated building. Where necessary, manual drain points will be included.

18.9.4 Fire Suppression System

All facilities will have a fire suppression system in accordance with the structure's function. For the most part, fire water will be used with an underground ring main network around the facilities. All buildings will have hose cabinets and handheld fire extinguishers. Electrical and control rooms will be equipped with dry-type fire extinguishers. Ancillary buildings will be provided with automatic sprinkler systems. For the reagents, appropriate fire suppression systems will be included according to their material safety datasheets.

18.9.5 Sewage Collection

A sewage treatment plant package will be supplied at both the plant/truck maintenance area and camp area to treat all sewage collected within the site. The collection network will be underground. Office and domestic waste will be collected and disposed of off site in accordance with applicable regulations.

18.9.6 Surface Water Management

The water management infrastructure was progressed from a pre-feasibility to a feasibility study design. The design accounted for the relocation of the topsoil pile for the Leprechaun complex since the pre-feasibility study design, increases/adjustments to other pile footprints, and design of haul roads. Key changes since the pre-feasibility study design include the following:

- The number of water management ponds was reduced from 16 ponds to 12 ponds in the feasibility study design, as a result of combining low head dams to higher dams and removing the requirement to segregate flow from Marathon low-grade ore pile from other project runoff.
- Reductions in pond excavation were realised in the feasibility study design by reducing the overall combined pond footprints and by relocating some ponds to low-lying areas from the confirmation that the existing ponds/watercourse in these areas were not fish habitat.
- Water management infrastructure design was adjusted in the feasibility study design to limit bedrock excavation, as this detail was not available in the pre-feasibility study design. In some cases, pond bottoms were raised or perimeter ditches circumvented the bedrock outcrop or in one case was designed to be piped below the Leprechaun waste rock pile.
- The dam embankment design was changed from a till core with rockfill to an HDPE-lined embankment as a result of the required 1.8 m frost cover and seepage/slope stability analysis. This change in dam design results in an additional rockfill material required, excess quantity of excavated till material, and HDPE and geotextile liner. However, the new dam design results in an overall lower dam embankment height than the till core design.

18.9.6.1 Design Objectives

The primary objectives of the water management design for the Valentine Gold Project were maintained from pre-feasibility study design to reduce operational risks and environmental impacts. These objectives include:

- reduce water inventory through perimeter berms, separation of groundwater and surface water flows and promote overland flow of non-contact runoff

- effectively control flooding and provide water management design that produces effluent achieving regulatory effluent criteria
- reduce final points of discharge through grading of ditches and construction of diversion channels to combine spill points to collective effluent discharge points and or sedimentation ponds
- maintain flow to fish-bearing streams and bogs by maintaining pre-development catchments
- reduce water management costs during operation through gravity drainage, where possible, thus reducing pump requirements

18.9.6.2 Design Criteria

In Newfoundland and Labrador, both water quantity and quality criteria are drawn from provincial and federal regulations and regulatory guidance, and in the case of the Valentine Gold Project, further project-specific Environmental Impact Screening (EIS) guidance (CEAA, 2019; NLDMA, 2020). Additional design criteria are sourced from industry best practices and Marathon Gold corporate direction. The design criteria that were incorporated into the water management design are described below.

The Valentine Gold Project will be registered under the Metal and Diamond Mining Effluent Regulations (MDMER). The MDMER sets a daily flow volume monitoring requirement at each final discharge point. Therefore, points of sedimentation pond effluent were combined to reduce the number of final discharge points subject to MDMER. Effluent from the Valentine Gold Project will be subject to MDMER discharge limits which set maximum allowable limits for specific deleterious substances (e.g., metals and total suspended solids (TSS)) for new mines). Specifically, as a new mine, the Valentine Gold Project will be subject to effluent limits from Table 1 of Schedule 4 of MDMER.

A 15 m setback from field-identified potentially fish-bearing streams and bogs/ponds was applied in design. This design criterion is in line with the Newfoundland and Labrador Policy on Flood Plain Management (DOEC, 2004). EIS guidance (NLDMA, 2020) requires that climate change be considered in design. This results in higher precipitation events and associated design flow.

As part of the EIS, an environmental flow to fish-bearing streams is required to reduce environmental effects to fish and fish habitat. Therefore, flow to fish-bearing streams and bogs was predominately maintained in design by draining mine site components to pre-development catchment areas, where reasonable.

Water management sedimentation ponds were designed with multiple stage outlets to incorporate system flexibility to manage water under variable climatic conditions. Sedimentation ponds were designed to store runoff from the project component areas for storm events up to 1:100 annual exceedance probability (AEP) with spring snowmelt and emergency spillways to accommodate the 1:200 AEP flow. The sedimentation pond effluent is slowly released to enhance baseflow augmentation in order to provide flood attenuation and reduce downstream scour and erosion. Ponds were excavated beneath ground surface to decrease the height of the dam to enhance dam safety.

The water management design of contact water treatment focused on sedimentation. As sedimentation will reduce TSS concentrations and the particulate fraction of metals. Ponds were designed primarily to meet the minimum residence time required for sediment to settle 1 m reaching a trapping efficiency of 80%. Runoff from the water quality design storm event will be detained in the sedimentation pond for a minimum of 24 hours. A primarily subsurface, reversed slope low-level outlet will act as a hydrocarbon and light non-aqueous phase liquids (LNAPL) containment feature, as well as reduce thermal discharge effects. A secondary outlet will be installed to relieve flood flows over a shorter period to maintain storage in the pond. The outlet structure will be equipped with a valve with the ability to shut-off flow should additional sedimentation/detention be required to meet MDMER limits. Finally, an emergency spillway will relieve flood flows commencing at the 1:100 AEP water level and greater.

Ditches will be constructed along the perimeter of piles to convey the 1:100 AEP surface runoff and toe drainage to sedimentation ponds for water quality and quantity control. Ditch runs have been designed to convey flow through gravity to reduce operational costs of pumping. Ditch excavation materials will be sidecast and berms constructed of the sidecast glacial till material following a standard trapezoidal geometry to reduce construction costs.

18.9.6.3 Water Management Infrastructure

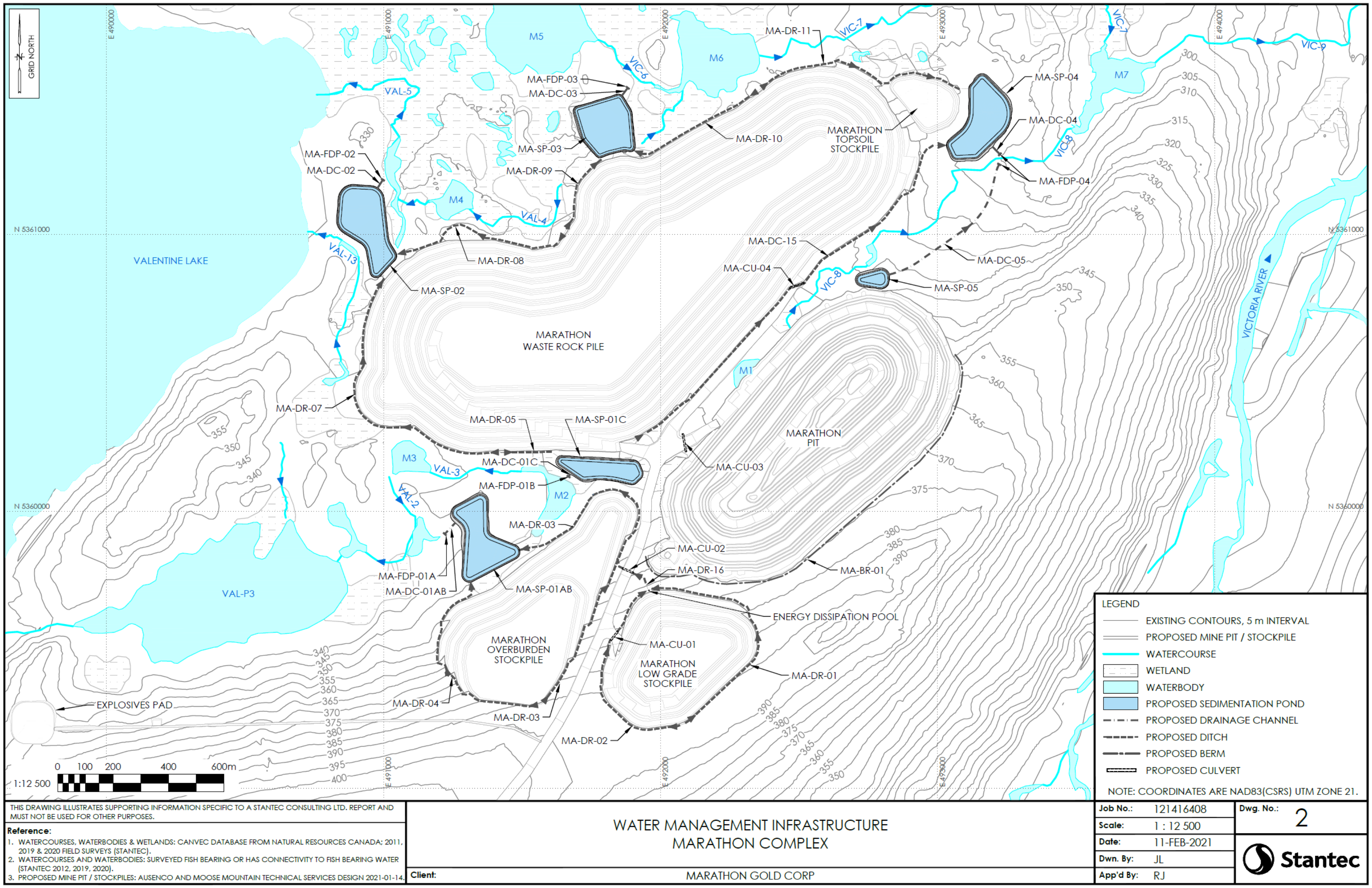
The mine site is subdivided into three complexes. From north to south, these are the Marathon Complex, the Process Plant and TMF Complex, and the Leprechaun Complex. Water management in these complexes function independently with decentralised water treatment and management in each. Water management components consist of sedimentation ponds, dams, drainage ditches, and pumps to collect and contain surface water runoff from waste rock, low-grade stockpiles, overburden stockpiles, topsoil stockpiles, and pits. Water management components are identified in Figure 18-10 for the Marathon Complex and Figure 18-11 for the Leprechaun Complex. The water management plan for the process plant was described in Section 18.9.6.1. The design of the TMF accounts for a positive water balance, which includes rainfall and snowmelt and the management of the effluent, which is described in Section 18.9.1.

The Leprechaun complex will be served by a series of ditches and sedimentation ponds that will discharge to Victoria Lake or one of its tributaries. The Marathon Complex ditches and ponds will discharge to tributaries of Valentine Lake or the Victoria River. Excess runoff from the TMF not reused in processing will be routed through a polishing pond and water treatment plant prior to discharge to Victoria Lake. Runoff from the process plant yard and associated stockpiles will be collected in a sedimentation pond and discharged to Victoria Lake.

Water management features for the Marathon and Leprechaun complexes were designed under a decentralised water treatment framework, operating under gravity drainage to reduce pumping needs. The design of the water management utilised cuts and fills to reduce initial trucking costs and make use of local materials. Measures to control erosion and prevent sedimentation into a fish-bearing watercourse or waterbody was accomplished in design through ditch and berm lining for erosion protection and energy dissipation measures, such as sediment traps and energy dissipation pools. Pumps will be required to dewater the Marathon and Leprechaun pits. A pit dewatering pond was designed at a low-lying location adjacent to each pit.

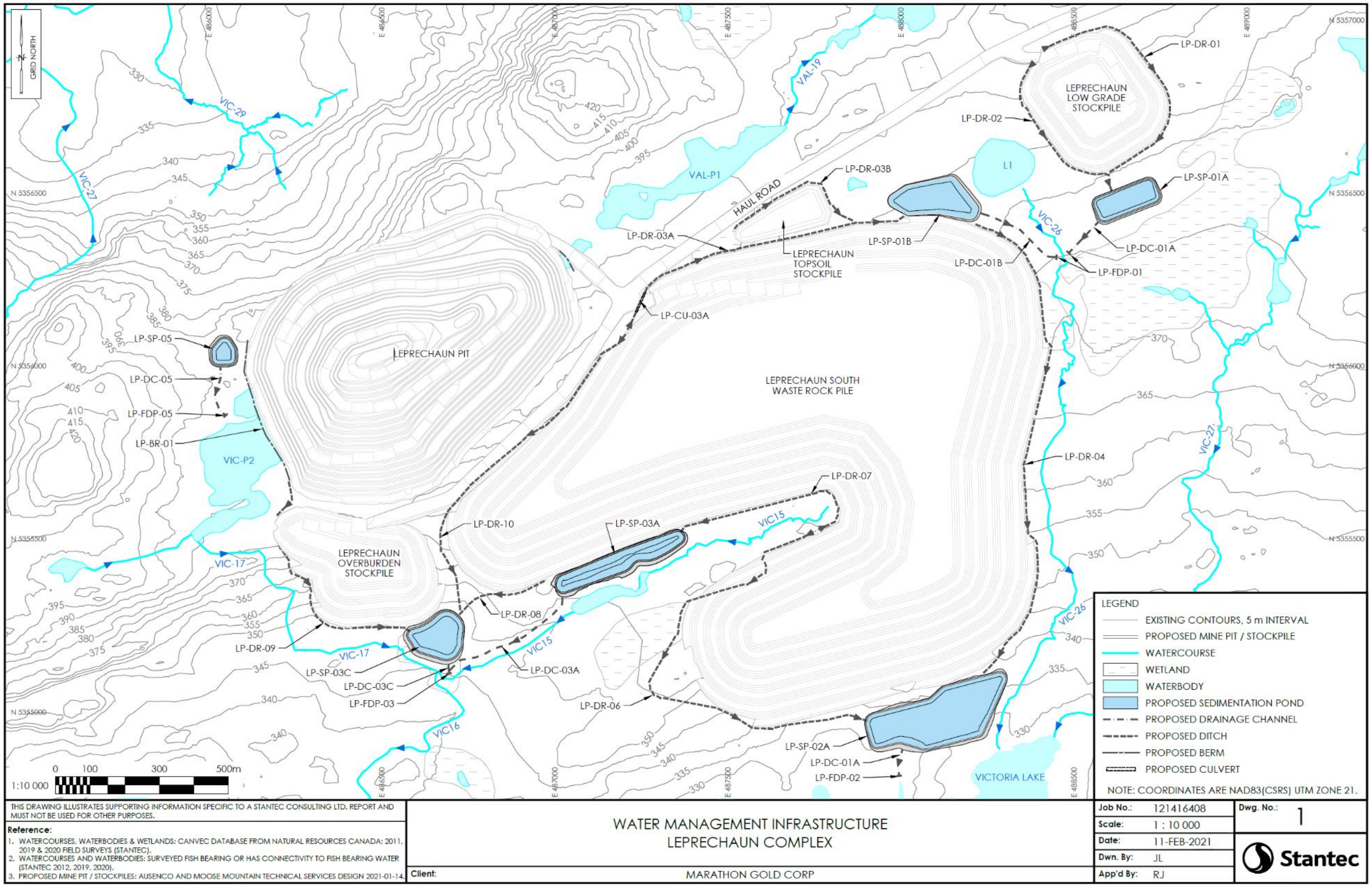
Water management pond normal water levels will account for a permanent pool (i.e., inactive storage at the ponds low operating water level) to promote settling and storage of sediment, and with consideration of an ice thickness during the cold season of 50 cm. All permeant pools will be excavated below grade. In areas with higher relief, the active storage in the ponds will also be (i.e., inactive storage volume) excavated below grade, thus reducing the total dam height and improving dam safety. Ponds will include multi-stage outlet control through a low-level submerged outlet, mid-level outlet and a spillway.

Figure 18-10: Marathon Water Management Components



Source: Stantec, 2020.

Figure 18-11: Leprechaun Water Management Components



Source: Stantec, 2020.

The water management pond dams will be constructed of a blasted rockfill, anticipated to be poorly graded 250 mm minus (10” minus) rock. A layer of screened sand and gravel will be placed on the upstream slope of the berm as bedding material for the HDPE geosynthetic liner (the liner).

The inlet to the pond will include a riprap ditch for energy dissipation to reduce the velocity of the flow into the pond thus limiting short circuiting. The dam crest will be 4 m wide and 3H:1V embankment slopes to allow for light vehicle access on top of the berm to facilitate maintenance and monitoring activities.

Ditches will follow a standard trapezoidal geometry with a maximum 2H:1V side slope tied into existing grade to reduce cost of construction and maintaining a minimum of 20 cm freeboard. Ditch excavation materials will be side cast and shallow berms constructed of the side cast glacial till material to reduce cost of construction. Sidecast berms will be constructed on the outside bank of the ditches. No berms will be constructed between the ditch and its source stockpile. Ditches will be lined with rip-rap for erosion protection where shear stresses warrant and vegetated in other locations.

Effluent from the sedimentation ponds was designed to meet MDMER limits prior to release to the receiving environment. To meet the required storage many of the pond embankment dam heights exceed the CDA safety guidelines trigger of 2.5 m from the toe of the downstream slope to the dam crest and 30,000 m^3 of liquid storage. In order to reduce effects to the environment, the footprint of the water management infrastructure avoids fish-bearing watercourses or waterbodies and therefore associated discharge of a deleterious substances.

Based on the feasibility level design completed by Stantec (2021), 10 of 12 water management pond embankments trigger Canadian Dam association (CDA) dam criteria of greater than 2.5 m high and > 30,000 m^3 liquid storage. An incremental consequence assessment was conducted as part of feasibility-level design to determine the dam classifications of each of the structures considered a dam under CDA. The consequence assessment considered loss of life, environmental and cultural losses, and infrastructure and economic losses.

The largest incremental consequences due to a dam breach are predicted under the fair-weather conditions within the small headwater watercourses/waterbodies downstream of the breach. The effects of a dam breach are fully attenuated by the receivers of Valentine Lake, Victoria Lake or Victoria River, in addition to downstream ponds along the release paths. The potential environmental and cultural losses as a result of a dam breach were assessed based on the ecological impact, intrinsic hazard of contents and the duration of impact for the species at risk – Brook Trout. The loss of habitat in the downgradient watercourses, lakes, or wetlands is considered a “low” environmental loss. Based on the CDA, a low classification corresponds to an inflow design flood of 1:100 years.

18.9.6.4 Pit Dewatering

Pumps will be required to dewater the Marathon and Leprechaun pits. A pit dewatering pond was designed at a low-lying location adjacent to each pit. It was assumed that a total pond volume of 10,000 m^3 for both Marathon and Leprechaun is adequate to contain the pit dewatering rates based on the rates reported by Terrane (2019). Pit dewatering discharge directed to the pit dewatering ponds at the surface will be subsequently drained to pre-development catchments.

18.10 Accommodations Camp

An accommodations camp is included in the design for the pre-production and operations phases. It will be tied into the plant power grid and will accommodate a maximum of 301 people. It is expected that the existing exploration camp, which carries a capacity of 60 people, will be maintained as an overflow camp.

The number of beds in camp takes into consideration all personnel, as there is the possibility of access restrictions due to weather conditions. Total labour force as well of full-time equivalents (FTE) expected on site at a given time (accounting for FIFO rotations) is summarised below:

- an average of 225 direct construction workers with a peak of 250
- an average of 25 EPCM construction management staff with a peak of 35
- an average of nine Marathon Gold office and site team staff with a peak of 12
- an average of 20 accomodation camp staff with a peak of 25
- operations peak – approximately 260 FTE in the camp

Short-term workforce spikes associated with TMF construction are in line with the peak operations workforce, and will be accounted for with the overflow camp. Accommodations will be provided in single-occupancy, 44-person dormitories. Rooms will be approximately 6.5 m² with a mix of ensuite or jack-and-jill style shared washrooms. Kitchen/dining, recreational, and laundry facilities are shared, and are linked to the dormitories through climate-controlled corridors.

19 Market Studies

Marathon Gold has not completed any formal marketing studies with regard to gold production that will result from the mining and processing of gold ore from the Valentine Gold Mine into doré bars. Gold production is expected to be sold on the spot market. Terms and conditions included as part of the sales contracts are expected to be typical of similar contracts for the sale of doré throughout the world. Gold is bought and sold on many markets in the world, and it is not difficult to obtain a market price at any particular time. The gold market is very liquid with a large number of buyers and sellers active at any given time.

The mineral resources were calculated at a gold price of US$1,500/oz. As of late March 2021, the average consensus price forecast from 30 investment dealers estimated a gold price of US$1,765/oz in 2023, US$1,712 in 2024 and US$1,599/oz over the long term. As of March 16, 2021, the trailing three-year gold price was US$1,511/oz and the trailing three-year CAD:USD foreign exchange rate was C$1.00:US$0.76. For the purpose of the 2021 Valentine Gold Project Feasibility Study, a gold price of US$1,500/oz was assumed and an exchange rate of C$1.00:US$0.75 was used.

Asahi Refining provided a quotation for transportation and refining costs that was used in the study. Marathon Gold plans to contract out the transportation, security, insurance, and refining of doré gold bars. Marathon Gold may enter into contracts for forward sales of gold or other similar contracts under terms and conditions that would be typical of, and consistent with, normal practices within the industry in Canada and in countries throughout the world.

20 Environmental Studies, Permitting & Social or Community Impact

Information presented in this chapter is based on publicly available information, including the Environmental Impact Statement (EIS) (Marathon Gold, 2020) and associated baseline study appendices for the Valentine Gold Project. The appendices are comprised of the environmental baseline studies conducted in the project area and surrounding vicinity. The project area as defined for the purposes of the EIS is shown in Figure 20-1 on the following page. Information included herein may require review and reassessment should changes to the scope, area, or design of the project occur as project planning and design progress.

20.1 Environmental Setting

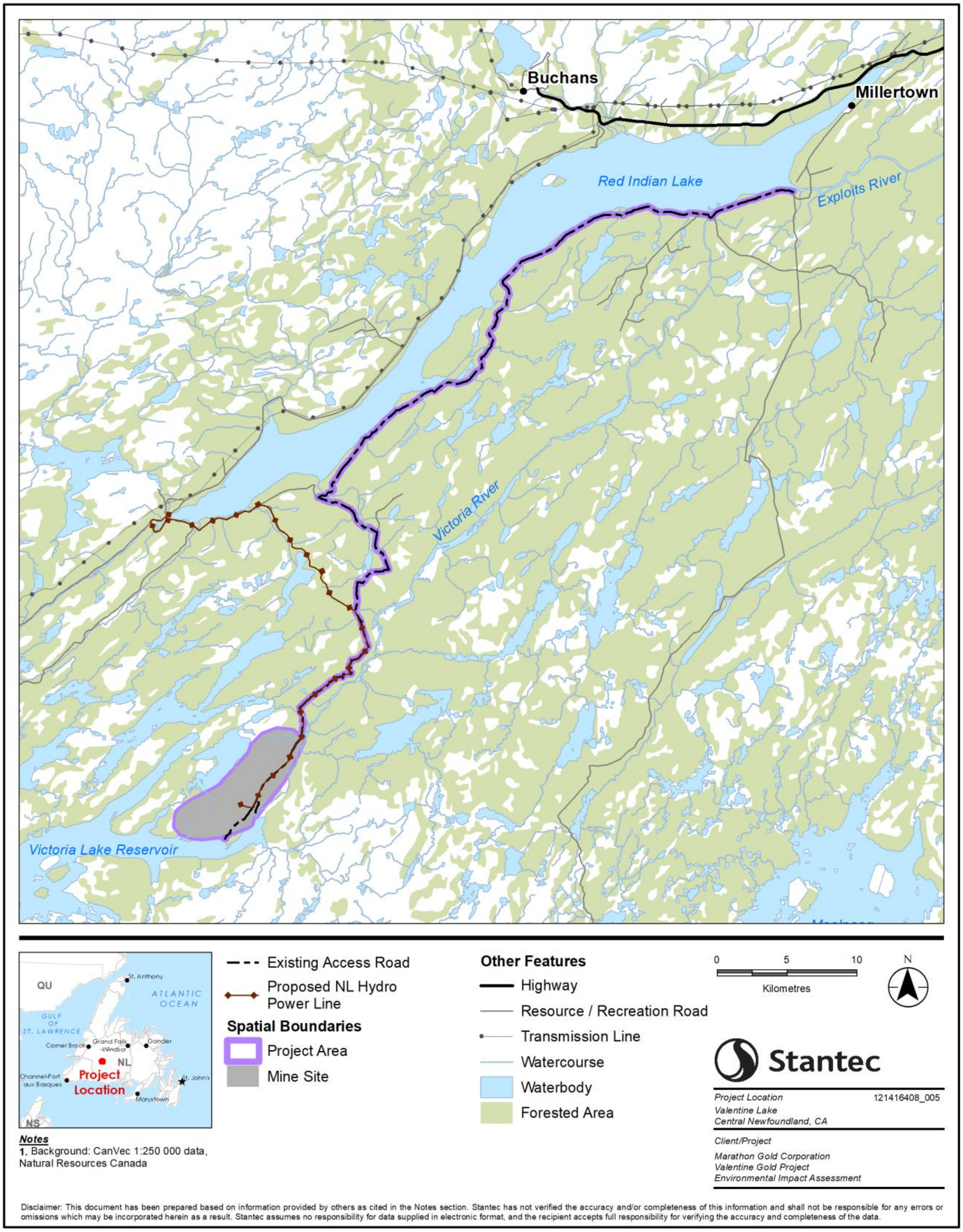
The project is located in the Central Region of the island of Newfoundland, in a rural area with a history of exploration and mining activities. Other land and resource use in the region includes commercial forestry, multiple hydroelectric developments, mineral exploration, outfitting, cabins, harvesting (e.g., trapping, hunting and fishing), and recreational land use (e.g., hiking, boating, snowmobiling and all-terrain vehicle (ATV) use). Although there are currently no active mines in the area, mineral exploration activity takes place throughout the region. The closest communities are the Town of Millertown (84 km straight line distance to the mine site), the Town of Buchans (49 km straight line distance to the mine site), and the Local Service District of Buchans Junction (66 km straight line distance to the mine site).

The following sections summarise the terrestrial and aquatic ecosystems present in the vicinity of the project and are based on literature reviews and baseline surveys conducted between 2011 and 2020. The social, cultural, and economic environment of the region is also discussed.

20.1.1 Terrestrial Ecology

The project is located within the Red Indian Lake Subregion of the Central Newfoundland Forest (CNF) Ecoregion (Newfoundland and Labrador Department of Fisheries and Land Resources [NLDFLR], 2019a). This ecoregion typically consists of rolling hills, dense forest, and organic deposits occurring in valleys and basins (Protected Areas Association (PAA), 2008). The CNF Ecoregion has the warmest summers and coldest winters on the island of Newfoundland, with potential for night frost year-round (NLDFLR, 2019a). Annual precipitation averages around 1,200 mm. The average annual temperature is approximately 3.8˚C, ranging from -8.4˚C in February to 16.3˚C in July. Mean annual runoff in the project boundaries ranges between 51% to 86% of climate normal precipitation (Stantec, 2017a). Terrain (i.e., topography and landforms) varies and includes boggy areas, thin to thick glacial till layers, and bedrock outcrops. Scattered wetlands, specifically patterned fens and bogs are common in the project area and vicinity. Balsam fir (*Abies balsamea*), paper birch (*Betula papyrifera*) and black spruce (*Picea mariana*) are dominant tree species in the region.

Figure 20-1: Project Area



Source: Stantec, 2021.

The region includes a variety of wildlife mammal species commonly found in the boreal forest on the island of Newfoundland. Mammal species confirmed in the project area (Marathon Gold, 2020) include woodland caribou (*Rangifer tarandus caribou*), moose (*Alces alces*), black bear (*Ursus americanus*), Canada lynx (*Lynx canadensis*), coyote (*Canis latrans*), red fox (*Vulpes vulpes*), marten (*Martes*), muskrat (*Ondatra zibethicus*), river otter (*Lontra canadensis*), southern red-backed vole (*Myodes gapperi*), meadow vole (*Microtus pennsylvanicus*), snowshoe hare (*Lepus americanus*), and American red squirrel (*Tamiasciurus hudsonicus*). Mink (*Neovison vison*), ermine (*Mustela erminea*), northern long-eared bat (*Myotis septentrionalis*), and little brown bat (*Myotis lucifugus*) are also expected to occur in the vicinity of the project.

Broadly, the avifauna groups present in this area include passerines, waterfowl, upland gamebirds, and raptors. Based on the available information, which included literature, project-specific field studies, and federal and provincial databases, a total of 98 species of birds were identified as having the potential to occur in or near the project. The most commonly recorded passerine species included white-throated sparrow (*Zonotrichia albicollis*), ruby-crowned kinglet (*Regulus satrapa*), Swainson's thrush (*Catharus ustulatus*), boreal chickadee (*Poecile hudsonicus*), black-capped chickadees (*Poecile atricapillus*), Canada jay (*Perisoreus canadensis*), black-and-white warbler (*Niotilta varia*), yellow-bellied flycatcher (*Empidonax flaviventris*), and common loon (*Gavia immer*) (a waterbird). The raptors observed in the vicinity of the project area were boreal forest-dwelling species that rely on the habitat for nesting, hunting, and breeding. In general, waterfowl were common in wetland and open water habitats in the vicinity of the project during spring breeding and fall staging periods. A Sensitive Wildlife Area along the Victoria River was identified as containing important waterfowl habitat (NL-EHJV, 2008). While this area overlaps with the project area, the waterfowl habitat that was likely the focus of this designation are "steadies" on the Victoria River system located north of the mine site, before the river drains into Red Indian Lake (B. Adams, pers. comm, 2020).

Habitats in the area also support designated species at risk (SAR) and species of conservation concern (SOCC). In Canada and in Newfoundland and Labrador, SAR include species listed as Extirpated, Endangered, Threatened, Vulnerable, or of Special Concern under the Newfoundland and Labrador *Endangered Species Act* (NL ESA), the federal *Species at Risk Act* (SARA), or by the Status of Endangered Wildlife Species in Canada (COSEWIC) (COSEWIC, 2017). SOCC include those species recommended for listing by the Species Status Advisory Committee (SSAC) as Endangered, Threatened, Vulnerable, of Special Concern, or are considered provincially rare by the Atlantic Canada Conservation Data Centre (AC CDC) (Stantec, 2017d).

Most of the project area is not considered to have high potential for rare vascular plant species due to habitat type, tree species composition, stand age, and/or microclimatic conditions (Stantec, 2019a). While no plant SAR or SOCC was identified in the project area during 2019 vegetation surveys (Stantec, 2019a), three plant SOCC were identified during 2017 field surveys of the project area. These were nodding water nymph (*Najas flexilis*), identified at a single location within the footprint of the proposed Marathon pit; short-scaled sedge (*Carex deweyana*); and perennial bentgrass (*Agrostis perennans*) (Stantec, 2017d). The provincial status rank (S-rank) for these three species is S2 (imperilled). Four graminoid (grass) species of SOCC were identified during regional surveys conducted in 2014 in support of the project's ELC.

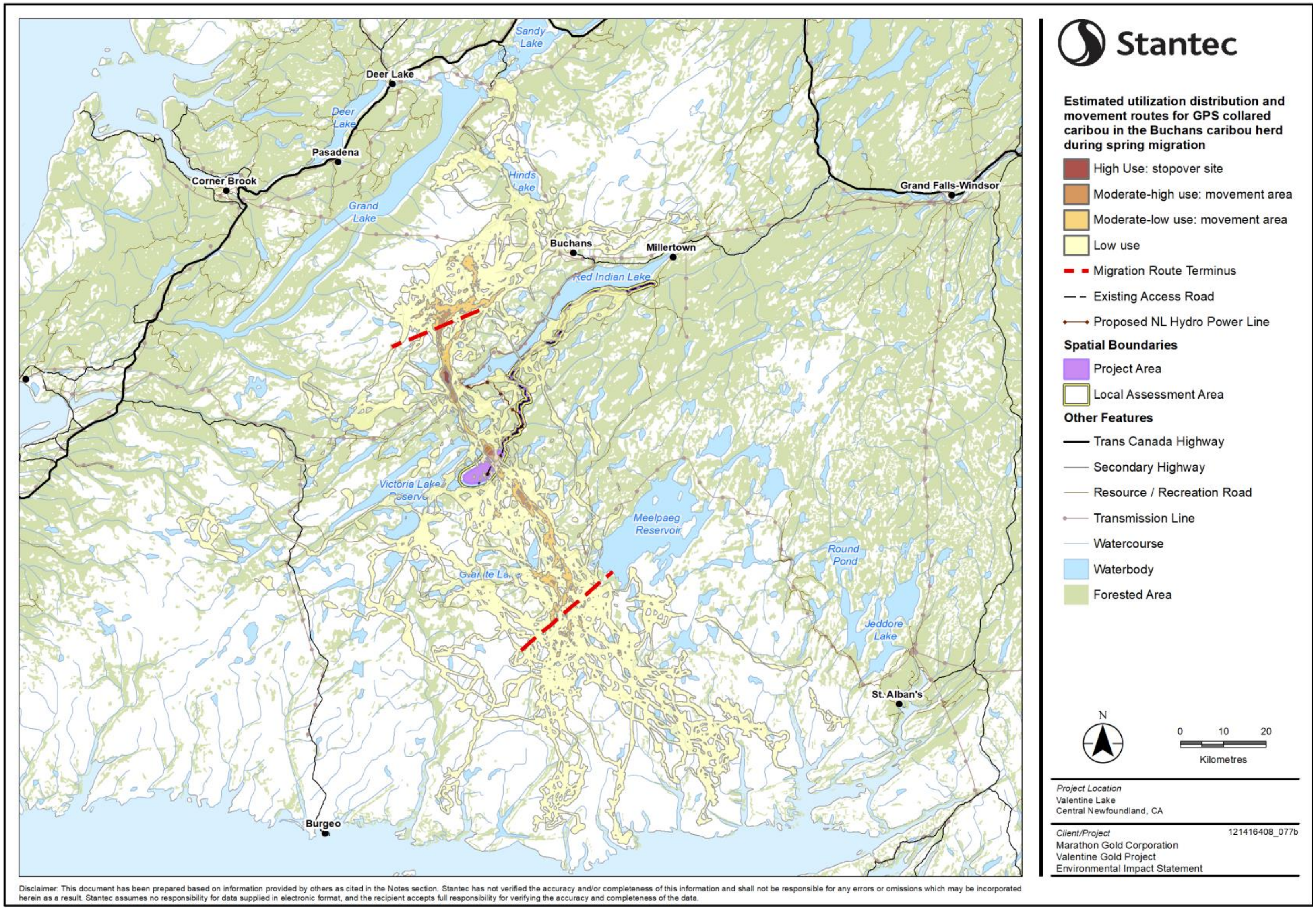
Caribou on the island of Newfoundland have been assessed as special concern by COSEWIC (COSEWIC, 2014). The project area overlaps or is in proximity to the ranges of caribou herds including the Buchans, Grey River, Gaff Topsails, and La Poile herds. Collectively, these herds represent approximately 36% of the caribou population on the island of Newfoundland (Government of NL, 2019a). The caribou population on the island of Newfoundland has recently declined, most likely due to a combination of food limitation with predation by coyotes. Recent population estimates indicate that the Grey River, Gaff Topsails and La Poile herds have decreased by 60-80% compared to population peaks recorded from the late 1980s. Recent surveys indicate that population trends for the caribou herds noted above may be stabilising (Government of NL, 2019a). The project area overlaps with the Grey River Caribou Management Area. Animals from the Buchans herd migrate through the mine site semi-annually (Figures 20-2 and 20-3), while resident caribou from the Grey River herd, can occur year-round within the project area. The La Poile herd has no overlap with the project area, and only a small portion of the winter range of the Gaff Topsails herd overlaps with the project area.

American marten (Newfoundland population) has been observed within the project area (incidental sightings, and marten hair snag traps). The Newfoundland population of marten is listed as Threatened and is protected under SARA (COSEWIC 2007) and the NL ESA. A small portion (6.3 km^2) of proposed critical habitat for American marten (Newfoundland population) overlaps the project area.

With respect to avifauna, three SAR (olive-sided flycatcher *(Contopus cooperi*), common nighthawk (*Chordeiles minor)*, and rusty blackbird (*Euphagus carolinus*)) and three SOCC (Caspian tern (*Hydroprogne caspia*), bay-breasted warbler (*Setophaga castanea*) and Nashville warbler (*Leiothlypis ruficapilla*)) were observed in the in the vicinity of the project area during field studies. Six olive-sided flycatchers were recorded in the project area in 2019. The rusty blackbird is listed as Special Concern under federal legislation and as Vulnerable under provincial legislation.

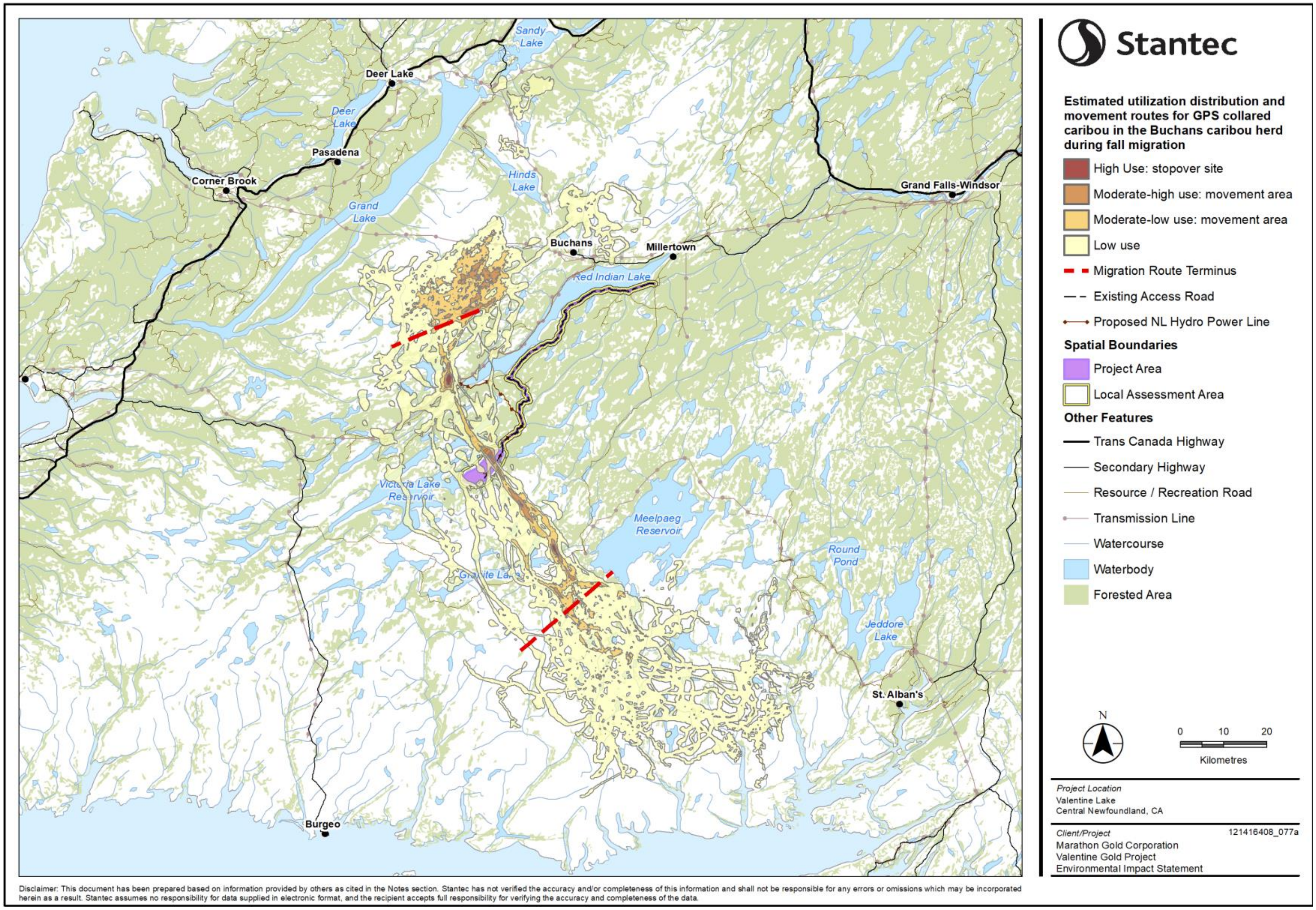
Additional SAR and SOCC have the potential to occur in the project area based on available habitats. While not detected in field studies, northern long-eared bat (*Myotis septentrionalis)* and little brown bat (*Myotis lucifugus)* are expected to occur in the vicinity of the project, based on the occurrence of mature mixed wood forest in the region. The nearest confirmed bat hibernation site is over 12 km from the project area. Gray-cheeked thrush (*Catharus minimus*), red crossbill (*Loxia curvirostra*), and bank swallow (*Riparia riparia*) may also occur in the project area (Stantec, 2014a).

Figure 20-2: Estimated Utilisation Distribution & Migration Corridors for GPS Collared Caribou in the Buchans Herd During Spring Migration



Source: Stantec, 2021.

Figure 20-3: Estimated Utilisation Distribution & Migration Corridors for GPS Collared Caribou in the Buchans Herd During Fall Migration



Source: Stantec, 2021.

20.1.2 Aquatic Ecosystem

The project is situated along a boundary between the Exploits River Watershed and the Bay D'Espoir Watershed (also referred to as the White Bear Watershed). The Victoria Lake Reservoir, to the south of the project area, was created in 1967 with the construction of the Victoria Lake Reservoir dam and spillway at the outflow of Victoria Lake, which originally flowed via the Victoria River to Red Indian Lake and ultimately to the Exploits River. With the construction of the dam, flow from Victoria Lake was diverted in a generally southeast direction to Bay D'Espoir and the Victoria Lake Reservoir is now part of the White Bear Watershed. The dam and spillway are located close to the project and remain operational. There are multiple hydroelectric projects downstream, between Victoria Lake Reservoir and Bay D'Espoir. The head of the Victoria River (altered by hydro development) to the east of the project area, and Valentine Lake to the northwest, feed into the Exploits River, one of the most important Atlantic salmon rivers on the Island for numbers of salmon returning.

Within the region, sea-run and landlocked (ouananiche) Atlantic salmon (*Salmo salar*), brook trout (*Salvelinus fontinalis*), Arctic char (*Salvelinus alpinus*), American eel (*Anguilla rostrata*), and threespine stickleback (*Gasterosteus aculeatus*) are known to occur (Cunjak and Newbury 2005; Porter et al. 1974). Migratory habitat of Sea-run Atlantic salmon and American eel is interrupted by several hydroelectric dams which provide upstream passage but may not facilitate optimal downstream migratory passage. The sea-run Atlantic salmon are part of the Northeast Newfoundland Atlantic Salmon population and are designated as Not at Risk by COSEWIC (COSEWIC 2010). Victoria Lake Reservoir and Valentine Lake are not accessible to sea-run Atlantic salmon. American eel is designated as Threatened by COSEWIC (COSEWIC 2012). American eel is known to occur along the access road on the south side of Red Indian Lake; however, it is not known to occur in Victoria Lake Reservoir or Valentine Lake.

