TECHNICAL REPORT
PRELIMINARY ECONOMIC ASSESSMENT OF THE

VALENTINE LAKE GOLD PROJECT

NEWFOUNDLAND, NL, CANADA

Prepared by Lycopodium Minerals Canada Ltd in accordance with the requirements of National Instrument 43-101, "Standards of Disclosure for Mineral Project", of the Canadian Securities Administrators

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1.0 SUMMARY

1.1 Overview

This Technical Report was prepared by Lycopodium Minerals Canada Ltd (Lycopodium), with input from John T. Boyd Company (BOYD), Apex Geoscience Ltd., and Stantec for Marathon Gold to summarize the results of a Preliminary Economic Assessment (PEA) of the Valentine Lake Project (the Project). The Project is located in the west-central region of the island of Newfoundland, NL, Canada.

For the purpose of this Technical Report, gold bearing rock that is processed to recover gold is referred to as "material".

1.2 Accessibility, Climate, Local Resources, Infrastructure and Physiography

The Property is accessed by a 73 km well-maintained year-round gravel road from the Town of Millertown to the northeast end of the Property. Millertown is situated 10 km by paved road off the Buchans Highway which provides paved road access to the Trans-Canada Highway, which transects the island of Newfoundland from east to west and connects the major populated centres.

The Project is located in the Central Uplands of Newfoundland, 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.

Maximum elevation on the Property is 480 m above sea level (masl), with lower ground on the flanks of the ridge to the northwest and southeast. The minimum elevation on the property is 320 masl and represents the level of the Victoria Lake in the south-western part of the property. Victoria Lake is a hydroelectric reservoir.

Marathon Gold has constructed an exploration camp in the southeast of the property proximal to the shoreline of Victoria Lake. The camp is powered by diesel generators and back-up generators, and includes accommodation, messing, cold/dry storage, core cutting, core storage and office facilities. A network of permitted and gated access roads from the camp to each prospect has been progressively developed by Marathon Gold and their predecessors.

Marathon Gold does not control surface rights at the property. Title to surface rights will be obtained by Marathon Gold when the company applies for and is issued a mining lease prior to any potential mining activities.

1.3 History

The Property has historically been explored by several companies since the 1960s (Table 1.1). 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 Property was first recognized as a gold prospect by Abitibi Price Inc. in 1983 and was acquired by BP Canada Inc. in 1985. Noranda Inc. acquired the Property from BP Canada Inc. in 1992, prior to entering into a joint venture agreement with Mountain Lake Resources in 1998.

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 - 2010	Mountain Lake Resources Inc.
2010 - 2011	Marathon PGM Corporation
2011 - Present	Marathon Gold Corporation

1.4 Geology and Mineralization

The Property is located within the Newfoundland Appalachians, which formed during closure of the Iapetus Ocean in the Cambrian to Ordovician, resulting in the accretion of Laurentia and Gondwana (Piercey et al., 2014). Newfoundland is divided into four major tectonostratigraphic zones which are juxtaposed by major regional sutures. From west to east, the Zones include the Humber Palaeozoic continental margin, the Dunnage Cambro-Ordovician mobile belt, the Gander Ordovician volcano-sedimentary sequence, and the Avalon Devonian sedimentary group. Granitoid and mafic intrusions were emplaced during the Devonian and intrude all four major tectonic subdivisions.

The Dunnage Zone hosts the Project and is characterized by island arc volcano-sedimentary sequences and ophiolite lenses that formed during the Middle to Late Ordovician, Taconic, and Penobscot orogenies. The Dunnage Zone is subdivided into the Notre Dame and Exploits subzones, which represent the Laurentian and Gondwana margins, respectively. 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 mineralization 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 in, intrusive bodies. The Dunnage Zone is also host to the past producing Buchans and Duck Pond copper-zinc volcanogenic massive sulfide (VMS) deposits and several other VMS occurrences. The authors have been unable to verify these historical deposits, and therefore, the deposits are not necessarily indicative of the mineralization the property that is the subject of this report.

Four gold deposits and several gold prospects and occurrences at earlier stages of exploration have been discovered to date over a total strike length of 20 km of the Property. Mineralization is hosted almost entirely within the Valentine Lake Intrusive Complex (VLIC), and is associated at a project scale with poorly defined second and third order splay faults off the Valentine Lake Thrust Fault. This major fault system appears to have

acted as a pathway and loci for gold-mineralizing fluids. The VLIC occurs at a major flexure in the Valentine Lake Thrust Fault, and deformation associated with sinistral shear along this thrust is inferred to have been a major factor in the structural control on gold deposition at the Valentine Lake Project.

The Leprechaun, Marathon, Sprite, and Victory gold deposits are the most advanced within the Property, with other gold prospects at the Frank, Rainbow, Triangle, Victoria Bridge, Narrows, and Victory NE occurrences located intermittently proximal to the contact between the VLIC and the Rogerson Lake Conglomerate. All the gold occurrences share similar general characteristics, where gold mineralization is associated with dominantly extensional and lesser shear parallel QTP veins hosted within trondhjemite and quartz porphyry sub-units of the VLIC.

1.5 Mineral Processing and Metallurgical Testing

Metallurgical testwork programs were conducted on mineralized samples from the Valentine Lake Gold Camp between 2006 and 2018. The majority of the testwork programs were carried out for the Leprechaun deposit, with Marathon deposit included in more recent testwork. Thus far, no representative samples from the Sprite or the Victory deposits have been tested, although all the gold occurrences for these deposits share similar general characteristics, where gold mineralization is associated with quartz-tourmaline-pyrite (QTP).

The following testwork programs has been conducted to date:

- 2006 preliminary scoping tests by Laboratoire LTM Inc. (LMT).
- 2010 preliminary testwork program by G&T Metallurgical Services (G&T).
- 2011 preliminary gold recovery flowsheet development by G&T.
- 2014 preliminary assessment of gold processing options by Thibault & Associates Inc. (Thibault).
- 2016 Marathon deposit flowsheet assessment by Thibault & Associates Inc.
- 2018 Testwork on Marathon Gold, Valentine Lake Project Samples (in-progress at SGS).

Lycopodium was directed by Marathon Gold to utilize the data from the Thibault reports (2014 and 2016) and the interim SGS testwork results for the PEA, as they contain the latest metallurgical testwork results for Leprechaun and Marathon deposits.

Table 1.2 presents a summary of the overall gold recovery options tested for the various flowsheets.

Table 1.2 Overall Gold Recovery for Various Flowsheet Options

Flowsheet Option	Unit Operation (Gold Recovery %)	Unit Operation (Gold Recovery %)	Unit Operation (Gold Recovery %)	Overall Gold Recovery
Option 1 (Minimum)	Flotation – FL-05 to FL-18 (94.7%)	Cyanidation of Flot. Conc. – CN-LEA-07 (91.0%)	N/A	86.1%
Option 1 (Maximum)	Flotation – FL-05 to FL-18 (94.7%)	Cyanidation of Float Conc. – CN-LEA-17 (98.6%)	N/A	93.4%
Option 2 (Minimum)	Flotation – FL-05 to FL-18 (94.7%)	Cyanidation of Flot. Conc. – CN-LEA-07 (91.0%)	Cyanidation of Flot. Tails – CN-LEA-11 (88.8%)	90.8%
Option 2 (Maximum)	Flotation – FL-05 to FL-18 (94.7%)	Cyanidation of Flot. Conc. – CN-LEA-17 (98.6%)	Cyanidation of Flot. Tails – CN-LEA-11 (88.8%)	98.1%
Option 3	Gravity Recovery – KN-01 (59.4%)	Cyanidation of Gravity Tails – CN-LEA-10 (88.4%)	N/A	95.3%

A combined gold recovery of 93.4% was achievable for Option 1 when using the most aggressive leach conditions. The highest overall gold recovery for Option 2 of 98.1% was achieved by using the most aggressive concentrate leach conditions tested along with leaching of the flotation tailings. Maximizing the gold extraction using Option 2 may be justified, as long as the concentrate leach tails could be used as the source of cyanide and the additional capital cost of the tailings leaching circuit was low enough to provide a net improvement from the revenue increase. The use of gravity recovery followed by direct tailings leaching also provided an attractive gold recovery at 95.3% with Option 3. The cyanide addition in this case was similar to the flotation concentrate leach Option 1. Tests to optimize cyanide concentration in the leaching of gravity tailings were not conducted and further decreases in cyanide use for gravity tailings may still be possible. The direct leach of gravity tailings in Option 2 may provide similar or higher gold recoveries as Option 1, using flotation pre-concentration; however, additional capital will be required in Option 3 based on a larger cyanide leach circuit.

Lycopodium believes that gravity recovery of gold ahead of flotation in any option would likely improve overall recovery, reduce the amount of gold to be loaded on carbon, reduce in-plant gold inventory, and lead to greater circuit stability.

Initial tests on the Marathon low grade and Leprechaun low grade samples indicate that there is good potential for gold in lower grade material to be recovered by heap leaching. Bottle rolls tests were conducted on crushed material to determine leachability and reagent requirements. The crushed material bottle roll leach tests indicated similar gold leachability for head grades ranging from 0.34 to 1.84 g/t gold. In addition, short column leach tests with continuous cyanide solution irrigation for 130 days were conducted at two different crush sizes. Results for the short column leach tests are as follow:

- Leprechaun low grade (LG) – 72.7% (minus ½”), 69.6% (minus ¾”).
- Marathon LG – 66.0% (minus ½”), 53.9% (minus ¾”).

The results also showed that the Leprechaun LG sample was more leachable than the Marathon LG sample. The Marathon LG sample appeared to be more sensitive to the crush size, and it was observed that a ½” or finer crush size would improve gold recovery.

The milling recovery equations were kept the same as the ones used in the PEA published on 13 July 2018. However, the heap leach recovery equations were amended upon receiving interim column leach results from the 2018 SGS program. The overall heap leach recovery for the combined Marathon and Leprechaun material increased from ~53.5 to ~60% by using the amended equations.

1.6 Mineral Resource

BOYD's Mineral Resource estimate for the deposit is provided in Table 1.3.

Table 1.3 Undiluted 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

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.

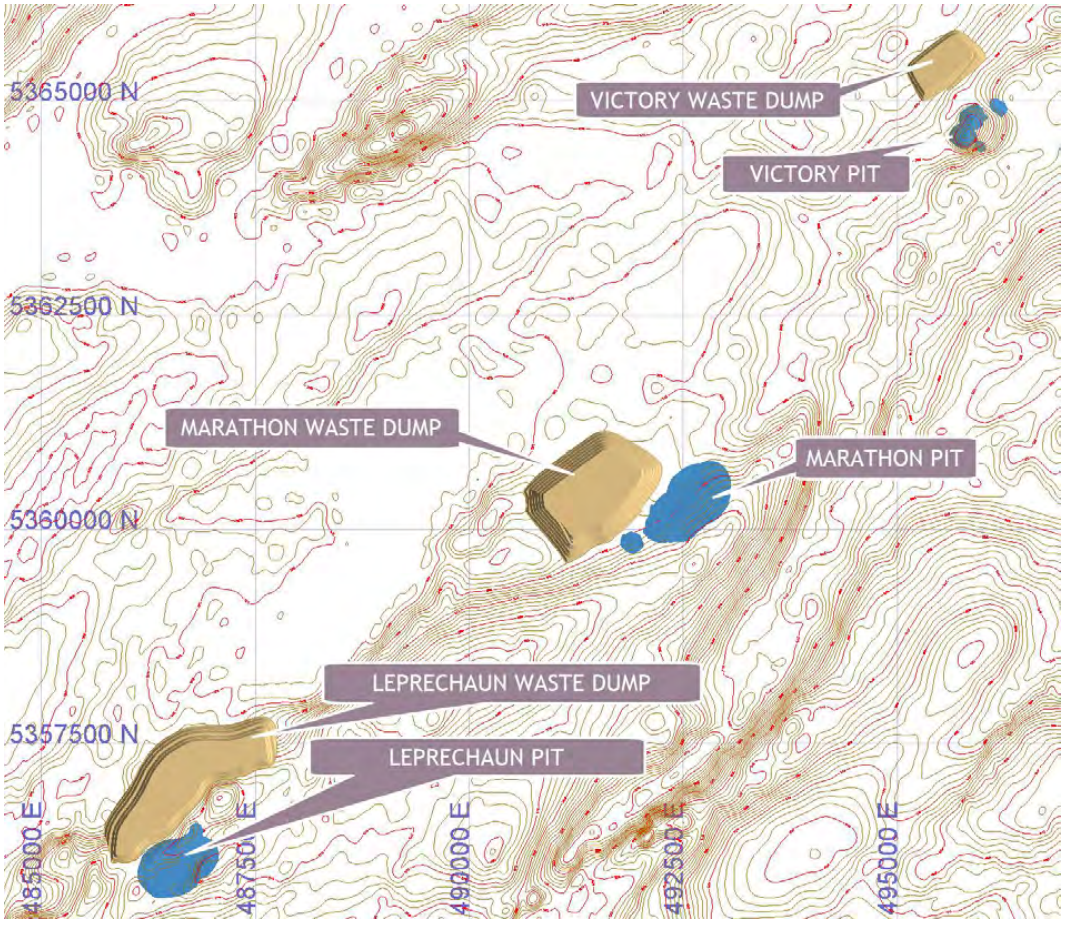
2. Mineral Resources are calculated at a gold price of $1,250 /troy oz.

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 mineralized 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 mineralized 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.**

1.7 Mining

The Project comprises four potential mining areas: Leprechaun in the southwest, the Sprite Zone adjoining Leprechaun towards the northeast, the Marathon deposit located about 4.1 km northeast of the Sprite Zone, and the Victory Deposit located 5.5 km northeast of the Marathon Deposit. These four mining areas are shown below in Figure 1.1.

Figure 1.1 Valentine Lake PEA Mining Locations



For this updated PEA, BOYD only considered surface mining methods for each of the deposits. In the previous PEA, BOYD determined that additional deep exploration drilling was required in order to complete an underground stope optimization. Since the completion of the last PEA, the additional exploration drilling has been confined to areas that would potentially be developed using surface mining techniques. As a result, potentially underground-mineable mineral resources have been excluded from the PEA. Ultimate pit limits were developed for the four deposits using the pit optimization process described below. Based on these initial results, mineral resources for the Sprite Zone have been excluded from the PEA until further exploration drilling and resource modelling can be completed. As a result, only potentially surface-mineable mineral resources from the Leprechaun, Marathon, and Victory deposits have been considered in this PEA.

The PEA assumes that standard surface mining techniques will be utilized to create an open pit within each of the three mining areas. The Leprechaun pit design comprises four mining phases and has maximum approximate dimensions of 900 m southwest to northeast by 600 m southeast to northwest, and a maximum depth of 300 m below current ground level. The Marathon pit design includes seven mining phases with one phase being a small standalone pit slightly southwest of the main Marathon pit. The Marathon pit has approximate dimensions of 1,200 m southwest to northeast by 700 m southeast to northwest and a maximum depth of 400 m below current ground level. The Victory pit design consists of four mining phases with one small

pit located slightly northeast of the main Victory pit. The Victory pit has approximate dimensions of 540 m southwest to northeast by 280 m southeast to northwest, and a maximum depth of 130 m below current ground level. Design of all of the pits was guided by the Whittle optimization process described in Section 16.1.2.

Marathon Gold will have responsibility for site preparation, haul road construction and maintenance, production drilling and blasting, the excavation and haulage of material and waste, management of material stockpiles, oversize breakage, pit dewatering, and haul road maintenance. Marathon Gold will provide the open-pit equipment, operator training, supervision, pit technical support services, mine consumables, and the pit operations and maintenance facilities. The manufacturer, per the terms and conditions of a standard maintenance and repair (MARC) agreement, will supply mine maintenance personnel. Specialized contractors will provide explosives storage on site. Established suppliers will provide explosives, blasting agents, fuel, and other consumables.

The ultimate pit designs developed for each of the three mining areas of the Valentine Lake Gold Project are based on the results of the Whittle pit optimization work. To approximate the optimal extraction sequence, the three mining areas are planned to be developed using a total of 15 distinct mining phases. Pit design parameters, such as wall slope angles and bench dimensions, were provided by Stantec. A mine production schedule for the entire complex was prepared by BOYD using Maptek's Chronos scheduling software.

1.8 Recovery Methods

The process plant design is based on a robust metallurgical flowsheet developed for optimum recovery while minimizing initial capital expenditure and operating costs. The flowsheet is based on unit operations well proven in the industry.

The Valentine Lake Project consists of two gold process plants, i.e. a Milling/Flotation/Carbon in Leach plant (Mill) and a Heap Leach plant. Both plant designs are based on a 13-year mine life.

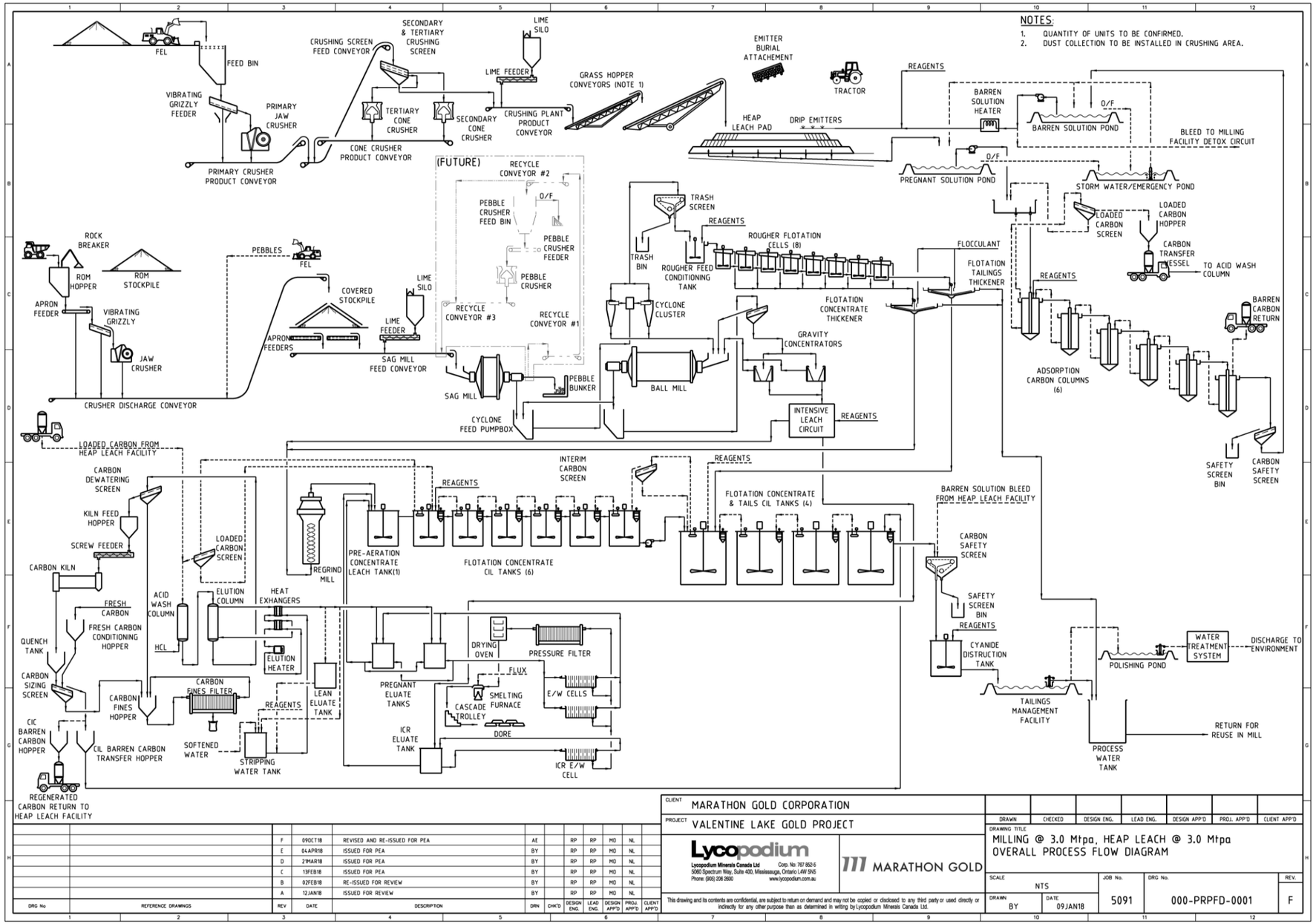
The Mill will process 3.0 Mtpa of high-grade material from open pit mines. The Mill will consist of crushing, milling, gravity recovery, flotation of gravity tails, flotation concentrate regrind, cyanidation of both flotation concentrate and flotation tailings via a carbon in leach (CIL) circuit, carbon elution and gold recovery circuit. CIL tails will be treated for cyanide destruction and disposed of as tails in the tailings storage facility (TSF). The Heap Leach plant will process 3.0 Mtpa of low-grade material from open pit mines and will consist of crushing, heap leaching and carbon-in-column (CIC) gold adsorption. The loaded carbon from this heap leach facility will be sent in carbon transport vessels to the milling facility for further processing in the elution circuit.

The key project design criteria for the plants are:

- Nominal throughput of 9,000 t of material per day for milling facility and 9,000 t of material per day for heap leach facility, equivalent to 6.0 Mtpa.
- Crushing plant availability of 75% for both flotation and heap leach plants.
- Plant availability of 91.3% for heap leach solution circulation, CIC area, grinding, gravity concentration, flotation, and leach plant and gold recovery operations.

An overall process flow diagram depicting the unit operations incorporated in the selected process flowsheet is presented in Figure 1.2 below.

Figure 1.2 Overall Process Flow Diagram



1.9 Infrastructure

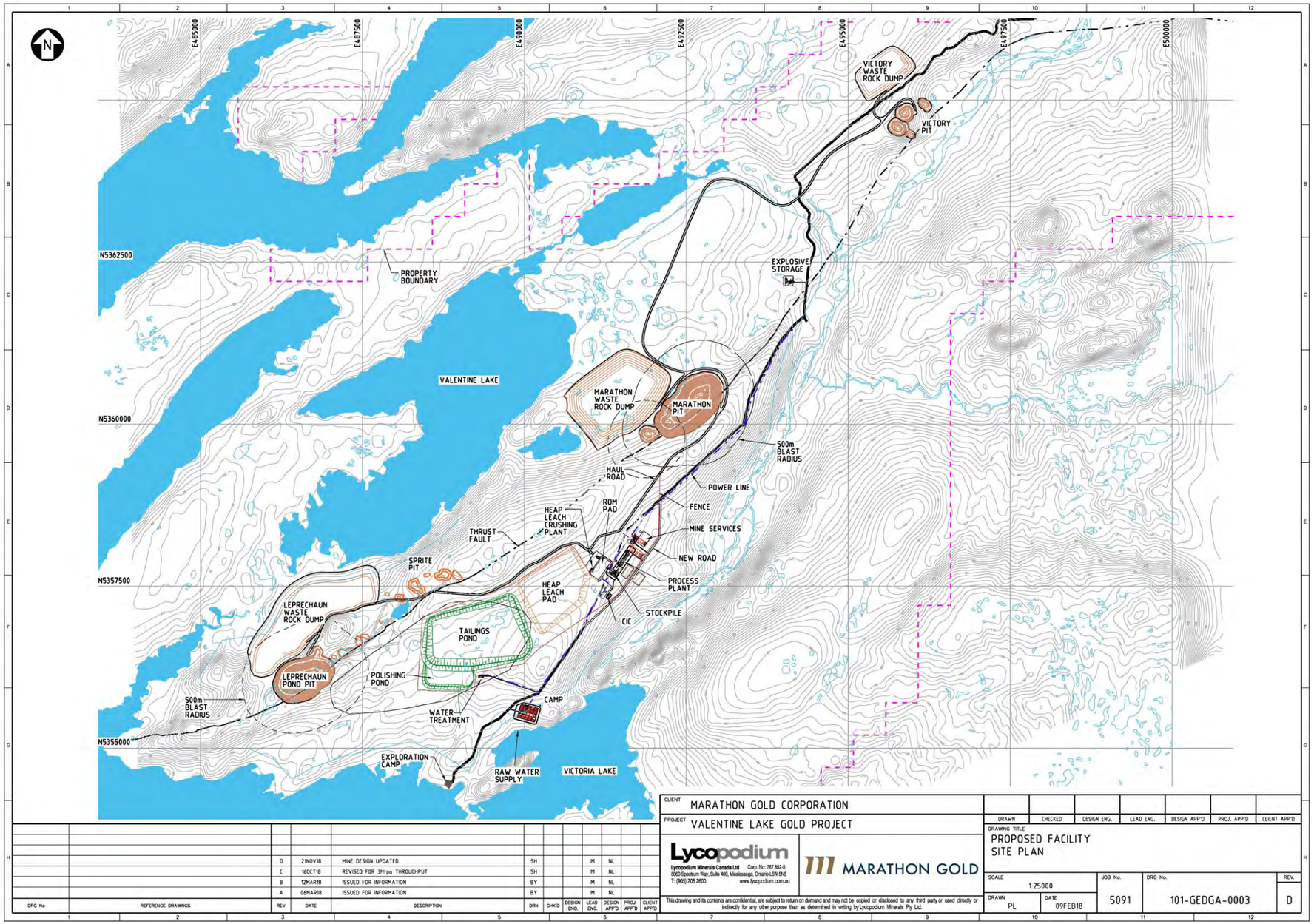
The overall site plan is shown in Figure 1.3 and includes major facilities of the Project including open pit mines, heap leach and milling/flotation/CIL processing plants, TSF, heap leach pad (HLP), waste rock facilities, polishing pond, mine services, access road, accommodations camp and waste water treatment plant.

Access to the facility is from the northeast side of the property off the existing access road. Main access will be via the main security gate near the process plant.

Grid power will be provided from an incoming HV line from the northwest side of the property.

The site as a whole will be fenced to clearly delineate the mine area and deter access by unauthorized people.

Figure 1.3 Overall Site Plan



1.10 Environmental Studies, Permitting and Social or Community Impact

The Project is located in rural central Newfoundland, in the Central Newfoundland Forest Eco region, which covers most of the central and northeastern portions of the Island. This part of the Island is characterized 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.

The Project will be subject to the Newfoundland and Labrador Environmental Protection Act, associated Environmental Assessment Regulations, and the Canadian Environmental Assessment Act, 2012. The Project will also require standard environmental permits and approvals including water use authorizations, fish and fish habitat authorization, emissions and discharge approvals, and approvals for infrastructure placement within the Project. These approvals can only be applied for once the Project has been released from Environmental Assessment (EA). In support of the Project and the EA process, numerous baseline environmental studies have been completed and additional surveys and studies are planned for the upcoming field season.

The TSF and HLP locations have been selected to reduce the potential risk to the surrounding environment by placing them in close proximity to the mill and in areas that have low potential for impacting major water bodies and fish habitat. The TSF will consist of earth embankment structure with a maximum dam height of 40 m. The HLP will consist of a double lined pad for leak detection and containment and have material placed in 10 m lift terraces with a maximum overall thickness of 40 m.

Rehabilitation and closure planning are a requirement under the Newfoundland and Labrador Mining Act. A complete plan has not been developed for the Valentine Lake Gold Project. This will be completed as part of the EA process, and will describe the proposed methods to restore the site to as close to pre-development conditions as practicable or to a suitable condition for an alternate use upon Project closure. It will outline the methods to be used for progressive and closure rehabilitation, and post-closure monitoring and required treatment.

Marathon is committed to sustainable exploration and development of Newfoundland and Labrador's rich resource potential, and realize the importance of building strong, long-term relationships and investments in people and communities. A key element to this is to actively consult with members of the general public and special interest groups, communities, Indigenous groups, associations, and regulators who have interest in or may be affected by the Project. Throughout the life of the Valentine Lake Project, Marathon aims to achieve positive and constructive relationships with all stakeholders. They currently have Procurement and Community Relations Policies which are being used to guide the development of the Consultation Strategy that will develop and strengthen stakeholder relationships.

1.11 Capital and Operating Costs

The capital estimate for the Project is summarized in Table 1.4. All overall costs are expressed in United States Dollars ($) unless otherwise stated, and are based on Q3 2018 pricing and deemed to have an accuracy of ±35%. The capital cost estimate conforms to AACEI (Association for the Advancement of Cost Engineering International) Class 5 estimate standards as prescribed in recommended practice 47R11.

The capital cost estimate was based on an engineering, procurement, and construction management ("EPCM") implementation approach and typical construction contract packaging. Equipment pricing was based on quotations and actual equipment costs from recent similar Lycopodium projects considered representative of the Project.

Table 1.4 Capital Estimate Summary by Area (Q3 2018, ±35%)

Area	$ Including Contingency/Excluding Duties and Taxes
000 Construction In-directs	$21,257,000
100 Treatment Plant Costs - Heap Leach Circuit	$47,626,000
100 Treatment Plant Costs - Milling Circuit	$92,739,000
200 Reagents & Plant Services - Heap Leach Circuit	$4,030,000
200 Reagents & Plant Services - Milling Circuit	$21,355,000
300 Infrastructure	$73,192,000
400 Mining[#]	$56,231,000
500 Management Costs	$22,434,000
600 Owners Project Costs	$16,440,000
Subtotal Directs	**$355,303,000**

[#]Mining capital costs are based on leased mining equipment and the initial capital is a 30% down payment of the mine fleet. This cost includes mine services and pre-production stripping.

The operating costs for the facilities are summarized in Table 1.5. The PEA estimates that the Project will produce approximately 2,723,300 oz of gold during the life of the Project, or an average of 225 koz/y for Years 1 to 12.

Mine operating costs were calculated from first principles using vendor-supplied estimates and BOYD's experience with similar mining operations. Fuel costs were calculated based on vendor-provided fuel consumption and a vendor quote for diesel of $0.943 /L. Over the life of the Project, overall mining operating costs, excluding rehandle, are estimated to be $2.099 /t mined.

The process plant operating costs were developed by Lycopodium based on a design processing rate of 3.0 Mtpa of material for the milling circuit, and 3.0 Mtpa of material for the heap leach circuit. Both circuits will normally operate 24 hrs/day, and 365 days/y with 75% (6,570 hrs/y) crushing plant availability and 91.3% plant utilization (nominal 8,000 hrs/y operation). The process operating costs for the Project have been developed in detail according to typical industry standards applicable to gold material processing plants.

Table 1.5 Operating Cost Summary (Q3 2018, +35%)

Cost Centre	Total Operating Cost		Proportion of Operating Cost
	$/y	$/t Material	
Plant: Milling[1]			
Operating Consumables[4]	$22,367,756	$7.46	16.6%
Plant Maintenance	$1,649,092	$0.55	1.2%
Power [5]	$5,514,058	$1.84	4.1%
Laboratory	$82,202	$0.03	0.1%
Labour (O & M)	$3,443,952	$1.15	2.6%
Subtotal - Milling	$33,057,060	$11.02	24.5%
Plant: Heap Leach[2]			
Operating Consumables	$3,745,846	$1.25	2.8%
Plant Maintenance	$787,950	$0.26	0.6%
Power	$592,031	$0.20	0.4%
Laboratory	$20,641	$0.01	0.0%
Labour (O & M)	$2,899,369	$0.97	2.1%
Subtotal - Heap Leach	$8,045,838	$2.68	6.0%
Common[3]			
Labour (G & A)	$1,000,113	$0.17	0.7%
G&A - Expenses	$1,946,840	$0.32	1.4%
Plant Maintenance	$689,953	$0.11	0.5%
Permanent Camp Catering	$2,362,668	$0.39	1.8%
Permanent Camp Power	$98,279	$0.02	0.1%
Subtotal Common Plant	$6,097,854	$1.02	2.7%
Subtotal - Plant Operating Cost	$47,200,751	$7.87	35.0%
Mining[3]			
Total	$86,683,000	$14.45	64.2%
Subtotal - Mine Operating Cost	$86,683,000	$14.45	64.2%
Water Treatment Plant[3]			
Plant Maintenance	$100,000	$0.02	0.1%
Labour (O & M)	$236,775	$0.04	0.2%
Power	$4,449	$0.00	0.0%
Others including Consumables	$721,580	$0.12	0.5%
Subtotal - Water Treatment Plant	$1,062,804	$0.18	0.8%
Grand Total Operating Cost [3]	$134,946,555	$22.49	100.0%

Notes:

1. **$/t is based on milling material throughput of 3.0 Mtpa.**
2. **$/t is based on heap leach material throughput of 3.0 Mtpa.**
3. **$/t is based on total throughput of 6.0 Mtpa.**
4. **Includes consumables for common elution, carbon regeneration and gold room areas.**
5. **Includes power for elution and carbon regeneration of carbon from heap leach and mill, gold room, and mine surface loads.**
6. **Figures are rounded, and totals may not add correctly.**

1.12 Economic Analysis

A preliminary economic assessment of the Valentine Lake Project has been conducted using a simple pre and after-tax cash flow model prepared by Lycopodium on behalf of Marathon Gold. The model was structured using an EXCEL workbook.

The PEA was prepared in accordance with National Instrument 43-101 Standards of Disclosure for Mineral Projects ("NI 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 categorized as mineral reserves, and there is no certainty that the PEA will be realized. 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.

Input data was provided from a variety of sources, including the various consultants' contributions to this PEA, pricing obtained from external suppliers and contractors, and exchange rates and project specific financial data such as the expected project taxation regime received from Marathon Gold.

The project economics are summarized in Tables 1.6 and Table 1.7.

Table 1.6 Net Profit after Tax Summary

	$M	$/Processed	$/oz Au
Revenue	$3,404	$46.90	$1250
Mine Operating Cost	$1,058	$14.58	$388
Processing Cost	$493	$6.79	$181
G&A Cost	$87	$1.21	$32
Refining Costs	$5	$0.07	$2
Total Operating Cost	**$1,643**	**$22.64**	**$603**
EBITDA	**$1,761**	**$24.26**	**$647**
Capital Costs	$338	$4.66	$124
Gross Profit before tax	**$1,253**	**$17.26**	**$460**
Newfoundland Mining Tax	$148	$2.03	$54
Income Tax Payable	$332	$4.58	$122
Net Profit after tax	**$773**	**$10.65**	**$284**

Table 1.7 Financial Summary

	Value
Revenue from gold	$3,404M
AOC	$603 /oz Au
Initial Capital	$355M
Sustaining capital	$150M
Closure costs/salvage	$20M
Pre-tax economics:	
IRR	44.0%
NPV (5%)	$834M
Payback	1.68 years
Post-tax economics:	
IRR	30.3%
NPV (5%)	$493M
Payback	2.48 years

The project value was assessed by undertaking sensitivity analyses on gold price, gold recoveries, operating costs and capital costs. The results of all sensitivity analyses are presented in Tables 1.8 and 1.9 and in Figures 1.4 and 1.5.

The project is most sensitive to changes in capital and operating costs because of the large range used in measuring their sensitivity. These ranges were chosen to align with the intended accuracy of the capital and operating costs. However, a ±10% change in gold price has a significant impact on the project revenue.

Table 1.8 NPV Sensitivity Analysis (Pre-Tax)

	Lower	Base Case	Higher
Gold Price (±10%)	$577,820,437	$833,705,894	$1,089,591,351
CAPEX (±35%)	$996,491,550	$833,705,894	$670,920,238
OPEX (±35%)	$1,267,486,498	$833,705,894	$399,925,290
Mill Recovery (±2%)	$788,962,601	$833,705,894	$878,449,187
HL Recovery (±10%)	$801,905,376	$833,705,894	$865,506,412

Table 1.9 IRR Sensitivity Analysis (Pre-Tax)

	Lower	Base Case	Higher
Gold Price (±10%)	32%	44%	56%
CAPEX (±35%)	80%	44%	28%
OPEX (±35%)	64%	44%	24%
Mill Recovery (±2%)	42%	44%	46%
HL Recovery (±10%)	43%	44%	45%

Figure 1.4 NPV Sensitivity Analysis (Pre-Tax)

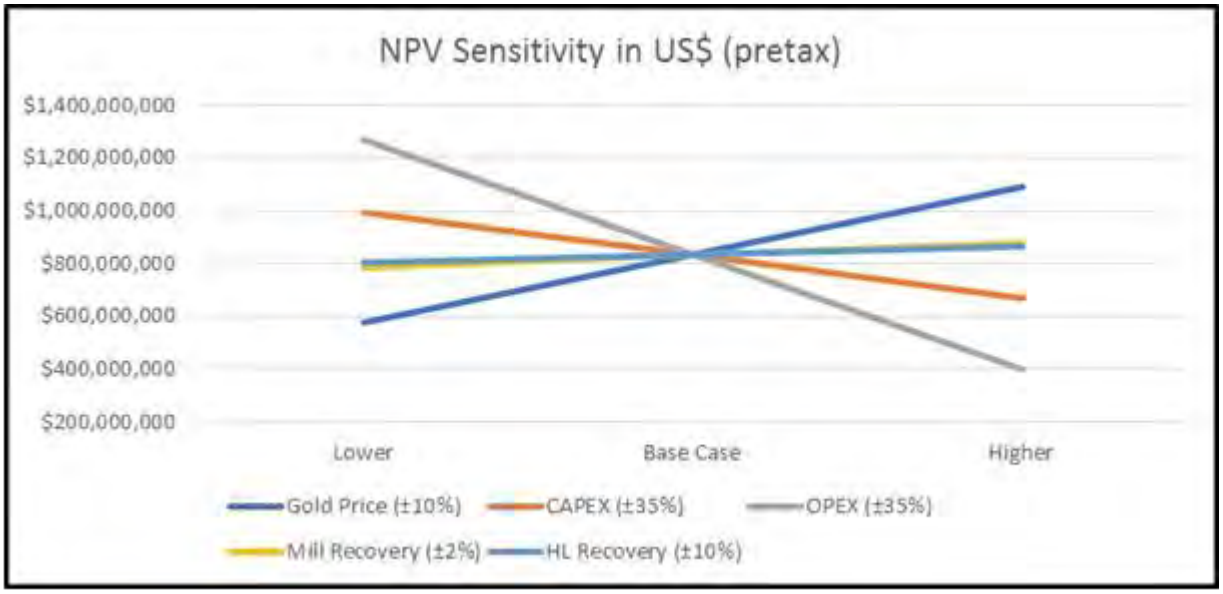
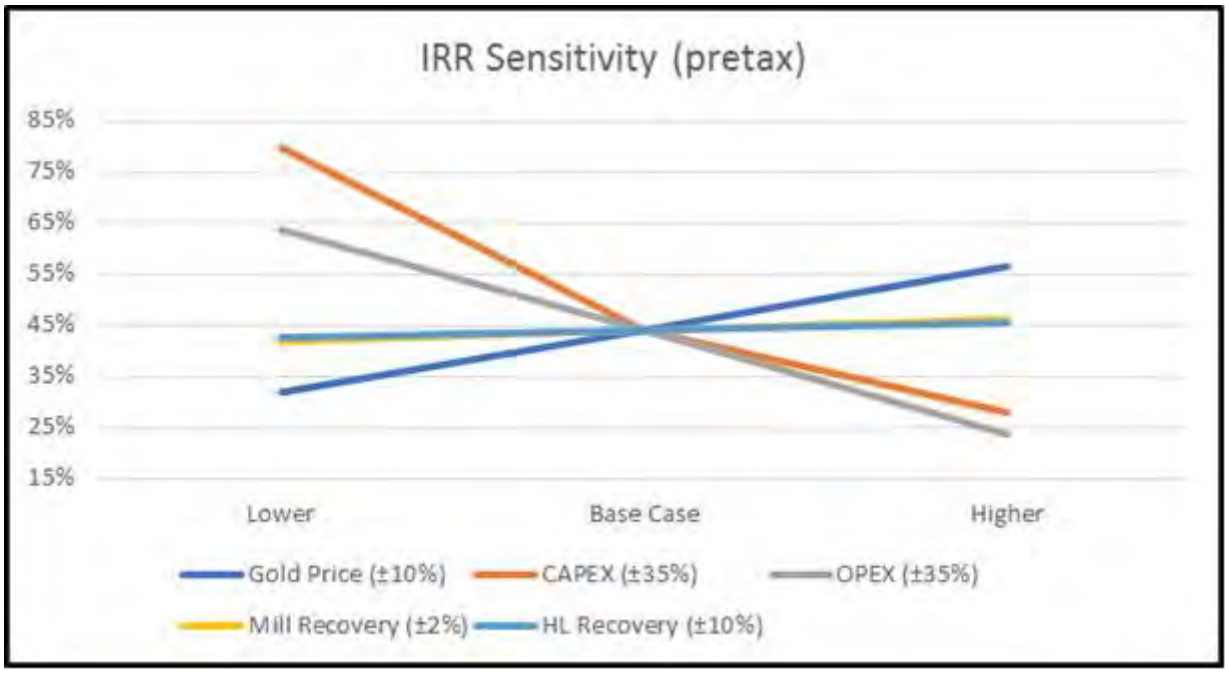


Figure 1.5 IRR Sensitivity Analysis (Pre-Tax)



1.13 Recommendations

1.13.1 Overall

The financial analysis of this PEA demonstrates that the Project has robust economics, and it is recommended to continue developing the project through further engineering and de-risking.

1.13.2 Exploration

It is recommended that additional focused prospecting and trenching, as well as detailed interpretation of the amalgamated aeromagnetic and ground geophysical surveys data is conducted to identify additional potential structural targets for channel sampling and exploratory drill testing.

This work should focus in areas along strike extension of known mineralization and in areas of low magnetic intensity west of, and proximal to, the Valentine Lake Thrust Fault, primarily between the Sprite and Marathon deposits. Ground and downhole IP surveys have been of little to no use to date in identifying new QTP mineralization as there is no distinct chargeability or resistivity signature to the QTP zones relative to host rock. The use of detailed magnetic surveys is much more useful in identifying mag-low alteration zones and brittle deformation zones potentially associated with mineralized systems.

Marathon has planned additional drilling to expand and upgrade the resources at depth and along strike. Geological and geophysical studies indicate the structure hosting gold mineralization may continue both east

and west of the current resources as well as down plunge. Addition of further resources through drilling has the potential to increase the life of mine and resulting economics.

1.13.3 Access Road

It is recommended to further define the scope of the 88 km access road and associated bridges, particularly the bridges over Victoria River. The schedule and sequencing of the road and bridge upgrades is to be defined. A trade-off study with an alternative shorter access road east of the current route should be conducted before entertaining a pre-feasibility study (PFS).

1.13.4 Metallurgical Testwork

It is recommended to continue the ongoing metallurgical testwork program at SGS Lakefield to support a PFS process plant design.

1.13.5 Heap Leach Pad

It is proposed to construct a heap leach pad at the Project site to use for mineral extraction. There have not been any geotechnical site investigations or design studies completed at this time to support this infrastructure on site. It is recommended for the Project to proceed to the PFS stage, that specific geotechnical investigations and design studies be completed.

1.13.6 Tailings Storage Facility

The following activities are recommended to support the design of the TSF for the PFS:

- Further fish sampling to be conducted to confirm fish presence/absence in the waterbodies of interest.
- Condemnation drilling for the selected site to verify the absence of mineralization.
- Geotechnical site investigations at the preferred site to characterize the foundation conditions and potential borrow sources.
- In-situ permeability tests of the overburden soils and bedrock.
- Tailings assessment to help characterize the geotechnical properties in order to understand the deposition characteristics.
- Refinement and further study of the proposed dam alignment and configuration.
- Further evaluation of the dam requirements such as allowable seepage gradients and management of seepage water.

1.13.7 Geotechnical Input for Mine Design

A drill program is recommended to provide geotechnical and hydrogeological data to support a PFS level of design for open-pit and underground mining.

Phase 1 – Geotechnical data collection:

- Training of Marathon staff in geotechnical data collection.
- Testing of relevant core from different lithologies.
- Compilation of the collected geotechnical data into a format suitable for rock slope stability analysis and underground ground control.

Phase 2 – Pit Slope and Underground Mine Design:

- Recommendations for face and inter-ramp pit slope angles.
- Geotechnical input for mining method selection.
- Ground support recommendations.
- Crown pillar assessment between open-pit and underground workings.

1.13.8 Environment, Permitting, and Community Relations

- Pursue environmental approvals, authorizations, and permits required to develop and initiate a mining operation.
- Develop a consultation strategy to engage with all stakeholders of the Project.
- Develop a tracking system to record stakeholder consultation and engagement activities

2.0 INTRODUCTION

2.1 Terms of Reference and Purpose of this Report

This Technical Report was prepared by Lycopodium for Marathon Gold to summarize the results of a Preliminary Economic Assessment (PEA) of the Valentine Lake Project. The report was prepared in compliance with the disclosure requirements of the Canadian National Instrument 43-101 (NI 43-101) and in accordance with the requirements of Form 43-101 F1.

For the purpose of this Technical Report, any gold bearing rock that is processed to recover gold is referred to as "material".

The PEA was prepared in accordance with National Instrument 43-101 Standards of Disclosure for Mineral Projects ("NI 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 categorized as mineral reserves, and there is no certainty that the PEA will be realized. Mineral resources that are not mineral reserves do not have demonstrated economic viability.

The Project is located in the west-central region of the island of Newfoundland, NL, Canada. The Property is accessed by gravel roads from the Town of Millertown, 90 km by road northeast of the Property. Millertown is situated on the paved Buchans Highway which provides good road access to the major Trans-Canada Highway, which transects the island of Newfoundland from east to west and connects the major populated centres.

JT Boyd (BOYD) and Stantec Consulting Ltd. (Stantec) 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 in NI 43-101 for this report. The QPs meet the requirement of independence as defined in NI 43-101.

Table 2.1 Persons Who Prepared this Technical Report

Qualified Persons Responsible for the Preparation of this Technical Report						
Qualified Person	**Position**	**Employer**	**Independent of Marathon Gold**	**Date of Last Site Visit**	**Professional Designation**	**Report Sections**
Neil Lincoln	VP Business Development & Studies	Lycopodium Minerals Canada Ltd	Yes	11 - 12 December 2017	P.Eng	1.1, 1.5, 1.8, 1.9, 1.11-1.13, 2, 13, 17, 18 (except 18.5 - 18.8), 19, 21 (except 21.2 & 21.5), 22, 24, 25.6-25.8, 26, 27.
Robert Farmer	Vice President	John T. Boyd Company	Yes	N/A	P.Eng	1.6, 1.7, 1.11, 14, 15, 16, 21.2, 21.5, 23, 25, 26.
Roy Eccles	Senior Consulting Geologist/COO	Apex Geoscience Ltd.	Yes	11 - 14 October 2017	P.Geo.	1.2-1.4, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 25.5, 26.
Paul Deering	Senior Geotechnical Engineer	Stantec Consulting Ltd.	Yes	N/A	P.Eng.	1.10, 18.5-18.8, 20, 26.5, 26.8.

2.2 Units

All measurement units used in this document are metric and all currencies are expressed in United States Dollars ($) 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

Neil Lincoln visited the site 11 - 12 December 2017, and inspected the proposed open pits, process plants, tailings storage facility, and infrastructure and access road.

Robert Famer has not visited the site.

Roy Eccles visited the site during 11 - 14 October 2017 and can verify: (1) the Property is active and in good standing; (2) material work has been conducted since the last technical disclosure; and (3) the physical and analytical characteristics of the geology and gold mineralization at the Valentine Lake Gold Camp.

Paul Deering has not visited the site.

3.0 RELIANCE ON OTHER EXPERTS

The authors of this report have assumed, and relied on the fact, that all the information and existing technical documents listed in the References chapter of this report 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 subsequent to the effective date of this report.

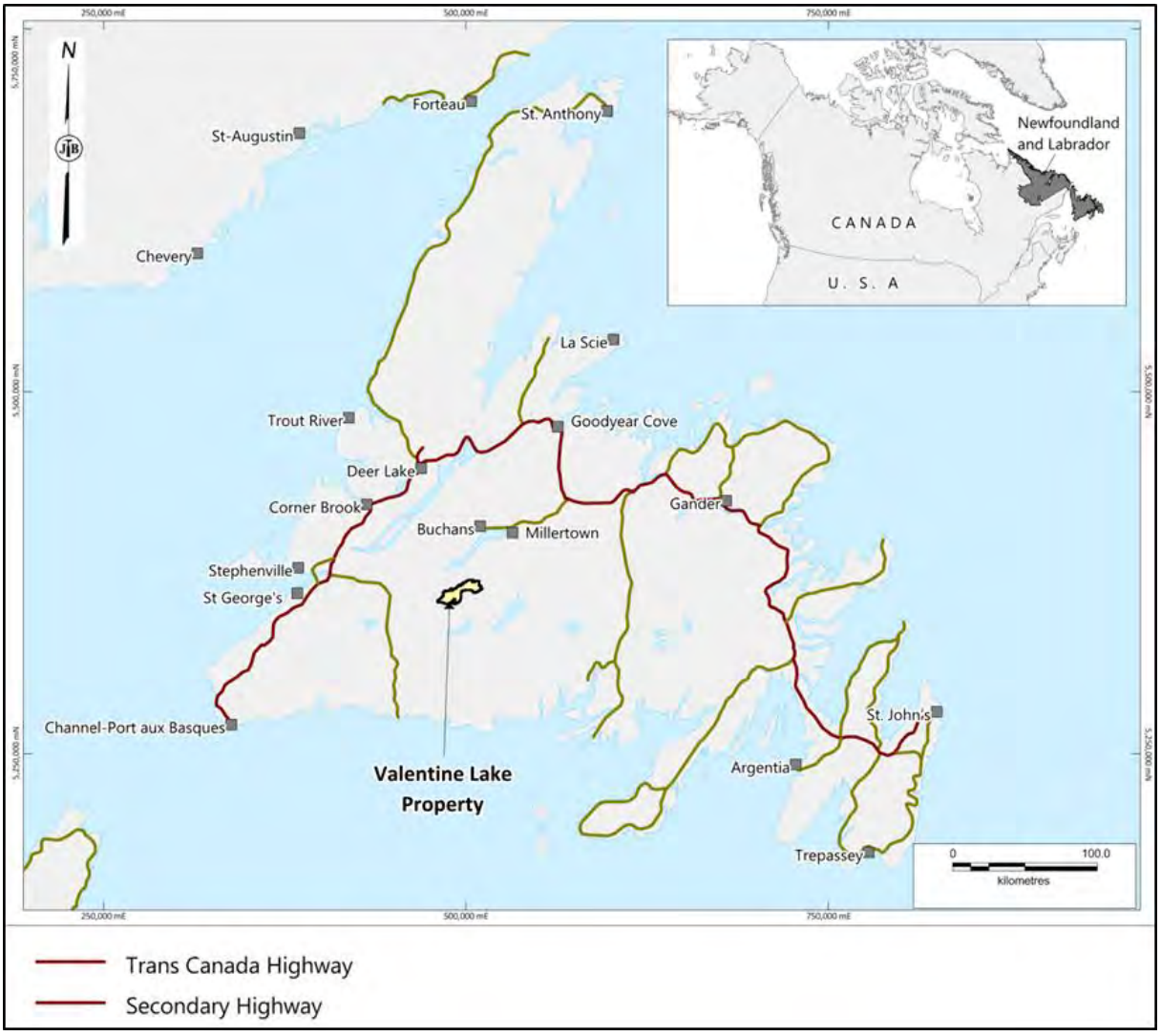
The authors are not experts with respect to legal, socio-economic, land title, or political issues, and are therefore not qualified to comment on issues related to the status of permitting, legal agreements and royalties. Information related to these matters has been provided by directly by Marathon Gold during the preparation of this Technical Report (late-December 2017 and April 2018), 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.