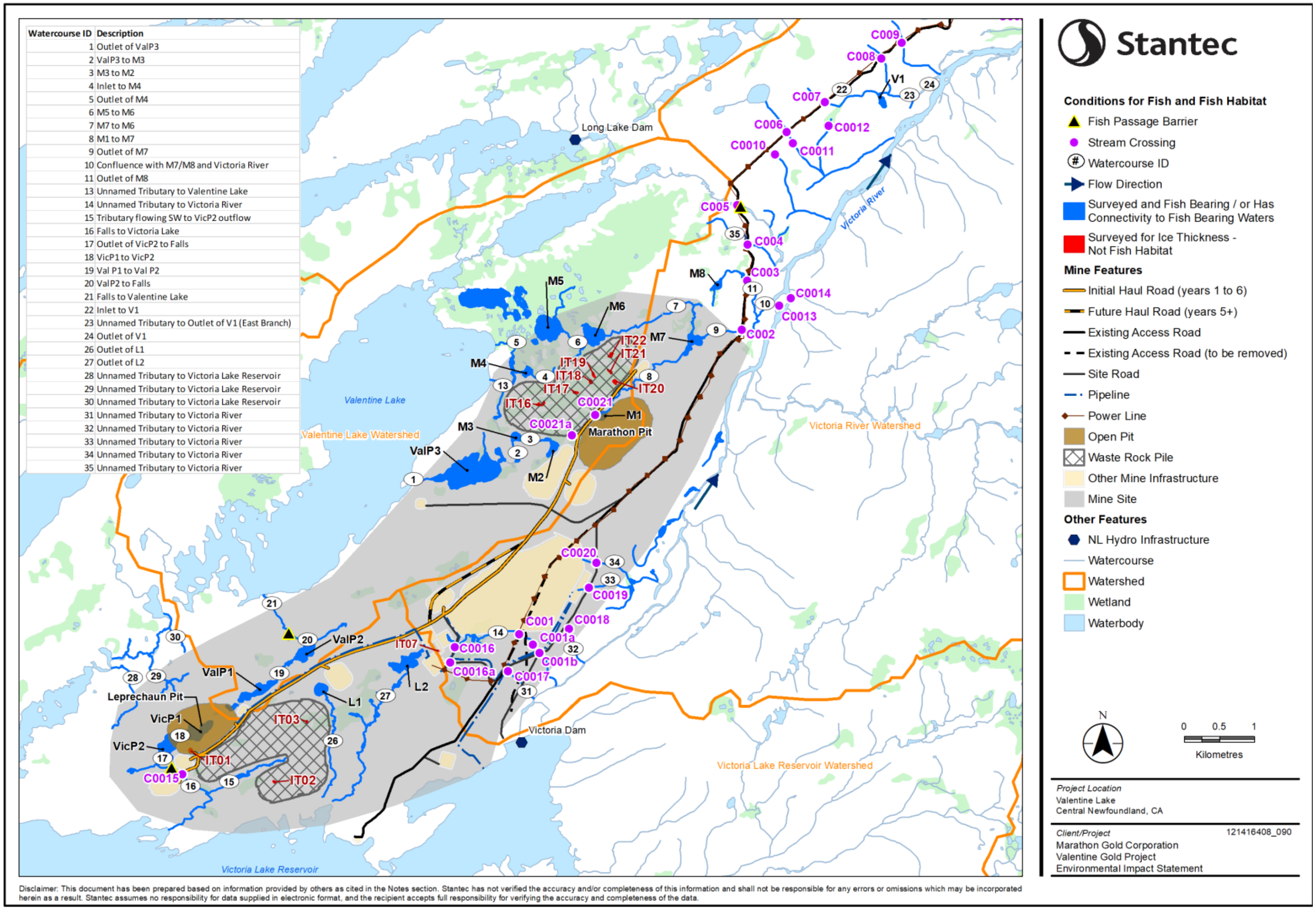
Aquatic baseline studies were completed in the project area in 2011, 2018, 2019 and 2020. Fish habitat at the mine site was characterised in ponds, bog holes, lakes, and streams (Figure 20-4). Ponds surveyed were estimated to have a maximum depth of 2 m and contain a high proportion of fines and low amounts of aquatic vegetation, with surface areas ranging from 0.5 to 26 ha. Habitat was shallow and generally poor for spawning, young of the year (YOY), juvenile, and adult life stages of brook trout and Atlantic salmon (ouananiche). However, habitat was more suitable for threespine stickleback. No fish SAR were captured in ponds, lakes, or streams in the Aquatic Survey Area.

Several bog holes surveyed within the proposed footprint of project infrastructure were frozen to the bottom and were therefore assumed to not be fish habitat. Fishing effort at these bog holes resulted in no fish catches, demonstrating that the bog holes within the project footprint do not support fish.

For Victoria Lake Reservoir, water depths in the reservoir are likely 35 m greater than pre-dam depths. Shorelines drop steeply in the lake, limiting the littoral zone, with shorelines consisting of rock and sand. The lake is naturally devoid of aquatic vegetation; however, the lake was found to contain generally suitable habitat for spawning, YOY, juvenile and adult life stages of brook trout, Atlantic salmon (ouananiche) and Arctic char. For Valentine Lake, with a maximum water depth of 25.4 m, suitable habitat was determined to be present based on the depth preferences of brook trout, threespine stickleback and Atlantic salmon (ouananiche).

The streams that were surveyed within the Aquatic Survey Area (which included the mine site and areas immediately adjacent), were generally small (<5 m width), shallow (<0.5 m), and slow flowing (<0.2 m/s). First order, low gradient streams that flowed through bog or wetland habitats were generally characterised by shallow flats with slow / negligible velocities, and fine grain substrates.

Figure 20-4: Aquatic Survey Area (Based on the Project Site Layout as Presented in the EIS)



Source: Stantec, 2021.

The lower reaches of streams were generally more riffle / run habitat, associated with increased gradient and velocities, coarser substrates, well-defined channels, and generally permanent flow characteristics. Habitat quality in streams was highly variable. First order streams that drained wetlands were generally poor for spawning, YOY, juvenile and adult life stages of brook trout and Atlantic salmon (ouaninache) due to the large quantity of fine grain substrates, while providing more suitable habitat for threespine stickleback. Rocky reaches of streams provided suitable habitat for spawning and rearing habitat for YOY, juvenile and adult life stages of brook trout. Higher order streams with gravel and cobble substrates provided spawning habitat and rearing habitat for YOY and juvenile Atlantic salmon (ouaninache). Suitable fish habitat was also found at several proposed stream crossing locations.

In general, the surface water quantity and quality in the project area and vicinity is within the acceptable ranges for supporting cold water fish communities, with mean discharges ranging from 0.004 m^3/s to 0.352 m^3/s throughout the year. Mean monthly flows were found to be highest in June and July, with the lowest flows occurring in October and November, with some streams becoming intermittent, due to low flows. In pond, lake, and stream sediments, there were no exceedances of the Canadian Sediment Quality Guideline Probable Effects Limits except for arsenic which was above the guidelines. In NL, naturally high arsenic levels are not uncommon and are influenced by bedrock geology, surficial and chemical processes, and proximity to areas of mineralisation (particularly copper and gold) (Serpa et al. 2009).

The lakes and ponds in the Aquatic Study Area were characterised by generally low primary productivity (i.e., the production of chemical energy into organic compounds by living organisms), while streams were characterised as having low to moderate primary productivity. Secondary productivity, characterised by benthic invertebrate community descriptors, showed that density (number of individuals per m^2) was variable in ponds, lakes, and streams, even within similar habitat types. Species evenness (a measure of the diversity of a benthic community) was low in ponds and moderate in lakes, while benthic invertebrate community diversity was moderate in both ponds and lakes. Overall, the benthic invertebrate communities were representative of undisturbed aquatic habitat.

20.1.3 Social, Cultural & Economic Environment

The project is located in a rural region and not within the boundaries of a municipality. The closest communities are the Town of Millertown, the Town of Buchans and the Local Service District of Buchans Junction. These nearby communities, along with Badger, Grand Falls-Windsor, and Bishop's Falls, have been shaped primarily by natural resource-based industries, including mining, forestry, and hydroelectric developments.

Exploration in the Buchans area began in the early part of the 20th century, and production of base metals (e.g., copper, zinc, and lead) began in 1926. A base metal mine established near Buchans contributed substantially to the provincial economy until closure in 1984 (Wardle, 2004). The region saw an economic resurgence with continued exploration and the discovery of the Duck Pond base metal deposit in 1987. Duck Pond Operations began commercial production in 2007, employing more than 270 people in the local Buchans-Millertown region (Canadian Mining Journal Editor, 2013). Duck Pond, the only recently active mine in the area, ceased operation in July 2015 (Teck, 2016). Some limited employment and procurement opportunities associated with the Duck Pond operation remain through the three-phase decommissioning process. There are currently no operating mines in the region, although mineral exploration has continued and there are many mineral licenses surrounding the project area.

Forestry and logging were important economic drivers in central Newfoundland from the early 20th century until the early 21st century. The industry was primarily in support of the pulp and paper industry, which was greatly reduced following the closure of Abitibi-Consolidated Inc.'s mill in Grand Falls-Windsor in 2009.

In 2016, the main industries providing employment to residents of the region were health care and social assistance, retail trade, and construction (Statistics Canada, 2017).

The region is also used for recreational activities, including hunting, fishing, hiking, backcountry camping, snowmobiling, ATV use and boating. Numerous gravel roads, formerly Abitibi forestry access roads that are now maintained by the provincial government, provide access to the area for recreational and other users. There are several private cabins in the region, primarily around ponds, lakes, and rivers. There are also 21 outfitters registered with the Land Division within a 35 km radius of the project area, nine of which are active (according to Tourism NL). The project area occurs within several provincial hunting and trapping areas for big game (e.g., moose, caribou, black bear) and small game (e.g., coyote, hare, furbearers).

Angling occurs on several waterbodies in the region. There is an active recreational salmon fishery on the Exploits River, which flows northeast from Red Indian Lake. The Exploits River (including tributaries) is a scheduled salmon river, regulated by Fisheries and Oceans Canada (DFO) under the *Fisheries Act* and the *Canada Wildlife Act*. Based on 2016 population surveys, the returns of Atlantic salmon to the Exploits River system have declined compared to previous five-year means (2011 to 2015), and the egg density was 37% of the conservation requirement (Veinott et al. 2018). Rivers in insular Newfoundland were closed to the retention of Atlantic salmon on July 20, 2018 (DFO 2018a, 2018b). The salmon rivers in the vicinity of the project area are considered 'Class 0' (catch and release) (DFO 2018c).

Currently, most salmon anglers fishing on the Exploits River use the lower river and tributaries from Grand Falls down to the river mouth. The middle section of the river is used less often, and there is little access and angler activity at the upper river above Red Indian Lake Dam (SCNL, pers. comm. 2020). Brook trout, arctic char, and land-locked Atlantic salmon (ouananiche) are also commonly fished in the region. Outfitters in the region reported salmon angling occurring at the Exploits River near Grand Falls-Windsor and Bishop Falls, occasionally at the mouth of Victoria River near Red Indian Lake (Snow Shoe Lake Hunting and Fishing, pers. comm. 2020) and the head of the Exploits River (near Exploits dam). One outfitter also identified areas for ouananiche and brook trout angling along the route between Victoria Lake Reservoir and Bay d'Espoir, including Victoria River, Granite Lake, Meelpaeg Lake, Cowy Lake, Snowshoe Pond, Hospital Pond, Blizzard Pond, and Wilding Lake (Snow Shoe Lake Hunting and Fishing, pers. comm. 2020).

The province manages 55 protected areas, including 31 provincial parks, 16 ecological reserves, three wildlife reserves, two wilderness reserves, and three other protected areas (NLDFLR 2019b). There are three provincial protected areas in the area, including Little Grand Lake Ecological Reserve (~27 km from the mine site and ~23 km from the project area), Little Grand Lake Wildlife Reserve (~28 km from the mine site and ~23 km from the project area), and T'Railway Provincial Park (~76 km from the mine site and ~26 km from the project area).

A Historic Resources Overview Assessment for the project was completed in 2017 and updated in 2020. Within the project area, ethnohistoric evidence indicates that important caribou migration corridors approach and traverse the project area, and that there is theoretical potential for precontact sites of all periods, particularly for sites of Maritime Archaic and late precontact Amerindian peoples, and also, to a lesser extent, potential for Paleo-Eskimo sites. With respect to historic resources, there is potential for Beothuk sites as the project area lies within the territory of the Beothuk prior to the second quarter of the nineteenth century, and potential for historic Mi'kmaq sites dating to the second half of the nineteenth century into the twentieth century.

The Federal EIS Guidelines identify Qalipu Mi'kmaq First Nation (Qalipu) and Miawpukek First Nation (Miawpukek) as Indigenous groups that may be affected by the project. The Miawpukek Reserve is located at the mouth of the Conne River on the south coast of the island of Newfoundland, approximately 113 km from the project area. The area of the reserve is approximately 620 ha. The total registered membership of Miawpukek is 3,063, of which approximately 33% live on reserve. Qalipu was registered as a band under the *Indian Act* in 2011. Although a registered band, Qalipu does not manage any reserve lands. Its members reside within 67 communities across the Island, with the nearest community to the project being Buchans located 49 km to the mine site (straight line distance), and the nearest community by road being Millertown. Qalipu maintains satellite administrative offices in Glenwood, Grand Falls-Windsor, Stephenville, and St. George's, with a head office in Corner Brook. Qalipu currently has approximately 22,000 members.

20.2 Jurisdiction, Applicable Laws & Regulations

20.2.1 Canadian Environmental Assessment Act (2012) & the Newfoundland & Labrador Environmental Protection Act

The proposed project components and ancillary infrastructure are exclusively located within the province of Newfoundland and Labrador. The project is therefore subject to the environmental assessment (EA) provisions of Part X of the Newfoundland and Labrador *Environmental Protection Act* (NL EPA), and the Environmental Assessment Regulations (Section 33 (2)). As the proposed production rate is greater than 600 t/d, the project is subject to the *Canadian Environmental Assessment Act 2012* (CEAA 2012) (Section 16 (c) of the Regulations Designating Physical Activities).

In August 2019, a new *Impact Assessment Act* (IAA) came into force, replacing CEAA 2012. Any EA under CEAA 2012 for which IAAC had already posted a Notice of Commencement continued under CEAA 2012 by default. Within 60 days, however, proponents could request that an EA be continued instead as an impact assessment under the IAA. Due primarily to the potential impacts on schedule associated with transferring the project assessment regime, Marathon Gold elected to continue under CEAA 2012.

Although there is no formal harmonisation agreement between Newfoundland and Labrador and the federal government, a proponent is typically permitted to prepare a single set of EA documents that addresses the requirements of both levels of government.

Marathon Gold submitted an EA Registration/Project Description in April 2019 to the Canadian Environmental Assessment Agency (CEA Agency, now IAAC) and to the EA Division of the provincial Department of Environment, Climate Change and Municipalities (NLDECCM) to initiate the regulatory assessment process. A summary of the Project Description Report is available online at https://ceaa-acee.gc.ca/050/documents/p80169/129223E.pdf. Following a period of public consultation and review of the document by federal and provincial regulators, Marathon Gold was advised on June 21, 2019 that it would be required to prepare an EIS, as was anticipated by Marathon. IAAC published finalised guidelines for the EIS in July 2019, while NLDECCM published finalised guidelines in February 2020.

A single EIS has been prepared by Marathon Gold and its primary EA consultant, Stantec Consulting Ltd., to meet the requirements of CEAA 2012, the NL EPA and the project-specific guidelines issued by the federal government and the provincial government. The EIS was submitted to IAAC and NLDECCM on September 29, 2020 and is available online at https://iaac-aeic.gc.ca/050/evaluations/document/136521. On November 3, 2020, the EIS was determined by IAAC to be conforming with the federal guidelines, and the federal and provincial technical review processes began, overseen by IAAC and a provincial Environmental Assessment Committee (EAC) established under the auspices of NLDECCM. A 50-day public review period occurred concurrently with the regulatory technical review.

As part of the standard EA regulatory process, following the technical reviews IAAC issued information requirements (IR) to Marathon Gold, and NLDECCM specified additional information required in order for ministerial determination to be made on the project. Marathon Gold is developing responses to these requests, to be submitted to the regulators in early 2021.

Once the federal and provincial governments have determined that adequate information has been made available relative to the project, each will make its respective decision regarding whether the project is likely to result in any significant adverse environmental effects and, if so, whether such effects are justified in the circumstances. Permitting for site-specific activities related to the project's construction and operation are expected to commence following successful release from the EA process. A list of key permits that may apply to the project is provided in Section ▯ of this report.

20.2.2 Species at Risk Act (SARA) & NL Endangered Species Act

Both federal and provincial governments regulate species at risk and their protection through specific legislation. SARA is intended to protect species at risk in Canada and their "critical habitat" (as defined by SARA). Under SARA, proponents are required to demonstrate that no harm will occur to listed species, their residences or critical habitat, or identify adverse effects on specific listed wildlife species and their critical habitat, followed by the identification of mitigation measures to avoid or reduce effects. Activities must comply with SARA, with prohibitions against (1) the killing, harming, or harassing of endangered or threatened SAR (Sections 32 and 36); and (2) the destruction of critical habitat of and endangered or threatened SAR (Sections 58, 60 and 61). The NL ESA also provides special protection for native plant and animal species considered to be endangered, threatened or vulnerable in NL.

20.2.3 Fisheries Act

Amendments to the *Fisheries Act* came into force in 2019, reintroducing provisions for the protection of fish and fish habitats, notably the prohibition against harmful alteration, disruption or destruction (HADD) of fish habitat. The Act also prohibits activities that cause the "death of fish" (other than permitted fishing activities), considers the cumulative effects of development activities, and provides additional protection for highly productive, sensitive, rare or unique fish and/or fish habitats. If death of fish or the HADD of fish habitat will likely result from a project, proponents are required to apply for an authorisation from the Minister of Fisheries, Oceans and the Canadian Coast Guard as per Paragraph 34.4(2)(b) or 35(2)(b) of the Fisheries Act Regulations. The application must include an offsetting plan to counterbalance the HADD, along with a financial guarantee as an assurance mechanism in the event that the offsetting plan is not completed. The *Fisheries Act* authorisation will include terms and conditions the proponent must follow to avoid, mitigate, offset and monitor impacts to fish and fish habitat resulting from a project. Other key amendments to the Act include strengthening the role of Indigenous peoples in application reviews and introducing a new permitting framework and codes of practice, and new decision-making criteria.

20.2.4 Metal & Diamond Mining Effluent Regulations

The Metal and Diamond Mining Effluent Regulations (MDMER), pursuant to the *Fisheries Act*, replace the former Metal Mining Effluent Regulations (MMER), with provisions that have come into effect gradually between June 1, 2018 and June 1, 2021.The MDMER strengthens effluent quality standards and improves the efficiency of environmental effects monitoring (EEM).

The MDMER adds requirements for a fish tissue study for selenium (under specified monitoring results), and additional substances to be monitored (i.e., chloride, chromium, cobalt, sulphate, thallium, uranium, phosphorus and manganese) as part of effluent characterisation and water quality monitoring studies. Sub-lethal toxicity testing focuses on the most sensitive test species, and biological monitoring studies focus on aquatic communities facing situations of higher risk for environmental effects. Exemptions may be allowed from some biological monitoring requirements for mines with effluent presenting lower risks of affecting fish and fish habitat.

Effective June 1, 2021, the authorised discharge limits for some deleterious substances (arsenic, copper, cyanide, lead, nickel and zinc) are reduced for existing mines (i.e., mines that become subject to the regulations within three years of promulgation of the Amendments), and reduced even further for new mines (i.e., mines that become subject to the regulations more than three years after promulgation of the Amendments). Effective June 1, 2021, un-ionised ammonia will also be added as a deleterious substance as well as a new requirement that effluent to freshwater not be acutely lethal to Daphnia magna.

20.2.5 Carbon Emissions Pricing

In 2016, the federal government announced the Pan-Canadian Approach to Pricing Carbon Pollution, providing flexibility to provinces and territories to develop carbon pollution pricing systems of their own and outlining the required criteria for these systems (ECCC, 2019). Provinces and territories could implement one of two system types, either a direct price on carbon pollution or a cap-and-trade system (ECCC, 2016a). To support this initiative and to facilitate achieving federal emissions reduction targets, the federal government, in consultation with the provinces and territories, developed the Pan-Canadian Framework on Clean Growth and Climate Change, to which Newfoundland and Labrador signed on in December 2016 (ECCC, 2016b). Provinces and territories without jurisdictional carbon pollution pricing systems (meeting the federal benchmark requirements) are required to comply with the federal carbon pollution pricing system.

The Made-in-Newfoundland-and-Labrador Carbon Pricing Plan was approved by the federal government to meet the requirements of the Pan-Canadian Approach to Pricing Carbon Pollution in October 2018 (NLMAE, 2018). The plan consists of a hybrid system containing performance standards for large emitting facilities and large-scale electricity generation, and a carbon tax on fuel combustion, as outlined below:

- Performance standards based on sector benchmarks for industrial facilities emitting more than 25,000 tonnes CO_2e annually under Newfoundland and Labrador's *Management of Greenhouse Gas Act* (2016) (MGGA). Facilities are subject to prescribed greenhouse gas reduction targets as per Section 5 of the MGGA and regulated under performance standards starting in the fourth year of production (and from that year forward) unless an exemption is granted.
- Carbon tax imposed under Newfoundland and Labrador's *Revenue Administration Act* (2011) and the Revenue Administration Regulations (NL Reg. 73/11). The carbon price was introduced on January 1, 2019 at $20 per tonne of CO_2e. Facilities that are regulated under a performance

standard pursuant to the MGGA (Section 5) are not also subject to the Revenue Administration Act carbon tax provisions.

- The Made in Newfoundland and Labrador Carbon Pricing Plan is projected to reduce cumulative GHG emissions by over 0.65 Mt between 2019 and 2030.
- In additional to carbon pricing, there are provincial GHG emission reporting requirements set out in Newfoundland and Labrador's *Management of Greenhouse Gas Act* (2016) and the Management of Greenhouse Gas Reporting Regulations (NL Reg. 14/17). There are three levels of reporting requirements as follows:
- Facilities emitting 15,000 tonnes of carbon dioxide equivalent (CO_2e) or more annually must report their emissions to the provincial government in accordance with the Management of Greenhouse Gas Reporting Regulations.
- Facilities emitting between 15,000 and 25,000 tonnes of CO_2e annually may apply to be designated as opted-in facilities, in which the facility opts to performing a third-party verification of emissions in compliance with ISO 14064-3 and ISO 14065.
- Facilities emitting more than 25,000 tonnes of CO_2e are subject to annual GHG reduction targets and require third party verification of emission quantifications in compliance with ISO 14064-3 and ISO 14065.

20.2.6 Canadian Navigable Waters Act

The *Canadian Navigable Waters Act* (CNWA), which came into force in August 2019 and replaced the former Navigable Protection Act, applies to anyone planning activities that will affect navigation in navigable waters. The CNWA regulates major works and obstructions on navigable waters, even those not listed on the schedule of navigation, and creates a new category for "major works". Major works are those likely to substantially interfere with navigation, and always require approval from Transport Canada. Transport Canada administers the CNWA through the Navigation Protection Program.

20.2.7 Water Resources Act (2002)

The *Water Resources Act* gives the Water Resource Management Division of the NL Department of Environment, Climate Change and Municipalities (NLDECCM) the responsibility and legislative power for the management of water resources in the province. The Environmental Control Water and Sewer Regulations, under the *Water Resources Act*, which incorporate the limits imposed by the MDMER, will also apply to discharge of water and effluent from the project. Water supply well construction for various project components (e.g., accommodations camp) is regulated under the Well Drilling Regulations (2003), NLR 63/03 under the *Water Resources Act*. The Newfoundland and Labrador Policy for Development in Wetlands (NLMAE 2001) describes developments that are not permitted within wetlands and defines activities that require permitting under Section 48 of the *Water Resources Act*.

In the province of NL, dam improvements and new construction are regulated via the *Water Resources Act*, and a permit to construct a dam is required under Act. The Act does not contain any specific dam safety regulations and the province looks to the Canadian Dam Association (CDA) for guidance on dam safety and references the CDA Dam Safety Guidelines (CDA, 2013) and associated bulletins specifically for any proponent / project contemplating developing or operating a dam for any purpose.

20.2.8 NL Mining Act

The *Mining Act* requires the implementation and documentation of progressive rehabilitation and a Rehabilitation and Closure Plan including applicable records.

20.2.9 Historic Resources Act (1985) (HRA)

The *Historic Resources Act* is administered by the Provincial Archaeology Office (PAO) of the Department of Tourism, Culture, Industry and Innovation, and, in the case of architectural resources, by the Heritage Foundation of NL. Historic resources are typically broken down into four broad categories: archaeological sites and materials (e.g., remains of campsites and/or stone tools pre-dating 1960); cultural / spiritual sites (e.g., Indigenous and non-Indigenous burial sites and other sacred places); paleontological sites and materials (fossils); and architectural resources (e.g., historical buildings and properties).

20.3 Environmental Studies

20.3.1 Baseline Studies

Table 20.1 on the following page lists the environmental baseline studies completed in support of the project, between 2011 and spring of 2020. These environmental studies were attached to the EIS as Baseline Study Appendices and can be accessed at https://iaac-aeic.gc.ca/050/evaluations/document/136521. Baseline studies listed in Table 20.1 were conducted by Stantec, except where noted.

20.3.2 Environmental Impact Statement

As indicated in Section 20.2.1, Marathon Gold prepared and submitted an EIS to meet the requirements of CEAA 2012, the NL EPA and the project-specific guidelines issued by the federal government and the provincial government. The full EIS can be accessed at https://iaac-aeic.gc.ca/050/evaluations/document/136521. A summary of the EIS can be accessed at https://iaac-aeic.gc.ca/050/evaluations/document/136514.

20.3.2.1 Scope & Methods

The scope of the project for the purposes of the EIS included the components and activities required to construct and operate the project facilities, as well as to ultimately decommission, rehabilitate and close the facilities at the end of the project life. Project components and activities associated with the primary mining, milling and processing activities include site and haul road construction and maintenance, waste rock management, electrical power supply and distribution, process and potable water supply and distribution, site wide stormwater and effluent management including monitoring, treatment and discharge; fuel storage and fuelling stations; mine and plant workshops and services; administrative office; personnel accommodations and lunchrooms; and security. A power line connected from nearby NL Hydro's Star Lake Generating Station to the mine site will be required to supply power to the project and will be constructed and operated by NL Hydro. The power line will be subject to separate environmental approvals with NL Hydro as the proponent, so was not included within the scope of the project; however, it was considered within the EIS as a contributor to potential cumulative effects.

Table 20.1: Environmental Studies Included as Baseline Study Appendices to the EIS (Marathon Gold, 2020)

Number	Baseline Study Appendix	Attachment Number	Attachment Name
BSA.1	Dam Safety	1-A	Dam Breach Assessment and Inundation Study – Valentine Gold Tailings Management Facility (2020) (Golder)
		1-B	Dam Breach Assimilative Capacity Study for the Valentine Gold Tailings Management Facility (2020) (Golder)
		1-C	Valentine Gold Project Blast Impact Assessment (2020) (Golder)
BSA.2	Woodland Caribou	2-A	Fall 2019 Caribou Survey – Remote Cameras (2019)
		2-B	Spring 2020 Caribou Survey – Remote Cameras (2020)
		2-C	2020 Post-Calving Aerial Survey (2020)
BSA.3	Water Resources	3-A	Valentine Lake Project: Preliminary Baseline Hydrogeology Assessment (2017)
		3-B	Valentine Lake Project: Preliminary Hydrogeology Assessment, Water Level Data (2019)
		3-C	Valentine Gold Project Hydrology and Water Quality Monitoring Baseline Report (2020)
		3-D	Hydrogeology Baseline Report (2020) (GEMTEC)
BSA.4	Fish, Fish Habitat and Fisheries	4-A	Fish and Fish Habitat Data Report (2012)
		4-B	Valentine Gold Project: 2018 Fish and Fish Habitat
		4-C	Aquatic Survey (2019)
		4-D	Ice Thickness Survey (2020)
		4-E	Fisheries Baseline Report
BSA.5	Acid Rock Drainage / Metal Leaching (ARD/ML)	5-A	Phase I Acid Rock Drainage / Metal Leaching (ARD/ML) Assessment (2018)
		5-B	Phase II ARD/ML Assessment (2020)
BSA.6	Atmospheric Environment	Not Applicable	Air, Noise and Light Baseline Field Study (2020)
BSA.7	Avifauna, Other Wildlife and Their Habitats	7-A	Winter Wildlife (2013)
		7-B	2011 Forest Songbird Surveys (2014)
		7-C	2011 Baseline Waterfowl and Waterfowl Habitat Study (2014)
		7-D	Ecological Land Classification (2015)
		7-E	Waterfowl (2017)
		7-F	Vegetation Baseline Study, Rare Plants Survey (2017)
		7-G	Newfoundland Marten (2018)
		7-H	Forest Songbird Survey (2019)
		7-I	Vegetation Baseline Study (2019)
BSA.8	Species at Risk / Species of Conservation Concern	--	Not Applicable
BSA.9	Community Health, Services and Infrastructure / Employment and Economy	9-A	An Analysis of the Economic Impacts Associated with Marathon Gold's Valentine Gold Project (2020)
		9-B	Estimate of Quarterly Direct Employment by Project Phase and National Occupational Classification (NOC)
		9-C	Educational Requirements by National Occupational Classification (NOC) and Availability of Training Programs within NL
BSA.10	Historic Resources	10-A	Valentine Lake Project: Historic Resources Baseline Study (2017)
		10-B	Valentine Gold Project: Historic Resources Baseline Study 2020 Update (2020)

The assessment of environment effects focused on valued components (VCs), which are the elements of the environment that could be affected by the project and are of importance or interest to regulators, Indigenous groups and stakeholders. Fifteen VCs were identified as relevant and important to the environmental assessment based on regulatory requirements and engagement with Indigenous groups and stakeholders. These were: Atmospheric Environment; Groundwater Resources; Surface Water Resources; Fish and Fish Habitat; Vegetation, Wetlands, Terrain and Soils; Avifauna; Caribou; Other Wildlife; Community Services and Infrastructure; Community Health; Employment and Economy; Land and Resource Use; Indigenous Groups; Historic Resources; and Dam Infrastructure. For each VC, a local assessment area (LAA) and regional assessment area (RAA) were identified to provide spatial boundaries for the assessment.

Scoping establishes the parameters of the EA and focuses the assessment on relevant issues and concerns. The factors considered for the EA for the project included the following:

- purpose of and need for the project
- alternatives to the project and alternative means of carrying out the project
- public and stakeholder comments and Indigenous group input
- local knowledge
- environmental effects of the project, including effects due to accidents and malfunctions, as well as consideration of cumulative effects of the project in combination with other projects and activities
- technically and economically feasible mitigation measures to avoid or reduce adverse effects or enhance or prolong beneficial environmental effects
- residual (post-mitigation) environmental effects that are beneficial or harmful that are likely to be caused by the undertaking regardless of the mitigation measures applied
- significance of the identified environmental effects
- requirements for follow-up programs
- changes to the project that may be caused by the environment
- the capacity of renewable resources that are likely to be significantly affected by the project to meet the needs of the present and those of the future
- the future predicted condition of the environment without the project

The EIS included a characterisation of the existing conditions within the spatial boundaries of each VC, including a discussion of the influences of past and present physical activities on the VC leading to the current conditions. The assessment followed standard EA methods for describing project interactions with each VC and for determining potential environmental effects associated with the project during construction, operation, and decommissioning, rehabilitation and closure phases.

The EA process serves as a mechanism to consider results of engagement in early project planning, and Marathon's EIS has incorporated outcomes of engagement in order to avoid and reduce adverse environmental effects. Several important aspects of the project concept and engineering design have been modified, refined and adapted to reduce potential adverse effects. These changes were made during the project pre-feasibility study and in consideration of discussions with regulators, stakeholders and Indigenous groups, and in response to input received during public, Indigenous and regulatory review of the Registration / Project Description submitted to the federal and provincial governments in April 2019.

20.3.2.2 Results of the EIS

The environmental assessment predicts that routine project activities will not cause significant adverse environmental effects on any of the VCs, with the exception of caribou. Similar results were determined for cumulative effects, where project effects are considered in combination with the effects of other projects (past, present, and reasonably foreseeable future projects).

The general results of the assessment that relate to the key issues raised by regulators, Indigenous groups, and stakeholders, are summarised below. A more detailed summary of residual effects for each VC is provided in Table 20.2. The EIS should be consulted for a full description of predicted residual effects of the project (Marathon Gold, 2020) (https://iaac-aeic.gc.ca/050/evaluations/document/136521):

- Employment and Economic Benefits: There are substantial employment and economic benefits to flow from the project to the benefit of local communities, the Central Region of NL, and the province. The development of an on-site accommodations camp for all workers, on-site medical and emergency response resources will reduce potential adverse effects on local community infrastructure and services. Local hiring and contracting policies for direct employment and contracts, and induced employment and business in the region will result in substantial benefits to the local, regional and provincial economy over a 15-year period (including construction, operation and decommissioning, rehabilitation and closure).
- Water Resources: The environmental assessment has determined there are no significant residual effects on groundwater or surface water resources resulting from routine project activities, or from the cumulative effects of the project in combination with other past, present, or reasonably foreseeable future projects. In the event of an accidental event such as a large spill of hazardous materials or effluent release, the risk of effects occurring is reduced based on contingency and emergency response plans. For a dam breach of the full-height TMF, there will be surface water effects in the Victoria River and a relatively small portion of Red Indian Lake only, and the effects are substantially reduced 2 km downstream from the TMF, in the Victoria River.
- Fish and Fish Habitat: The environmental assessment has determined there are no significant effects on fish and fish habitat that will result from routine project activities or from the cumulative effects of the project in combination with other past, present, or reasonably foreseeable future projects. Some small streams and ponds on site will be affected by project development and operation, most of which is habitat for threespine stickleback only. Marathon Gold will develop and implement a Fish Habitat Offsetting Plan in consultation and with approval of Fisheries and Oceans Canada (DFO) that will create replacement habitat in a nearby location. For accidental events, a potential TMF dam breach carries the most substantial risk. The assessment has determined that for the worst-case TMF dam breach, effects will be limited to the Victoria River and a relatively small area of Red Indian Lake, and therefore will not affect Atlantic salmon resources in the Exploits River.

Table 20.2: Summary of Residual Effects from Routine Project Activities

Valued Component	Potential Environmental Effects	Summary of Residual Effects Predictions	Select Key Mitigation*
Atmospheric Environment	• Changes in air quality • Changes in GHG emissions • Changes in ambient sound quality • Changes in ambient light levels	Residual project-related effects to air and sound quality during the construction and operation phases of the project will result from air contaminant and noise emissions, although the magnitudes of releases will be limited and well managed. Residual project-related effects to GHG emissions during construction and operation represent a small contribution to provincial and national GHG emissions. With proper design, the levels of light trespass, glare and skyglow will be maintained at levels representative of a rural environment. With mitigation and management measures, residual environmental effects on the atmospheric environment are predicted to be **not significant**.	• Best practices from Blaster's Handbook (ISEE 2016) and Environmental Code of Practice for Metal Mines (ECCC 2009) will be followed to reduce and monitor noise emissions during blasting. • An Air Quality Management Plan will be developed and implemented as part of the EPP. The Air Quality Management Plan will specify the mitigation measures for the management and reduction of air emissions during project construction and operation. • Project facilities and infrastructure will be designed to limit noise emissions and where practicable. • Ambient air quality and noise monitoring programs will be implemented throughout the life of the project, as required and in accordance with project permitting and conditions of approval. • A Greenhouse Gas Management Plan will be created to manage project GHG emissions, and outline and track the effectiveness of mitigation measures, including follow-up and monitoring activities. • Project lighting will be limited to that which is necessary for safe and efficient project activities. Lighting design guidelines will be followed, such as the Commission Internationale de L'Éclairage, International Dark Sky Association, Illuminating Engineering Society, and the lighting requirements for workspaces, as applicable.
Groundwater	• Changes in groundwater quantity • Changes in groundwater quality	During construction, local changes in infiltration rates and changes in evapotranspiration rates and runoff are considered to have a limited effect on groundwater resources due to their limited extent of development (footprint) during construction. During operation, the lowering of water levels through continued dewatering of the open pits, and the continued development of the waste rock piles and stockpiles and operation of the TMF is predicted to result in a change in groundwater level is less than 5 m in the project area and 1 m in the LAA/RAA; therefore, the magnitude of the effect is considered low to moderate. The magnitude of changes to groundwater quality effects during all phases of the project will be low in the LAA/RAA, as the change in groundwater quality will not adversely affect any existing or reasonably foreseeable groundwater users. With mitigation and management measures, residual environmental effects on groundwater resources are predicted to be **not significant**.	• Marathon Gold will implement a Water Management Plan for the site which will incorporate standard management practices, including drainage control, excavation and open pit dewatering which collectively comprise the water management infrastructure currently designed as part of the project scope. The Water Management Plan provides detail on runoff and seepage collection strategies and systems (e.g., local seepage collection ponds, berms, drainage ditches, pumps) to collect and contain surface water runoff and groundwater discharge from major project components (open pit, waste rock piles, TMF, ore stockpile and overburden storage areas, process plant) during climate normal and extreme weather conditions. • Groundwater quality and quantity will be monitored and adaptively managed, if required, using a network of groundwater monitoring wells to document project effects on groundwater flow and quality. Monitoring locations will be maintained until the water levels and water quality have stabilised post-closure. • Progressive rehabilitation (e.g., placement of soil cover and vegetation over waste rock piles, erosion stabilisation and temporary vegetation of completed organics, topsoil, and overburden stockpiles) will be implemented. • Open pit filling will be accelerated at closure, which will return groundwater levels to baseline conditions in a shorter timeframe.
Surface Water	• Changes in surface water quantity • Changes in surface water quality	Expected mean annual flows (MAFs) were calculated for the 23 local watersheds overlapped by project infrastructure during the construction, operation, and closure phases of the project. At the LAA boundaries for the Victoria River, Valentine Lake and Victoria Lake Reservoir, with mitigation measures and environmental measures applied, changes in MAF are less than 10%. Effluent water quality will be below MDMER limits at the final discharge points and no watershed management targets will be contravened. Local water quality immediately downstream of some final discharge points and points where seepage enters surface water will experience increases of parameters of potential concern (POPC) above baseline levels and the Canadian Water Quality Guidelines for the Protection of Aquatic Life (CWQG-FAL). However, these changes are expected to be contained within the boundaries of the LAA and to be dissipated within 300 m of entering one of the three ultimate receiving waterbodies. With mitigation and management measures, residual environmental effects on surface water resources are predicted to be **not significant**.	• Marathon Gold will implement a Water Management Plan for the site which will incorporate standard management practices, including drainage control, excavation and open pit dewatering which collectively comprise the water management infrastructure currently designed as part of the project scope. The Water Management Plan provides detail on runoff and seepage collection strategies and systems (e.g., local seepage collection ponds, berms, drainage ditches, pumps) to collect and contain surface water runoff and groundwater discharge from major project components (open pit, waste rock piles, TMF, ore stockpile and overburden storage areas, process plant) during climate normal and extreme weather conditions. • Progressive water management will be implemented over the life of the mine. This includes construction of water management infrastructure as an area is developed and decommissioning / rehabilitation of water management infrastructure as an area is decommissioned. • Water withdrawals from Victoria Lake Reservoir and Valentine Lake, for the purposes of expediting the filling of the open pits, will be done in accordance with a pumping operations plan. This plan will be developed to reduce effects on the lakes. • A water treatment plant will receive discharge water from the tailings pond and use proven processes to treat the water to meet MDMER limits prior to discharge to the polishing pond and subsequent discharge to the environment.

Valued Component	Potential Environmental Effects	Summary of Residual Effects Predictions	Select Key Mitigation*
			• Passive water quality treatment technologies will be employed, where and if required, for closure / post-closure including engineered wetlands to treat site seepage and runoff, as practicable.
Fish and Fish Habitat	• Changes in fish habitat quantity • Changes to fish habitat quality • Changes to fish health and survival	The project is conservatively anticipated to result in the direct and indirect loss of 183,537 m^2 of fish habitat within the LAA. Overall, the effects to fish habitat are not expected to affect sustainability and productivity of the fisheries, and fish habitat loss will be offset with habitat of similar quality, and equal or higher quantity. Given that project discharge is predicted to meet MDMER limits, residual adverse effects on fish health and survival resulting from release of deleterious substances are anticipated to be negligible to low. Residual project-related effects to fish habitat quality from methylmercury production in organic soils or terrestrial vegetation (resulting from flooding the TMF) are anticipated to be negligible to low with mitigation. Structures will be designed to avoid impingement and entrainment of fish and to allow fish passage, avoiding residual effects on fish health and survival. Increased angling by project employees will not occur as prohibitions will be in place for all stages of the project. With mitigation and management measures, residual environmental effects on fish and fish habitat are predicted to be **not significant**.	• Siting of project infrastructure will be designed to avoid fish habitat to the extent practicable. Where Harmful Alteration, Disruption or Destruction (HADD) of fish habitat cannot be avoided, the habitat will be offset, as required by the *Fisheries Act*, through the development and implementation of a Fish Habitat Offsetting Plan. • In-water work will be planned to respect DFO timing windows to protect fish in Newfoundland and Labrador (DFO 2019). • Minimum flows will be maintained in watercourses where practicable. Where HADD of fish habitat cannot be avoided, habitat alternation, disruption or destruction will be offset. New culverts will be sized appropriately and designed to be passable to fish to maintain fish passage. • The duration of instream works will be minimised. In-water worksites will be isolated from flowing water to contain or reduce suspended sediment where possible. Clean, low permeability material and rockfill will be used to construct cofferdams. When possible, machinery will be operated above the high-water mark or inside of isolated areas. • Use of explosives in or near water will be avoided, however, if required, will follow DFO blasting guidelines. • Best efforts will be made by a qualified environmental professional to relocate fish from areas of in-water works or areas of water drawdown to an appropriate location in the same watershed. • Fish screens and/or other barriers will be installed and maintained to prevent fish from entering water withdrawal intakes.
Vegetation, Wetlands, Terrain and Soil	• Changes in vegetation species diversity • Changes in community diversity • Changes in wetland function • Changes in terrain • Changes in soil quality • Changes in soil quantity	Project-related residual effects on vegetation species diversity include the loss or change of up to 41.0 km^2. This is based on a conservative assumption that all habitat within the project area will be removed or altered; this likely overstates the effect since only a portion of the vegetation will be cleared within the project area. The measurable change in habitat for SOCC will be less than 5% of the habitat within the ELCA. For changes to community diversity, it is conservatively predicted that ~65.6 km^2 of vegetation communities could be altered by the project through direct (clearing activities at the mine site) and indirect (e.g., edge effects and hydrological changes) effects. This is less than 5% of the total area of ecological communities in the ELCA, resulting in adverse residual effects that are predicted to be low in magnitude. Overall, the magnitude of the effect on wetland function will be low as the measurable change in wetland area will be less than 5% of the total area of wetlands in the ELCA. The effects include ~3.4 km^2 of direct loss within the footprint of site features; 9.7 km^2 of wetlands directly or indirectly affected within the project area; 10.2 km^2 affected by road upgrades / dust deposition; conservative estimate of 6.3 km^2 of potentially affected wetland area through changes to hydrological outputs and groundwater drawdown). Adverse residual effects related to terrain and terrain stability are anticipated to be low in magnitude. For soil quality, the project is predicted to result in a low adverse residual effect. With implementation of erosion control measures, the residual effects on soil quantity are predicted to be low in magnitude. With mitigation and environmental protection measures, the residual environmental effects on vegetation, wetlands, terrain, and soils are predicted to be **not significant**.	• Project footprint and disturbed areas will be limited to the extent practicable. Sensitive areas (e.g., wetlands, hibernacula, mineral licks, roosts, caribou migration corridors) will be identified prior to construction and appropriate buffers will be flagged and maintained around these areas, where feasible. • Where crossing of wetlands beyond the area to be cleared is unavoidable, protective layers such as matting or biodegradable geotextile and clay ramps or other approved materials will be used between wetland root / seed bed and construction equipment if ground conditions are encountered that create potential for rutting, admixing or compaction. • Known occurrences of plant SOCC will be avoided. If avoidance of plant SOCC is not possible, seed collection or transplant of the plant will be considered in consultation with the applicable regulators. • Slope stability will be considered with respect to the development of project infrastructure, and if required a slope stability assessment will be conducted for areas where risks may exist. Where possible, construction in areas with potentially unstable terrain will be avoided. Where avoidance is not possible, best management practices will be implemented which may include: – Reduction of slope gradient with grading or terracing – Slope stabilisation methods: retaining wall, drainage management, etc. – Geotextiles, wire mesh, shotcrete to manage erosion and rockfall potential. – Revegetating soil slopes as soon as possible • Marathon Gold will develop and implement a Soil and Rock Management Plan as part of the Environmental Protection Plan, which will outline management practices for handling of overburden / soils and associated stockpiles. Soil management will also be conducted in accordance with the Rehabilitation and Closure Plan. • Marathon Gold will develop a Rehabilitation and Closure Plan that meets the requirements of the Department of Industry, Energy and Technology, Department of Environment, Climate Change, and Municipalities, and Department of Fisheries, Forestry and Agriculture. The plan will be reviewed and updated regularly until implemented. • Progressive rehabilitation (e.g., placement of soil cover and vegetation over waste rock piles, erosion stabilisation and temporary vegetation of completed organics, topsoil, and overburden stockpiles) will be implemented.

Valued Component	Potential Environmental Effects	Summary of Residual Effects Predictions	Select Key Mitigation*
Avifauna	• Changes in habitat • Changes in mortality risk	~ 35 km² of potential avifauna habitat will be potentially lost within the project area (based on a conservative assumption that all habitat within the project area will be lost). ~ 51 km² of avifauna habitat is conservatively predicted to be altered due to sensory effects. With the application of mitigation measures, residual adverse effects are anticipated to be low in magnitude and localised to the LAA. Critical habitat, as defined by SARA, has not been designated for any of the avifauna SAR observed within the project area, nor noted as potentially being within the LAA. While mortality risk could be increased by project activities, incidents are predicted to be infrequent. With mitigation and management measures, residual environmental effects on avifauna are predicted to be **not significant**.	• An Avifauna Management Plan will be developed and implemented for the project and will include such measures as conducting pre-clearing surveys for active migratory bird nests during the breeding bird season and buffer / set-back distances from active nests. Where practicable, clearing and grubbing during the breeding season will be avoided. • Trees that provide actual or potential habitat will be retained where safe to do so and technically feasible. Removal activities, where required, will be scheduled to the extent practicable, outside the migratory bird breeding season. If tree clearing is required during the migratory bird breeding season, experienced environmental monitors will inspect the trees to assess occupancy before tree removal. • Avifauna use of the TMF ponds, open aquatic areas and other key project locations will be monitored (primarily targeting waterfowl but also other wildlife species). If problematic avifauna use occurs, adaptive management measures (e.g., deterrents and/or exclusionary measures) will be implemented. • Prior to demolishing existing building and infrastructure, surveys for breeding birds and for bats will be conducted as per the Avifauna Management Plan. Where practicable, existing buildings and infrastructure will be demolished outside of the migratory breeding bird season.
Caribou	• Changes to caribou habitat • Changes to caribou movement • Changes to caribou mortality risk	28.5 km^2 of high and moderate-ranked caribou habitat will be directly lost through site preparation (e.g., vegetation clearing and mine construction), conservatively assuming that all habitat within the project area will be lost. Indirect habitat loss attributed to sensory disturbance within a 500 m buffer around the project area will be up to 57.3 km^2 of high and moderate-ranked habitat. Adverse effects to caribou habitat are anticipated to be low in magnitude. With respect to change in movement, the effects of the project on the migration of the Grey River, Gaff Topsails and La Poile herds are expected to be low. However, adverse effects are anticipated to be high in magnitude for the Buchans herd because of the overlap of the project area with a well-defined and well-used migration corridor. A project-related change in movement could result in changes to timing of movement or movement rate, which may ultimately cause a change in recruitment or survival. With the implementation of mitigation measures, a change in mortality risk for caribou resulting from the project is expected to be greatest for the Buchans and Grey River herds as their ranges overlap the project area. However, the magnitude is anticipated to be low in the construction and operation phases, and negligible to low during decommissioning for all assessed caribou herds. Project-related effects that may affect change in movement of Buchans herd are predicted to be high in magnitude. While caribou may be able to circumnavigate the project, it is unclear what effects a deviation from a migratory corridor will have on the Buchans herd, some of which may not be realised for several years. Given these uncertainties and additional uncertainties related to the effectiveness of planned mitigation, the residual adverse effect of change in movement for the Buchans herd is conservatively predicted to be significant, and therefore, the residual adverse effects of the project on caribou are predicted to be **significant**.	• Caribou crossing on roads / features will be facilitated where they occur (e.g., crossing point across ditch) within the caribou migration corridor. The access road, site roads and haul roads will be designed for provision of low areas in the plowed snowbanks, where practicable, to facilitate wildlife movements: – Breaks in snowbanks will be created at approximately 200 m intervals, to the extent practicable, to provide wildlife crossing opportunities. – Snow berms will typically be less than 1 m tall to facilitate caribou crossing. – Where feasible, breaks in snowbanks will be aligned on opposing sides and with existing wildlife trails, where they occur, to facilitate caribou crossing. • Water management ditches will be designed to allow wildlife crossing opportunities, aligned with wildlife trails where practicable. • The potential for on-site activity to be limited / restricted during caribou migration to reduce sensory disturbance will be reviewed with regulators. • Activities in the Marathon pit area that may result in sensory disturbance to migrating caribou (e.g., blasting, loading, hauling) will be reduced or ceased while caribou are migrating through the corridor and within a set distance from the site (e.g., 10 km north or south). The extent of the activity reduction, and the conditions regarding caribou migration proximity will be determined in consultation with NLFFA-Wildlife Division and potentially developed under an adaptive management approach. • Wildlife-vehicle collisions, near misses or observations of wildlife (caribou, moose) road mortality on site roads and/or involving project vehicles on the access road will be reported to the on-site environmental team and the NLDFFA-Wildlife Division. Adaptive management measures will be implemented should locations of high frequency wildlife-vehicle interactions be identified. • The on-site environment team will be notified if caribou are observed within 500 m of project activities such as vegetation clearing, construction, heavy equipment use, and the environmental manager will determine if the activity will be reduced or delayed (in consultation with NLDFFA-Wildlife Division, as applicable). • The TMF will be monitored daily during caribou migration for hazards to caribou and caribou activity. Observations or signs of caribou within 500 m of the TMF will be reported to the on-site environmental manager. If observed repeatedly, Marathon Gold will employ mitigation measures, such as fencing at the TMF, to discourage caribou from accessing the area. • If caribou are observed near the open pits during migratory periods, fencing may be installed as needed around the crest of the pits to reduce the risk of caribou becoming entrapped or injured. Note that a barrier (usually large rock) is required to be installed adjacent to the pit crest for closure and is usually completed as part of progressive rehabilitation activities – this barrier could be erected to achieve both purposes. Marathon Gold will consult with NLFFA-Wildlife Division on this issue.

Valued Component	Potential Environmental Effects	Summary of Residual Effects Predictions	Select Key Mitigation*
			• Caribou activities during the migratory periods will be monitored in the vicinity of the project through visual observation, aerial surveys, and/or telemetry data from GPS (global positioning system) collars. • To reduce the risk of caribou-vehicle collisions, caribou will have right-of-way except where deemed unsafe to site personnel. If wildlife is on a road, speed will be reduced and vehicle stopped if necessary, to allow wildlife to leave road. • If a caribou mortality is observed or discovered on site or are reported by project personnel, Marathon Gold will report this event to NLDFFA-Wildlife Division as soon as possible. • To reduce sensory disturbance, a visual survey for caribou will be conducted prior to blasting. If caribou are observed within a 500 m blasting radius buffer activity will be delayed until animals have left the buffer.
Other Wildlife	• Changes to wildlife habitat • Changes to wildlife mortality risk	Project-related residual effects on wildlife habitat include the direct loss of habitat for wildlife and habitat avoidance (i.e., indirect loss) due to sensory disturbance. Project activities will also result in some forest fragmentation, particularly within the mine site. Suitable roosting habitat for bats is abundant in the RAA and alternative roosts are predicted to be widely available in the surrounding areas. This is also predicted for other large mammals, furbearers, small mammals, and marten, who have widely available suitable habitat in the RAA; loss of habitat ranged from 2.1% to 8% of the ECLA for all of the key, representative species assessed. Adverse effects to wildlife habitat are anticipated to be low in magnitude. Given proposed mitigation measures and predicted change in mortality risk, adverse effects to mortality risk are anticipated to be low in magnitude during the construction and operation phases, and low to negligible during decommissioning. With mitigation and management measures, residual environmental effects on other wildlife are predicted to be **not significant**.	• Observations of bat colonies, potential hibernacula sites, sick or dead bats will be reported to the provincial Wildlife Division at 709-637-2025. Bat sightings can also be reported to the toll-free bat hotline: 1-833-434-2287 (BATS). • During the construction of buildings or other structures, bats will be discouraged from establishing roost sites by sealing openings of 15 mm in diameter or larger. Chutes and ducts will be sealed at the outside / top, so as to prevent entry by bats. Structures will be assessed to identify potential entry points before they become a problem. • If a bat colony is found to exist within a project structure, bats can remain there when it is safe for people and where there is no chance of contact with people. If it is not safe for bats to remain, Wildlife Division will be contacted to develop an approved removal plan. • Vegetation clearing will be avoided during the bird breeding season, if feasible, which will also protect other breeding wildlife species, by preventing the destruction of small mammal nests and bat maternity roosts. If avoidance is not practicable, pre-clearing surveys will be conducted for bat maternity roosts. Buffers / set back distances will be established if maternity roosts are identified. • Hunting / fishing / harvesting of wildlife will be strictly prohibited on the mine site. Workers will not be permitted to hunt / fish / harvest while staying at the accommodations camp and will not be permitted to bring firearms or angling gear to site.
Community Services and Infrastructure	• Changes to local housing and temporary accommodations • Changes in local services and infrastructure	During construction and operation, workers will be accommodated at a 300-bed accommodations camp at the project site, placing limited demand on current housing and accommodations in the LAA/RAA. A variety of services will be provided at the accommodations camp, including water, wastewater, limited medical, and security, reducing demands on water, sewer, health and emergency health services, transportation, recreation services and infrastructure within the LAA/RAA. it is anticipated that the project will not place additional demands on the local waste infrastructure beyond its capacity. Marathon Gold will reduce the demands on transportation infrastructure by providing buses to move employees between designated local communities and the mine site. With mitigation and environmental protection measures, the residual environmental effects on community services and infrastructure are predicted to be **not significant**.	• Marathon Gold will develop and implement a Traffic Management Plan to manage transportation of workers and materials to site, product leaving site, the number of vehicles accessing the site, and to reduce traffic delays. • Marathon Gold will work to develop cooperative protocols with responsible agencies to address access of project personnel to emergency and other medical services, including employee medicals and check-ups. • Work schedules / rotations for project workers, and the requirement to stay at the mine site accommodations camp during their rotation will deter workers from spending time in local communities and accessing community recreation services and facilities outside of working hours. • Marathon Gold will continue to engage with local communities, including through the negotiation of Community Cooperation Agreements with the six communities in proximity to the project area. Community engagement will include regular updates on planned and ongoing project activities, the timely dissemination of environmental, employment, contracting, and procurement information, and sponsorship of community programs, activities, and initiatives, consistent with Marathon's corporate sponsorship policy and values. • Marathon Gold will liaise with local emergency providers so that roles and responsibilities are understood, and that the necessary resources required to respond are in place.

Valued Component	Potential Environmental Effects	Summary of Residual Effects Predictions	Select Key Mitigation*
Community Health	• Changes in community well-being • Changes in physical health conditions	The project is expected to have a beneficial effect on community well-being index scores of LAA/RAA communities and result in positive effects on community well-being. Workforce education to encourage healthy lifestyle choices will help reduce potential adverse health effects related to negative coping mechanisms, such as drug and alcohol use. To address issues of diversity and inclusion, Marathon Gold will implement the mitigation and management measures identified, including a Gender Equity and Diversity Plan and a business access strategy for members of underrepresented populations. Although the project is anticipated to result in changes to air, water and sound, direct exposures are not expected to exceed health-based guidelines; therefore, the risk of adverse effects to physical health conditions from direct exposures is negligible, while the potential for a change in physical health related to country foods consumption is considered to be low. With mitigation and management measures, residual environmental effects on community health are predicted to be **not significant**.	• Workforce education will be provided to address topics such as: – healthy lifestyle choices – anti-harassment training – cultural awareness training – Marathon's health and safety policies • Marathon Gold will provide an Employee Assistance Program to project personnel. • An on-site first aid facility will be provided with paramedic / nurse / ambulatory technician and an ambulance, as required. Designated, trained personnel will provide transport to the nearest hospital when required. During project construction and operation, first aid stations and equipment will be distributed through the site, as appropriate. • A Gender Equity and Diversity Plan will be implemented that meets the approval of the Minister of Industry, Energy and Technology and Minister Responsible for the Status of Women and Marathon Gold will engage with both Indigenous groups during the development of the Plan. A business access strategy for members of underrepresented populations will be included in the plan. • A Benefits Agreement will be implemented that meets the approval of the Minister of Industry, Energy and Technology and Minister Responsible for the Status of Women. • Marathon Gold will communicate employment information to local communities and Indigenous groups in a timely manner so that local and Indigenous residents have an opportunity to acquire the necessary skills to qualify for potential project-related employment. • Procurement packages will be developed with consideration for capacity and capabilities of local and regional Indigenous and non-Indigenous businesses.
Employment and Economy	• Changes to the regional labour force • Changes in regional businesses • Changes in economic activities of outfitters • Changes in the economy	Based on direct labour costs, a total of 4,861 FTEs of direct employment are estimated over the life of the project (743 during construction, 3,823 during operation and 295 FTEs during decommissioning, rehabilitation, and closure). Approximately 80% of direct employment effects are anticipated to occur in NL. It is estimated that 50% of total direct employment requirements (65% of estimated employment effects in NL) could be filled by residents of the LAA. During operation, wages paid to the project's direct workforce are expected to exceed the range of mean annual wages paid to NL workers employed in comparable industries and sectors. Overall, 45% of domestic indirect employment and labour income effects are expected to occur in NL while the remaining 55% occur in other parts of Canada. Given the relatively small reduction in area and the limited use of the area for resource use, along with the implementation of mitigation and management measures (e.g., prohibiting workers from hunting or bringing firearms to the mine site), adverse effects on outfitters operating near the project area range from negligible to low (low effects anticipated for outfitters that currently operate within a 1 km buffer around the mine site and a 500 m buffer around the access road) in magnitude. For the economy, the project is expected to have a moderate magnitude positive effect on the GDP of the LAA and RAA during construction and operation. With mitigation and management measures, adverse residual environmental effects on economy and employment are predicted to be **not significant**.	• A Gender Equity and Diversity Plan will be implemented that meets the approval of the Minister of Industry, Energy and Technology and Minister Responsible for the Status of Women and Marathon Gold will engage with both Indigenous groups during the development of the Plan. A business access strategy for members of underrepresented populations will be included in the plan. • A Benefits Agreement will be implemented that meets the approval of the Minister of Industry, Energy and Technology and Minister Responsible for the Status of Women. • Marathon Gold will communicate employment information to local communities and Indigenous groups in a timely manner so that local and Indigenous residents have an opportunity to acquire the necessary skills to qualify for potential project-related employment. • Marathon Gold will work with the Province, educational and training institutions, Indigenous groups, and stakeholders to identify skilled trade shortages relative to the project and to identify training needs and opportunities to contribute to a sustainable project workforce. • On-the-job training programs and apprenticeship opportunities will be made available. • Summary reports will be provided to the provincial regulator that include information on the number of persons employed by 4-digit National Occupational Classification (NOC), the number of full- and part-time employed, the number of apprentices (by level) and journey persons for each applicable 4-digit NOC code, gender and source of the workforce. • Procurement packages will be developed with consideration for capacity and capabilities of local and regional Indigenous and non-Indigenous businesses. • Project purchasing requirements will be posted in a timely manner so that local and regional businesses can position themselves to compete to supply goods and services needed for project construction and operation.

Valued Component	Potential Environmental Effects	Summary of Residual Effects Predictions	Select Key Mitigation*
Land and Resource Use	• Changes to land use • Changes to resource use • Change to recreational activities	Residual effects from project activities on land use are associated with the loss / restriction of access to designated lands. The mine site overlaps approximately 32 km² of provincial Crown land area, which will have restricted access throughout the life of the project. Adverse effects on the Victoria Steadies Sensitive Wildlife Area are not anticipated given that the area that is the focus of protection is located much further downstream than the LAA boundary. The project is anticipated to result in a relatively small change in sound levels to nearby cabin users that will be well below regulatory thresholds for noise. The overlap of the mine site with wildlife management areas is relatively small (i.e., less than 1%), and there are alternate areas within the LAA where resource users could pursue these harvesting activities. Assuming the successful implementation of mitigation measures and the low levels of resource use within the LAA, it is anticipated that associated effects to harvesting success rate is anticipated to be low in magnitude. As the mine site accounts for less than 1% of the total area of Forest Management District (FMD) 13, the impacts to commercial forestry and adverse effects on the annual allowable cut (AAC) will be low as the AAC may still be achieved by relocating harvesting activities. Visual effects from material stockpiles are anticipated during the operation phase; however, given there are low levels of resource activity identified within the LAA, residual effects are anticipated to be low. The access road upgrade / realignment will provide improved year-round access, potentially resulting in additional resources users within the LAA and increasing demand on resources. However, given it is an existing access road, the change in harvesting success is predicted to be low. With mitigation and management measures, residual environmental effects on land and resource use are predicted to be **not significant**.	• Signage will be installed around the mine site to alert the public and land users of the presence of the project and its facilities. • Marathon Gold will implement traffic control measures to restrict public access to the mine site, which may include gating approaches, placing large boulders and/or gated fencing. • Where practicable in accessible areas (e.g., along cleared rights-of-ways), trees and other vegetation will be left in place or encouraged to grow to obstruct the view of project facilities, reducing the change in viewshed and muffling nuisance noise. • Hunting / fishing / harvesting of wildlife will be strictly prohibited on the mine site. Workers will not be permitted to hunt / fish / harvest while staying at the accommodations camp and will not be permitted to bring firearms or angling gear to site. • Workers will be bussed from nearby designated communities to the mine site for rotations to reduce effects of traffic on roads in the communities and the access road. • Marathon Gold will continue to engage with cabin owners within the project area to discuss their occupancy, potential future use of these cabins, and potential applicable mitigation measures. • Marathon Gold will continue to engage with local resource users (hunters, outfitters, trappers, anglers) regarding the overlap of the project with hunting, trapping, and fishing areas in the project area. This will include the communication of project information, updates on ongoing and planned activities, and a discussion of issues and concerns and a potential means of addressing them. • Measures will be taken to address public health and safety requirements throughout rehabilitation and closure. • Desired land and resource end-uses will be considered in the preparation of the Rehabilitation and Closure Plan.
Indigenous Groups	• Changes in current use of lands and resources for traditional purposes • Changes in Indigenous health conditions • Changes in Indigenous socio-economic conditions • Changes in physical and cultural heritage	During construction, access to land within the mine site (32 km²) will be restricted for the life of the project. Based on information provided by Miawpukek, it is Marathon's understanding that its current land and resource use in the project area has declined in recent years. Based on a traditional knowledge study prepared by Qalipu in 2020, it is also Marathon's understanding that active Qalipu land use in the project area appears to be limited. It is therefore anticipated that loss of access to current use areas is low, with current use able to continue at current levels in the LAA and RAA. Air contaminants concentrations, parameters of potential concern for water quality, potential for heavy metals in air particulate to affect the quality of terrestrial foods, potential for heavy metals in water to affect the quality of aquatic foods and potential for sound levels to result in annoyance or sleep disturbance were all considered in a screening assessment. Residual effects were determined to be negligible to low and would not result in a change to Indigenous health conditions. Residual effects on change in socio-economic conditions are anticipated to be negligible to low in magnitude. During construction and operation, positive effects will be low in magnitude, conservatively characterised based on uncertainty with respect to levels of local employment and the extent to which project wages will be realised by Indigenous people. Given there are no known registered heritage sites within the project area, and no cultural or spiritual sites within the project area that have been identified by Indigenous groups engaged by Marathon Gold, no residual project effect to heritage, cultural, or spiritual sites is anticipated.	• Marathon Gold will communicate employment information to local communities and Indigenous groups in a timely manner so that local and Indigenous residents have an opportunity to acquire the necessary skills to qualify for potential project-related employment. • Procurement packages will be developed with consideration for capacity and capabilities of local and regional Indigenous and non-Indigenous businesses. • Project activities, locations, and timing will continue to be communicated to Indigenous groups, affected land and resource users, environmental non-government organisations, the provincial government, and local authorities throughout the life of the project. In particular, Marathon Gold will communicate in advance with respect to project activities that may limit / affect use of the access road (i.e., upgrading activities or transport of large loads or equipment). This information will be communicated through local town councils, local radio stations and social media. • Marathon Gold will continue to engage with Indigenous groups, including Indigenous resource users, throughout the life of the project. This will include the communication of project information, updates on ongoing and planned activities, and a discussion of issues and concerns and a potential means of addressing them. This will also include a discussion of Indigenous involvement in the development and implementation of project-specific environmental management and monitoring plans. • Marathon Gold will continue to engage with Indigenous groups for the identification, review, and analysis of existing and available information on Indigenous land and resource use activities, to consider this early and throughout project planning, design, and implementation.

Valued Component	Potential Environmental Effects	Summary of Residual Effects Predictions	Select Key Mitigation*
		With mitigation and management measures, residual environmental effects on Indigenous groups are predicted to be **not significant**.	
Historic Resources	• Loss of information about or alteration to historic resource(s) and their context	Construction of the project is unlikely to result in residual effects on historic resources primarily because there are no known registered archaeological sites within the project area. Mitigation measures will reduce the potential for finds of presently unknown sites to be discovered during the construction phase, and mitigation measures will be implemented in the event of an unexpected discovery of historic resources. Residual effects on historic resources resulting from project construction activities are therefore not likely to occur. If disturbance or loss of historic resources did occur, it would occur as a single event(s) during construction activities and within the project area, during initial ground disturbance. Because historic resources are static and finite, residual environmental effects which did occur would be adverse, permanent, and irreversible. With mitigation and management measures, residual environmental effects on historic resources are predicted to be **not significant**.	• Mitigation measures to be applied with approval and appropriate permits issued by the Provincial Archaeology Office: – Field assessment surveys will be undertaken prior to construction wherever the project area has potential to interact with identified areas of high potential for archaeological resources. – Ground-truthing of the three identified Victoria River sites will be undertaken in the event that the project area expands to interact with their hypothesised locations. – Review of historical field notes pertaining to the Victoria River sites that are presently housed in the Provincial Archives will be undertaken in association with further field assessment. – Archaeological field assessment and testing of road routes and other required infrastructure (new and upgraded) at selected river crossings and lakeshores will be undertaken prior to construction once development plans are finalised. • Measures to be included in the Heritage and Cultural Resources Protection Plan to mitigate the potential of adverse effects on historic resources resulting from an accidental discovery: – Prior to construction, personnel will be made aware of potential historic resources in the area and understand their responsibility should they identify potential historic resources. – Personnel will be advised to report unusual findings to the Site Supervisor and not to touch such findings. – Work will be suspended in the immediate area should a potential resource be identified. – If features are found using heavy equipment, the equipment will not be moved so that historical information and evidence is left intact and not further disturbed. – The area of findings will be flagged to protect it from looting and further disturbance. – A qualified archaeologist or historic resources professional will be contacted by the Site Supervisor to assess the site.
Dam Infrastructure	• Changes in water quality in Victoria Lake Reservoir • Changes in water balance in Victoria Lake Reservoir • Changes in stability of Victoria Dam	Project-related environmental effects will not cause a change in water quantity in Victoria Lake Reservoir greater than natural variability. Project-related environmental effects on the water quality in Victoria Lake Reservoir are not expected greater than 300 m from the discharge location into the lake and are predicted to not affect Victoria Lake Reservoir operation or Victoria Dam. An initial blasting impact assessment has been completed for the project by Golder (Golder 2020) to evaluate the potential effects of open pit blasting on the Victoria Dam. Based on a conservative assessment, the estimated peak particle velocity transmitted to the Victoria Dam is 0.16 mm/s, which is well below the threshold at which a reduction in dam stability is likely to occur (50 mm/s). With mitigation and management measures, residual environmental effects on dam infrastructure are predicted to be **not significant**.	• An Explosives and Blasting Management Plan will be developed by Marathon Gold and its selected, licensed blasting contractor(s) to provide direction for the safe storage, handling and use of explosives and explosive components at the project site, to address the safety of the public and project personnel, and protection of both the environment, project components and the Victoria Dam. The Explosives and Blasting Management Plan will include requirements for Blast Design vibration limits and seismic monitoring for blasting activities. • Blasting activities will be included under a contract service agreement with the explosives supplier, who will have a valid blasters certificate issued by NLDECCM. • Blasting activities will be limited to only those areas required to achieve foundation grades for site development or open pit pioneering. • Blasting for site development will be done by a certified blasting contractor who will develop a conservative Blast Design for engineering review and approval prior to carrying out the work. The Blast Design will be required to meet strict seismic (vibrational) limits at appropriate distances from any existing structures (Victoria Dam), developing infrastructure, and fish habitat. • Engagement with NL Hydro regarding blasting requirements, timing, vibration thresholds and monitoring.

Note: A full list of mitigation can be found in the Summary of the Environmental Impact Statement, available at: https://iaac-aeic.gc.ca/050/evaluations/document/136514

- Caribou: Potential project residual effects of change in habitat and mortality risk are predicted to be low magnitude for all four herds. The magnitude for change in movement for the Gaff Topsails, Grey River and La Poile herds is also predicted to be low. However, the residual effect for change in movement for the Buchans herd is predicted to be high due to the amount of overlap of the project with an existing migration corridor, and the proportion of collared caribou that use the path overlapping the project. The Buchans herd, which is part of South Coast sub-population, represents 13.7% of the total caribou population on the Island. The prediction of a significant effect is established on a conservative basis, and reflects both the uncertainty in how project activities may affect the migratory movement of the Buchans herd and what the long-term effects on the herd may be, and the uncertainty of success of the proposed mitigation measures. Marathon Gold is committed to working with regulators, Indigenous groups and stakeholders to develop comprehensive programs to monitor migration patterns and populations of the caribou herds in the area, and in particular the Buchans herd. Marathon Gold is currently working with provincial regulators to conduct ongoing baseline monitoring programs and plans to continue and adapt these monitoring programs over the life of the project.
- Victoria Lake Reservoir and Victoria Dam: The environmental assessment has determined there are no significant effects on Victoria Lake Reservoir or Victoria Dam resulting from routine project activities, or from the cumulative effects of the project in combination with other past, present, or reasonably foreseeable future projects. Due to Marathon's re-location of the TMF downstream of the Victoria Dam, a worst-case TMF dam breach is also not expected to impact the Victoria Dam.

With respect to cumulative effects, residual adverse effects from project activities may combine with other mining projects; exploration activities; forestry; hunting, outfitting, trapping, and/or fishing; off-road vehicles; hydroelectric development; and linear features (e.g., power lines) to result in cumulative environmental effects. Except for caribou, the VCs are not anticipated to experience adverse effects that would contribute cumulatively to significant residual effects. The project is conservatively predicted to result in significant adverse effects on caribou, specifically related to change in movement for the Buchans herd. Future activities associated with other projects are expected to combine with potential project effects contributing to the predicted high magnitude effect on movement of the Buchans herd and may measurably affect the abundance and/or sustainability of the Buchans herd in the RAA.

With respect to accidental events, the following potential accidents or malfunction scenarios were identified as having the potential to occur during the project: TMF malfunction; open pit slope failure; low-grade ore and high-grade ore stockpiles and waste rock piles slope failure; fuel and hazardous materials spill; unplanned release of contact water; sewage treatment plant failure; over blasting; fire / explosion; vehicle accident; and watercourse crossing failure. In the unlikely event of a worst-case industrial accident or malfunction which results in a large-scale release into the environment (i.e., worst-case TMF malfunction or fire / explosion), there is a potential for significant residual adverse effects to VCs. However, the risk of a significant effect associated with an accident or malfunction is low, given the project design, maintenance and monitoring measures that will be in place to reduce the risk of such an occurrence. Emergency response plans and contingency measures will be in place to limit the extent and nature of potential environmental effects in the event of an accident or malfunction. For minor incidents with a higher likelihood of occurrence (e.g., small hydrocarbon spills from equipment), the residual effects are not likely to be significant, as these will be contained within the mine site and readily cleaned up.

20.3.3 Future Environmental Management & Monitoring Plans

The EIS includes commitments to implement mitigation and conduct follow-up monitoring for VCs throughout project construction, operation and decommissioning, rehabilitation and closure (Marathon Gold, 2020). Many of these commitments will be operationalised through the preparation and implementation of environmental management and monitoring plans. The EIS contains commitments to prepare the following:

- Environmental Protection Plan
- Chemical and Hazardous Materials Storage and Handling Plan
- Waste Management Plan
- Contingency Plan
- Explosives and Blasting Management Plan
- Fish Habitat Offset Plan
- Water Management Plan
- Gender Equity and Diversity Plan
- Benefits Agreement
- Community Cooperation Agreements
- Soil and Rock Management Plan
- TMF Operations, Maintenance and Surveillance Manual
- Public (Stakeholder) Safety Plan
- Effluent Monitoring Plan
- Tailings / Effluent Release Emergency Response Plan
- Emergency Response and Spill Contingency Plans
- Follow-up and Monitoring Plan(s)
- Rehabilitation and Closure Plan
- Acid Rock Drainage and Metal Leaching Management Plan

20.4 Environmental Permitting

Upon release from the provincial and federal EA processes, numerous approvals, authorisations, and permits will be required prior to initiating project construction. Each of these permits or authorisations is applied for separately with relevant information included in the applications. Regulators can only issue permits following release of the project from the EA process. However, to reduce potential schedule delays, some long-lead items can be initiated and discussed with regulators, and some applications can be filed prior to release from the EA processes. Compliance with terms and conditions of approvals, standards contained in federal and provincial legislation and regulations, and commitments made during the EA processes (including application of mitigation measures and monitoring and follow-up requirements), will need to be assured throughout all project phases.

Table 20.3 provides a list of key approvals, authorisations, and permits that may be required from provincial and federal agencies and departments.

Table 20.3: Key Environmental Approvals, Authorisations & Permits that May Be Required

Environmental Permit, Approval or Authorisation Activity	Issuing/Approval Agency
Provincial	
Release from EA Process	NLDECCM– Minister
Approval of Environmental Protection Plan	
Monitoring Plan for Certificate of Approval	NLDECCM– Pollution Prevention Division
Certificate of Approval for Construction and Operation (Industrial Processing Works)	
Certificate of Approval for Generators	
Approval of Environmental Contingency Plan/Emergency Spill Response	
Permit to construct a Non-Domestic Well	NLDECCM– Water Resources Management Division
Certificate of Environmental Approval to Alter a Body of Water	
Culvert Installation	
Fording/Bridge	
Pipe Crossing/Water Intake	
Stream Modification or Diversion	
Other Works Within 15 m of a Body of Water	
Water Use License	
Permit to Construct a Potable Water System	
Permit to Occupy Crown Land	Department of Fisheries and Land Resources (NLDFFA) – Crown Lands Division
Permit to Control Nuisance Animals	NLDFFA– Wildlife Division
Operating Permit to Carry out an Industrial Operation During Forest Fire Season on Crown Land	NLDFFA– Forestry and Agrifoods Agency
Permit to Cut Crown Timber	
Permit to Burn	
Surface and Mining Leases	NL Department of Industry, Energy and Technology – Mineral Development and Mineral Lands Division
Development Plan	
Rehabilitation and Closure Plan	
Financial Assurance	
Mill License	
Quarry Development Permit	
Blasters Safety Certificate	Department of Digital Government and Service NL – Government Service Centre
Approval for Storage and Handling of Gasoline and Associated Products	
Fuel Tank Registration	
Approval for Used Oil Storage Tank System (Oil/Water Separator)	
Certificate of Approval for a Waste Management System	
Certificate of Approval for a Sewage/Septic System	
National Building Code – Fire, Life Safety, and Building Safety	
Buildings Accessibility Registration and Permit	
Food Establishment License	
Application to Develop Land for Septic	
Federal	
Release from EA Process	Impact Assessment Agency
Fisheries Act Authorisation permitting serious harm to fish	Fisheries and Oceans Canada (DFO)
Tailings Impoundment Area Designation	Environment and Climate Change Canada
Initiate Metal and Diamond Mining Effluent Regulations (MDMER) process with ECCC including notification, identification of final discharge point, effluent monitoring, and environmental effects monitoring (EEM)	
Approval of MDMER Emergency Response Plan	
Approval to Interfere with Navigation	Transport Canada
License to Store, Manufacture, or Handle Explosives (Magazine License)	Natural Resources Canada

This list shown in Table 20.3 is intended primarily for environmental management planning purposes and may not be exhaustive. Marathon Gold will continue to engage with regulatory authorities throughout project planning to confirm regulatory permitting and compliance requirements. Note that, as the project is not located within a municipality, municipal approvals, authorisations, and permits are not anticipated. Marathon Gold currently has mineral licenses and permits in place for the existing exploration activities and accommodations camp.

20.5 Baseline Hydrology

Baseline hydrology studies for the project site were completed by Stantec from 2012 to 2020. The following summarises key baseline hydrology observations and findings.

The Valentine Gold Project area sits at the drainage divide between Victoria Lake Reservoir draining to the southeast and the Victoria River draining to the north. Valentine Lake and the Victoria Steadies drain to the Exploits River via the Victoria River and Red Indian Lake. Victoria Lake, which formerly drained to the Victoria River, now because of hydroelectric development, drains from the southeast end of the reservoir through the Bay D'Espoir watershed. The Exploits and Bay D'Espoir watersheds are two of the largest watersheds in the island portion of the province and are significantly altered and controlled by hydroelectric developments.

The Valentine Gold Project is primarily focused on three feature complexes, the Leprechaun and Marathon deposit complexes and the processing area and TMF. The Leprechaun complex area is comprised of two watersheds, one flowing north to Valentine Lake and the other flowing south to Victoria Lake Reservoir. The Leprechaun open pit area consists of three ponds (Middle, East and West ponds), small creeks, and wetlands. The East Pond drains to Valentine Lake and the Middle and West Ponds drain to Victoria Lake. All other areas of the Leprechaun complex drain via a series of small tributaries to Victoria Lake. The Marathon open pit area contains a single pond and small stream which drains east to tributaries of Victoria Steadies and then to the Victoria River. Other areas of the Marathon complex will also drain to the Victoria Steadies and west to Valentine Lake, which drains to the Victoria River. The processing plant area drains to a tributary of Victoria Lake and the TMF area drains via a series of small tributaries to the Victoria River. Project infrastructure was mapped into 22 small sub-watershed areas ranging in size from 0.1 to 2.3 km^2.

Climate affects the runoff characteristics and stream flows that define hydrologic conditions in the project area. The project area lies within the Western Mountains and Central Uplands climate zone of NL and is generally characterised by cloudy conditions, strong winds and heavy snowfall in winter. The climate normal annual precipitation amount is 1,236 mm at the Buchans climate station. The highest mean monthly precipitation occurs in December (123.1 mm) and the lowest mean monthly precipitation occurs in April (85.7 mm). The snowfall climate normal statistics show that average annual snowfall recorded at Buchans is 359.3 cm, with month-end snow depths typically highest in February (refer to Section 5.4 of this report).

Based on a review of soils, surficial geological maps and aerial photographs, the overburden material in the project area generally consists of a discontinuous layer of till of variable thickness over exposed bedrock. The Water Resources Atlas of Newfoundland classifies the surficial geology as a veneer of glacial till (less than 1.5 m) over bedrock (NLDOEC 1992). The project area is considered part of the Mountain pedoclimatic zone, which is characterised by stony, shallow, coarse textured soils (Agriculture Canada 1988). These soils are further described as imperfectly drained, commonly very shallow and associated with large areas of rock outcrops. Coarse textured soils are considered to correspond with sands and loamy sands.

The topography of the site is hilly with elevations in the local sub-watersheds ranging from 273 to 437 metres above sea level (masl). A local ridge runs through the project area in a NE to SW direction, with water draining south and east to the Victoria River and Victoria Lake Reservoir or north and west to Valentine Lake.

A regional hydrological assessment was conducted using the Water Survey of Canada hydrometric monitoring stations flow data from the region. The mean annual stream flow ranges from 51% to 86% of climate normal total precipitation. The remaining 14% to 49% of total precipitation is evapotranspiration. A streamflow coefficient for the project area was calculated to be 62.5% and was determined using the climate normal precipitation data from Buchans and the evapotranspiration rate 463 mm from the Water Resources Atlas of Newfoundland (NLDOEC 1992. The mean annual flow per unit area was 0.034 $m^3/s/km^2$ and ranged from 0.020 $m^3/s/km^2$ to 0.037 $m^3/s/km^2$. Stream flow tends to peak twice a year in April to May due to spring freshet, and in November due to autumn rainfall. Minimum flows are observed during winter months from January to February and late summer in August. Regional relationships were developed for annual flows, low flows, and peak flows.

Local hydrologic conditions are assessed using the continuous water level data collected at nine hydrometric monitoring stations and manual water discharge measurements at three hydrometric stations. Initial monitoring installations occurred October 2012 and stations added as the project plans developed in subsequent years. Local hydrometric stations have been sited to monitor flows in watercourses or water levels in ponds that would either be future receiving waters or may be affected by future project activities, and the distribution of the hydrometric network provides a highly correlated representation to local hydrometric conditions in the project area.

The mean annual flows ranged from 0.017 to 0.040 $m^3/s/km^2$ and correlates with regional estimates. The low flows ranged from 0.0 to 0.001 $m^3/s/km^2$ and the peak flows ranged from 0.259 to 2.12 $m^3/s/km^2$. Monthly baseflows contributions to totals were estimated to range from 23% (April) to 43% (March) with an annual average baseflow contribution estimated at 35%. Baseflows vary with depth to water table and areas with higher rock permeability.

20.6 Hydrogeology

Several hydrogeological programs have been completed since 2017, including a project-wide baseline hydrogeology programs by Stantec Consulting Ltd. (Stantec 2017, 2019) and GEMTEC Consulting Engineers and Scientists Ltd. (GEMTEC 2020). The results of the hydrogeological baseline programs were used to support early mine planning and engineering, and environmental permitting requirements. Additional hydrogeological investigations have been conducted by GEMTEC to support this feasibility study, including the installation of 13 boreholes in the vicinity of the proposed waste rock piles and tailings management facility.

Based on a review of geological maps and aerial photographs, the overburden material in the vicinity of the project primarily consists of a discontinuous layer of till of variable thickness. Along with glacial deposits, areas of organic and peaty soils are present overlying either till or bedrock in areas of poor drainage. Areas of high ground in the Leprechaun and Marathon deposit areas are characterised by bedrock outcrop exposed within the till veneer and various other surficial deposits. The Leprechaun deposit lies along the boundary of the Neoproterozoic Valentine Lake intrusive complex and the Silurian Rogerson Lake Formation of the Exploits Subzone. The Marathon deposit is located within the Valentine Lake Intrusive Complex (Van Staal et al., 2005). A well-defined northeast-trending regional fault (Valentine Lake Shear Zone) occurs immediately to the south of the Leprechaun deposit.

The prominent topographic ridge that underlies the project is inferred to act as a regional flow divide for both surface water drainage and groundwater flow and defines an area of groundwater recharge. Overall, the direction of shallow groundwater flow is assumed to follow topography and surface runoff, and discharge into the low-lying surface waterbodies that border the property. Locally, groundwater flow from the Marathon deposit is expected to travel southeast towards Victoria River and northwest towards Valentine Lake, which flows into Victoria River northeast of the project, and ultimately discharges into the Exploits River approximately 100 km to the north. Groundwater flow from the Leprechaun deposit is expected to primarily travel south-southeast towards Victoria Lake Reservoir, with a lesser component flowing north towards Valentine Lake.

Hydraulic testing completed to date includes packer testing of deep geotechnical boreholes, slug testing of hydrogeological baseline monitoring wells, and short-term constant rate testing of historical exploration boreholes. Results of these programs indicate a trend in decreasing hydraulic conductivity with depth with a geometric mean of 5×10^{-6} m/s determined for the overburden till material, decreasing two orders of magnitude to geometric means of 6×10^{-8} m/s and 5×10^{-8} m/s, respectively, for deep bedrock associated with the Leprechaun and Marathon deposits. This decreasing trend in hydraulic conductivity with depth is attributed to decreasing bedrock weathering and fracturing with depth and is observed in the geotechnical RQD dataset. No correlation between hydraulic conductivity and lithological unit has been identified to date, supporting the assumption that permeability is likely controlled by fractures and joints. There is currently no indication of significantly increased hydraulic conductivity in areas tested along the thrust fault separating the Valentine Lake Intrusive Complex and the Rogerson Lake Conglomerate. However, hydraulic testing along the thrust fault is limited to one packer test at the Leprechaun pit and one packer test at the Marathon pit.

Baseline water quality testing to date indicates a calcium-sodium-bicarbonate-chloride-sulphate type groundwater that is characterised as clear, slightly hard to very hard, and predominantly slightly alkaline with moderate acid buffering potential and low conductivity, indicating fresh conditions. Langelier Saturation Index values for groundwater samples indicate groundwater is neither strongly corrosive nor scale-forming with respect to solid $CaCO_3$, with generally low dissolved metals content.

Groundwater modelling was conducted to support the EIS. Groundwater inflow rates to the open pits required for dewatering were estimated to be up to 1,350 m^3/d at the Leprechaun pit, and 1,846 m^3/d at the Marathon pit, based on the full development of the pits.