4.0 PROPERTY DESCRIPTION AND LOCATION

4.1 Property Description

The Property is located in the west-central region of the island of Newfoundland, NL, Canada within National Topographic System map sheets: 12A/06 and 12A/07 (Figure 4.1). The center 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). The Property is 100% owned by Marathon Gold and hosts four gold deposits, namely Leprechaun, Marathon, Sprite, and Victory, which are the focus of this report, as well as several other early stage gold prospects. The collective deposits and occurrences are located within a 20 km long northeast trending zone that is known as the Project.

Figure 4.1 Island of Newfoundland and Location of the Valentine Lake Project



4.2 Mineral Tenure

4.2.1 Governance

The Newfoundland and Labrador (NL) 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.

Any number of contiguous mineral licenses may be grouped to form a single mineral license provided that the number of claims grouped does not exceed 256. Additionally, the mineral licenses comprising the group must have passed their first anniversary date or have had first year assessment reports submitted and accepted, and must be in good standing.

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 CAD65; this includes a CAD15 /claim staking fee and a CAD50 /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, provided that annual assessment work is completed, and renewal fees are paid. The minimum expenditure per claim increases year through 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 Summary of Mineral Claim Renewal Fees and Minimum Expenditures in Newfoundland and Labrador

Assessment Year(s)	Minimum Expenditure per Year (CAD per claim)	Renewal Fees (CAD 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, provided that:

- 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 area being applied for.

Mining leases are charged an annual rental of CAD120 /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 un-alienated minerals described in the lease, subject to registration under NL's Environmental Protection Act and 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 the granting of 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

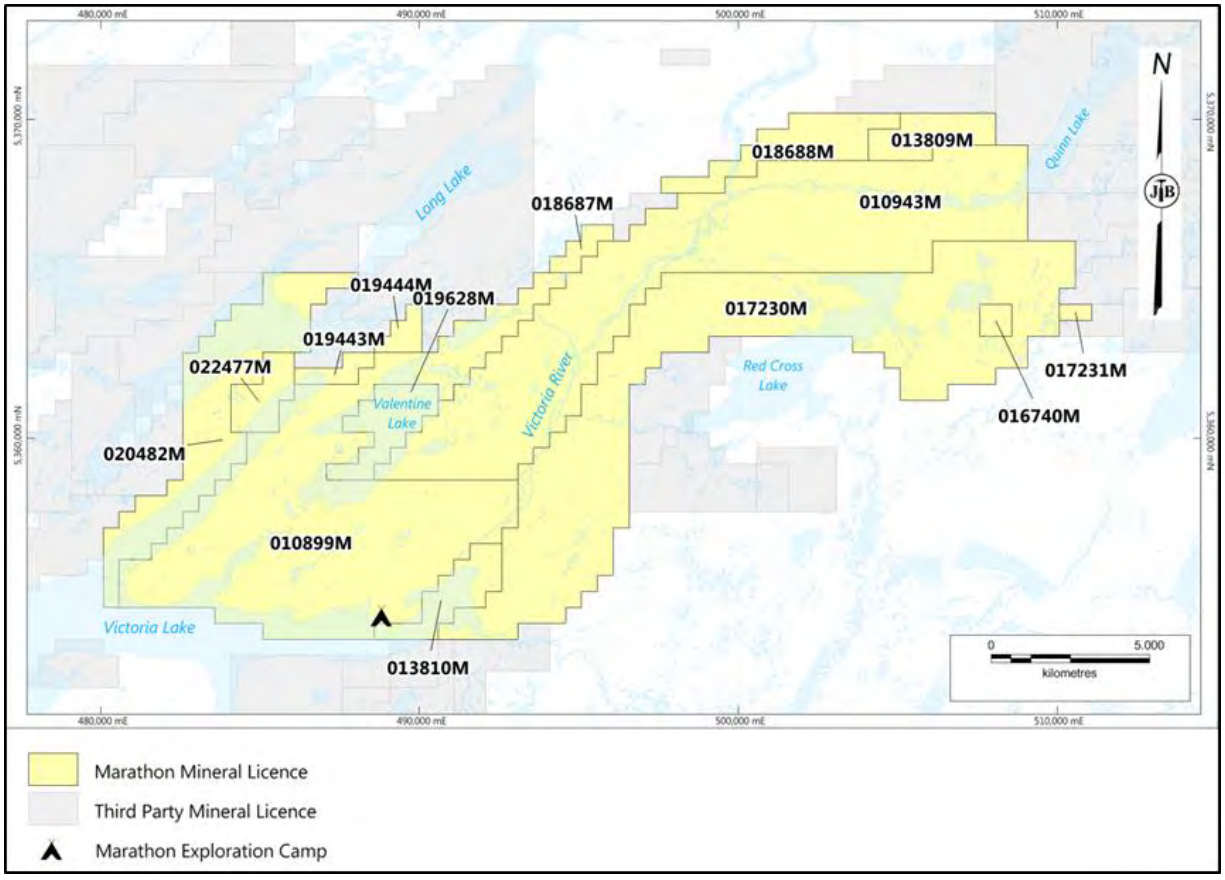
The Valentine Lake Property comprises 14 contiguous mineral licenses, for a landholding of 240 km^2 (see Figure 4.2). The status of the Valentine Lake mineral licenses, numbers, renewal dates, and annual exploration expenditures is shown in Table 4.2. The mineral licenses in Table 4.2 are all 100% controlled by Marathon Gold and are reportedly held in good standing.

Table 4.2 Valentine Lake Property License Summary

License ID	Issuance Date	Years Held	Renewal Date	No. of Claims	Area km^2	Expenditures Required (CAD)	Expenditure Due Date
010899M	27-Apr-04	13	27-Apr-19	246	61.5	492,000.00	28-Apr-25
010943M	27-Apr-04	13	27-Apr-19	256	64	512,000.00	28-Apr-25
013809M	06-Sep-07	10	06-Sep-22	18	4.5	12,814.91	06-Sep-20
013810M	06-Sep-07	10	06-Sep-22	19	4.75	9,165.80	06-Sep-19
017230M	09-Feb-10	7	09-Feb-20	256	64	198,067.58	09-Feb-23
017231M	09-Feb-10	7	09-Feb-20	2	0.5	350.47	09-Feb-22
018687M	29-Mar-11	6	29-Mar-21	6	1.5	4,279.31	29-Mar-23
018688M	29-Mar-11	6	29-Mar-21	29	7.25	9,151.44	29-Mar-22
016740M	26-Nov-09	8	26-Nov-19	4	1	2,054.93	26-Nov-24
019443M	17-Oct-11	6	17-Oct-21	6	1.5	1,634.56	17-Oct-23
019444M	17-Oct-11	6	17-Oct-21	6	1.5	1,634.56	17-Oct-23
019628M	29-Dec-11	6	29-Dec-21	21	5.25	13,548.23	29-Dec-25
020482M	08-Oct-12	5	08-Oct-22	77	19.25	17,303.13	08-Oct-20
022477M	06-Nov-14	3	06-Nov-19	14	3.5	1,670.31	06-Nov-22
			Totals	**960**	**240**	**1,276,039.23**	

Source: Marathon Gold data (DNR website October 29, 2018).

Figure 4.2 Map Showing Marathon Gold Mineral License and Numbers, Valentine Lake Project



4.3 Permits

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, motorized 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.

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 terrane vehicles is covered under the Exploration Approval permit. Restrictions apply to limited use on wetlands.
- 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 BOYD that all the necessary permits are in place to conduct mineral exploration and to 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 and Other Agreements

Gold production from the Property is subject the following royalty agreements:

- A 7.5% NPI royalty is payable to Reid for gold recovered from the Leprechaun and Sprite deposits.
- A 2% NSR is payable to Mr. Kevin Keats for gold recovered from a mineral license for which no Mineral Resource estimate is available.

BOYD 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 Water Fowl 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 should be avoided during May to mid-July, for example drilling, line cutting, or blasting. 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 base line study. Stantec completed a Waterfowl Baseline report in 2011 and a Waterfowl Habitat report in 2017. In NL, 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. Proposed 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. authorization for works or undertakings affecting fish habitat).

BOYD is not aware of any other environmental liabilities at the Property.

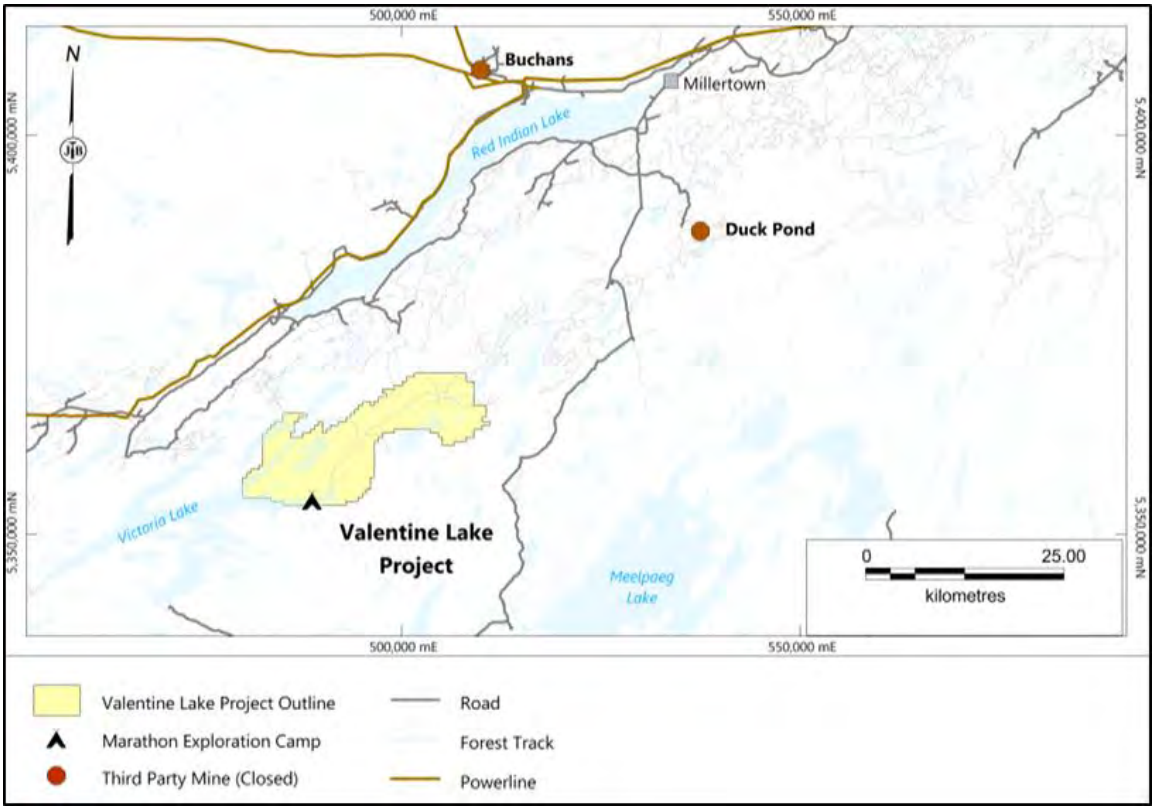
5.0 ACCESSIBILITY, CLIMATE, LOCAL RESOURCES, INFRASTRUCTURE AND PHYSIOGRAPHY

5.1 Accessibility

The Property is accessed by a 73 km well-maintained year-round gravel road from the Town of Millertown to the northeast end of the Property (refer to Figure 5.1). Millertown is situated 10 km by paved road off the Buchans Highway which provides paved road access to the Trans-Canada Highway, which transects the island of Newfoundland from east to west and connects the major populated centers (see Figures 4.1 and 5.1). Marathon Gold has a regional office in the Town of Pasadena, western Newfoundland, and the Project is accessed by road from Pasadena via Millertown. The Deer Lake Regional Airport is located 20 km NE of Pasadena. Travel time by road from Pasadena to the property is approximately five hours. Helicopter access from both Pasadena and Deer Lake is also possible.

Turf Point Port is located at the Town of St. George's on the west coast of Newfoundland (Figure 4.1), and was used historically to ship copper and zinc concentrates produced at the Duck Pond Mine, operated by Teck Resources Limited between 2007 and 2015. Goodyear's Cove Port is located at the Town of South Brook approximately 120 km north of the Project (Figure 4.1) and is another potential shipping terminal (Valliant, 2013).

Figure 5.1 Infrastructure and Accessibility at the Valentine Lake Project



5.2 Physiography

The Project is located in the Central Uplands of Newfoundland, typified by gentle to moderately steep, hilly terrain. The Project is situated at the northeast end of Victoria Lake (Figure 5.1). 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 (Figure 5.2).

Maximum elevation on the Property is 480 masl, with lower ground on the flanks of the ridge to the northwest and southeast. The minimum elevation on the property is 320 masl and represents the level of the Victoria Lake in the south-western part of the property. Victoria Lake is a hydroelectric reservoir.

A plateau in the central part of the ridgeline is covered by boggy ground. The remainder of the central ridgeline is covered by a mix of dominantly spruce and fir forest and grassy clearings. To the northwest of the ridge, the property comprises mainly boggy ground. To the southeast, the property is cut by the incised valley of the Victoria River. Outcrop across the property is limited to stream beds and banks, with occasional exposures along the ridgeline. However, overburden along ridge areas is thin providing abundant outcrop exposure in numerous man-made trenches.

Figure 5.2 View Northeast Along the Central Ridge of the Valentine Lake Property

5.3 Climate

Newfoundland is subject to a temperate maritime climate, typified by cool summers and cold winters with moderate precipitation. The average summer temperature is 16°C, with an average high of 22°C. Winters average -10°C with lows of -15°C. Average annual precipitation is 1,200 mm, with approximately one third falling as snow and up to 1 m or more of snow coverage. The climate does not limit the operating season and Marathon Gold conducts exploration all year round.

5.4 Infrastructure and Local Resources

Marathon Gold has constructed an exploration camp in the southeast of the property proximal to the shoreline of Victoria Lake. The camp is powered by diesel generators and back-up generators, and includes accommodation, messing, cold/dry storage, core cutting core storage and office facilities. A network of permitted and gated access roads from the camp to each prospect within the property has been progressively developed by Marathon Gold and their predecessors.

Marathon Gold does not control surface rights at the property. Title to surface rights will be obtained by Marathon Gold when the company applies for and is issued a mining lease prior to any potential mining activities (see Section 4.2.1, Governance).

Except for diesel generators, there is no other source of power on the property. A power line is located approximately 15 km north of the license boundary which is a potential source of power for possible future mining operations. There are hydroelectric power stations at Star Lake and Granite Lake, located approximately 30 km north and 40 km southeast of the property, respectively.

BOYD considers that there is sufficient area and appropriate physiography to accommodate potential tailings storage, waste disposal, heap leach pad, and processing plant sites on the property. Sufficient water is available for potential mining operations, notwithstanding the relevant permitting requirements.

NL has an active mining industry, and there are several suppliers and contractors in communities local to the Property, such as Millertown, Springdale, Grand Falls, Badger and Buchans that provide services to the exploration and mining industry. Skilled mining personnel are available from within the province as well as elsewhere in Canada. Mineral exploration companies and the Government in NL have adopted proactive strategies to attract, recruit, diversify, and retain skilled workers associated with, and committed to, the mining industry.

6.0 HISTORY

6.1 Ownership History

The Property has historically been explored by several companies since the 1960s (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 Property was first recognized as a gold prospect by Abitibi Price Inc. in 1983 and was acquired by BP Canada Inc. in 1985. Noranda Inc. acquired the Property from BP Canada Inc. in 1992, prior to entering into a joint venture agreement with Mountain Lake Resources in 1998.

Table 6.1 Summary of Ownership History

Date	Operator
1960s	ASARCO Inc.
1970s - 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 - 2010	Mountain Lake Resources Inc.
2010 - 2011	Marathon PGM Corporation
2011 - Present	Marathon Gold Corporation

In 2002, MOA earned a 50% interest in the Property and retained an option to acquire a 100% interest in the Property by expending $2.5M on exploration within five years, and either paying $1M or issuing one million shares to Noranda Inc. Noranda Inc. retained a 2% NSR royalty on base metal production, and a 3% NSR royalty on precious metal production. An NPI royalty was retained by Reid 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 $2.5M in exploration by 31 October 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 Inc.

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 and MAR became the operator in 2010.

MAR was acquired by Stillwater Mining Company in November 2010 and the gold properties held by MAR, including the Property, were spun out into a new company, 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.

In November 2017, Marathon Gold purchased the 3% NSR royalty on precious metal production, as well as the 2% NSR royalty on base metal production.

6.2 Historical Exploration

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

Drilling for gold mineralization was first conducted in the late 1980s by BP Canada Inc. (Table 6.2), and ultimately led to a maiden 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) is not considered relevant by Marathon Gold or the authors; and (3) is superseded by the Mineral Resource estimate presented in this report.

Table 6.2 Summary of Historic Drillholes Completed by Companies Other than Marathon Gold at the Valentine Lake Property

Operator	Date	No. of Drill Collars	Meters
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, as well as making significant new discoveries at the Marathon, Sprite, and Victory deposits and subsequently issuing several previous mineral resource estimates for each of these new discoveries (see Section 6.3). Marathon Gold's 2010 to present drill programs are presented in Chapter 10 of this report.

A summary of work completed by the operators is given below (prior to Marathon Gold's formation and their taking over the project) and is summarized from the Micon Report (Murahwi, 2017).

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

Between 1960 and 1983, ASARCO Inc. and Hudson's Bay Oil and Gas Company targeted base metal mineralization at Valentine Lake. Reconnaissance geological mapping, soil and stream sediment sampling completed by ASARCO Inc. resulted in the identification of a 1 m wide quartz-pyrite-chalcopyrite vein, which was tested with four short diamond drillholes (lengths not known) and a 1 km^2 soil sampling and Very Low Frequency Electromagnetic (VLF-EM) survey. ASARCO Inc. determined that the vein pinched out 30 m below surface. The location of the work completed by ASARCO Inc. is not known by BOYD. In 1966, an airborne EM-Magnetic survey was flown, but the results were not publicly reported.

Hudson's Bay Oil and Gas Company 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 Price Inc. completed a 400 m by 25 m spaced soil sampling survey targeting gold mineralization over the Valentine Lake Intrusion, southeast of Valentine Lake. The survey defined gold anomalies, however Abitibi Price Inc. did not follow up on the anomalies. Results and locations of the Abitibi Price Inc. surveys are not known.

6.2.3 BP Canada Inc. (1985 to 1992)

BP Canada Inc. advanced the gold-in-soil anomalies identified by Abitibi Price through grab rock sampling and geological mapping over a 25 km strike length. A 13 km long zone was prioritized and subjected to 100 m spaced line cutting to allow further geological mapping, soil sampling, and VLF-EM and magnetic geophysical surveys.

BP Canada Inc. identified gold prospects at 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 mineralization over a strike length of 3 km. A small scale Induced Polarization survey was conducted at Leprechaun by BP Canada Inc.; however, the results and locations of the survey are unknown.

6.2.4 Noranda Inc. (1992 to 1998)

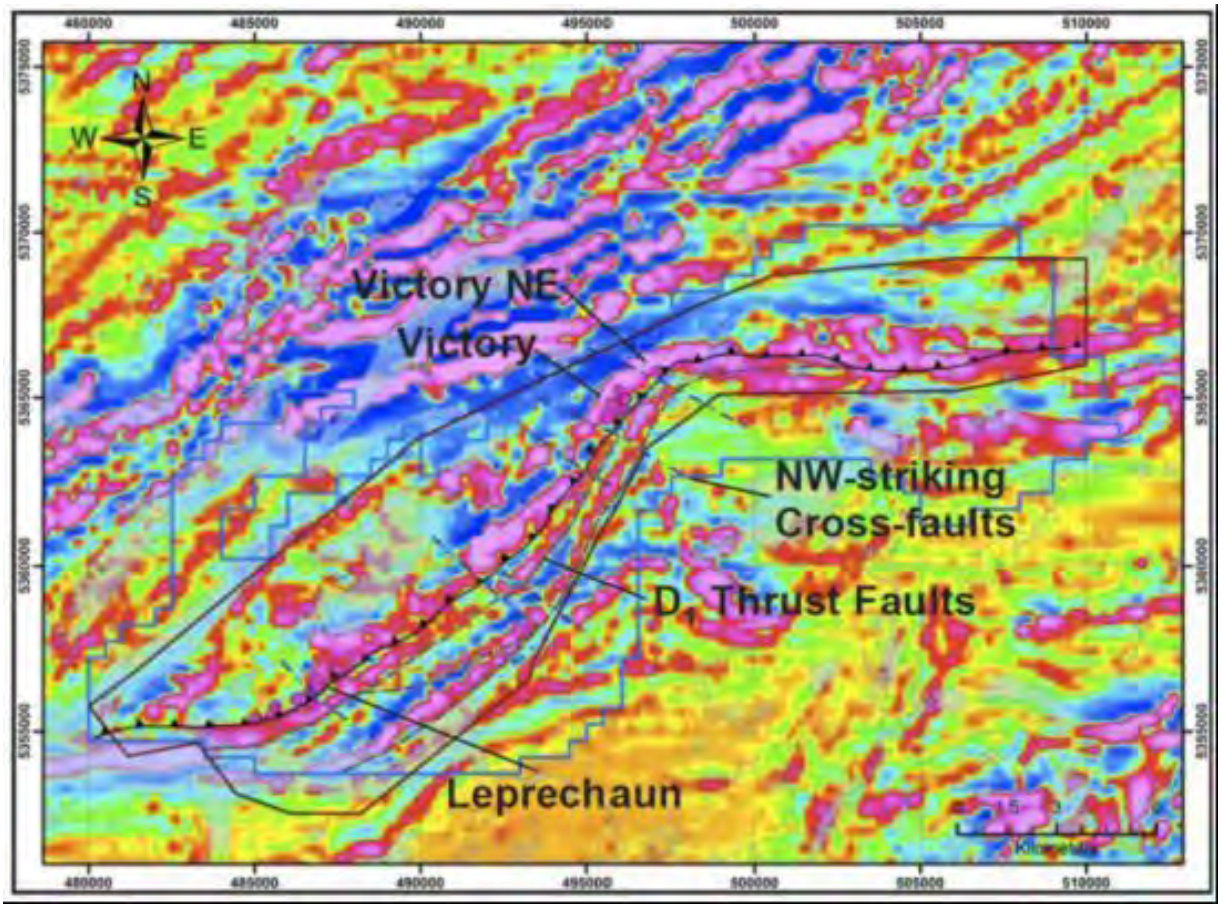
Noranda Inc. explored the Quinn Lake area in the northeast part of the property and conducted soil and till sampling that reportedly defined gold and base metal anomalism (Murahwi, 2017). Noranda Inc. did not complete any other work on the property, and the locations and results of the work conducted by Noranda Inc. are not known.

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

Mountain Lake Resources (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 25 km long mineralized 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 (Table 6.3).

MOA conducted a helicopter-borne magnetic, radiometric, and VLF-EM survey over the entire project area in 2007. Interpretation of the magnetic data (Figure 6.1) has identified the large scale structural features of the property, including the regional scale Valentine Lake Thrust Fault and late northwest striking normal faults. Other results and interpretations of the geophysical surveys are discussed in more detail in Chapter 9 - Exploration.

Figure 6.1 First Vertical Derivative Aeromagnetic Data for the Valentine Lake Property



Source: SRK (2014)

Table 6.3 Historic 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

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 $425 /oz 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.**

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 resources and the issuer and the authors of this report are not treating the historical estimate as a current mineral resource.

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

Eight diamond drillholes were completed in 2007 to test mineralization 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 and Marathon PGM (2007 to 2011)

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 (Table 6.2) 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 11 December 2010 (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 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	

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 $1,000 /oz 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 were limited by conditions applied to the search ellipse.**
7. **Numbers may not add due to rounding.**

The mineral resource estimates summarized in Table 6.4 were prepared in accordance with CIM Definition Standards, but are superseded by the mineral resource estimates presented in Chapter 14 of this report, and the issuer and authors are not treating the mineral resource estimates 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 expanding the size of the Leprechaun deposit and making significant new discoveries at the Marathon, Sprite, and Victory deposits.

The mineral resource estimates in Tables 6.5, 6.6, 6.7, and 6.8 are 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.

During this period, Marathon Gold issued several mineral resource estimates as the exploration work progressed, summarized in Tables 6.5 to 6.10.

Table 6.5 Summary of January 9, 2012 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	

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 $1,300 /oz was used for this Mineral Resource estimate.**
4. **Composites were capped using statistical analysis per domain.**
5. **Numbers may not add due to rounding.**
6. **The mineral resource estimates summarized in Table 6.5 were prepared in accordance with CIM Definition Standards, but are superseded by the mineral resource estimates presented in Chapter 14 of this report, and the issuer and authors are not treating the mineral resource estimates in Table 6.5 as current mineral resources.**

Table 6.6 Summary of August 1, 2013 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	

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 optimizations 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 $1,350 /oz was used for this Mineral Resource estimate.**
5. **Numbers may not add due to rounding.**
6. **The mineral resource estimates summarized in Table 6.6 were prepared in accordance with CIM Definition Standards, but are superseded by the mineral resource estimates presented in Chapter 14 of this report, and the issuer and authors are not treating the mineral resource estimates in Table 6.6 as current mineral resources.**

Table 6.7 Summary of April 30, 2015 Mineral Resource Estimate (Open Pit and Underground) for Marathon, Sprite, and 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

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 optimizations 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 $1,200 /oz was used for this Mineral Resource estimate.**
5. **Composites were capped using statistical analysis per domain.**
6. **Numbers may not add due to rounding.**
7. **The mineral resource estimates summarized in Table 6.7 were prepared in accordance with CIM Definition Standards, but are superseded by the mineral resource estimates presented in Chapter 14 of this report, and the issuer and authors are not treating the mineral resource estimates in Table 6.7 as current mineral resources.**

Table 6.8 Summary of February 21, 2017 Mineral Resource Estimate

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	1,153	1.73	64,100	3	2.71	300	**1,156**	**1.73**	**64,400**
Indicated	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	4,096	2.00	263,000	50	5.00	8,100	**4,146**	**2.04**	**271,100**
Indicated	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	**12,786**	**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	0	0	0	0	0	0	**0**	**0**	**0**
Indicated	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	0	0	0	0	0	0	**0**	**0**	**0**
Indicated	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**
Totals									
Total Measured	**5,249**	**1.94**	**327,100**	**53**	**4.87**	**8,400**	5,302	1.97	335,500
Total Indicated	**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

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 optimizations 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 $1,200 /oz was used for this Mineral Resource estimate.**
5. **Composites were capped using statistical analysis per domain.**
6. **The mineral resource estimates summarized in Table 6.8 were prepared in accordance with CIM Definition Standards, but are superseded by the mineral resource estimates presented in Chapter 14 of this report, and the issuer and authors are not treating the mineral resource estimates in Table 6.8 as current mineral resource.**

Table 6.9 Summary of November 27, 2017 Mineral Resource Estimate

Deposit 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)
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	1.710	369,200
Victory Deposit									
Measured	0	0.000	0	0	0.000	0	0	0.000	0
Indicated	1,074,000	1.448	50,000	0	0.000	0	1,074,000	1.448	50,000
M+I	1,074,000	1.448	50,000	0	0.000	0	1,074,000	1.448	50,000
Inferred	2,167,000	1.156	80,500	134000	3.320	14,300	2,301,000	1.281	94,800
Sprite Deposit									
Measured	0	0.000	0	0	0.000	0	0	0.000	0
Indicated	343,000	1.988	21,900	71,000	4.640	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	3.030	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	1.570	940,000	1,521,000	3.540	173,100	20,141,000	1.719	1,113,100
Inferred	6,276,000	1.077	217,200	2,710,000	3.270	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

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 optimizations 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 $1,250 /oz.**
5. **Totals may not add correctly due to rounding.**
6. **The mineral resource estimates summarized in Table 6.9 were prepared in accordance with CIM Definition Standards, but are superseded by the mineral resource estimates presented in Chapter 14 of this report and the issuer and authors are not treating the mineral resource estimates in Table 6.9 as current mineral resources.**

Table 6.10 Summary of May 28, 2018 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	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

1. **The effective date for this mineral resource estimate for Leprechaun, 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 5 March 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 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 ("NI 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 categorized as mineral reserves, and there is no certainty that the PEA will be realized. 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 by 6 m by 6 m sub-blocked to a minimum block size of 2 m by 2 m by 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 0.267 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 mineralized 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 mineralized 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 mineralized 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, 2014.**
7. **Figures are rounded and totals may not add correctly.**

7.0 GEOLOGICAL SETTING AND MINERALIZATION

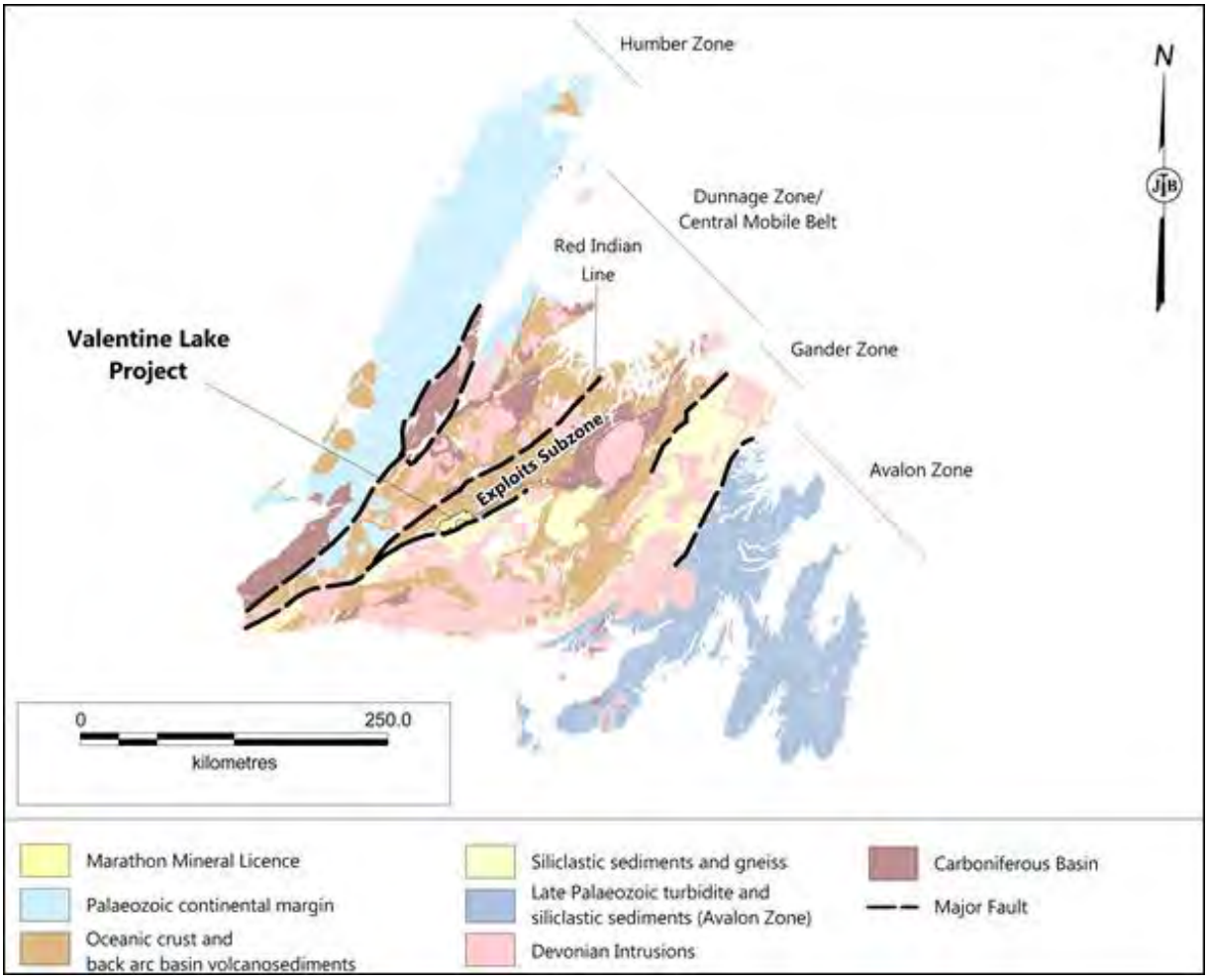
7.1 Geotectonic Setting

The Property is located within the Newfoundland Appalachians, which formed during closure of the Iapetus Ocean in the Cambrian to Ordovician resulting in the accretion of Laurentia and Gondwana (Piercey et al., 2014). Newfoundland is divided into four major tectonostratigraphic zones, which are juxtaposed by major regional sutures. From west to east, the Zones include: the Humber Palaeozoic continental margin, the Dunnage Cambro-Ordovician mobile belt, the Gander Ordovician volcano-sedimentary sequence, and the Avalon Devonian sedimentary group. Granitoid and mafic intrusions were emplaced during the Devonian and intrude all four major tectonic subdivisions.

The Dunnage Zone hosts the Project and is characterized by island arc volcanic sedimentary sequences and ophiolite lenses that formed during the Middle to Late Ordovician, Taconic, and Penobscot orogenies. The Dunnage Zone is subdivided into the Notre Dame and Exploits subzones, which represent the Laurentian and Gondwana margins, respectively. 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 mineralization 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 in, intrusive bodies. The Dunnage Zone is also host to the past producing Buchans and Duck Pond copper-zinc volcanogenic massive sulfide (VMS) deposits and several other VMS occurrences. The authors have been unable to verify these historical deposits, and therefore, the deposits are not necessarily indicative of the mineralization the property that is the subject of this report.

Figure 7.1 Major Tectonic Subdivisions of Newfoundland and Location of Valentine Lake Project



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

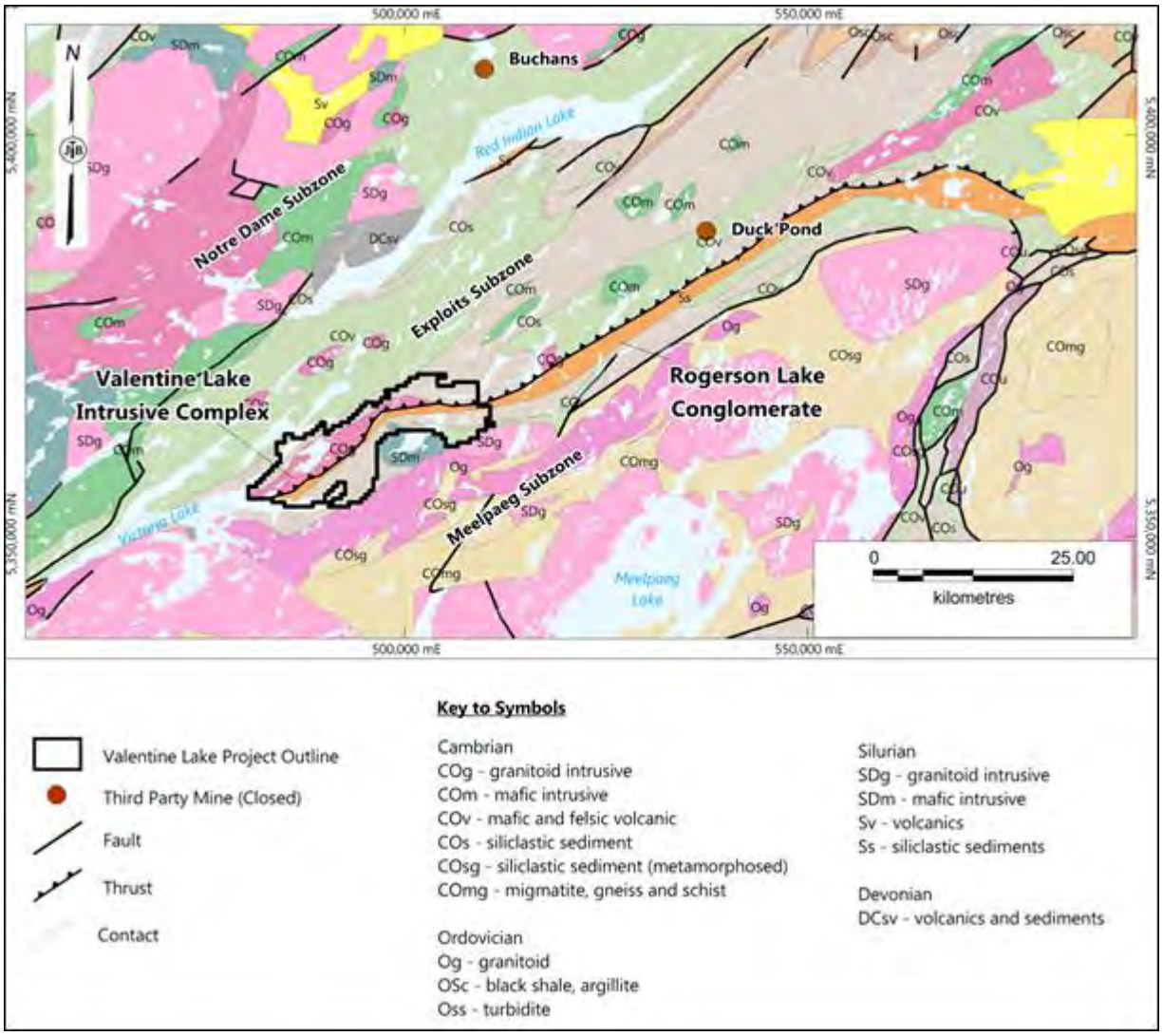
7.2 Regional Geology

The Project is located within the Exploits subzone, which is largely composed of Victoria Lake Group volcanic and epiclastic rocks, intruded by Cambrian to Silurian granitoid and gabbroic intrusions. The volcano-sedimentary sequence strikes northeast, dips sub-vertically, and displays a regional low grade greenschist metamorphic assemblage. The Exploits subzone is bound to the north by the Red Indian Line, a major Appalachian crustal suture in Newfoundland between the Exploits and Notre Dame subzones, and to the south by a regional scale thrust fault (Figures 7.1 and 7.2).

The Project is centred on the large multiphase, trondhjemite, quartz monazite, andgabbro VLIC, which is dated at 563 ± 2 Ma (U-Pb zircons; Evans et al., 1990) and forms a structural inlier within the Victoria Lake Group volcano-sedimentary rocks. The VLIC is situated along the contacts between the Victoria Lake Group to the northwest and the Silurian (or younger) Rogerson Lake Conglomerate to the southeast. The contact between

the Victoria Lake Group and Rogerson Lake Conglomerate is the northeast-southwest, regional crustal-scale, subvertical to steeply northwest dipping Valentine Lake thrust fault (Valentine Lake Shear Zone) which forms the south-eastern extent of the Exploits subzone. The VLIC occurs at a flexure in this regional structure, where the strike of the thrust fault steepens to north-northeast (Figure 7.2).

Figure 7.2 Regional Geology of the Dunnage Zone and Valentine Lake Project



Modified from Newfoundland and Labrador Geoscience Atlas Online and Piercey et al., 2014

7.3 Local Geology

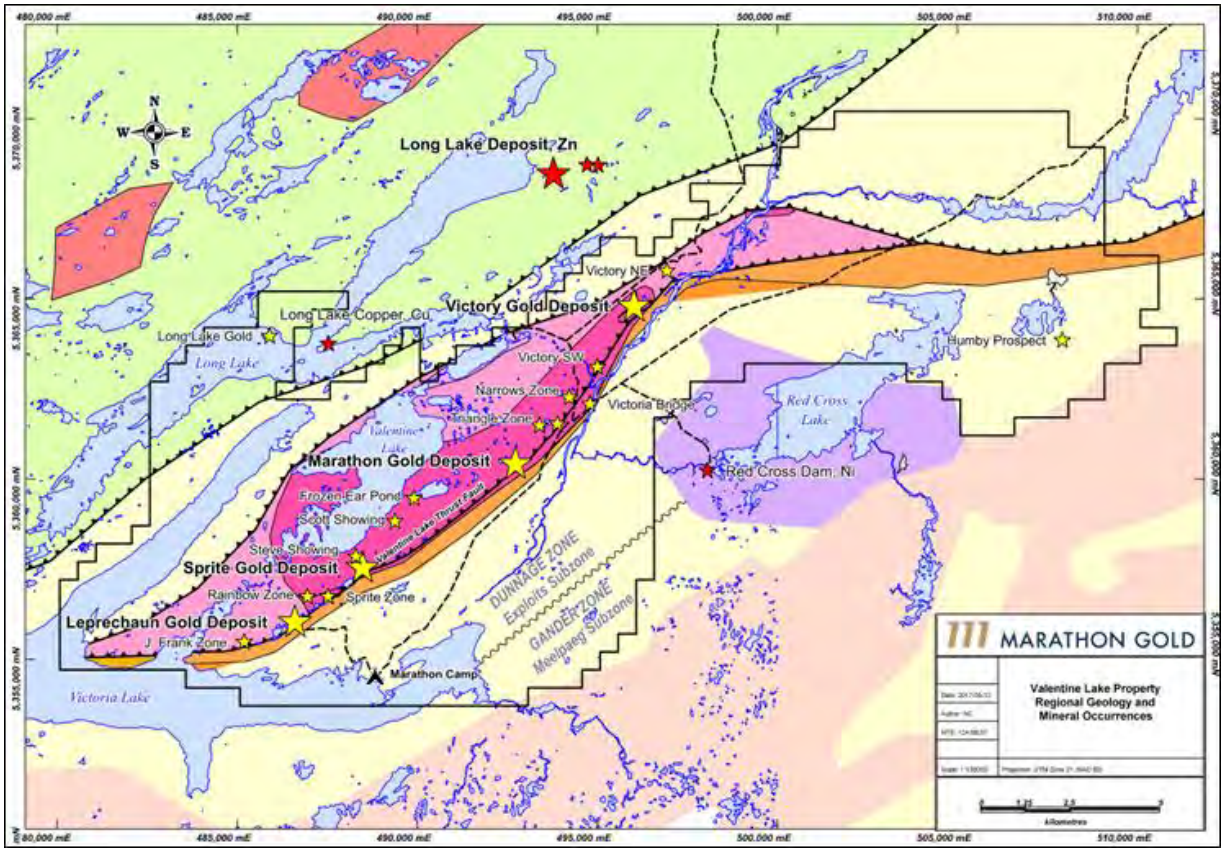
Lithostratigraphy of the Project comprises a southeast younging sequence of Cambrian-Ordovician mafic and felsic submarine volcanic rocks, overlain by a volcano-sedimentary formation composed of banded to finely laminated siltstone, argillite and tuffaceous siltstone with intercalated mafic tuff (Figure 7.3). The Cambrian-Ordovician rocks occur in the western part of the Project area and strike northeast.

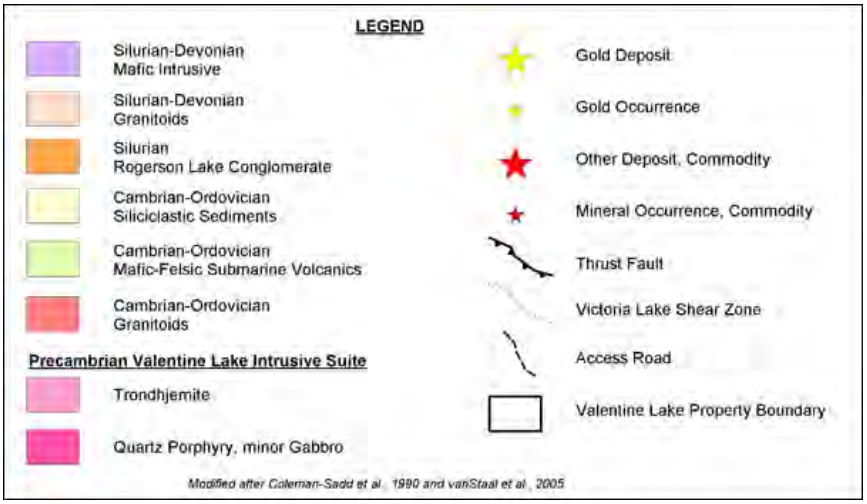
An elongate 22 km long, <4.5 km wide, zoned intrusive body (the VLIC) is hosted within the Victoria Lake Group in the central-western part of the Project area and is the major host to gold mineralization at the Property. Quartz porphyry monzonite and trondhjemite are the dominant lithologies that make up the VLIC, with northwest parts composed of gabbro and diorite. Aplite, quartz porphyry and mafic dykes cross cut the VLIC, and xenoliths of gabbro are observed within the felsic units.

The Precambrian VLIC is unconformably overlies the younger Rogerson Lake Conglomerate, which strikes northeast through the entire central part of the Project area and is host to minor volumes of mineralization proximal to the contact with the VLIC. The conglomerate is laterally extensive and up to 20 m thick, composed of polymictic, unsorted, pebble to cobble size conglomerate. Clasts are composed of trondhjemite, quartz monazite, mafic volcanic, epidote-quartz, red chert and siltstone, and the unit displays a strong, pervasive foliation and elongation of clasts. The Rogerson Lake Conglomerate is a basal unit overlain by siliciclastic sedimentary strata, which occupy the eastern part of the Project area. The Rogerson Lake Conglomerate is interpreted to have unconformably infilled a fault bounded paleotopographical depression.

The entire Project area is overlain by glacial till between 1 m and 4 m thick, as well as deeper boggy areas and ponds, with only rare bedrock exposures along the ridge and in stream beds.

Figure 7.3 Geology and Gold Deposits of the Valentine Lake Project, from Marathon Gold





7.3.1 Structure

Volcano-sedimentary units strike northeast and dip steeply to sub-vertically northwest and are sub-parallel to the regional foliation, which formed as a result of two main stages of deformation (D_1 and D_2). Stage D_1 is inferred to result from compression and transgression during Middle to Late Ordovician orogenic events. This period of transgression also formed the Valentine Lake Thrust Fault, which is a major regional structure that strikes northeast and dips between 70° to 90° northwest, and displays a reverse fault movement (throw undefined) and sinistral shear sense.

A regional scale flexure where the Valentine Lake Thrust Fault displays a sinuous morphology is coincident with the location of the VLIC and major gold prospects of the Property. The Rogerson Lake Conglomerate has been locally overturned in the footwall of this fault.

Second and third order splays at oblique angles to the Valentine Thrust Fault are poorly defined but are inferred to provide localized structural control to gold deposition, having provided zones of extension for the formation of gold bearing quartz vein arrays, stockworks, and shear zones.

A penetrative northeast striking, 70° northwest dipping foliation (S_1) is observed in the Rogerson Lake Conglomerate and, variable developed the VLIS where these units are inferred to have behaved in a ductile manner during D_1 transgression. The VLIC has been sheared and faulted, in later more brittle deformation with the stress manifesting as steeply northwest dipping, brittle-ductile shear zones and shallowly southeast dipping, discontinuous en echelon quartz veins and vein arrays.

Penetrative stretching lineations (L_1) are observed in all units, and typically plunge moderately to steeply north-northeast. Mafic dykes are boudinaged locally, and transposed parallel to the S_1 foliation.

Stage D2 deformation is associated with small scale, isoclinal folding (Murahwi, 2017), and is inferred as a late phase continuum of D_1. Stage D_2 is observed mainly in the volcanic, sedimentary and mafic intrusive units.

7.4 Mineralization

Four gold deposits and numerous gold prospects and occurrences at earlier stages of exploration have been discovered to date over a total strike length of 20 km of the Property. Mineralization is hosted almost entirely within the Valentine Lake Intrusive Complex (VLIC) and is associated at a project scale with poorly defined second and third order splay faults off the Valentine Lake Thrust Fault. This major fault system appears to have acted as a pathway and loci for gold-mineralizing fluids. The VLIC occurs at a major flexure in the Valentine Lake Thrust Fault, and deformation associated with sinistral shear along this thrust is inferred to have been a major factor in the structural control on gold deposition at the Valentine Lake Project.

The Leprechaun, Marathon, Sprite, and Victory gold deposits are the most advanced within the Property, with other gold prospects at the Frank, Rainbow, Triangle, Victoria Bridge, Narrows, and Victory NE occurrences located intermittently proximal to the contact between the VLIC and the Rogerson Lake Conglomerate. All the gold occurrences share similar general characteristics, where gold mineralization is associated with dominantly extensional and lesser shear parallel QTP veins hosted within trondhjemite and quartz porphyry sub-units of the VLIC.

The QTP veins occur as a variety of shallow dipping, en-echelon arrays, steeply dipping sub-parallel shear zones (Figure 7.4) and localized zones of intense stockwork veining (Figure 7.5). Individual veins are between 2 mm to 3 mm to >100 cm thick, composed of white to light grey, medium- to coarse-grained, crystalline to massive quartz with acicular tourmaline intergrowths and euhedral, medium- to coarse-grained pyrite crystals and aggregates. Veins are discontinuous along strike and locally pinch and swell, although the most extensive veins can be traced along strike for up to 280 m. Pyrite typically comprises <1% of mineralized QTP veins but displays a positive correlation with gold grade. Coarse (<2 mm) gold is commonly observed as interstitial grains within quartz, tourmaline, and pyrite. Gangue minerals including scheelite, chalcopyrite, bornite, sphalerite, and galena are observed in QTP veins, but form minor components to the overall mineralization and are not universally present.

Figure 7.4 Sheeted, Shallow Dipping Quartz Tourmaline Pyrite Vein Array, Marathon Deposit

Figure 7.5 Stockwork Quartz Tourmaline Pyrite Veins Hosted in Strongly Sericite-Silica Altered Quartz Porphyry, Marathon

The QTP veins are spatially and temporally associated with a narrow (typically decimeter scale), moderate to strong, pervasive and locally texture destructive selvedge alteration assemblage of sericite-silica-iron carbonate. The QTP veins occur within a wider zone of weak to moderate, patchy hematite alteration which grades outwardly to a distal and weak chlorite-epidote assemblage. Trace to weak disseminated pyrite is observed within the host rocks. There are several generations of pyrite present, inferred to relate to hydrothermal alteration and as low-grade metamorphism.

Sulphide minerals, mainly pyrite, have been partially oxidized at surface to form localized box works of hematite and limonite. Localized fracture oxidation is observed to depths of >100 m below surface however, in general, there is little evidence of pervasive oxidation deeper than approximately 5 m below surface.

The individual characteristics of mineralization at the Marathon, Leprechaun, Sprite, and Victory deposits are described below. The information in the following sections is summarized from Murahwi (2017) and Dunsworth, Capps and Tettelaar (2017).

7.4.1 Marathon Gold Deposit

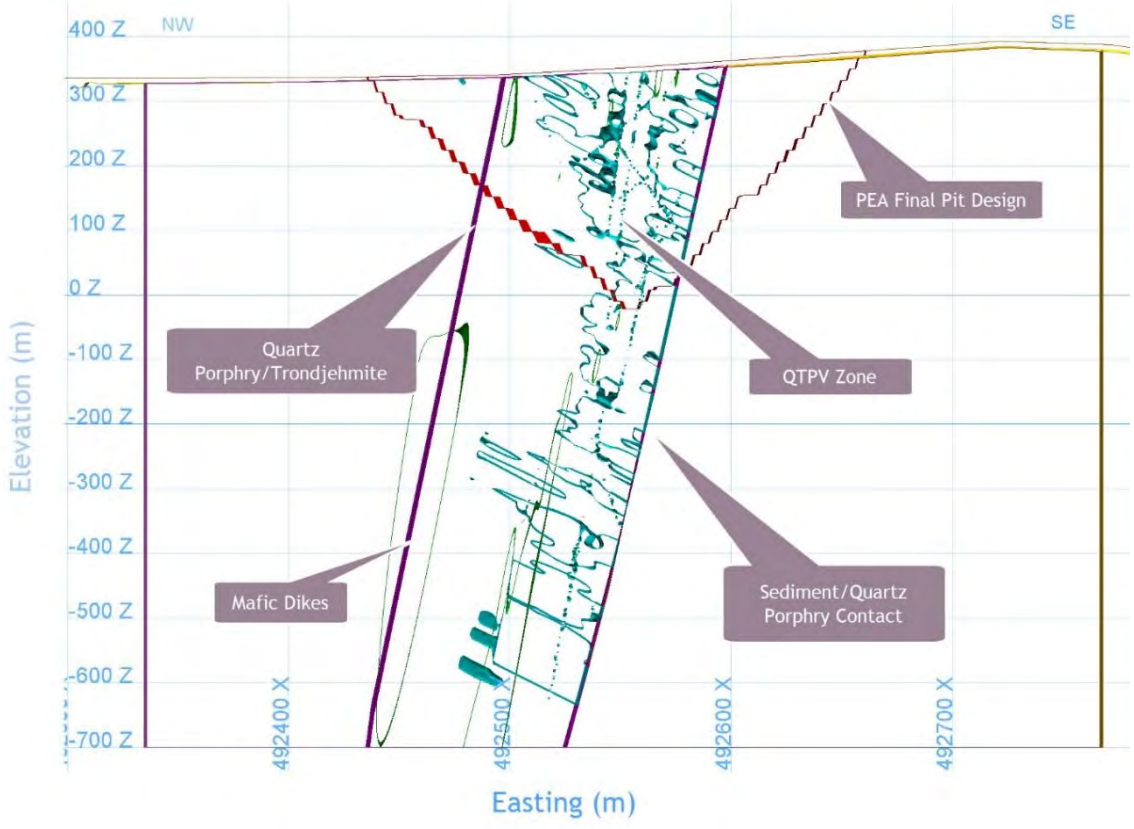
Mineralization at Marathon strikes northeast over 1,500 m and has been intercepted in drilling up to 1,000 m below surface. The mineralization has a true thickness of up to 150 m and remains open at depth and along strike. The deposit is hosted by the VLIC, mainly quartz porphyry and monzonite, and is located 150 m northwest of the contact between the VLIC and the Rogerson Lake Conglomerate.

Gold mineralization is hosted in QTP vein zones, which occur principally as sub-parallel arrays of en echelon quartz veins striking northeast and dipping 25° to 30° southwest. The arrays form discrete lenses of mineralization, however the quartz vein density increases towards the centre of the deposit where the quartz vein arrays are less distinct and mineralization is almost continuous with depth (Figure 7.6).

A central core of intense QTP veins has been identified from drilling and is likely structurally controlled, related to a third order splay. The zone forms an upright, elongate, lenticular body and is open at depth.

The peripheries of the mineralized zone are poorly defined, with an outward gradational decrease in quartz vein density northwest and southeast from the central, dense vein zone. The mineralization has not been closed off to the northwest and southeast, although the mineralization is a slightly low tenor at the currently defined outer limits.

Figure 7.6 Section 17100 Showing Geology of the Marathon Deposit



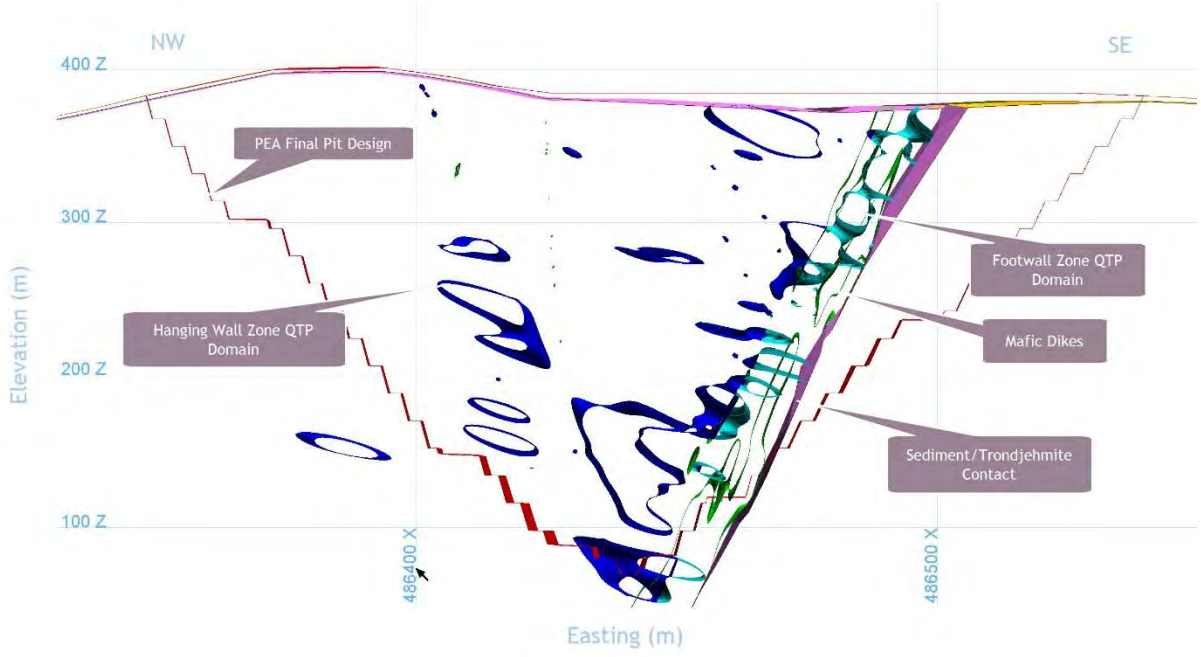
Elevation and the Easting Grids are in 100 m increments.

7.4.2 Leprechaun Deposit

Mineralization at Leprechaun occurs over a strike length of >950 m and has been identified in drilling up to 400 m below surface, within a zone up to 400 m wide. Mineralization is hosted in three domains from west to east: the Hanging Wall Zone, Main Zone, and Footwall Zone (Figure 7.7).

The Main Zone contains the majority of the known gold mineralization at Leprechaun, hosted in trondhjemite and comprising of steeply northwest dipping shear parallel as well as dominantly shallow southwest dipping extensional QTP veins and lesser shear parallel, northwest dipping QTP veins. . The Main Zone is open at depth, and is constrained to the southeast by the Valentine Lake Thrust Fault. To the north-west, the Main Zone transitions to the Hanging Wall Zone.

Figure 7.7 Section 10000 Showing Geology of the Leprechaun Deposit



A high-grade core exists within the Main Zone, bound by mafic dykes to the northwest and the Rogerson Lake Conglomerate to the southeast, forming a lenticular body of dense QTP veining which is open at depth. This high-grade zone is inferred to represent a fault jog associated with a potential third order structure as a splay from the Valentine Lake Thrust.

The Hanging Wall Zone is located west of the Main Zone and the contact between the two zones is transitional. The Hanging Wall Zone consists of a series of variably shallow southwest dipping , stacked en-echelon extensional QTP tension gashes, as well as minor steeper dipping QTP veins that extend up to 350 m northwest into the hanging wall of the deposit, and remains open to the northwest. The Hanging Wall Zone comprises several, discrete QTP vein arrays which form lenticular zones within the domain. The vein density and concentration of vein arrays increases towards the east, proximal to the Main Zone.

The Footwall Zone is a minor component of the Leprechaun deposit and comprises localized QTP veins, which extend into the structurally underlying Rogerson Lake Conglomerate.

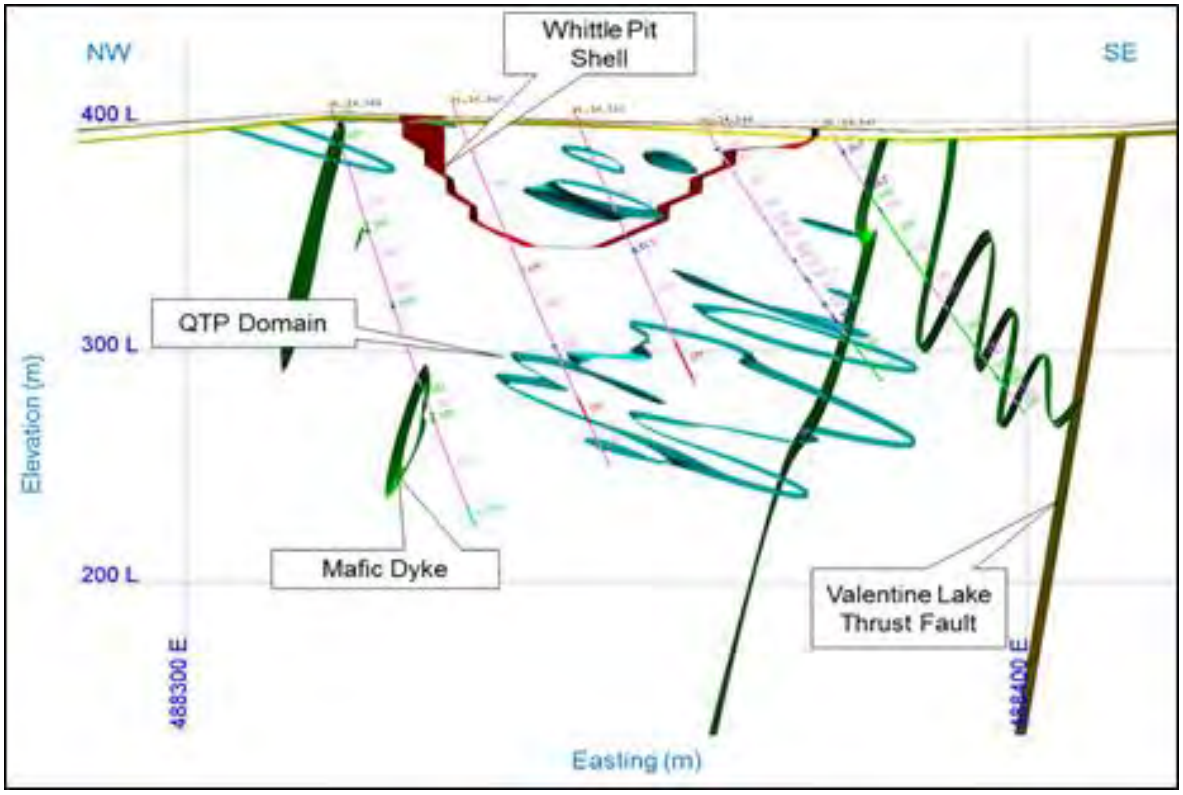
The dip of the Valentine Lake Thrust Fault at Leprechaun varies from 80° NW in the northern end of the Leprechaun Gold Deposit to 65° to 70° in the southern end of the current known deposit. A slight flattening of the thrust plane to 55° to 65° is also observed at deeper elevations in the southern end of the deposit. The lower boundary of the Main Zone lies just above and parallels the Valentine Lake Thrust Fault in the northern part of the deposit. 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 dikes observed near the contact in this area. The gold-bearing mineralizing fluids appear to have locally dammed up against, as well as regularly breaching and brecciating, the mafic dikes.

7.4.3 Sprite Deposit

Sprite has been defined by drilling over a total strike length of 3,000 m and comprises four discrete zones of mineralization hosted in quartz-eye porphyry. The zones are named, from west to east, as Rainbow, Sprite, Sprite A & B, and Sprite Northeast (Figure 7.3). The zones vary between 130 m to 250 m strike length, up to 130 m wide and have been drilled to depths of approximately 200 m below surface (Figure 7.8).

Mineralization comprises a series of shallowly southwest dipping QTP vein arrays, located 125 m to 350 m northwest of the Valentine Lake Thrust Fault. Mineralization is inferred to lie on a third order splay. Mineralization remains open at depth and is open along strike to the north.

Figure 7.8 Section 12260 Showing Geology of the Sprite Deposit

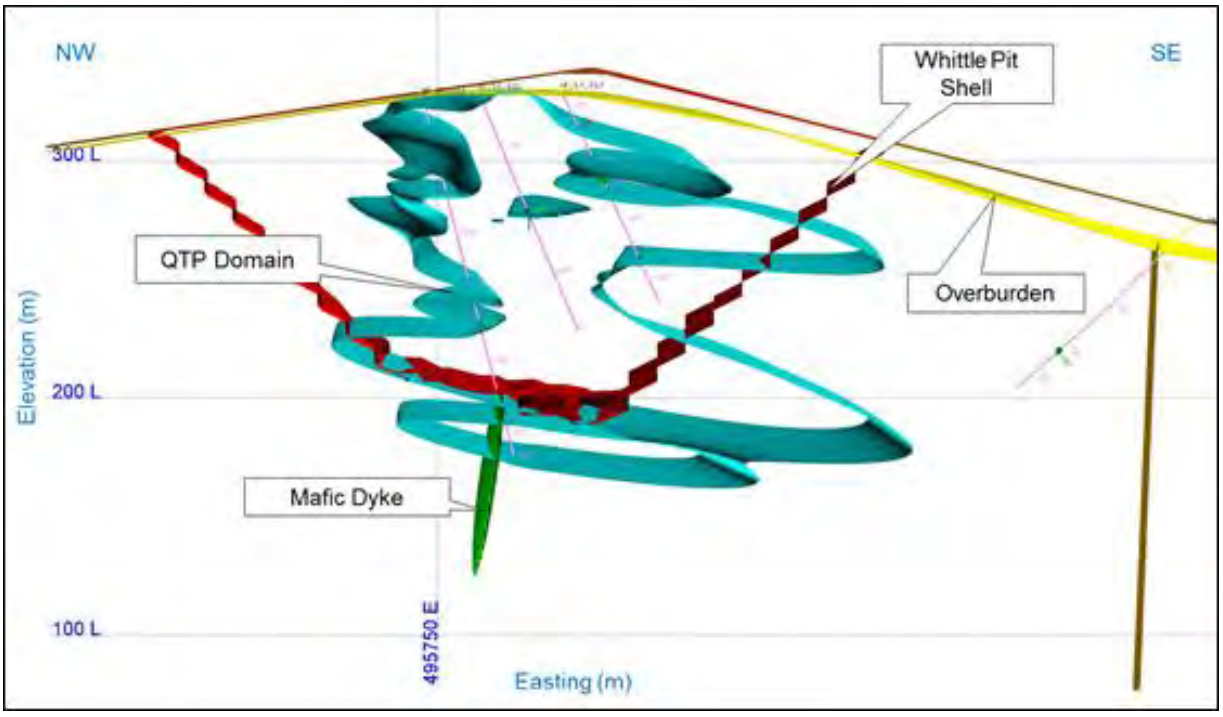


7.4.4 Victory Deposit

The Victory deposit (formerly Valentine East) is located 13 km northeast and along strike from Leprechaun. The gold mineralization at the Victory Gold Deposit is similar to the Marathon Gold Deposit area in that it is hosted by shallow southwest-dipping, multiple stacked QTP veins cutting dominantly quartz-eye porphyry of the VLIC. A significant amount of moderately northeast dipping QTP veining also occurs in the Victory Gold deposit area.

Mineralization occurs over a strike length of 750 m and is 100 m wide, and has typically been drilled to 100 m below surface (Figure 7.9). Limited drilling to >300 m below surface has identified weak mineralization.

Figure 7.9 Section 6950 Showing Geology of the Victory Deposit



8.0 DEPOSIT TYPES

There are four principal types of gold mineralization 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).

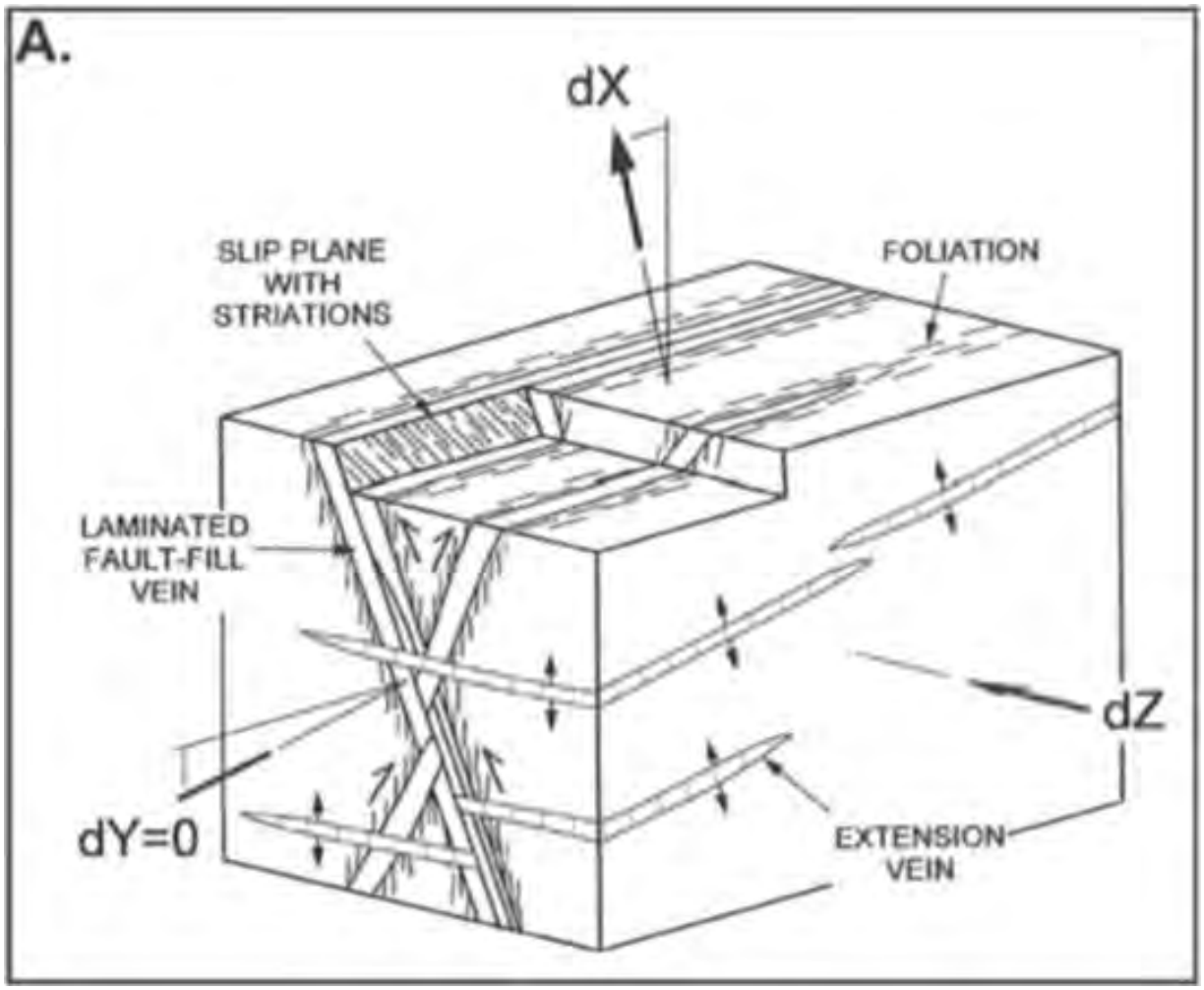
Gold mineralization at the Valentine Lake Property is of mesozonal to epizonal, orogenic origin (Groves et al., 2003). The main characteristics of this broad class of gold deposits include vein-hosted gold in association with crustal-scale shear zones and faults, and a late orogenic timing (Wardle, 2005). Deposits are largely vein-hosted and may be associated with wall rock alteration from metamorphic fluids as manifested by extensive carbonate alteration and the presence of CO_2-rich fluid inclusions. The ultimate genetic origin is uncertain; in some occurrences, gold mineralization may be intrusion-related and/or have textures suggestive of epithermal styles.

The Valentine Lake gold mineralization is spatially related to second and third order splays and fault jogs in the hanging wall of the Valentine Lake Thrust Fault, a regional and deep suture zone which provided a conduit for deep metamorphogenic fluids. The Valentine Lake Thrust Fault, and associated second and third order structures, are inferred to have formed during southeast verging D_1 events, with later northwest oriented faults associated with post-compression relaxation.

At the project scale, mineralization has been inferred to be located in zones of more intense faulting within the brittle intrusive rocks of the VLIC that has enhanced the permeability of the host rock, and therefore provided conduits for mineralizing fluids. These zones are inferred to be proximal to sub-units of the VLIC that display an elevated magnetic response (SRK, 2014), and may have acted as structural traps for accumulation of gold.

The vein geometry observed at the Property is indicative of sinistral strike-slip deformation that formed sub-horizontal extensional veins and conjugate, steeply northwest dipping fault-fill veins. This vein morphology and structural framework is commonly observed in shear zone hosted gold deposits (Figure 8.1), where the shallow dipping extension veins are less laterally extensive, and the steeper fault-fill veins may display a large vertical extent. Such a pattern is particularly evident at the Marathon Deposit, where mineralization has been traced to at least 1,000 m below surface within an approximately 100-150 m wide mineralized corridor.

Figure 8.1 Vein, Foliation and Lineation Relationships in an Oblique Reverse Fault System



Source: SRK (2014) and Robert and Poulsen (2001).

9.0 EXPLORATION

9.1 Introduction

Between 2010 and present, Marathon Gold conducted a systematic exploration program to follow up on historic prospects within the Property and to discover additional zones of mineralization along the Project trend. This work includes geological mapping, lithogeochemical grab and channel sampling, ground geophysical surveying (induced polarization, magnetic, and seismic), drilling, and metallurgical processing. Marathon Gold subsequently discovered the Marathon and Sprite deposits, and has significantly expanded the known extents of mineralization at the Leprechaun and Victory deposits. Additional early stage exploration targets were identified by Marathon Gold along the 20 km mineralized trend including the Frank Zone, Repeater Hill, Rainbow Zone, Narrow, Victory SW and Victory NE occurrences (Figure 7.3).

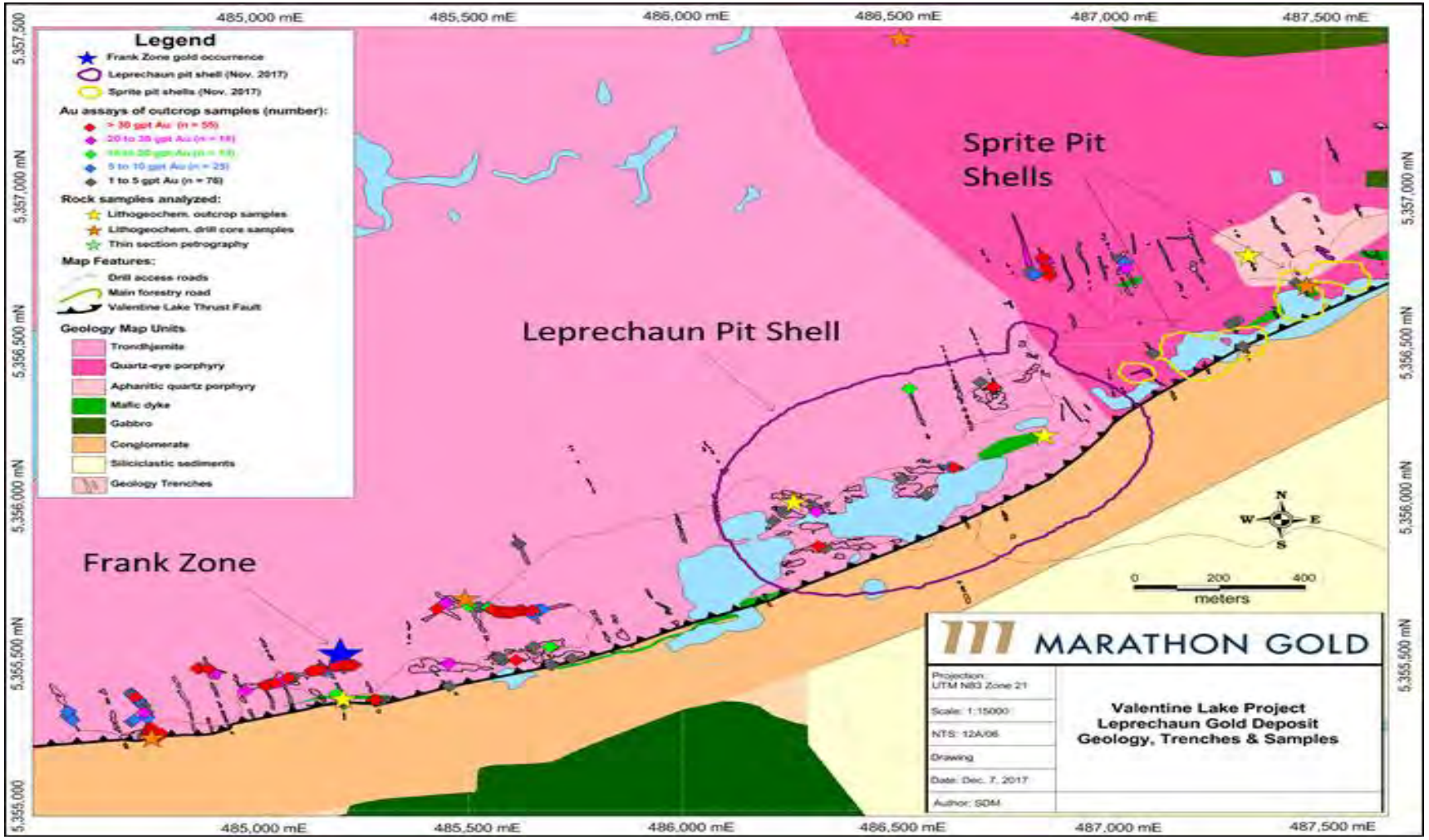
A summary of the ground exploration completed by Marathon Gold between 2010 and present is described in this Chapter. This information is summarized from Murahwi (2017) and Dunsworth, Capps, and Tettelaar (2017). The collective ground exploration work completed by Marathon Gold has formed the basis for understanding the geology at the Property, and this data was considered during the construction of the three-dimensional geological model 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 summarized 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 in stripped outcrop areas. Selected rock exposures were channel sampled and/or grab sampled for lithogeochemistry, petrography, and thin section study. Thin sections were prepared and analyzed at Memorial University of Newfoundland. Petrographic samples were prepared and analyzed by Vancouver Petrographic Inc. in Vancouver, British Columbia. Lithogeochemical samples were prepared and analyzed by Eastern Analytical Ltd. In Springdale, Newfoundland and Activation Laboratories Ltd. in Ancaster, Ontario. The results of the detailed mapping, lithogeochemistry, and petrographic studies were used to prepare detailed geological maps for each deposit area (Figures 9.1 to 9.3).

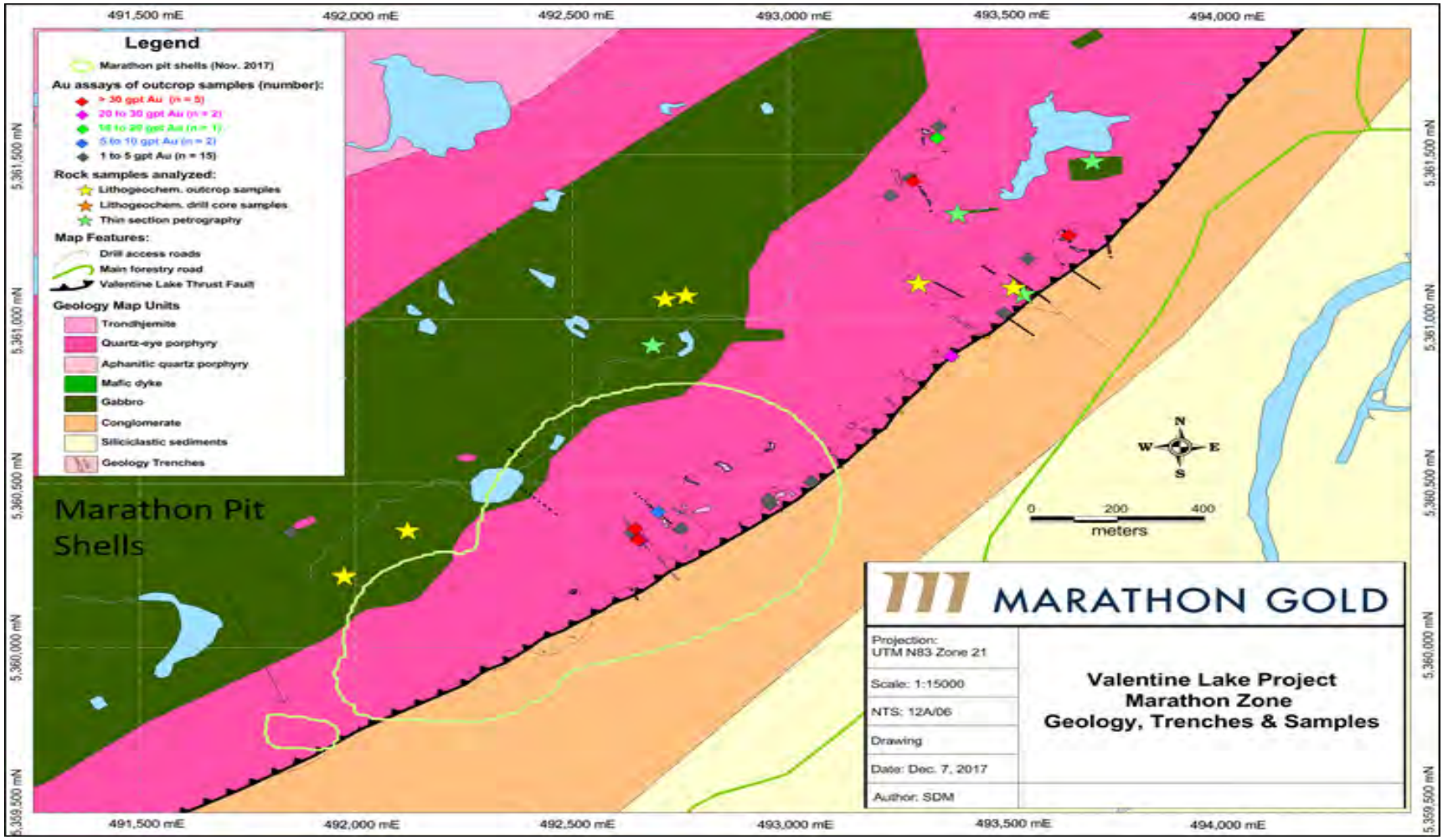
Marathon Gold engaged SRK Consulting in 2014 to conduct a structural geology investigation of the Property, which included a site visit conducted by S. Dunsworth and a review of Marathon Gold Corporation's field mapping, diamond drill core logging, and geophysical data. The study concluded that mineralization 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 Thrust Fault. Mineralization is inferred to have formed proximal to sub-units of the VLIC that display greater magnetic intensity, where mineralization is associated with fault splays, duplexes and bends.

Figure 9.1 Detailed 1:5000 Scale Geological Maps Constructed during Marathon Gold's Ground Mapping, Petrological, and Lithogeochemical Work (Frank to Leprechaun Area)



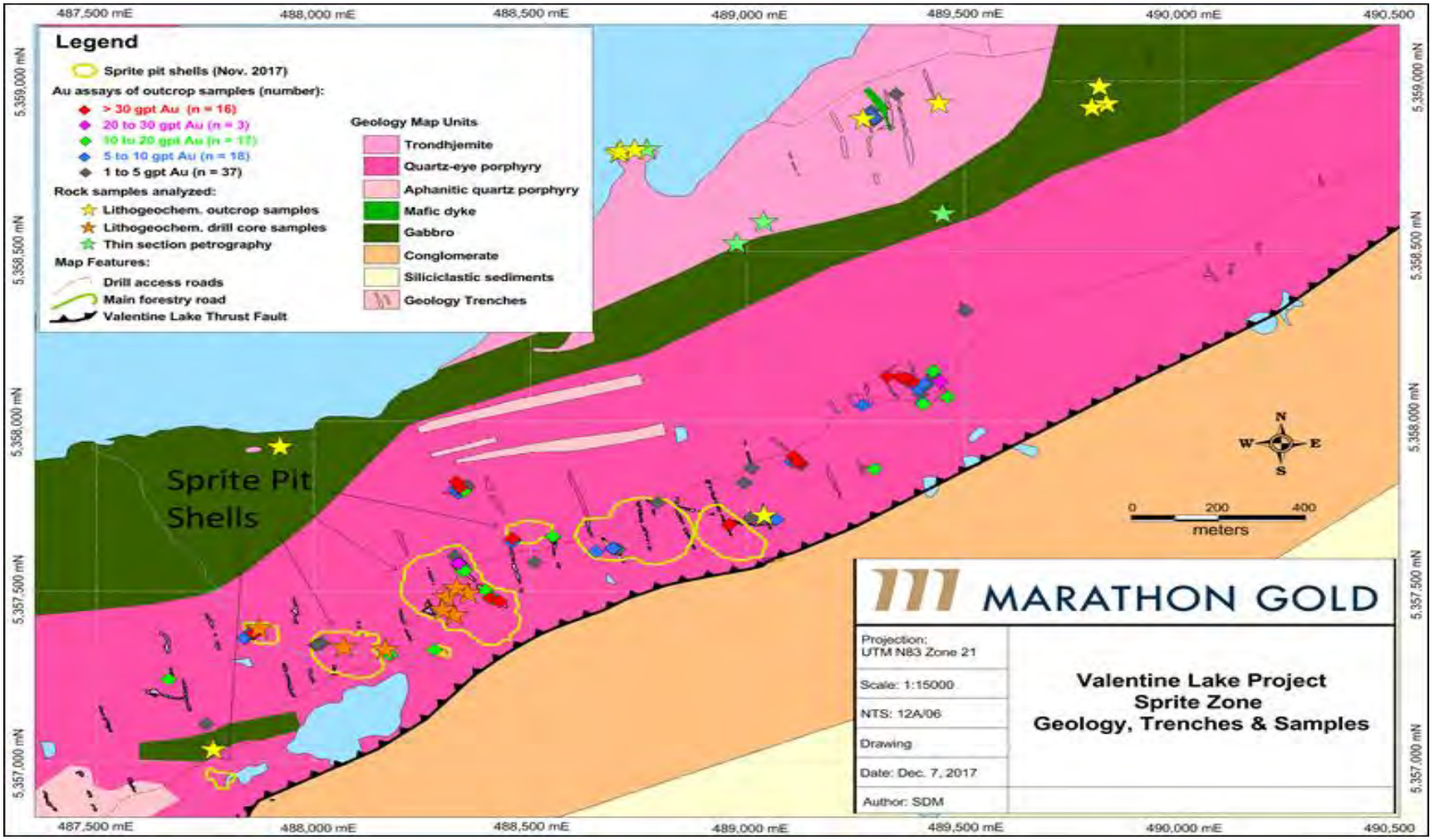
Source: Marathon Gold

Figure 9.2 Detailed 1:5000 Scale Geological Maps Constructed during Marathon Gold's Ground Mapping, Petrological, and Lithogeochemical Work at Marathon



Source: Marathon Gold

Figure 9.3 Detailed 1:5000 Scale Geological Maps Constructed during Marathon Gold's Ground Mapping, Petrological, and Lithogeochemical Work at the Sprite Zone



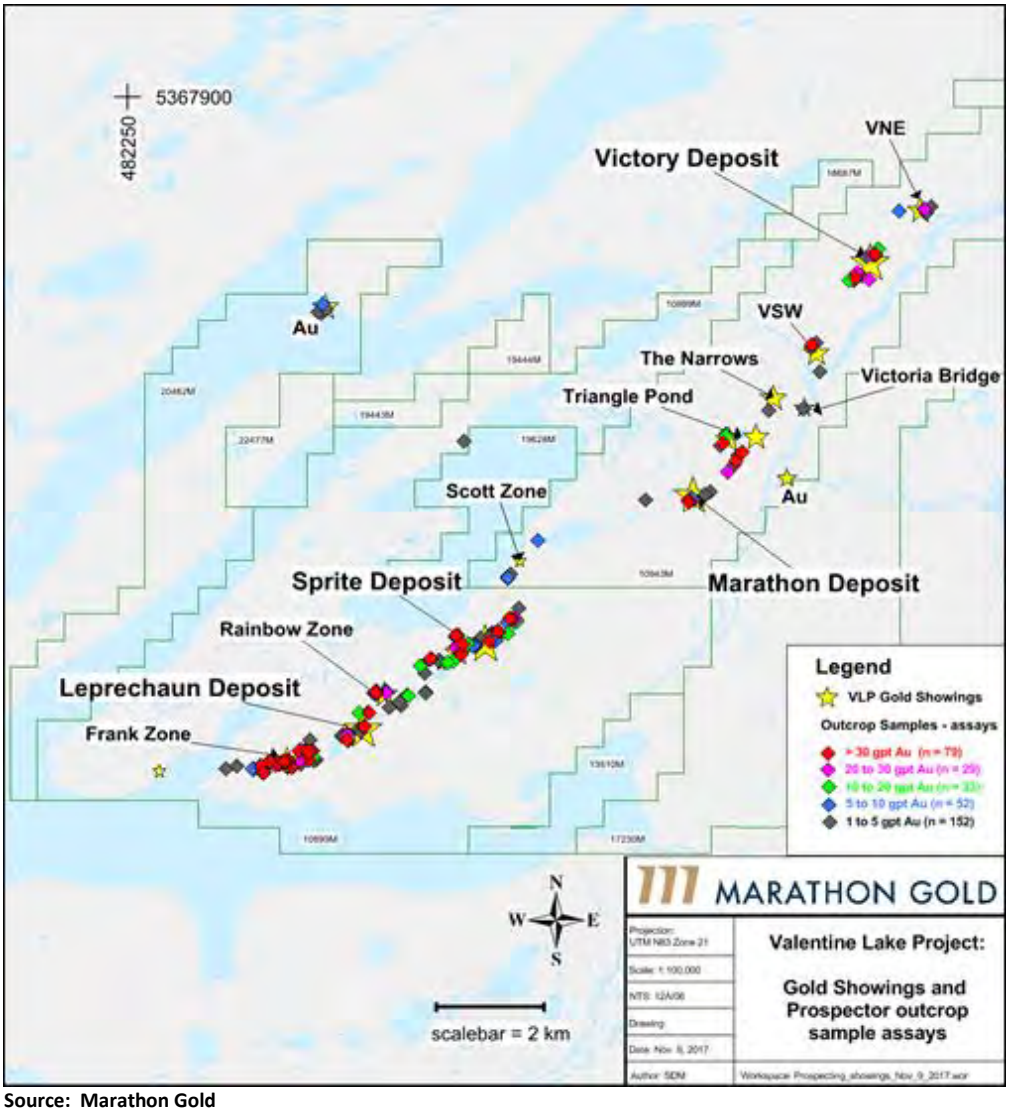
Source: Marathon Gold

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 of outcrop using a geological hammer, with a target sample size of 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 prioritizing targets for follow up exploration. The locations of the grab rock sampling by Marathon Gold with the thematic gold results is presented on Figure 9.4.

Figure 9.4 Grab Rock Sample Locations and Thematic Gold Results, Valentine Lake Property



Source: Marathon Gold

9.4 Channel Rock Sampling (2010 to Present)

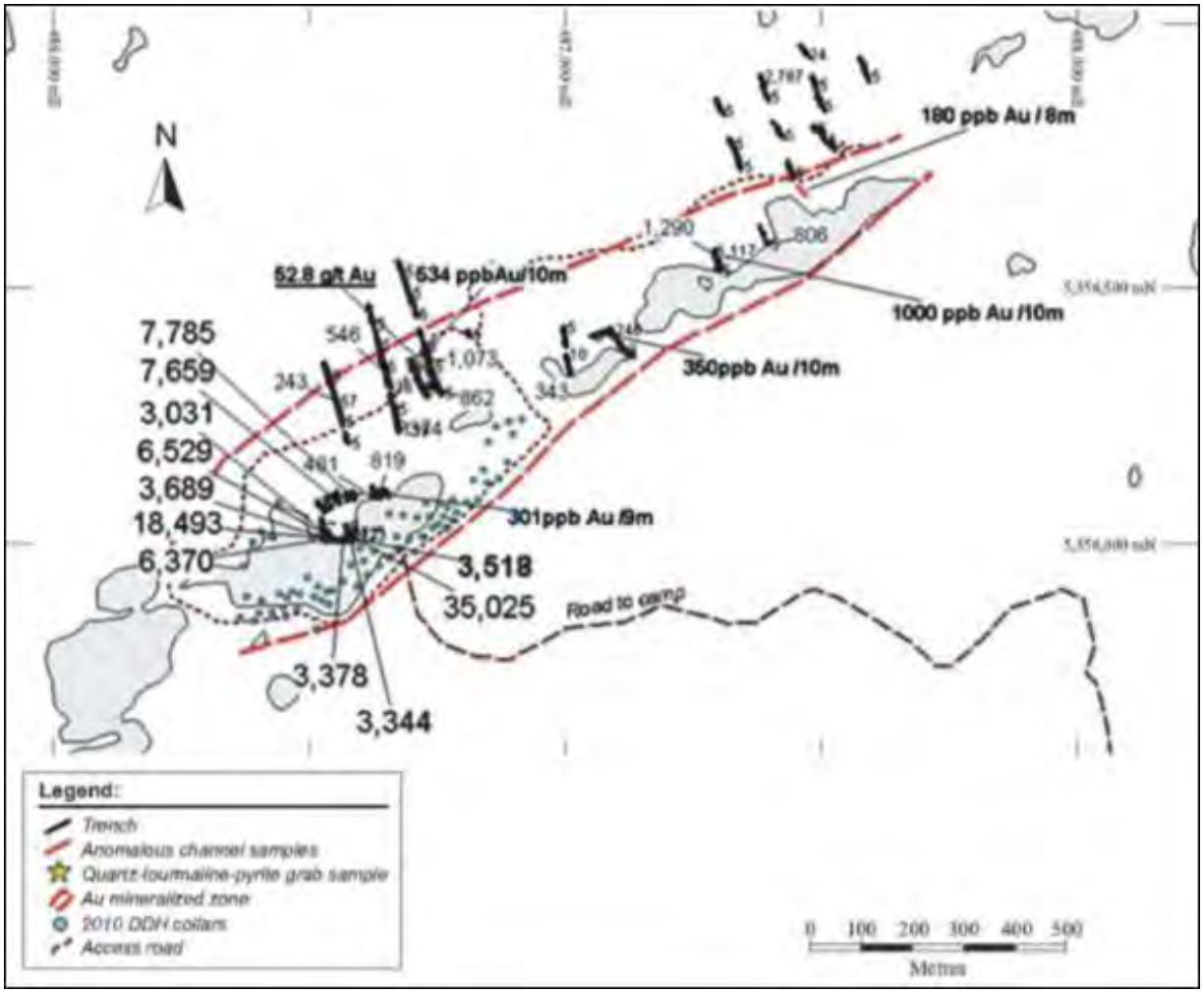
To present, Marathon Gold has channel-sawed 121 outcrops and collected 5,767 channel rock samples from throughout the Property. The locations of the channel samples are shown on Figures 9.1 to 9.4. Channel sample sites were typically stripped of vegetation and/or glacial surficial material using a backhoe, 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 mineralization. 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 m and 2 m in length using a hammer and chisel. Samples were placed into cloth 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 mineralization 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 (Figure 9.5). Channel sampling was also used to successfully identify significant mineralization at the Marathon deposit. Results from channel sampling including 16.5 m at 5.79 g/t gold, 16.5 m at 2.53 g/t gold, and 9.0 m at 4.84 g/t gold were used to define the initial drill targets that led to the discovery of the Marathon deposit.

The channel rock sample data was 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 and Sprite Deposits (2010)



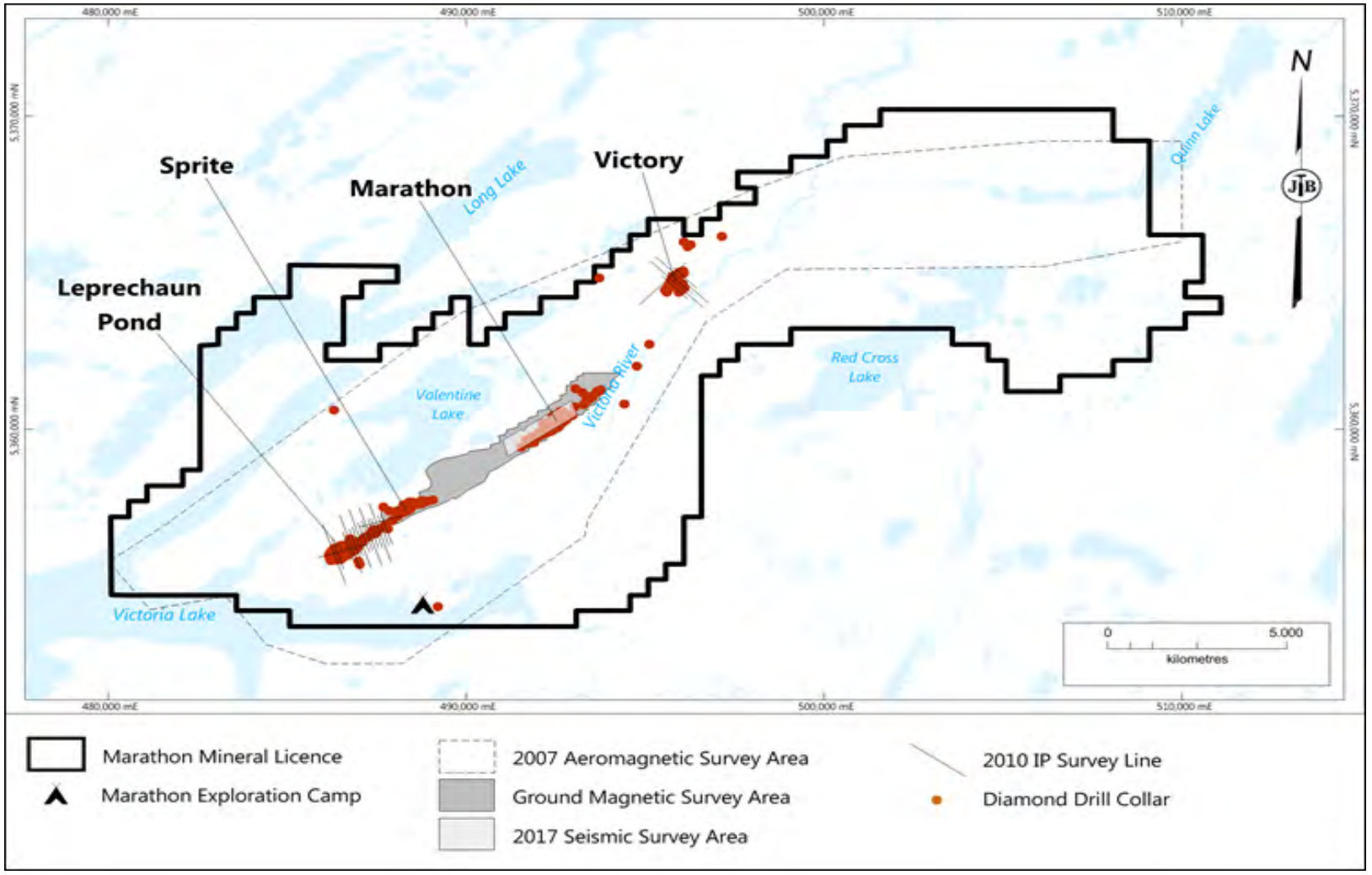
Source: Murahwi, 2017

9.5 Geophysical Surveys

Marathon Gold conducted Induced Polarization (IP) surveys at Leprechaun and Victory deposits, ground magnetic surveys along the length of the main mineralized 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 in the text below.