20.7 Acid Rock Drainage/Metal Leaching

The methods for the ARD/ML assessment generally followed the Mine Environment Neutral Drainage (MEND) publication entitled “Prediction Manual for Characterising Drainage Chemistry from Sulphidic Geologic Materials” (Price 2009). The geochemistry testing program included:

- static testing of approximately 350 samples of waste rock, ore, overburden and tailings for acid-base accounting (ABA), shake flask extraction (SFE), and total metals
- characterisation of composite samples using the static tests and mineralogical methods
- laboratory kinetic testing of composite samples including 14 humidity cells (running for at least 20 weeks long), two ageing tests of process water (continuing for 56 days) and two sub-aqueous tailing columns tests (36 weeks long)
- field kinetic testing of 11 composite samples of waste rock and ore started in fall of 2020

The key findings of the ARD/ML assessment and modelling of contact water quality conducted as part of the EIS are summarised below.

20.7.1 Waste Rock Piles

In the Marathon deposit, approximately 14% of waste rock is conservatively classified as PAG. The acidic pore water generated in localised pockets of PAG rock within the pile will be neutralised as the ARD migrates and interacts with the non-PAG rock that has an excess of NP and constitutes the majority of waste rock. To achieve the neutralisation, blending PAG and non-PAG rock is recommended and PAG rock should be encapsulated within non-PAG rock. As a result of the recommended management measures, the final drainage from waste rock is not expected to be acidic. The waste rock pile will be covered during rehabilitation further reducing the risk of ARD/ML. There are no exceedances of the MDMER limits observed in leachates from the waste rock humidity cells. The current water quality model does not predict exceedances of the MDMER limits in seepage from waste rock during any mine phase, at 95th percentile confidence level.

The Leprechaun deposit's waste rock is estimated to contain less than 0.5% PAG material. Overall, the waste rock pile is not expected to generate ARD due to the small amount of PAG material. There are no exceedances of the MDMER limits observed in humidity cell leachates. Water quality modelling does not predict exceedances of the MDMER limits in seepage from waste rock.

20.7.2 Low-Grade Ore Stockpiles

Approximately 50% of the low-grade ore from Marathon deposit is conservatively classified as PAG. The minimum ARD onset time in PAG ore is approximately six years based on laboratory leaching rates. There are no exceedances of the MDMER limits observed in leachates humidity cell under neutral pH conditions or predicted by the water quality model. The Marathon low-grade ore stockpile runoff and seepage will be collected and monitored. Additional treatment will be utilised if the discharge will exceed the MDMER limits.

At Leprechaun, about 10% of low-grade ore is estimated to be PAG, but overall is not expected to generate ARD. There are no exceedances of the MDMER limits observed in leachates from low-grade ore or predicted in seepage.

20.7.3 Ore & Tailings

Approximately 13% of Leprechaun high-grade ore is classified as PAG, and 67% of Marathon high-grade ore is conservatively classified as PAG. Overall, the mixture of Leprechaun and Marathon ores is non-PAG and the high-grade ore stockpile is not expected to generate ARD. No exceedances of the MDMER are observed in shake flask tests.

Tailings will be produced from a combination of the Marathon and Leprechaun high-grade and low-grade ores. Composite samples of tailings are classified as non-PAG and are not expected to generate ARD. The current water quality model predicts exceedances of MDMER limits for CN_T, Cu, and $N\text{-}NH_{3\ UN}$ in the tailings pond. Overflow and seepage from the tailings will be treated between Years 1 to 10. Tailings will be deposited in the Leprechaun pit starting in mine Year 10, and until end of operation. During this period, overflow and seepage from the TMF will be used in processing and subsequently directed to the Leprechaun pit as slurry water. By post closure, TMF overflow quality will improve because there will not be plant discharge and as result of cover placement. However, CN_T, Cu, and $N\text{-}NH_{3\ UN}$ is predicted to exceed the MDMER limit in toe seepage from the tailings dam in post closure. Therefore, a mitigation such as passive treatment of the seepage should be considered.

20.7.4 Open Pits

Most of the pit walls and rubble on pit wall benches will be represented by waste rock, which has low ARD/ML potential in both deposits. No exceedances of MDMER guidelines are predicted in mine water or pit lake overflows at 95th percentile concentrations from the Marathon and Leprechaun open pits.

20.8 Rehabilitation & Closure Planning

Rehabilitation is defined as measures taken to restore a property as close to its former use or condition as practicable, or to an alternate use or condition that is deemed appropriate and acceptable by NL Department of Industry, Energy and Technology (DIET), NLDECCM, and NLDFFA-WD. For mining projects, a Rehabilitation and Closure Plan is a requirement under the *Newfoundland and Labrador Mining Act* (Chapter M-15.1 Sections 8, 9 and 10). There are three key stages of rehabilitation activities that occur over the life span of a mine, which include:

- progressive rehabilitation
- closure rehabilitation
- post-closure monitoring and treatment

Progressive rehabilitation involves rehabilitation that is completed throughout the mine operation prior to closure wherever practicable to do so. This includes activities that contribute to the overall rehabilitation effort and would otherwise be carried out as part of the closure rehabilitation at the end of mining life.

Closure rehabilitation involves activities that are completed after mining operation ceases, to restore and/or reclaim the project to as close to its pre-mining condition as practicable. Such activities include demolition and removal of site infrastructure, re-vegetation of disturbed areas, and other activities to achieve the requirements and goals as detailed in the project's Rehabilitation and Closure Plan.

Once closure rehabilitation activities have been completed, a period of post-closure monitoring is required to show that the rehabilitation has been successful. The post closure monitoring will continue until it has been demonstrated that the rehabilitation of the site has been successful. The site can then be closed out or released by NLDIET and an application to relinquish the property back to the Crown.

A complete Rehabilitation and Closure Plan has not yet been developed for the project; however, the following sections outline the rehabilitation and closure philosophies and concepts that will be used in the development of the project's Rehabilitation and Closure Plan. This plan will be drafted and finalised in consultation with NLDIET upon release from the EA process.

In addition to compliance with the approved Rehabilitation and Closure Plan, Marathon Gold will be required to register closure of the mine as an undertaking subject to assessment under the NL Environmental Protection Act. It is anticipated that such assessment will engage the closure requirements of the Rehabilitation and Closure Plan.

20.8.1 Approach to Rehabilitation & Closure

As the planning and design stages of the project continue, consideration for the future closure issues and requirements will continue to be incorporated into project design. In efforts to be proactive with rehabilitation activities, the following steps will be implemented:

- Disturbances of terrain, soil, and vegetation will be limited to the areas necessary to complete the required work as defined by the project.
- Organic soils, mineral soils, glacial till, and excavated rock will be stockpiled separately, where practicable, and protected for future use.
- Stabilisation of disturbances will be completed to reduce erosion and promote natural revegetation.
- Natural revegetation will be encouraged throughout the project area
- Organic material, topsoil, and overburden will be removed from various development areas and stockpiled for progressive and final rehabilitation activities. Some overburden (suitable glacial till) may be used as a low-permeability fill material for dams, ditching, and as a base for stockpile pads to assist in drainage control. As the project design process moves forward, the volume of soils required for all rehabilitation activities will be assessed, and a materials (rock and soils) balance and Soil and Rock Management Plan will be developed for the overall project to ensure that sufficient soils are available for rehabilitation, while avoiding excavating and stockpiling soils in greater quantities than those required, thereby resulting in increased project footprint and soils excavation, management and closure impacts.
- ARD/ML test results are presented in detail in EIS Baseline Study Appendix 5 and summarised in Section 20.7 of this report. Overall, the soils and rock materials at the site have a low risk of being acid generating, with some ore materials having an increased risk and are currently classified as PAG. However, with appropriate mitigation (mixing and blending of PAG and non-PAG materials and encapsulation), none of the permanent site waste rock stockpiles are expected to generate acidic drainage. As such, the site design and development, as well as the plans for rehabilitation and closure (soil cover), include measures to address ARD/ML issues. In the unlikely event that further testing determines that ARD/ML may present a risk post-closure, the project design, as well as the rehabilitation and closure plans. will be adapted. Tailings toe seepage is predicted to have MDMER exceedances of CN_T, Cu, and $N\text{-}NH_3$ UN. During operations, a treatment plant and polishing pond are proposed to treat TMF effluent quality. During closure and post closure passive treatment approaches such as constructed/engineered wetlands, permeable reactive barriers will be considered to address water quality exceedances.

20.8.2 Progressive Rehabilitation

As the mine advances from development to operational stages and throughout the operational phase of the project, opportunities for progressive rehabilitation are possible. Opportunities include, but are not limited to, the following:

- demolishing and rehabilitation of construction or exploration related infrastructure (e.g., buildings, roads, and laydown areas)
- grading and revegetating completed tailings areas, where practicable
- stabilising and temporarily seeding longer-term organics, topsoil, and overburden stockpiles to reduce erosion
- installing rock barricades and signage along the highwalls of the open pits
- progressively rehabilitating waste rock piles as benches and/or sections are completed (ongoing over life of project) – waste rock piles will be constructed from the ground up using slopes and benches of 10 m height; when a bench is finished in one area, the horizontal bench and downhill slope will be covered with overburden / organics (anticipated 0.3 m in total thickness) and revegetated

- completing revegetation studies and trials
- decommissioning and rehabilitating the TMF while project operation continues, once tailings deposition moves from the TMF to the Leprechaun open pit in Year 9 of the operation phase (noting that decant water from the TMF will continue to be recycled for process water)
- directing tailings and contact water to Leprechaun pit, and contact water to Marathon pit, as each of the pits is exhausted and while milling operation continues; based on the hydrogeological assessment, it has been determined that the pits could require up to 42 years to fully flood without supplementing inflow (alternatively, the EIS considered an accelerated pit filling scenario where water would be pumped from Valentine Lake and Victoria Lake Reservoir to the Marathon and Leprechaun pits, respectively, to further reduce the time to flood the pits from 42 years to a total of 8 years)

20.8.3 Closure Rehabilitation

Closure rehabilitation activities will be carried out at the mine site once it is no longer economical to mine, or once resources have been exhausted. In general, the closure activities that will be completed for the site include, though are not limited to, the following, and will be conducted in accordance with regulations at the time of closure:

- removing hazardous chemicals, reagents and similar materials for re-sale or disposal at an approved facility as per provincial and federal regulations
- disconnecting, draining, cleaning, disassembling and, where feasible, selling equipment for re-use to a licensed scrap dealer; if this is not achievable, equipment will be removed from site for disposal
- dismantling and removing site buildings and surface infrastructure for re-use, disposal, or recycling at approved facilities
- demolishing concrete foundations to a minimum of 0.3 m below the surface grade and covering areas with natural overburden materials to promote re-vegetation; demolished concrete will be used as fill material for re-grading or removed from site for disposal in an appropriate facility
- removing and rehabilitating fuel and explosive storage and dispensing facilities; this will include Environmental Site Assessments, if required
- breaching water management ponds to allow drainage to the surrounding areas for natural filtration – prior to release to the environment, water quality testing will be completed on the pond waters; these features will subsequently be graded and contoured to re-establish drainage patterns and revegetated as required
- decommissioning any wells on site (including groundwater monitoring wells and potable drinking water wells), in compliance with the Guidelines for Sealing Groundwater Wells (Government of NL 1997)
- re-establishing pre-mining site drainage patterns to the extent feasible
- grading and/or scarifying disturbed areas, covering these with overburden and organic materials, where required, and seeding to promote natural re-vegetation

20.8.3.1 Open Pits

Upon closure, equipment and dewatering infrastructure will be removed, and the open pit(s) will be allowed to fill with surface water runoff, precipitation, and groundwater seepage. Natural filling of the pits is forecast to require from 34 to 38 (Marathon pit) and 37 to 42 (Leprechaun pit) years without supplementing inflow. While the site is still in operation, and potentially for some time following operation and prior to final closure, excess site contact water will be directed to the open pits, as practicable, to accelerate filling. It is also proposed to pump water from Valentine Lake and Victoria Lake Reservoir to further expedite filling of the Marathon pit and Leprechaun pit, respectively, reducing the flooding times to within the closure and anticipated post-closure monitoring periods. Water would be withdrawn from Victoria Lake Reservoir (0.178 m^3/s) and Valentine Lake (0.145 m^3/s) over an eight-year period. Further details and assessment of potential effects of the proposed approach are provided in Chapter 7 of the EIS.

Once filled to the spill elevation, the water will be permitted to overflow the pit. A detailed assessment of the pit geometry and spill elevation in relation to the surrounding terrain will be required during operation to determine where the water will ultimately flow from the pit post-closure, and a channel may be required to reconnect this drainage to the natural, adjacent waterbodies. Monitoring of water quality within the open pit during filling will be completed to assess the potential discharge water quality and to determine if any water treatment could be required until water quality meets the appropriate criteria.

Rock or soil barricades and signage will be constructed along the crest of the open pit(s), as well as across any access roads or ramps, barricading access to the open pit(s). Warning signs will be erected at regular intervals along the berm, notifying the public of the open pit. Areas of sloped access, above and below the final high-water mark, will be constructed to permit ingress and egress for people or animals.

20.8.3.2 Waste Rock Piles

Two waste rock piles, one adjacent to each of the open pits, will be created throughout the operational life of the project. These piles will be sloped and benched in accordance with the closure design as they are developed, creating overall safe slopes for final closure of three horizontal to one vertical (3H:1V), incorporating interim benching. The waste rock piles will also be progressively rehabilitated via placement of overburden / organic materials on benches and slopes and subsequent revegetation. At final closure, only the remaining areas of the waste rock piles that could not be progressively rehabilitated will require rehabilitation. The ditching and sedimentation ponds constructed to manage the runoff from these piles will be left in place until the runoff water quality is suitable for direct release, at which point the ditching and pond infrastructure will be removed and regraded to return drainage patterns to as close to natural as possible.

20.8.3.3 Tailings Management Facility

The tailings that are produced from the milling process will be deposited in the TMF for the first nine years of the project operation phase using a thickened tailings process as described in Chapter 17. Once the Leprechaun open pit is exhausted in Year 9, the tailings will be pumped to and deposited in this open pit.

The TMF is being designed for closure in accordance with the guidance provided by the CDA, such that the geometry of the dams will not require modification during the mine closure phase to provide long-term stability of the facility. When the tailings deposition is moved to the Leprechaun open pit in Year 9, the process of closure and rehabilitation of the TMF will commence. It is expected that the water treatment plant and polishing pond components of the TMF will operate for some time, and that water collecting within the TMF (seepage drainage from the tailings, as well as runoff) will continue to be pumped to the mill as reclaim water. Exposed tailings will be covered with overburden, organic soil materials and revegetated, and as water quality and flows reach equilibrium within the facility, a larger, closure spillway will be constructed to lower the water level within the tailings impoundment. At this time, the water treatment plant and polishing pond will be removed and water flowing from the tailings impoundment will be channelled to release to the environment.

After closure, covered tailings beaches are not expected to produce acidic runoff and/or have high or moderate leaching except for P. The seepage from the TMF is predicted to exceed MDMER limits for CN_T, un-ionised NH_3, and Cu in post-closure. Runoff over the covered tailings surface will be considered non-contact water and will drain overland via the post-closure spillway. Passive treatment systems for TMF toe seepage are considered as a mitigation option.

As the project progresses, Marathon Gold will evaluate the tailings impoundment and consider options to further dewater the stored tailings working towards classifying the TMF as a landform (under the CDA closure guidelines) and therefore alleviating the requirements for maintaining and inspecting the dams post-closure. Conservatively, Marathon Gold will work with NLDIET and NLDECCM, Water Resources Division, and use the guidance established by the CDA and MAC, and Global Industry Standards on Tailings Management, to establish a plan for long-term inspection and maintenance of the dams.

The regulatory landscape regarding tailings management has been changing because of significant dam failures in recent years, and it is anticipated that regulation and guidance will continue to change with respect to tailings management, closure of tailings facilities, and needed alignment with climate change. Marathon Gold is committed to working with provincial regulators and following CDA guidelines so that the TMF is designed, constructed, operated, and ultimately rehabilitated, in a safe and responsible manner that will protect the environment in the long term.

20.8.4 Post-Closure & Long-Term Monitoring

The post-closure monitoring program will continue after final closure activities are completed for an estimated 6 to 10 years noting that final closure for some key components will be closed and rehabilitated prior to the end of the operation phase of the project. The monitoring period could also be shortened based on the satisfaction of regulators that physical and chemical characteristics of the site are acceptable and stable. When the project is deemed physically and chemically stable, it is currently anticipated that the site will be relinquished to the Crown, noting the requirements for relinquishment in 2035 may be different from current requirements.

The post-closure and long-term monitoring plans are not yet developed. These programs will be developed based on the experience gained through monitoring plans during construction and operation and it is anticipated that the closure monitoring plans will mirror the operational monitoring program to provide continuity of data and a historical baseline. It is also anticipated that, as the post-closure monitoring program moves forward, the monitoring requirements will decrease until ultimately, they will no longer be required.

20.8.5 Cost Estimate for Closure

The estimated cost to complete the closure activities for the Valentine Gold Project included in the financial analysis sections of this feasibility study report are based on Marathon Gold completing the closure activities described above. These costs are based on the current level of detail for the project and is equivalent to a Class 4 Estimate (±25%). Refer to Chapter 21 for further closure cost details.

20.8.6 Financial Assurance

As defined in the *Mining Act*, a lessee shall provide financial assurance as part of a Rehabilitation and Closure Plan prior to site development. The financial assurance amount is based on the cost estimate for the closure activities as presented in the Rehabilitation and Closure Plan. The Rehabilitation and Closure Plan is yet to be developed for the Valentine Gold Project. Refer to Chapter 21 for further closure cost details.

20.9 Community Relations & Consultation

Marathon Gold is committed to operating the project within a sustainable development framework which reduces harm to the environment, contributes to local communities, respects human and Indigenous rights, and adheres to openness and transparency in operations. One of the key principles of sustainable development is meaningful engagement with the individuals, communities, groups, and organisations interested in or potentially affected by the project to build and maintain positive, long-term and mutually beneficial relationships. Marathon Gold has engaged and continues to engage with relevant government departments and agencies, Indigenous groups, and stakeholder organisations, including communities, business and industry organisations, fish and wildlife organisations, environmental non-governmental organisations and individuals.

The objectives of Marathon's engagement and consultation efforts are to:

- provide project information and updates on a timely and continuing basis in a manner which is inclusive, culturally sensitive and appropriate to the circumstances of Indigenous groups and stakeholders
- engage Indigenous groups and stakeholders in respectful and meaningful dialogue throughout the environmental assessment process and over the life of the project
- identify, document, and respond to issues or concerns by Indigenous groups and stakeholders throughout the environmental assessment process and over the life of the project
- integrate feedback from Indigenous groups, communities and stakeholders into project planning and execution, the assessment of effects and the implementation of mitigation
- demonstrate how issues and concerns raised during engagement have been addressed

20.10 Regulatory Engagement

Marathon Gold met with representatives from individual provincial and federal departments and agencies throughout the preparation of the EIS, particularly to seek clarification on interpretation and application of the EIS Guidelines requirements and will continue to meet as needed through the EA review process and permitting stage. Marathon Gold has also met with the municipal governments of the communities located closest to the project. Outcomes of regulatory consultation and regulatory review processes (of the Project Description and EIS guidelines) were incorporated as applicable throughout the EIS, including in VC selection, approach to baseline studies, modelling methodology, proposed mitigation measures, and depth and focus of the various VC assessments.

The regulatory authorities that have an interest in the project are identified in Table 20.4.

Table 20.4: Relevant Regulatory Authorities & Jurisdictions

Federal Government	Provincial Government	Municipal Government
• IAAC (formerly Canadian Environmental Assessment Agency) • Environment and Climate Change Canada • Fisheries and Oceans Canada • Health Canada • Natural Resources Canada • Indigenous Services Canada	• Department of Industry, Energy and Technology • Department of Fisheries, Forestry and Agriculture • Department of Environment, Climate Change and Municipalities • Department of Tourism, Culture, Arts and Recreation • Department of Health and Community Services • Office for the Status of Women	• Town of Buchans • Town of Millertown • Local Service District (LSD) of Buchans Junction • Town of Badger • Town of Bishop's Falls • Town of Grand Falls-Windsor

20.10.1 Stakeholder Engagement

Public engagement and public participation activities undertaken by Marathon Gold have involved a wide range of stakeholders, including communities, fish and wildlife organisations, environmental non-governmental organisations, trade and industry groups, cabin owners, individuals and members of the public. Key community and stakeholder engagement activities have included:

- information sharing through Marathon's website, social media, quarterly newsletters and direct mailouts
- meetings in person, by conference and video calls, and virtual meetings to provide corporate and project updates and information on the environmental assessment process; this has included in person and virtual public meetings (the latter format was adopted to adhere to provincial COVID-19 restrictions)
- exit surveys and questionnaires to enable community residents and members of organisations to provide input and feedback

Many questions and comments raised during the engagement activities for the project focused on the following topics:

- capitalising on employment, training, and procurement opportunities from the project
- equitable representation of local residents and businesses in employment and contracting
- tailings pond design and potential impacts on water quality
- impacts to fish and fish habitat, should a dam breach occur
- compensation for impacts to fish habitat
- emergency response should a dam breach occur
- design alternatives to the TMF
- management of waste rock and acid rock drainage / heavy metals concerns
- air quality concerns related to emissions, greenhouse gases (GHGs), tailings and dust
- use of cyanide
- impacts to wildlife (caribou, moose) and associated outfitting operations
- socio-economic effects (salaries, accommodations, health services and working conditions)
- life of the mine and rehabilitation of the mine site

Further details on Marathon's response to the questions and concerns raised can be found in Chapter 3 of the EIS (Marathon Gold, 2020).

20.10.2 Indigenous Engagement

The Federal EIS Guidelines (Part 2, Section 5) identify Miawpukek and Qalipu as Indigenous groups that may be affected by the project. No other Indigenous groups have come forward or have been identified by either level of government or by Marathon Gold as having an interest in, or being potentially affected by, the project. Marathon Gold has provided each Indigenous group with opportunities to learn about the project, including its location, design, potential effects and proposed mitigation measures, to provide input respecting the potential effects of the project upon Indigenous interests and activities, and to discuss potential mitigation, avoidance and monitoring measures. More specifically, Marathon's engagement activities with each group have included the following:

- Information Sharing Initiatives: Transmission of, and opportunities to review, project-related documentation including EIS baseline information, newsletters, notices and other materials (e.g., press releases), related to the project, Marathon's corporate operations, and employment and business opportunities.
- Meetings: Meetings and offers to meet with Indigenous leadership, community members and other groups in person (by video, conference calls, or webcast) to discuss the project and associated regulatory processes, issues and concerns and potential mitigation, and holding a project review workshop to provide information related to the project's proposed layout and design.
- Land and Resource Use Studies: Offers of funding to conduct land and resource use studies and to collect Indigenous knowledge to enhance Marathon's understanding of the potential project effects on Indigenous interests and activities, and to incorporate into the EIS.
- Avoidance, Mitigation and Monitoring Initiatives: Discussion with representatives of each Indigenous group of potential mitigation, monitoring and avoidance measures to address potential effects.

Throughout engagement, Indigenous groups have been given opportunities to provide Marathon Gold with their views on:

- indigenous activities or interests in or near the project area or elsewhere that might be relevant to the assessment of the project and its potential effects
- the effects of changes to the environment on their health and socio-economic conditions, physical and cultural heritage and current use of lands and resources for traditional purposes pursuant to paragraph 5(1)(c) of CEAA 2012

Marathon's engagement process has been based upon consistent and regular contact and information exchange designed to enable each group or representative organisation to understand the project and identify potential effects on their communities, activities, and asserted or established Indigenous rights.

Questions and concerns on a variety of issues were raised by Indigenous groups including:

- need to balance economic benefits against potential adverse environmental effects
- education, training, and employment opportunities specifically employment for women
- need for ongoing engagement and engagement with youth

- involvement in environmental monitoring
- tailings management
- impacts to wildlife, including caribou, moose and pine marten
- impacts on fish and fish habitat, with particular reference to salmon and trout
- water quality and water treatment
- impacts to Victoria Dam
- impacts to air quality
- rehabilitation and closure
- impacts to plants
- limitation of access to, and impacts upon, current use of lands and resources for traditional purposes
- impacts to heritage resources

Further details on Marathon's response to the questions and concerns raised can be found in the Chapter 3 of the EIS (Marathon Gold, 2020).

21 Capital & Operating Costs

Unless stated otherwise, all costs presented in this chapter are in Canadian dollars (CAD or C$).

21.1 Capital Costs

The estimate conforms to Class 3 guidelines for a feasibility study level estimate with a ±15% accuracy according to the Association for the Advancement of Cost Engineering International (AACE International).

Table 21.1 on the following page provides a summary of the estimate for overall initial capital cost. The estimate includes costs for mining, site preparation, process plant, tailings facility, power infrastructure, camp, owners' costs, spares, first fills, buildings, roadworks, and off-site infrastructure.

The estimate is based on an EPC execution approach for the process/infrastructure areas, and a EPCM execution for the civil-earthworks camp and power infrastructure packages, as outlined in Chapter 24. The following parameters and qualifications were considered:

- No allowance has been made for exchange rate fluctuations.
- There is no escalation added to the estimate.
- A growth allowance was included.
- Data for the estimates have been obtained from numerous sources, including:
  - mine schedules
  - feasibility-level engineering design
  - topographical information obtained from the site survey
  - geotechnical investigations
  - budgetary equipment quotes from Canadian and International suppliers
  - budgetary unit costs from numerous local NL contractors for civil, concrete, steel, electrical, piping and mechanical works
  - data from similar recently completed studies and projects

Major cost categories (permanent equipment, material purchase, installation, subcontracts, indirect costs, and Owner's costs) were identified and analysed. Percentage of contingency was allocated to each of these categories on a line-item basis based on the accuracy of the data. An overall contingency amount was derived in this fashion.

As outlined in Table 21.1, the overall capital cost of the project in Phase 1 will be approximately C$305 million, followed by the expansion in Phase 2 at C$44 million, with ongoing sustaining costs of C$332 million. Of the total Phase 1 capital costs, more than 88% of the project costs were derived from first principles bulk material take-offs and equipment sizing calculations, with supporting quotations for major equipment, and contractor supply/installation rates. Furthermore, above 70% of the project costs are projected to be spent within Newfoundland and Labrador.

Table 21.1: Summary of Capital Costs (C$M)

WBS	Description	Phase 1 Cost (C$M)	Phase 2 Cost (C$M)	Sustaining Costs (C$M)
1100	Mine Development (Pre-strip)	32	0	0
1200	Mine Fixed Equipment	3	0	2
1300	Mine Mobile Equipment	16	0	184
2100	Primary Crushing	14	0	0
2200	Grinding	33	0	0
2300	Leaching	11	1	0
2400	Elution & Gold Room	11	0	0
2500	Tailings Disposal	6	0	0
2600	Reagents	3	0	0
2700	Air & Water Services	4	2	0
2800	Process Buildings	7	0	2
2900	Phase 2 - Flotation / Concentrate Leach / Pebble Crushing	0	23	0
3100	Bulk Earthworks	6	0	6
3200	High-Voltage Power Switchyard & Power Distribution	11	0	0
3400	Fuel Storage	0	0	0
3500	Sewage	1	0	8
3600	Infrastructure Buildings	6	0	0
3700	Water Supply	1	0	58
3800	Tailings Management Facility	16	0	15
3900	Permanent Camp	14	1	0
4100	Main Access Road	7	0	0
4200	High-Voltage Power Supply	13	0	0
5100	Temporary Construction Facilities & Services	10	5	0
5200	Commissioning Representatives & Assistance	1	0	0
5300	Spares	1	0	0
5400	First Fills & Initial Charges	1	0	0
5500	Freight & Logistics	3	0	0
6100	Phase 1 - Lump Sum EPC Scope Delivery	19	0	0
6200	Phase 1 - EPCM Scope Delivery	7	0	0
6300	Phase 1 - Engineering Subconsultants & QA/QC	3	0	0
6500	Phase 2 - EPCM Scope Delivery	0	6	0
7200	Pre-production Labour	3	0	0
7500	Owner's Cost	13	0	36
	Subtotal	**273**	**40**	**311**
8100	Project Contingency	32	4	21
	Total Project Costs	**305**	**44**	**332**

21.2 Basis of Capital Cost Estimate – Initial & Expansion

21.2.1 Exchange Rates

Vendors and contractors were requested to price in native currency. The estimate is prepared in the base currency of Canadian dollars (CAD or C$). Pricing has been converted to Canadian dollars using the exchange rates in Table 21.2.

Table 21.2: Estimate Exchange Rates

Code	Currency	Exchange Rate
CAD	Canadian	1.00
AUD	Australian Dollar	0.98
EUR	Euro	1.53
USD	United States Dollar	1.33

21.2.2 Area 1000 – Mining

Mine capital costs have been derived from vendor quotations and operational data collected by other Canadian open pit mining operations.

Pre-production mine operating costs (i.e., all mine operating costs incurred before mill start-up) are capitalised and included in the capital cost estimate. Pre-production pit operating costs include grade control, drill and blast, load and haul, support, and GME costs. All mine operations site development costs—such as clear and grub, topsoil stripping, standing water removal, haul road construction and explosive pad preparation—are capitalised.

The mine equipment fleet purchases are planned as financing or lease agreements with the vendors. Down payments and monthly lease payments are capitalised through the initial and sustaining periods of the project.

Estimated fleet spare and estimated initial fuel, lube, and tire inventories are capitalised.

The following items are also capitalised through the initial and sustaining periods:

- explosives magazine and mixing plant
- high precision site GPS (global positioning system) and machine guidance systems
- communication radios
- mine survey gear and supplies
- geology, grade control, and mine planning software licenses
- maintenance tooling and supplies
- mine rescue gear
- piping for pit dewatering and culverting materials for haul roads

21.2.3 Area 2000 – Process Plant & 3000 – On-Site Infrastructure

All major processing equipment for both Phase 1 and Phase 2 was sized based upon the process design criteria, as outlined in Chapter 17. Once the mechanical equipment list was outlined, the mechanical scopes of work were derived and sent for budgetary pricing by Canadian and

International equipment suppliers (see Table 21.3). Once the budgetary quotations were reviewed and integrated, in total 88% of the value of mechanical equipment was sourced from budgetary quotations, with the remainder of minor process equipment pricing sourced by benchmarking against other recent Canadian gold projects and studies.

Table 21.3: Major Mechanical Packages

Package No.	Package Name
P0001	Mills
P0002	Vibrating and Static Screens
P0003	Agitators
P0004	Gravity Concentrators and Intensive Leach Reactor
P0005	Acid Wash, Elution, Carbon Regeneration and Gold Room Equipment
P0006A	Slurry, Sump and Water Pumps
P0006B	Reagent Pumps
P0007	Thickeners & Flocculant System
P0008	Lime Silo
P0009	Effluent Treatment Plant
P0010	Compressed Air
P0011	Samplers
P0012	Cranes
P0013	Shop Fabricated Platework
P0014	Regrind Mill
P0015	Flotation Cells
P0016	Cyclones
P0017	Interstage Screens
P0018	Sewage Treatment Plant
P0019	Truck Shop Fit-out
P0020	Miscellaneous Reagents
P0021	Safety Showers
P0022	Analysers
P0023	Larger Utility Water Pumps
P0024	CIL Crane

Similar to the above, all major electrical equipment for both Phase 1 and Phase 2 was sized based on the project equipment list. Once the electrical equipment list was outlined, scopes of work were derived and sent for budgetary pricing by Canadian and International equipment suppliers, as outlined in Table 21.4. Once the budgetary quotations were reviewed and integrated, in total 92% of the value of electrical equipment was sourced from budgetary quotations, with the remainder of minor equipment pricing sourced by benchmarking against other recent Canadian gold projects and studies.

In support of the major mechanical and electrical equipment packages, the process plant and infrastructure engineering design was completed to a feasibility study level of definition, allowing for the bulk material quantities (steel, concrete, earthworks, piping, cables, instruments, etc.) to be derived for the major commodities, as outlined in Table 21.5.

Table 21.4: Major Electrical Packages

Package No.	Package Name
P0201	High-Voltage Substation
P0206	600 V Standby Emergency Diesel Generator
P0207	Plant Control System
P0208	Communication Infrastructure
P0209	Electrical Rooms Integrated package
P0210	Instruments and Valves

Table 21.5: Material Commodity Codes

Commodity Code	Commodity Description
A	Architectural
B	Earthworks
C	Concrete
D	Mining
E	Electrical Equipment + Bulks
F	Platework
I	Instrumentation + Bulks
M	Mechanical Equipment
N	Plant & Ancillary Equipment
O	Mobile Equipment
P	Pipework
S	Structural Steel
U	Field Indirects
V	Third-Party Packages/Other
W	Project Delivery
Y	Owner's Costs
Z	Taxes & Duties

After the derivation of all the bulk material quantities, for the process plant and infrastructure areas, major construction contracts were formed, and tendered to experienced Newfoundland and Labrador contractors for budgetary pricing bids (see Table 21.6).

As a total in Phase 1, above 88% of the project costs were derived from first principles, with quotation of equipment, or contract supply/installation, and furthermore, above 70% of the project costs are projected to be spent within Newfoundland and Labrador. Detailed scope summaries, with basis of estimates are described below for each of the major contracts.

Table 21.6: Construction Contracts

Package No.	Package Name
P0500	Crushing Plant Area
P0501	Mining Contract
P0503	Concrete & Batch Plant
P0504	Industrial Buildings
P0505	Modular Buildings
P0506	Steel, Mechanical, and Piping Installation
P0507	Electrical / Instrumentation Installation
P0508	Site Erected Tanks
P0509	Off Plot Pipe Supply
P0510	Site MV Powerlines
P0513	Metallurgical Laboratory
P0514	Fabric Buildings
P0516	Major Earthworks
P0518	Off-site High-Voltage Powerline
P0519	Access Road
P0520	Accommodation Camp
P0521	Fire Protection System

21.2.3.1 P0500 – Crushing, Stockpile & Reclaim

<u>Scope</u>

The estimate allows for all works required to develop the crushing, stockpile and reclaim system, including design, supply, delivery, and installation of equipment.

<u>Quantities</u>

A datasheet was developed defining the service requirements of the system by process and mechanical engineering. Equipment selection and area layout design to meet service requirements included in the scope of work of contractors for pricing.

<u>Pricing</u>

Design, supply, delivery and installation of all equipment and works was quoted by contractors by providing them with a bill of quantities for completion of unit rates for each designated work front.

This area was priced as a break-out crushing, stockpile and reclaim contract; other installation and supply packages exclude the works in this area. Clearing and grading of the area and concrete supply are notably excluded from the crushing, stockpile contract package and are considered elsewhere.

The returned price schedules included the direct and indirect costs to install the agreed-upon scope for the mechanical equipment scope. The returned rates were compared and evaluated, and the selected contractor rates have been carried in the estimate.

21.2.3.2 P0503 – Concrete Supply & Installation

Scope

The scope of the civil concrete works allows for all new concrete work, including the deployment and operation of an on-site batch plant and concrete installation.

Quantities

All concrete quantities were estimated from quantity take-offs from the model and/or historical data from other Ausenco projects by the civil/structural department. MTOs for major structures including foundations, footings, walls, pedestals, slab on grade and elevated concrete, detailed excavation, detailed backfill have been developed based on these calculations.

The sizing of the major concrete structures is based on the general arrangement drawings and similar projects previously executed. MTOs for major structures including foundations, footings, walls, pedestals, slab on grade and elevated concrete have been developed based on these calculations.

Pricing

Budget pricing was sourced from the market for supply and delivery of batched concrete including supply/operation of the batch plant.

The concrete supply rates are inclusive of supply of batched concrete with separate mobilisation and demobilisation identified and included in the estimate.

The concrete works were scheduled to avoid winter construction. However, contractors were requested to provide optional pricing for cold weather heating.

The basis for the total cost of installed concrete is the cost of materials supply and installation costs:

- the cost of materials includes formwork, required embedments and reinforcement steel
- the cost for labour includes categorised installation hours multiplied by the direct labour rate and distributable rate as quoted by the contractor

Concrete install rates inclusive of formwork, reinforcement steel detailed excavation and backfill and were quoted by contractors as part of the concrete supply and installation package by means of a schedule of rates. The returned price schedules included the direct and indirect costs to supply and install the agreed concrete scope.

The returned rates were compared and evaluated, and the selected contractor rates have been used in the estimate.

21.2.3.3 P0506 – Mechanical Equipment Installation

Scope

The estimate allows for the supply and installation of all new mechanical equipment for the process plant and other supporting infrastructure such as effluent treatment plants and sewage treatment plants.

Quantities

The mechanical equipment list has been developed and equipment sized by process and mechanical engineering. The mechanical equipment was specified utilising project-specific equipment datasheets highlighting agreed-upon process performance criteria and were accompanied by typical engineering specifications.

Supply

Supply and delivery pricing was sought for the major mechanical equipment packages using competitive pricing submissions from equipment suppliers. Where budget quotes were not obtained, existing Ausenco database pricing were used. For minor equipment, in-house historical pricing and estimates were used.

Installation

Mechanical equipment installation was quoted by contractors as part of the SMP package by providing them with a bill of quantities for completion of unit rates for each designated mechanical equipment item. The returned price schedules include for the direct and indirect costs to install the agreed-upon scope for the mechanical equipment scope.

The returned rates were compared and evaluated, and the selected contractor rates have been carried in the estimate.

21.2.3.4 P0506 – Structural Steel Installation

Scope

The estimate allows for supply and installation of all new steel work in the process plant.

Quantities

All structural steel quantities were estimated from quantity take-offs from the model and/or historical data from other Ausenco projects by the civil/structural department. Structural steel take-offs include light, medium, heavy, and extra-heavy structural steel designations and miscellaneous steel including grating and handrail and stair treads.

Pricing

Budget pricing was sourced from the market for supply and delivery to site of fabricated structure steel and other elements such as floor grating, handrailing, stair treads, etc.

Structural steel supply and fabrication (including delivery to site) as well as installation was quoted by contractors as part of the SMP package by providing them with a bill of quantities for completion of unit rates.

The returned rates were compared and evaluated, and the selected contractor rates have been carried in the estimate.

21.2.3.5 P0506 – Pipework, Fittings & Valves Installation

Scope

The estimate allows for the supply and installation of all pipework, fittings, valves special pipe items for the process plant and off plot pipework. There were no considerations made in the feasibility study for future construction tie-ins.

Quantities

Pipework quantities were estimated from quantity take-offs from the project model by the mechanical department and fittings/valve quantities were applied to the calculated length of each piping schedule. MTOs were developed for the off-plot lines such as water supply and return from storage, potable water, fire water and sewage, as well as for main process areas. An allowance for small bore piping will be carried using in-house data from other relevant projects in Eastern Canada.

Pricing

Pipework supply, fabrication (including delivery to site), and installation was quoted by contractors as part of the SMP package by providing them with a bill of quantities for completion of unit rates. The returned price schedules include for the direct and indirect costs to supply and install the agreed shop fabricated platework scope.

The returned rates were compared and evaluated, and the selected contractor installation rates have been carried in the estimate.

21.2.3.6 P0507 – Electrical Installation

Scope

The estimate allows for the supply and installation of all the electrical equipment and electrical bulks for the process plant buildings, mining buildings, and site-wide power distribution.

Electrical Equipment

An electrical equipment list was developed based on the mechanical equipment list, load list, single line diagrams and general arrangement drawings.

Pricing

Equipment pricing is a mixture of budget quotes and Ausenco historical data.

Major equipment prices were acquired from vendors and the returned data was technically and commercially evaluated by engineering. The supply costs from the recommended vendor's price have been included into the estimate. Minor equipment has been costed using either engineering estimates or Ausenco in-house data.

Electrical Bulks Supply & Electrical Installation

The installation of the electrical equipment and the supply and installation of electrical bulks (cables, terminations, light fittings, cable ladder, etc.) was priced using the bulks MTO and electrical equipment list and issued to contractors for pricing as the electrical and instrumentation package.

The returned rates were compared and evaluated, and the selected contractor rates have been carried in the estimate.

21.2.3.7 P0508 – Site-Erected Tanks

Scope

The estimate allows for the supply and installation of large diameter bolted tanks associated with the process plant facility.

Pricing

Detailed design, supply, freight, and installation of bolted tanks was quoted by contractors as part of the field-erected tanks package by providing them with a bill of quantities for the completion of unit rates.

The returned prices were compared and evaluated, and the selected contractor prices have been used in the estimate.

21.2.3.8 P0516 – Major Earthworks

Scope

The estimate allows for all the works required for:

- construction of the process plant pad and infrastructure pad (administration area and truck shop area), plant access road (tie-in to public road), and in-plant roads
- construction of ROM pad, ramp and any associated MSE wall in the area
- supply, installation and operation of the mobile crushing and screening plant for production of all engineered material for the project
- construction of temporary construction roads to facilitate earthwork activities
- construction of TMF dam embankment, dam spillway, seepage and runoff collection systems, polishing pond, site water management structures

Per conversations with Marathon Gold, Ausenco will segregate the quantities and costs for waste rock sourced within the Valentine site boundary from the waste rock sourced from a foreign borrow pit.

Quantities

Except for the TMF and mining areas, all earthworks quantities were estimated from quantity take-offs from the model and/or historical data from other Ausenco projects by the civil/structural department.

Pricing

To obtain quotes as part of the major earthworks package, contractors were provided a bill of quantities and asked to provide completion unit rates for each designated task. The returned price schedules include the direct and indirect costs to perform the works. The returned rates were compared and evaluated, and the selected contractor rates were included in the estimate.

21.2.3.9 P0520 – Permanent Camp

Scope

The estimate allows for the design, supply, and construction of permanent camp facilities that will be utilised for both the initial construction and ongoing operations for the life of mine. A scope of work was developed that stipulated that the camp be a modular, full turnkey installation complete with camp module, kitchen, recreation room, TVs and Internet services, as well as all facilities required for operation (e.g., potable water plant and sewage treatment system).

Quantities

A datasheet was developed to define the service requirements of the system by the engineering team by assessing the personnel load for the construction window for each contractor, and the period in which each contractor is present at site. Facility selection and area layout design to meet service requirements are included in the scope of work of contractors for pricing.

Pricing

Design, supply, delivery, and installation of the facilities was quoted by contractors by providing them with a bill of quantities for completion of unit rates for each designated work front.

The returned price schedules included the direct and indirect costs to install the agreed-upon scope as well as a projected fee for ongoing camp management services. Camp services include camp management, maintenance, kitchen operation and catering, housekeeping, and janitorial activities. The returned rates were compared and evaluated, and the selected contractor rates have been carried in the estimate.

21.2.3.10 P0521 – Fire System

The estimate allows for the design, supply, and installation of the fire systems within the process plant facilities, site power distribution, emergency power generation, and ancillary facilities. Ausenco's preferred vendor provided pricing.

21.2.4 Area 3000 – Tailings Management Facility

Golder was retained by Marathon Gold to carry out Feasibility Study level design of the TMF. As part of this study, Golder has completed construction material take-off's (MTO) for each stage of the TMF and for closure considerations. The TMF will be constructed in six stages. The MTOs were provided to Ausenco in order to carry out the initial and sustaining capital expenditure cost estimates for the project. In general, Ausenco was responsible for establishment of construction unit rates and for overall cost estimation for the project development.