Figure 9.6 Geophysical Survey Locations at the Valentine Lake Property



Source: BOYD

9.5.1 IP Data

Ground IP 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 (Figure 9.6).

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 mineralization 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 mineralization. Marathon Gold drill tested the anomalies, however no significant results were obtained (Dunsworth, p.comm 2017).

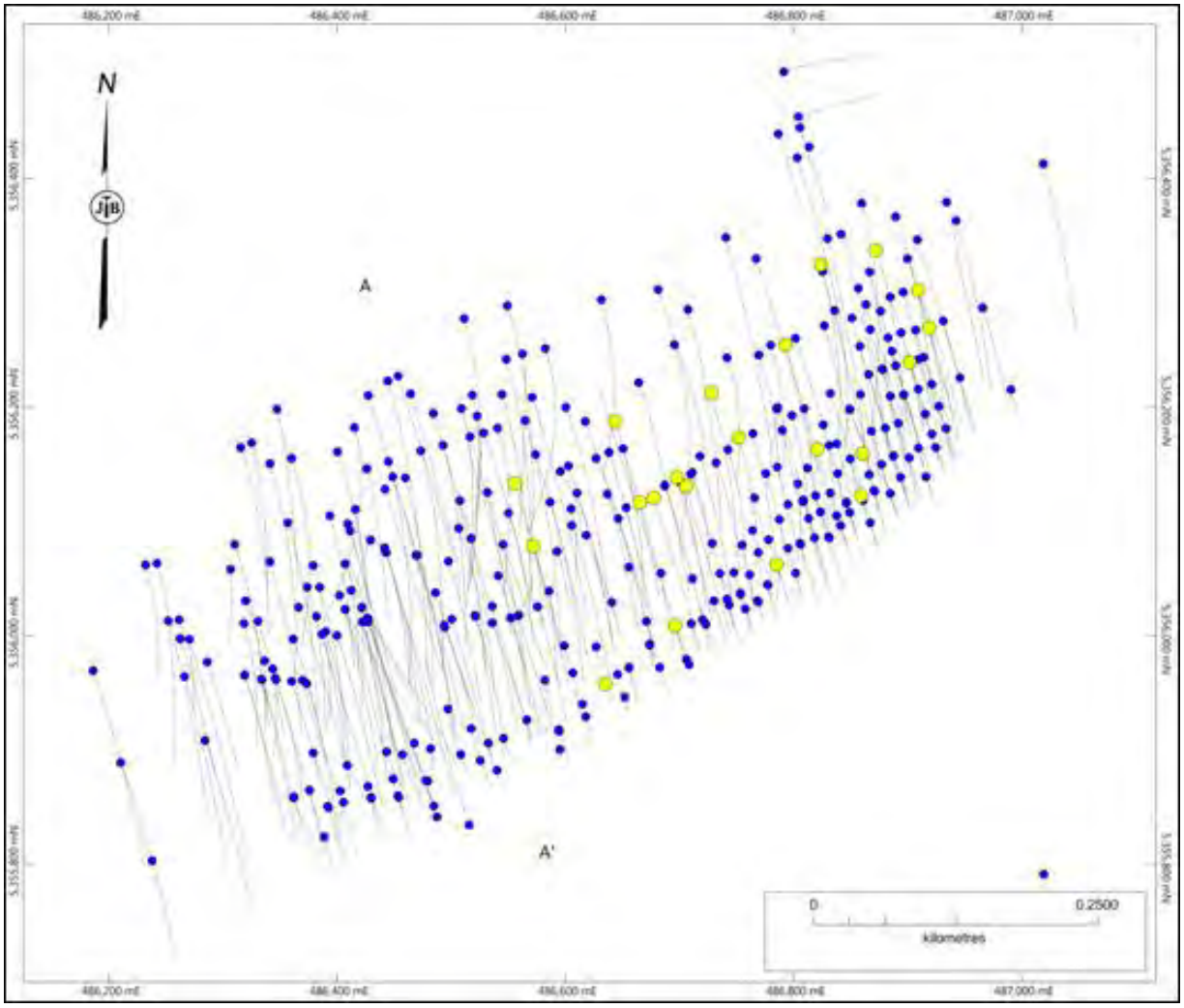
Downhole Spectral IP Survey

Downhole Spectral IP (DSIP) surveys were conducted on twenty one drillholes (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 mineralized envelope at the Leprechaun deposit (Webster and Jelenic, 2012). Apparent resistivity and chargeability were measured using Pole-Dipole and Gradient arrays, to produce two- and three-dimensional models of chargeability and resistivity.

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 mineralization despite presenting as a valid geophysical target.

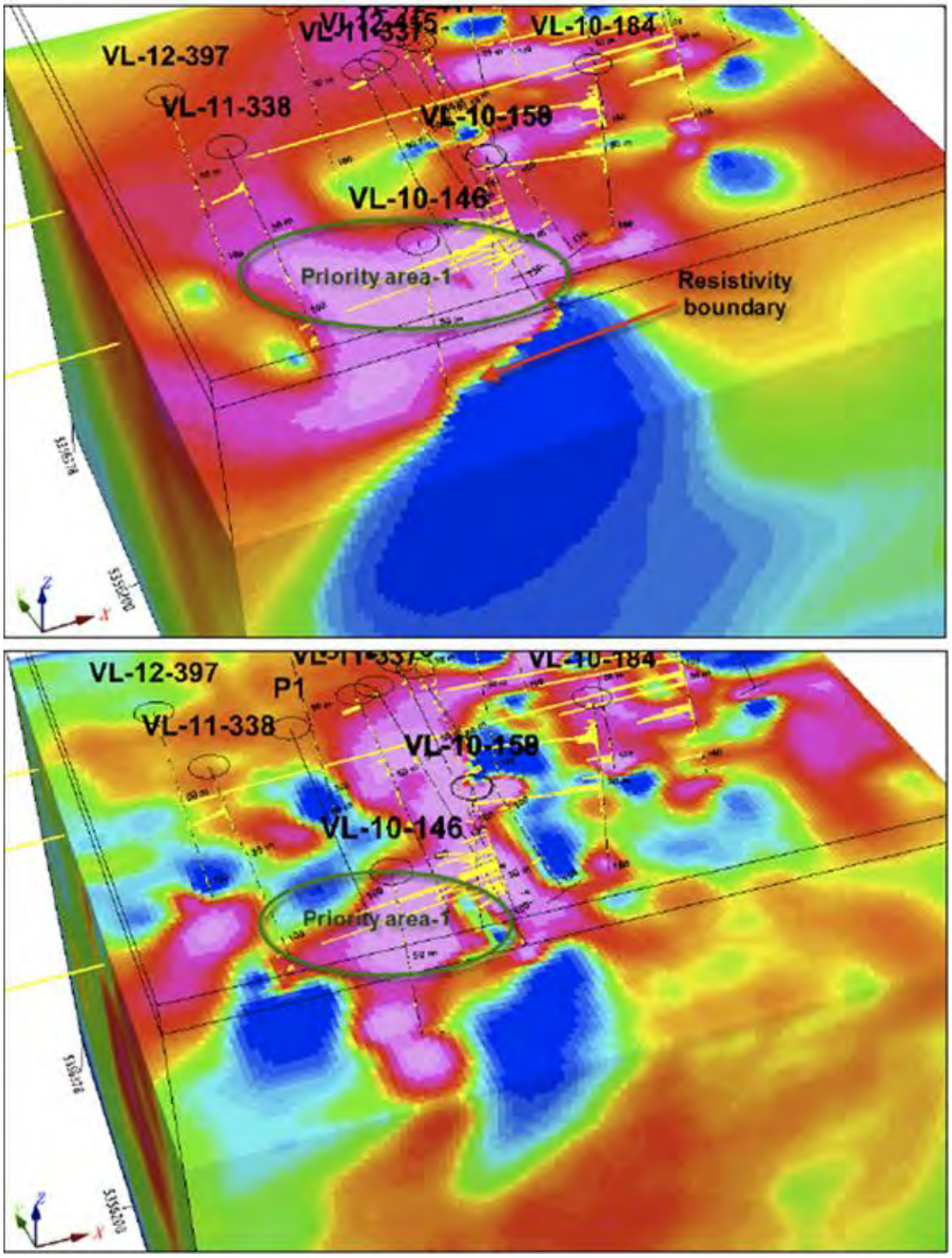
The IP survey identified two geophysical anomalies with potential for gold mineralization (Figures 9.8 and 9.9), and these zones have since been drilled by Marathon Gold. Overall, the survey results confirmed the presence of chargeability and resistivity anomalies coincident with known mineralization, but did not yield sufficient exploration targets to warrant more extensive use of the DSIP survey across the rest of the property.

Figure 9.7 Leprechaun Drill Collars (Blue) and Holes that were Selected for DSIP Surveys (Yellow)



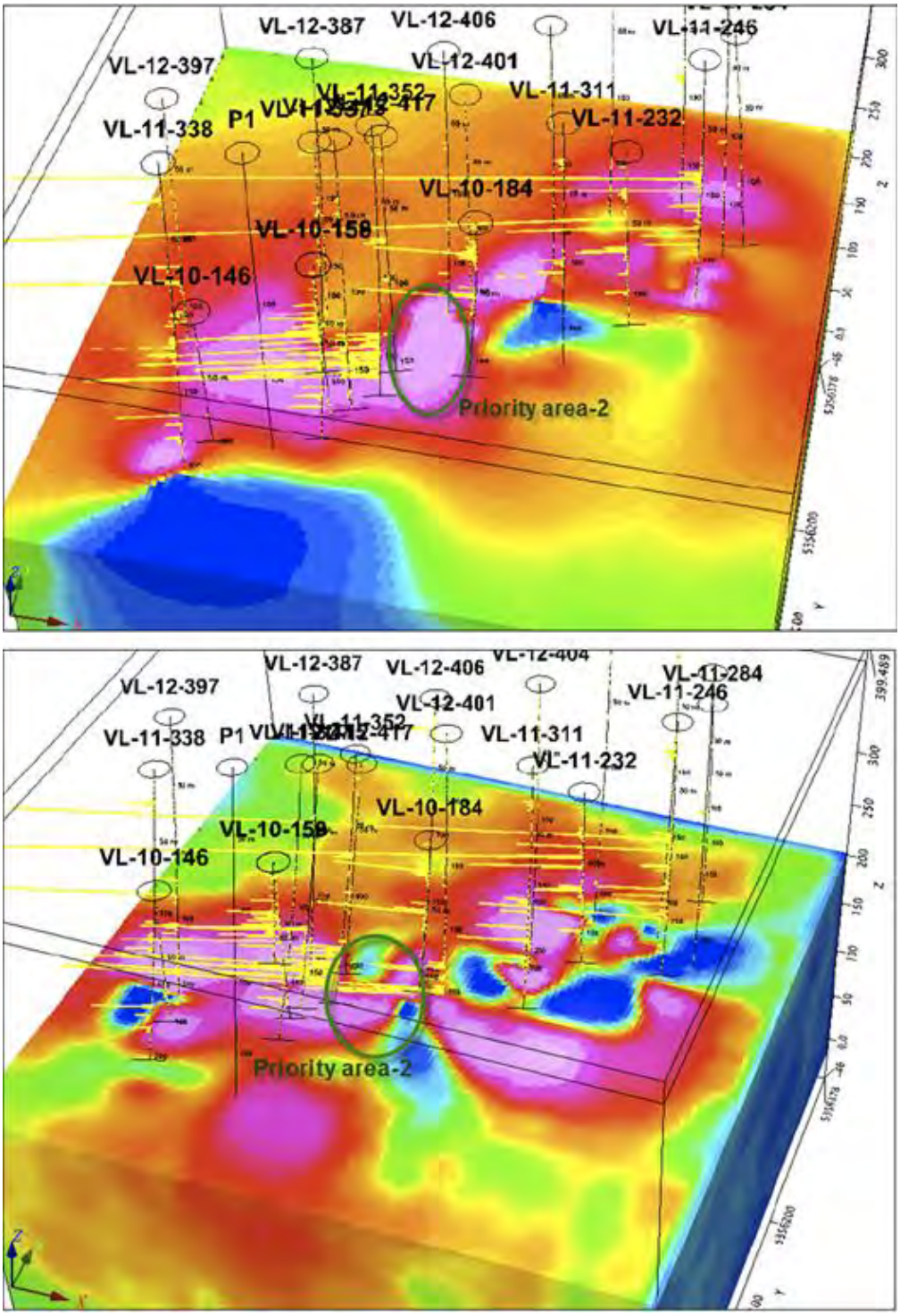
Source: BOYD

Figure 9.8 3D Resistivity (upper) and Chargeability (lower) Models at 90 m Depth Derived from DISP Survey, Leprechaun, Showing Drillholes and Priority Area 1 Target Area



Source: Webster and Jelenic, 2012

Figure 9.9 3D Resistivity (upper) and Chargeability (lower) Models at 183 m Depth Derived from DISP Survey, Leprechaun, Showing Drillholes and Priority Area 2 Target Area



Source: Webster and Jelenic, 2012

9.5.2 Magnetic Data

Aeromagnetic Survey

In 2007, Richmont Mines conducted a detailed aeromagnetic survey across the entire project area (Figure 9.10). The results show that there is a complex structural geological association at the deposit areas, particularly at the Leprechaun, Marathon, Sprite, and Victory deposits. Distinct magnetic splays off the regional structural fabric at the Leprechaun and Sprite deposits are evident (SRK, 2014; Figure 9.11). These splays and their strike extensions represent good 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).

Figure 9.10 Airborne Magnetic (Reduced to Pole) Data from Richmond Mines (2007)

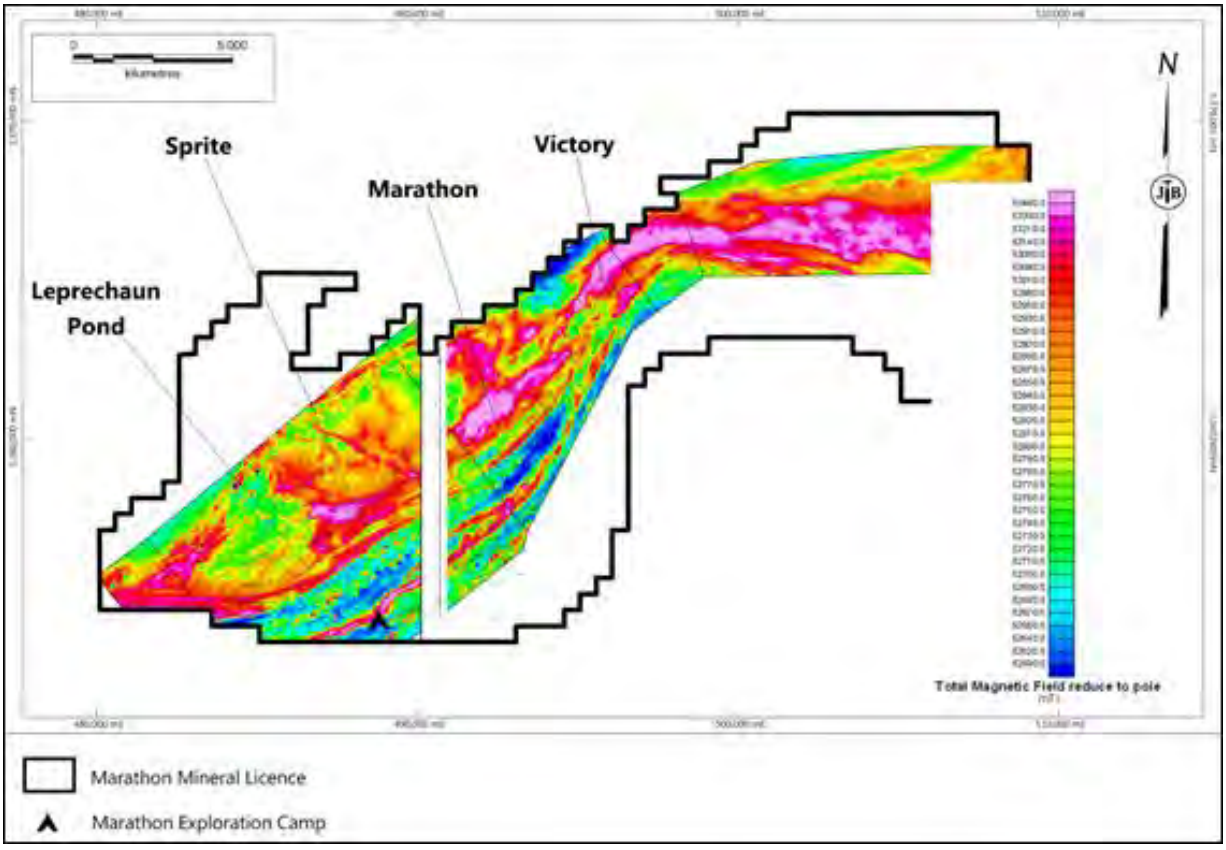
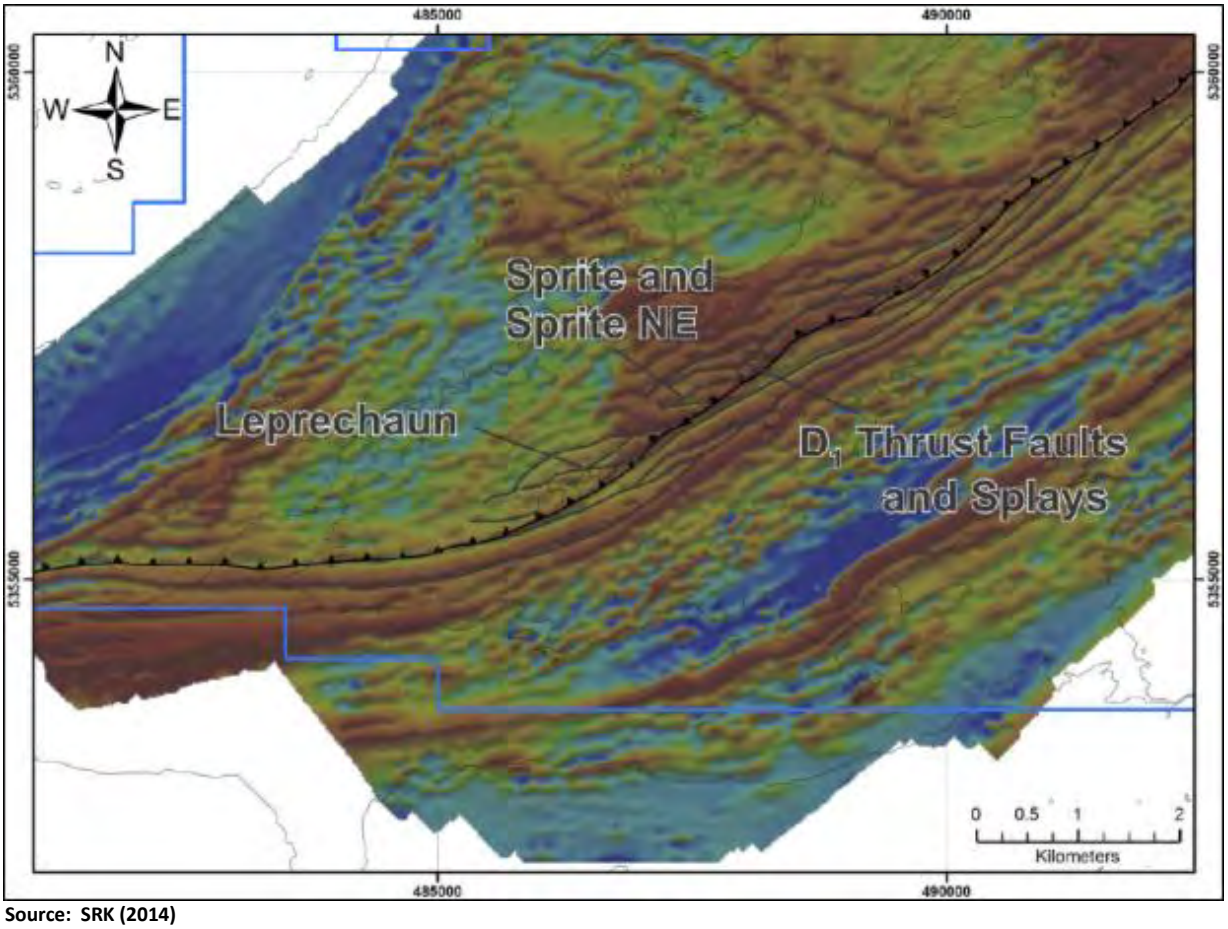


Figure 9.11 Detailed Total Magnetic Field Data at the Leprechaun and Sprite Deposits

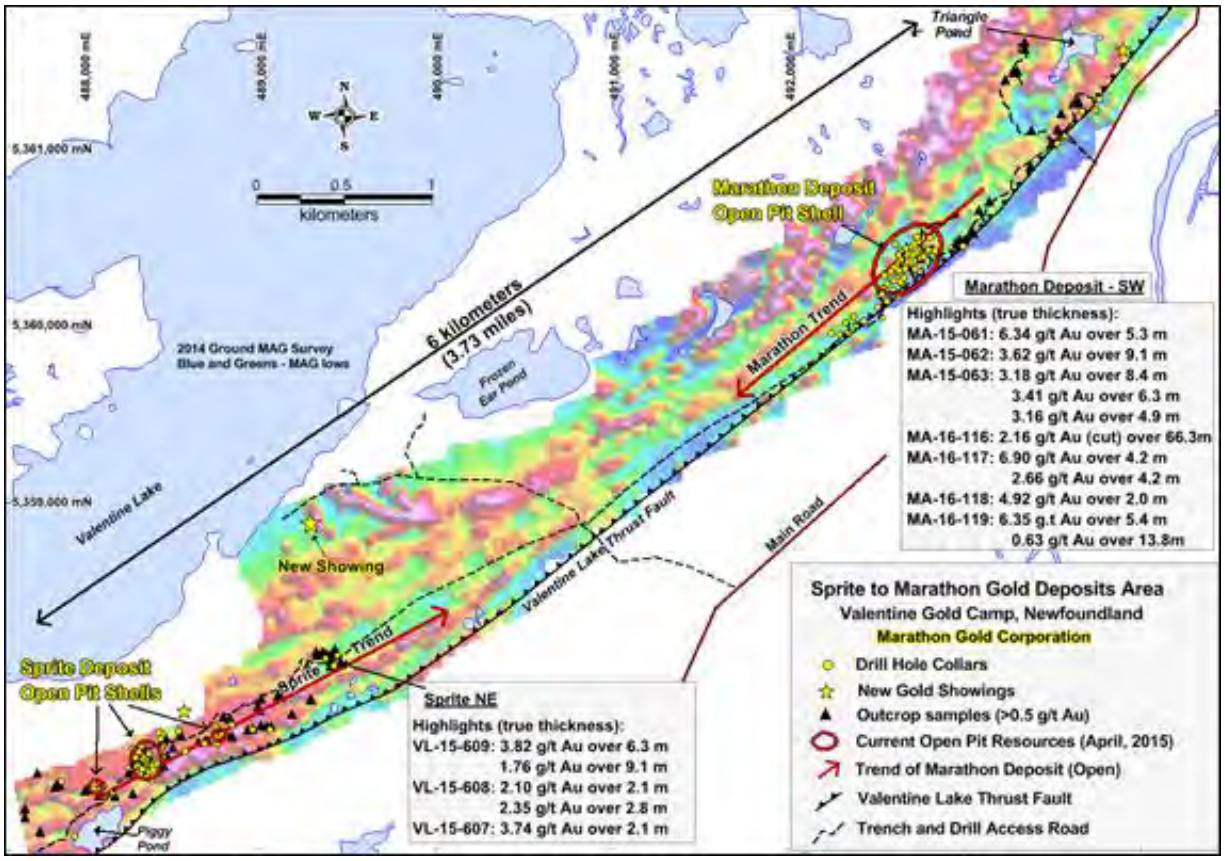


Source: SRK (2014)

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 mineralization 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 (Figure 9.12).

Figure 9.12 Ground Magnetic Data (Total Magnetic Field) and Drill Highlights, Valentine Lake Property



Source: Marathon Gold

9.5.3 Seismic Data

During 2017, a seismic survey was carried out by Acoustic Zoom Inc. (AZI) of Paradise, NL across a southwest-orientated 500 m wide by 2 km long zone at the Property (Figure 9.6). 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 sub-contracted 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.

Interpretation of the data from this survey by AZI is ongoing and will be included in a future Marathon Gold assessment report. The results of the survey and interpretation were not available at the Effective Date of this eport.

10.0 DRILLING

10.1 Introduction

To October 2018, Marathon Gold has drilled 950 holes totalling 219,825.35 m at the Property since 2010 (refer to Figures 10.1 to 10.5 and Table 10.1). The drilling incorporated into the databases used to estimate Mineral Resources is summarized in Table 10.2. Of the 950 drillholes, 865 holes were used in the resource estimation process. The 85 holes not used in the resource modelling and estimation are exploration drillholes that lie outside of the resource estimation area.

Table 10.1 Drilling Completed by Marathon Gold

Deposit/Occurrence Area	No. of Drillholes	Meters
Frank Zone (within Sprite Deposit)	67	9,236.80
Leprechaun	342	70,910.00
Marathon (as of October 29, 2018)	347	113,889.87
Sprite (includes the Rainbow Zone)	133	18,494.78
Victory	61	7,293.90
Total	**950**	**219,825.35**

Table 10.2 Drillhole Database Summary for Mineral Resource Estimates

Deposit	No. of Drillholes	Downhole Survey Points	Meters
Leprechaun	371	19,974	79,032
Marathon	333	17,087	108.575
Sprite	97	3,075	13,134
Victory	64	1,479	8,781

All drilling was completed as diamond core holes producing NQ diameter core. There has been no RC drilling and core splits are archived for future geological confirmation and QA/QC work. Drilling has been conducted as both inclined and subvertical holes to accommodate the variable dip of mineralized domains. Inclined holes were typically drilled at an inclination of 50° to 80° and were oriented 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 30 m x 30 m and rarely 10 m x 10 m at the Marathon and Leprechaun deposits.

Figure 10.1 Location of Diamond Drillholes Completed by Marathon Gold, Valentine Lake Project

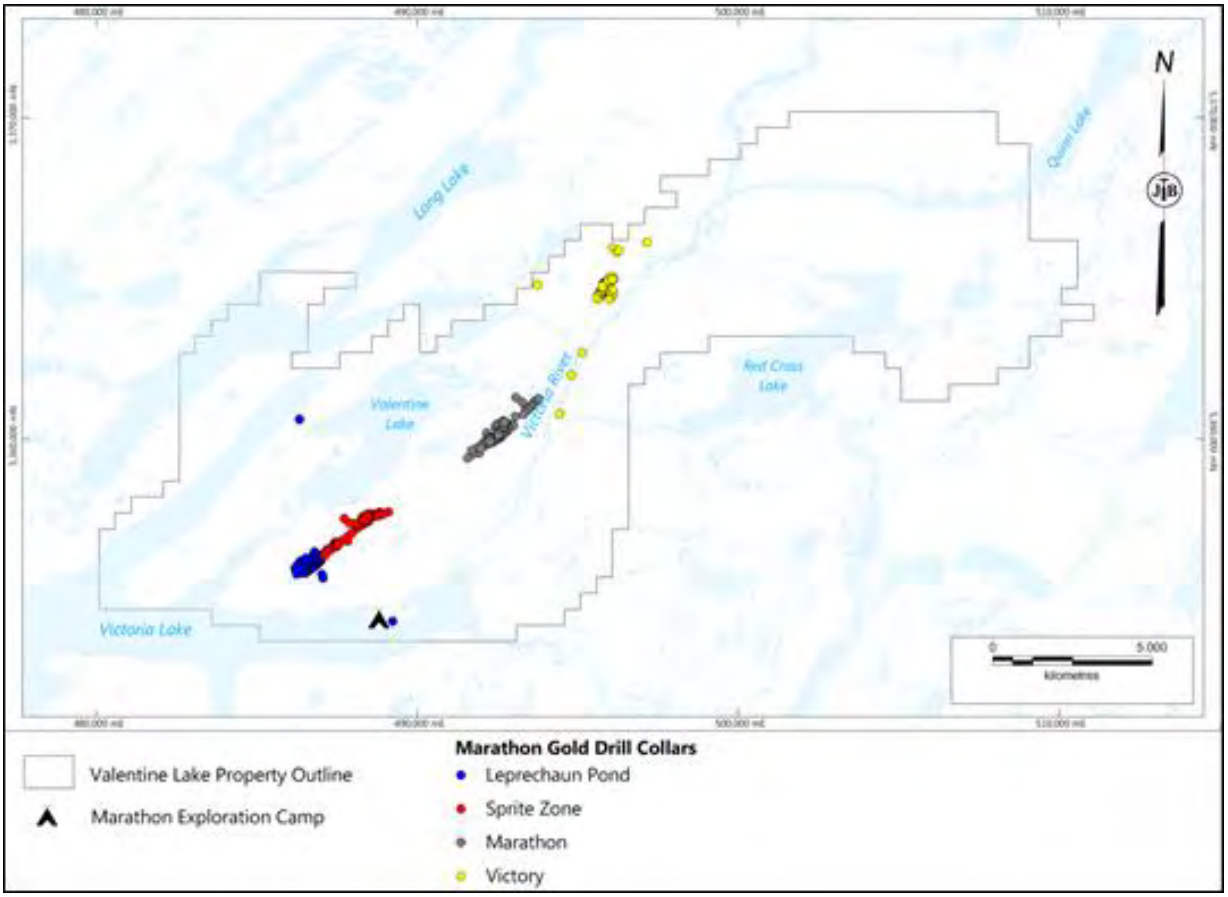


Figure 10.2 Diamond Drill Collars (Blue Cross) and Trace Shade (Line), Leprechaun Deposit

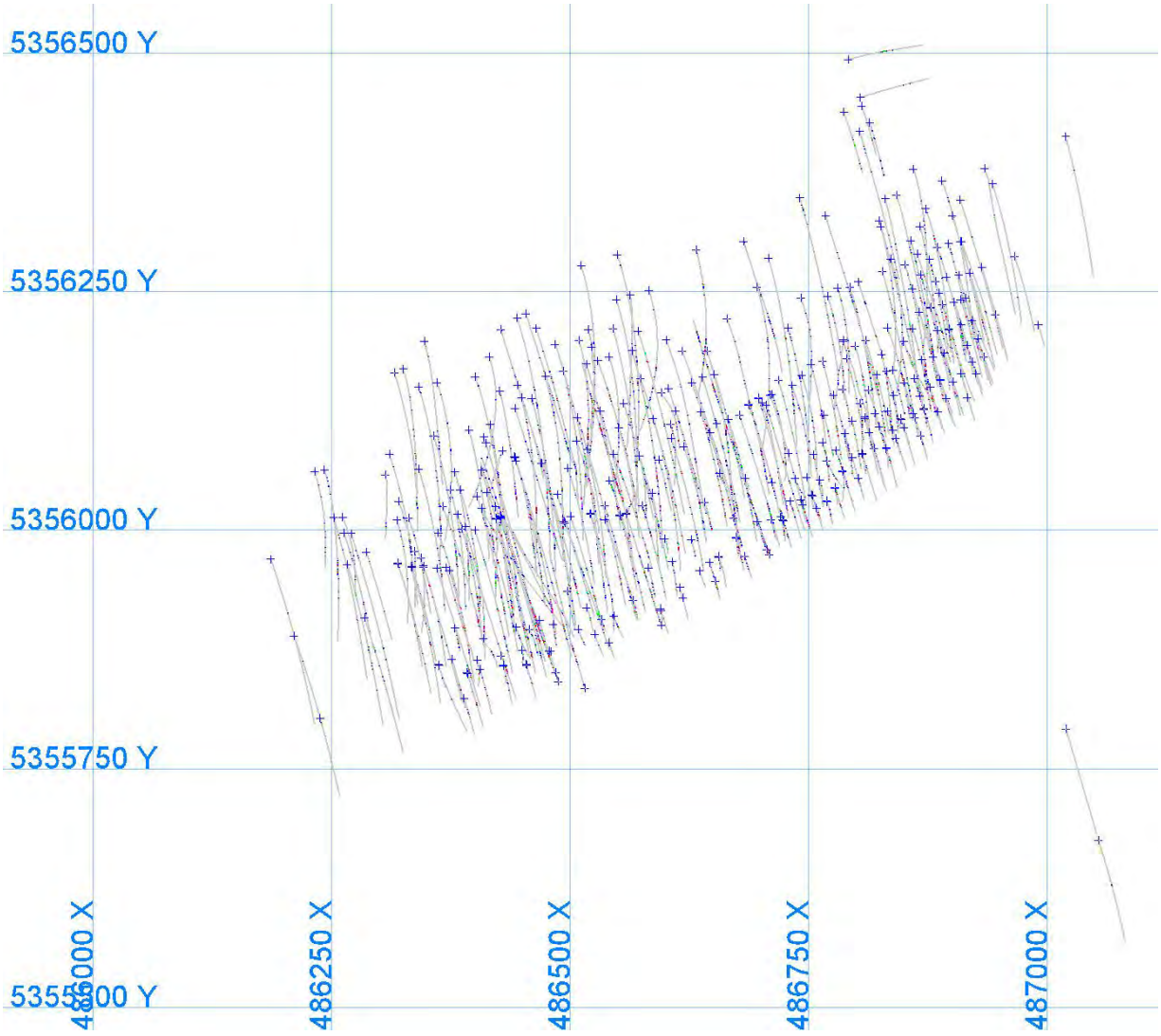


Figure 10.3 Diamond Drill Collars (Blue Cross) and Trace Shade (Line), Marathon Deposit

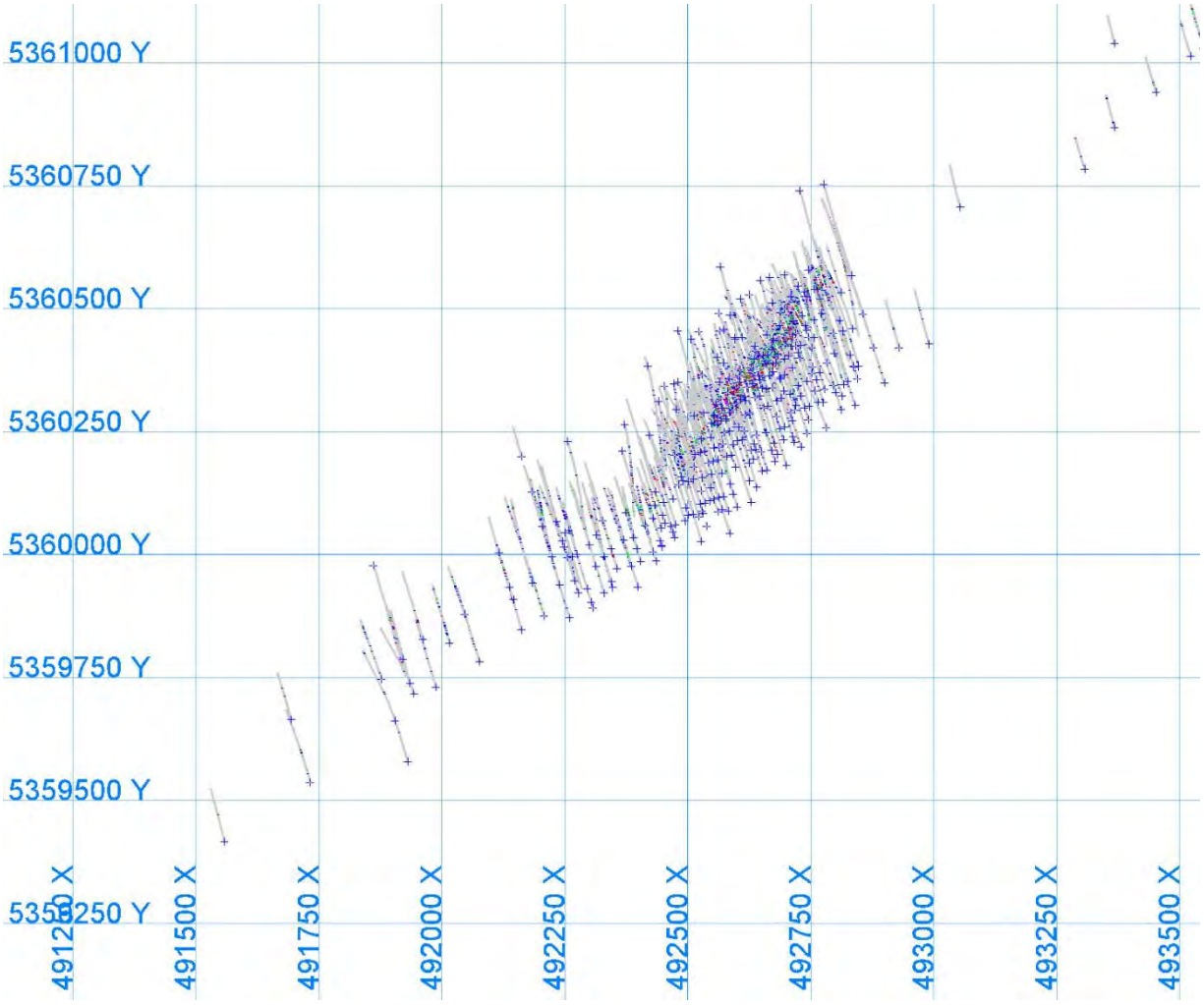


Figure 10.4 Diamond Drill Collars (Blue Cross) and Trace Shade (Line), Sprite Deposit

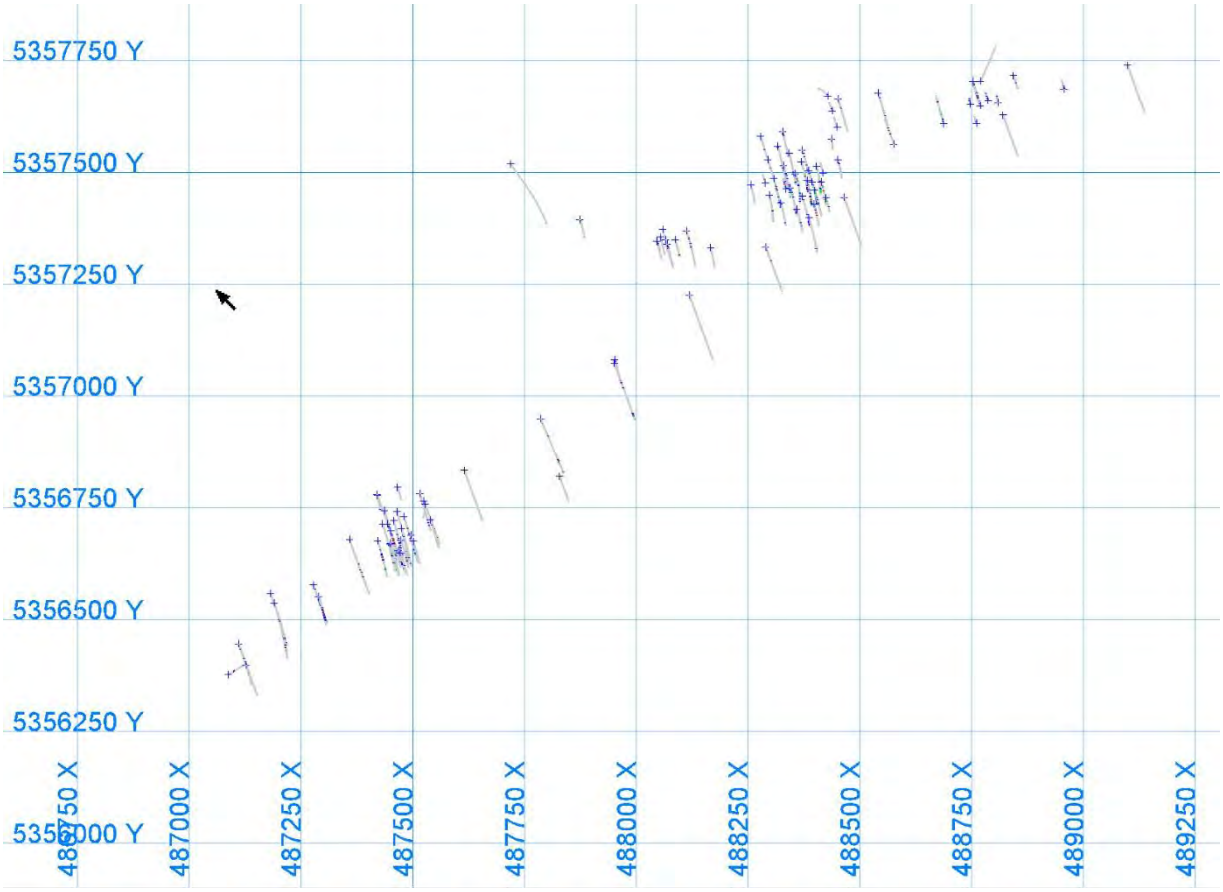
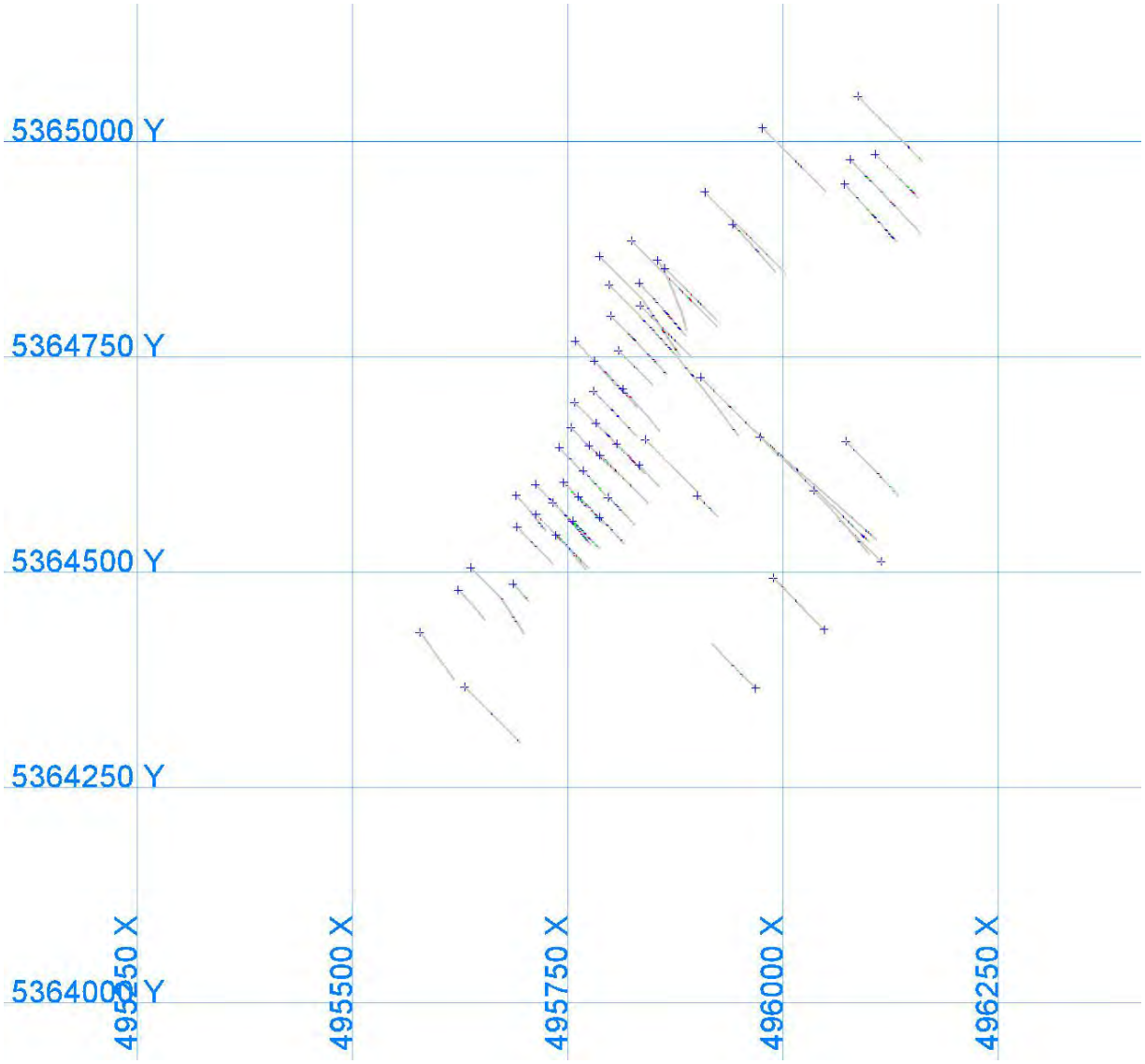


Figure 10.5 Diamond Drill Collars (Blue Cross) and Trace Shade (Line), Victory Deposit



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 between 2012 and 2018. Drilling was conducted using wireline double tube barrels that produced NQ size core over the entire program. Run lengths were typically 3 m, and were reduced in zones of poor recovery. Downhole deviation surveys were routinely measured using a Reflex Maribor II and Reflex Easy-Gyro instruments (Table 10.2).

At the end of each run, drill core was placed by the driller into core boxes which were marked with a drillhole and box number. The driller inserted a block marked with the run depth at the end of each run. The drill core was transported to the company core logging facility at the end of each shift.

Following completion of the hole, collars were marked with a wooden pole inserted into the casing which was labelled with the hole number. Drill collar positions were located after completion of the drillhole using a Trimble GPS system, comprising an R8 base station and hand-held Geo XM with base station correction. This has yielded an accuracy of <10 cm on collar locations, and has also 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 fit on a core rack, marked with an orientation line and geotechnically logged. The core was placed back into the core box, photographed, geologically logged, and marked up 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 Section 10.3 and 10.4, below.

10.3 Logging

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. Geological logging included an initial summary log of the principle rock types and mineralized intervals, followed by a detailed geological log that described a pre-determined index of rock type, detailed lithology, alteration type and degree, mineralization 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

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 mineralized zones and 2-m intervals in barren zones. Sample locations were noted on the geological log sheet. 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 regardless of mineralization.

Specific gravity measurements were routinely taken by Marathon Gold geologists' onsite using the Archimedes method. Samples were selected from whole core and were chosen to represent the different lithologies, alteration types, and mineralized domains observed at Marathon Gold.

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 nor 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, are entered directly into Excel worksheets per hole, and are manually updated into a master worksheet by Marathon Gold's VP of Exploration..

Assay results are appended to the geological worksheets using the automatic VLookup function in Excel, with the sample number providing a unique reference. This minimizes the risk of data transcription errors when receiving analytical results.

10.7 Results of Drilling Programs

Drilling by Marathon Gold has defined four gold deposits (Leprechaun, Marathon, Victory, and Sprite) at the Property, and the results of this drilling have been used to prepare the Mineral Resource estimates on all four deposits as presented in Chapter 14 of this report. The QTP veins occur as a variety of shallow dipping, en echelon arrays, lesser steeply dipping sub-parallel shear zones and localized zones of intense stockwork veining. The individual characteristics of mineralization at the Marathon, Leprechaun, Sprite, and Victory deposits are described in Section 7.4, Mineralization. Representative sections of each deposit are shown in Figures 10.6 to 10.9.