Most of the MTOs are related to earthworks type construction and are based on the stratigraphic boundaries shown on the borehole and test pit records which are inferred from non-continuous sampling, observations of drilling and excavation progress and the results of Standard Penetration Tests. These boundaries, therefore, represent transitions between soil types rather than exact planes of geological change. Variation in the stratigraphic boundaries and foundation conditions, and hence the quantities derived from this information, between and beyond investigation locations will exist and is to be expected.

21.2.4.1 Sources of Data

Topographic mapping used for the MTOs was obtained from Marathon in 2019 and comprised 5 m contour interval data over the broader project area and 1 m contour interval data from aerial survey in the area roughly bounded by Victoria River, Victoria Lake and Valentine Lake. 2019 and 2020 site investigation data within the foundations of the TMF and associated infrastructure was provided by GEMTEC.

This data was gathered in support of the pre-feasibility and feasibility studies. Survey of the investigation locations was completed by Marathon and provided by GEMTEC. A total of 39 test pits, 11 boreholes, and one monitoring well have been advanced at the TMF. Investigation spacings are approximately 100 m to 250 m along the dam alignment, which is reasonable for the level of study. There is limited investigation data for the polishing pond (i.e., 1 test pit in the area). Investigation data is documented in GEMTEC's factual investigation reports.

21.2.4.2 Methodology

Quantity estimate calculations were carried out using commercially available CAD software (Civil3D and/or Muk3D) to make direct measurements from constructed 3-dimensional models and surfaces or derived from Microsoft excel spreadsheet equations and formulas using inputs from measurements made in CAD as required (e.g., ditch alignment lengths, 2-D footprint areas, etc.). Volume measurements resulting from CAD software models were verified with excel spreadsheets to validate the quantities.

The MTOs were based upon the design typical sections and details, plans, cross-sections and profiles illustrated on the figures included within Golder's Feasibility Study TMF design report. All quantities are based on the neat design lines illustrated on the figures. Quantities for all zoned fill materials are based upon compacted, in-place volumes and an appropriate bulking factor will need to be applied for determining volumes required from the supplier/source. Quantities for channels and ditches are based on the typical sections and not on actual design grading profiles, which will be defined at the next stage of design. No contingency was applied to any of the quantities estimated.

21.2.5 Area 4000 – Off-Site Infrastructure

21.2.5.1 P0518 – High-Voltage Power Supply

The estimate allows for development of a high-voltage powerline connecting the site to the provincial electricity supply. All associated costs were provided by NL Hydro and incorporated into the estimate by Ausenco.

21.2.5.2 P0519 – Main (Site) Access Road

The estimate allows for upgrades to the site access road connecting Millertown and the site, including rehabilitation of bridges, re-surfacing of the roadway, and ditching and culverts for water management. Roadwork quantities and bridge rehabilitation requirements were scoped by the civil/structural department, with support of road survey works by others.

Roadworks were quoted as part of the site access road package by providing contractors with a bill of quantities for completion of unit rates for each designated task. The returned price schedules included the direct and indirect costs to perform the works. The returned rates were compared and evaluated, and the selected contractor rates have been carried in the estimate.

21.2.6 Area 5000 – Project Indirects

21.2.6.1 Area 5100 – Contractor Indirects

Contractor indirect costs are related to the contractor's direct costs, but cannot easily be allocated to any part of them, including:

- mobilisation and demobilisation
- site offices and utilities
- construction equipment including mobile equipment, scaffolding, safety supplies, etc.
- head office costs/contribution
- financing charges
- insurances
- profit

Contractors provided indirect costs as part of their pricing schedules. Consideration was also given to the indirect costs, to ensure that appropriate COVID-19 management and site testing was performed at site, for any persons mobilising to site.

21.2.6.2 Area 5200 – Vendor Representatives

Vendor representative costs during commissioning and construction includes vendor representative support during the installation of the purchased equipment.

Vendor representative costs have been based on the engineer's evaluation of recommendations and prices provided by equipment vendors during the pricing enquiry process.

21.2.6.3 Area 5300 – Spares Parts

Commissioning spares quantities were recommended and priced by equipment suppliers. Where equipment pricing was not solicited from vendors, historical information was used to derive a cost for commissioning spares. This resulting cost covers all commission spares for mechanical and E&I spares.

Capital spares prices for mechanical, piping, electrical and instrumentation are based on the prices provided by equipment vendors during the enquiry process. If vendors did not provide a cost for capital spares, a factored allowance was included based upon the supply price and benchmarked against Ausenco's in-house database of projects.

21.2.6.4 Area 5400 – First Fills

Process first fill quantities (e.g., mill media and reagents) and first fill lubricants (e.g., greases, oils, and hydraulic fluids) are calculated based on the engineering design and priced using quotes that were provided by reagent and media suppliers.

21.2.6.5 Fuel

The estimate considers fuel supply by the Owner. Contractors provided fuel usage requirements, to which a rate inclusive of storage and supply was applied.

21.2.6.6 Area 5500 – Freight Costs

All materials and equipment items within the direct costs are based on delivery direct to site. Freight costs are deemed to include inland transportation, export packing, all forwarder costs, ocean freight and insurance, receiving port custom agent fees, and local inland freight to the project site.

Freight and transportation companies were engaged to provide advice and projections on the freight allowances for the project's equipment and material supply, as a function of the recent logistics constraints observed around the world, due to the COVID-19 pandemic.

A third-party logistics company was also engaged to review the transportation and logistics considerations specific to the project and provide transportation cost estimates for the major mechanical and electrical equipment packages. This included international sea-freight and land-based transportation costs inclusive of any requisite breakbulk/oversized cargoes.

21.2.7 Area 6000 – Project Delivery Costs

The engineering, procurement, project, and construction management budget was compiled by identifying resources over a defined schedule. The EPCM and consulting services estimate includes the following items:

- engineering – with > 50% of labour spent in the island of Newfoundland
- procurement (home office based)
- construction management (site based)
- project office facilities
- staff transfer expenses
- secondary consultants
- field inspection and expediting
- corporate overhead and fees
- travel expenses
- home office expenses
- site office expenses
- commissioning support
- other consulting services (geotechnical, environmental, shipping logistics, surveys, and QA/QC)

The engineering, procurement, project, and construction management estimate has been developed from a deliverables list and by identification of resources over a defined schedule. A detailed assessment of consultants and project general expenses is also included in EPC costs.

21.2.8 Area 7000 – Owner's Costs

21.2.8.1 General Owner's Costs

Owner's costs include the following:

- owner's team (including construction, start-up, and commissioning)
- pre-production process and administrative costs
- land
- First Nations
- environmental
- freight and logistics support
- recruiting, training and site visits
- IT and communications
- insurance, finance, legal, and offices
- closure costs for the process plant and tailings management facility
- operational readiness

21.2.9 Area 8000 – Estimate Contingency

Estimate contingency is included to address anticipated variances between the specific items contained in the estimate and the final actual project cost.

Contingency is defined as a monetary allowance that is included, over and above the base cost, to contribute to the success of the project by providing for the various cost uncertainties. The level of contingency varies depending on the nature of the contract and the Client's requirements. Due to uncertainties at the time the capital cost estimate was developed (in terms of the level of engineering definition, basis of the estimate, schedule development, etc.), it is essential that the estimate include a provision to cover the risk from these uncertainties.

The amount of risk was assessed with due consideration of the preliminary level of design work, the way pricing was derived, and the preliminary nature of the plan for project implementation.

A contingency analysis was conducted per commodity to assess the conditions above, and contingency was applied on a per line item basis accordingly, as per Table 21.7.

The estimate contingency does not allow for the following:

- abnormal weather conditions
- changes to market conditions affecting the cost of labour or materials
- changes of scope within the general production and operating parameters
- effects of industrial disputes

Table 21.7: Contingency Applied

Commodity Code	Discipline	Contingency Applied
A	Architectural	10%
B	Earthworks	20%
C	Concrete	10%
D	Mining	4%
E	Electrical Equipment + Bulks	10%
F	Platework	10%
I	Instrumentation + Bulks	10%
M	Mechanical Equipment	10%
N	Plant & Ancillary Equipment	0%
O	Mobile Equipment	4%
P	Pipework	10%
S	Structural Steel	10%
U	Field Indirects	10%
V	3rd Party Packages/Other	7.5%
W	Project Delivery	7.5%
Y	Owner's Costs	7.5%
Z	Taxes & Duties	7.5%

21.2.10 Growth Allowance

Each line item of the estimate is developed initially at base cost only. A growth allowance is then allocated to each element of those line item costs to reflect the level of definition of design and pricing strategy.

Estimate growth is:

- is intended to account for items that cannot be quantified based on current engineering status but which are empirically known to appear
- accuracy of quantity take-offs and engineering lists based on the level of engineering and design undertaken at a feasibility study level
- pricing growth for the likely increase in cost due to development and refinement of specifications as well as re-pricing after initial budget quotations and after finalisation of commercial terms and conditions to be used on the project

Where an allowance has been used that is the result of factoring, no growth has been applied, as the factor has been surmised from a total cost.

Growth has been calculated at the line-item level by evaluating the status of the engineering scope definition and maturity and the ratio of the various pricing sources for equipment and materials used to compile the estimate. The capital cost growth allowance is presented in Table 21.8.

Table 21.8: Growth Allowances

Commodity Code	Discipline	Growth Applied
A	Architectural	5%
B	Earthworks	5%
C	Concrete	5%
E	Electrical	5%
F	Platework	5%
I	Instrumentation	5%
M	Mechanical Equipment	5%
P	Pipework	5%
S	Structural Steel	5%

21.2.11 Exclusions

The following costs and scope will be excluded from the capital cost estimate:

- senior finance charges
- residual value of temporary equipment and facilities
- environmental approvals
- this study or any further project studies
- force majeure issues
- future scope changes
- special incentives (schedule, safety, or others)
- no allowance has been made for loss of productivity and/or disruption due to religious, union, social and/or cultural activities
- management reserve (project contingency)
- Owner’s escalation costs
- Owner’s foreign exchange exposure
- operating costs
- working capital
- land acquisition
- project-specific risk reserve has not been evaluated

21.3 Basis of Capital Cost Estimate – Sustaining

21.3.1 Area 1000 – Mining

Down payments and monthly lease payments for the mine equipment fleet are capitalised through the sustaining periods of the project. Expansions to the capitalised spare components, to the high precision GPS systems, and radio communications systems are included in the sustaining period as the additional mobile fleet is commissioned. The piping system for pit dewatering is also expanded during the sustaining capital period. Fleet management and dispatch systems are added to mine operations in the sustaining period.

21.3.2 Area 2000 – Process Buildings

The reagents building is a fabric building on a 60-month pre-payment contract, after which the building will be owned by Marathon Gold. The total cost of the building after all payments is $1.7 million.

21.3.3 Area 3000 – Water Management Facilities

As outlined in Chapter 18, an overall surface water management strategy was developed that includes several ponds and ditches around the site, typically adjacent to the stockpiles. The quantities for these civil works were estimated by Stantec and assigned to a specific period, such as pre-production or Years 1 to 3. The quantities produced were then combined with rates received from the heavy civil contract from local contractors, and costs estimated as shown in Table 21.9.

Table 21.9: Water Management Facility Costs

Phase	Completion Month-Year	Costs (C$M)
2	November 2023	4.3
3	November 2024	1.0
4	November 2025	1.1
Total		6.3

21.3.4 Area 3000 – Infrastructure Buildings

Quotations for infrastructure buildings, which were acquired from Canadian and Newfoundland-based contractors, varied between outright purchase, lease-to-own and rental. For the project, the pre-engineered steel buildings were nominated as outright purchase, the fabric buildings are lease-to-own, and lastly all modular buildings were nominated as rental agreements.

Each of the fabric buildings are listed in the table below; however, the modular building rental cost have been considered as operating costs, under G&A. The breakdown of the repayment plan per building is shown in Table 21.10.

Table 21.10: Infrastructure Buildings Costs

Building	Repayment Terms	Amount (C$M)
Reagent Storage - Fabric Building	60-month lease to own	0.4
Plant Warehouse/Maintenance Shop	60-month lease to own	0.6
Truck Shop Buildings (x2) - Fabric	60-month lease to own	5.4
Truck Wash Building - Fabric	60-month lease to own	1.0
Truck Warehouse/Maintenance Shop - Fabric	60-month lease to own	0.4
Total		7.8

21.3.5 Area 3000 – Tailings Management Facility

21.3.5.1 Effluent Treatment Plant

The effluent treatment plant is broken up into Phases 1 and 2. Phase 1 will commence with one stage of submerged attached grown reactor (SAGR), to be commissioned in April 2024, six months after the target first gold date. Phase 2 will add two more SAGR stages, to be commissioned in April 2025. The total cost includes the costs for the first and second phase, as well as the related labour costs based on unit rates provided by the installation contractors as part of their pricing schedules and are shown in Table 21.11.

Table 21.11: Water Treatment Plant Costs

Phase	Completion Month-Year	Costs (C$M)
1	January 2024	6.0
2	January 2025	6.7
Total		12.7

21.3.5.2 Tailings Management Facility

Following construction of the start-up configuration, the tailings dam will be raised in five stages over the mine life, as outlined in Chapter 18. The quantities for these civil works were estimated by Golder and assigned to a specific period. The quantities produced by Golder were then combined by Ausenco with rates received from the heavy civil contract from local contractors, and costs estimated as shown in Table 21.12.

Table 21.12: Tailing Management Facility Costs

Phase	Completion Month-Year	Costs (C$M)
2	January 2024	7.6
3	August 2024	7.7
4	June 2025	10.1
5	June 2027	12.2
6	December 2029	6.6
Total		44.2

21.3.5.3 Tailings Slurry Pipeline

The costs for the tailing piping (C$0.9 million) to the Leprechaun pit were calculated based on estimated quantities applied to the unit rates provided by the installation contractors in their pricing schedules.

21.3.6 Area 3000 – Permanent Camp

The quotations for permanent camps, which were acquired from Canadian and Newfoundland-based contractors, varied between outright purchase, lease-to-own and rental. A contractor quotation for a lease-to-own agreement was nominated for the project. The accommodations camp cost of C$15.1 million is to be paid out evenly over a period of 10 years.

21.3.7 Area 7000 – Owner's Cost – Closure Costs

Within the heavy earthworks contract, Ausenco estimated the bulk material take-off for all necessary demolition, rehabilitation, revegetation, earth grading/contouring, scrap metal disposal/tipping fees, as well as post-closure monitoring. The total closure cost was calculated to be C$36.0 million based on the unit rates provided by the installation contractors as part of their pricing schedules.

Process Plant

Site closure for the process plant area capture the cost associated with the demolition of equipment, process plant, and mining building infrastructure and remediation works of the site. The closure costs were derived from unit rate costs provided by the installation contractors as part of their pricing schedules.

Tailings Management Facility

Site closure costs for the non-process plant footprint include works to soil cover, revegetate/hydroseed the stockpiles and TMF, and construct a closure spillway. The closure costs for the TMF and remaining stockpiled were provided by the responsible party as per the WBS and included in the cost estimate by Ausenco.

21.3.7.1 Salvaging

Salvaging costs have been projected by assuming that all mechanical, electrical, and mobile equipment will carry a 10% resale value at the end of the mine life, and that all spares remaining in the warehousing can be returned to the stock provider, projected at 5% of the mechanical cost value of the project. Total salvaging value was estimated at $20 million.

21.3.8 Area 8000 – Contingency

The same contingency method as described in Section 21.2.9 has been used for sustaining costs.

21.3.9 Growth Allowance

The same growth method as described in Section 21.2.10 has been used for sustaining costs.

21.4 Operating Costs

The operating cost estimate is presented in Q1 2021 Canadian dollars (CAD or C$). The estimate was developed to have an accuracy of ±15%. The estimate includes mining, processing, general and administration (G&A), and accommodations costs.

The operating cost estimates for the life of mine are provided in Table 21.13. The overall life-of-mine operating cost is $1,765 million over 13 years, or $38/t of ore milled, with three years of operation for Phase 1 and nine years of operation for Phase 2. Mine costs are shown separately in detail, as the yearly average values are variable.

Table 21.13: Average Annual Plant and G&A Operating Cost Summary

	Phase 1 – 2.5 Mt/a		Phase 2 – 4.0 Mt/a	
Cost Centre	**C$M**	**C$/t**	**C$M**	**C$/t**
Processing & Tailings				
Consumables	19.4	7.77	28.5	7.13
Plant Maintenance	1.16	0.47	1.51	0.38
Power	6.89	2.75	8.66	2.16
Laboratory	0.17	0.07	0.21	0.05
Labour (O&M)	7.57	3.03	7.94	1.99
Processing Mobile Equipment	0.14	0.05	0.13	0.03
Subtotal	**35.3**	**14.1**	**47.0**	**11.7**
Effluent Treatment				
Plant Maintenance	0.11	0.04	0.11	0.03
Labour	0.05	0.02	0.05	0.01
Power	0.23	0.09	0.23	0.06
Other (including consumables)	0.70	0.28	0.79	0.20
Subtotal	**1.1**	**0.4**	**1.2**	**0.3**
Subtotal Plant Operating Cost	**36.4**	**14.6**	**48.1**	**12.0**
General & Administration				
Labour (G&A)	3.94	1.58	3.94	0.99
G&A Expenses	6.41	2.57	6.45	1.61
Site Maintenance	0.72	0.29	0.72	0.18
Camp	5.11	2.05	5.16	1.29
Subtotal	**16.2**	**6.5**	**16.3**	**4.1**
Total	**52.6**	**21.0**	**64.4**	**16.1**

21.4.1 Basis of Operating Cost

21.4.1.1 Assumptions

Common to all operating cost estimates are the following assumptions:

- Cost estimates are based on Q1 2021 pricing without allowances for inflation.
- For material sourced in US dollars, an exchange rate of 1.33 Canadian dollar per US dollar was assumed.
- Fuel costs and associated taxes were established with several fuel suppliers in Newfoundland after reviewing 18-month average pricing for diesel and gasoline. Estimated costs are C$0.914/L for diesel and C$0.902/L for gasoline.
  - Rates are increased during the first three years of operation, as surcharges are applied to account for the suppliers cost of installing on-site fuel distribution systems.
  - Rates are decreased during the construction period of the project as the Newfoundland and Labrador Provincial Road Tax is assumed not to apply.
  - Diesel rates applied are $0.819/L during construction, $0.959/L during the first two years of operations, and $0.914/L thereafter as a base rate.

- The annual power costs were calculated using a unit price of C$0.063/kWh. Ausenco and Marathon Gold worked together to provide the electrical load numbers to NL Hydro to receive a quote based on the best information available.
- Labour is assumed to come mostly from Newfoundland, and locally from places such as Buchans, Millertown, Badger, Grand Falls-Windsor, and Bishop's Falls.

21.4.1.2 Basis of Process Operating Cost

The following was used to determine the project's LOM process operating costs in agreement with the cost definition and estimate methodologies outlined below. This basis considers the development of a facility capable of processing 6,850 t/d of ore in Phase 1 and 10,960 t/d in Phase 2.

Assumptions made in developing the process operating cost estimate are listed below:

- Mill production is set at an average of 2.5 Mt/a for Phase 1 and 4.0 Mt/a for Phase 2.
- Process plant operating costs are calculated based on labour, power consumption, and process and maintenance consumables.
- Off-site gold refining, insurance, and transportation costs are excluded, as they are included elsewhere.
- Oxygen is assumed to be delivered to site as liquid oxygen.
- Operating costs incurred during the pre-production period have been capitalised within Marathon Gold.
- Labour rates were provided by Marathon Gold, following an industrial market survey completed in 2020 that specifically reviewed mining and technical engineering roles within the Province of Newfoundland and Labrador.
- General and administration (G&A) costs were baselined against previous project experience, defined along with specific inputs from Marathon Gold.
- Consumables costs are based on data from quotes from similar projects in Eastern Canada.
- No factor for spare parts has been applied to adjust for consumption of less spare parts in early years of operation.
- Grinding media consumption rates have been estimated based on the ore characteristics.
- Reagent consumption rates have been estimated based on the metallurgical testwork results at a nominal basis.
- Mobile equipment cost provides for fuel and maintenance, not for purchase or vehicle lease.

21.4.2 Mining Operating Costs

Estimated annual and life-of-mine unit mining costs are shown Table 21.14 on the following page.

Mine operating costs are built up from first principles. Inputs are derived from vendor quotations and historical data collected by MMTS. This includes quoted cost and consumption rates for such inputs as fuel, lubes, explosives, tires, undercarriage, GET, drill bits/rods/strings, machine parts, machine major components, and operating and maintenance labour ratios. Labour rates for planned hourly and salaried personnel have been supplied by Marathon Gold.

21.4.2.1 Benchmarking Unit Costs

MMTS has benchmarked the unit rates for the Valentine Project against other feasibility studies and operations within Canada, North America, and worldwide. The $2.55 life-of-mine average unit mining cost is reasonable based on the expected pit production and operating conditions for Marathon.

Some of the unique characteristics that set this project apart from its peers include:

- A comparatively high stripping ratio (waste tonnes mined over ore tonnes mined):
  - Waste mining unit costs are generally less expensive than ore mining costs, as controls for loss and dilution are not as stringent for waste.
  - Also, in Marathon's case, waste rock stockpiles are located immediately adjacent to the open pits, whereas ore is hauled to a crusher located ~3 km from each deposit. Waste rock stockpile elevations are also kept low to reduce significant additions to the haul cycle times.
- A relatively high total annual mining rate: the mine production schedule calls for between 45 and 60 Mt/a (125 to 165 kt/d) of total pit production. Fixed costs for the following items are diluted by the larger tonnage amounts:
  - costs for support operations, such as pit lighting, pit dewatering, employee shuttling and transport, materials transport, mine safety and first aid, maintenance and tire handling support
  - general mine expenses (GME) or operations and maintenance management and technical services departments

21.4.2.2 Mine Operations

The mine will operate 365 days per year, 24 hours per day with two 12-hour shifts per day. Four shifts are specified, all based on a rotation of one week on and one week off: one crew on dayshift, one crew on night shift, and two crews off, drive-in and drive-out. An allowance of 15 days of no production has been built into the mine schedule to allow for adverse weather conditions.

21.4.2.3 Mine Production Schedule

Annual ore production tonnes, waste tonnes, and stockpiled management tonnes are taken from the feasibility study mine production schedule shown in Table 16.4. Drilling, loading, and hauling hours are calculated based on the capacities and parameters of the equipment fleet. These tonnes and hours also provide the basis for blasting consumables, and support fleet inputs.

Table 21.14: Unit Mine Operating Costs, $/t mined

	LOM	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
Grade Control	$0.26	$0.05	$0.06	$0.05	$0.05	$0.05	$0.05	$0.06	$0.08	$0.13	$0.18	$0.21
Production Drilling	$0.06	$0.22	$0.24	$0.26	$0.26	$0.23	$0.25	$0.25	$0.29	$0.35	$0.38	$0.44
Blasting	$0.40	$0.37	$0.38	$0.39	$0.36	$0.38	$0.38	$0.41	$0.44	$0.57	$0.59	$0.80
Loading	$0.29	$0.26	$0.28	$0.28	$0.29	$0.28	$0.29	$0.28	$0.28	$0.28	$0.37	$0.46
Hauling	$0.93	$0.61	$0.56	$0.70	$0.79	$0.74	$0.99	$1.16	$1.29	$1.37	$1.39	$2.49
Support	$0.33	$0.34	$0.26	$0.28	$0.30	$0.30	$0.30	$0.35	$0.33	$0.47	$0.55	$0.68
Site	$0.03	$0.22	$0.06	$0.03	$0.01	$0.01	$0.01	$0.01	$0.01	$0.02	$0.05	$0.06
Unallocated Labour	$0.05	$0.10	$0.03	$0.03	$0.02	$0.02	$0.02	$0.03	$0.04	$0.10	$0.19	$0.24
Direct Costs – Subtotal	**$2.36**	**$2.17**	**$1.87**	**$2.02**	**$2.06**	**$2.02**	**$2.30**	**$2.57**	**$2.75**	**$3.30**	**$3.68**	**$5.38**
Mine Operations GME	$0.08	$0.15	$0.07	$0.06	$0.05	$0.05	$0.06	$0.07	$0.08	$0.17	$0.31	$0.35
Mine Maintenance GME	$0.03	$0.05	$0.02	$0.02	$0.02	$0.02	$0.02	$0.03	$0.03	$0.06	$0.12	$0.10
Technical Services GME	$0.09	$0.13	$0.07	$0.07	$0.06	$0.06	$0.07	$0.08	$0.09	$0.20	$0.38	$0.32
Total GME Costs – Subtotal	**$0.20**	**$0.33**	**$0.16**	**$0.16**	**$0.13**	**$0.13**	**$0.14**	**$0.17**	**$0.21**	**$0.44**	**$0.81**	**$0.77**
Total Mine Operating Cost	**$2.55**	**$2.50**	**$2.04**	**$2.18**	**$2.19**	**$2.15**	**$2.44**	**$2.75**	**$2.96**	**$3.74**	**$4.49**	**$6.15**

Note: LOM costs include rehandling of ore from stockpiles.

21.4.2.4 Grade Control Inputs

Grade control drilling is applied to all scheduled mineralised material (ore and waste) to "look ahead" at upcoming benches and better define mineralisation boundaries for controlled blasting and loading operations. A requirement for reverse circulation (RC) grade control drilling hours is calculated with inputs from hole size, pattern dimensions, bench height, material density, and penetration rate of the drill.

Additional costs are added to the grade control drill for sampling and assaying on 3 m intervals. Costs for assay lab technicians are also included.

21.4.2.5 Production Drilling Inputs

Based on the tonnes scheduled, a requirement for production drilling hours is calculated with inputs from hole size, pattern dimensions, bench height, material density, and penetration rate of the drill.

Drilled patterns and depths are applied in identified selective mining zones, and alternative patterns and depths in bulk mining zones. Patterns and collars are modified to target specific powder factors in the various lithologies that are encountered.

Trim blasting in 5% of mined rock is planned to be drilled on an alternative pattern and depth.

No drilling is assumed in topsoil and overburden materials.

21.4.2.6 Blasting Inputs

Variable powder factors are estimated for the various encountered lithologies and range from 0.22 to 0.27 kg/t. For each targeted powder factor, pattern area, and explosive density, the quantity of explosives is calculated and costed. In addition, an estimate for initiation systems and blasting accessories is provided on a per hole basis which includes detonation cord, a booster, and electric detonator. As an emulsion product is assumed, no liners are included in the per hole pricing.

Costs are estimated for emulsion product and initiation systems which include detonation cord, boosters, and electric detonators.

Explosive blasting operations are planned as a supplier operated function. Additional costs are included for delivery of the product to the site, site storage, delivery of the product to the hole, hole loading and shooting blasts, as well as coverage for lease costs for necessary equipment and facilities (pickup trucks, blasting trucks, stemming loader, storage facilities, magazine, garage, trailers, and fencing).

21.4.2.7 Loading & Hauling Inputs

Fleet requirements for loading and hauling are calculated on loader and hauler productivities applied to the mine production schedule.

Loader productivities are applied to the scheduled material movement to calculate required equipment operating hours. For selectively mined zones of the deposit (Section 16.1.2 for description) the 12.0 m^3 bucket hydraulic excavator is applied to the scheduled tonnes, with 50% direct loaded into haulers and the other 50% placed in piles on the bench and rehandled with the wheel loader.

Planned average annual loader productivities for the 15.5 m^3 bucket hydraulic excavator are 2,250 t/h, and for the 12.0 m^3 bucket hydraulic excavators range from 1,388 t/h to 1,771 t/h, depending on material loaded (ore, waste, till) and selective or bulk mining conditions. Planned average annual loader productivities for the 13.5 m^3 wheel loader are 1,580 t/h in rehandle piles and 1,404 t/h while production loading. The wheel loader is also planned to load the primary crusher for 25% of the mill feed tonnages, at a planned productivity of 792 t/h.

Haulage profiles are estimated from pit centroids at each bench to designated dumping points for each scheduled period. These haul profiles are inputs to a haul cycle simulation program and the resulting cycle times are used to estimate required hauler operating hours and fuel burn in each scheduled period. Annual average hauler productivities for the 91-tonne payload haulers range from 140 t/h to 480 t/h depending on the haul distances and elevation changes incurred in the year. Annual average hauler productivities for the 140-tonne payload haulers range from 220 t/h to 670 t/h. Stockpile reclaim productivities are assumed to be 340 t/h. Articulated haulers are assigned to topsoil stripping activities as well as operating hours initially assigned to the 91-tonne payload hauler fleet at a ratio of 36.9/84.9. All productivities listed above are on a NOH (net operating hour) basis.

21.4.2.8 Pit Support Inputs

Pit services include the following:

- haul road development and maintenance
- pit floor and ramp maintenance
- stockpile maintenance
- ditching
- dewatering
- mobile fleet fuel and lube support
- topsoil excavation
- secondary blasting and rock breaking
- snow removal
- reclamation and environmental control
- lighting
- transporting personnel and operating supplies
- mine safety and rescue

A fleet of mobile equipment is specified to handle these pit support activities. Annual utilisation of this support equipment is driven by the utilisation of the primary equipment in the fleet.

21.4.2.9 Equipment Operating Cost

All equipment is costed using quoted or estimated fuel consumption rates, consumables costs, GET estimates, labour ratios and general parts and preventative maintenance costs, per hour, or per hour interval. The hourly rates are then multiplied by the operating hours of the machine to find a constant distributed operating cost per operating or working hour.

The costs for major components of the larger equipment types are calculated separately from the distributed hourly cost. Major repairs are clocked with the usage of the piece of equipment so that major repairs costs are forecast in the year it occurs, rather than averaging this cost over many years. This method gives a more representative cash flow. Equipment replacement is clocked in the same manner, so that individual equipment units cumulative operating hours are tracked up to a set limit, and then a replacement is introduced, and sustaining capital costs incurred in that year.

Running hours (service metre unit) on each piece of equipment are estimated based on operating capacities and requirements of the mine production schedule. These service metre unit hours are multiplied by the hourly consumables rates and unit operating costs to calculate the total equipment operating costs for each year of operation.

Diesel price of \$0.913/L is used. This value is reduced by \$0.095/L during the pre-production period due to the removal of the provincial road tax before operational start-up, and addition of supplier costs to cover on site fuel distribution systems. The value in increased by \$0.045/L over the first three years of operations to account for supplier costs to over on-site fuel distribution systems.

21.4.2.10 Hourly Labour

Labour workhour ratios are categorised for the different labour types (e.g., operators, mechanics, electricians, etc.) and assigned to each piece of equipment, and then multiplied by the operating hours. The total hours required for each category are added together and rounded off to assign a full person to each crew; any additional hours remaining, after rounding, are grouped together into an unallocated labour pool. Table 21.15 on the following page shows a summary of mine hourly labour counts.

21.4.2.11 Mine GME

General mine expense (GME) is a category for mine operation's overhead and technical services costs. It consists of costs for all salaried staff, a consumable and rental allowance, staff travel allowance, and software and fleet management and engineering systems' licensing and maintenance. This category is a fixed cost, and does not vary by production or fleet size, except for ramp-ups to full staffing and ramp-downs at the end of the mine life. Table 21.16 shows a summary of estimated salaried staff and technical personnel.

21.4.2.12 Mine Operations Site Development Costs

Mine operations site development costs are described below:

- Clearing & Grubbing – The costs for clearing and grubbing are estimated for the pits, haul road, and stockpile areas. The costs are incurred prior to those areas being required for mine operations. It is assumed that 70% of all open pit areas and 20% of haul road and stockpile areas are already cleared via existing on-site activities. Any cost discounts for not recovering non-merchantable timber have not been considered.
- Wetland Till Removal – For the Leprechaun and Marathon deposits, the costs for removal of wetland areas in the pit limits are estimated at a premium of \$2/t over the normal till removal costs. Quantities are estimated based on the measured wetland areas, and an excavation depth of 2 m and a density of 2.0 t/m^3.
- Topsoil Excavation – Topsoil quantities for pit stripping are included in the mine production schedule, with loading and hauling hours accounted for in the mine fleet. Additional topsoil stripping quantities for the haul roads and stockpile footprints are also estimated. Topsoil hauling productivities of 104 m^3/h are based on 1.5 km hauling distances for the articulated haulers. Hydraulic excavator topsoil excavation productivity is estimated to be two times the hauler productivity.
- Crusher Rock Production – An estimate to produce crush rock for mine operations is included. Crush rock will be used for haul road construction and maintenance, as well as for stemming materials in blasting. Haul roads are planned with a 0.5 m crush rock topping when constructed and 0.1 m resurfaced per year. Stemming quantities are estimated based on blastholes produced per year and stemming length in each blasthole.

Table 21.15: Mine Hourly Labour Summary

Position	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034-2036
Mine Operations													
Drill Operator	4	16	20	20	24	20	20	16	16	12	8	4	0
Blasters	3	6	6	6	6	6	6	6	6	6	3	3	0
Excavator Operator	4	14	14	15	18	19	16	17	13	6	6	2	0
Loader Operator	0	6	6	5	6	5	4	3	3	2	2	2	2
Haul Truck Driver	20	60	72	76	96	96	100	100	100	60	36	22	8
Grader Operator	4	12	12	12	16	16	16	16	16	12	8	4	2
Track Dozer Operator	8	24	24	24	28	28	24	20	16	12	8	4	2
Water Truck Operator	3	7	9	9	10	10	10	11	11	9	6	3	1
Fuel Truck Operator	1	5	7	7	7	6	6	5	5	3	2	1	1
Mine Maintenance													
Electrician	2	6	8	8	8	8	8	8	8	4	4	2	2
HD Mechanic	6	22	28	26	34	32	33	31	29	16	9	6	3
LD Mechanic	3	4	4	4	5	5	5	5	5	4	3	2	1
Machinist	2	5	6	6	7	7	6	6	6	3	2	2	1
Welder	2	7	8	8	11	10	10	10	10	5	4	2	1
Labourer	2	6	8	8	10	10	10	10	10	6	4	2	2
Total Hourly Labour	**64**	**202**	**232**	**228**	**284**	**276**	**274**	**264**	**254**	**160**	**105**	**61**	**26**

Table 21.16: Mine Salaried Staff Summary

Position	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034-2036
Mine Operations													
Mine Manager	0	1	1	1	1	1	1	1	1	1	1	0	0
Mine Superintendent	1	1	1	1	1	1	1	1	1	1	1	1	0
Clerks	0	1	1	1	1	1	1	1	1	1	1	1	0
Mine Foreman	4	4	4	4	4	4	4	4	4	4	4	2	2
Pit Supervisors	0	4	4	4	4	4	4	4	4	4	4	2	0
Safety/Training Officer	3	3	3	3	2	2	2	2	2	2	2	1	1
Pit Labourer/Field Sampler	4	8	8	8	8	8	8	8	8	8	8	4	0
Assay Lab Technicians	2	8	8	8	8	8	8	8	8	8	4	2	0
Dispatch Controllers	0	2	4	4	4	4	4	4	4	4	2	0	0
Mine Maintenance													
Maintenance Superintendent	0	1	1	1	1	1	1	1	1	1	1	0	0
Maintenance Supervisor	0	2	2	2	2	2	2	2	2	2	2	1	1
Maintenance Clerk	0	1	1	1	1	1	1	1	1	1	1	1	0
Maintenance Planner	0	2	2	2	2	2	2	2	2	2	2	0	0
Technical Services													
Chief Geologist	1	1	1	1	1	1	1	1	1	1	1	1	0
Senior Geologist	0	1	1	1	1	1	1	1	1	1	1	0	0
Mine Geologist	0	2	2	2	2	2	2	2	2	2	2	1	1
Ore Grade Technicians	2	8	8	8	8	8	8	8	8	8	8	2	1
Chief Mining Engineer	0	1	1	1	1	1	1	1	1	1	1	0	0
Senior Mining Engineer	1	1	1	1	1	1	1	1	1	1	1	1	1
Planning Engineer	0	2	2	2	2	2	2	2	2	2	2	0	0
Drill and Blast Engineer	0	2	2	2	2	2	2	2	2	2	2	1	0
Geotechnical Engineer	1	1	1	1	1	1	1	1	1	1	1	1	0
Dispatch Engineer	0	1	2	2	2	2	2	2	2	2	2	0	0
Surveyor / Technician	1	2	2	2	2	2	2	2	2	2	2	1	0
Total Staff	**20**	**60**	**63**	**62**	**62**	**62**	**62**	**62**	**62**	**62**	**56**	**23**	**8**

21.4.3 Process Operating Costs

The LOM process operating cost is $589 million over 13 years. A breakdown of this value and its unit costs is presented in Table 21.17.

Table 21.17: Average Annual Process Operating Cost

	Phase 1		Phase 2	
Cost Centre	**C$M**	**C$/t**	**C$M**	**C$/t**
Consumables	19.4	7.77	28.5	7.13
Plant Maintenance	1.16	0.47	1.51	0.38
Power	6.89	2.75	8.66	2.16
Laboratory	0.17	0.07	0.21	0.05
Labour (O&M)	7.57	3.03	7.94	1.99
Processing Mobile Equipment	0.14	0.05	0.13	0.03
Total	**35.34**	**14.13**	**47.00**	**11.74**

21.4.3.1 Consumables

Individual reagent consumption rates were estimated based on the metallurgical testwork results, Ausenco's in-house database and experience, industry practice, and peer-reviewed literature. Each reagent cost was obtained through benchmarking for similar projects performed by Ausenco. A detailed description of the reagents required for the process is provided in Chapter 17.

Other consumables (e.g., liners for the primary crusher, SAG mill, ball mill, and ball media for the mills) were estimated using:

- metallurgical testing results (abrasion)
- Ausenco's in-house calculation methods, including simulations
- forecast nominal power consumption

Reagents and consumables represent approximately 53% to 59% of the total process operating cost at C$7.77/t milled for Phase 1 and $7.13/t milled for Phase 2.

21.4.3.2 Maintenance

Annual maintenance consumable costs were calculated based on a total installed mechanical capital cost by area using a weighted average factor from 1% to 5%. The factor was applied to mechanical equipment, platework, and piping. The total maintenance consumables operating cost is C$0.39 to 0.47/t milled, or approximately 3% of the direct mechanical capital cost, which is equivalent to approximately 3% of the total process operating cost.

21.4.3.3 Power

The processing power draw was based on the average power utilisation of each motor on the electrical load list for the process plant and services. Power will be supplied by the NL Hydro grid to service the facilities at the site.

21.4.3.4 Laboratory & Assays

Operating costs associated with laboratory and assay activities were estimated according to the anticipated number of assays per day and per year, estimated by Ausenco. Assay costs include environmental sampling and assaying. Assay costs associated with processing mine grade control samples or exploration samples are included in the mine operating costs. The laboratory and assays comprise approximately 0.5% of the total process operating cost, and the forecasted annual requirement for internal assays will be around 15,000 for Phase 1 and 21,000 for Phase 2 for the processing plant. Approximately 1,700 samples per year are required for the environmental sampling schedule.

21.4.3.5 Mobile Equipment

Vehicle costs are based on a scheduled number of light vehicles and mobile equipment, including fuel, maintenance, spares and tires, and annual registration and insurance fees.

21.4.3.6 Labour

Staffing was estimated by benchmarking against similar projects. The labour costs incorporate requirements for plant operation, such as management, metallurgy, operations, maintenance, site services, assay lab, and contractor allowance. The total operational labour averages 72 employees for Phase 1 and 76 employees for Phase 2.

Individual personnel were divided into their respective positions and classified as either 8-hour or 12-hour shift employees. Salaries were provided by Marathon Gold, who performed a local survey for the salaries of each expected role. Marathon Gold also confirmed the specific benefits and bonuses to be allocated. Thus, the rates were estimated as overall rates, including all burden costs, but do not include camp costs (included separately under “Camp Costs” in the G&A cost centre).

An organisational staffing plan outlining the labour requirement for the process plant is shown in Table 21.18 on the following page. The G&A staffing plan is summarised in Table 21.19.

21.4.4 Tailings Management Facility Operating Cost

Operating costs for the TMF include personnel for operating, maintenance, environmental monitoring, safety-related dam surveillance, and a light vehicle. These costs are included with the process operating costs. Supporting engineering studies, investigations, design, construction supervision, safety-related dam inspections, and general consulting costs are included with the engineering costs covered by Ausenco.

Table 21.18: O&M Staffing Plan

Labour / Contractor Summary	#/Shift	# Shifts	Quantity
Process Upper Management			
Plant & Site Maintenance Superintendent	1	1	1
Maintenance Planner	1	1	1
Manager Process Plant	1	1	1
Chief Assayer	1	1	1
Mill Trainer	1	1	1
Chief Metallurgist/Process Superintendent	1	1	1
Mill Operations			
Shift Foreman	1	4	4
Control Room Operator	1	4	4
Crusher Operator	1	4	4
Grinding Operator	1	4	4
Leach & Reagents Operator	1	4	4
Elution / Reagents Operator	1	4	4
Gravity/Gold Room Foreman	1	2	2
Gold Room Operator	1	2	2
Technical Services			
Graduate Metallurgist	1	2	2
Metallurgical Technician	1	2	2
Assay Laboratory Technician	2	4	8
Mill Maintenance			
Maintenance Foreman	1	1	1
Electrical Foreman	1	1	1
Electrician	2	2	4
Millwright/Fitter	2	4	8
Mechanical Apprentice	1	2	2
Electrical Apprentice	1	2	2
Instrument Technician	2	2	4
Electrician Technician	2	2	4
Total	**30**	**58**	**72**

Table 21.19: G&A Staffing Plan

Labour / Contractor Summary	#/Shift	# Shifts	Quantity
General Manager	1	1	1
Assistant to the General Manager	1	1	1
Community & Stakeholders Liaison Supervisor	1	1	1
H&S &Operations Training Superintendent	1	1	1
Manager Human Resources	1	1	1
Reception	1	1	1
Manager Environment	1	1	1
Water Management Technician	2	1	2
Personnel Coordinator	1	1	1
Environmental Engineer	1	1	1
Flora & Fauna Technician	2	1	2
Security EMT	4	1	4
Security Personnel	2	4	8
Employee Health Advisor	1	1	1
Safety & Training Coordinator	1	1	1
Contracts/Procurement Manager	1	1	1
Warehouse Foreman	1	2	2
Warehouse Staff	2	2	4
Payroll Clerk	1	1	1
Manager Administration	1	1	1
Senior Accountant	1	1	1
ERP Administration	1	1	1
Clerk	1	1	1
Superintendent IT	1	1	1
IT Technicians	1	4	4
Subtotal	**54**	**43**	**88**

21.4.5 General & Administrative Operating Costs

General and administrative (G&A) costs are expenses not directly related to the production of gold and include expenses not included in mining, processing, external refining, and transportation costs. These costs were developed with input from Marathon Gold, as well as Ausenco's in-house data on existing Canadian operations.

A bottom-up approach was used to develop estimates for G&A costs over the life of mine. The G&A costs were determined for a 13-year mine life with an average cost of $6.48/t milled for Phase 1 and $4.07/t milled for Phase 2. These costs were assembled according to the following departmental cost reporting structure:

- G&A maintenance (includes snow-clearing, surface grading, and watering during the summer)
- G&A personnel

- camp (including camps for mine labour)
- modular building rentals
- human resources (including recruiting, training, and community relations)
- infrastructure power (including power, fuel, and heat)
- site administration, maintenance and security (including subscriptions, professional memberships and dues, external training, advertising and promotional material, first aid, office supplies and equipment, sewage and garbage disposal, bank and payroll fees)
- assets operation (including non-operation-related vehicles)
- health and safety (including personal protective equipment and hospital service costs)
- environmental (including sampling and TMF operation)
- IT and telecommunications (including hardware and satellite link)
- contract services (including insurance, consulting, sanitation, auditing, licenses, freight, and legal fees)
- cyanide code fees

The G&A labour costs were estimated by developing a headcount profile for each department which was then forecast over the life of mine. Labour rates provided by Marathon Gold were applied to develop the total G&A labour cost.

G&A labour resources include 88 employees.

Health and safety equipment, supplies, training, and environmental costs were provided by Marathon Gold, as were the IT and telecommunications costs for telecommunication, networking, Internet, computers, radio system, and repairs.

A breakdown summary of LOM G&A costs is shown in Table 21.20.

Table 21.20: Annual Average G&A Operating Cost Summary

	Phase 1		Phase 2	
Cost Centre	**C$M**	**C$/t**	**C$M**	**C$/t**
Labour (G&A)	3.94	1.58	3.94	0.99
G&A Expenses	6.41	2.57	6.45	1.61
General Maintenance	0.72	0.29	0.72	0.18
Camp	5.11	2.05	5.16	1.29
Total	**16.20**	**6.48**	**16.27**	**4.07**

21.4.6 Effluent Treatment Operating Costs

Water treatment costs are expenses not directly related to the production of gold and include expenses not included in mining, processing, external refining, and transportation costs. These costs were developed from first principles by Ausenco and checked alongside effluent treatment plant vendors, regarding required power for operation and consumables. A breakdown summary of effluent treatment operating costs is shown in Table 21.21.

Table 21.21: Effluent Treatment Plant Operating Cost Summary

	Phase 1		Phase 2	
Cost Centre	**C$M**	**C$/t**	**C$M**	**C$/t**
Plant Maintenance	0.11	0.04	0.11	0.03
Labour	0.05	0.02	0.05	0.01
Power	0.23	0.09	0.23	0.06
Others (including consumables)	0.70	0.28	0.79	0.20
Total	**1.08**	**0.43**	**1.17**	**0.29**

21.4.7 Exclusions

The following costs and scope will be excluded from the operating cost estimate:

- An additional operating cost of C$3.93/oz of sold gold is considered in the financial model for refining and transportation charges, based on a recent quote received from Asahi.
- In addition, a credit for contained silver within the final doré was declared as a refining credit within the financial model, which totalled C$9.32/oz, weighted over life-of-mine. The contained silver credit in the sold gold was determined by reviewed the silver in the core head assay, by ICP, and applying a 50% recovery of head to sold gold.

22 Economic Analysis

22.1 Cautionary Statement

The results of the economic analyses discussed in this chapter represent forward-looking information as defined under Canadian securities law. The results depend on inputs that are subject to a number of known and unknown risks, uncertainties, and other factors that may cause actual results to differ materially from those presented herein. Forward-looking information includes the following:

- mineral reserve estimates
- assumed commodity prices and exchange rates
- proposed mine production plan
- projected mining and process recovery rates
- assumptions about mining dilution and the ability to mine in areas previously exploited using underground mining methods as envisaged
- sustaining costs and proposed operating costs
- interpretations and assumptions regarding joint venture and agreement terms
- assumptions as to closure costs and closure requirements
- assumptions about environmental, permitting, and social risks

Additional risks to the forward-looking information include:

- changes to costs of production from what is assumed
- changes in the estimated timing and quantity of production
- unrecognised environmental risks
- unanticipated reclamation expenses
- unexpected variations in quantity of mineralised material, grade or recovery rates
- geotechnical or hydrogeological considerations during mining being different from what was assumed
- failure of mining methods to operate as anticipated
- failure of plant, equipment or processes to operate as anticipated
- changes to assumptions as to the availability of electrical power, and the power rates used in the operating cost estimates and financial analysis
- ability to maintain the social license to operate
- accidents, labour disputes and other risks of the mining industry
- changes to interest rates
- changes to tax rates
- changes in government regulation of mining operations
- potential delays in the issuance of permits and any conditions imposed with the permits that are granted

The mine plan is based on the estimated mineral reserves for the project. No inferred mineral resources were included in the material scheduled for processing.

22.2 Methodology Used

An engineering economic model was developed to estimate annual pre-tax and post-tax cash flows and sensitivities of the project based on a 5% discount rate. It must be noted that tax calculations involve complex variables that can only be accurately determined during operations and, as such, the actual after-tax results may differ from those estimated. A sensitivity analysis was performed to assess the impact of variations in metal prices, foreign exchange rates, operating costs and capital costs.

The capital and operating cost estimates developed specifically for this project are presented in Chapter 21 of this report in 2021 Canadian dollars. The economic analysis has been run on a constant dollar basis with no inflation.

22.3 Financial Model Parameters

A base case gold price of US$1,500/oz is based on consensus analyst estimates and recently published economic studies. The forecasts are meant to reflect the average metal price expectation over the life of the project. No price inflation or escalation factors were taken into account. Commodity prices can be volatile, and there is the potential for deviation from the forecast.

The economic analysis was performed using the following assumptions:

- construction starting January 1, 2022
- commercial production starting on October 1, 2023
- mine life of 13.1 years
- exchange rate of 0.75 (USD:CAD)
- cost estimates in constant Q1 2021 Canadian dollars with no inflation or escalation
- 100% ownership with 1.5% NSR (assumes buy back of 0.5% NSR)
- capital costs funded with 100% equity (no financing costs assumed)
- all cash flows discounted to December 31, 2021 using mid period discounting convention
- a working capital balance of C$15 million is carried through the first year, which is then reduced to a balance of C$5 million until the end of the mine life
- gold is assumed to be sold in the same year its produced
- no contractual arrangements for refining currently exist

22.4 Taxes

The project has been evaluated on an after-tax basis to provide an approximate value of the potential economics. The tax model was compiled with assistance from third-party taxation professionals. The calculations are based on the tax regime as of the date of the feasibility study. At the effective date of the cashflow, the project was assumed to be subject to the following tax regime:

- The Canadian corporate income tax system consists of 15% federal income tax and 15% provincial income tax.
- The mining tax rate in Newfoundland and Labrador is 15%.

At the base case gold price assumption, total tax payments are estimated to be C$413 million over the life of mine.

22.5 Working Capital

Working capital investment of C$15 million to be made in the first year of production, partially recovered in the subsequent year and the remaining amount recovered in the final year of production. The effective sum of working capital over the life of mine is zero.

22.6 Refining & Transport Cost & Silver Credit

Mine revenue is derived from the sale of gold doré into the international marketplace. No contractual arrangements for refining exist at this time. However, the parameters used in the economic analysis are consistent with current industry rates. A refining and transport charge of C$3.93/oz was assumed with 99.95% gold payability resulting in a C$8 million cost over the life of mine. Silver credits were estimated based on a price of US$20/oz with a 50% recovery and 99.5% payability resulting in a C$18 million credit over the life of mine.

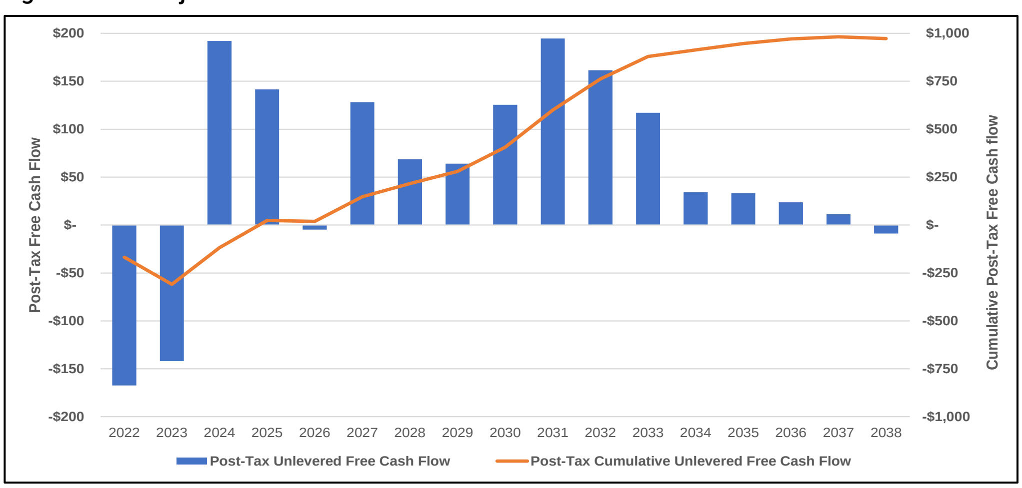
22.7 Royalty

A 1.5% royalty has been assumed for the project, resulting in approximately C$58 million in royalty payments over life of mine. Currently, the project has an outstanding NSR of 2%, but the company is eligible to buy back 0.5% of the outstanding NSR for approximately C$9 million before December 31, 2022. The company plans to exercise this option, which would result in the financial model carrying only a 1.5% NSR. As the financial model is based on an asset level, the C$9 million outflow has not been incorporated in the financial model.

22.8 Economic Analysis

The economic analysis was performed assuming a 5% discount rate. The pre-tax NPV discounted at 5% is C$867 million; the internal rate of return IRR is 36.9%; and payback period is 1.8 years. On an after-tax basis, the NPV discounted at 5% is C$600 million; the IRR is 31.5%; and the payback period is 1.9 years. A summary of project economics is shown graphically in Figure 22-1 and listed in Table 22.1. An analysis was done on monthly, quarterly and annual cashflow basis, but the cashflow output is shown on an annualised basis in Table 22.2.

Figure 22-1: Project Economics



Source: Ausenco, 2021.

Table 22.1: Summary of Project Economics

General		LOM Total / Avg.
Gold Price (US$/oz)		$1,500
Mine Life (years)		13.1
Total Waste Tonnes Mined (kt)		339,816
Total Mill Feed Tonnes (kt)		47,055
Strip Ratio		7.2x
Production		**LOM Total / Avg.**
Mill Head Grade (g/t)		1.36
Mill Recovery Rate (%)		94%
Total Mill Ounces Recovered (koz)		1,932
Total Average Annual Production (koz)		147
Operating Costs		**LOM Total / Avg.**
Mining Cost (C$/t Mined)		$2.55
Processing Cost (C$/t Milled)		$12.51
G&A Cost (C$/t Milled)		$4.58
Refining & Transport Cost (C$/oz)		$3.93
Silver Credit (C$/oz)		($9.32)
Total Operating Costs (C$/t Milled)		$37.52
Cash Costs (US$/oz AuEq)		$704
AISC (US$/oz AuEq)		$833
Capital Costs		**LOM Total / Avg.**
Initial Capital (C$M)		$305
Sustaining Capital (C$M)		$294
Expansion Capital (C$M)		$44
Closure Costs (C$M)		$38
Salvage Costs (C$M)		($20)
Financials	**Pre-Tax**	**Post-Tax**
NPV (5%) C($M)	$867	$600
IRR (%)	36.9%	31.5%
Payback (years)	1.8	1.9

Notes: *Cash costs consist of mining costs, processing costs, mine-level G&A and refining charges and royalties.
** AISC includes cash costs plus sustaining capital and closure costs

22.9 Sensitivity Analysis

A sensitivity analysis was conducted on the base case pre-tax and after-tax NPV and IRR of the project, using the following variables: gold price, discount rate, initial capital costs, and operating costs. Pre-tax sensitivity results are shown in Table 22.3 and Figure 22-2; Table 22.4 and Figure 22-3 show post-tax sensitivity results. The analysis revealed that the project is most sensitive to changes in gold price and less sensitive to operating costs, discount rate, and initial capital costs.

Table 22.2: Project Cash Flow on an Annualised Basis

Cash flows discounted to December 31, 2021	Units	Sum/Avg	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041
Macro Assumptions																						
Gold Price - Flat	US$/oz	$1,500	$1,500	$1,500	$1,500	$1,500	$1,500	$1,500	$1,500	$1,500	$1,500	$1,500	$1,500	$1,500	$1,500	$1,500	$1,500	$1,500	$1,500	$1,500	$1,500	$1,500
Foreign Exchange	C$:US$	$0.75	$0.75	$0.75	$0.75	$0.75	$0.75	$0.75	$0.75	$0.75	$0.75	$0.75	$0.75	$0.75	$0.75	$0.75	$0.75	$0.75	$0.75	$0.75	$0.75	$0.75
Free Cash Flow Valuation																						
Revenue	**C$mm**	**$3,861**	**--**	**$71**	**$386**	**$382**	**$270**	**$400**	**$303**	**$281**	**$364**	**$438**	**$361**	**$269**	**$117**	**$117**	**$102**	**--**	**--**	**--**	**--**	**--**
Operating Cost	C$mm	($1,765)	--	($31)	($147)	($155)	($181)	($180)	($190)	($182)	($171)	($128)	($105)	($88)	($71)	($71)	($65)	--	--	--	--	--
Refining Charges (incl. Silver Credit)	C$mm	$10	--	$0	$1	$1	$1	$1	$1	$1	$1	$1	$1	$1	$1	$1	$1	--	--	--	--	--
Royalties	C$mm	($58)	--	($1)	($6)	($6)	($4)	($6)	($5)	($4)	($5)	($7)	($5)	($4)	($2)	($2)	($2)	--	--	--	--	--
EBITDA	**C$mm**	**$2,048**	**--**	**$39**	**$234**	**$222**	**$85**	**$216**	**$109**	**$96**	**$188**	**$304**	**$251**	**$178**	**$45**	**$45**	**$37**	**--**	**--**	**--**	**--**	**--**
Initial Capital Cost	C$mm	($305)	($167)	($138)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Expansionary Capital Cost	C$mm	($44)	--	--	--	--	($44)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Sustaining Capital Cost	C$mm	($294)	--	($28)	($52)	($55)	($45)	($50)	($30)	($19)	($10)	($2)	($1)	($0)	($0)	($0)	--	--	--	--	--	--
Closure Capital Cost	C$mm	($38)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	($13)	($13)	($13)	--	--	--
Salvage Value	C$mm	$20	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	$20	--	--	--	--
Changes in Working Capital	C$mm	--	--	($15)	$10	--	--	--	--	--	--	--	--	--	--	--	$5	--	--	--	--	--
Pre-Tax Unlevered Free Cash Flow	**C$mm**	**$1,386**	**($167)**	**($142)**	**$192**	**$167**	**($5)**	**$166**	**$79**	**$77**	**$179**	**$302**	**$250**	**$178**	**$45**	**$45**	**$29**	**$7**	**($13)**	**--**	**--**	**--**
Pre-Tax Cumulative Unlevered Free Cash Flow	C$mm	$1,386	*($167)*	*($310)*	*($117)*	*$50*	*$45*	*$211*	*$289*	*$366*	*$545*	*$846*	*$1,096*	*$1,274*	*$1,319*	*$1,363*	*$1,392*	*$1,399*	*$1,386*	*$1,386*	*$1,386*	*$1,386*
Newfoundland-Labrador Mining Tax	C$mm	($118)	--	--	--	($12)	--	($9)	--	--	($14)	($35)	($28)	($18)	($1)	($1)	($0)	--	--	--	--	--
Income Tax Payable	C$mm	($296)	--	--	--	($14)	--	($28)	($10)	($13)	($39)	($72)	($60)	($43)	($9)	($10)	($5)	$4	$4	--	--	--
Post-Tax Unlevered Free Cash Flow	**C$mm**	**$973**	**($167)**	**($142)**	**$192**	**$141**	**($5)**	**$128**	**$69**	**$64**	**$126**	**$195**	**$162**	**$117**	**$34**	**$33**	**$24**	**$11**	**($9)**	**--**	**--**	**--**
Post-Tax Cumulative Unlevered Free Cash Flow	C$mm	*$973*	*($167)*	*($310)*	*($117)*	*$24*	*$19*	*$148*	*$216*	*$280*	*$406*	*$600*	*$762*	*$879*	*$913*	*$947*	*$971*	*$982*	*$973*	*$973*	*$973*	*$973*
Production Profile																						
Production Summary																						
Total Resource Mined	kt	47,055	57	1,527	7,024	5,746	4,475	5,620	3,000	3,000	5,180	5,097	4,000	2,328	--	--	--	--	--	--	--	--
Total Waste Mined	kt	339,816	5,203	12,096	39,620	41,101	54,383	49,696	48,630	39,816	30,896	11,931	5,006	1,436	--	--	--	--	--	--	--	--
Total Material Mined	kt	386,871	5,261	13,623	46,644	46,847	58,858	55,316	51,630	42,816	36,076	17,029	9,007	3,764	--	--	--	--	--	--	--	--
Strip Ratio	w:o	7.22	90.59	7.92	5.64	7.15	12.15	8.84	16.21	13.27	5.96	2.34	1.25	0.62	--	--	--	--	--	--	--	--
Percent of Resource Depleted	%	100.0%	--	2.3%	15.1%	12.3%	9.6%	12.1%	6.4%	6.4%	11.1%	10.9%	8.6%	5.0%	--	--	--	--	--	--	--	--
Project Life (Cumulative)	yrs	13.1																				
Project Life	yrs	13.1																				
Mill Feed	kt	47,055	--	465	2,461	2,500	2,500	3,625	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	3,503	--	--	--	--	--
Mill Head Grade (Au)	g/t	1.36	--	2.56	2.62	2.55	1.82	1.81	1.24	1.16	1.49	1.79	1.48	1.11	0.49	0.49	0.49	--	--	--	--	--
Contained (Au)	koz	2,050	--	38.24	207.21	204.96	146.38	210.42	160.08	148.70	191.89	230.01	190.28	142.39	62.41	62.41	54.66	--	--	--	--	--
Mill Recovery (Au)	%	94.2%	--	93.2%	93.3%	93.3%	92.2%	95.2%	94.6%	94.5%	94.9%	95.2%	94.8%	94.5%	93.8%	93.8%	93.8%	--	--	--	--	--
Gold Production	koz	1,932	--	36	193	191	135	200	151	141	182	219	180	134	59	59	51	--	--	--	--	--
Recovered Gold	**koz**	**1,932**	**--**	**36**	**193**	**191**	**135**	**200**	**151**	**141**	**182**	**219**	**180**	**134**	**59**	**59**	**51**	**--**	**--**	**--**	**--**	**--**
Gold % Payable	%	99.95%	--	99.95%	99.95%	99.95%	99.95%	99.95%	99.95%	99.95%	99.95%	99.95%	99.95%	99.95%	99.95%	99.95%	99.95%	--	--	--	--	--
Payable Gold	**koz**	**1,931**	**--**	**36**	**193**	**191**	**135**	**200**	**151**	**140**	**182**	**219**	**180**	**134**	**59**	**59**	**51**	**--**	**--**	**--**	**--**	**--**
Revenue	**C$mm**	**$3,861**	**--**	**$71**	**$386**	**$382**	**$270**	**$400**	**$303**	**$281**	**$364**	**$438**	**$361**	**$269**	**$117**	**$117**	**$102**	**--**	**--**	**--**	**--**	**--**
Operating Costs																						
Total Operating Costs	**C$mm**	**$1,765**	**--**	**$31**	**$147**	**$155**	**$181**	**$180**	**$190**	**$182**	**$171**	**$128**	**$105**	**$88**	**$71**	**$71**	**$65**	**--**	**--**	**--**	**--**	**--**
Mine Operating Costs	C$mm	$962	--	$20	$95	$102	$129	$119	$126	$118	$107	$64	$40	$23	$7	$7	$6	--	--	--	--	--
Mill Processing incl. Water Treatment Costs	C$mm	$589	--	$7	$36	$36	$36	$44	$48	$48	$48	$48	$48	$48	$48	$48	$43	--	--	--	--	--
G&A Costs	C$mm	$215	--	$4	$16	$16	$16	$16	$16	$16	$16	$16	$16	$16	$16	$16	$16	--	--	--	--	--
Operating Costs per tonne Processed	*C$/t Processed*	*$38*	--	*$67*	*$60*	*$62*	*$73*	*$50*	*$48*	*$46*	*$43*	*$32*	*$26*	*$22*	*$18*	*$18*	*$19*	--	--	--	--	--
Refining & Transport Costs & Royalties																						
Per Oz (Au)																						
Refining & Transport Cost $3.93	**C$/oz Au**	**$8**	--	$0	$1	$1	$1	$1	$1	$1	$1	$1	$1	$1	$0	$0	$0	--	--	--	--	--
Silver Credit		**($18)**	--	($0)	($2)	($2)	($1)	($2)	($1)	($1)	($2)	($2)	($2)	($1)	($1)	($1)	($1)	--	--	--	--	--
Total Off-Site Operating Costs	**C$mm**	**($10)**	**--**	**($0)**	**($1)**	**($1)**	**($1)**	**($1)**	**($1)**	**($1)**	**($1)**	**($1)**	**($1)**	**($1)**	**($1)**	**($1)**	**($1)**	**--**	**--**	**--**	**--**	**--**
NSR Royalty																						
Total Revenue	C$mm	$3,861	--	$71	$386	$382	$270	$400	$303	$281	$364	$438	$361	$269	$117	$117	$102	--	--	--	--	--
Refining & Transport Costs	C$mm	($8)	--	($0)	($1)	($1)	($1)	($1)	($1)	($1)	($1)	($1)	($1)	($1)	($0)	($0)	($0)	--	--	--	--	--
Silver Credit	C$mm	$18	--	$0	$2	$2	$1	$2	$1	$1	$2	$2	$2	$1	$1	$1	$1	--	--	--	--	--
Total Net Revenue	C$mm	$3,872	--	$71	$387	$383	$270	$401	$304	$282	$365	$439	$362	$270	$118	$118	$103	--	--	--	--	--
NSR Royalty 1.5%	%	1.5%	--	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	--	--	--	--	--
Royalties	**C$mm**	**$58**	**--**	**$1**	**$6**	**$6**	**$4**	**$6**	**$5**	**$4**	**$5**	**$7**	**$5**	**$4**	**$2**	**$2**	**$2**	**--**	**--**	**--**	**--**	**--**
Cash Costs																						
Cash Cost *	US$/oz Au	$704	--	$674	$591	$627	$1,028	$692	$962	$990	$724	$458	$455	$506	$928	$926	$965	--	--	--	--	--
All-in Sustaining Cost (AISC) **	US$/oz Au	$833	--	$1,271	$793	$844	$1,280	$879	$1,111	$1,090	$764	$466	$461	$507	$929	$927	$1,152	--	--	--	--	--

* Cash costs consist of mining costs, processing costs, mine-level G&A and refining charges and royalties
** AISC includes cash costs plus sustaining capital and closure costs (excluding salvage)

Capital Expenditures	Units	Sum/Avg	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041
Total Initial Capital	**C$mm**	**$305**	**$167**	**$138**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**
Pre-strip Mining Capital Cost	C$mm	$32	$19	$13	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Mining Cap Capital Cost ex	C$mm	$19	$11	$8	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Process Plant Capital Cost	C$mm	$88	$39	$48	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Infrastructure Capital Cost	C$mm	$54	$34	$21	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Off-site Infrastructure	C$mm	$21	$18	$3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Contractor Indirects	C$mm	$16	$7	$8	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Project Delivery	C$mm	$29	$15	$15	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Owners Cost	C$mm	$15	$7	$8	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Contingency	C$mm	$32	$18	$15	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total Expansion Capital	**C$mm**	**$44**	**--**	**--**	**--**	**--**	**$44**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**
Total Sustaining Capital	**C$mm**	**$294**	**--**	**$28**	**$52**	**$55**	**$45**	**$50**	**$30**	**$19**	**$10**	**$2**	**$1**	**$0**	**$0**	**$0**	**--**	**--**	**--**	**--**	**--**	**--**
Sustaining Infrastructure Capital	C$mm	$95	--	$12	$22	$23	$4	$17	$4	$9	$2	$2	$1	--	--	--	--	--	--	--	--	--
Sustaining Mining Capital	C$mm	$199	--	$17	$31	$32	$42	$33	$26	$9	$8	$0	$0	$0	$0	$0	--	--	--	--	--	--
Closure Cost	**C$mm**	**$38**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**$13**	**$13**	**$13**	**--**	**--**	**--**
Salvage Value	**C$mm**	**($20)**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**($20)**	**--**	**--**	**--**	**--**
Total Capital Expenditures incl. Salvage Value	**C$mm**	**$662**	**$167**	**$166**	**$52**	**$55**	**$90**	**$50**	**$30**	**$19**	**$10**	**$2**	**$1**	**$0**	**$0**	**$0**	**$13**	**($7)**	**$13**	**--**	**--**	**--**

Table 22.3: Pre-Tax Sensitivity

Pre-Tax NPV Sensitivity to Discount Rate

Discount Rate	Gold Price (US$/oz) $1,300	$1,450	$1,500	$1,550	$1,650	$1,750
0.0%	$879	$1,260	$1,386	$1,513	$1,767	$2,020
3.0%	$634	$941	$1,044	$1,146	$1,351	$1,556
5.0%	$508	$777	$867	$956	$1,135	$1,314
8.0%	$361	$583	$658	$732	$880	$1,028
10.0%	$284	$482	$547	$613	$745	$877

Pre-Tax IRR Sensitivity to Discount Rate

Discount Rate	Gold Price (US$/oz) $1,300	$1,450	$1,500	$1,550	$1,650	$1,750
0.0%	24.4%	33.8%	36.9%	39.9%	45.8%	51.7%
3.0%	24.4%	33.8%	36.9%	39.9%	45.8%	51.7%
5.0%	24.4%	33.8%	36.9%	39.9%	45.8%	51.7%
8.0%	24.4%	33.8%	36.9%	39.9%	45.8%	51.7%
10.0%	24.4%	33.8%	36.9%	39.9%	45.8%	51.7%

Pre-Tax NPV Sensitivity to Foreign Exchange

FX	Gold Price (US$/oz) $1,300	$1,450	$1,500	$1,550	$1,650	$1,750
0.65	$868	$1,178	$1,282	$1,385	$1,592	$1,798
0.70	$676	$963	$1,059	$1,155	$1,347	$1,539
0.75	$508	$777	$867	$956	$1,135	$1,314
0.80	$362	$614	$698	$782	$950	$1,118
0.85	$233	$470	$549	$628	$786	$944

Pre-Tax IRR Sensitivity to Foreign Exchange

FX	Gold Price (US$/oz) $1,300	$1,450	$1,500	$1,550	$1,650	$1,750
0.65	36.9%	47.3%	50.6%	53.9%	60.5%	66.9%
0.70	30.3%	40.1%	43.3%	46.5%	52.7%	58.8%
0.75	24.4%	33.8%	36.9%	39.9%	45.8%	51.7%
0.80	19.1%	28.1%	31.1%	34.0%	39.7%	45.3%
0.85	14.3%	23.0%	25.8%	28.6%	34.1%	39.5%

Pre-Tax NPV Sensitivity to Operating Costs

Opex	Gold Price (US$/oz) $1,300	$1,450	$1,500	$1,550	$1,650	$1,750
(20.0%)	$759	$1,027	$1,117	$1,206	$1,385	$1,564
(10.0%)	$634	$902	$992	$1,081	$1,260	$1,439
--	$508	$777	$867	$956	$1,135	$1,314
10.0%	$383	$652	$742	$831	$1,010	$1,189
20.0%	$258	$527	$616	$706	$885	$1,064

Pre-Tax IRR Sensitivity to Operating Costs

Opex	Gold Price (US$/oz) $1,300	$1,450	$1,500	$1,550	$1,650	$1,750
(20.0%)	33.1%	42.1%	45.1%	48.0%	53.7%	59.3%
(10.0%)	28.8%	38.0%	41.0%	44.0%	49.8%	55.6%
--	24.4%	33.8%	36.9%	39.9%	45.8%	51.7%
10.0%	19.9%	29.5%	32.6%	35.7%	41.8%	47.7%
20.0%	15.2%	25.1%	28.2%	31.4%	37.6%	43.6%

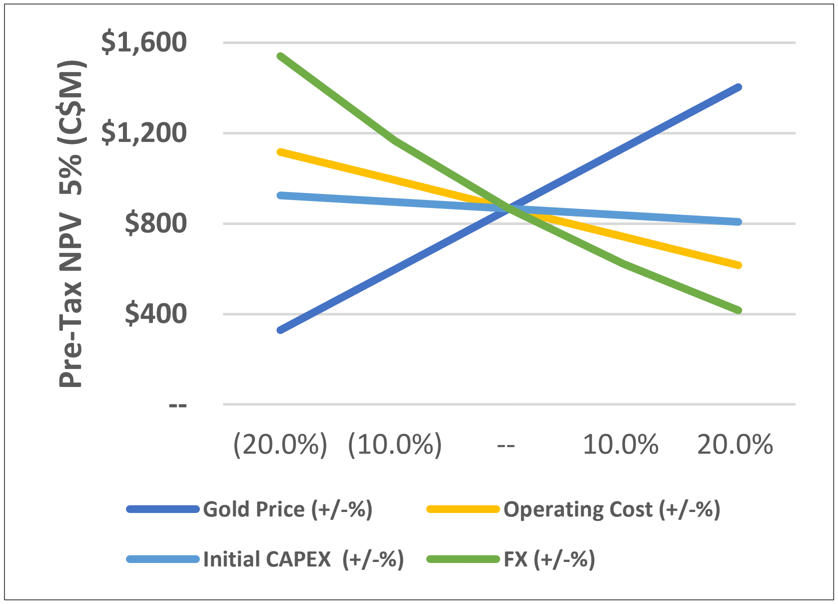
Pre-Tax NPV Sensitivity to Initial Capital Costs

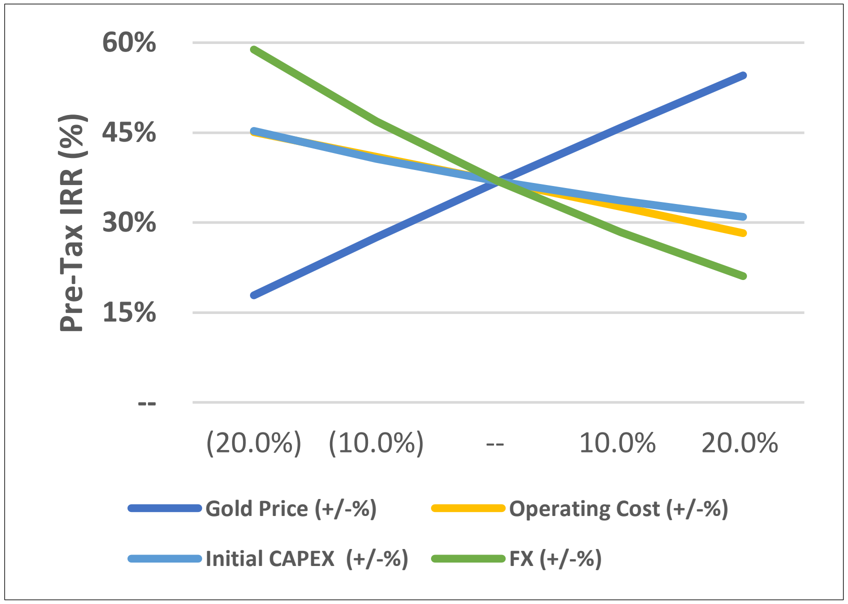
Initial Capex	Gold Price (US$/oz) $1,300	$1,450	$1,500	$1,550	$1,650	$1,750
(20.0%)	$567	$836	$925	$1,015	$1,194	$1,373
(10.0%)	$538	$806	$896	$985	$1,164	$1,344
--	$508	$777	$867	$956	$1,135	$1,314
10.0%	$479	$748	$837	$927	$1,106	$1,285
20.0%	$450	$719	$808	$898	$1,077	$1,256

Pre-Tax IRR Sensitivity to Initial Capital Costs

Initial Capex	Gold Price (US$/oz) $1,300	$1,450	$1,500	$1,550	$1,650	$1,750
(20.0%)	30.4%	41.6%	45.3%	48.9%	56.1%	63.1%
(10.0%)	27.1%	37.3%	40.7%	44.0%	50.5%	56.8%
--	24.4%	33.8%	36.9%	39.9%	45.8%	51.7%
10.0%	22.1%	30.8%	33.7%	36.5%	42.0%	47.4%
20.0%	20.1%	28.3%	30.9%	33.6%	38.7%	43.7%

Figure 22-2: Pre-Tax NPV & IRR Sensitivity Results





Source: Ausenco, 2021.

Table 22.4: Post-Tax Sensitivity

Post-Tax NPV Sensitivity to Discount Rate

Discount Rate	Gold Price (US$/oz) $1,300	$1,450	$1,500	$1,550	$1,650	$1,750
0.0%	$664	$809	$883	$957	$1,098	$1,234
3.0%	$537	$663	$727	$792	$915	$1,033
5.0%	$432	$544	$600	$657	$765	$868
8.0%	$309	$402	$450	$497	$587	$672
10.0%	$245	$328	$370	$412	$492	$568

Post-Tax IRR Sensitivity to Discount Rate

Discount Rate	Gold Price (US$/oz) $1,300	$1,450	$1,500	$1,550	$1,650	$1,750
0.0%	24.4%	29.2%	31.5%	33.9%	38.1%	42.2%
3.0%	24.4%	29.2%	31.5%	33.9%	38.1%	42.2%
5.0%	24.4%	29.2%	31.5%	33.9%	38.1%	42.2%
8.0%	24.4%	29.2%	31.5%	33.9%	38.1%	42.2%
10.0%	24.4%	29.2%	31.5%	33.9%	38.1%	42.2%

Post-Tax NPV Sensitivity to Foreign Exchange

FX	Gold Price (US$/oz) $1,300	$1,450	$1,500	$1,550	$1,650	$1,750
0.65	$667	$790	$849	$909	$1,028	$1,146
0.70	$540	$661	$720	$776	$887	$998
0.75	$432	$544	$600	$657	$765	$868
0.80	$332	$442	$494	$547	$653	$755
0.85	$237	$349	$402	$451	$549	$649

Post-Tax IRR Sensitivity to Foreign Exchange

FX	Gold Price (US$/oz) $1,300	$1,450	$1,500	$1,550	$1,650	$1,750
0.65	34.2%	39.1%	41.4%	43.7%	48.1%	52.3%
0.70	29.0%	34.0%	36.4%	38.6%	42.9%	47.0%
0.75	24.4%	29.2%	31.5%	33.9%	38.1%	42.2%
0.80	19.7%	24.8%	27.1%	29.3%	33.7%	37.7%
0.85	15.3%	20.5%	23.0%	25.2%	29.4%	33.6%

Post-Tax NPV Sensitivity to Operating Costs

Opex	Gold Price (US$/oz) $1,300	$1,450	$1,500	$1,550	$1,650	$1,750
(20.0%)	$590	$701	$752	$804	$907	$1,010
(10.0%)	$510	$624	$680	$733	$836	$939
--	$432	$544	$600	$657	$765	$868
10.0%	$350	$465	$520	$577	$689	$797
20.0%	$260	$386	$442	$498	$610	$721

Post-Tax IRR Sensitivity to Operating Costs

Opex	Gold Price (US$/oz) $1,300	$1,450	$1,500	$1,550	$1,650	$1,750
(20.0%)	31.0%	35.5%	37.5%	39.6%	43.6%	47.3%
(10.0%)	27.7%	32.4%	34.7%	36.8%	40.9%	44.8%
--	24.4%	29.2%	31.5%	33.9%	38.1%	42.2%
10.0%	20.6%	25.8%	28.2%	30.6%	35.2%	39.5%
20.0%	16.4%	22.3%	24.9%	27.3%	32.0%	36.5%

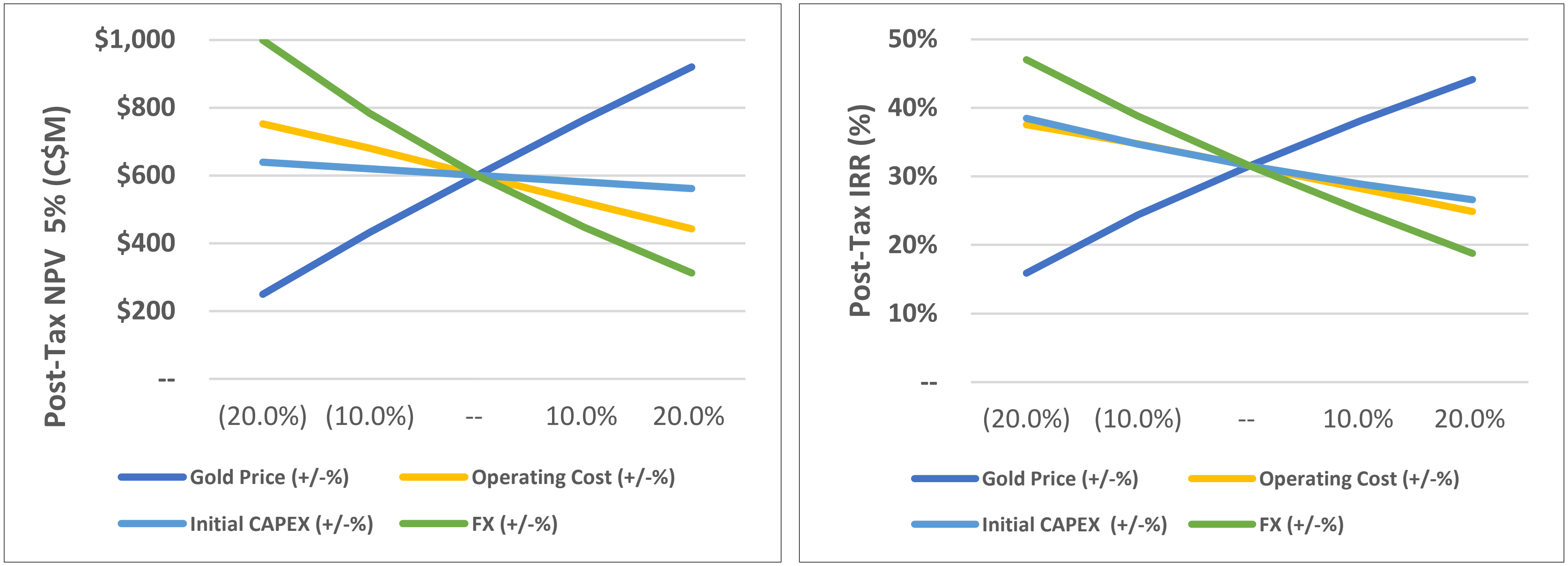
Post-Tax NPV Sensitivity to Initial Capital Costs

Initial Capex	Gold Price (US$/oz) $1,300	$1,450	$1,500	$1,550	$1,650	$1,750
(20.0%)	$470	$582	$639	$694	$799	$902
(10.0%)	$451	$563	$620	$675	$782	$885
--	$432	$544	$600	$657	$765	$868
10.0%	$413	$524	$581	$638	$748	$851
20.0%	$392	$504	$561	$618	$730	$834

Post-Tax IRR Sensitivity to Initial Capital Costs

Initial Capex	Gold Price (US$/oz) $1,300	$1,450	$1,500	$1,550	$1,650	$1,750
(20.0%)	30.0%	35.7%	38.5%	41.1%	46.2%	50.9%
(10.0%)	27.0%	32.1%	34.7%	37.1%	41.8%	46.1%
--	24.4%	29.2%	31.5%	33.9%	38.1%	42.2%
10.0%	22.2%	26.7%	28.9%	31.0%	35.1%	38.8%
20.0%	20.2%	24.5%	26.6%	28.6%	32.5%	36.0%

Figure 22-3: Post-Tax NPV & IRR Sensitivity Results



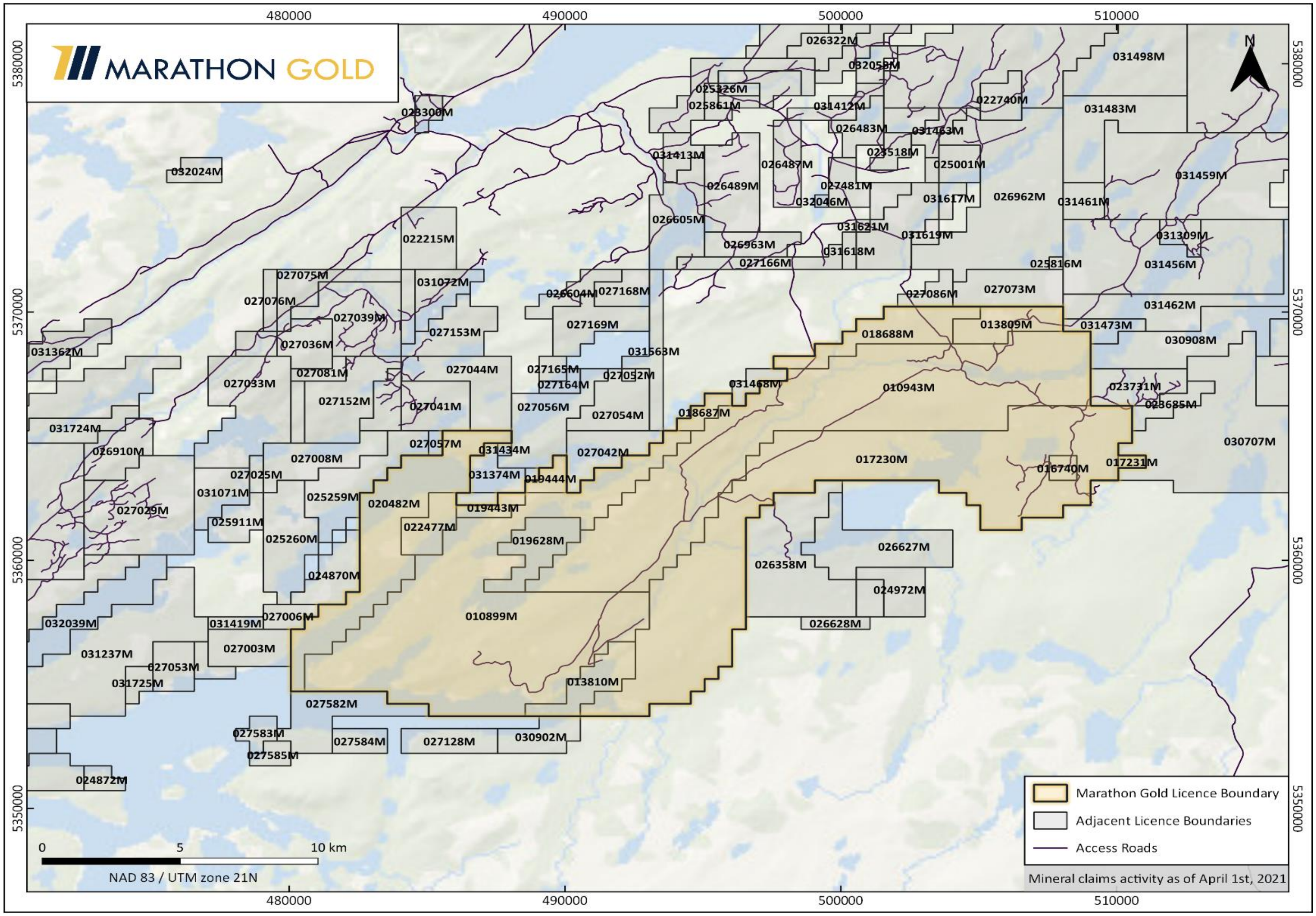
Source: Ausenco, 2021.