Figure 10.6 Example Cross Section Showing Lithological Trace Shade and Gold Assay Histogram, Leprechaun Deposit

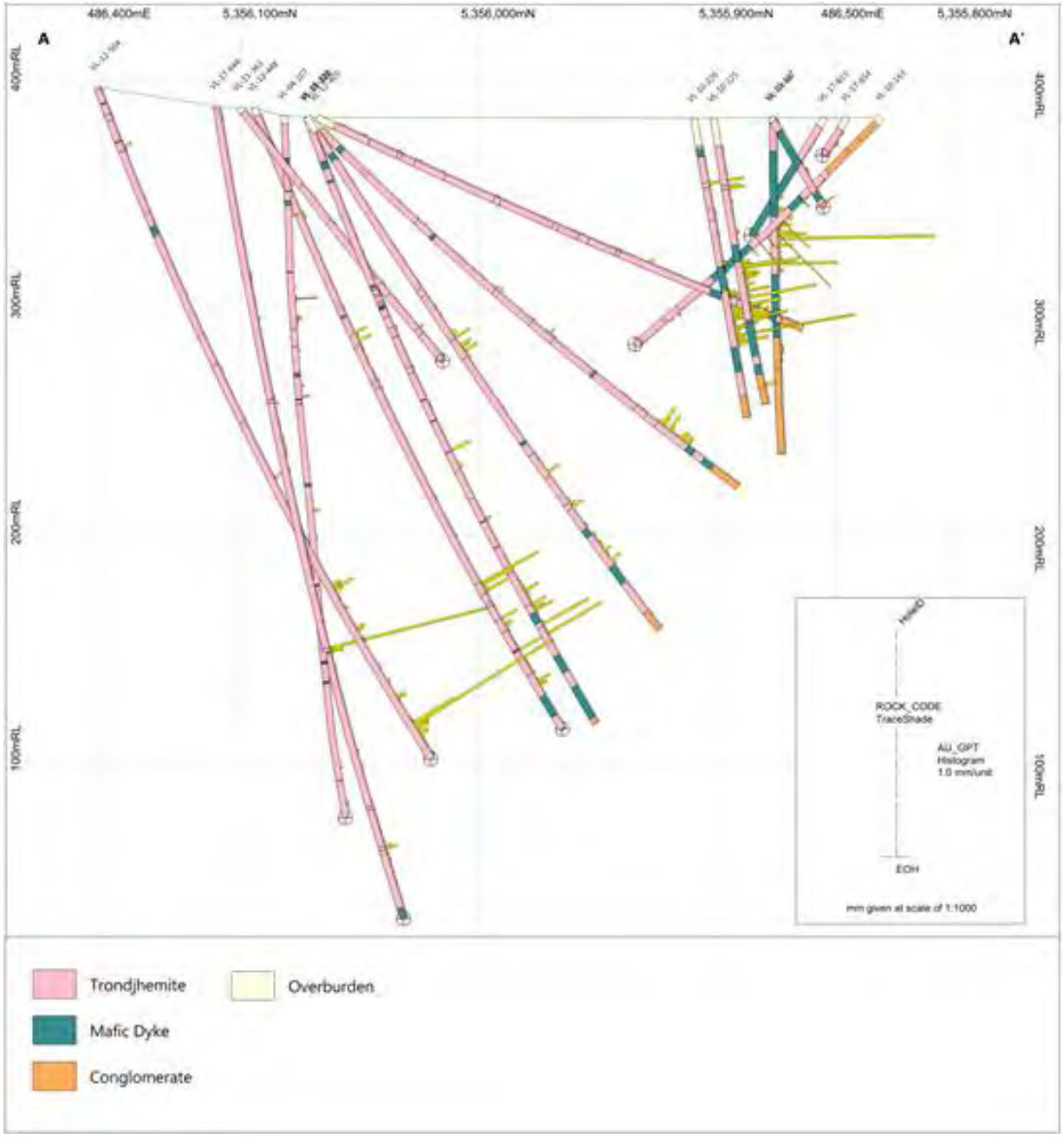


Figure 10.7 Example Cross Section Showing Lithological Trace Shade and Gold Assay Histogram, Marathon Deposit

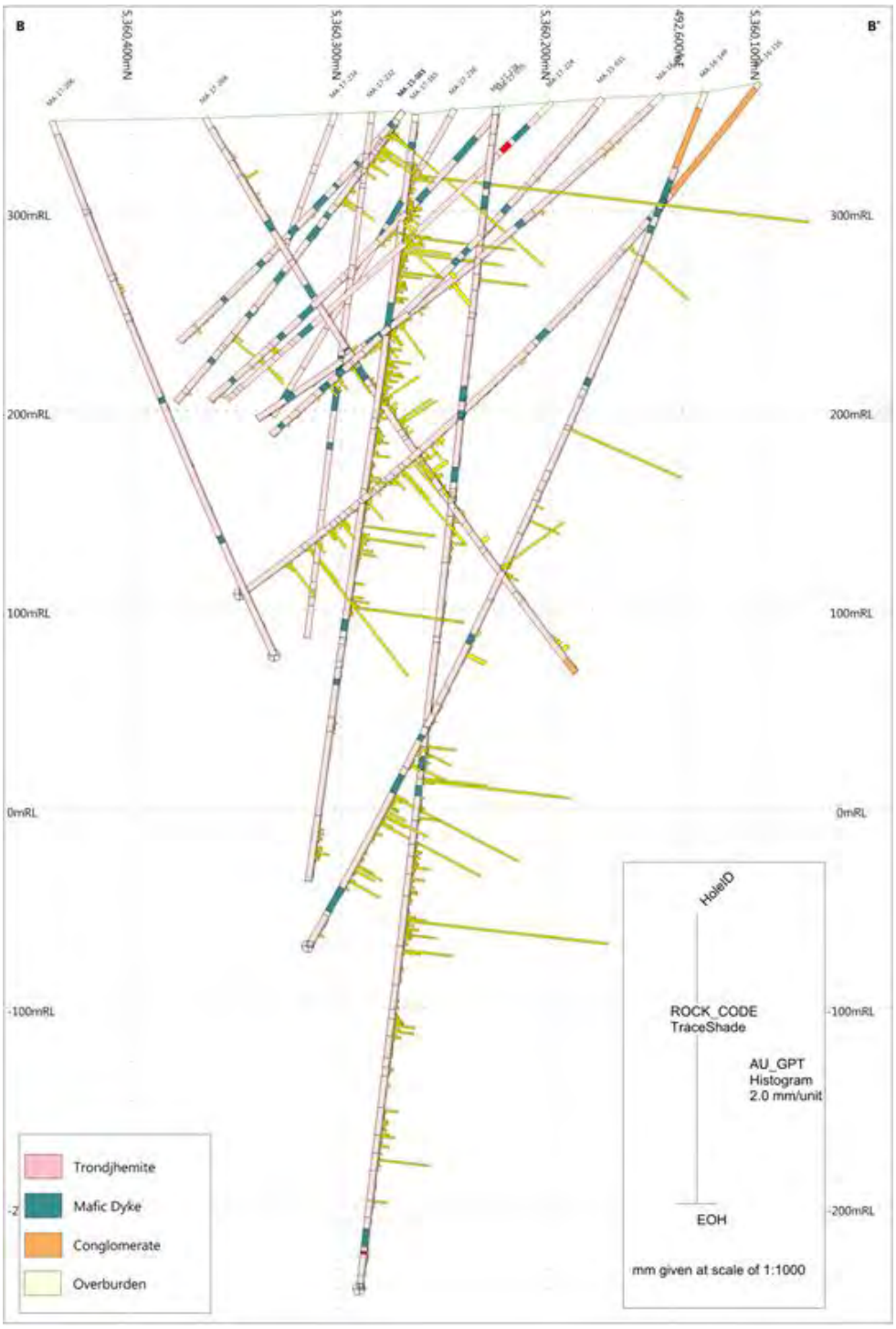


Figure 10.8 Example Cross Section Showing Lithological Trace Shade and Gold Assay Histogram, Sprite Deposit

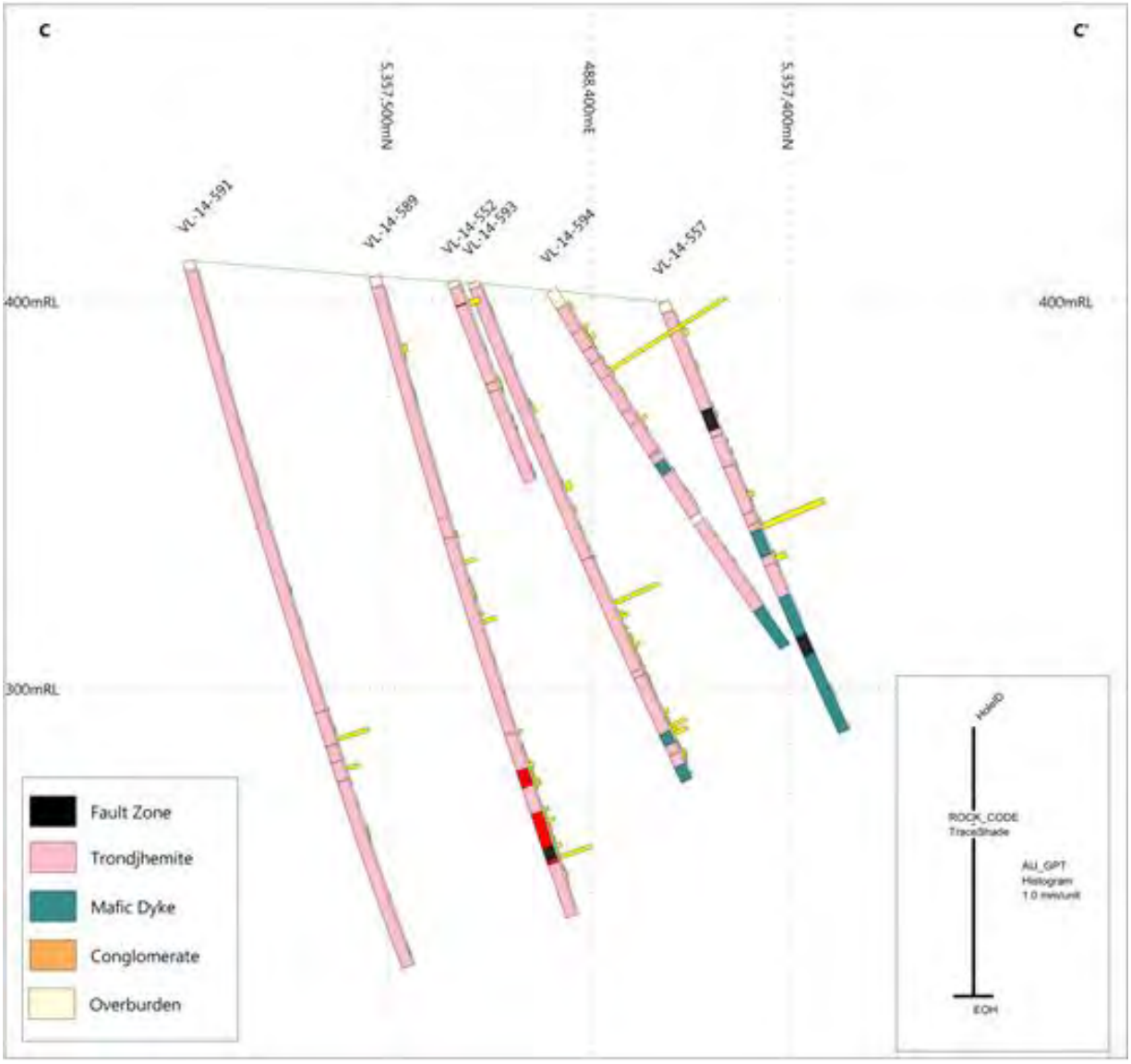
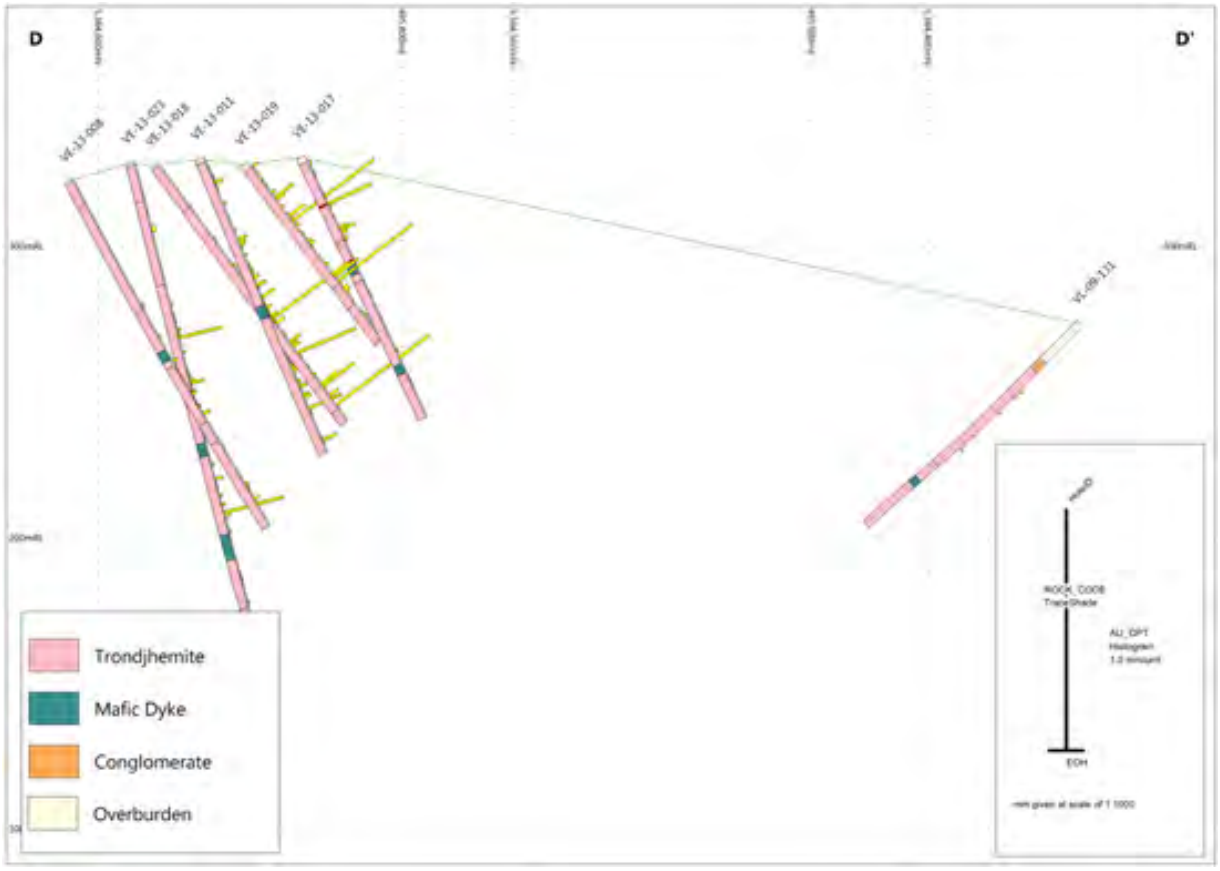


Figure 10.9 Example Cross Section Showing Lithological Trace Shade and Gold Assay Histogram, Victory Deposit



11.0 SAMPLE PREPARATION, ANALYSES AND SECURITY

11.1 Introduction

All exploration samples that were used in the Mineral Resource estimate databases were prepared and analyzed 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 pulverized to at least 95% minus 150 mesh (106 µm).

11.4 Analyses

Eastern Analytical analyzed each sample for gold by fire assay. All samples that assayed greater than 100 ppb gold were also 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 analyzed samples by multi-element (32) 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 analyzed 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 procedure as follows:

- The entire sample was crushed to 80% passing -10 mesh and pulverized to 95% passing -150 mesh, prior to being sieved through a 150 mesh screen. The +150 mesh fraction was fire assayed as one sample and the weight was recorded.
- 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 ICP-32

Each sample comprised a 500 g 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 deionized water, stirred to homogenize and left to settle for one hour prior to analysis by ICP. Samples were prepared and analyzed in batches of 40 including two duplicates, one blank and one standard.

11.5 Quality Control and Quality Assurance

As well as reviewing the results of Eastern Analytical 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 analyzed 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 that the control sample had returned an acceptable value within the control limits.

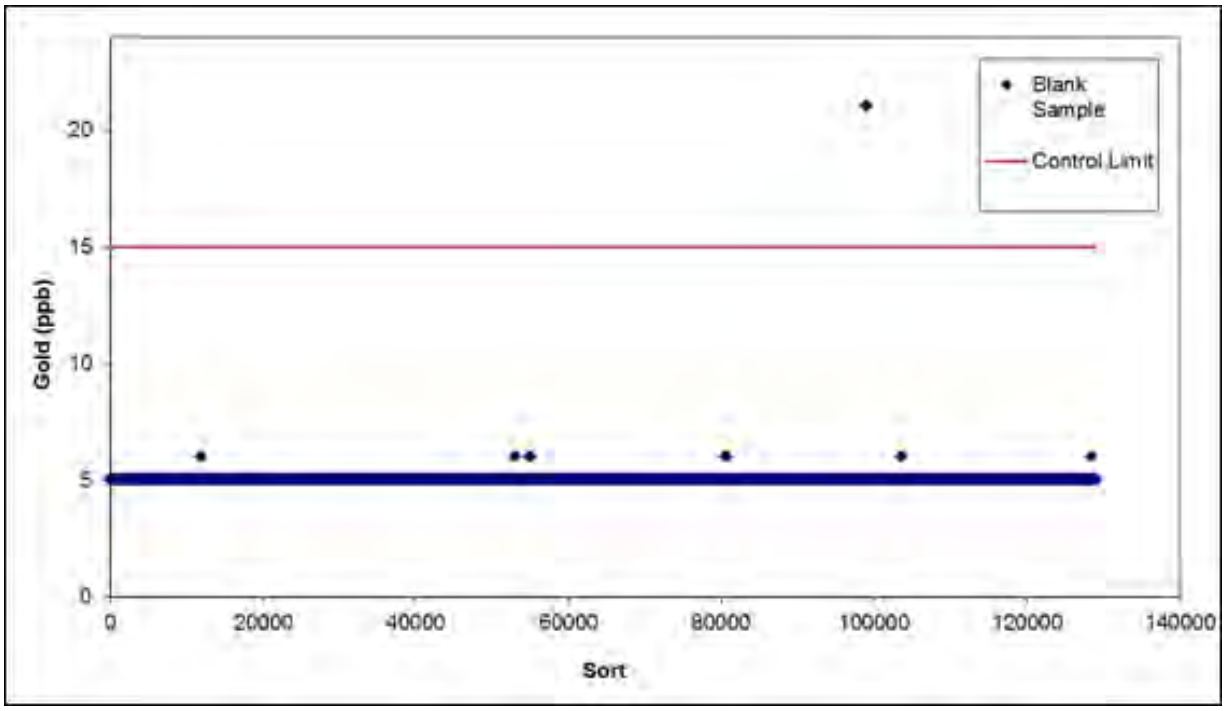
The materials used, protocols, control limits, and results are described below.

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 drill database contains 2,311 Sample Blanks. Only one failure is observed in the Project assay databases. The reason for this single failure is unknown, but BOYD considers that there is no evidence of sample contamination in the dataset.

Figure 11.1 Sample Blank Assay Results



11.5.2 Certified Reference Material

Marathon Gold has used 10 different CRMs with mean grades of 0.5 to 9.3 g/t gold (Table 11.1) and has analyzed a total of 4,825 CRMs. Marathon Gold rejects any batch of samples where the CRM returns an assay outside of ± 3 standard deviations and the batch is re-assayed.

Overall, the CRM performance is excellent with very few failures (Table 11.1). The results do demonstrate a potential weak negative bias for some CRMs, with a total average of 12.3% of CRMs assaying outside of -2 standard deviations, ranging between 0 and 39.1% of CRM samples (Table 11.1). The cause of this weak negative bias is not known, but it does not have a material impact on the mineral resource estimate.

Table 11.1 Summary of CRM Control Sample Performance

CRM ID	No. of Samples	CRM Mean (Au ppb)	Data Set Mean (Au ppb)	>+2SD (%)	<-2SD (%)	>3SD (%)	<-3SD (%)
GS-3Q	441	3,300	3,115	0.0	3.7	0.0	0.2
GS-P5C	581	575	560	0.9	3.4	0.2	0.2
GS-9A	893	9,310	9,223	1.1	4.0	0.1	1.0
GS-9B	220	9,020	8,850	0.0	0.0	0.0	0.0
GS-3L	295	3,180	3,040	0.0	20.7	0.0	2.7
GS-3F	417	3,100	2,918	0.2	39.1	0.2	4.3
GS-8A	843	8,250	8,062	0.1	2.4	0.0	0.9
GS-3H	650	3,040	2,858	0.0	32.5	0.0	1.2
GS-3J	257	2,710	2,601	0.4	8.9	0.0	3.1
GS-3K	228	3,190	3,043	0.0	19.3	0.0	2.2
Total	**4,825**		**Weighted Average:**	**0.4**	**12.3**	**0.1**	**1.4**

11.5.3 Duplicate Samples

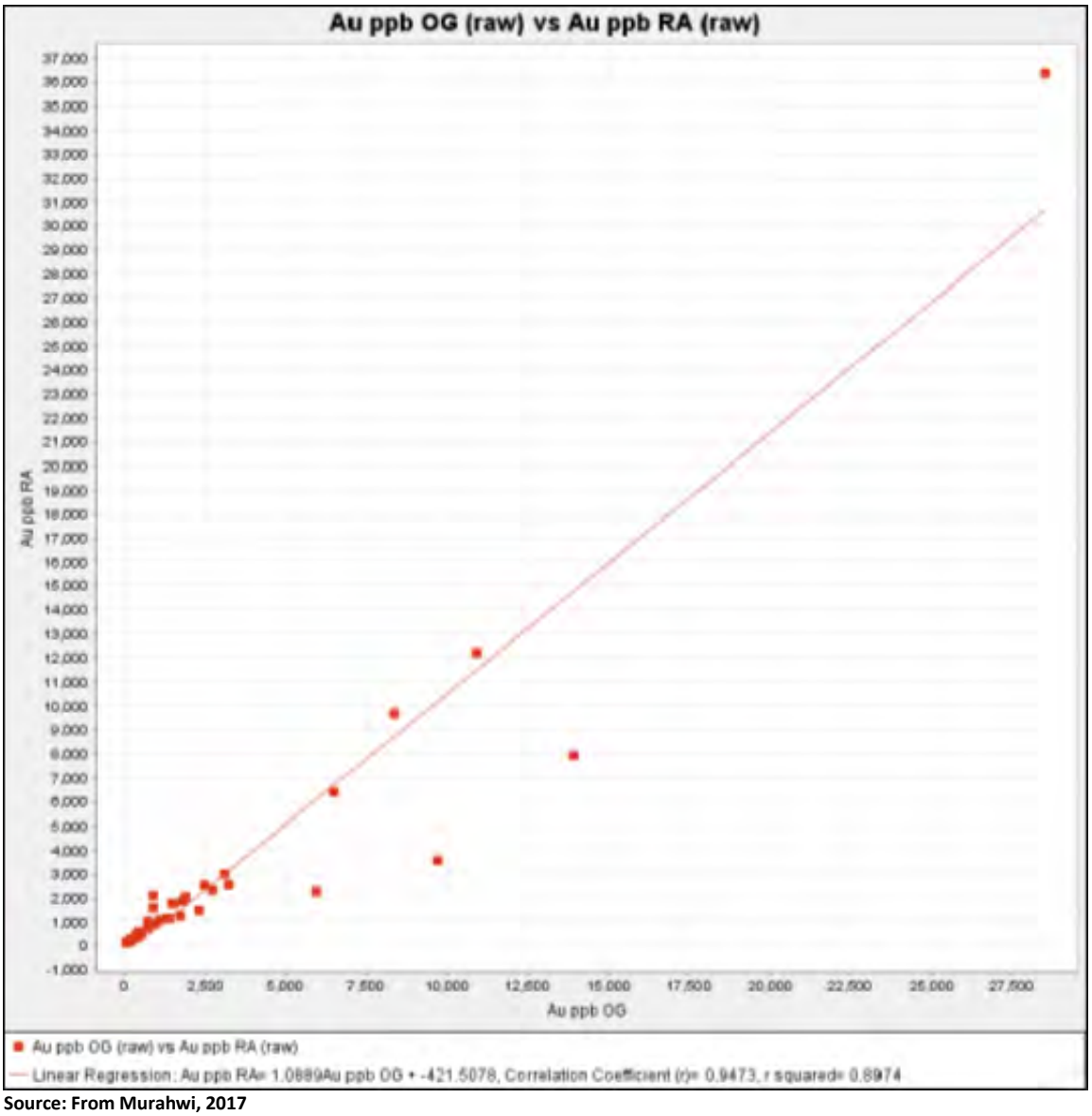
Marathon Gold does not routinely analyze field or laboratory duplicate samples. As part of their data verification during independent technical reporting in 2010 and 2017, Micon submitted a total of 47 sample pulps for re-assay at Eastern Analytical. The sample pulps were selected from drill core samples and represented a range of gold grades, from 0.5 to >3,500 g/t gold. Results of the pulp duplicate analyses are shown in Figures 11.2 to 11.3, and demonstrate an overall good degree of repeatability.

There are several outliers from higher grade samples (Figure 11.3) that demonstrate an inherent nugget effect even in the pulverized 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

12.0 DATA VERIFICATION

12.1 Introduction

The authors 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. These included a site inspection, drill database verification, and independent analytical testwork by the authors, and are described below.

12.2 Site Inspection

BOYD and APEX conducted a site visit on 12 and 13 October 2017, to review field exposures and outcrop, observe select drill core intercepts, collect samples for independent analytical testwork, and discuss the geology and mineralization with Marathon Gold's senior technical team.

The authors conducted:

- 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 Sprite, Victory, Leprechaun Pond, and Marathon deposits. The remaining drillholes were validated by checking the digital geology logs and sample locations versus the original hardcopy drill logs.
- Field visits to the Frank, Leprechaun Pond, and Marathon deposits to observe outcrops and surface exposures, and to collect samples for independent analytical testwork. The authors also flew over the entire mineralized trend at the Project and observed the areas stripped for channel sampling and mapping at Sprite.
- Independent co-ordinate readings using hand held GPS of randomly selected drillhole collars to verify the accuracy of the reported locations.

The site inspection allowed the authors to verify the location and good standing of the property, and to confirm the geological interpretations made in support of mineral resource estimation. No significant errors were found during the course of the site visit.

12.3 Drill Database

In order to verify the exploration data supplied by Marathon Gold, the authors 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. No issues were encountered with the database verification.

12.4 Independent Analytical Testwork

A total of seven samples were collected for independent analytical testwork by the authors: three from drill core and four from outcrop (Table 12.1). The samples were collected, bagged, sealed and couriered by the author to an independent laboratory, ALS Canada Ltd as well as an alternate laboratory, Eastern Analytical. (ALS) in Vancouver, British Columbia. At the independent laboratory, the samples were subjected to ALS' standard sample preparation and analytical practices as follows:

- Rock preparation Code PREP-31D, which 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, pulverize split to better than 85% passing 75 microns.

- Gold by Fire Assay and atomic absorption spectrometry Code Au-AA26 using a 50-gram nominal sample weight. Samples that analyzed over 100,000 ppb were further subjected to a 50-gram analysis by Fire Assay with a gravimetric finish.

The author's three random 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 in an attempt to duplicate 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 and Figure 12.1 show / compare the Marathon Gold assay results and those results from the Qualified Person'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 the Company 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.

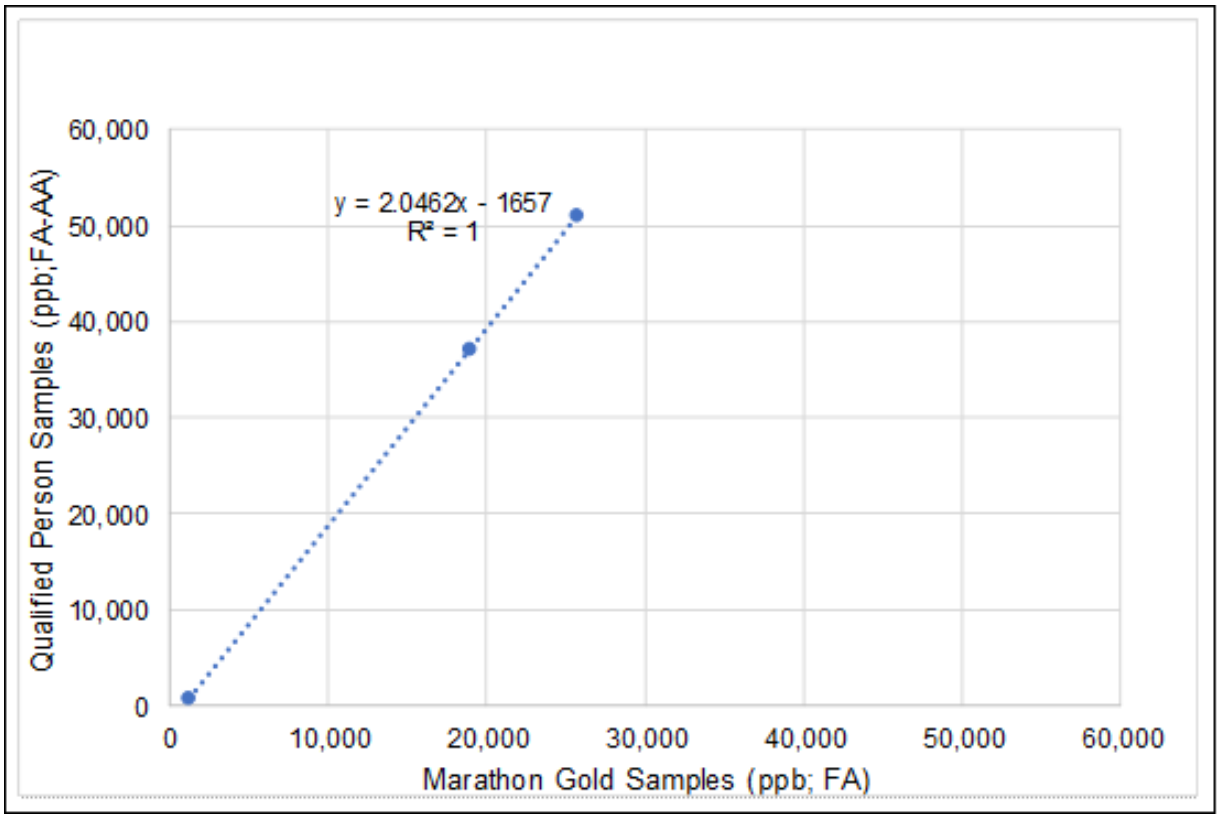
The difference could be related to many issues including, but not limited to sampling inconsistencies, sample preparation, and sample fire assaying techniques.

Table 12.1 Analytical Results of Seven Samples Collected by the Qualified Person during an October 2017 Site Inspection at the Valentine Lake Property

Sample ID	Drillhole or Outcrop Occurrence ID	Easting (m, Z21; Nad83)	Northing (m, Z21; Nad83)	Description	Drillhole, Sample & Assay Detail (from Marathon Gold Corp.)					QP Site Visit: Assay Results*	
					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 & 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 & quartz-tourmaline-pyrite vein(s)	225	226	124117	18,836	16,710	37,00	/
RE17-MA-003	Drillhole MA-16-149	492593	5360122	Quartz-eye porphyry & 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	492708	5360454	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

***Analytical work conducted at ALD Canada Ltd.; Au-AA26 is material grade Au 50 g FA-AA finish; Au-GRA22 is Au 50 g FA-GRAV finish (finalized 2017.11.14).**

Figure 12.1 **Comparison of Three Core Sample Assays that were Analyzed Separately by Marathon Gold, and the Qualified Person and Author of this Report**



Four samples were analyzed from outcrop material collected 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-analyzed 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 Qualified Person, and the results of analytical work conducted at an independent laboratory, confirm the gold mineralization at Marathon Gold's Valentine Lake Property. Three samples, including two random core samples and one outcrop float sample, yielded between 37,000 ppb and 251,000 ppb Au (37 - 251 g/t). In addition, a comparison between core assay work conducted by Marathon Gold and the author of this report shows that the Marathon Gold assays are not overstated.

13.0 MINERAL PROCESSING AND METALLURGICAL TESTING

13.1 Introduction

Metallurgical testwork programs were conducted on mineralized samples from the Valentine Lake Gold Camp between 2006 and 2018. The majority of the testwork programs were carried out for the Leprechaun deposit, with Marathon deposit included in more recent testwork. Thus far, no representative samples from the Sprite or the Victory deposits have been tested, although all the gold occurrences for these deposits share similar general characteristics, where gold mineralization is associated with quartz-tourmaline-pyrite (QTP).

The following testwork programs have been conducted to date:

- 2006 preliminary scoping tests by Laboratoire LTM Inc. (LMT).
- 2010 preliminary testwork program by G&T Metallurgical Services (G&T).
- 2011 preliminary gold recovery flowsheet development by G&T.
- 2014 preliminary assessment of gold processing options by Thibault & Associates Inc. (Thibault).
- 2016 Marathon deposit flowsheet assessment by Thibault & Associates Inc.
- 2018 Testwork on Marathon Gold, Valentine Lake Project Samples (in-progress at SGS).

Lycopodium was directed by Marathon Gold to utilize the data from the Thibault reports (2014 and 2016) and the interim SGS testwork results for the PEA, as they contain the latest metallurgical testwork results for Leprechaun and Marathon deposits.

13.2 Historical Testwork Programs

13.2.1 LMT 2006 Test Program

A total of 882 kg of assay rejects from five drillholes at the Leprechaun deposit were shipped to be tested at the LMT laboratory in 2006. The test program was intended to conduct cyanide leaching and gravity separation; however, LTM stated the possibility of a mix-up of samples during the analyses. Despite this possible error, LTM still concluded that approximately 85% of the contained gold could be extracted by standard gold recovery methods.

13.2.2 G&T 2010 Test Program

Approximately 50 kg of split drill core from the Leprechaun deposit was selected by Marathon Gold to form a master composite (MC1) representing typical mineralization at about average grade (3.6 g/t Au and 0.65 g/t Ag) for the deposit. The main objectives of this program were as follow:

- Study the mineral composition and characteristics of the composite using the Particle Mineral Analysis (PMA) function built into QEMSCAN (Quantitative Evaluation of Minerals by SCANning electron microscopy).

- Investigate the material's amenability to cyanidation and gravity separation techniques.
- Conduct gold searches using Gold Automated Digital Imaging System (ADIS) technique on the gravity concentrate to identify gold occurrences in sample.
- Study the material hardness using standard Bond ball mill work index test.
- Determine if gold and silver can be recovered as flotation concentrate.
- Optimize gold and silver extract through combining gravity, flotation and cyanidation techniques.

Material Properties

The chemical analysis of the composite feed sample is presented in Table 13.1.

Table 13.1 Metallurgical Sample Head Chemical Analysis – G&T 2010

Element	Cu (%)	Fe (%)	Au (g/t)	Ag (g/t)	S (%)	C (%)
Value	0.004	1.59	3.62	0.65	0.64	0.82

Pyrite was determined to be the dominant sulphide mineral making up about 1% of the feed mass. Chalcopyrite and pyrrhotite had a minor presence. The sample liberated well at a P_{80} of 71 µm with pyrite and pyrrhotite liberation at about 90%. ADIS searches on the pan concentrate showed that just over 50% of the gold was locked in binary assemblages with pyrite, with most of the remaining occurrences as liberated gold particles. Some of the pyrite particles were quite complex and gold would be difficult to extract using cyanidation leach processes. The material was considered to be of moderate hardness, with a Bond BWi of 14.5 kWh/t.

Metallurgical Results

Four gravity separation tests were completed in total, two were conducted on primary grind sizes (P_{80}) of 71µm and 193 µm, and the other two were conducted at a P_{80} of 120 µm. The tailings from the first two tests were subjected to cyanidation bottle roll tests at three cyanide solution strengths, i.e. 0.5, 1.0 and 2.0 g/L. This resulted in gold extractions ranging between 80 and 87% with respect to the cyanidation feed. Tailings from the last two tests were then subjected to rougher flotation separation. The rougher concentrates from these two tests were combined and subject to a cyanidation leach test. Overall gold recoveries for the combined processes ranged from 86 to 95%. Silver recoveries were lower, ranging from 46 to 56%.

Two cleaner flotation tests on fresh material (without gravity separation) were also completed at two primary grind sizes (P_{80}), i.e. 71 µm and 143 µm. Gold recoveries to the final concentrate were lower at 77% and 66%, respectively, in comparison to the other flowsheets. Gold recoveries were 81% and 77%, respectively, to the rougher flotation concentrate, which is still lower than the flowsheets that comprises of a gravity concentration process.

The gravity process accounted for between 46 to 62% of the overall gold recovery. The remaining 38 to 50% of the gold extraction was recovered using the cyanidation leach process or flotation process on the gravity tailings.

G&T stated that higher recoveries in the gravity, flotation, and cyanidation tests were achieved at the finer primary grind sizes. However, an economic analysis evaluating the cost and throughput implications of finer grinding would need to be undertaken to determine if the additional gold extraction is economically justified.

13.2.3 G&T 2011 Test Program

An additional program by G&T was conducted to optimize gold recovery process flowsheets for a Leprechaun master composite (MC2). Subsequent composites at varying gold grades were also tested using the most promising processing method. However, this was never conducted and only MC2 was used per Marathon Gold's direction at the time.

MC2 had a measured gold head grade of 3.24 g/t, although duplicate assays showed significant variability. Approximately 40 to 50% of the feed gold was recovered in the gravity concentration step, suggesting the presence of coarse free gold. This explains some of the difficulties in achieving consistent measurements of the gold feed grade, even using metallic assaying procedures.

A QEMSCAN PMA was completed on pulverized MC2. The sulphide mineral content was 1.3% of the composite mass. The main sulphide minerals observed were pyrite and chalcopyrite. The non-sulphide gangue minerals were mainly feldspars, quartz, and muscovite.

Three flowsheets featuring gravity/cyanidation, gravity/flotation, and gravity/flotation followed by cyanidation of the rougher concentrate were tested. At a primary grind size (P_{80}) of 169 µm, overall gold recoveries were similar for the gravity/cyanidation and gravity flotation flowsheets. The overall gold recovery was about 89% for the gravity/cyanidation flowsheet, and 95% for the gravity/flotation flowsheet. The rougher flotation concentrate gold grade was about 70 g/t with a feed mass recovery of about 1.5% for the gravity flotation flowsheet. Cyanidation of the rougher concentrate resulted in a decrease in overall gold recovery. When very intensive leach conditions were used on the rougher concentrate, an overall gold recovery of 88% was obtained. This result would need to be confirmed via further testing.

According to this particular test program, G&T concluded that the best flowsheet for processing MC2 appears to be gravity separation plus cyanidation of gravity tailing. Although the overall gold recoveries are lower than the gravity/flotation flowsheet, it appears to be less sensitive to primary grind sizing. G&T noted, once again, that further testing is required for confirmation, and that additional testing will also be required to establish variability in metallurgical performance across a range of representative samples from the deposit. G&T recommended selecting variability samples on the basis of lithology, geographical coordinates, and gold content in the feed. A modal of gold recovery by gold feed grade could then be developed from the variability data.

13.3 Most Recent Test Programs

The Thibault 2014 report (Phase 1) focused only on studying high-grade material in the Leprechaun deposit, while the 2016 report (Phase 2) focused on studying high-grade material in the Marathon deposit and the lower grades material in both Marathon and Leprechaun deposits. The current 2018 SGS program focuses on providing sufficient testwork for a milling and heap leach design at a PFS level. The sections to follow describe the two Thibault reports and the interim 2018 SGS results in greater details.

13.3.1 Thibault 2014 Test Program

Metallurgical Sample

Marathon selected 51 samples of halved drill core to represent the Leprechaun deposit and submitted them to be stage-crushed and blended to form a 100 kg bulk sample as feed for the Thibault Phase 1 test program. This bulk sample is referred to as Master Composite 3 (MC3) to maintain similar naming convention used in previous test programs.

Material Properties

The gold head grade of MC3 was assessed by various methods including direct fire assay, metallic screen assay and bulk cyanide leach. The assayed gold head grade for MC3 was stated as 3.30 g/t Au based on the average of triplicate metallic screen assays.

The Bond BWi for MC3 was determined to be 15.9 kWh/t based on sieve size of 150 mesh (106 µm). This compares well to the 14.5 kWh/t stated in the G&T test program.

Gold was identified to be the only precious metal of economic significant for the sample. There were small amounts of sulphides (mainly pyrite) in a primarily silicate gangue. Concentrations of base metals (Cu, Pb, Zn) and deleterious heavy metals (As, Cd, Hg, Se) were all very low (less than 50 g/t each), as was the organic carbon content. Hence, MC3 was considered to be "clean", in which processing the material should come with ease along with minimum environmental considerations.

Flowsheet Options

Four gold processing flowsheet concepts were proposed for the Thibault scoping-level assessment:

- Option 1 – Gravity Gold Recovery followed by Cyanidation of Gravity Tailings.
- Option 2 – Gravity Gold Recovery followed by Flotation of Gravity Tailings and Cyanidation of Flotation Concentrate.
- Option 3 – Direct Flotation of Gold followed by Cyanidation of Flotation Concentrate.
- Option 4 – Direct Flotation of Gold plus Cyanidation of Flotation Concentrate and Tailings.

Metallurgical Results

<u>Gravity Separation Tests</u>

Gravity separation testing was completed on 10 kg of sub-samples of MC3 at three primary grind sizes (P_{80}) of 250, 150 and 75 µm. The tests were conducted using a Knelson centrifugal separator and a Mozley table for cleaning of the gravity concentrate to assess the amount of gravity recoverable gold in MC3. Gold recovery to a gravity concentrate generally increased with decreasing feed particle size, and ranged from 32.7% at a P_{80} of 250 µm to 51.6% at a P_{80} of 75 µm, confirming that the Leprechaun Deposit contains significant gravity recoverable gold. Refer to Table 13.2 for a summary of the gravity separation results.

Table 13.2 Gravity Separation Results for MC3

Test No.	Grind Size (P_{80} – µm)	Mass Pull (%)	Concentrate Grade (Au g/t)	Gold Recovery (%)
KN-01	75	0.03	4,717	51.6
KN-02	150	0.04	2,876	43.4
KN-03	250	0.06	2,006	32.7

Flotation Tests

Direct flotation on the MC3 sample at primary grind specifications including a P80 of 150, 75 and 50 µm produced high recoveries to a combined rougher-scavenger concentrate ranging from 92.3% to 97.7%. The concentrates produced from direct flotation were also relatively high grade and assayed between 122.5 g/t and 517.6 g/t Au. The flotation kinetics were considered to be relatively fast with over 80% of gold recovered within the first three minutes.

Flotation tests completed on the gravity tailings produced gold recoveries in the range of 82.6 to 85.9% to a combined rougher-scavenger product grades between 66.2 g/t and 92.8 g/t Au. The gold recoveries were observed to be relative to the gravity tailings gold grades. The combined recovery for pre-concentration using a combination of gravity gold recovery followed by flotation of the gravity tailings ranged from 90.1 to 93.2%.

The reagents used in the flotation tests were potassium amyl xanthate as the main sulphide mineral collector, AEROFLOAT 208, as the promoter, copper sulphate as the activator, and MIBC as the frother.

Thibault theorized that the overall recoveries of gold for the combined gravity separation followed by flotation of the gravity tailings should be comparable to the recovery obtained by direct flotation for the same conditions. Removing gravity recoverable gold was not expected to have an adverse affect on the flotation response of the remaining gold in the gravity tailings. This was evident in comparing the data from bulk flotation tests on gravity tailings for a primary grind P_{80} of 150 and 75 µm to the data from the direct flotation tests on MC3 for the same primary grind sizes. The results for both flowsheet options provided similar recoveries ranging between 90.1 to 93.2% for gravity followed by flotation, and 92.3 to 94.0% for direct flotation. The flotation test data also showed that it was possible to achieve higher recoveries at a finer primary grind size: 95.4% for the bulk direct flotation test at 69 µm P_{80}, and 97.7% for the direct flotation test P_{80} of 50 µm.

Cyanidation Leach Tests

The cyanidation test program included a standard preg-robbing test on MC3, intensive cyanidation of the gravity concentrate, cyanidation of gravity tailings, and cyanidation of both flotation concentrate and tailings.

According to the industry standard preg-robbing test conducted on MC3, the pre-robbing potential (PRP) of the sample was determined to be zero, indicating that there should not be any preg-robbing issues during cyanidation.

Intensive cyanidation of the gravity concentrate product with gold grade of 2,876 g/t generated a high gold extraction of slightly over 98% within the first 7 hrs, and 98.9% within 48 hrs of leaching.

Cyanidation of gravity tailings without regrinding resulted in limited gold leach extraction to a maximum value of 80.6% in 48 hrs at a relatively high target cyanide concentration of 5 g/L. In general, leach extraction from gravity tailings can be low due to slow reaction kinetics, indicating that gold in the gravity tailings may be encapsulated in pyrite or gangue minerals.

A series of leach tests were also conducted on gravity tailings with and without carbon-in-leach (CIL) at lower target cyanide concentrations and the results showed improvements in gold recovery from 71.7 to 78.2% at 1.5 g/L NaCN, and from 73.3 to 77.0% at 2.5 g/L NaCN. All gravity tailings tests were carried out on gravity tailings at a P_{80} of 150 µm. The results of subsequent cyanidation tests indicated that higher leach extractions could be achieved with regrinding of the gravity tailings and/or a finer primary grind size.

Cyanidation tests were conducted on flotation concentrates at P_{80} of 75µm without any regrinding and also without CIL. The result showed only 66.6% leach extraction was possible within 48 hrs at a target cyanide concentration of 5.0 g/L. A similar test (with the same leach conditions) conducted on flotation concentrate at P_{80} of 69 µm produced gold extraction of 82%. The leach extraction on the direct flotation concentrate was considered low, and regrinding to a relatively fine particle size (i.e. 15 to 20 µm) would likely provide higher recovery. Furthermore, a third cyanidation test on flotation concentrate without regrinding but with carbon at 5 g/L NaCN was conducted. The leach extraction for this test improved from 82.0 to 90.6%. This result indicated that the optimization of flotation concentrate leachability include the application of CIL.

Subsequent cyanidation tests were then conducted on flotation concentrate of P_{97} of 20 µm, combined with high targeted cyanide concentrations in the leach ranging from 5 to 10 g/L NaCN. The results from this series of testing generated a gold leach extraction as high as 98.2% within 48 hrs for the test conducted with 10 g/L NaCN.

Cyanidation testing of direct flotation tailings provided a maximum gold leach extraction of 78.4% from a tailings gold grade of 0.19 g/t. The leach residues of these tests were all approximately 0.05 g/t Au, which approaches the limit of gold leachability due to the low driving force for additional dissolution of gold; therefore, further recovery optimization would not be expected. Thibault suggested that a hybrid circuit, including recovery of gold from the reground flotation concentrate by CIL combined with CIL leaching of the flotation tailings using residual cyanide from the concentrate leach, may have merit and should be further investigated.

Gold Recovery and Selection of Unit Operations

Table 13.3, reproduced from the Thibault report, presents the gold recoveries for the four proposed flowsheet options mentioned earlier.

Table 13.3 Comparison of Proposed Flowsheet Options for Leprechaun

Flowsheet Option	Unit Operation (Gold Recovery %)	Unit Operation (Gold Recovery %)	Unit Operation (Gold Recovery %)	Unit Operation (Est'd Gold Recovery %)	Overall Gold Recovery
1	Gravity – KN-02 (43.4%)	Leach gravity tailings (80.6%)	Int. Cyanidation of Grav. Conc. – CN-LEA-02 (98.9%)	CIP-EW-Doré (99.0%)	87.7 %
2	Gravity – KN-01 (51.6%) Intensive CN Leach (98.9%)	Gravity Tailings Flotation – FL-07 to FL-10 (85.9%)	Cyanidation of Flot. Conc. – CN-LEA-08 (66.6%)	CIP-EW-Doré (99.0%)	77.9%
3	Direct flotation (95.4%)	Cyanidation of Flot. Conc. – CN-LEA-15 (98.2%)	N/A	CIP-EW-Doré (99.0%)	92.8%
4	Direct flotation (95.4%)	Cyanidation of Flot. Conc. – CN-LEA-15 (98.2%)	Cyanidation of Flot. Tailings – CN-LEA-18 (78.7%)	CIP-EW-Doré (99.0%)	96.3%

Flowsheet Option 3 and 4, with direct flotation as pre-concentration of gold, demonstrated the highest overall gold recovery, followed by Option 1 and 2 with gravity separation incorporated upstream of the flotation and cyanide leaching unit operations.

Although Option 4 provided the highest overall gold recovery, Thibault believed that the complexity and cost outweighed the benefit using a high-level economical assessment. Thibault recommended that further review of the concept be required to investigate the leachability of flotation tailings using CIL at low cyanide concentrations and low retention time to minimize the associated capital and operating costs of this flowsheet.

Thibault also mentioned that although Option 2 provided the lowest overall gold recovery, the leach extraction from gravity tailings has not been optimized. Further optimization on flotation combined with gravity gold recovery within primary grinding circuit is required to confirm the overall gold recovery for this flowsheet.

Geochemical Tests

Thibault completed static tests for preliminary characterization of the acid generating and metal leaching potential of samples of mineralized material, waste rock and tailings from the Leprechaun deposit in its Phase 1 study. Thibault concluded that the results of standard acid-base accounting (ABA) and toxicity characteristic leaching procedure (TCLP) tests demonstrated a low potential for acid generation and metal leaching from most samples, with the exception of one high-grade drill core pulp sample and a sample of the bulk sulphide concentrate. Based on the preliminary characterization of environmental stability, Thibault stated that it expected that any potential for acid generation and metal leaching from mineralized resource material, waste rock or process tailings could be effectively mitigated using industry standard sub-aqueous tailings disposal methods (i.e. neutralization and placement of potentially acid generating tailings under water cover).

13.3.2 Thibault 2016 Test Program

Metallurgical Samples

Marathon Gold selected and submitted drill core intervals to produce the five composite test samples to be used in the Thibault Phase 2 test program. The test samples comprised of one high grade and two low-grade composites representing the Marathon deposit, and two low-grade composites representing the Leprechaun deposit. The high-grade Marathon composite was subjected to similar testwork as the Leprechaun composite (MC3) per Phase 1 test program. The low-grade composites were subjected to short column leach testwork in order to evaluate the material's amenability to heap leaching.

Material Properties

The average gold grades based on all bench scale tests completed on the five composites are as follow:

- Marathon HG – 3.15 g/t Au.
- Marathon LG – 1.79 g/t Au.
- Marathon LG2 – 0.34 g/t Au.
- Leprechaun LG – 1.55 g/t Au.
- Leprechaun LG2 – 0.39 g/t Au.

A portion of the Marathon HG composite was submitted to SGS Mineral Services for a standard Bond BWi test at a closing size of 106 µm. The BWi result for sample was 15.7 kWh/t, very comparable to Leprechaun MC3's result.

Flowsheet Options

The three flowsheet options evaluated using the Marathon HG sample were as follows:

- Option 1 – Flotation followed by cyanidation of the flotation concentrate.
- Option 2 – Flotation followed by cyanidation of the flotation concentrate and flotation tailings.
- Option 3 – Gravity gold recovery followed by cyanidation of the gravity tailings.

Metallurgical Results

Gravity Separation and Flotation Tests

The Marathon HG sample had a significant amount of gravity recoverable gold at a grind size P_{80} of 75 µm, equivalent to 59.4% gravity recoverable gold in a concentrate product gold grade of 4,714 g/t. Refer to Table 13.4 for more details of the gravity separation results.

Table 13.4 Gravity Separation Test KN-01 Results for Marathon HG

Sample	Distribution Mass (%)	Gold Assay (g/t Au)	Gold Distribution (%)
Gravity Concentrate	0.046	4,717	59.4
Gravity Tailings	99.954	1.49	40.6
Calculated Head	100.000	3.66	100.0
Assayed Head		3.55	

The sample was also amenable to pre-concentration by flotation, with gold recovery as high as 94.7% to a flotation concentrate with a gold grade of 89.2 g/t at a grind size of 75 µm P_{80}. Marathon HG was also considered to have fast flotation kinetics similar to the Leprechaun MC3, with more than 80% gold recovered within the first 5 mins. Table 13.5 present all the flotation results at varying grind sizes for Marathon HG.