23 Adjacent Properties

The Valentine Lake property is almost surrounded by other mineral claims belonging to various mineral exploration companies (see Figure 23-1 on the following page), not all of which have gold as the primary metal of interest.

The tenure and claims presented in Figure 23-1 are based on data from the Newfoundland and Labrador Government website, which is updated daily. Ausenco has not verified the information or the styles of mineralisation on the properties held by other companies. The mineralisation on other properties is not necessarily indicative of the mineralisation at the Valentine Lake property.

Figure 23-1: Valentine Lake Property Tenure Map & Adjacent Claims



Source: Marathon Gold, 2021.

24 Other Relevant Data

24.1 Project Execution & Organisation

The Project Execution Plan (PEP) is a governing document that establishes the means to execute, monitor, and control the execution phase of the Valentine Gold project. The plan will serve as the main communication tool to ensure the project team is aware and knowledgeable of project objectives and how they will be accomplished.

The following subsections summarise the contents of the Valentine Gold Project PEP.

24.1.1 Summary

The PEP includes, but is not limited to, the following:

- an overview of the project
- the scope of work and services
- execution strategy
- the project schedule with key activities and target dates identified
- an organisational chart

The Valentine Gold Project is intended to be constructed in two distinct phases, an initial installation (Phase 1) and an expansion (Phase 2).

The PEP will be supported by various sub-plans including, but not limited to, the following:

- Health, Safety and Environment Management Plan
- Engineering Execution Plan
- Procurement Strategy and Management Plan
- Contracting Strategy and Management Execution Plan
- Construction Execution Plan
- Commissioning Execution Plan
- Project Controls Plan
- Project Quality Plan
- Risk Management Plan
- Logistics and Materials Management Plan
- Site Requirements for Construction
- Commercial Management Plan

24.1.2 Objectives

Marathon Gold aims to bring the Valentine Gold Project into operation while satisfying the following objectives:

- zero harm to personnel involved with construction, operation, and maintenance of the facilities, and zero unintended environmental impact or incidents
- preserve or improve the project value through effective control of project costs and completion of construction and commissioning on or ahead of schedule
- satisfy quality and performance targets
- comply with company policies and legislative requirements, negotiated benefits agreements
- maintain positive community relations

24.1.3 Execution Strategy

Three contract strategies will be employed to deliver the detailed engineering and execution phases of the project:

1. EPC contract, led by a contractor selected by Marathon Gold, that generally encompasses the process plant and select on-site infrastructure
2. EPCM scope, led by an engineering consultant nominated by Marathon Gold, that generally encompasses site bulk earthworks
3. EPCM scope, led by Marathon Gold, that generally encompasses the development of the mining pits, off-site infrastructure, and permanent camp

These are described in more detail in the following subsections.

24.1.3.1 EPC Contract

Under this agreement, the contractor will deliver the process plant (and select on-site infrastructure) for a fixed price.

The delivery strategy is summarised as follows:

- Engineering and design for construction will be completed by the contractor. Detailed design will start in September 2021 and be completed in June 2022.
- Procurement of equipment and materials will be completed by the contractor. Procurement tasks will be prioritised by equipment delivery time and to support engineering progress. Purchase orders for non-critical equipment and materials supplied from Canada, USA, or Europe will include transport to site. Transport of critical goods will be managed by a freight forwarder;
- The contractor will finalise the contracting strategy for construction of the process plant during detailed engineering following a process of contractor evaluations and pricing reviews. Contracts will be managed by the construction team on site.
- The contractor's site team will report to the project manager. The contractor will provide safety and field supervision who will manage interfaces between the various construction sub-contractors working on site and monitor quality and progress. The construction team will be based on site.

24.1.3.2 EPCM Scope Led by Engineering Consultant

This delivery strategy can be summarised as follows:

- Engineering and design for construction will be completed by the engineering consultant. Detailed design will start in September 2021 and be completed in June 2021.
- Procurement of equipment and services, expediting and contract management will be performed by Marathon Gold. The engineering consultant will advise Marathon Gold on vendor and contractor selection through production of specification and contractor packages and performing technical and commercial bid evaluations.
- Marathon Gold will continue to perform commercial management of contractors during construction. The engineering consultant will provide technical supervision and support on-site as required. The engineering consultant's site team will report to Marathon Gold's project manager.

24.1.3.3 EPCM Scope Led by Marathon Gold

Marathon Gold will manage select scope areas and engage delivery contractors as required to execute fixed scopes. Notable scope inclusions are as follows:

- mobile mining equipment selection and procurement
- mining pit detailed design and development
- permanent camp design and procurement
- access road upgrades scoping and development
- high-voltage powerline to site permitting, engineering and development

24.1.4 Project Organisation

24.1.4.1 Organisation & Resourcing

The project team is organised based on an integrated team approach, minimising the duplication of roles and activities between the Owner's Team and their major delivery partners. A project organisation chart is shown in Figure 24-1 on the following page.

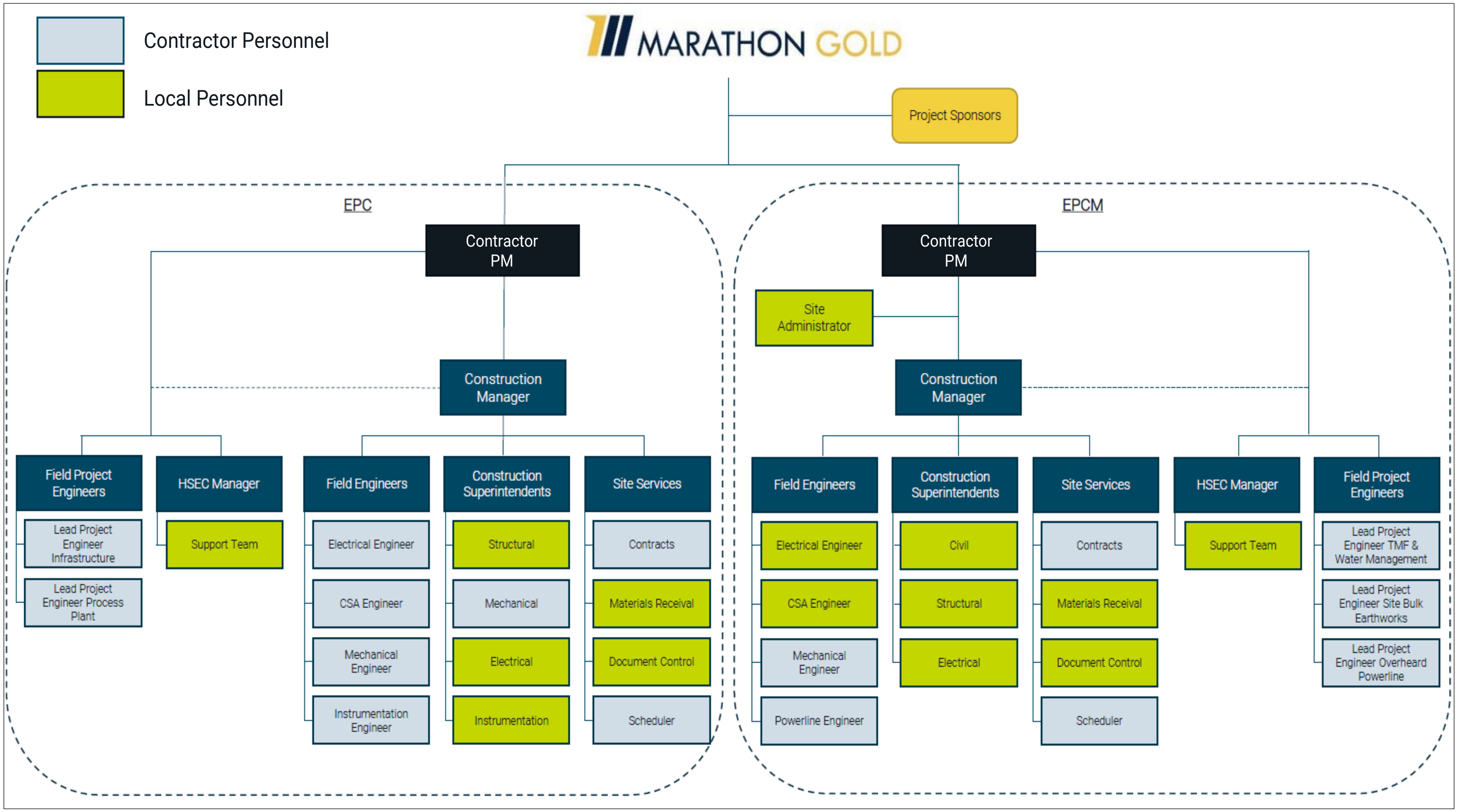
Marathon Gold will be performing or managing a considerable portion of the project scope, including the mine design, power transmission line, pit pre-stripping and delivery of certain construction materials to designated work sites. Key persons will be established on both teams at site to ensure efficient coordination.

24.1.4.2 Alignment Strategy

The project alignment strategy aims to create shared understanding of the project vision and strategy to enable Marathon Gold and its internal and external stakeholders to achieve the project objectives. The project delivery team will operate as one team with defined responsibilities, accountabilities, and authorities. The team will be established and supported to deliver "Best for Project" outcomes in line with Marathon Gold's expectations and critical success factors.

Establishment of the delivery team working relationships and agreeing acceptable desired outcomes will be done in facilitated alignment sessions.

Figure 24-1: Project Organisation



Source: Ausenco, 2021.

The alignment effort will be concentrated at the front-end of the project, although ongoing activities will be planned throughout to increase overall effectiveness, commitment, and cohesiveness of project team members.

24.1.4.3 Sponsor Group

A Sponsor Group will be formed to reinforce corporate commitment to the project as it passes through its various phases.

Key activities include:

- directing the business objectives for the participants to achieve 'best for project' outcomes
- providing corporate commitment to achieving the desired outcomes for the project
- reinforcing common purpose in achieving the project goals
- managing third party events outside of the control of the project team
- providing corporate recognition and reward for performance
- supporting the project in resolution of issues

The Sponsor Group will comprise senior executives from the EPC contractor and Marathon Gold. The Sponsor Group will stay abreast of events and issues on and around the project. The principal responsibility of each member in their role on the Sponsor Group is directed at ensuring that the project is guided, supported, and encouraged to achieve the project objectives. Each member's association with their own organisation is secondary to their responsibility to support the project.

24.1.5 Construction Execution Strategy

24.1.5.1 Construction Sequencing

An overall master execution schedule is included in 24.2; however, this section will outline the high-level execution sequencing constraints that were evaluated in order to determine the execution schedule baseline for the feasibility study.

After completion of the feasibility study in April 2021, there will be a period of early works that will need to be completed prior to the first mobilisation to site. These early works include the following main tasks:

- environmental and construction permitting activities
- detailed engineering
- procurement of long lead items (mining fleet, ball/SAG mills, ADR circuit)
- access road upgrades, including road widening and bridge repairs
- award of key construction contracts (camp construction, site civil works)

These early works activities will all be completed prior to first mobilisation to site, which is planned for December 2021. This date is predicated on Marathon Gold receiving their EIS permit approval in September and filing and receiving the appropriate environmental/construction permits to allow ground breaking to occur.

It is critical that no site works that progress the project forward occur until these permits are in hand. This includes early mobilisation and staging equipment on site, early site preparations or stockpiling of construction materials. If required, local townships can be utilised to stage equipment away from the project property.

Once the permits are in hand, the first contractors to mobilise will be the camp construction contractors and early civil works contractors responsible for clearing and grubbing specific site works boundaries. It is critical that the clearing and grubbing contractors drop the trees in the specific site boundaries in the winter before the migratory bird nesting window opens in April 2022.

As the clearing and grubbing activities continue, the heavy civil work will follow to strip topsoil and organics and stockpile them in designated areas for future remediation works. Temporary water management catchments and ditches will also be developed as the civil works continue in the Marathon and Leprechaun pits, the tailings management dam footprint, as well as the process plant pad development.

After the early civil works are completed, there will be three main work-fronts on the project property. The mining works will continue the pit development of both the Marathon and Leprechaun pit locations, generating and stockpiling waste rock material that will be crushed/screened via a contract crushing/screening plant and used for construction materials. The TMF works will be placing and compacting hauled waste rock to raise the dam wall and finishing with crushed/screened material and installing the geomembrane liner. The process plant works will begin concrete works in spring 2022 for building/major equipment foundations and construction will be continuous until commissioning activities begin in Q3 2023 prior to “first gold” in October 2023.

24.1.5.2 Winter Construction

Construction work will continue through the 2022/2023 winter. In order to mitigate downtime and loss of productivity, the considerations described below were included in the execution schedule.

The concrete works for the process plant are, for the most part, scheduled to be carried out within the summer months. The construction sequence for the process plant is such that the process plant and reagent pre-engineered buildings will be fully constructed and cladded prior to the winter. This will allow installation works to continue within the buildings, sheltered from any inclement weather. Priority will also be given to erect the fabric truck shop/warehouse buildings for additional all-weather storage for the winter months.

The TMF geomembrane liner installation works consists of laying both coarse and fine bedding material on the dam wall and then rolling out and keying in large areas of geomembrane liner. This work is especially dependent on weather, as large precipitation events can wash out the bedding material and the high winds associated with this region can hamper liner installation productivity. The decision was made as a project team to complete the dam construction and key in the liner to a reasonable point prior to the 2022/2023 winter and then stop that activity. The remainder of the liner will be installed in the spring of 2023 when the weather is more favourable. The hauling, placement, and compaction of waste rock material to continue dam wall construction can continue through the winter period.

24.1.5.3 Site Laydown Requirements

An early priority for site construction should be the assembly of temporary and permanent storage warehouse facilities with sufficient space to store any goods with indoor storage requirements.

Any goods or equipment that can be stored outdoors may be placed in an on-site, outdoor laydown area that is ideally located near the storage warehouse. The outdoor laydown area will have to be on level ground, with all snow removed prior to the arrival of goods and equipment. A typical laydown area would normally have a surface area of 10,000 m^2 (e.g., 100 m x 100 m).

A storage warehouse will be required for all materials requiring protection from the elements. An industrial building that is constructed early and is not immediately required for other purposes (e.g., reagents building) may be used as a storage warehouse. In similar projects, the reagent building has served this function.

Both the site laydown and storage warehouse will need to obtain the necessary authorisations to store any hazardous materials. The required security, protective and handling equipment should be on hand to allow hazardous materials to be temporarily stored as necessary.

24.1.5.4 Camp Requirements

A single camp will be built and utilised for both the construction phase and operations phase of the project. Due to the permitting constraints within the province, no physical work or staging will be allowed on the project property prior to all approved permits being returned. As accommodation will be required for the construction workforce, this lead time will be mitigated by early procurement activities by Marathon Gold. The project will aim to fabricate, transport and stage camp modules in nearby towns to allow for quick mobilisation once permits are in hand. The utilisation of used camp modules could also be an option for the first phase of camp construction if the fabrication and delivery lead times do not meet the construction schedule.

The current operating camp that houses the drilling and exploration workforce has capacity for 60 persons. For the initial phase of construction, it is assumed that exploration activities will cease for a few months to allow the camp construction and clearing and grubbing workforce to stay at the operating camp, while the permanent camp is being built. The permanent camp will be completed to its full capacity prior to the influx of personnel in spring 2022 to construct the process plant.

24.1.5.5 Construction Staffing

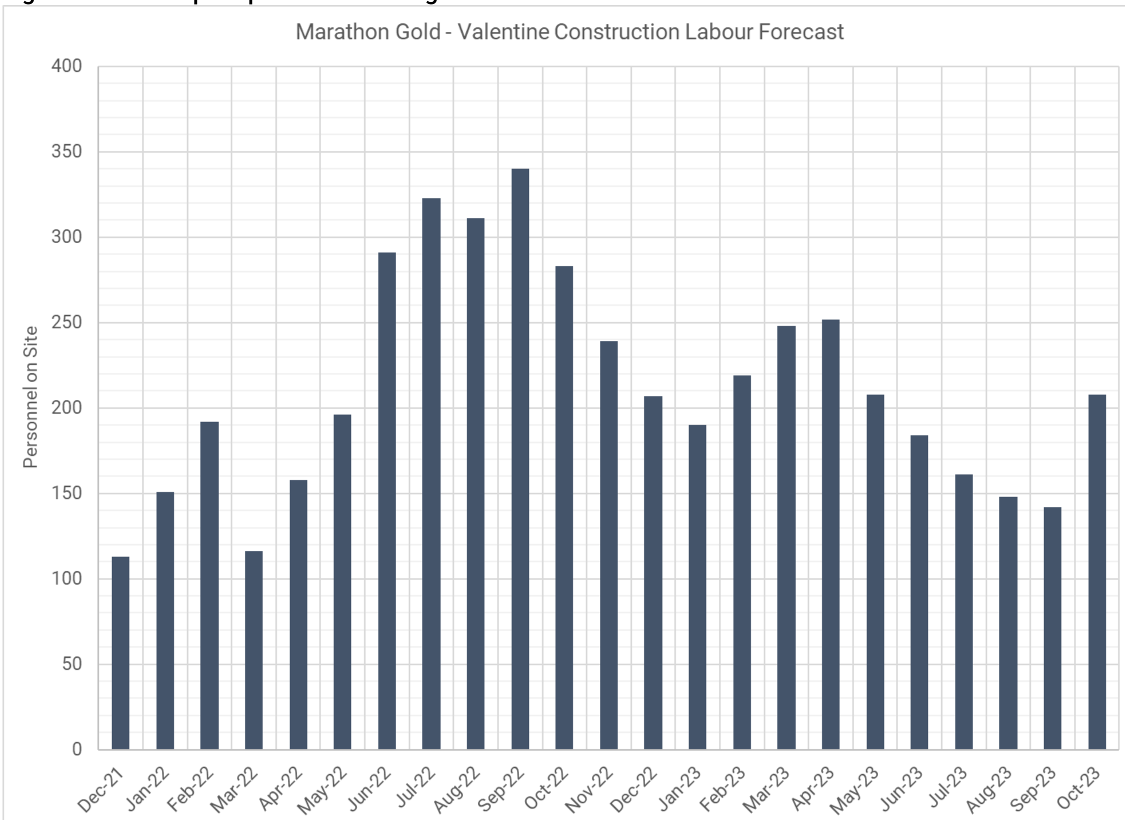
A labour loading forecast was developed for the construction phase (see Figure 24-2 on the following page). The forecast was developed utilising labour hours received from contractors who provided budgetary pricing for the feasibility study, as well as from organisation charts for the construction management teams from both the owner and the engineering firms.

24.1.5.6 COVID-19 Considerations

For the purposes of the feasibility study, an allowance was included to capture the additional costs associated with managing the project due to the ongoing COVID-19 pandemic. These costs include off-site quarantining of all non-provincial workers; on-site testing facilities for non-provincial workers starting their rotations (as well as the ability to spot-test); camp operation costs for additional cleaning staff and staggered kitchen catering times to spread out dining room capacity; and additional busses and drivers to move workers from the camp to/from the work-front each shift change.

A full COVID-19 Management and Response Plan will be developed and utilised during the project.

Figure 24-2: Camp Requirements During Construction Period



Source: Ausenco, 2021.

24.1.5.7 Shared Site Services

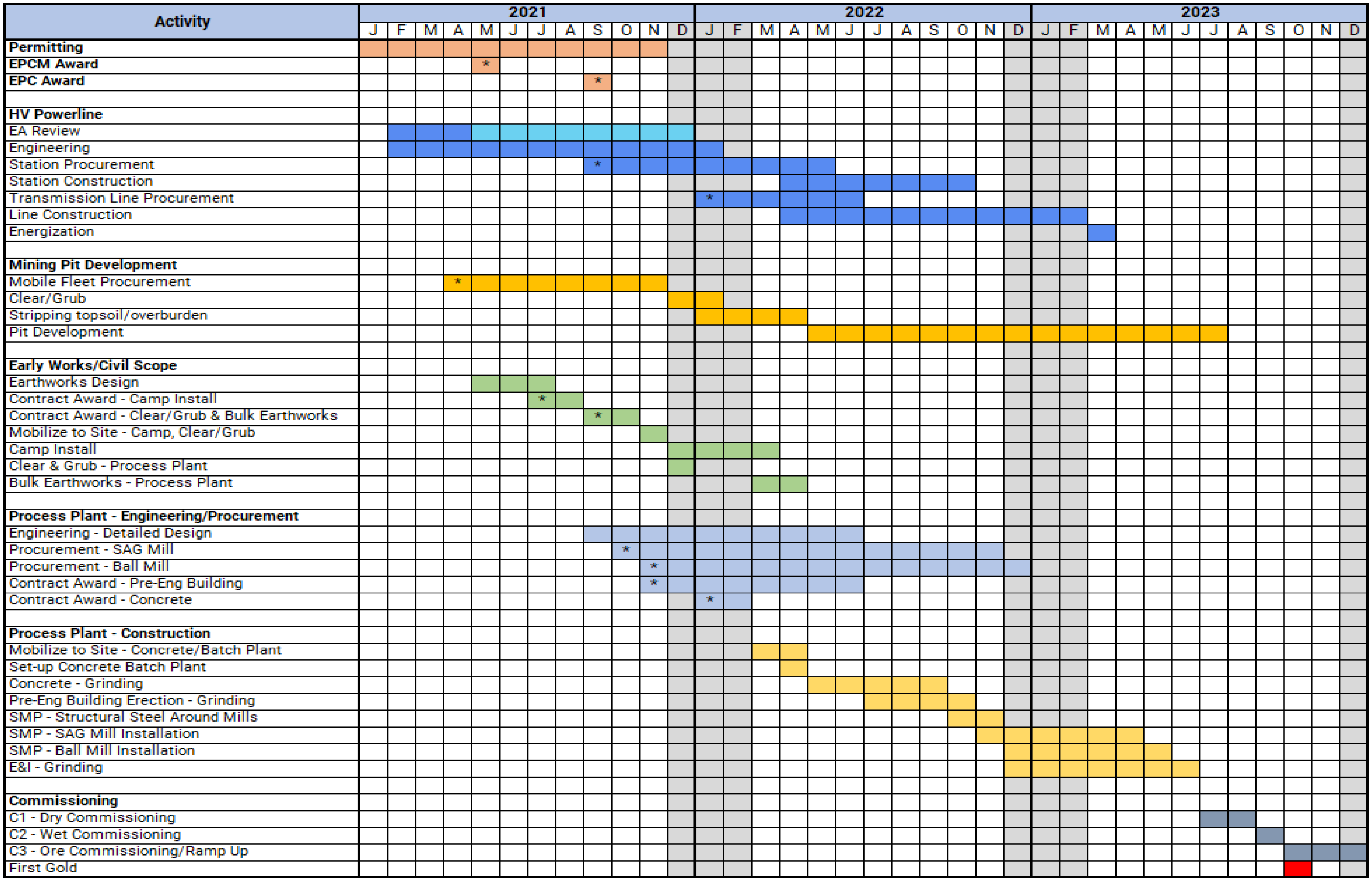
A number of services were identified during the feasibility study that were common across the work fronts during construction. It may be advantageous to offer these common services to the contractors both from a cost perspective, as well as to allow site service contracts to local businesses. These services include:

- diesel fuel supply
- temporary power supply
- road maintenance/snow clearing
- garbage removal
- bussing workforce to/from the camp each day
- upfront purchase or lease of mobile equipment that will be required by operations that can be free issued to the construction contractors for use during construction

24.2 Project Execution Schedule

The preliminary project execution schedule is shown in Figure 24-3.

Figure 24-3: Marathon Gold Project Execution Schedule



Source: Ausenco, 2021.

24.3 Risk

Risk identification and mitigation was ongoing throughout the feasibility study, and will continue through value/detailed engineering, construction, operations and closure. Risks were identified and qualitatively ranked in the Valentine Gold Project Risk Register. As the project moves from the feasibility study phase into the execution phase, it will be necessary to update the Project Risk Register.

The evaluations were based on the following categories/areas:

01 - Health & Safety
02 - Environmental
03 - Stakeholder Relations
04 - Schedule
05 - Technical / Engineering
06 - Procurement
07 - Construction
08 - Operations
09 - Commissioning
10 - Human Resources / Staffing
11 - Cost
12 - Security

24.3.1 Risk Analysis Workshop Process

The objective of this process was to a undertake a risk analysis in a workshop environment utilising expert input from consultants, engineering firms and Marathon Gold representatives. The purpose was to capture the results in a Risk Register that can be utilised for ongoing project risk management.

The methodology adopted for this risk analysis was in accordance with the best practices of risk management standards. Risk identification is the most important part of the process by which risks are identified based heavily on "expert judgement". Quantified evaluations of likelihood and consequences are captured in the workshop environment under the guidance of the risk facilitator.

The risk levels used were based on the categories listed in Table 24.1 and the criteria in Table 24.2.

Table 24.1: Risk Categories

Risk Level	Definition
5 - Catastrophic	Unacceptable Risk - Mitigation and risk reduction measures must be implemented as soon as possible.
4 - Major	Unwanted Risk - Implementation of preventive control measures and risk reduction measures, as well as re-evaluation of risks at regular intervals.
3 - Serious	Acceptable risk with control – Risks must be reduced to the lowest possible level.
2 - Medium	Acceptable Risk
1 - Minor	Negligible risk

Table 24.2: Risk Criteria

Risk Type (Project)	1 - Minor	2 - Medium	3 - Serious	4 - Major	5 - Catastrophic
Capital Costs (Baseline - 400 m)	**0 to 1.5 M (<1%)**	**1.5 M to 7 M (1%)**	**8 M to 19 M (2%)**	**20 M to 39 M (5%)**	**Overlapping from 1 M to more than 40 M (10%)**
Project Schedule	-Less than 2 weeks delay of project schedule. - Minor impact on project financial returns (IRR).	- Between 2 weeks and 1 month delay of project schedule. - Impact on financial returns of the project.	- Between 1 month and 2 months delay of project schedule. - Impact on financial returns of the project.	- Project schedule end date delayed between 2 months and 4 months. - Notable/Important impact on financial returns of the project.	- Project scheduled delayed by more than 4 months. - Major impact on financial returns of the project.
Disturbance of Production	Little effect on production.	Production is affected, with loss of non-critical sector(s).	Production is affected, with temporary loss of one critical sector.	Production is affected, there is loss of more than one critical sector. Example: loss of operations of a critical sector, crushing, tailings.	Required to use contingency plans and/or provisional operation plans.
	No need for overtime to compensate for effects on production.	Obligation to compensate with occasional overtime.	Obligation to compensate with frequent overtime.	Obligation to compensate through regular (daily) use of overtime.	Overtime cannot fully compensate for production loss.
	Event has little impact on the project.	Project is affected.	Production can be delayed with some loss of production.	Production often delayed; important loss of production.	Production loss.
Acceptance of the Project by the Users	Resistance to change with little impact on integration of the project in production.	Resistance to change preventing project acceptance.	- Resistance to change preventing project acceptance. - Minor modifications to obtain acceptance of deliverables by employees and integration of project.	- Resistance to change preventing project acceptance. - Additional employee training, equipment modification, technical modification etc, required to obtain acceptance.	- Plant employees refuse the deliverables of the project. - Major difficulties prevent project acceptance; project rejected; extraordinary effort required to save the situation.
Commissioning and Ramp-up of the Project	Minor problems while the operations team takes ownership of the project.	Problems while the operations team takes ownership of the project operation and ramp-up (temporary lack of availability of labour compensated for by overtime).	Problems while the operations team takes ownership of the project operation and ramp-up (change management problems: hiring, training, scheduling, availability of labour, etc.).	Major problems while the operations team takes ownership of the project operation and ramp-up. (change management problems, lack of spare parts, poor pre-operational verifications (POV), difficulties in meeting production objectives, equipment deficiencies, hiring, training, availability of labour, etc.).	Major problems with operation and ramp-up (major change management problems, unable to meet production targets, hiring, training, availability of manpower, critical equipment deficiencies, unavailability of spare parts, etc.).
Engineering/Technology/ Constructability	Minor technical and/or process problems with negligeable impact on attaining production objectives.	Problems of a technical nature and/or process nature making it difficult to reach production objectives.	- Technical and/or process with important and/or permanent negative impact on attaining production objectives and maintaining equipment. - Possible to attain only 95% of production objectives.	Major technical and/or process problems making it impossible to attain more than 85% of production objectives.	Major technical and/or process problems making it impossible to attain 75% of production objectives.
Social Acceptance of the Project by the Community & Social Acceptability	Few complaints or no significant impact on the community.	Complaints and some impact on the immediate community.	Important impact on the community requiring modifications to scope.	Important impact on the community requiring major modifications to scope (<25%).	Important impact on the community requiring major modifications to scope (25%) or project cancellation.
Human Resources/Work Relations	Little reaction by workers.	Union Reaction.	Serious work slowdown; refusal to work overtime.	Construction end dates questioned and/or sporadic stoppage of work. Labour walk-out.	Work stoppage generating important losses. Necessitating force majeure.
Environmental Impact (EIA & Permitting)	**Project site** (process plant, facilities, WTP, mining area, TMF) - Near-source confined and promptly reversible impact. - Normally reversible within one shift.	**On site** - Near-source confined and short-term reversible impact. - Normally reversible within one week.	**On site** - Near-source confined and medium-term recovery impact. - Normally reversible within one month.	**On site** - Unconfined impact requiring long-term recovery, with residual damage. - Unconfined incident/release resulting in significant but limited in area.	**On site** - Impact that is widespread-unconfined and requiring long-term recovery, with major residual damage.

Risk Type (Project)	1 - Minor	2 - Medium	3 - Serious	4 - Major	5 - Catastrophic
				- Normally reversible within one year.	- Normally reversible within more than one year.
	Off site: NA	**Off site** - Near-source confined and promptly reversible impact. - Normally reversible within one shift. - Very minor perturbation of wildlife or floristic.	**Off site** - Near-source confined and short-term reversible impact. - Normally reversible within one week. - Minor perturbation of wildlife or floristic.	**Off site** - Near-source confined and medium-term recovery impact. - Normally reversible within one month. - Important perturbation of wildlife or floristic.	**Off site** - Off-site or unconfined incident/release resulting in extensive or long-lasting damage to habitat, resources, wildlife or neighbouring communities. - Normally reversible within one year.
Community Impact	**Socio-economic** Minor level community dissatisfaction.	**Socio-economic** Low level community dissatisfaction/support.	**Socio-economic** Censure/endorsement in local media.	**Socio-economic** Significant harm/sustainable benefit with wide group implications.	**Socio-economic** Permanent or irreversible harm/sustainable benefit.
	Cultural heritage Community complaint solved via existing site procedures.	**Cultural heritage** Non-compliance with Corporate standards.	**Cultural heritage** Repairable damage to site or item of cultural significance.	**Cultural heritage** - Irreparable damage to site or item of international cultural significance - Breach of license or non-compliance with community agreement.	**Cultural heritage** Irreparable damage to site or item of international cultural significance.
	Outrage Isolated incident.	**Outrage** Low level community dissatisfaction.	**Outrage** Repeated community complaints requiring site management or business unit response.	**Outrage** Severe, prolonged local community resistance greater than one year of public exposure in national media.	**Outrage** Severe, prolonged complaints, greater than three years of public exposure in international media.
Personnel Safety	Discomfort or minor injury (minor cuts, bruises, abrasions).	Reversible injury requiring medical treatment with return to normal duties (no restrictions).	Reversible injury, moderate irreversible damage or impairment to one person.	Serious injury, severe irreversible damage or severe impairment to one person.	One or more fatalities or permanent damage of several individuals.
	No medical treatment required Near miss.	First aid medical treatment.	Lost time injury.	Permanent injury.	One fatality or more.
Health Impact	Reversible health effect or little concern, requiring first aid treatment at most.	Reversible health effects normally requiring medical treatment.	Severe, reversible health effects normally with lost time incident.	Single fatality or irreversible damage to health or disabling illness.	Multiple fatalities, irreversible health damage, or serious disablement of more than one person.
	Minor irritations of eyes, throat, nose, skin or muscular discomfort.	Could include heat stress, dehydration.	Could include acute short-term effects such as extreme heat stress, muscular skeletal, vibration, nervous system, certain infectious disease.	Could include progressive chronic conditions and/or acute/short-term high-risk effects.	Could include effects of carcinogens, mutagens, teratogens and/or agents toxic to reproductive system (known or suspected), sensitisation of respiratory tracts.
Compliance Impact	Non-compliance with internal operational procedure with low potential for impact.	Non-compliance with external standard or operating procedure with low to medium potential for impact.	Non-compliance with moderate potential for impacts (e.g., intermittent compliance of work permit or licence).	Breach of licence, legislation, or regulation or repeated non-compliance.	Partial or total business unit closure or license suspension
	No impact.	Minor fines.	Moderate fines.	High potential for prosecution and severe fines.	Regulator imposed suspension or severe reduction of operations.
	No impact on clients or investors.	Minor impact on clients or investors.	Some client loss, no impact on investors.	Public exposure in national media major effort must be invested to recuperate lost clients and investors.	Important and irreversible loss of a majority of clients and investors.

Risk probabilities used to assess the chances of that risk occurring were based on the criteria summarised in Table 24.3.

Table 24.3: Risk Probability Criteria

Level	Definition	Descriptive	Probability	Frequency Interval (Multiple Events)
A	**Almost Certain**	Recurring event during the lifetime of a project/operation. Very high probability that the event will happen during the first year of operation, even at many occasions, will certainly happen.	> 90%	More than twice a year
B	**Likely**	Event that may occur frequently during the lifetime of a project/operation. Will probably happen in the first year of operation.	50% - 90%	once per year
C	**Possible**	Event that may occur during the lifetime of a project/operation. Could probably happen.	20% - 49%	1 once in 2 years
D	**Unlikely**	Low probability of occurrence during the lifetime of a project/operation.	5% - 19%	1 once in 1 to 5 years
E	**Very Unlikely (Rare)**	Event that is probable, but very unlikely to occur during the lifetime of a project/operation.	< 5%	More than 20 years

By taking the information listed in Tables 24.1 to 24.3 and combining it and providing weightings, a risk prioritisation Table was created, such as the one shown in Table 24.4.

24.3.2 Risk Analysis

The process of risk analysis begins by selecting an area/category of interest. The area is analysed with various risks proposed by the team. The proposed risk is quantified for likelihood and impact based on the tables in Section 24.3.1. The standard method of assessing and displaying overall risk for each activity is graphically in the risk prioritisation matrix.

The results of the Valentine Gold Project risk analysis are summarised in the prioritisation matrix shown in Table 24.5.

The results show that 65 risks that were notable enough to record. Within the summary, three risks were noted in the red danger zone. Those risks were mostly related to plant operational dangers. A detailed review of the risks with the purpose of determining practical risk mitigation procedures was conducted. The risks were then once again assessed after mitigation and a new post-mitigation prioritisation matrix was produced, as shown in Table 24.6.

The results were positive, with an elimination of all the red, “very high” risks.

Table 24.4: Risk Prioritisation Table

		Weights	2	3	5	9	13
Consequences	Weights		E - Very Unlikely (Rare)	D - Unlikely	C - Possible	B - Likely	A - Almost Certain
	32	5 - Catastrophic	64	96	160	288	416
	16	4 - Major	32	48	80	144	208
	8	3 - Serious	16	24	40	72	104
	4	2 - Medium	8	12	20	36	52
	2	1 - Minor	4	6	10	18	26

Table 24.5: Pre-Mitigation Risk Prioritisation Matrix

		Weights	2	3	5	9	13
Consequences	Weights		E - Very Unlikely (Rare)	D - Unlikely	C - Possible	B - Likely	A - Almost Certain
	32	5 - Catastrophic	12		2		
	16	4 - Major	1	8	1		
	8	3 - Serious	1	8	13	1	
	4	2 - Medium		5	4	1	
	2	1 - Minor	2	2	2	1	1

Table 24.6: Post-Mitigation Risk Prioritisation Matrix

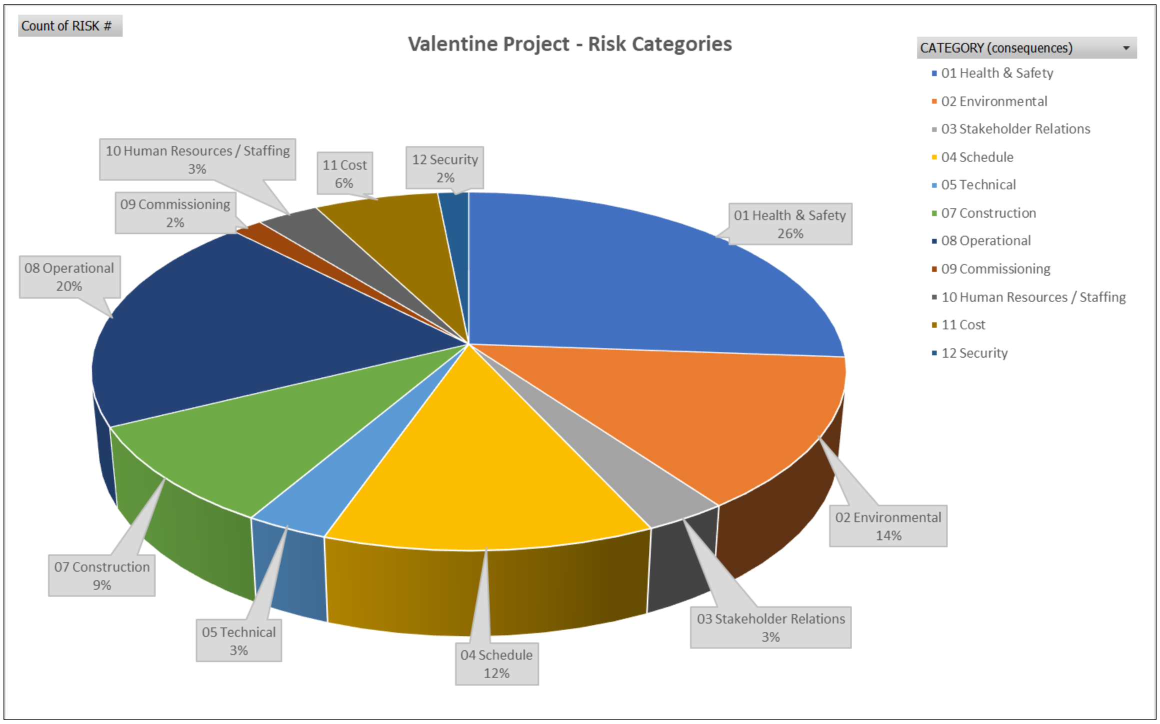
		Weights	2	3	5	9	13
Consequences	Weights		E - Very Unlikely (Rare)	D - Unlikely	C - Possible	B - Likely	A - Almost Certain
	32	5 - Catastrophic	10				
	16	4 - Major	7	2			
	8	3 - Serious	11	15	1		
	4	2 - Medium	3	7	2		
	2	1 - Minor	4	2			1

Legend for Tables 24.4 to 24.6

Risk Level
Very High (>160)
High (80 to 144)
Medium (26 to 72)
Low (10 to 24)
Very Low (4 to 8)

The pie chart in Figure 24-4 summarises the percentage of the total risks per area. A discussion of the most notable risks is provided in Section 24.3.3.

Figure 24-4: Valentine Gold Project Risk Categories



Source: Ausenco, 2021.

24.3.3 Summary of Notable Project Risks

24.3.3.1 Mining

A list of the major mining risks is noted below. The risks have been assessed with mitigation to minimise their impact to the project and mainly fall under the low- to medium-risk range.

1. The estimate of the mineral reserves is subject to the risks related to the geological model, mine plan and dilution, and mining recovery during operations. The risk due to dilution and mining recovery is addressed by the provision of both RC and blasthole assaying as well as the selection of the type and size of the primary loading units.
2. The start-up schedule and start-up equipment and personnel deployment are some of the main areas of risk and opportunity that will benefit by further studies and schedule definition and detailing.
3. There is a risk that the mining operating cost could go up due to the hardness and abrasiveness of the rock. The consumption of ground-engaging tools (GETS) will need to be studied as operations start-up. Experienced-based assumptions have been used to model these consumables and calculate their contribution to the operating cost.

24.3.3.2 Environmental Assessment

The following list provides the risks associated with environmental assessment and permitting. Extensive design and investigations have gone into preparing the Environmental Impact Statement that was submitted to both the federal and provincial governments. Considering all the rigorous work and studies completed to date, there are still several external factors that could contribute to the risk of a delayed environmental approval. The following risks mainly fall under the medium- to high-risk range, because much of the risk is outside of Marathon Gold's control.

1. Regulators determine if consultation/engagement efforts have been sufficient.
2. Capacity constraints within the regulatory agencies and/or any changes made to government policies and expectations around environment act legislation generally and/or Indigenous engagement specifically could affect environmental approval timelines.
3. Various technical details within Value Added Components submitted may need further clarification or work resulting in information requests (IRs) by the governments and a longer evaluation process.

To minimise or avoid any approval delays, Marathon Gold, in conjunction with Stantec, have regularly liaised with regulators through the environmental assessment preparation and EIS review process to help mitigate delays and missing information. These risks are still seen as potentially high.

24.3.3.3 Tailings Management Facility

The following list provides some of the main risks associated with the TMF during construction and operations. The risks fall mostly in the low- to medium-risk range.

1. Inadequate characterisation of the TMF foundation conditions could lead to increased construction material requirements and costs.
2. Water management issues associated with both the quantity and quality of the inflows to the TMF could result in excess water stored in the TMF that would require additional treatment and discharge to the environment to maintain dam containment.
3. Damage to the dam liner due to improper construction or installation could result in excess seepage. This may overwhelm the downstream sumps and cause uncontrolled discharge to the environment thus incurring additional costs for environmental rehabilitation and the implementation of additional controls.
4. A failure of the tailings dam would result in the uncontrolled release of water and/or tailings into the environment, resulting in operations shutdown and significant costs for environmental clean-up and rehabilitation and dam reconstruction.

The above risks have been currently classified as low, as it is recognised that contingency planning and engineering and quality controls during design, construction, and operation will be implemented to mitigate these risks.

24.3.3.4 Process

Many dangerous chemicals, products and pieces of equipment in the process plant which if not properly used could result in serious harm or death. The risks associated with personnel safety in the process plant were some of the most serious risks noted in the assessment. After mitigation procedures and proper training were taken into consideration, the risks were reassessed as being in the low to medium range.

The main items captured in the risk register include the following:

1. Insufficient training of personnel in the use and care of equipment within the plant (i.e., mills, conveyors, and pumps).
2. Insufficient training of personnel in the use and exposure to various chemicals in the plant (i.e., cyanide, and NaOH).
3. Failure of monitoring equipment such as cyanide gas detectors.
4. Improper operation of plant resulting in gold recovery loses.
5. Improper operation of plant resulting in environmental spills to the environment.

The above risks have been currently classified as medium but planning around proper training protocols via operational readiness and experienced training personnel as well as proper upfront engineering to mitigate are being implemented.

24.3.3.5 Infrastructure

Both on-site and off-site infrastructure items have been identified as potential, cost, schedule and safety risks. Many of these items listed below have been mitigated to minor or medium consequences with unlikely occurrence. Proper scheduling, engineering, and planning mitigate most of the issues listed below with the risks assessed mostly in the low range.