Table 13.5 Flotation Results at Varying Grind Sizes for Marathon HG after 15 Minutes

Test Number	Grind P80 (µm)	Gold Recovery (wt%)	Concentrate Gold Grade (g/t)	Mass Recovery (%)
FL-01	38	94.1	74.9	3.9
FL-02	75	94.5	114.3	3.0
FL-03	120	90.6	102.3	2.8
FL-05 to FL-18 (Bulk)	75	94.7	89.2	3.2

Flotation tests were also conducted on the gravity tailings generated from the gravity gold recovery test (KN-01). The gold recovery was 82.3% with a concentrate gold grade of 58.3 g/t. The overall gravity plus flotation gold recovery for this test was 91.8%, which is slightly lower than the direct flotation test at 94.5% gold recovery. Overall, it was observed that the flotation and gravity gold recovery results for the Marathon HG sample are comparable to the results achieved with the Leprechaun MC3 sample.

A flotation reagent scheme was also evaluated by conducting three additional flotation tests at a grind size P80 of 75 µm. The flotation conditions were kept the same but the reagent additions were varied – for example, doubling copper sulphate and collector dose, halving copper sulphate and collectors dose, and omitting copper sulphate while keeping collectors the same. The results from the reagent scheme evaluation indicated that a reduction in reagent additions for the Marathon HG sample from the standard conditions used in Phase 1 test program would still yield similar gold recovery.

Since the mass pull for the flotation concentrate was 3.2%, it is expected that the mass for the downstream processing of the flotation concentrate will be small.

Cyanidation Tests

Cyanidation tests were conducted on the Marathon HG flotation concentrate, flotation tailings and gravity tailings, with the focus mainly on cyanidation of flotation concentrate. The objectives of the flotation concentrate leach tests included evaluating the impact on leaching with and without carbon, impact of leaching

with varying cyanide concentration, and lastly with varying regrind size. Table 13.6 presents the results for the cyanidation tests for Marathon HG at varying leach conditions after 48 hrs of leaching.

Table 13.6 Marathon HG Cyanidation Tests with Variable Leach Conditions after 48 hrs

Test No.	Feed Solids	Description	Grind P_{80} (µm)	Target NaCN (g/L)	Pulp Density	Gold Extraction (wt%)	
						Relative to Feed Solids	Relative to Total Sample
CN-LEA-07	FL-05 to -18 Float Con	Bottle Roll Kinetic	34.8	5	20%	91.0%	86.1%
CN-LEA-08	FL-05 to -18 Float Con	Bottle Roll Kinetic	14.9	5	20%	96.8%	91.7%
CN-LEA-09	FL-05 to -18 Float Con	Bottle Roll Kinetic	23.4	5	20%	94.8%	89.8%
CN-LEA-10	KN-01 Gravity Tailings	Bottle Roll CIL	75	1.5	50%	88.4%	35.9%
CN-LEA-11	FL-02 Float Tailings	Bottle Roll CIL	75	0.5	50%	88.8%	4.8%
CN-LEA-12	FL-03 Float Tailings	Bottle Roll CIL	12	0.5	50%	88.7%	8.4%
CN-LEA-13	FL-05 to -18 Float Con	Bottle Roll CIL	34.8	5	20%	94.4%	89.4%
CN-LEA-14	FL-05 to -18 Float Con	Bottle Roll CIL	14.9	5	20%	97.9%	92.7%
CN-LEA-15	FL-05 to -18 Float Con	Bottle Roll CIL	23.4	5	20%	96.0%	90.9%
CN-LEA-16	FL-05 to -18 Float Con	Bottle Roll CIL	34.8	10	20%	95.6%	90.5%
CN-LEA-17	FL-05 to -18 Float Con	Bottle Roll CIL	14.9	10	20%	98.6%	93.4%
CN-LEA-18	FL-05 to -18 Float Con	Bottle Roll CIL	23.4	10	20%	97.5%	92.3%

The gold extraction was found to increase with CIL when compared with no carbon, as well as with increasing cyanide concentration and with decreasing regrind size. Gold extractability from the gold contained in the flotation concentrate ranged from 91.0 to 98.6%, depending on the conditions. Gold extraction from either gravity tailings or flotation tailings was 88 to 89% of the gold remaining in the tailings, respectively.

Gold Recovery and Selection of Unit Operations

Table 13.7, reproduced from the Thibault report, presents a summary of the overall gold recovery for the various flowsheets tested.

Table 13.7 Overall Gold Recovery for Various Flowsheet Options

Flowsheet Option	Unit Operation (Gold Recovery %)	Unit Operation (Gold Recovery %)	Unit Operation (Gold Recovery %)	Overall Gold Recovery
Option 1 (Minimum)	Flotation – FL-05 to FL-18 (94.7%)	Cyanidation of Flot. Conc. – CN-LEA-07 (91.0%)	N/A	86.1%
Option 1 (Maximum)	Flotation – FL-05 to FL-18 (94.7%)	Cyanidation of Float Conc. – CN-LEA-17 (98.6%)	N/A	93.4%
Option 2 (Minimum)	Flotation – FL-05 to FL-18 (94.7%)	Cyanidation of Flot. Conc. – CN-LEA-07 (91.0%)	Cyanidation of Flot. Tailings – CN-LEA-11 (88.8%)	90.8%
Option 2 (Maximum)	Flotation – FL-05 to FL-18 (94.7%)	Cyanidation of Flot. Conc. – CN-LEA-17 (98.6%)	Cyanidation of Flot. Tailings – CN-LEA-11 (88.8%)	98.1%
Option 3	Gravity Recovery – KN-01 (59.4%)	Cyanidation of Gravity Tailings – CN-LEA-10 (88.4%)	N/A	95.3%

A combined gold recovery of 93.4% was achievable for Option 1 when using the most aggressive leach conditions. The highest overall gold recovery for Option 2 of 98.1% was achieved by using the most aggressive concentrate leach conditions tested along with leaching of the flotation tailings. Maximizing the gold extraction using Option 2 may be justified as long as the concentrate leach tailings could be used as the source of cyanide and the additional capital cost of the tailings leaching circuit was low enough to provide a net improvement from the revenue increase. The use of gravity recovery followed by direct tailings leaching also provided an attractive gold recovery at 95.3% with Option 3. The cyanide addition in this case was similar to the flotation concentrate leach Option 1. Tests to optimize cyanide concentration in the leaching of gravity tailings were not conducted, and further decreases in cyanide use for gravity tailings may still be possible. The direct leach of gravity tailings in Option 2 may provide similar or higher gold recoveries as Option 1 using flotation pre-concentration, however additional capital will be required in Option 3 based on a larger cyanide leach circuit.

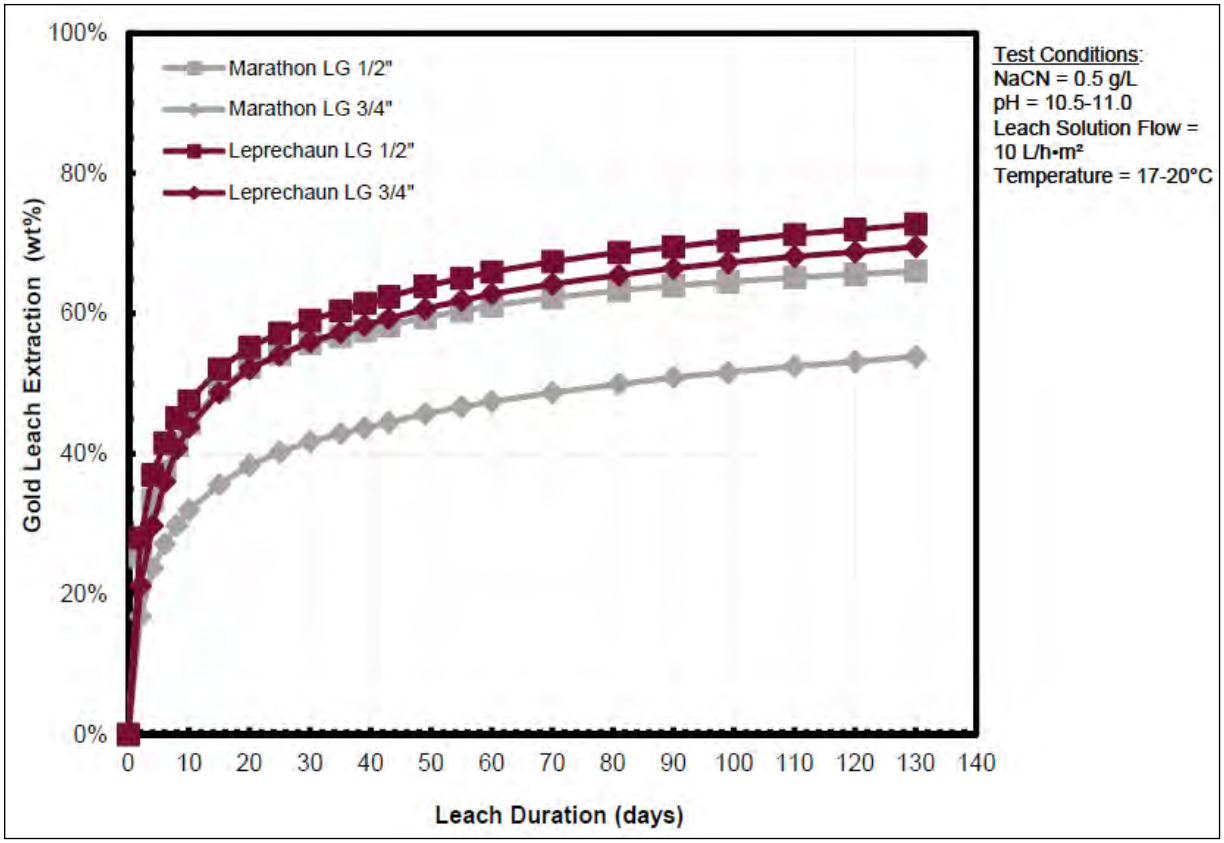
Lycopodium believes that gravity recovery of gold ahead of flotation in any option would likely improve overall recovery, reduce the amount of gold to be loaded on carbon, reduce in-plant gold inventory, and lead to greater circuit stability.

Heap Leaching Amenability Tests

Initial tests on the Marathon LG and Leprechaun LG samples indicate that there is good potential for gold in lower grade material to be recovered by heap leaching. Bottle rolls tests were conducted on crushed material to determine leachability and reagent requirements. The crushed material bottle roll leach tests indicated similar gold leachability for head grades ranging from 0.34 to 1.84 g/t gold. In addition, short column leach tests with continuous cyanide solution irrigation for 130 days were conducted at two different crush sizes. Figure 13.1, extracted from the Thibault report, indicates the results for the short column leach tests as follows:

- Leprechaun low grade (LG) – 72.7% (minus ½"), 69.6% (minus ¾").
- Marathon low grade (LG) – 66.0% (minus ½"), 53.9% (minus ¾").

Figure 13.1 Gold Extraction Kinetics for Column Leach Tests



Source: Thibault 2016

The results showed that the Leprechaun LG sample was more leachable than the Marathon LG sample. The Marathon LG sample appeared to be more sensitive to the crush size, and it was observed that a ½" or finer crush size would improve gold recovery.

Geochemical Tests

Initial acid-base accounting tests on flotation tailings and flotation concentrate cyanide leach residue suggests that the flotation tailings are non-acid generating, while the cyanide leach residue is acid generating due to the high sulphide mineral content. The leachability of metals following TCLP methods was low for both flotation tailings and concentrate, with the exception of copper leachability from the flotation tailings, which exceeded MMER limits and will require further evaluation depending on tailings disposal methods. Refer to ARD/ML assessment report (No. 121414740.180) prepared by Stantec for Marathon Gold for further information related to geochemical characterization.

13.3.3 SGS 2018 Testwork Program

Marathon Gold has been managing new ongoing testwork since the initial PEA completion. The new testwork, which was only partially complete at the time of writing this report includes a heap leach and a milling program.

The heap leach program includes:

- Head analysis.
- Low-energy impact test (CWi).
- Coarse ore bottle roll (COBR) cyanidation.
- Agglomeration.
- Column leach tests.

The milling program includes:

- Head analysis.
- Grindability tests (DWT, SMC, Ai, RWi, Ci, SPI).
- Gravity separation and flotation.
- Cyanidation and CIP modelling.
- Solid-liquid separation.
- Cyanide detoxification.
- Tailings environmental analysis.

Metallurgical Samples

In early 2018, Marathon Gold engaged a contractor to drill HQ core targeting lower grade zones suitable for heap leaching. Marathon Gold then selected and submitted 21 new interval drill core samples to form composites for the Marathon and Leprechaun heap leach program. A list of the individual core samples showing their corresponding drillholes and intervals is shown in Table 13.8.

Table 13.8 SGS 2018 Testwork HQ Core Samples

Sample No.	DDH	DDH #	Section	Interval (m)		Intersection (m)	Gold Fire Assay Avg. (g/t)
				From	To		
Marathon							
1	MA-HQ-15-067	15-067	16900	116	142	26	0.43
2	MA-HQ-16-119	16-119	16920	87	109	22	0.39
3	MA-HQ-17-162	17-162	17170	48	65	17	16.3
4	MA-HQ-17-212	17-212	17180	42	55	13	0.66
5	MA-HQ-17-212	17-212		95	104	9	5.23
6	MA-HQ-17-217	17-217	17230	27	50	23	0.82
7	MA-HQ-17-218	17-218	17210	20	27	7	0.42
8	MA-HQ-17-218	17-218		36	52	16	0.53
9	MA-HQ-17-222	17-222	17080	116	138	22	0.19
10	MA-HQ-17-222	17-222		140	155	15	1.29
Leprechaun							
11	LP-HQ-10-161	10-161	10300	38	49	11	0.34
12	LP-HQ-10-183	10-183	10350	37	49	12	5.44
13	LP-HQ-10-189	10-189	10400	8	16	8	0.44
14	LP-HQ-11-232	11-232	10450	30	43	13	0.30
15	LP-HQ-11-232	11-232		70	87	17	2.85
16	LP-HQ-11-257	11-257	10510	50	68	18	0.99
17	LP-HQ-11-276	11-276	10420	27	42	15	0.17
18	LP-HQ-11-310	11-310	10360	23	50	27	0.78
19	LP-HQ-11-334	11-334	10110	24	41	17	0.17
20	LP-HQ-11-336	11-336	10130	32	41	9	0.13
21	LP-HQ-11-336	11-336		47	57	10	0.48

Low grade HQ core samples were used to produce Composites A, B and C for use in the Marathon column leach tests, and Composites D, E and F for use in the Leprechaun column leach tests. Each composite represented different geographic areas in the respective resources. Marathon HQ interval samples No. 1, 4, 8 and 10 and Leprechaun HQ samples No. 15, 16, 18, and 19 were submitted for Bond low-energy impact tests, along with the composite samples. Leprechaun sample No. 20 was the only sample submitted for DWT and SMC testing since other samples were significantly lower grade than the expected mill feed grade.

High grade samples for the milling testwork were produced by selecting half NQ core from the core library. Samples were combined to produce Composites MZA to MZE for use in the Marathon milling testwork, and Composites LZA to LZE for the Leprechaun milling testwork.

Material Properties

Visual material sorting showed that colour could not provide any indication of the gold content, as shown in Table 13.9. White coloured material which is mainly quartz may or may not contain pyrite and gold. Black material could be tourmaline which may or may not contain gold. Grey and pink material that were thought to be waste may still contain gold.

Table 13.9 SGS 2018 Visual Material Sorting

Size	Colour	Mass (%)	Au (g/t)	S (g/t)	Mass (%)	Au (g/t)	S (g/t)	Mass (%)	Au (g/t)	S (g/t)
Marathon		**Sample 1**			**Sample 2**			**Sample 4**		
-1 inch / +1/2 inch	Black	10.1	0.15	0.28	15.5	0.18	0.23	0.4	0.17	0.49
	White	3.3	2.34	0.87	5.0	6.2	0.16	2.4	0.1	0.08
	Grey	12.0	0.28	0.42	7.9	0.18	0.35	13.9	1.41	0.68
	Pink	28.8	0.22	0.22	27.6	0.22	0.27	41.5	0.19	0.34
-1/2 inch		45.8	0.45	0.41	43.9	0.46	0.41	41.9	4.24	0.66
Total		100	0.40	0.36	100	0.62	0.33	100	2.05	0.52
Dup. 50 g Fire Assay		-	0.43	-	-	0.39	-	-	0.66	-
Leprechaun		**Sample 14**			**Sample 17**			**Sample 19**		
-1 inch / +1/2 inch	Black	0.9	0.04	0.10	1.8	0.53	9.89	8.3	0.02	0.74
	White	2.5	0.89	5.94	1.6	0.03	0.52	0.9	0.08	0.32
	Grey	8.8	0.72	16.91	11.7	0.16	19.92	0.0	0.00	0.00
	Ping	48.4	0.10	12.93	45.2	0.04	19.17	51.3	0.19	43.79
-1/2 inch		39.4	0.61	64.12	39.7	0.12	50.50	39.6	0.31	55.15
Total		100	0.37	100	100	0.09	100	100	0.22	100
Dup. 50 g Fire Assay		-	0.3	-	-	0.17	-	-	0.17	-

Head analysis along with quantitative and semi-quantitative analysis were conducted on the heap leach and milling test composites. The interim results are presented in Table 13.9.

Table 13.10 SGS 2018 Interim Head Analysis, Quantitative and Semi-quantitative Analysis on Test Composites

Element	Heap Leach Composites						Milling Composites									
	Marathon Comps			Leprechaun Comps			Marathon Comps					Leprechaun Comps				
	A	B	C	D	E	F	MZA	MZB	MZC	MZD	MZE	LZA	LZB	LZC	LZD	LZE
Quantitative Analyses																
[1]Au, g/t	0.49	0.73	0.90	0.35	0.50	0.76	2.89	4.08	3.25	1.98	3.94	2.69	2.61	5.19	3.82	2.75
Cu, g/t	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
As, %	<0.00	0.003	<0.001	<0.001	<0.001	0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Hg, g/t	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3
S, %	0.44	0.45	0.66	0.19	0.21	0.31	0.68	0.68	0.79	0.70	0.51	0.30	0.28	0.43	0.34	0.36
$S^{=}$, %	0.30	0.42	0.59	0.15	0.20	0.30	0.68	0.60	0.74	0.64	0.47	0.28	0.25	0.37	0.34	0.33
C(t), %	0.39	0.41	0.22	0.69	0.75	0.85	0.48	0.41	0.38	0.33	0.38	0.80	0.64	1.40	0.93	0.84
C(g), %	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
TOC leco, %	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.06	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
CO^{2}, %	-	-	-	2.51	2.71	3.00	1.81	1.52	1.46	1.24	1.49	2.98	2.44	5.12	3.47	3.09
Semi-Quantitative ICP Scan Analyses																
Ag, g/t	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8
Ba, g	9.38	10.5	5.63	12.5	56.5	53.2	12.5	10.8	13.8	8.93	12.3	44.3	58.5	33.3	28.9	35.7
Be, g/t	0.08	<0.08	<0.08	<0.09	0.13	0.14	<0.09	<0.09	<0.09	<0.09	<0.09	0.15	0.12	0.11	0.14	0.13
Bi, g/t	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Cd, g/t	<0.9	<0.9	<0.9	<0.9	<0.9	<0.9	<0.9	<0.9	<0.9	<0.9	<0.9	<0.9	<0.9	<0.9	<0.9	<0.9
Co, g/t	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	<10	<10	<10	<10
Li, g/t	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20
Mo, g/t	<6	<6	<6	<20	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6
Ni, g/t	<6	<6	<6	<6	<6	<6	11	<6	<6	<6	6	<10	<10	<10	<10	<10
Pb, g/t	26	42	<20	11	<20	<20	<20	<20	<20	<20	<20	<40	<40	<40	<40	<40
Sb, g/t	<30	<30	<30	<20	<10	<10	<30	<30	<30	<30	<30	<10	<10	<10	<10	<10
Se, g/t	<50	<50	<50	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30

Element	Heap Leach Composites						Milling Composites									
	Marathon Comps			Leprechaun Comps			Marathon Comps					Leprechaun Comps				
	A	B	C	D	E	F	MZA	MZB	MZC	MZD	MZE	LZA	LZB	LZC	LZD	LZE
Sn, g/t	<40	<40	<40	<40	<40	<40	<40	<40	<40	<40	<40	<30	<30	<30	<30	<30
Sr, g/t	10.6	9.24	6.12	14.7	62.1	65.9	14.7	10.1	9.75	9.59	10.5	44.9	45.4	68.5	74.2	68.9
Tl, g/t	<40	<40	<40	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30
U, g/t	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Y, g/t	6.4	3.8	2.3	5.9	2.8	2.9	5.9	3.7	3.3	3.3	3.5	3.3	2.9	5	3.4	3
Zn, g/t	23	139	25	16	38	39	16	13	15	14	11	26	44	44	35	26

[1]From screened metallics analysis of five screen fractions at each of three top sizes.

A summary of the interim comminution results is presented in Table 13.11. The DWT and SMC results for sample 20 is presented in Table 13.12.

Table 13.11 SGS 2018 Interim Comminution Results

Samples	DWT	SMC	Ai (g)	Bond Wi (kWh/t)			Ci	SPi (min)
				CWi	RWi	BWi	Metric	
No. of Tests	**1**	**1**	**6**	**8**	**11**	**8**	**11**	**11**
Marathon								
MZA	-	-	-	-	14.5	15.3	9.7	111.8
MZB	-	-	0.630	-	14.3	15.7	13.5	95.5
MZC	-	-	0.528	-	13.5	15.6	14.5	88.6
MZD	-	-	0.571	-	12.6	15.1	14.1	83.2
MZE	-	-	-	-	13.3	15.5	17.5	85.5
Averages	**-**	**-**	**0.576**	**-**	**13.6**	**15.4**	**13.9**	**92.9**
Sample 01	-	-	-	10.5	-	-	-	-
Sample 04	-	-	-	10.9	-	-	-	-
Sample 08	-	-	-	9.7	-	-	-	-
Sample 10	-	-	-	15.0	-	-	-	-
Averages	**-**	**-**	**-**	**11.5**	**-**	**-**	**-**	**-**
Leprechaun								
LZA	-	-	-	-	14.6	-	17.8	111.1
LZB	-	-	0.597	-	13.4	-	36.5	88.3
LZC	-	-	0.563	-	14.3	-	35.3	103.0
LZD	-	-	0.510	-	14.7	15.7	33.7	121.0
LZE	-	-	-	-	14.9	16.0	29.9	114.7
Averages	**-**	**-**	**0.557**	**-**	**14.4**	**15.9**	**30.7**	**107.6**
Sample 15	-	-	-	12.7	-	-	-	-
Sample 16	-	-	-	14.0	-	-	-	-
Sample 18	-	-	-	15.3	-	-	-	-
Sample 19	-	-	-	16.0	-	-	-	-
Averages	**-**	**-**	**-**	**14.5**	**-**	**-**	**-**	**-**
Sample 20	Yes	Yes	-	-	12.0	16.4	16.3	69.7
Average	**-**	**-**	**0.6**	**13.0**	**13.9**	**15.7**	**21.8**	**97.9**
Minimum	**-**	**-**	**0.5**	**9.7**	**12.0**	**15.1**	**36.5**	**121.0**
Maximum	**-**	**-**	**0.6**	**16.0**	**14.9**	**16.4**	**9.7**	**69.7**

Table 13.12 SGS 2018 JK Drop-weight and SMC Tests

Sample Name	A	b	A x b	Hardness Percentile	t_a[1]	Hardness Percentile	DWi (kWh/m³)	M_{ia} (kWh/t)	M_{ih} (kWh/t)	M_{ic} (kWh/t)	SCSE (kWh/t)	Relative Density
Sample 20 - DWT	**77.9**	**0.55**	**42.8**	**56**	**0.35**	**69**	**-**	**-**	**-**	**-**	**9.5**	**2.65**
Sample 20 - SMC	100	0.42	42.0	57	0.41	-	6.6	19.6	14.5	7.5	9.6	2.65

The new BWi's are in line with the previous test results. A number of other strength properties were assumed for the earlier PEA, such as the CWi, Ai and A x b, due to no available test results at the time the design was carried out. The new CWi's are in line with the assumed CWi used in the design, however the Ai and A x b values are not similar to the assumed values. The new results indicate that Marathon and Leprechaun materials are harder than the assumed values in the PEA. The milling circuit shall be re-assessed using the new information in the next study phase.

Interim Metallurgical Results

Coarse Bottle Roll Tests

The coarse bottle roll results are presented in Figure 13.2 and Figure 13.3 for Marathon and Leprechaun composites, respectively. Gold extractions were observed to increase by approximately 10% between the 0.5" and 0.25" crush size. Composite E was an exception possibly due to gold nugget effect. It is noteworthy that all extraction-time curves were increasing when the tests were terminated.

Figure 13.2 SGS 2018 Coarse Bottle Roll Results for Marathon Composites

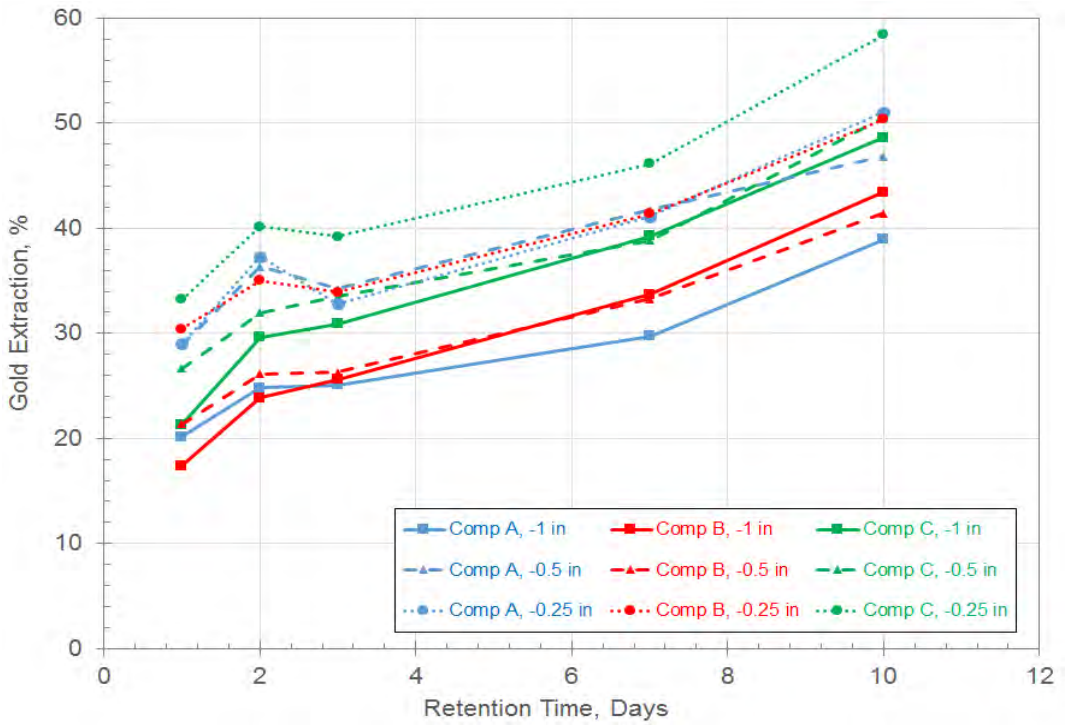
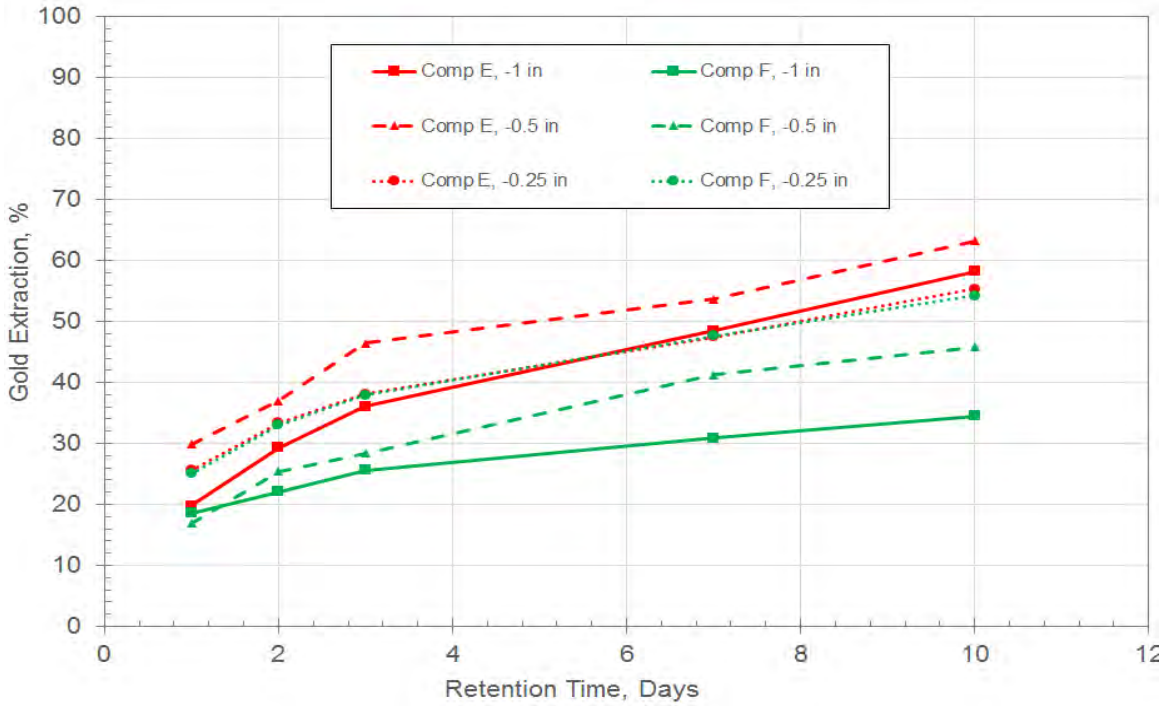


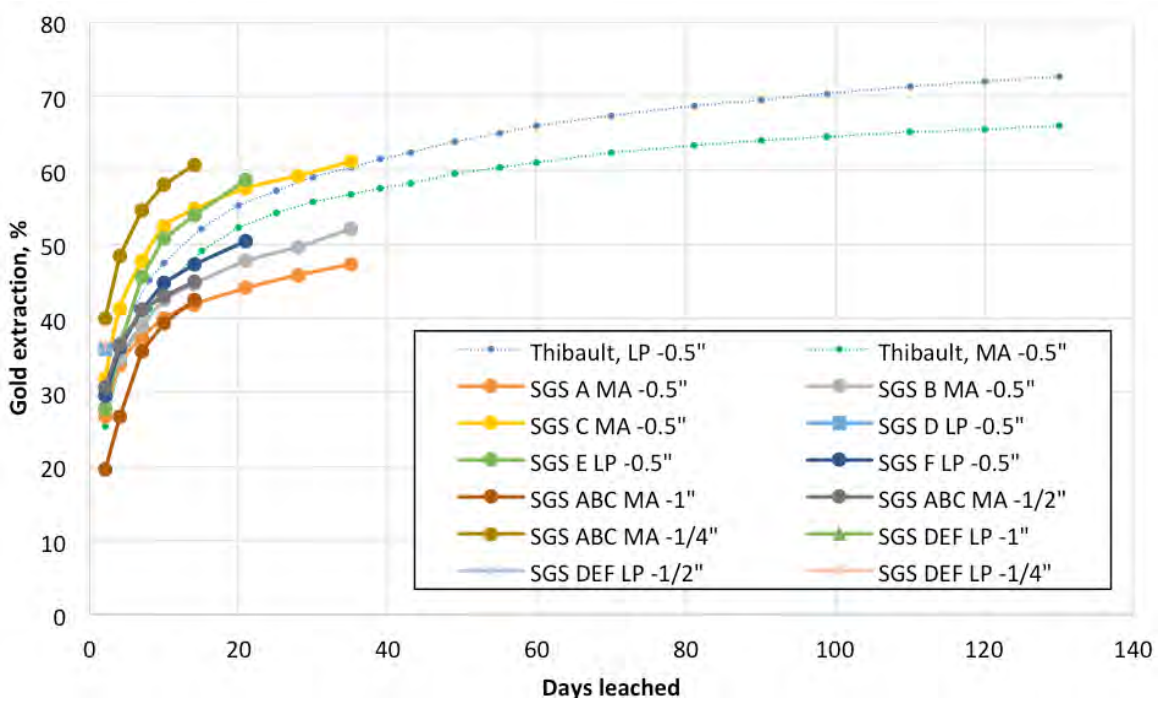
Figure 13.3 SGS 2018 Coarse Bottle Roll Results for Leprechaun Composites



Column Leach Tests

The new SGS interim column leach results are plotted next to the old Thibault column leach results in Figure 13.2. Note that the extraction values are still preliminary, pending the completion of tailings analysis in 2019.

Figure 13.4 SGS 2018 Interim Column Leach Test Results in Comparison to Thibault's



All new results show an upward trajectory, with a few of the 0.5" and 0.25" samples already surpassing 60% gold extraction in only a quarter of the total planned leach time. In general, the SGS column leach tests are currently performing well considering their head grades are a lot lower than the Thibault samples, which had gold head grades of 1.73 g/t Au for Marathon and 1.95 g/t Au for Leprechaun.

Gravity Separation Tests

Three Marathon milling samples were submitted with two Leprechaun milling samples to form five composites for gravity separation testwork, and the results are presented in Table 13.13. The gravity concentrate recoveries for both Marathon and Leprechaun are in line with the design values in the initial PEA.

Table 13.13 SGS 2018 Gravity Separation Results

Comp. Name	Composite Make-Up	Test	Grind Size, P_{80} µm	Concentrate			Tailings Grade, Au g/t	Head, Au, g/t	
				% Mass	Au, g/t	% Au Recovery		Calc	Direct
MC1	50% MZA, 50% MZB	G1	147	0.032	3,769	39.6	1.85	3.06	3.49
MC2	100% MZC	G2	145	0.026	5,554	52.2	1.35	2.81	3.25
MC3	50% MZD, 50% MZE	G3	150	0.034	3,240	43.2	1.43	2.52	2.96
LC1	54% LZA, 32.4% LZB, 13.6% LZC	G4	145	0.020	13,751	67.2	1.34	4.10	3.00
LC2	15% LZC, 43% LZD, 42% LZE	G5	153	0.025	6,401	54.6	1.35	2.98	3.57

Gravity Tailings Flotation Tests

The Marathon and Leprechaun gravity tailings were subjected to further grinding to generate flotation samples at three targeted grind sizes, i.e. 150 µm, 90 µm, and 75 µm. The interim flotation results at the longest tested time are presented in Table 13.14. The flotation recoveries and mass pulls are in line with previous Thibault results. The finer the grind size as tested yielded better recovery as expected.

Table 13.14 SGS 2018 Selected Interim Gravity Tailings Flotation Results

Feed = Tailings from Grav. Test	Flot Test	Feed Size, P_{80}, µm	Product	Mass %	Assays		% Distribution		
					Au, g/t	$S^{=}$, %	Au		$S^{=}$
							Flot (unit)	Grav Flot	
Marathon Comp MC1									
G1	F1	147	Rougher Conc. @ 20 min	3.0	3.01	TBD	87.7	*92.5*	TBD
G1	F2	90	Rougher Conc. @ 20 min	2.8	78.0	27.3	93.4	*96.0*	94.1
G1	F3	68	Rougher Conc. @ 20 min	2.8	51.6	TBD	89.9	*93.8*	TBD
Marathon Comp MC2									
G2	F4	145	Rougher Conc. @ 20 min	3.3	37.6	26.5	84.9	*92.8*	94.7
G2	F5	97	Rougher Conc. @ 20 min	3.2	36.0	26.6	88.9	*94.7*	94.7
G2	F6	69	Rougher Conc. @ 20 min	3.8	30.9	22.4	90.7	*95.6*	94.7
Marathon Comp MC3									
G3	F7	150	Rougher Conc. @ 20 min	2.6	44.2	24.0	82.0	*89.8*	92.8
G3	F8	98	Rougher Conc. @ 20 min	2.7	44.0	22.4	81.9	*89.7*	92.4
G3	F9	70	Rougher Conc. @ 20 min	3.3	39.0	TBD	87.1	*92.6*	TBD
Leprechaun Comp LC1									
G4	F10	147	Rougher Conc. @ 30 min	3.6	30.9	8.9	87.6	*95.9*	87.0
G4	F11	87	Rougher Conc. @ 30 min	5.6	24.4	0.0	91.0	*97.0*	TBD
G4	F12	65	Rougher Conc. @ 30 min	5.3	21.7	6.2	92.7	*97.6*	TBD
Leprechaun Comp LC2									
G5	F13	153	Rougher Conc. @ 20 min	2.9	37.0	0.0	84.6	*93.0*	TBD
G5	F14	87	Rougher Conc. @ 20 min	2.6	47.8	0.0	87.4	*94.3*	TBD
G5	F15	65	Rougher Conc. @ 20 min	3.2	37.9	0.0	89.5	*95.2*	TBD

Preg-robbing Analysis

Preg-robbing analysis indicates that the Marathon and Leprechaun milling samples exhibit some preg-robbing behaviours. Preliminary results show 2 to 5% increase in gold extraction can be expected when carbon is added during cyanidation.

Other remaining tests at SGS are still in progress and the results will be presented in the next study phase.

13.4 Recovery Equations for Mine Modelling

A conservative approach was used for generating gold recovery equations for input into the mine model during the initial PEA. It was recommended by Marathon Gold's metallurgical consultant, Mr. J. Goode, with agreement by Lycopodium, to utilize the Brittan relationship to develop a recovery model based on the material head grade.

The gold recoveries from the Brittan relationship were discounted by 2% to account for solution and other losses.

Table 13.8 describes the simplified fractional recovery equations used as input into the mine optimization model. The milling recovery equations were kept the same as the ones used in the PEA published on 13 July 2018. However, the heap leach recovery equations were amended upon receiving interim column leach results from the 2018 SGS program. The amended heap leach equations are shown in Table 13.15. The overall heap leach recovery for the combined Marathon and Leprechaun material increased from ~53.5 to ~60% by using the amended equations.

Table 13.15 Simplified Fraction Recovery Equations for Mine Modelling

Deposit	Process	Fractional recovery	Nominal Au g/t	If grade < lower limit	If grade > upper limit
Marathon	Milling	0.944+0.003 x Grade (g/t)	0.5 to 8	Use lower limit	Use upper limit
Leprechaun	Milling	0.921+0.005 x Grade (g/t)	0.5 to 8	Use lower limit	Use upper limit
Marathon	Heap Leach	0.5 + 0.11 x Grade (g/t)	0.2 to 2	Waste	Use upper limit
Leprechaun	Heap Leach	0.6 + 0.09 x Grade (g/t)	0.2 to 2	Waste	Use upper limit

13.5 Testwork Results Contributing to Process Design

Metallurgical results from the Thibault reports (Phase 1 and Phase 2) were used for developing process design criteria (PDC) for both the milling and the heap leach facilities. The sections to follow describe the basis for several of the important decisions and inputs into the PDC.

13.5.1 Justification for Process Circuit Inclusion

Two high-level trade-off studies were previously conducted to justify the inclusion of the following circuits into the PDC, i.e. flotation tailings leaching circuit; and a finer primary grind circuit for a P_{80} of 75µm instead of a coarser primary grind with P_{80} of 120 µm.

Based on the high-level assessments shown in Table 13.16 and Table 13.17, it was concluded that incorporating these two circuit would yield economic benefits for the project.

Table 13.16 High Level Trade-Off Study for Flotation Tailings Leach Circuit

Flotation Tailings Leaching Trade-off Conclusion:	Install flotation tailings CIL	
Gold Price	CAD /oz	1,500
Annual Throughput	Mtpa	2.50
Flot. Tailings Grade	g/t Au	0.45
Leach Tailings Grade	g/t Au	0.13
Leach Product Grade	g/t Au	0.32
Gold Production from Flot. Tailings Leaching	Au kg/yr	800
	Au oz/yr	25,720.56
Revenue /yr from Flot. Tailings Leaching	CAD /yr	**38,580,840**
Steel Cost (mat'l, lab, instal.)	CAD /t	11,000
Flot. Tailings CIL Tank Volume	m^3	3,150
Number Tanks	#	3
Tank Diameter	m	15
Tank Height	m	17.83
Plate Thickness	mm	6
Steel Density	t /m^3	7.7
Tank Mass	t	38.8
Cost of Flot. Tailings CIL Tanks	CAD	**1,280,664**
Foundation Price	CAD /m^3	1,000
Estimated Foundation Volume	m^3	2,362.50
Tank Foundation Price	CAD	**2,362,500**
Rough Guess for Agitator Price	CAD /unit	1,000,000
Rough Guess for Agitator Price	CAD	**3,000,000**
Total Cost of Flot. Tailings CIL	**CAD**	**6,643,164**

Opex not considered, as it will be a small portion.

Table 13.17 High Level Trade-Off Study for Primary Grinding Circuit

Courser (120 micron) Grind Flotation Trade-off Conclusion:	75 µm Grind Size	
Flotation Au Recovery at 75 micron	Au %	94.5
Flotation Au Recovery at 120 micron	Au %	90.6
Difference	Au %	3.9
Average Difference	Au %	2.55
Assumed Recovery Lost from Flotation b/w the Two Grind Sizes	Au %	2.5
Estimated Decrease in Overall Recovery	Au %	0.3
Difference in Product Grade Recovered	g/t Au	0.02
Gold Price	CAD /oz	1,500
Annual Throughput	Mtpa	2.50
Lost in Gold Produced from Coarser Grind	Au kg/yr	50
	Au oz/yr	1,607.54
	CAD /yr	**2,411,303**
Motor Power Difference b/w the Two Grind Sizes	MW	1
Cost of Power	CAD /kWh	0.08
Ball Mill Specific Energy for 75 micron	KWh/t	11.9
Ball Mill Specific Energy for 120 micron	kWh/t	8.5
Difference in Specific Energy	kWh/t	3.4
Difference in Annual Power Consumption	kWh/t	8,500,000
Difference in Annual Power Cost	CAD	**680,000**

Assume capex difference is not significant over the long run.

13.5.2 Estimation of Cyanide Consumption

The total sodium cyanide consumption required for the Project is estimated to be 10 t/day, approximately 3 t/day at the heap leach facility, and approximately 7 t/day at the milling facility. The basis for this estimation is described in Table 13.18.

Table 13.18 Basis for Estimation of Cyanide Consumption

			Annual Tonnage	Marathon	Leprechaun	Operating Hours Per Year
		Heap Leach Tonnage	3,000,000	13,056,000	10,089,000	8,000
		Milling Tonnage	3,000,000	28,078,000	8,448,000	

Cyanide Consumption (kg/t)	Testwork Results		Comments	Input for PDC		Comments
	Marathon	Leprechaun		Marathon	Leprechaun	
Heap Leach	0.45 to 1.85	0.42 to 2.05	Coarse bottle roll averages	0.28	0.29	Thibault mentioned cyanide consumption did not decrease significantly, as the extraction of gold slowed down, meaning other cyanide consumers continued to react with cyanide, even as the gold was depleted. This explains the higher NaCN consumption observed in testwork. Although, bottle tests for heap leach material run for many days and reagent consumption tend to be higher than commercial operation. A scale-up factor of 25% is applied.
	Average 1.12			Weighted Avg. 0.28		
Flotation Concentrate Leaching	0.44 to 0.87	0.136 to 0.257	Only flotation conc. leach results were considered	0.58	0.16	The Thibault report mentioned that the testwork maintained high NaCN concentration. If the NaCN concentration was maintained at a lower level, then perhaps less could be consumed. Based on this, a discount of 15% is applied to the NaCN consumption.
	Average 0.44			Weighted Avg. 0.49		
Flotation Tailings Leaching	0.48 to 0.52	0.29 to 0.554	Only flotation tailings leach results were considered	0.425	0.356	The Thibault report mentioned that the testwork maintained high NaCN concentration. If the NaCN concentration was maintained at a lower level, then perhaps less could be consumed. Based on this, a discount of 1% is applied to the NaCN consumption.
	Average 0.46			Weighted Avg. 0.41		
Leach Residual CN Concentration	50 mg/L					Typical leach residue has 150 mg CN /L but assume only 50 CN mg/L due to flotation tailings leach utilizing CN residue from flotation conc. leaching.
Leach Residual NaCN Concentration	94 mg/L					Convert to mg NaCN /L
Solution in Leach Tailings	458 m^3/h					Estimated based on 45% solids in tailings slurry.
NaCN in tailings	0.12 kg/t material					
Heap Leach Facility Total	0.28 kg/t material					
Milling Facility Total	1.014 kg/t material					
Total for Both Plants	1.29 kg/t material					
Total (NaCN t/day)	**11.61 t/day**					

13.6 Future Testwork Recommendations

The following comminution and metallurgical testwork activities are recommended for the high and low-grade material at Marathon and Leprechaun deposits. A number of the recommendations listed in the PEA published on 13 July 2018 were completed with only the following items outstanding.

Comminution:

- Regrinding tests should be consulted with vendors to confirm sample quantities and mass requirement.

Metallurgical:

- Continue with ongoing detailed gravity tests to evaluate the benefits of incorporating gravity into the grinding circuit. Conduct planned extended GRG testwork with input from the vendors.
- Carbon-in-leach modelling for both flotation concentrate and tailings.
- Bulk flotation testwork with thickening tests on the concentrate and tailings.
- Evaluate the response of the gravity/flotation/leach process to feedstock variability.
- Complete ongoing column leach tests in 3 m columns, evaluate results and consider larger-scale, on-site tests.
- Include load and permeability testing as part of any future heap leach testwork.
- Investigate process conditions to improve on reagent and grinding power consumptions while maintaining or improving gold recoveries.
- Complete program of environmental studies, including cyanide destruction in tailings (including heap leach residue) and more detailed tailings disposal stability tests.

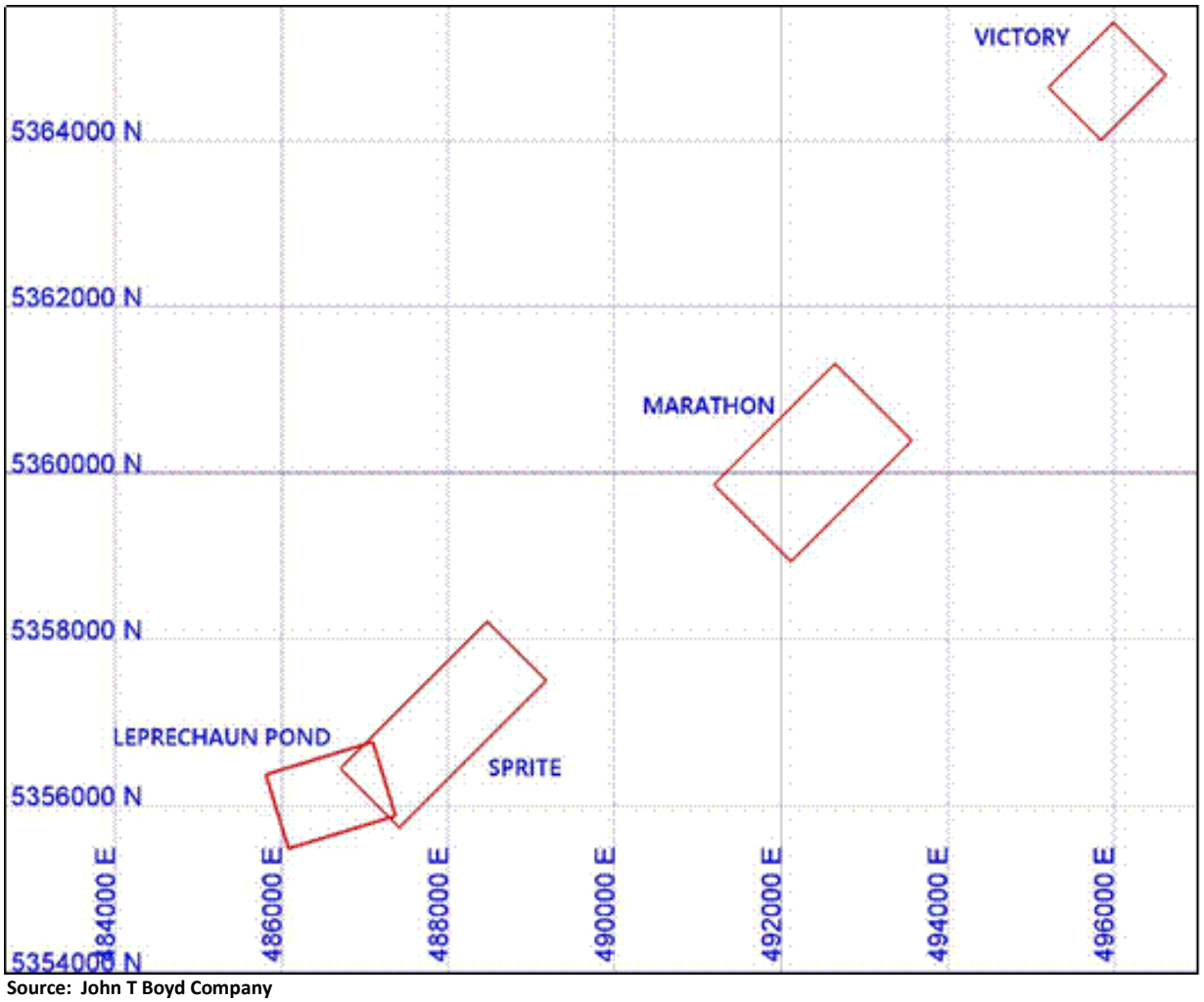
14.0 MINERAL RESOURCE ESTIMATES

14.1 Overview

This Chapter describes the preparation and estimation of, and provides BOYD's independent Mineral Resource estimates for, the four identified gold deposits – Leprechaun, Marathon, Sprite, and Victory – that comprise the Project. The Mineral Resource estimates reported herein were prepared under the supervision of Mr. Robert J. Farmer, P.Eng., and were prepared in accordance with NI 43-101 and the CIM Standards. Mr. Farmer is a Vice President of BOYD and a QP, as defined under the prevailing definitions of NI 43-101.

The general location of the four deposits, and their respective resource block models, is shown below in Figure 14.1.

Figure 14.1 Valentine Lake Resource Estimation Areas



Source: John T Boyd Company

Estimates of mineral resources for all four of the deposits were previously provided by BOYD in their 28 May 2018 Technical Report (Farmer, 2018), filed on SEDAR. The Mineral Resource estimates reported herein supersede those of the previous BOYD estimates, and are the result of additional exploration data and/or revised technical parameters arising from this updated PEA. The effective date of the revised mineral resource estimates is 9 October 2018.

14.1.1 Mineral Resource Estimation Procedures

BOYD developed 3D geologic models for each of the four 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 mineralized 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 mineralized domains developed in Step 3 above.
6. Determine, based on log-normal 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 geologic domains as developed in Step 3 above.
8. Using the composites from Step 7, develop variograms for gold grades in each potentially mineralized 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 optimization.
12. Validate the block grade estimates using Q-Q 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 optimizer.
14. Import the block model into the Whittle pit optimizer.
15. Determine economic pit limits to constrain the Open-Pit Mineral Resource estimates using Whittle's pit optimization tools.

16. Import the pit optimization 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 Leprechaun, Sprite, and Victory deposits, Step 3 above 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 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 deposit; however, QTP veins could not be established with implicit modelling. Instead, a 100 ppb gold grade shell was used to limit mineralization in the QTP veins. All orientations used in the modelling were based on field observations, as well as numeric data.

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.

Mineralization 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 mineralization 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 applying to a Measured Mineral Resource, and may only be converted to a Probable Mineral Reserve.

Mineralization may be classified as an **Indicated Mineral Resource** by the Qualified Person when the nature, quality, quantity, and distribution of data are such as to allow confident interpretation of the geological framework and to reasonably assume the continuity of mineralization. The Qualified Person must recognize 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 Prefeasibility or Feasibility Studies, or in the Life of Mine plans and cash flow models of developed mines. Inferred Mineral Resources can only be used in economic studies as provided under NI 43-101.

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.

14.1.3 Previous Mineral Resource Estimates

The previous mineral resource estimates were reported by BOYD in a NI 43-101 Technical Report dated 28 May 2018 (Farmer, 2018), and are provided below in Table 14.1.

Table 14.1 Valentine Lake 28 May 2018 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	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

1. **The effective date for this mineral resource estimate for Leprechaun, 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 5 March 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 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 ("NI 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 categorized as mineral reserves, and there is no certainty that the PEA will be realized. 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 ID^3 methods for grade estimation. Mineral resources for the Leprechaun and Sprite deposits are reported using an open-pit gold cut-off of 0.267 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 mineralized 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 applied during grade estimation by mineralized 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 mineralized 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.**

This estimate is superseded by the Mineral Resource estimates presented in this report.

14.2 Leprechaun Deposit Mineral Resource Estimate

Additional metallic screened assays were available and incorporated into this mineral resource estimate. Also, there were updated revisions to the project's technical parameters (e.g. metallurgical recoveries, mining costs, etc.) derived from the PEA.

The Leprechaun mineral resource is contained in a series of flat laying, gold bearing QTP veins with an azimuth of 135°, a plunge of -10°, and a dip of -20°. The highest-grade gold mineralization 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 mineralization is bounded in the hanging wall by a series of mafic dikes. To the northwest of the mafic dikes, the flat laying, gold-bearing QTP veins continue to be mineralized and make up the hanging wall mineralization at the Leprechaun gold deposit.

Significant gold mineralization 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 mineralization occurs in areas with no significantly logged QTP mineralization. In fact, these areas probably do include QTP mineralization in that many of the areas included very minor occurrences of QTP within the logging, but not enough to be considered a significant unit.

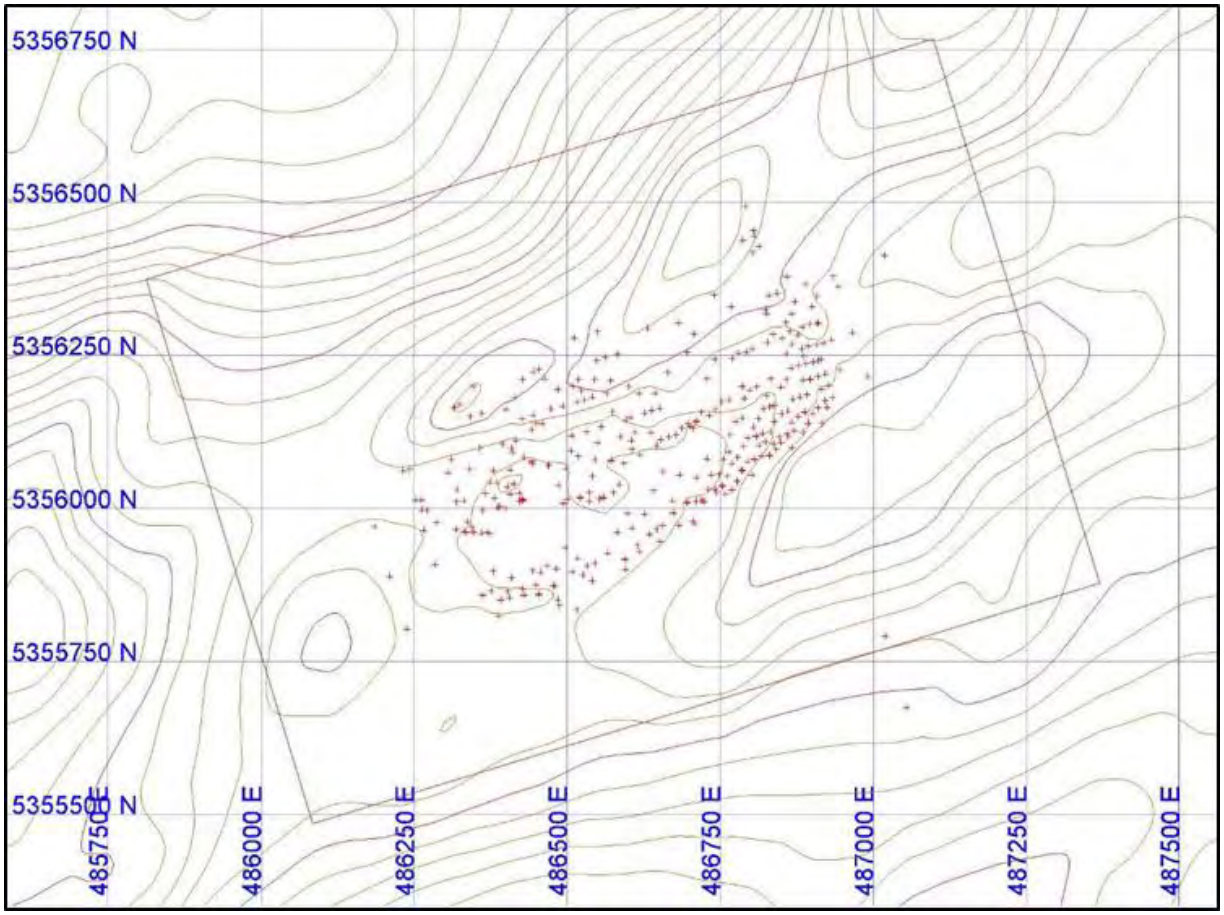
Previous mineral resource estimation work completed at Leprechaun assumed a series of steeply dipping, gold-bearing veins over the flat dipping QTP veins. This is not supported by the geologic field observations, nor is it supported by additional drilling completed during 2017. As a result, a new Mineral Resource estimate is warranted for the Leprechaun deposit

14.2.1 Leprechaun Deposit Data

Drillholes

The Mineral Resource estimates for the Leprechaun deposit reported herein are based on all drillholes whose assays were available as of 29 July 2018, and consists of 371 diamond core drillholes totalling approximately 79,033 m. Figure 14.2 shows the collars of these drillholes.

Figure 14.2 Leprechaun Drillhole Locations and Topography



Assays

Of the 54,971 gold assays available as of 29 July 2018, all were used. For un-sampled intervals, gold grade values were set to zero. All gold grades were determined from fire or metallic screened assays. Total assayed sample length is 74,923 m.

Density

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

Table 14.2 Leprechaun Density Measurements

Lithology Type	Samples	Specific Gravity t/m³
Mafic Dikes	229	2.79
QTPV	444	2.64
Sediments	140	2.75
Trondhjemite	827	2.61
Overburden	-	1.50

Topography

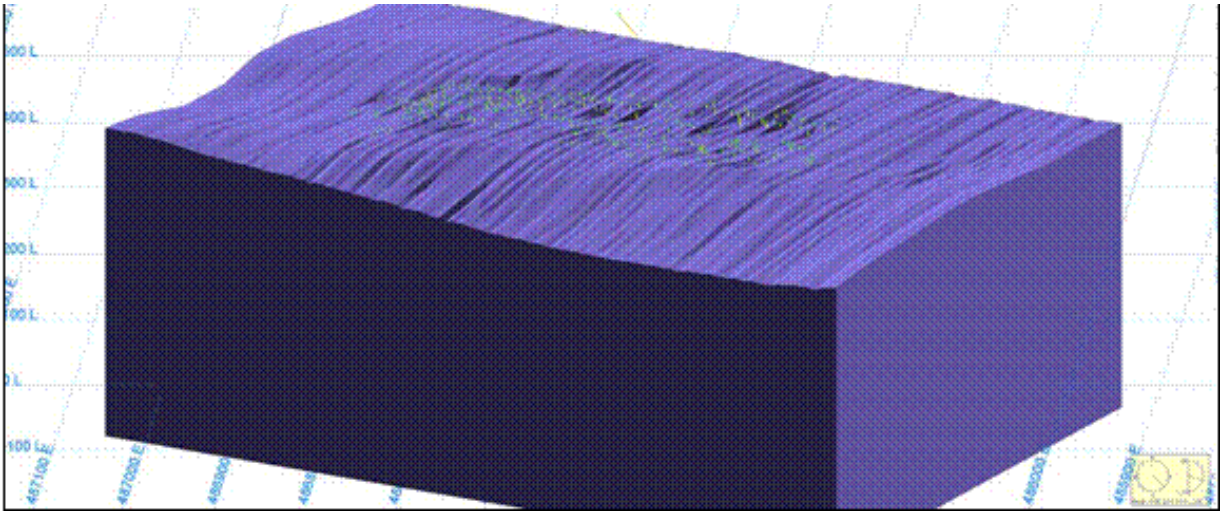
The topography of the area around the Leprechaun deposit is shown on Figure 14.2. All contours are expressed in meters above sea level (masl). Contour intervals are every 5 m. The Leprechaun deposit sits on a flat-topped ridge in a shallow, water-filled depression (Leprechaun). Towards the north, the topography falls off steeply while towards the south the topography slopes gently downhill.

Geological Modelling

The Leprechaun deposit contains four potentially mineralized domains. These domains are the SED, hanging wall trondhjemite (TRJ), flat lying quartz-tourmaline-pyrite veins (QTPV), and mafic dikes (MD) intruding into the TRJ and QTP domains. Additionally, surface overburden was also noted in the drill logs but was not considered as a potentially mineralized host.

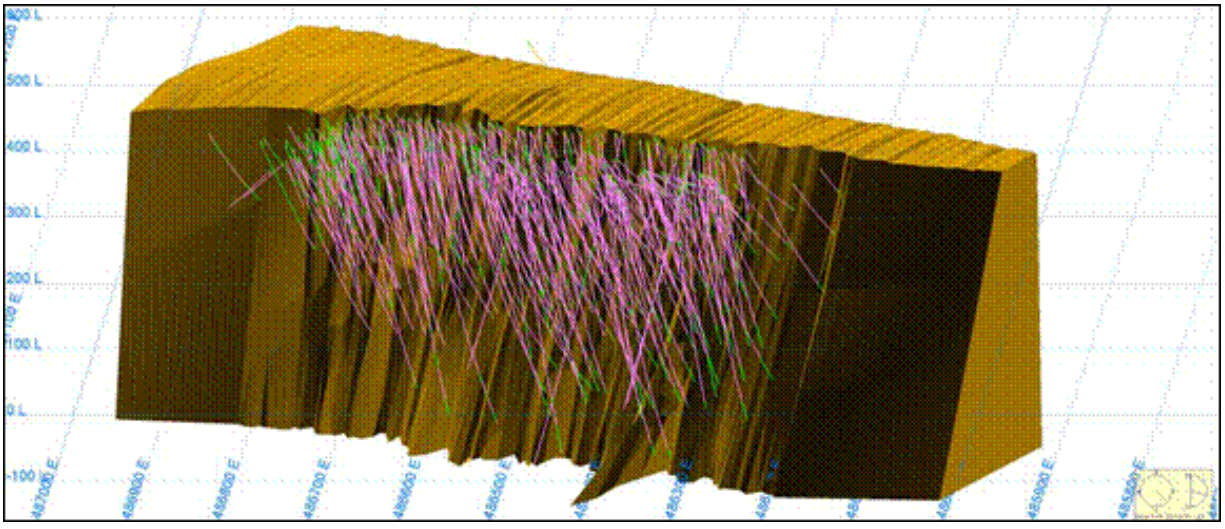
Geological modelling of these units is based on the logged geology, as well as interpretations made by Marathon Gold staff. On every 10-m cross-section through the deposit, a line was drawn reflecting the actual or projected overburden surface below the topography. These lines were then used to construct the rock/overburden surface to constrain compositing, geologic implicit models, as well as block modelling. The overburden surface is shown below in Figure 14.3.

Figure 14.3 Leprechaun Base of Overburden



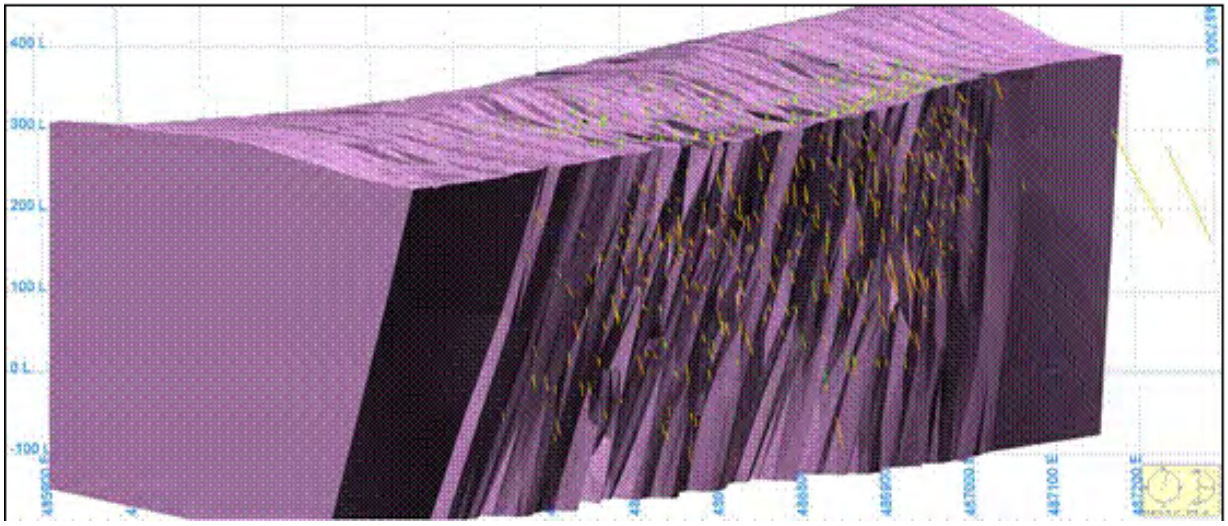
The SED/TRJ contact was determined by drillhole intercepts or projections between intercepts and a surface constructed to represent this geologic contact. This was completed on every 10-m section through the deposit where data were available. This contact was then used to construct a solid model of the SED domain below the overburden horizon. The sediment unit is shown below in Figure 14.4.

Figure 14.4 Leprechaun Sediment Domain



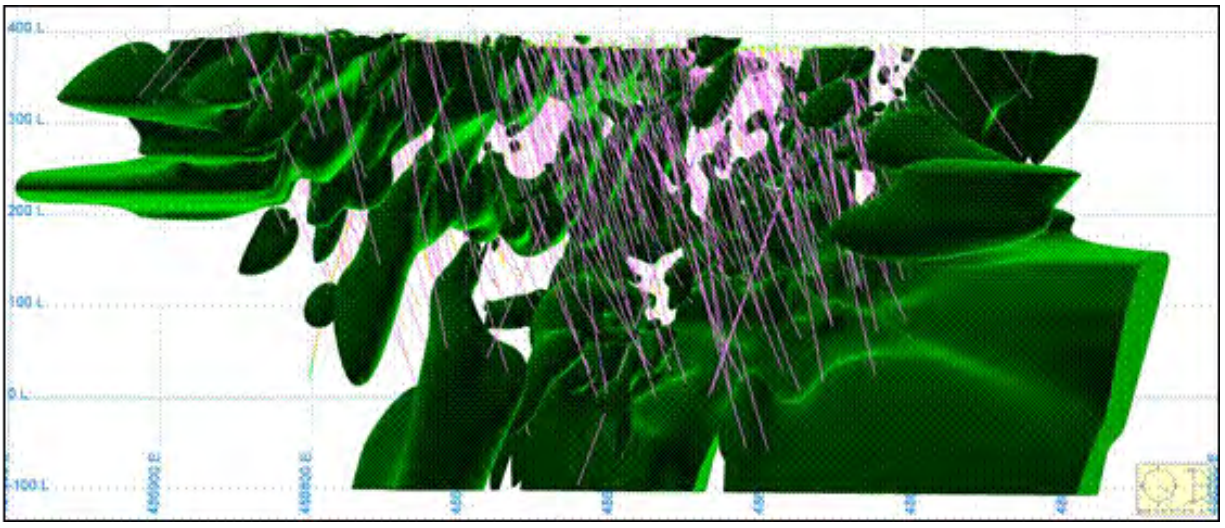
The TRJ domain is the remaining rock mass northwest of the SED solid and below the overburden horizon. The TRJ domain is shown in Figure 14.5 below.

Figure 14.5 Leprechaun Trondhjemite Domain



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°. Based on discussions with Marathon Gold geologic staff, the MD have 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 14.6 below.

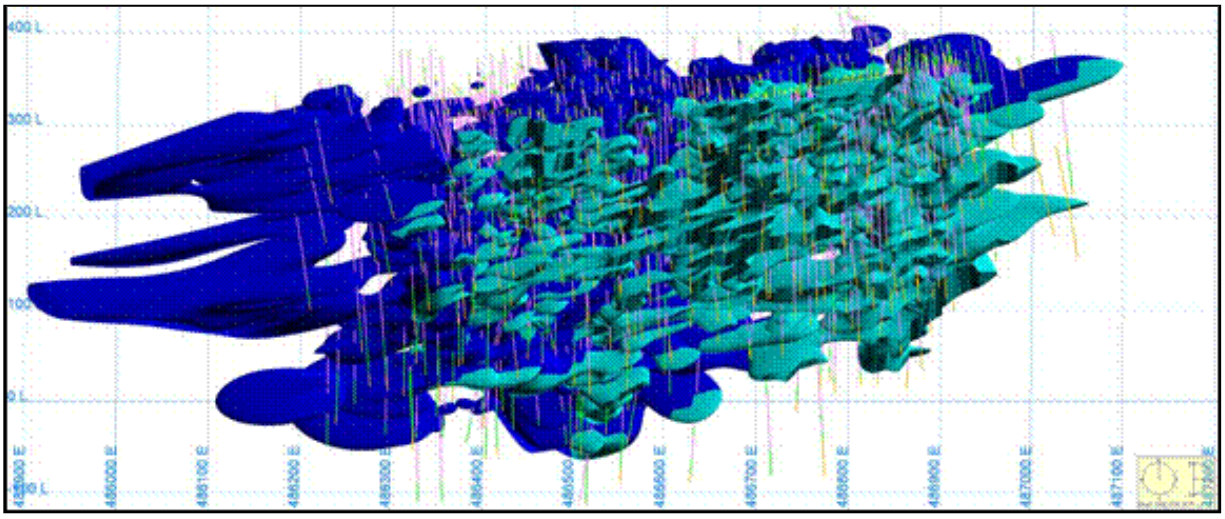
Figure 14.6 Leprechaun Dike Domain



For the QTP domain, the same implicit modelling approach was used to develop the mineralized solid as the MD domain. 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. This zone was further divided into two sub-domains. The first represents the

hanging wall QTP 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 MD or the hanging wall QTP domain. The hanging wall and footwall QTPV domains are shown below in Figure 14.7.

Figure 14.7 Leprechaun Hanging Wall (Dark Blue) and Footwall (Light blue) QTPV Domains



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

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 below in Table 14.3.

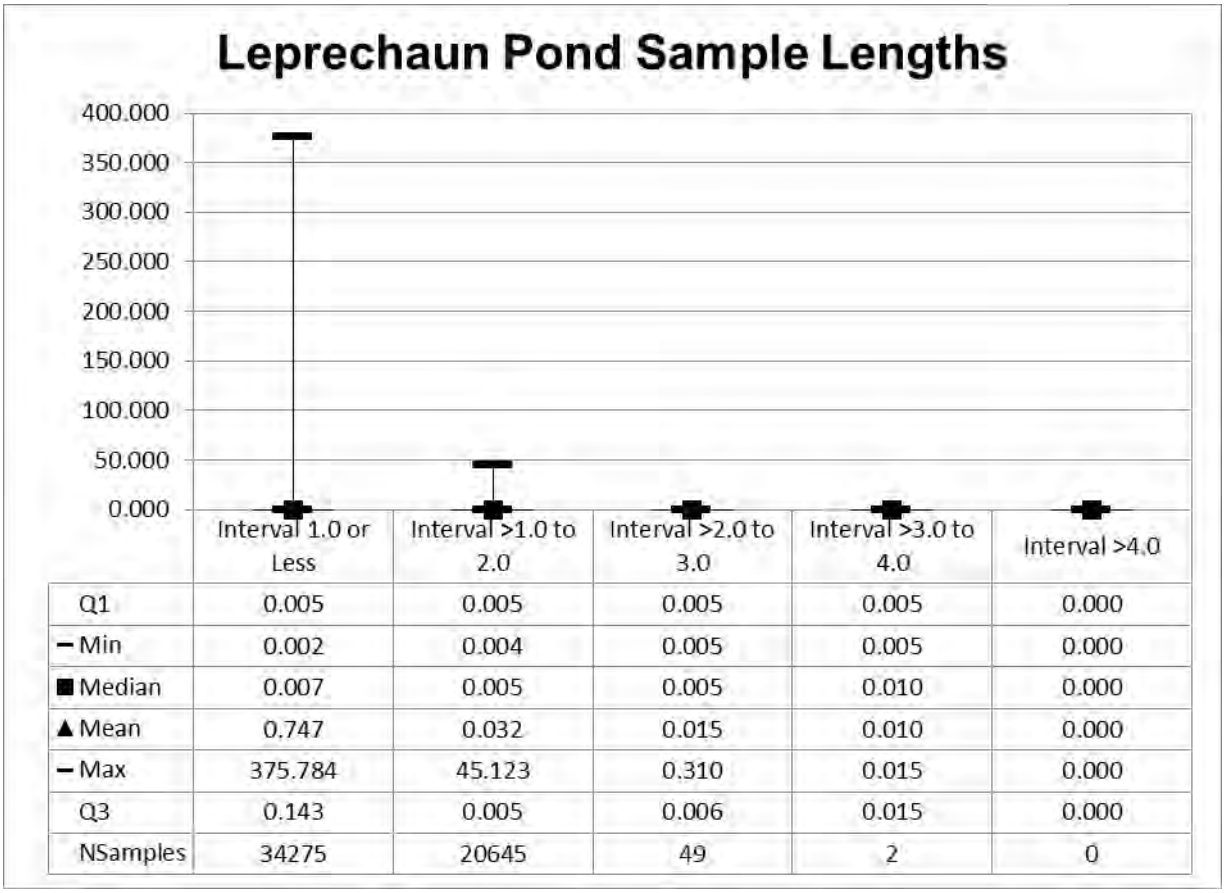
Table 14.3 Leprechaun Descriptive Statistics

Item	Domains					
	All	Hanging Wall QTPV	Footwall QTPV	Mafic Dikes	Sediment	Trondhjemite
Number of samples	54,971	11,262	9,068	4,984	2,456	30,284
Minimum	0.002	0.005	0.005	0.005	0.005	0.002
Maximum	375.784	150.116	192.243	37.559	25.476	375.784
Range	375.782	150.111	192.238	37.554	25.471	375.782
Average	0.478	0.714	1.475	0.138	0.180	0.210
Standard deviation	3.944	4.284	6.683	1.096	1.087	3.111
Variance	15.555	18.353	44.662	1.201	1.182	9.678
Coef. of variance	8.258	6.002	4.531	7.920	6.037	14.783

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 box-plot in Figure 14.8 below shows the results of this analysis.

Figure 14.8 Leprechaun 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	0.005	0.000
– Min	0.002	0.004	0.005	0.005	0.000
■ Median	0.007	0.005	0.005	0.010	0.000
▲ Mean	0.747	0.032	0.015	0.010	0.000
– Max	375.784	45.123	0.310	0.015	0.000
Q3	0.143	0.005	0.006	0.015	0.000
NSamples	34275	20645	49	2	0

In examining the results of this analysis, it can be seen that most samples with potentially economic gold mineralization 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 mineralized 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 mineralization in the individual drillholes within each mineralized zone.

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 log-normal probability plot was generated for gold in each mineralized 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 log-normal probability plots for gold found in each mineralized domain are shown below in Figures 14.9 through 14.13, which follow.

Figure 14.9 Leprechaun Hanging Wall QTPV Domain Log-Normal Plot

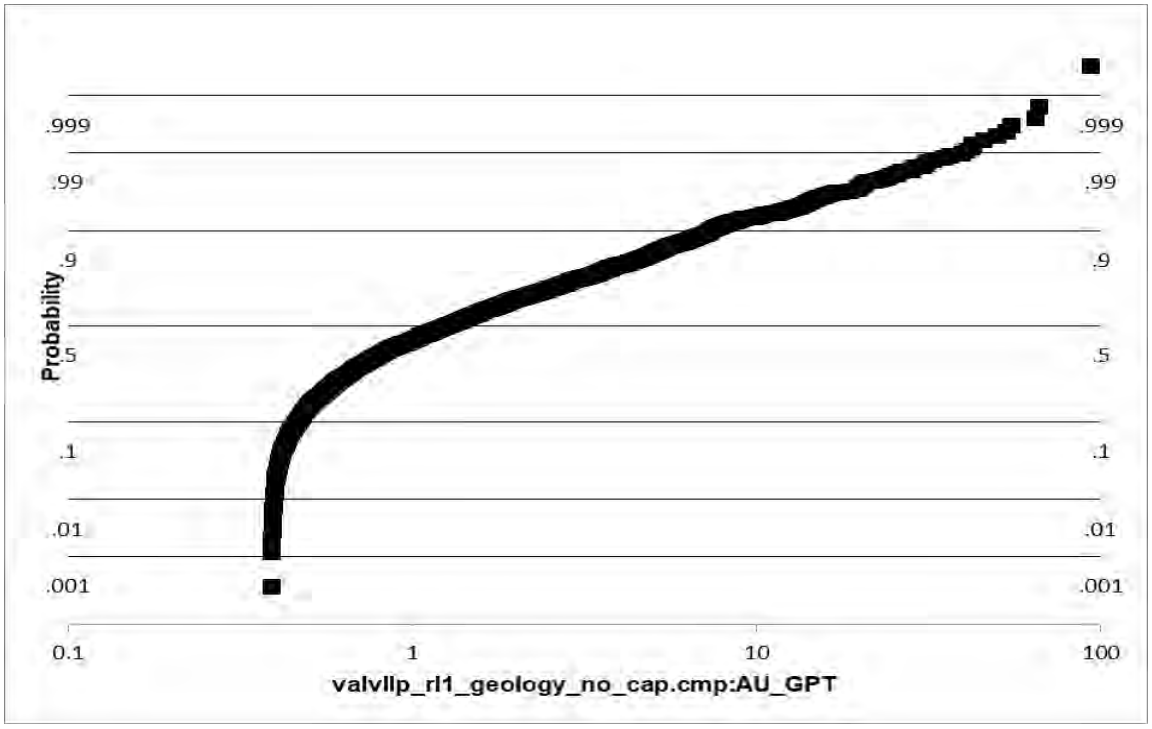


Figure 14.10 Leprechaun Footwall QTPV Domain Log-Normal Plot

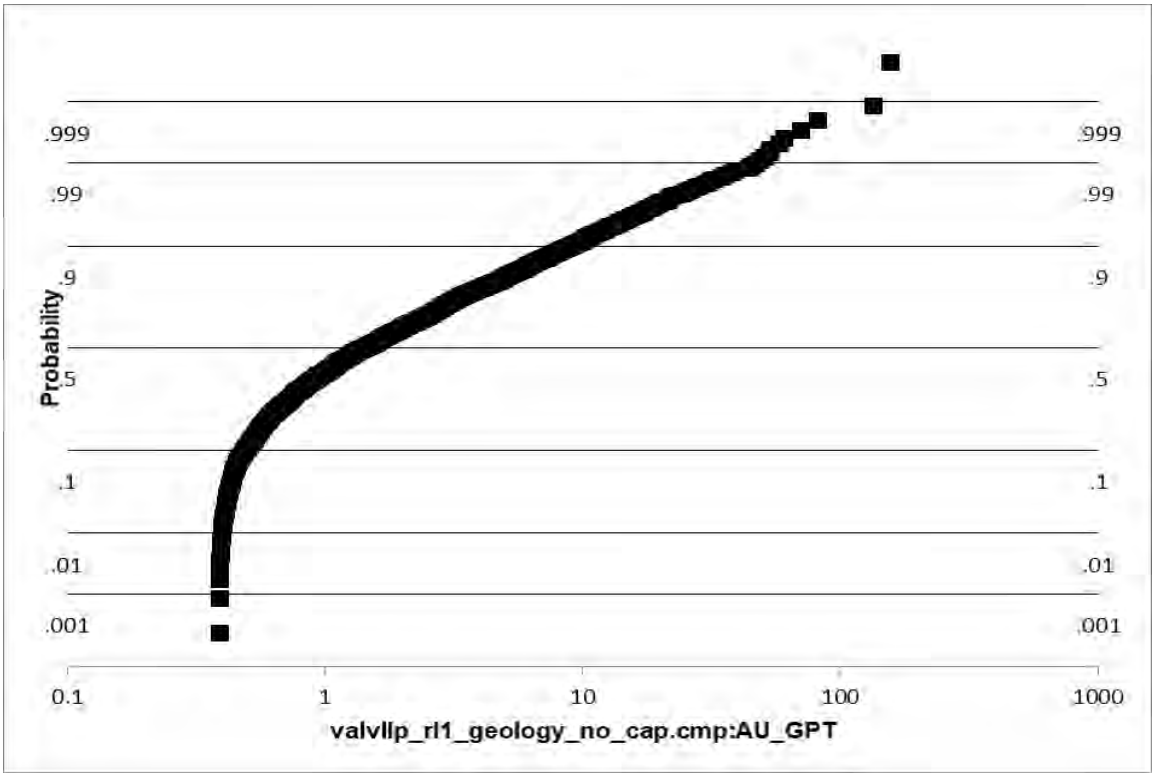


Figure 14.11 Leprechaun MD Domain Log-Normal Plot

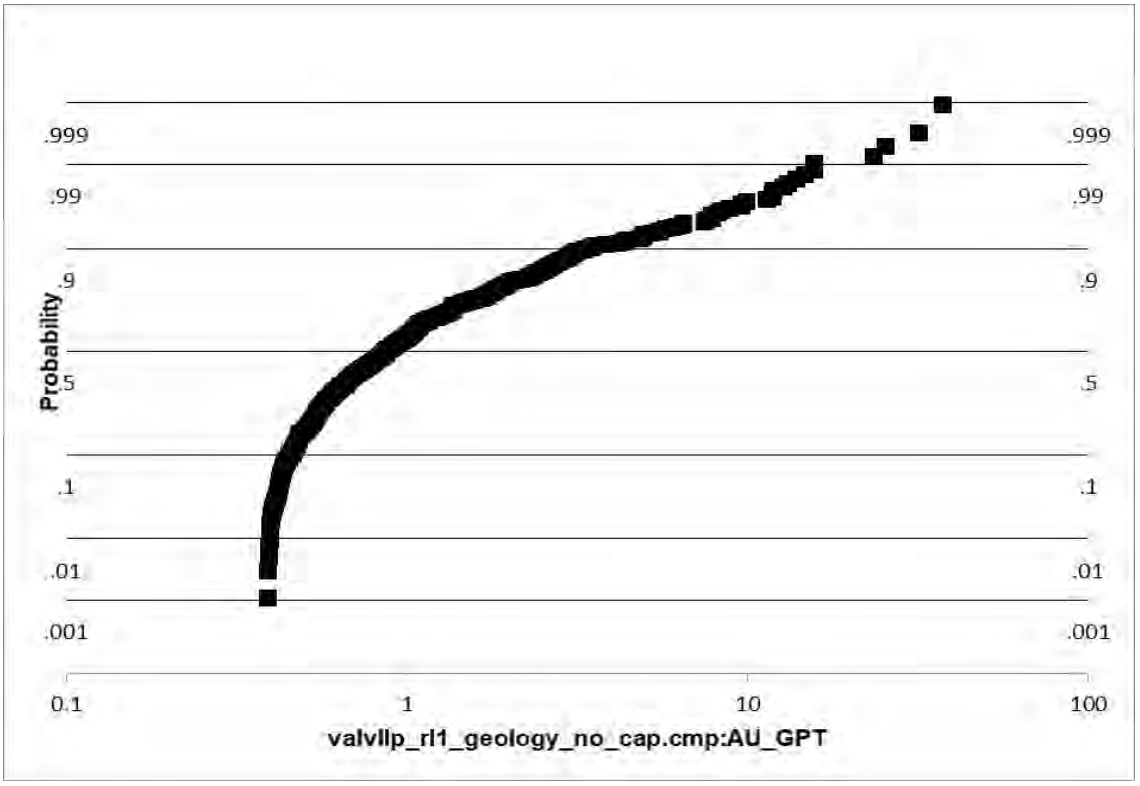


Figure 14.12 Leprechaun SED Domain Log-Normal Plot

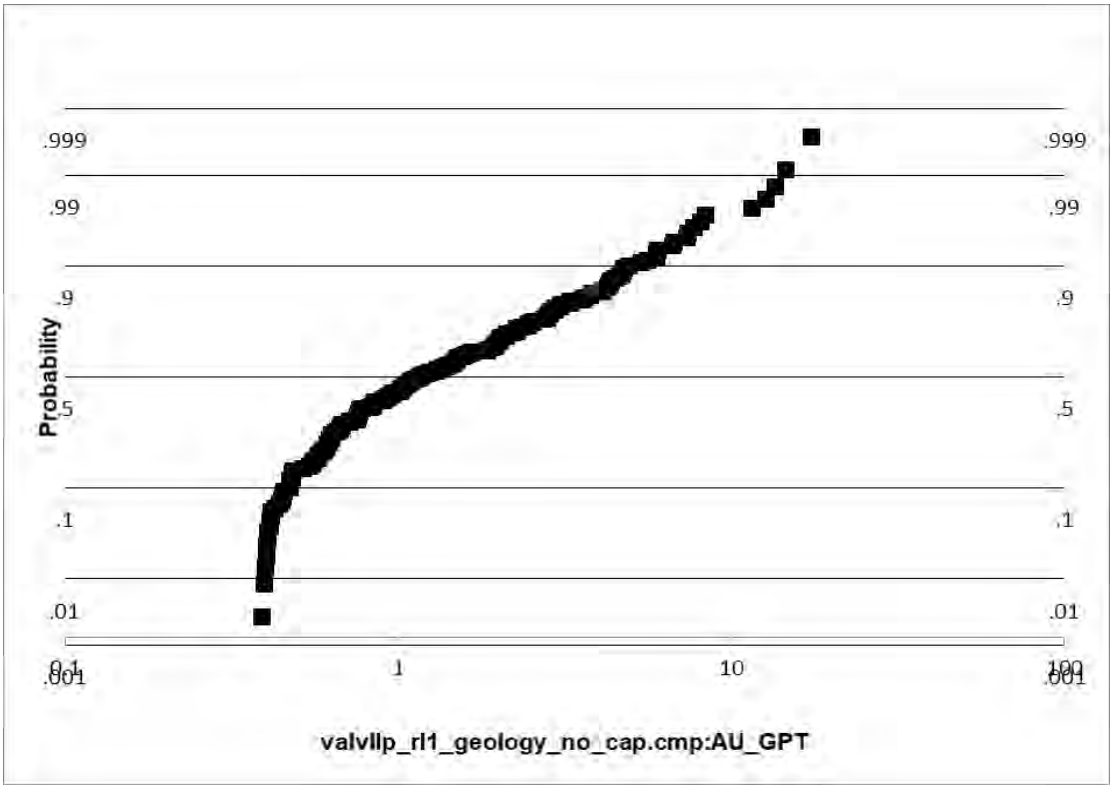
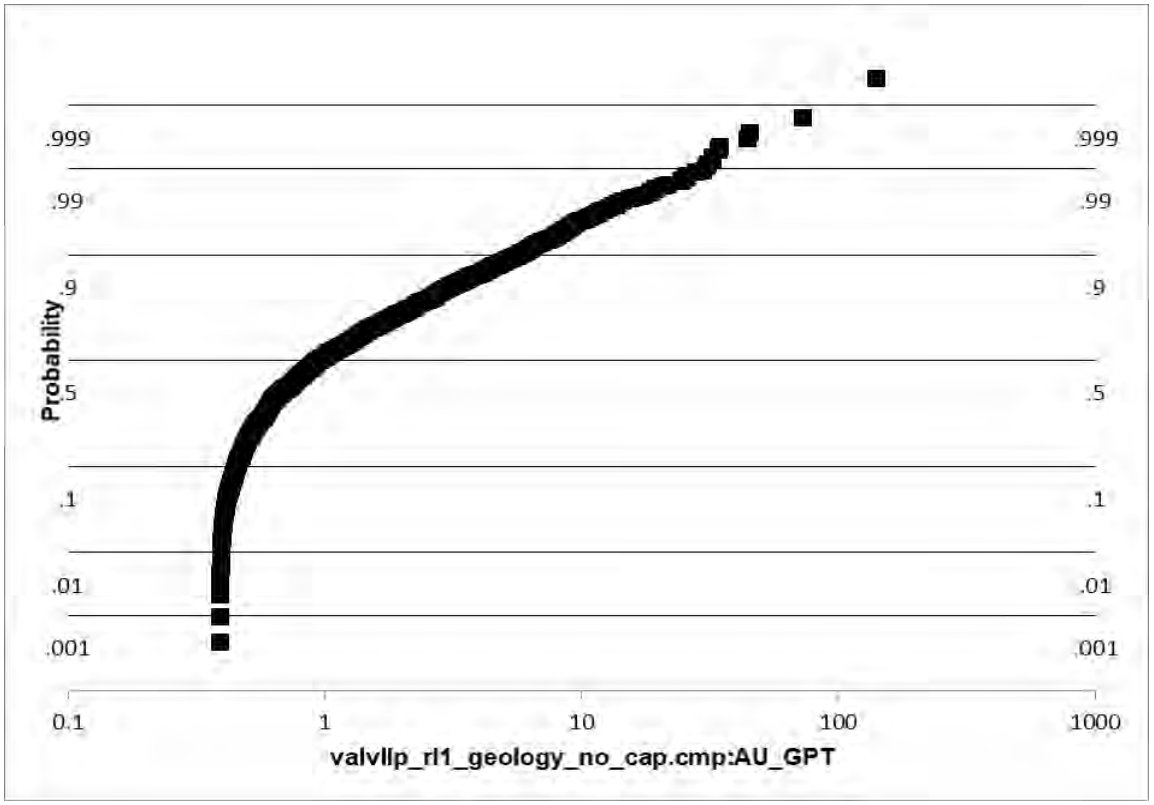


Figure 14.13 Leprechaun TRJ Domain Log-Normal Plot



The log-normal 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 mineralized domains and the selected metal threshold grades are shown below in Table 14.4.

Table 14.4 Leprechaun Gold Threshold Grades

Domain	Threshold (Au g/t)	Major (m)	Semi-Major (m)	Minor (m)
Hanging Wall QTPV	41.0	30.0	20.0	10.0
Footwall QTPV	53.0	10.0	10.0	10.0
Mafic Dikes	15.0	30.0	15.0	10.0
Sediments	8.4	10.0	15.0	5.0
Trondhjemite	24.0	10.0	15.0	5.0

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

14.2.2 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 mineralized solids. Gold grade variograms for each mineralized domain are shown below in Figures 14.14 through 14.18.

Figure 14.14 Leprechaun Hanging Wall QTPV Variograms

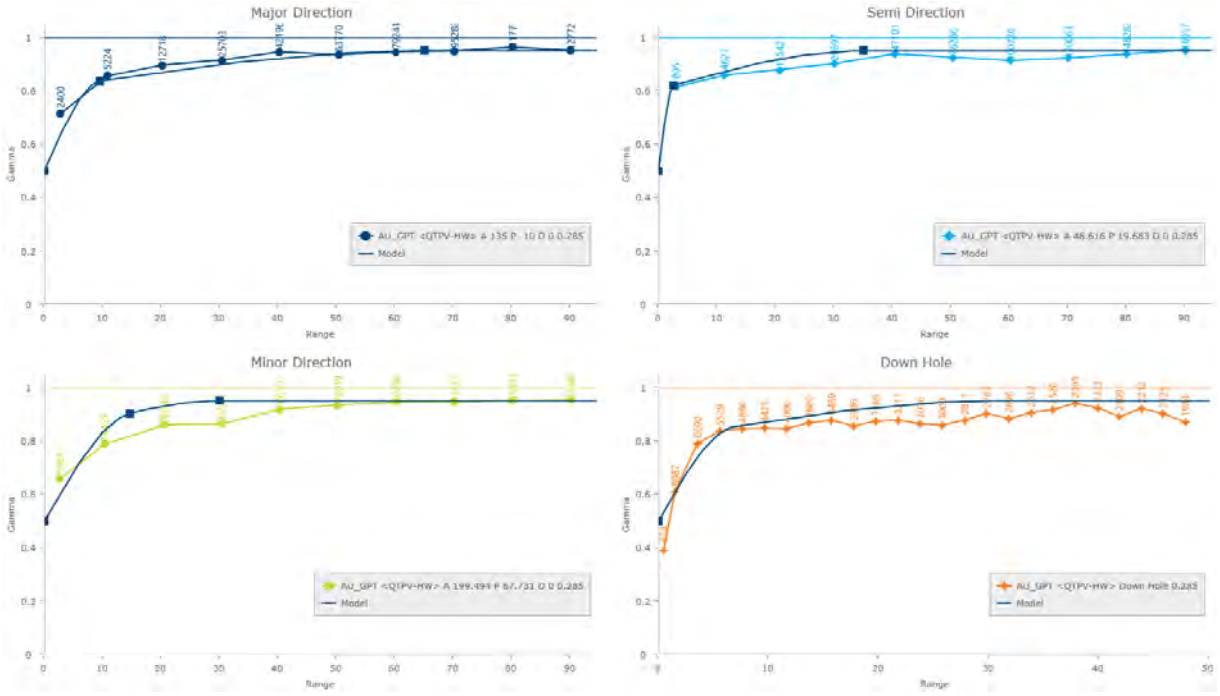


Figure 14.15 Leprechaun Footwall QTPV Variograms

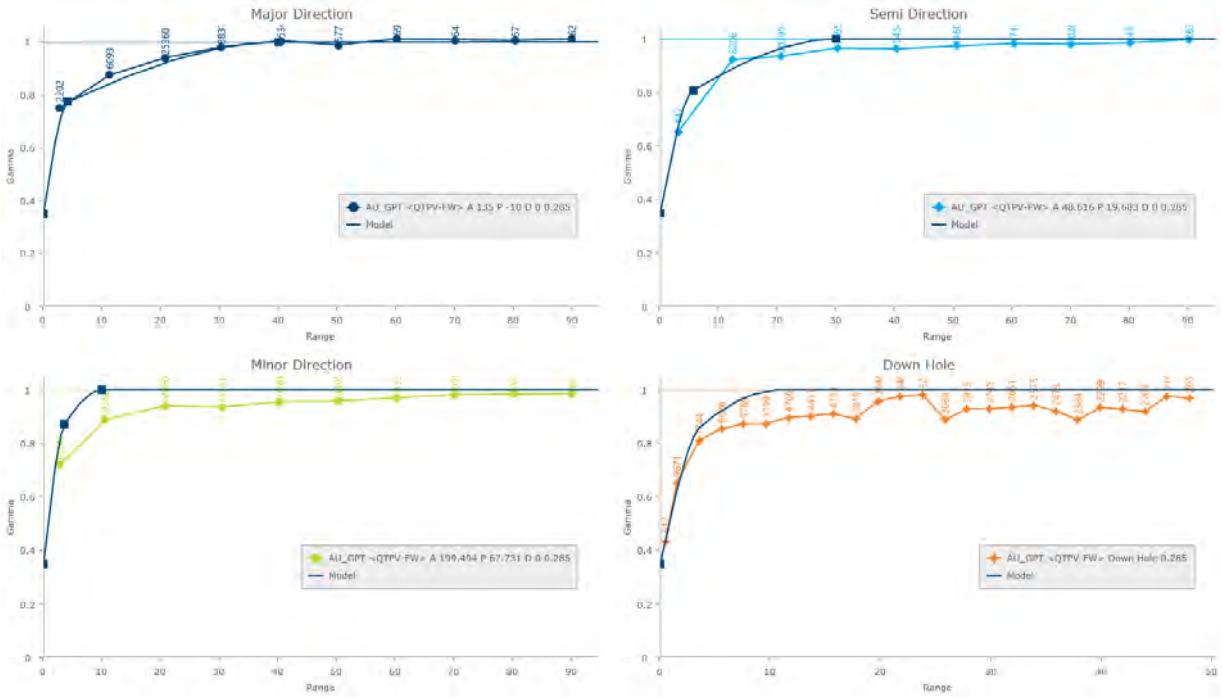


Figure 14.16 Leprechaun Mafic Dike Variograms

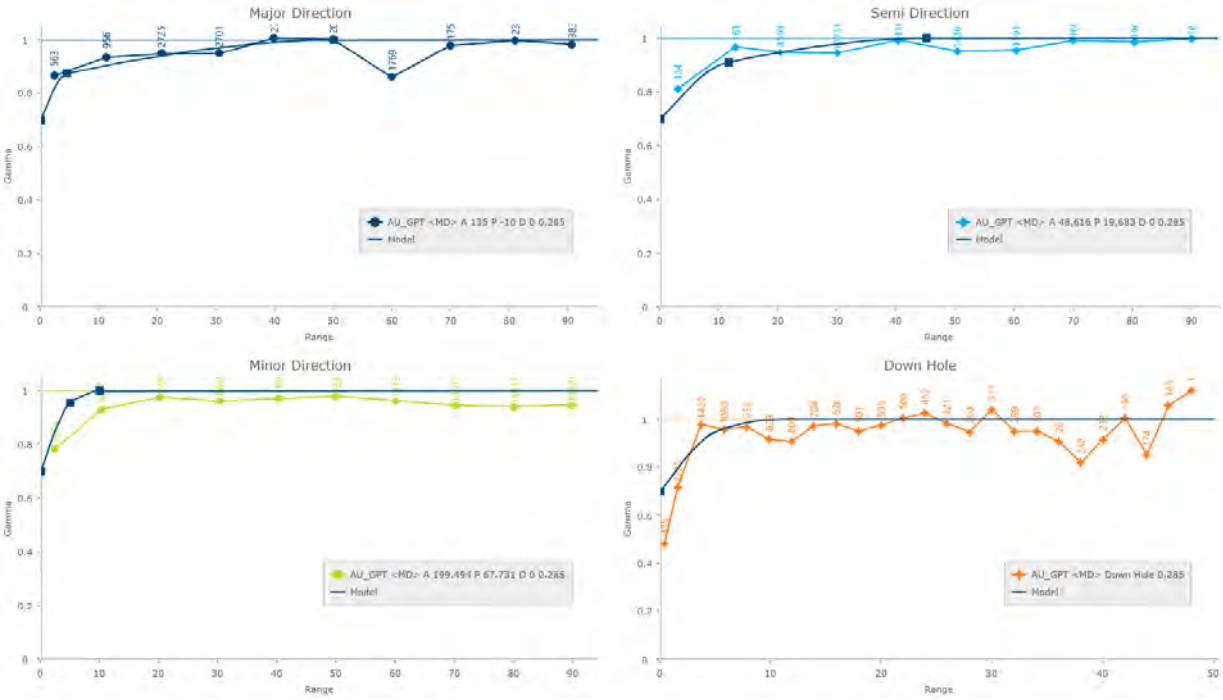


Figure 14.17 Leprechaun Sediment Variograms

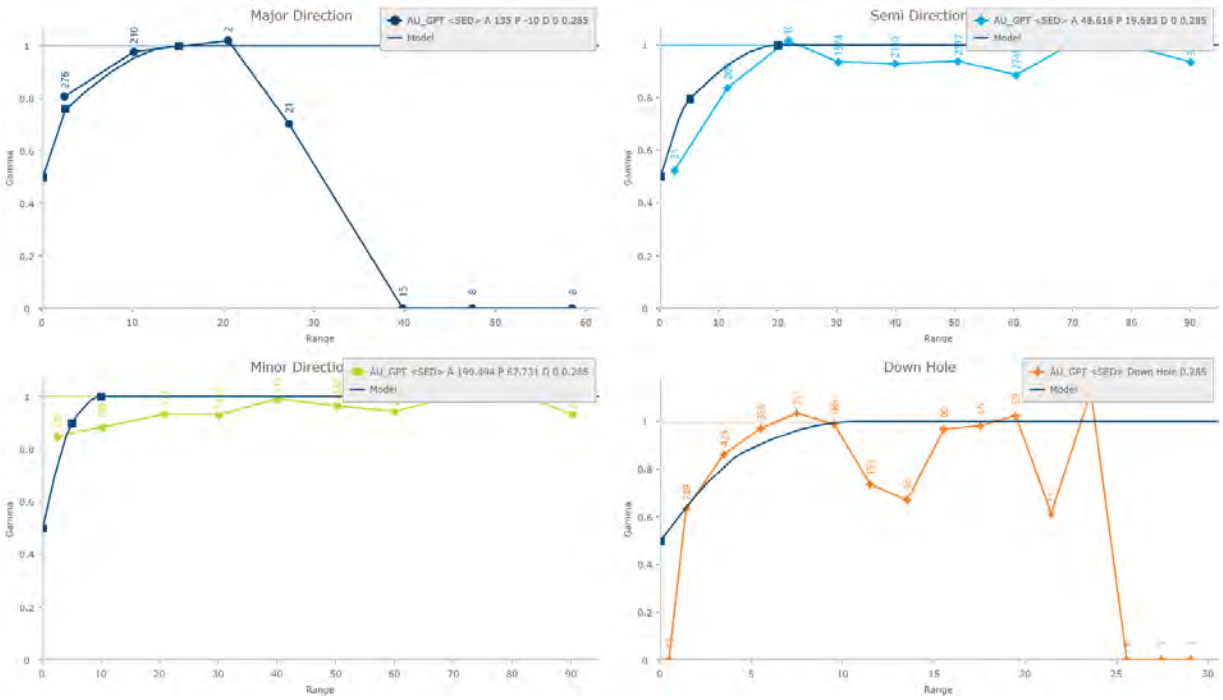
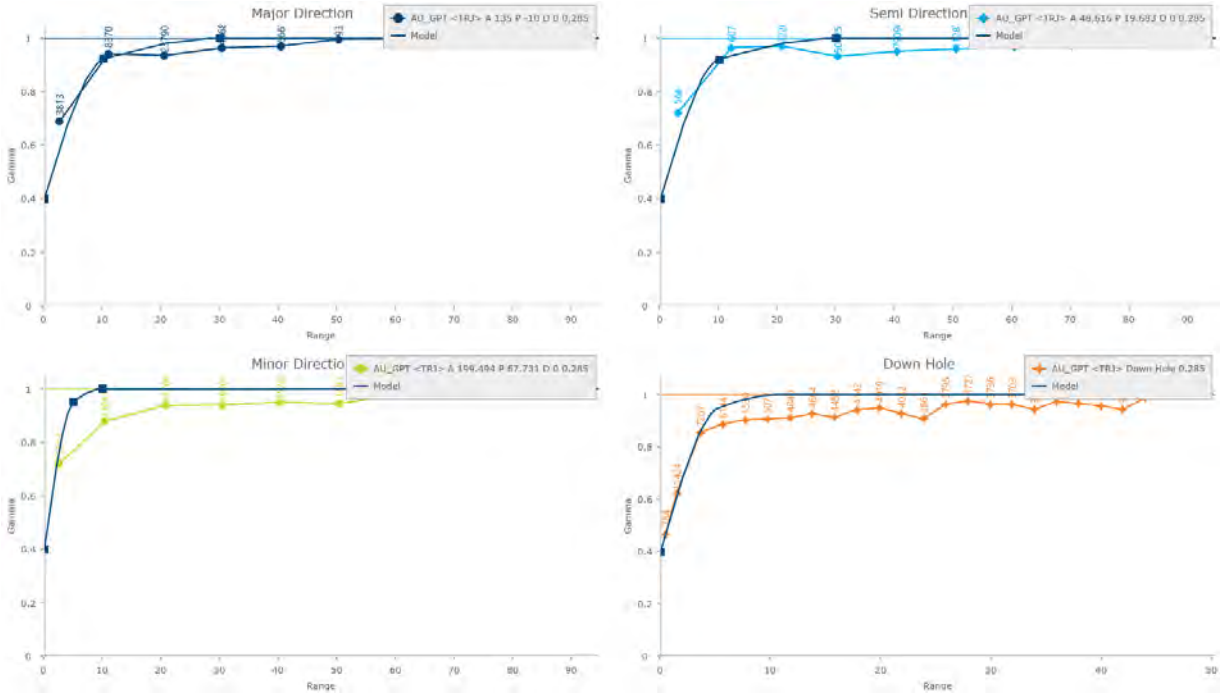


Figure 14.18 Leprechaun Trondhjemite Variograms



Based on these analyses, the search ellipsoid for each mineralized domain was established as shown below in Tables 14.5 through 14.9.