1. Cost and schedule impact of NL Hydro upgrades required to provide power to the project. This is outside of Marathon Gold's control, but constant dialogue and interfacing with NL Hydro has moved this aspect forward, resulting in the mitigation of time lost and costs due to interfacing delays.
2. Site access road resurfacing and bridge repairs have been cited as items that may impact the schedule, since they have a direct influence on mobilising equipment and personnel to site.
3. Proper site road design for operational safety.

The cost and schedule impact of the infrastructure upgrades required may be a risk if this project component is not well managed.

25 Interpretations & Conclusions

25.1 Property Description & Location

Mineral rights to the property are 100% controlled by Marathon Gold. The 14 contiguous mineral licenses (24,000 hectares) are in good standing as of the effective date of this report and are fully permitted for work expenditures associated with annual assessment work requirements. Surface rights are not held by Marathon Gold and would need to be acquired as part of any future mining lease applications.

The Valentine Gold Project is subject to regulation under the environmental protection regimes of the *Canadian Environmental Assessment Act* and the Newfoundland and Labrador (NL) *Environmental Protection Act*. To APEX's knowledge, there are no other significant factors or risks that may affect access, title, or the right or ability to perform work on the property.

25.2 Exploration

Marathon Gold has conducted numerous ground exploration surveys since 2010. This work includes geological mapping, lithogeochemical grab and channel sampling, ground geophysical surveying (induced polarisation, magnetic, and seismic), drilling, metallurgical processing and environmental baseline studies. The results of this work have significantly improved the understanding of exploration potential at the project through a systematic and detailed geological approach.

The work collectively expedited the discovery, confidence level and advancement of five main gold deposits at the project: Leprechaun, Marathon, Sprite, Victory and Berry deposits. Several other exploration targets have been identified by Marathon Gold across the property, namely the Frank, Rainbow, Steve, Scott, Triangle, Victoria Bridge, Narrows, Victory SW and Victory NE occurrences.

In addition, the exploration results have been used by BOYD to develop robust 3D geological models, resource estimation files and mineral resource estimations, the geological evidence of which, in the case of indicated and measured resources, is derived from detailed and reliable exploration, sampling and testing and is sufficient to confirm geological and grade or quality continuity between points of observation (Table 25.1).

25.3 Drilling

Between 2010 and the present, Marathon Gold has drilled 1,502 diamond drillholes totalling 339,044.25 m. In 2019, Marathon Gold completed the company's largest drill program in the history of the Valentine Lake property which focussed on infill drilling of the Marathon and Leprechaun deposits. A summary of the drillholes and gold assays used to update the Marathon, Leprechaun and Berry resource estimations is provided in Table 25.1.

During 2020, Marathon Gold undertook a drill program focused on characterising the newly discovered Berry deposit. APEX and BOYD consider the drilling procedures have been conducted to a high standard, and that there are no drilling, sampling, or recovery factors that could materially impact the accuracy and reliability of results.

Table 25.1: Exploration Results that form the Marathon, Leprechaun & Berry Geological Databases

Exploration Activity	Marathon (to 21 November 2019)	Leprechaun (to 19 August 2019)	Berry (to 8 March 2021)
Drillholes	487 drillholes totalling 151,663.00 m in total length drilled	442 drillholes totalling 100,025.30 m in total length drilled	209 drillholes totalling 41,617.93 m in total length drilled
Gold Assays	105,965 assays totalling 146,145.37 m of total assayed length (96.4% of the total length drilled)	70,302 assays totalling 95,256.76 m of total assayed length (95.2% of the total length drilled)	29,045 assays totalling 39,577.04 m of total assayed length (95.1% of the total length drilled)
Geological Records	12,205 geological records	7,554 geological records	4,645 geological records
Survey Records	25,553 survey records	24,128 survey records	9,120 survey records
Visible Gold Records	1,439 visible gold records	1,274 visible gold records	351 visible gold records
QTPV Records	3,757 QTPV records	2,704 QTPV records	1,658 QTPV records

Note: QTPV = quartz-tourmaline-pyrite zones.

25.4 Sample Preparation, Analyses & Security

APEX reviewed and compared hardcopy laboratory certificates and drill logs against the electronic spreadsheets provided by Marathon Gold and found no issues. APEX considers that the sample preparation, analytical procedures, and security were of a good standard and that the results are adequate for use in mineral resource estimation.

A weak, but consistent, negative bias was observed in the results of Certified Reference Materials (CRM) assays dating back to 2010, which may indicate that some FA results are weakly underestimated. Marathon Gold does not routinely analyse duplicate pulp samples. Limited data on duplicate pulp samples can exhibit a nugget effect at relatively low gold grades (less than 6 g/t). The use of metallic sieve analyses on any sample that assays greater than 100 ppb Au (and 300 ppb Au as a threshold since 2019) was used to increase the accuracy of gold analytical results.

25.5 Data Verification

The site inspection allowed APEX to confirm the geological interpretations made in support of mineral resource estimation. The verification of the drill databases conducted by BOYD in preparation of the mineral resource estimates presented in Chapter 14 have shown the data to be reliable and accurate. Further, results of the independent analytical testwork conducted by APEX demonstrate that the Marathon Gold assay dataset is valid and appropriate to be used in resource estimation without any limitations.

The qualified person therefore considers that the data collected and prepared by Marathon Gold is adequate for the estimation of mineral resources in accordance with N.I. 43-101 and CIM definitions and guidelines (2014, 2019).

25.6 Mining

25.6.1 Mineral Reserve Estimates

Proven and probable mineral reserves have been modified from measured and indicated mineral resources at Marathon and Leprechaun. Inferred mineral resources have been set to waste. The mineral reserves are supported by the 2021 Valentine Gold Feasibility Study.

Factors that may affect the mineral reserve estimates include metal prices, changes in interpretations of mineralisation geometry and continuity of mineralisation zones, geotechnical and hydrogeological assumptions, ability of the mining operation to meet the annual production rate, operating cost assumptions, process plant and mining recoveries, the ability to meet and maintain permitting and environmental license conditions, and the ability to maintain the social license to operate.

25.6.2 Mine Plan

Reasonable open pit mine plans, mine production schedules, and mine capital and operating costs have been developed for the mineral reserves estimates at Marathon and Leprechaun.

Pit layouts and mine operations are typical of other open pit gold operations in Canada, and the unit operations within the developed mine operating plan are proven to be effective for these other operations.

The mine plan supports the cash flow model and financials developed for the feasibility study.

25.7 Metallurgical Testwork & Processing

Metallurgical testwork was analysed and several process options were assessed in the initial stages of the feasibility study. Analysis included recovery, production ounces, flowsheet robustness and simplicity, operating and capital cost and resultant financial analysis.

As per the mining production schedule, as the high-grade ore is fed to the mill in the first three years, the project will utilise a more cost-effective flowsheet design, nominating gravity recovery and gravity tails cyanidation at a primary grind of 75 µm.

As the mill feed grade decreases, and plant capacity is required to increase to maintain gold production, the project will use the existing grinding mills, and instead coarsen the primary grind to 150 µm.

Flotation equipment will then be employed to recover the majority of the gold to a small concentrate stream, and ultra-fine grind will be applied. Using this approach, initial capital costs will be reduced where possible to improve the viability of the project, and when required to expand, the flowsheet will be modified to again reduce the expansion costs.

The project will be constructed in two distinct phases, as follows:

- Phase 1 (2.5 Mt/a) – gravity-leach
- Phase 2 (expansion to 4.0 Mt/a) – gravity-flotation-regrind-leach flotation concentrate-leach flotation tail

25.8 Site Infrastructure

The infrastructure for this project consists of open pit mines, tailings management facility (TMF), waste rock facilities, polishing pond, mine services, access road, accommodations camp, and effluent treatment plant. Access to the facility is from the northeast side of the property from the existing public access road. Process plant access will be via the security gate at the public road intersection.

25.9 Impact on Third-Party Assets

Moving the TMF downstream of the Victoria Dam and reservoir has significantly reduced the potential impact of an assumed TMF failure. Further engineering work was carried out to fully assess the potential for Marathon's proposed project to impact NL Hydro's Victoria Lake Reservoir assets:

- Following completion of the pre-feasibility study, a dam breach assessment was conducted for the TMF (Golder, 2020a). An update to the dam break and inundation analysis is currently being carried out considering design updates adopted during the feasibility study.
- A vibration analysis determined that vibrational energy from blasting in the open pits transferred to the Victoria Dam foundation and/or dam will be below the threshold peak particle velocity of 50 mm/s (Golder, 2020b).

25.10 Capital & Operating Costs

AACE Class 3 costs have been developed for this feasibility study with an accuracy of ±15%. The cost estimates were derived from first principles bulk material take-offs and equipment sizing calculations, with supporting quotations for major equipment, and contractor supply/installation rates to the value of 88% of the cost estimate, with the remaining cost items benchmarked against recent Canadian mining projects.

25.11 Economic Analysis

The economic analysis was performed assuming a 5% discount rate. The pre-tax NPV discounted at 5% is C$867 million; the internal rate of return IRR is 37%; and payback period is 1.8 years. On an after-tax basis, the NPV discounted at 5% is C$600 million; the IRR is 32%; and the payback period is 1.9 years. The sensitivity analysis revealed that the project is most sensitive to changes in gold prices and less sensitive to operating costs, discount rate and initial capital costs.

25.12 Risk

Risk identification and mitigation was ongoing throughout the feasibility study, and will continue through value/detailed engineering, construction, operations and closure. Risks were identified and qualitatively ranked in the Valentine Gold Project Risk Register. As the project moves from feasibility into the execution phase, it will be necessary to update the project risk register.

26 Recommendations

26.1 Overall

The financial analysis of this feasibility study demonstrates that the Valentine Gold Project has robust economics, and it is recommended to continue developing the project through engineering and de-risking, and into a construction decision in late 2021. Table 26.1 summarises the proposed budget to advance the project through to the construction decision.

Table 26.1: Proposed Budget Summary

Description	Cost ($)
Detailed Engineering	**6,985,000**
Mine Planning	90,000
Geotechnical, Hydrology and Hydrogeology Investigations and Design	2,600,000
Infrastructure Studies (e.g., Off-site Roads, Permits, Communications)	630,000
Consultant Support (e.g., Project Management, Metallurgical, Contracts)	518,000
TMF Design	397,000
EPC – Plant Site (Engineering)	1,400,000
Site Engineering (Site Civil Works Design, Electrical Substation Design)	1,350,000
Berry Zone Exploration / Mineral Resource	**6,080,000**
Geological Modelling and Updated Resource	80,000
Resource Drilling (30,000 m @ $200/m)	6,000,000
Site Access	**1,835,000**
Access Road and Bridge Repairs	1,155,000
NL Hydro Power Supply Contract	680,000
Administration	**350,000**
Administration (Travel, GFW Office, Support Services)	350,000
Contingency	**486,503**
Contingency	486,503
Total Cash Basis (without HST)	**15,736,503**
HST Calculations - 13%	**2,045,745**

26.2 Exploration

26.2.1 Geophysical Surveys

It is recommended that a detailed interpretation of the amalgamated aeromagnetic and ground geophysical surveys data be undertaken to support and advance ongoing structural geological interpretation of the VLSZ and VLIC.

This work should focus in areas along strike extension of known mineralisation and in areas of low magnetic intensity west of, and proximal to, the VLSZ, primarily between the Leprechaun and Marathon deposits. Geophysical IP surveys may be beneficial at areas inferred as structural traps with associated low magnetic intensity to further define potential drill targets associated with moderate to high chargeability and resistivity. A new, detailed and low altitude aeromagnetic survey covering the immediate hanging-wall area of the VLSZ should be considered to delineate individual mafic dykes that are interpreted to have an important influence in the mobilisation and localisation of gold mineralisation.

26.2.2 Drilling

Marathon Gold should continue with the company's infill and exploratory drill program strategies. Infill drilling should be focused on the recently defined Berry deposit to further increase confidence in the Main Zone style mineralisation found at Berry. Exploratory drilling should continue to be used in collaboration with geophysical interpretations to test for gold mineralisation along the (1) VLIC – Rogerson Lake Conglomerate contact, and (2) trend of magnetic lows west of, and proximal to, the Valentine Lake Shear Zone, primarily between the Leprechaun and Marathon deposits.

Given the coarse nature of gold, as evidenced by the abundance of visible gold logged in drill core, consideration should be given to investigating the potential for reducing sample variance using wider diameter drill core, thereby producing a larger sample size.

26.2.3 Quality Assurance – Quality Control

Marathon Gold should continue with the company's current QA/QC protocols and consider new strategies intended to increase the confidence level of the QA/QC work to feasibility study levels, such as umpire assaying, and collection and analysis of variability of duplicate samples.

26.3 Mineral Resource Estimations

No new work was completed on the mineral resource estimates for the Marathon, Leprechaun, Sprite and Victory deposits, other than updating economics and slope sectors. The Berry mineral resource estimate is a new discovery and is first reported as part of this document. Based on the geologic work completed for the previous Pre-feasibility Study Mineral Resource Estimate, the following actions are recommended to be completed as part of a future mineral resource estimate:

- Further refine the constraining mineralized domains within the Leprechaun and Marathon geological models. This would involve improving the mafic dike solids as well as the 100 PPB gold QTPV domain.
- Add the results of the Terrane structural analysis to Leprechaun and Marathon mineral resource estimate.

Continue exploration and infill drilling at the Berry deposit.

26.4 Mineral Reserves & Mining Methods

The following recommendations are made to advance the project into construction:

- Execute a grade control drilling and interpretation program in selected areas of the Marathon and Leprechaun deposits that are planned to be mined for initial mill feed. The resultant tonnes and grade from this interpretation should be compared to the equivalent area resource modelled tonnes and grade. Results should be incorporated in ongoing grade control strategy and mine planning.

  - Early in the mine's operating life a campaign of RC drilling, sampling, assaying should be compared to a campaign of blasthole sampling and assaying to determine ore/waste boundary prediction using each method. These campaigns can be performed over the same area of the pit to ensure a direct comparison. It may be possible to forego RC drilling and rely solely on blasthole sampling for ore/waste boundary prediction, which would lead to a reduction in mine operating costs.

- Additional hydrogeological and geotechnical field and lab work to bring the models to a construction level of confidence.
  - Additional targeted geotechnical drilling on the south side of the Leprechaun deposit should be carried out, including scan line mapping to further characterise structural fabric in this zone, packer testing, and associated updates to the geotechnical model.
  - Installation of additional vibrating wire piezometers, as well as individual piezometers within the pits and outlying areas should be completed. Additionally, ongoing collection of monitoring data from the existing piezometers for further evaluation of hydraulic gradients and pore pressures should be continued.
  - Targeted pumping tests and new observation wells within each pit should be completed to provide another measure of bulk hydraulic conductivity of the rock mass at the pit-scale and to provide data on anisotropy (both horizontal and vertical) in the hydraulic response to refine predictions of pit inflows and dewatering requirements.
- Further engagement with potential mining contractors to obtain updated quotations for services should be carried out.
- Further engagement with equipment vendors to secure build spots for long lead time items should be carried out.
- Further engagement with blasting material and diesel fuel suppliers to provide detailed designs for supply chain and on-site storage in support of required operating permits should be carried out.
- Further engagement with tire vendors to secure supply for estimated early project tire needs should be carried out.
- Blasting to both minimise dilution while improving mine-to-mill performance can be optimised in future studies. This will require field measurements and adjustments during operations.
- Opportunities should be explored to increase project value via alternative deposit development strategies. The inclusion of the Berry, Sprite, and Victory resource deposits into the overall project should be examined.
- Completing a desktop study on the potential impacts of ore sorting is recommended. The variable nature of the mineralisation and the fact that it is a vein-gold deposit would strongly suggest that this deposit is a candidate for ore-sorting.

26.5 Metallurgical Testwork

The following activities are recommended to support the detailed design of processing facility beyond the feasibility study:

- Further optimise concentrate leach residence time before the Phase 2 expansion is deployed. Consider reducing from 48 hours to 36 hours, prior to transfer of the residue to tail leach for an additional 22 hours.
- Further optimise gravity-leach flowsheet cyanide detoxification reagent consumption before operation. Focus on control of pH and cyanide decay in leach discharge for presentation to cyanide detoxification.
- Given the significant reduction in concentrate regrind energy requirement using the HIG mill signature plot (feasibility study) compared with the IsaMill signature plot (pre-feasibility study), it is recommended to further explore the difference and consider additional concentrate testing, before the Phase 2 expansion is deployed.

26.6 Recovery Methods

The following activities are recommended to support the design of the processing plant beyond the feasibility study:

- Additional geotechnical site investigations (both test pit and borehole methods) should be carried out at the preferred process plant site locations to validate the existing information that has been gathered on the foundation conditions associated with the proposed buildings.
- Material flowability testwork results and recommendations should be incorporated into the crushing and stockpile circuit detailed design.

26.7 Site Infrastructure

The following activities are recommended to support the detailed design of site infrastructure beyond the feasibility study:

- Further confirmatory geotechnical site investigations should be carried out at the preferred surface infrastructure site locations to characterise the foundation conditions associated with the proposed buildings.
- The access road to site should be further analysed, reviewed and engineered, culminating in a detailed work package to be tendered to local contractors.
- The design of the 66 kV high-voltage powerline and substation should be further refined by NL Hydro and their selected consultants in mid-2021.

26.8 Water Management

The following activities are recommended to support the design of the water management systems beyond the feasibility study and into detailed design:

- Progress the design of de-centralised water management in each complex (i.e., sedimentation ponds, berms, drainage ditches and outlet channels).
- Maintain adequate component waterbody setbacks to account for regulatory buffers and water management infrastructure.
- Identify opportunities to enhance sedimentation pond volumes at select locations.
- Continue geochemical testing and assessment of ARD/ML to further refine parameters of potential concern.
- Refine assimilative capacity study of effluent meeting MDMER criteria in keeping with water management infrastructure updates.

- Further optimise cut and fill of water management components and/or use of surplus material.
- Conduct a geotechnical program at the locations of proposed water management features prior to detailed design to refine the assumptions associated with overburden, bedrock, and required grubbing.

26.9 Tailings Management Facility

The following activities are recommended to support the design of the TMF in the next phase of study:

- Supplemental geotechnical and hydrogeological site investigations are recommended to further define the subsurface conditions and to support construction material quantity estimation.
- Geotechnical investigations should be carried out within the property boundary to identify potential borrow sources and requirements for development of the borrow areas.
- Additional in-situ permeability tests of the overburden soils and bedrock beneath the proposed dam foundations are recommended. The results of the investigation shall be used to optimise the design of the current seepage mitigation measure (i.e., upstream geomembrane liner installed on foundation).
- A site-specific seismic ground motion hazard assessment should be carried out to determine the appropriate earthquake design input parameters for dam design.
- Optimisation of the proposed dam alignment, deposition planning (including in-pit disposal at Leprechaun Pit), and construction staging should be carried out based on the findings of the geotechnical site investigations and other project developments.
- The 2020 Dam Breach and Inundation Study should be updated to support the dam classification and consideration for the updated TMF infrastructure layout.
- Detailed TMF water balance modelling should be carried out that includes monthly wet, average and dry year scenarios for each year of operation to set operating guidelines for the TMF pond. Adequate process plant-make up water supply storage will be required at start-up and before winter.
- The design of the water treatment plant and polishing pond should be optimised.
- Construction drawings and technical specifications for the first stage of construction should be developed.

26.10 Environment, Permitting, & Community Relations

As indicated in Section 20.2.1, Marathon Gold prepared and submitted an EIS to meet the requirements of CEAA 2012, the NL EPA and the project-specific guidelines issued by the federal government and the provincial government. Upon release from the provincial and federal EA processes, numerous approvals, authorisations, and permits will be prepared and submitted for approval prior to initiating project construction. As permits can only be issued after the project is released from EA, these will be initiated at that time. However, some long-lead items are currently being initiated such as the Fisheries Act authorisation application.

A detailed list of anticipated permitting is provided in Chapter 20. Compliance with terms and conditions of approvals, standards contained in federal and provincial legislation and regulations, and commitments made during the EA processes (including application of mitigation measures and monitoring and follow-up requirements), will need to be addressed throughout project planning, construction, operation, and decommissioning. Approvals, authorisations, and permits will be required prior to initiating project construction. A complete list of anticipated permitting and approval activities is provided in Chapter 20. Permits can only be issued after the project is released from EA. Key permitting activities are described below:

- To reduce potential scheduling delays a Fisheries Act Authorisation Application is currently being prepared prior to the release from the EA processes. This authorisation will be prepared in accordance with Section 35 (2) of the *Fisheries Act* to receive authorisation to cause Harmful Alteration and Disruption to fish habitat as a result of the project. Regulatory consultation will be completed with key stakeholders and indigenous groups as part of the Fisheries Act authorisation and offsetting plan.
- Baseline Environmental Effects monitoring project as part of the Metal and Diamond Mining Effluent Regulations is planned for 2021.
- Marathon Gold will continue to engage with regulatory authorities throughout project planning to confirm permitting requirements.
- Municipal approvals, authorisations, and permits are not anticipated, as the project is not located within a municipality.
- Marathon Gold currently has mineral licenses and a range of permits in place for their existing exploration activities and accommodations camp.

The environmental and community consultation work required to advance the project to the detailed design stage is being conducted as part of the information request response and will be part of the upcoming baseline environmental effects monitoring planned for summer 2021.

Marathon Gold has entered into cooperation agreements with six central Newfoundland communities located in proximity to the Valentine Gold Project. The agreements provide a framework for a long-term, positive working relationship between Marathon Gold and local stakeholders and identify the interests of each community in employment, business opportunities, community investment, and environmental protection.

27 References

27.1.1 Literature, Studies & Reports

Barbour, D.M., (1999). Assessment report on geological, geochemical, trenching and diamond drilling exploration for 1999 submission for the Anglo-Newfoundland Development Company Limited Charter and Reid Lots 227 and 229 in the Valentine Lake area, central Newfoundland, Mountain Lake Resources Inc., Newfoundland and Labrador Department of Natural Resources Assessment Report No. 12A/0907, 1999.

Barrington, M.A., Layne, G.D., Dunning, G.R. and Dunsworth, S., (2016). A mineralogical, geochemical, and geochronological study of Marathon Gold Corporation's Valentine Lake Gold Camp, central Dunnage Zone, Newfoundland, Canada; Abstract in Geological Association of Canada Newfoundland and Labrador Section, 2016 Spring Technical Meeting, 1 p.

Canadian Environmental Assessment Agency (CEEA). (2019). Guidelines for the Preparation of an Environmental Impact Statement. Pursuant to the Canadian Environment Assessment Act 2012.

Canadian Institute of Mining, Metallurgy and Petroleum (CIM), (2019). Estimation of Mineral Resources and Mineral Reserves, Best Practice Guidelines: Canadian Institute of Mining, Metallurgy and Petroleum, November 29, 2019.

Canadian Institute of Mining, Metallurgy and Petroleum (CIM), (2014). CIM Standards for Mineral Resources and Mineral Reserves, Definitions and Guidelines: Canadian Institute of Mining, Metallurgy and Petroleum, May, 2014.

Canadian Securities Administrators (CSA), 2011: National Instrument 43-101, Standards of Disclosure for Mineral Projects, Canadian Securities Administrators.

Capps, N.J.M. and Dunsworth, S.M., (2020). Assessment Report of Diamond Drilling, Environmental Studies and Road Repair and Maintenance; Valentine Lake Property, central Newfoundland, NTS 12A/06, 106 pages, Newfoundland and Labrador Department of Natural Resources Assessment Report, Submitted 2020.

Caterpillar Inc., (2018). Caterpillar Performance Handbook: 48th edition, June 2018.

Colman-Sadd, S.P., Hayes, J.P. and Knight, I., (2000). Geology of the Island of Newfoundland (digital version of Map 90-01 with minor revisions). Newfoundland Department of Mines and Energy, Geological Survey, Map 2000-30, scale 1:1 000 000.

COSEWIC (Committee on the Status of Endangered Wildlife in Canada) (2014). COSEWIC assessment and status report on the Caribou Rangifer tarandus, Newfoundland population, Atlantic-Gaspésie population and Boreal population, in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. xxiii + 128 pp. Available at: https://wildlife-species.canada.ca/species-risk-registry/virtual_sara/files/cosewic/sr_Caribou_NF_Boreal_Atlantic_2014_e.pdf. Accessed: November 24, 2019.

COSEWIC (Committee on the Status of Endangered Wildlife in Canada) (2013). COSEWIC assessment and status report on the Little Brown Myotis Myotis lucifugus, Northern Myotis Myotis septentrionalis and Tri-coloured Bat Perimyotis subflavus in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. xxiv + 93 pp. Available online at: https://www.registrelep-sararegistry.gc.ca/virtual_sara/files/cosewic/sr_Little%20Brown%20Myotis%26Northern%20Myotis%26Tri-colored%20Bat_2013_e.pdf. Last accessed on January 21, 2020.

COSEWIC (Committee on the Status of Endangered Wildlife in Canada) (2007). COSEWIC assessment and update status report on the American marten, Martes americana atrata (Newfoundland Population in Canada). Available at: https://www.sararegistry.gc.ca/virtual_sara/files/cosewic/sr_martes_americana_atrata_e.pdf. Accessed on January 21, 2020.

COSEWIC (Committee on the Status of Endangered Wildlife in Canada) (2010). COSEWIC assessment and status report on the Atlantic Salmon Salmo salar (Nunavik population, Labrador population, Northeast Newfoundland population, South Newfoundland population, Southwest Newfoundland population, Northwest Newfoundland population, Quebec Eastern North Shore population, Lake Ontario population, Gaspe-Southern Gulf of St. Lawrence population, Eastern Cape Breton population, Nova Scotia Southern Upland population, Inner Bay of Fundy population, Outer Bay of Fundy population) in Canada. Committee on the Status of Endangered Wildlife in Canada, Ottawa, ON, xlvii+136 pp.

COSEWIC (Committee on the Status of Endangered Wildlife in Canada) (2012). COSEWIC assessment and status report on the American Eel Anguilla rostrata in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. xii + 109 pp.

COSEWIC (Committee on the Status of Endangered Wildlife in Canada) (2014). COSEWIC assessment and status report on the Caribou Rangifer tarandus, Northern Mountain population, Central Mountain population and Southern Mountain population in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. xxii + 113 pp.

Cunjak, R.A., and R.W. Newbury (2005). 21 - Atlantic Coast Rivers of Canada. (Benke, A.C. and C.E. Cushing, eds.). Elsevier Inc. (Academic Press), San Diego, CA. 1144p.

Department of Newfoundland and Labrador (DOEC) (2004). Policy on Flood Plain Management.

DFO (Department of Fisheries and Oceans) (2018a). Notice to Anglers: Atlantic Salmon Management Change. News Release, July 19, 2018. Government of Canada, St. John's, NL. Available at: http://www.nfl.dfo-mpo.gc.ca/NL/CP/Orders/2018/ na18011SalmonManagement Change

DFO (Department of Fisheries and Oceans) (2018b). Notice to Anglers: Correction – Atlantic Salmon Management. News Release, July 19, 2018. Government of Canada, St. John's, NL. Available at: http://www.nfl.dfo-mpo.gc.ca/NL/CP/Orders/2018/na18012CorrectionSalmonManagement

DFO (Department of Fisheries and Oceans) (2018c). Newfoundland and Labrador Angler's Guide 2018-2019. Available at: http://waves-vagues.dfo-mpo.gc.ca/Library/40707647.pdf

DFO. 2018. Stock Assessment of Newfoundland and Labrador Atlantic Salmon – 2017. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2018/034.

Dunsworth, S.M. (2011). Assessment Report of Diamond Drilling, Line Cutting, IP Geophysical Survey, Channel Sampling, Soil Sampling, Prospecting, Camp Construction and Road Repairs; Valentine Lake Property, central Newfoundland, NTS 12A/06 and 12A/07, 80 pages, Newfoundland and Labrador Department of Natural Resources Assessment Report, 2011.

Dunsworth, S.M., Capps, N.J.M. and Tettelaar, T. (2017). Assessment Report of Diamond Core Drilling, Seismic Surveying, Environmental Studies, and Road Repair & Maintenance; Valentine Lake Property, Central Newfoundland, NTS 12A/06 and 12A/07, 62 pages, Newfoundland and Labrador Department of Natural Resources Assessment Report, 2017.

Environment and Climate Change Canada (ECCC) (2016a). "Pan-Canadian Approach to Pricing Carbon Pollution." Available online at: https://www.canada.ca/en/environment-climate-change/news/2016/10/canadian-approach-pricing-carbon-pollution.html

Environment and Climate Change Canada (ECCC) (2016b). “Pan-Canadian Framework on Clean Growth and Climate Change.” ISBN: 978-0-660-07023-0. Available online at: http://publications.gc.ca/collections/collection_2017/eccc/En4-294-2016-eng.pdf

Environment and Climate Change Canada (ECCC) (2019). “How we’re putting a price on carbon pollution.” Available online at: https://www.canada.ca/en/environment-climate-change/services/climate-change/pricing-pollution-how-it-will-work/putting-price-on-carbon-pollution.html

Evans, D.T.W. (1993). Gold mineralisation in the Eastern Dunnage Zone, central Newfoundland; Current Research (1993) Newfoundland and Labrador Department of Natural Resources Geological Survey, Report 93-1, p. 339-349.

Evans, D.T.W. (1996). Epigenetic gold occurrences, eastern and central Dunnage Zone, Newfoundland. Government of Newfoundland and Labrador, Department of Mines and Energy, Geological Survey, Mineral Resources Report 9, 135 p.

Evans, D.T.W. (1999). Epigenetic gold mineralisation, Baie Verte Peninsula, Newfoundland. In Current Research. Government of Newfoundland and Labrador, Department of Mines and Energy, Geological Survey Branch, Report 99-1, p. 163-182.

Evans, D.T.W. and Wilson, M. (1994). Epigenetic gold occurrences in the eastern Dunnage Zone, Newfoundland: Preliminary stable-isotope results. In Current Research. Government of Newfoundland and Labrador, Department of Mines and Energy, Geological Survey Branch, Report 94-1, p. 211-223.

Evans, D.T.W. and Wilton, D.H.C. (2000). The Midas Pond Gold Prospect, Victoria Lake Group, central Newfoundland: A mesothermal quartz vein system with epithermal characteristics; Exploration Mining Geology, v. 9, No. 1, p. 65-79.

Evans, D.T.W., Kean, B.F. and Dunning, G.R. (1990). Geological Studies, Victoria Lake Group, Central Newfoundland, In Current Research, Newfoundland Department of Mines and Energy, Geological Survey Branch, Report 90-1, 1990.

GEMTEC Consulting Engineers and Geoscientists (2019). “Limited Geotechnical Investigation, Proposed Site Development, Valentine Gold Project”. Draft Factual Report, December 2, 2019. 112p.

GEMTEC Consulting Engineers and Geoscientists (2020). “Hydrogeology Baseline Report, Marathon Valentine Gold Project, Central NL”. Draft Report, March 18, 2020. 185p.

GEMTEC Consulting Engineers and Geoscientists (2021). Feasibility Level Site Wide Geotechnical and Hydrogeological Investigations Valentine Gold Project. Draft Report prepared for Marathon Gold Corporation. Project No: 80018.07. January 30, 2021.

Gilman, Tony L.; Guest, Andrew; Anstey-Moore, Carolyn (2021). Feasibility Geotechnical Investigation: Marathon & Leprechaun Deposits, March, 2021.

Gilman, Tony L.; Kruse, Dr, Stefan; Guest, Andrew (2020). Pre-Feasibility Geotechnical Investigation: Marathon & Leprechaun Deposits, February, 2020.

Golder (2020a). Dam Breach Assessment and Inundation Study. Valentine Gold Tailings Management Facility. Final Report prepared for Marathon Gold Corporation. Project No: 20141194. August 4, 2020.

Golder (2020b). Blast Impact Assessment – Valentine Gold Project. Final Report prepared for Marathon Gold Corporation. Project No: 19130660. September 18, 2020.

Groves, D.I., Goldfarb, R.J, Robert, F. and Hart, C.J.R. (2003). Gold deposits in metamorphic belts: overview of current understanding, outstanding problems, future research, and exploration significance; Economic Geology, 98 (2003), p. 1-29.

Honsberger, I.W., Bleeker, W., Sanderman, H.A.I., Evans, D.T.W. and Kamo, S.L. (2019). Structural geology of a gold-bearing quartz vein system, Wilding Lake region, central Newfoundland; Current Research (2019) Newfoundland and Labrador Department of Natural Resources Geological Survey, Report 19-1, pages 23-38.

Hunt, W., La Rosa, D. (2019). To Flitch or Not to Flich: Using Post-Blast 3D Optimisation to Make the Decision, Ore Control Blasting Consultants, February, 2019.

Kean, B.F. (1977). Geology of the Victoria Lake Map Area (12A/6), Newfoundland, Newfoundland Department of Mines and Energy, Mineral Development Division, Report 77-4, 11 Pages, 1977.

Kean, B.F. and Evans, D.T.W. (1988). Regional Metallogeny of the Victoria Lake Group, Central Newfoundland, In Current Research, Newfoundland Department of Mines and Energy, Mineral Development Division, Report 88-1, 1988.

La Rosa, D., Thornton, D. (2011). Blast Movement Modelling and Measurement. Blast Movement Technologies, September 2011.

Lincoln, N., Farmer, R., Eccles, R., Deering, P. (2018a). N.I. 43-101 Technical Report Preliminary Economic Assessment of the Valentine Lake Gold Project, Newfoundland, Canada. May 2018

Lincoln, N., Farmer, R., Eccles, R., Deering, P. (2018b). N.I. 43-101 Technical Report – Updated Preliminary Economic Assessment of the Valentine Lake Gold Project, Newfoundland, Canada. October 2018.

Marathon Gold Corporation (2020a). FS Site Plan for Mine Site Components at Full Development. AutoCAD drawing files.

Marathon Gold Corporation (2020b). Valentine Gold Project: Environmental Impact Statement, Pages 2110-2114, September 29, 2020.

Marathon Gold Corporation. (2020c). Valentine Gold Project Environmental Impact Statement. Available at: https://iaac-aeic.gc.ca/050/evaluations/document/136521.NLDFLR (Newfoundland and Labrador Department of Fisheries and Land Resources). 2019a. Central Newfoundland Subregions. Available at: https://www.gov.nl.ca/ffa/files/natural-areas-pdf-ecoregions-nf-lab.pdf. Last updated: July 31, 2019. Accessed: January 29, 2020.

Marathon Gold Corporation (2019). Marathon Gold Completes Sale of Royalty to Franco-Nevada for Proceeds of $18 Million; News Release dated February 21, 2019.

Marathon Gold Corporation (2017). Marathon Gold Buys Back the 3% Precious Metals and 2% Base Metals Royalty on the Valentine Lake Gold Property in Newfoundland; News Release dated November 14, 2017.

McCabe, G. & and Markstrom, S. (2007(. A Monthly Water-Balance Model Driven by a Graphical User Interface. U.S. Department of the Interior. U.S. Geological Survey.

Moose Mountain Technical Services, (2021). Valentine Gold Project Feasibility Study – Mine Planning Descriptions: report prepared for Marathon Gold, March, 2021.

Murahwi, C. (2017). Technical Report on the Mineral Resource Estimate of the Valentine Lake Gold Project, Newfoundland, Canada. Prepared for Marathon Gold Corp.

Newfoundland and Labrador Municipal Affairs and Environment (NLMAE) (2018). "Provincial Government Releases Federally-Approved Made-in-Newfoundland and Labrador Approach to Carbon Pricing." Available online at: https://www.gov.nl.ca/releases/2018/mae/1023n01/

Newfoundland Department of Municipal Affairs (NLDMA) (2020). Environmental Impact Statement Draft Guidelines for the Valentine Gold Project. Draft for Public Review. January 2020. Prepared by the 2015 Environment Assessment Committee.

Newfoundland-Labrador Environmental Protection Guidelines (2018). Government of Newfoundland and Labrador, Department of Fisheries and Land Resources, Date Effective, January 01, 2018, 26 p. <Available on 27 February 2020 at: https://www.faa.gov.nl.ca/forestry/managing/pdf/Environmental-Protection-Guidelines.pdf >.

NLDOEC (Newfoundland and Labrador Department of Environment and Conservation) (1992). Water Resources Atlas of Newfoundland. Retrieved from Municipal Affairs and Environment: https://www.mae.gov.nl.ca/waterres/cycle/hydrologic/atlas.html

NL-EHJV (Newfoundland and Labrador Eastern Habitat Joint Venture). (2008). Eastern Habitat Joint Venture five year plan for the implementation of the North American Waterfowl Management Plan in Newfoundland and Labrador (2008-2012). Newfoundland and Labrador Eastern Habitat Joint Venture. St. John's. 50pp + Appendices. Available at: https://www.ehjv.ca/ehjv-content/uploads/2013/11/NS-Implementation-Plan.pdf. Accessed February 5, 2019.

PAA (Protected Areas Association). (2008). Central Newfoundland Ecoregions – Red Indian Lake Subregion. Parks and Natural Areas Division. Available at: http://ww.flr.gov.nl.ca/publications/parks/ecoregions/island_2b_red_indian_lake.pdf. Accessed January 31, 2019.

Piercey, S.J., Squires, G.C. and Brace, T.D. (2014). Lithostratigraphic, Hydrothermal, and Tectonic Setting of the Boundary Volcanogenic Massive Sulfide Deposit, Newfoundland Appalachians, Canada: Formation by Subseafloor Replacement in a Cambrian Rifted Arc. Economic Geology, v. 109, p. 661-687.

Pollock, J.C., Wilton, D.H.C., and Van Staal, C.R. (2002). Geological Studies and Definitions of the Tally Pond Group, Victoria Lake Supergroup, Exploits Subzone, Newfoundland Appalachians, In Current Research, Newfoundland Department of Mines and Energy, Geological Survey, Report 02-1, Pages 155-167, 2002.

Porter, T.R., L.G. Riche and G.R. Traverse. (1974). Catalog of Rivers in Insular Newfoundland. Environment Canada Fisheries and Marine Science. Data Record Series Number NEW/D-74-9.

Sandeman H.A., Rafuse H. and Copeland D. (2010). The setting of orogenic auriferous quartz veins at the Golden Promise prospect, central Newfoundland, and observations on veining and wall-rock alteration; St. John's, Newfoundland Department of Natural Resources, Geological Survey, 16 p.

Serpa, C., M. Batterson and K. Guzzwell. (2009). The Influence of Bedrock and Mineral Occurrences on Arsenic Concentrations in Groundwater Wells in the Gander Bay Area, Newfoundland. Newfoundland and Labrador Department of Natural Resources Geological Survey, Report 09-1. Pp. 315-337.

Stantec (2020a). Valentine Gold Project – Environmental Impact Statement – Baseline Study Appendix 5: Acid Rock Drainage / Metal Leaching (ARD/ML) (BSA.5). Final Report prepared for Marathon Gold Corporation. File No: 121416408. September 25, 2020.

Stantec (2020b). Valentine Gold Project (VGP) – Water Quantity and Water Quality Modelling Report: Leprechaun Complex and Processing Plant & TMF Complex. Final Report prepared for Marathon Gold Corporation. File No: 121416508. September 23, 2020.

Stantec (2019a). Valentine Gold Project: 2019 Vegetation Baseline Study – Results of the 2019 Rare Plant Survey. Prepared for: Marathon Gold Corporation.

Stantec (2019b). Valentine Gold Project: 2019 Avifauna Baseline Study – Results of the 2019 Songbird and Common Nighthawk Surveys. Prepared for: Marathon Gold Corporation.

Stantec (2019c). Valentine Gold Project: 2019 Aquatic Study. Prepared for: Marathon Gold Corporation.

Stantec (2019d). Valentine Lake Project: Preliminary Baseline Hydrogeology Assessment, Water Level Data. Prepared for Marathon Gold Corp.

Stantec (2017). Valentine Gold Project: Preliminary Baseline Hydrogeology Assessment. Prepared for Marathon Gold Corp.

Staples, P., Schulte, M., Farmer, R., Eccles, R., Merry, P., Smith, S., Deering, P. (2020). N.I. 43-101 Technical Report & Pre-Feasibility Study on the Valentine Gold Project. Ausenco Engineering Canada, April 21, 2020.

Statistics Canada. (2017). Census Profile. 2016 Census. Statistics Canada Catalogue no. 98-316-X2016001. Ottawa. Released November 29, 2017. Available at: https://www12.statcan.gc.ca/census-recensement/2016/dp-pd/prof/index.cfm?Lang=E. Accessed April 2020.

Swinden, H.S., Evans, D.T.W. and Kean, B.F. (1991). Metallogenic framework of base and precious metal deposits, central and western Newfoundland; Geological Survey of Canada, Open File Report 2156, 245 p.

Terrane Geoscience Inc. (2021). Feasibility Geotechnical Investigation: Marathon and Leprechaun Deposits. Draft Report prepared for Marathon Gold Corporation. Project No. 20-0052-H. January 8, 2021.

Terrane Geoscience Inc. (2020). “Pre-Feasibility Geotechnical Investigation: Marathon and Leprechaun Deposits”. Draft Report, February 18, 2020. 212p

Terrane GeoScience Inc. (2019). Feasibility Geotechnical Investigation: Marathon & Leprechaun Deposits - Draft. Issued November 14, 2019. Prepared by Gilman, Tony & Kruse, Stefan & Guest, Andrew. Halifax, NS.

Thornthwaite, C.W. 1948. An approach toward a rational classification of climate. Geographical Review v. 38, p. 55-94.

Thornton, D.M. (2009). The application of Electronic Monitors to Understand Blast Movement Dynamics and Improve Blast Designs. Blast Movement Technologies, 2009

Tuach, J., Dean, P.L, Swinden, H.S., O’Driscoll, C.F., Kean, B.F. and Evans, D.T.W. 1988: Gold mineralisation in Newfoundland: A 1988 review. In Current Research. Government of Newfoundland and Labrador, Department of Mines, Mineral Development Division, Report 88-1, p. 279-306.

Van Staal, C.R., P. Valverde-Vaquero, A. Zagorevski, N. Rogers, C.J. Lissenberg, and V.J. McNicoll, (2005). Geology, Victoria Lake, Newfoundland and Labrador; Geological Survey of Canada, Open File 1667, scale 1:50 000.

Veinott, G.I., Robertson, M.J., Bradbury, I., Dempson, J.B., Grant, C., Kelly, N., Whalen, J., and Poole, R. 2018. Status of Atlantic Salmon (Salmo salar L.) stocks within the Newfoundland and Labrador Region (Salmon Fishing Areas 1-14B), 2016. DFO Can. Sci. Advis. Sec. Res. Doc. 2018/008. v + 38 p. Available at: http://publications.gc.ca/collections/collection_2018/mpo-dfo/fs70-6/Fs70-6-2018-034-eng.pdf

Wardle, R.J. (2005). Compiler: Mineral commodities of Newfoundland and Labrador: Gold. Newfoundland and Labrador Department of Natural Resources Geological Survey, Mineral Commodities Series, Number 4, 15 p.

Woods, G. (2009). Technical Report, 2005-2008 Exploration Programs, Valentine Lake Gold District, A Joint Venture with Richmont Mines Inc., central Newfoundland, NTS 12A/06 and 12A/07, March 23, 2009.

27.1.2 Personal Communication

Adams, B. Director, Wildlife Division, Newfoundland and Labrador Department of Fisheries and Land Resources, E-mail communication to Marathon Gold, July 2020.