Table 14.5 Leprechaun Hanging Wall Search Ellipsoid

Grade Estimation Pass	1	2	3	4
Major Range (m)	65.0	65.0	65.0	97.5
Semi-Major Range (m)	35.0	35.0	35.0	52.5
Minor Range (m)	30.0	30.0	30.0	45.0
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 14.6 Leprechaun Footwall Search Ellipsoid

Grade Estimation Pass	1	2	3	4
Major Range (m)	40.0	40.0	40.0	60.0
Semi-Major Range (m)	30.0	30.0	30.0	45.0
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

Table 14.7 Leprechaun Mafic Dike Search Ellipsoid

Grade Estimation Pass	1	2	3	4
Major Range (m)	50.0	50.0	50.0	75.0
Semi-Major Range (m)	45.0	45.0	45.0	67.5
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

Table 14.8 Leprechaun Sediment Search Ellipsoid

Grade Estimation Pass	1	2	3	4
Major Range (m)	15.0	15.0	15.0	22.5
Semi-Major Range (m)	20.0	20.0	20.0	30.0
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

Table 14.9 Leprechaun Trondhjemite Search Ellipsoid

Grade Estimation Pass	1	2	3	4
Major Range (m)	30.0	30.0	30.0	45.0
Semi-Major Range (m)	30.0	30.0	30.0	45.0
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.

14.2.3 Leprechaun Deposit Block Model

Table 14.10 shows the Leprechaun block model extents. Figure 14.19 shows a typical block model section of the mineralized domain.

Table 14.10 Block Model Extents

Item	X	Y	Z
Origin	486,084.374	5355484.861	-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 14.19 Leprechaun Typical Mineralized Domain Block Model Cross-Section

14.2.4 Leprechaun Grade Estimation

A 3D block model was constructed in Vulcan that was constrained by the mineralized domains (described above). The current topographic surface was used to flag the topo 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 optimization 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 mineralized domain. Grade interpolation runs were set up for only that material within the mineralized domain for gold. All domains were run for gold with the exception of the overburden domain, which is assumed to not be mineralized.

Using the composited assays (described above), block grade interpolations were run in each mineralized domain for gold. Runs were completed using inverse distance cubed (ID3). Four passes were run to allow for use in resource classification. Only composites and blocks flagged as within the mineralized domain were considered in the grade estimation. The block model interpolation parameters are shown in Table 14.11 through Table 14.15.

Table 14.11 Leprechaun Hanging Wall QTPV Grade Estimation Parameters

Item	1	2	3	4
Search Parameters	1.00	1.00	1.00	1.50
Major Range (m)	65.0	65.0	65.0	97.5
Semi-Major Range (m)	35.0	35.0	35.0	52.5
Minor Range (m)	30.0	30.0	30.0	45.0
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)	65.00	65.00	65.00	97.50
Semi-Major (m)	50.00	50.00	50.00	75.00
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 14.12 Leprechaun Footwall QTPV Grade Estimation Parameters

Item	Pass			
	1	2	3	4
Search Parameters	1.00	1.00	1.00	1.50
Major Range (m)	40.0	40.0	40.0	60.0
Semi-Major Range (m)	30.0	30.0	30.0	45.0
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)	75.00	75.00	75.00	112.50
Semi-Major (m)	65.00	65.00	65.00	97.50
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 14.13 Leprechaun Mafic Dikes Grade Estimation Parameters

Item	Pass			
	1	2	3	4
Search Parameters	1.00	1.00	1.00	1.50
Major Range (m)	50.0	50.0	50.0	75.0
Semi-Major Range (m)	45.0	45.0	45.0	67.5
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)	35.00	35.00	35.00	52.50
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 14.14 Leprechaun Sediment Grade Estimation Parameters

Item	Pass			
	1	2	3	4
Search Parameters	1.00	1.00	1.00	1.50
Major Range (m)	15.0	15.0	15.0	22.5
Semi-Major Range (m)	20.0	20.0	20.0	30.0
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)	15.00	15.00	15.00	22.50
Semi-Major (m)	15.00	15.00	15.00	22.50
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 14.15 Leprechaun Trondhjemite Grade Estimation Parameters

Item	Pass			
	1	2	3	4
Search Parameters	1.00	1.00	1.00	1.50
Major Range (m)	30.0	30.0	30.0	45.0
Semi-Major Range (m)	30.0	30.0	30.0	45.0
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)	30.00	30.00	30.00	45.00
Semi-Major (m)	30.00	30.00	30.00	45.00
Minor (m)	6.00	6.00	6.00	9.00
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

14.2.5 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.

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 four is considered as waste material.

14.2.6 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.
- 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.

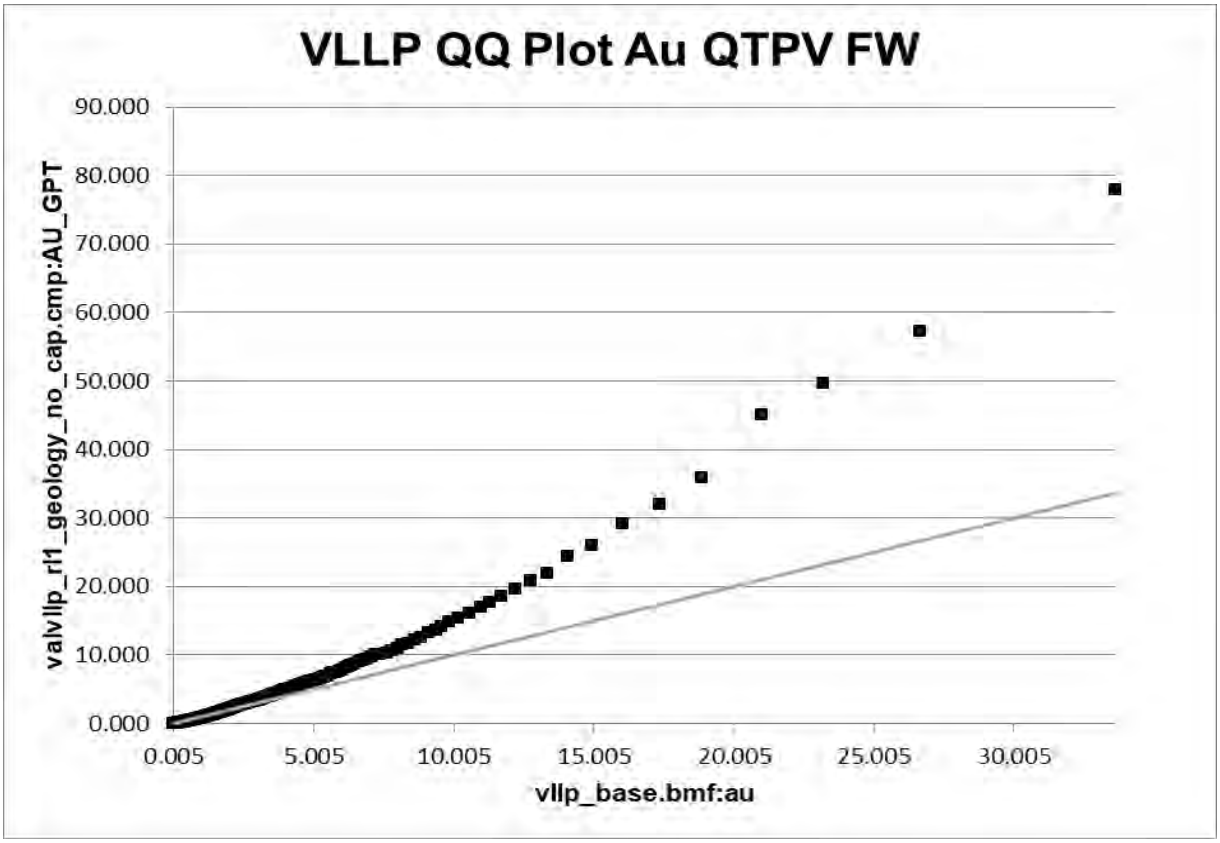
The overall block metal grades were examined to confirm that all the estimation parameters were honoured, as well as staying within the individual mineralized domains. A visual check on a sectional basis showed this to be true with block grades being consistently below the underlying drillhole assay value. Each of the cross-sections were 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-section 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 below in Table 14.16.

Table 14.16 Leprechaun Mineral Resource Estimation Model Statistics

Item	Drillholes	1-m Comps	Block Model
Number of Samples	54,971	78,777	2,463,138
Minimum	0.002	-	-
Maximum	375.784	157.376	141.177
Range	375.782	157.376	141.177
Average	0.478	0.346	0.603
Standard Deviation	3.944	2.613	2.054
Variance	15.555	6.827	4.218
Coef. Of Variance	8.258	7.556	3.407

The Footwall QTPV QQ plot of the block model estimated gold grades versus the composites are shown below in Figure 14.20.

Figure 14.20 Leprechaun Footwall QTPV QQ Plot



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 under-estimated relative to the underlying composites.

14.2.7 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 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 are defined. 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.

Economic Assumptions

The operating assumptions (economic and gold recovery) used for the Whittle economic open pit optimization are shown in Table 14.17, and the operating assumptions (economic and gold recovery) used for the calculation of an underground cut-off grade is shown below in Table 14.18.

Table 14.17 Leprechaun Open Pit Economic Assumptions

Item	Value	Units
Waste Mining Cost	2.00	$/Waste t
Millfeed and Heap Leach Mining Cost	2.50	$/Millfeed or Heap Leach t
Mill Processing Cost	12.00	$/Millfeed t
Heap Leach Processing Cost	3.00	$/Heap Leach t
G&A Cost	1.50	$/Millfeed or Heap Leach t
Mill Gold Recovery (at Cut-off)	92.4	%
Heap Leach Gold Recovery (at Cut-off)	62.5	%t
Royalty	1.5	%
Gold Price	1,250.00	$/troy oz
Mill/Heap Leach Calculated Cut-off Grade	1.142	g/t
Mill Calculated Cut-off	0.435	g/t
Incremental Mill Cut-off Grade	0.380	g/t
Heap Leach Calculated Cut-off Grade	0.281	g/t
Incremental Heap Leach Cut-off Grade	0.203	g/t

Table 14.18 Leprechaun Underground Economic Assumptions

Item	Value	Units
Millfeed Mining Cost	52.00	$/Millfeed t
Processing Cost	12.00	$/Material t
G&A Cost	1.50	$/Material t
Recovery (at Cut-off)	93.0	%
Royalty	1.5	%
Gold Price	1,250.00	$/Troy oz
Calculated Cut-off	1.767	g/t

For mineral resources estimation, a cut-off grade of 0.281 g/t gold was used for open pit, and a cut-off grade of 1.767 g/t gold was used for underground. The assumed overall pit slope in Whittle was assumed to be 47.5° in sediments (not including ramps) and 54.3° (not including ramps) everywhere else.

Please note that gold recovery is variable and is determined using the following:

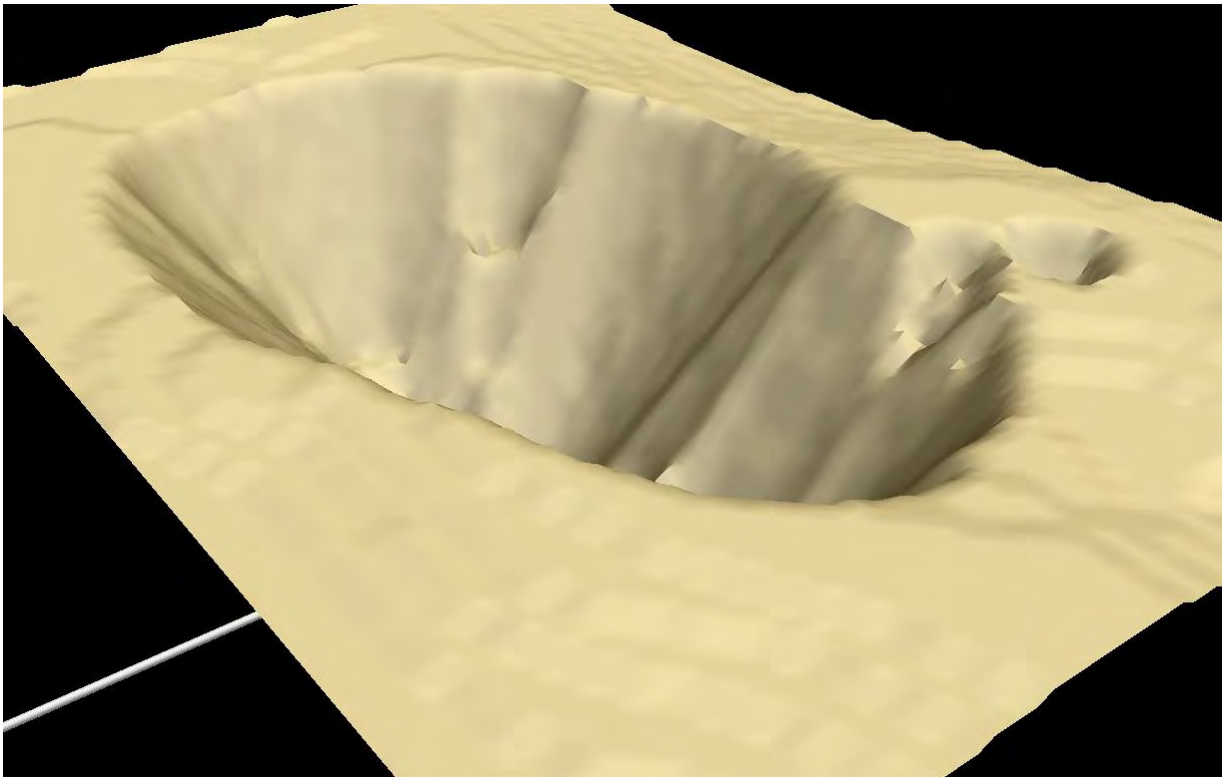
- Millfeed:
  - For gold grades less than 0.5 g/t a recovery of 92.4% is used.
  - For gold grades from 0.5 g/t to 8.0 g/t a formula is used: Recovery = 0.005 x Au + 0.921.

- For gold greater than 8.0 g/t or greater a recovery of 96.1% is used.

- Heap Leach:
  - Gold grades less than 0.2 g/t are not recovered.
  - For gold grades from 0.2 g/t to 2.0 g/t a formula is used: Recovery = 0.090 x Au + 0.600.
  - For gold grades 2.0 g/t or greater a recovery of 78.0% is used.

Using these assumptions, a Whittle economic pit optimization was completed and an economic pit shell generated. This pit shell was used to design a conceptual open pit which is shown below in Figure 14.21.

Figure 14.21 Leprechaun Whittle Open Pit Shell



Mineral Resource Estimate

BOYD's Mineral Resource estimate for the Leprechaun deposit is provided below in Table 14.19.

Table 14.19 Mineral Resource Estimate for the Leprechaun Deposit

Mining Method	Resource Classification	Gold Cut-off Grade (g/t)	Tonnes	Au g/t	Au Troy Ozs
Open Pit - Mill	Measured	1.142	2,581,000	4.587	380,600
Open Pit - Mill	Indicated	1.142	1,304,000	3.644	152,800
Open Pit - Mill	*Measured + Indicated*	*1.142*	*3,885,000*	*4.270*	*533,400*
Open Pit - Mill	Inferred	1.142	2,420,000	3.418	265,900
Open Pit - Heap Leach	Measured	0.281	3,179,000	0.589	60,200
Open Pit - Heap Leach	Indicated	0.281	1,706,000	0.596	32,700
Open Pit - Heap Leach	*Measured + Indicated*	*0.281*	*4,885,000*	*0.592*	*92,900*
Open Pit - Heap Leach	Inferred	0.281	5,113,000	0.557	91,500
Total Open Pit	Measured	-	5,760,000	2.381	440,800
Total Open Pit	Indicated	-	3,010,000	1.916	185,500
Total Open Pit	*Measured + Indicated*	-	*8,770,000*	*2.221*	*626,300*
Total Open Pit	Inferred	-	7,533,000	1.476	357,400
Underground	Measured	1.767	81,000	3.910	10,200
Underground	Indicated	1.767	64,000	3.460	7,100
Underground	*Measured + Indicated*	*1.767*	*145,000*	*3.711*	*17,300*
Underground	Inferred	1.767	388,000	4.274	53,300
Open Pit + Underground	Measured	-	5,841,000	2.402	451,000
Open Pit + Underground	Indicated	-	3,074,000	1.949	192,600
Open Pit + Underground	*Measured + Indicated*	-	*8,915,000*	*2.245*	*643,600*
Open Pit + Underground	Inferred	-	7,921,000	1.613	410,700

1. **The effective date for this mineral resource estimate is 4 October 2018 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.**
2. **Mineral Resources are calculated at a gold price of $1,250 /troy oz.**
3. **The mineral resources presented above are global and do not include a detailed pit or underground design, only an economic 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 ID^3 methods for grade estimation. All mineral resources 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 which was applied during grade estimation by mineralized 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, 2014.**
7. **Figures are rounded and totals may not add correctly.**

14.3 Victory Deposit Mineral Resource Estimate

No additional exploration data were available to update the Victory Deposit geologic 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.).

The description of that previous mineral resource estimate is duplicated below from the 28 May 2018 BOYD Technical Report.

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

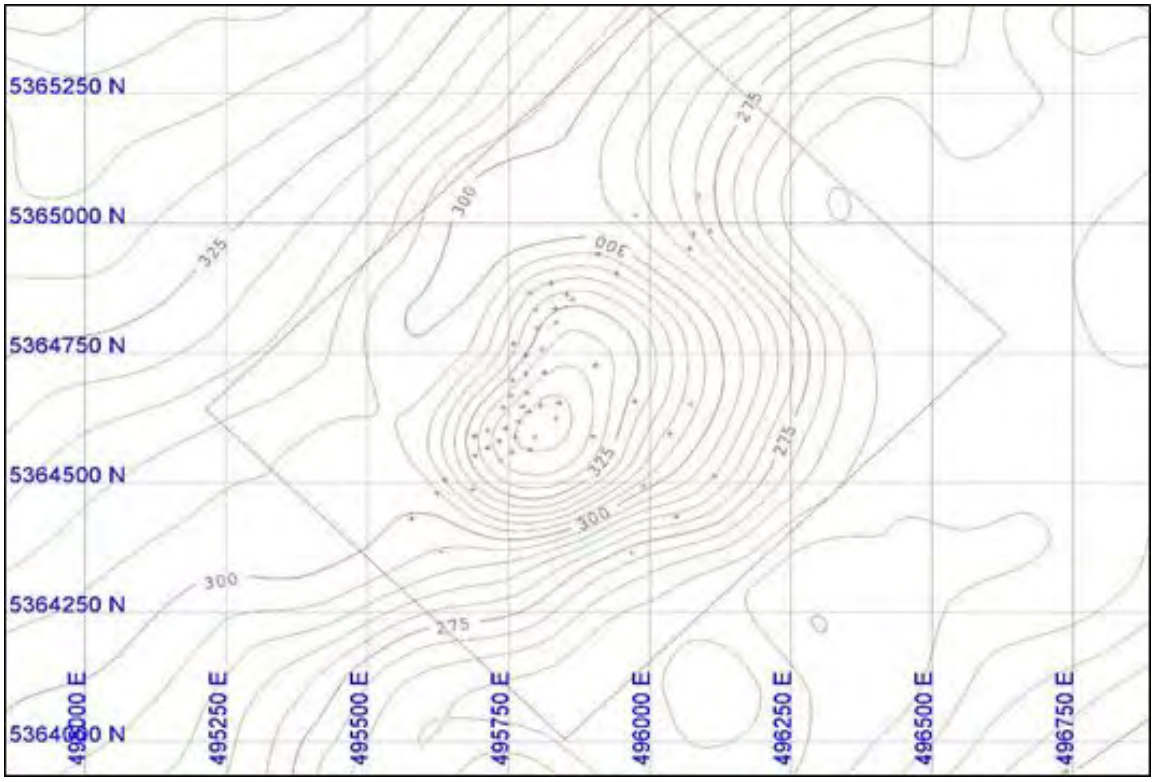
Potentially economic gold mineralization is encountered in the QTPV and TRJ domains. There is minor mineralization present in the other domains but only a very limited amount of information in these areas was available and no attempt was made to make a Mineral Resource estimate in them.

Previous geologic modelling work completed for the Victory deposit assumed a series of steeply-dipping gold-bearing veins as opposed to the flatter QTP veins. This is not supported by the observed field geology recorded by Marathon geologists and as a result, a new Mineral Resource estimate is warranted on the Victory Deposit Data.

Drillholes

The estimates of mineral resources reported herein for the Victory deposit are based on all drillholes whose assays were available by 6 March 2014 (the most recent available data) and consists of 64 diamond core drillholes totalling approximately 8,781 m. Figure 14.22 shows the collars of these drillholes.

Figure 14.22 Victory Deposit Drillhole Locations and Topography



Assays

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

Density

To date, there have been 349 density measurements taken at the Victory deposit. The results of these measurements are shown below in Table 14.20. Block densities were assigned based on the blocks domain of lithology type.

Table 14.20 Victory Deposit Density Measurements

Lithology Type	Samples	Specific Gravity t/m³
Mafic Dikes	56	2.72
Quartz-Tourmaline- Pyrite Veins	97	2.59
Sediments	2	2.68
Trondhjemite	194	2.60
Overburden	---	1.50

Topography

The topography of the area around the Victory deposit is shown on Figure 14.22. All contours are expressed as masl. Contour intervals are every 5 m. The Victory deposit sits on a steep hilltop protruding southeast from northeast trending ridge. Towards the south, the ridge drops steeply downward towards a creek drainage.

14.3.1 Victory Deposit Data Analysis

Geological Modelling

The Victory deposit contains four major potentially mineralized 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 mineralized 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, geologic implicit models, as well as block modelling. The overburden surface is shown below in Figure 14.23.

Figure 14.23 Victory Deposit Base of Overburden

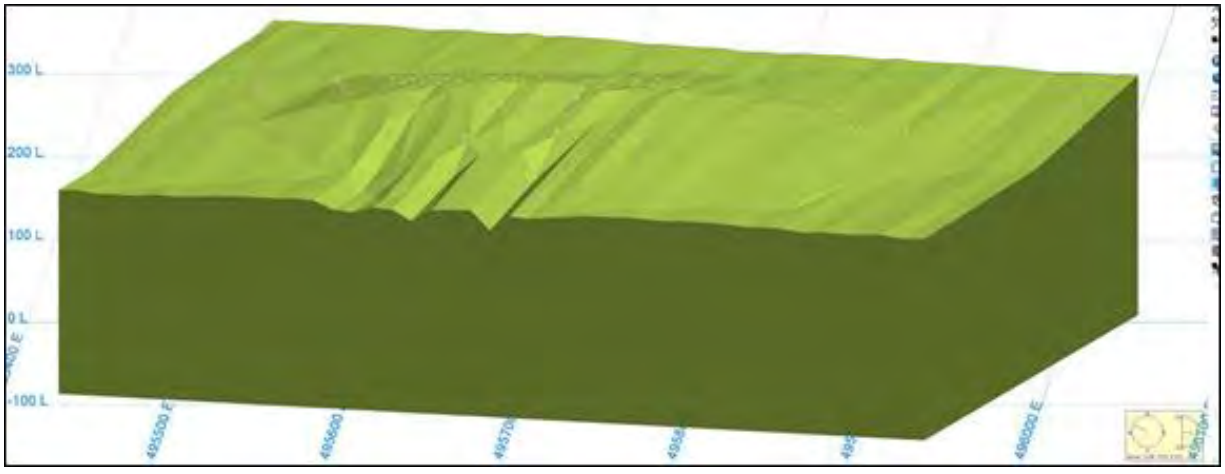
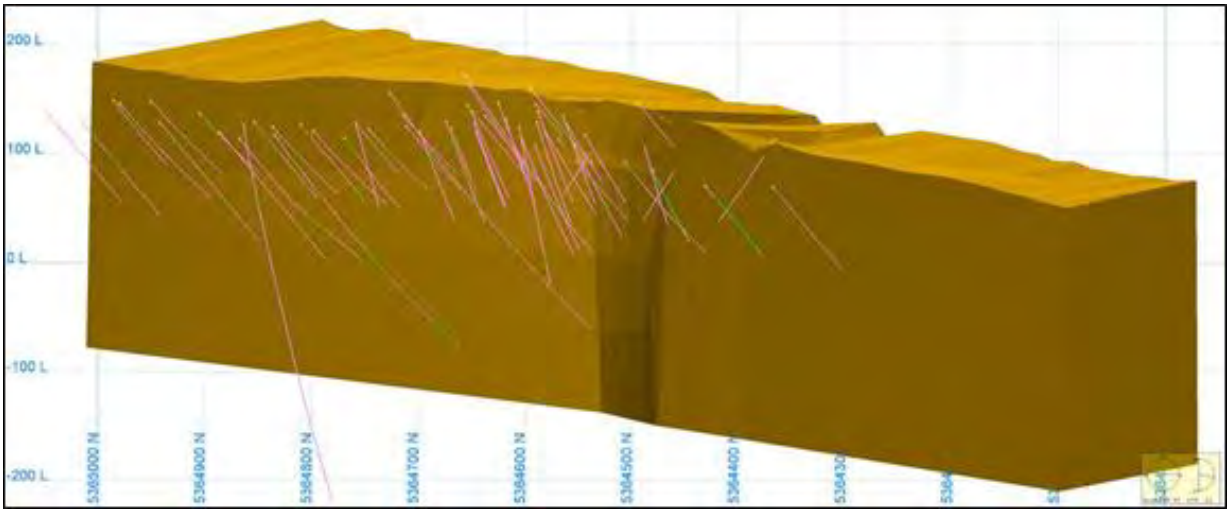
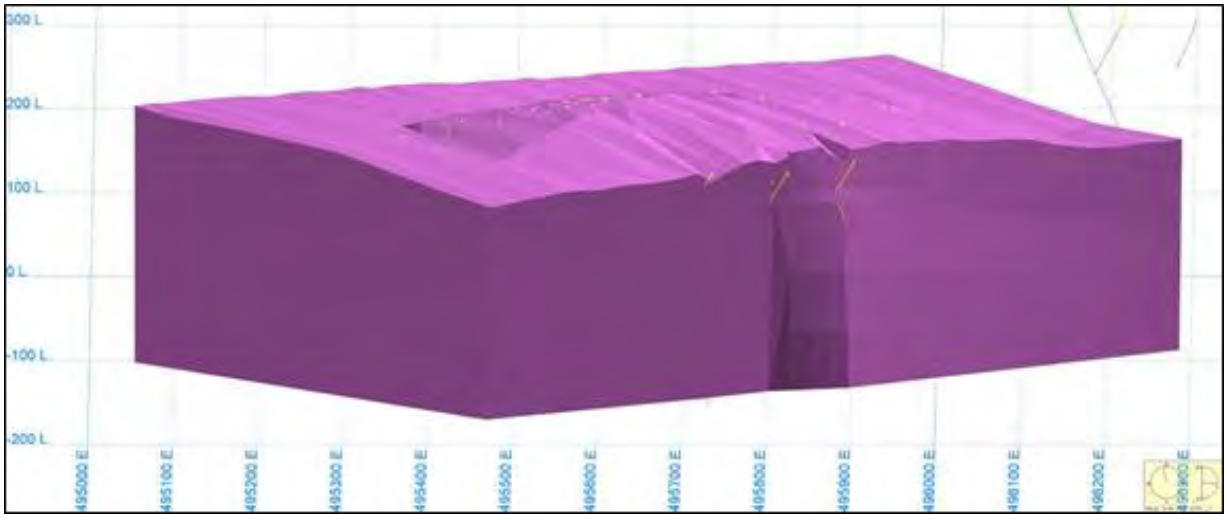


Figure 14.24 Victory Deposit Sediment Domain



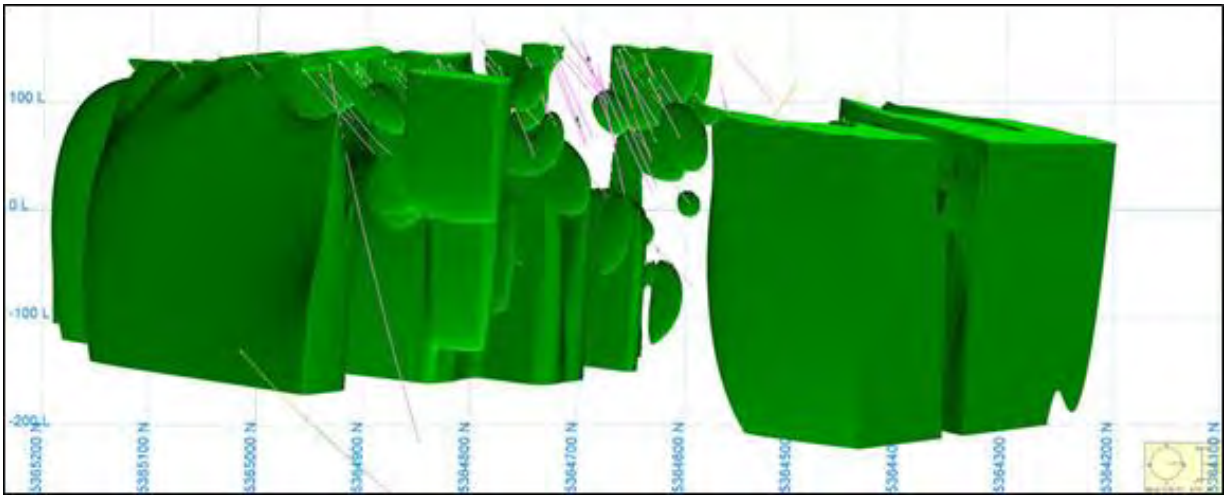
The TRJ domain is the remaining rock mass northwest of the sediment solid and below the overburden horizon. The TRJ domain is shown below in Figure 14.25.

Figure 14.25 Victory Deposit Trondhjemite Domain



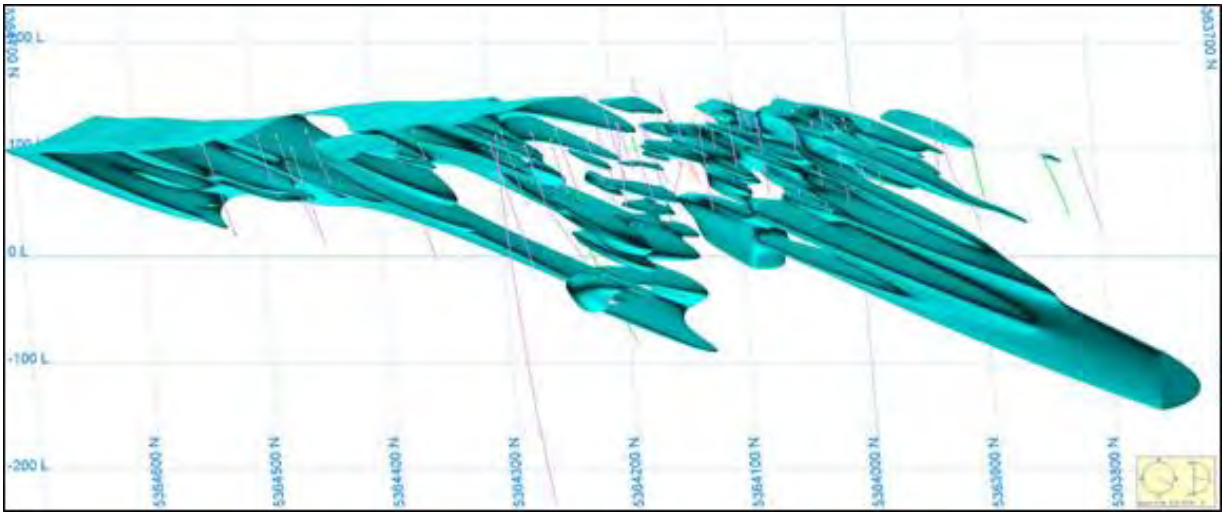
For the MD domain, implicit modelling was used to develop a geologic solid based on the drillhole intercepts within the Victory deposit drillhole database. The implicit model used an azimuth of 218°, plunge of 0°, and a dip of -85°. Based on discussions with Marathon Gold geologic staff, the mafic dikes 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 below in Figure 14.26.

Figure 14.26 Victory Deposit Mafic Dike Domain



For the QTPV domain, the same implicit modelling approach was used to develop the mineralized 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 are shown below in Figure 14.27.

Figure 14.27 Victory Deposit QTPV Domain



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

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 below in Table 14.21.

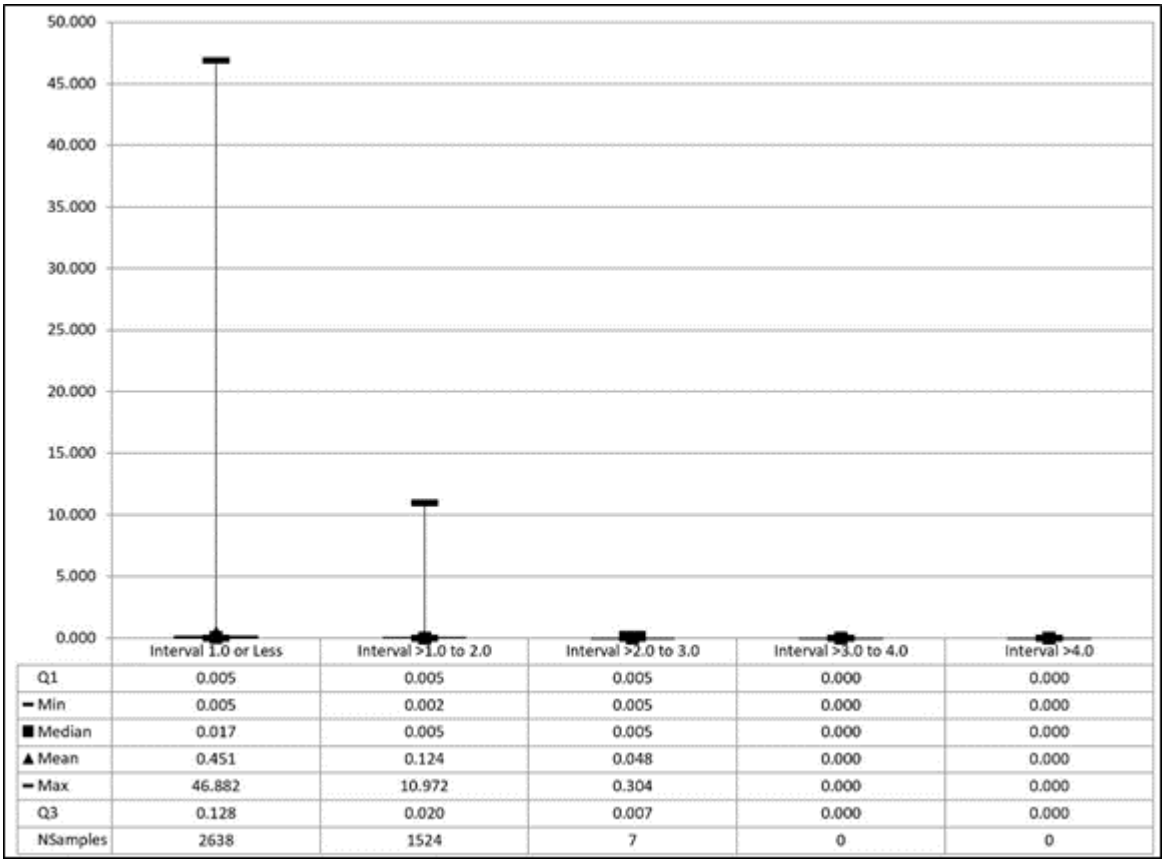
Table 14.21 Victory Deposit Descriptive Statistics

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

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 box-plot in Figure 14.28 below shows the results of this analysis.

Figure 14.28 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

In examining the results of this analysis, it can be seen that most samples with potentially economic gold mineralization 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 mineralized 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 mineralization in the individual drillholes within each mineralized zone.

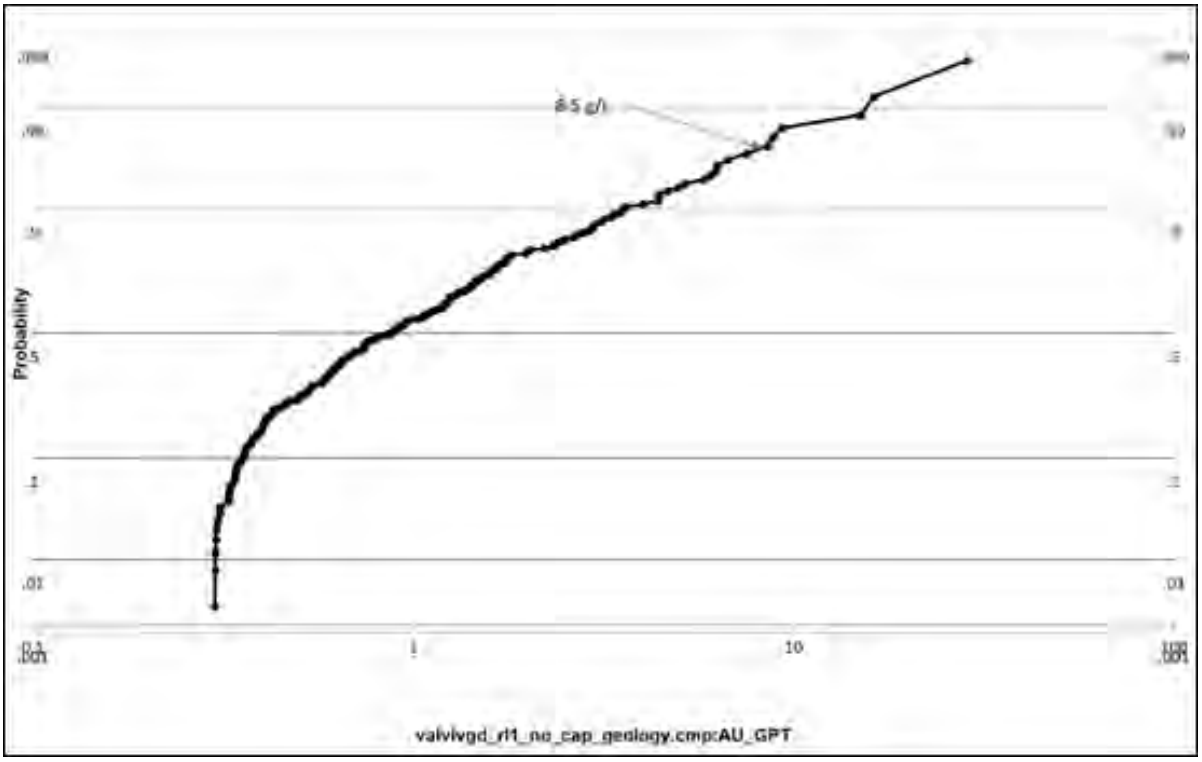
High Value Grade Limits

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 log-normal probability plot was generated for gold in each mineralized 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 log-normal probability plots for gold found in each mineralized domain are shown below in Figures 14.29 and 14.30, which follow.

Figure 14.29 Victory Deposit QTPV Domain Log-Normal Plot

Figure 14.30 Victory Deposit Trondhjemite Domain Log-Normal Plot



The log-normal 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 Modeler, 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 mineralized domains and the selected metal threshold grades are shown below in Table 14.22.

Table 14.22 Victory Deposit Gold Threshold Grades

Domain	Limited Search Ellipsiod			
	Threshold (Au g/t)	Major (m)	Semi-Major (m)	Minor (m)
QTPV	13.0	20.0	20.0	8.0
Trondhjemite	8.5	20.0	20.0	10.0

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

14.3.2 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 mineralized solids. Gold grade variograms for each mineralized domain are shown below in Figures 14.31 and 14.32.

Figure 14.31 Victory Deposit QTPV Variograms

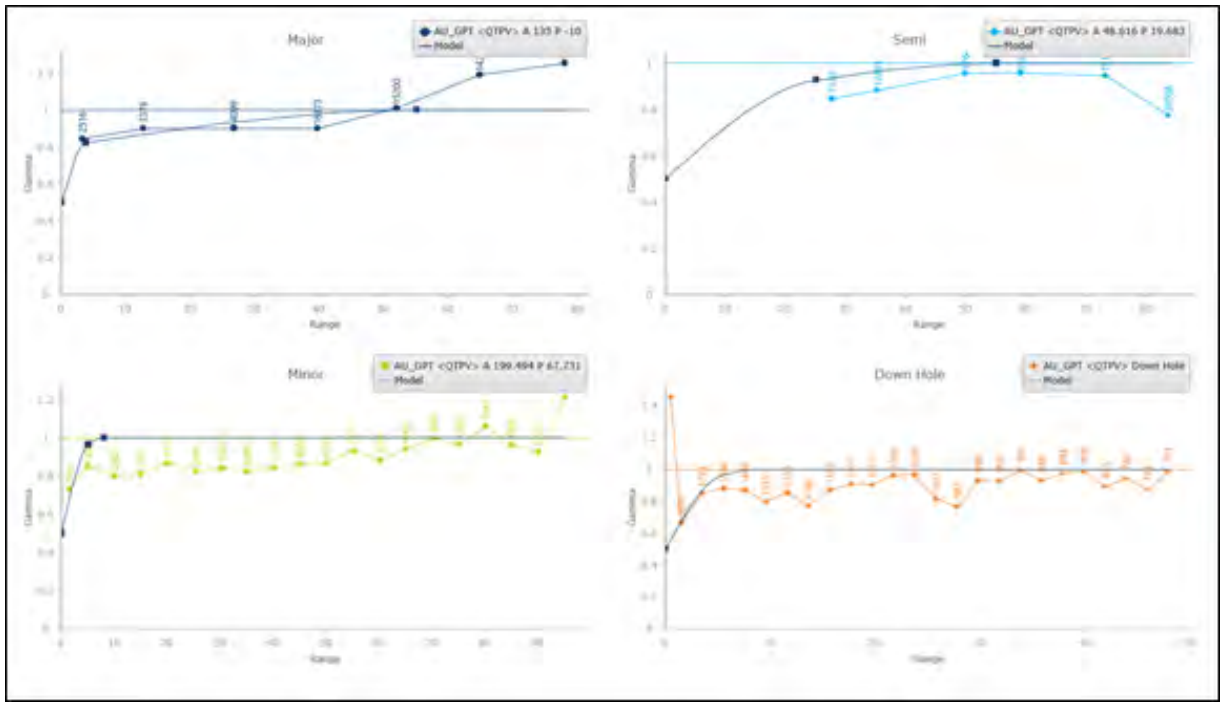
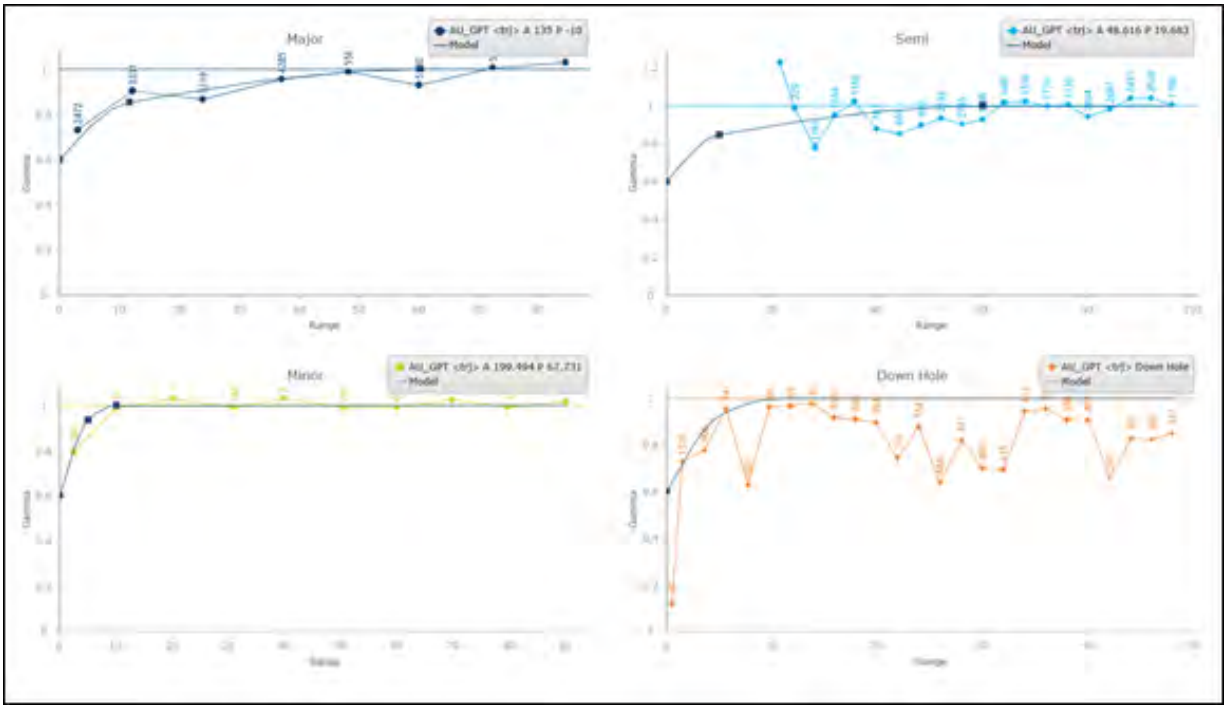


Figure 14.32 Victory Deposit Trondhjemite Variograms



Based on these analyses, the search ellipsoid for each mineralized domain was established as shown below in Tables 14.23 and 14.24.

Table 14.23 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 14.24 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.

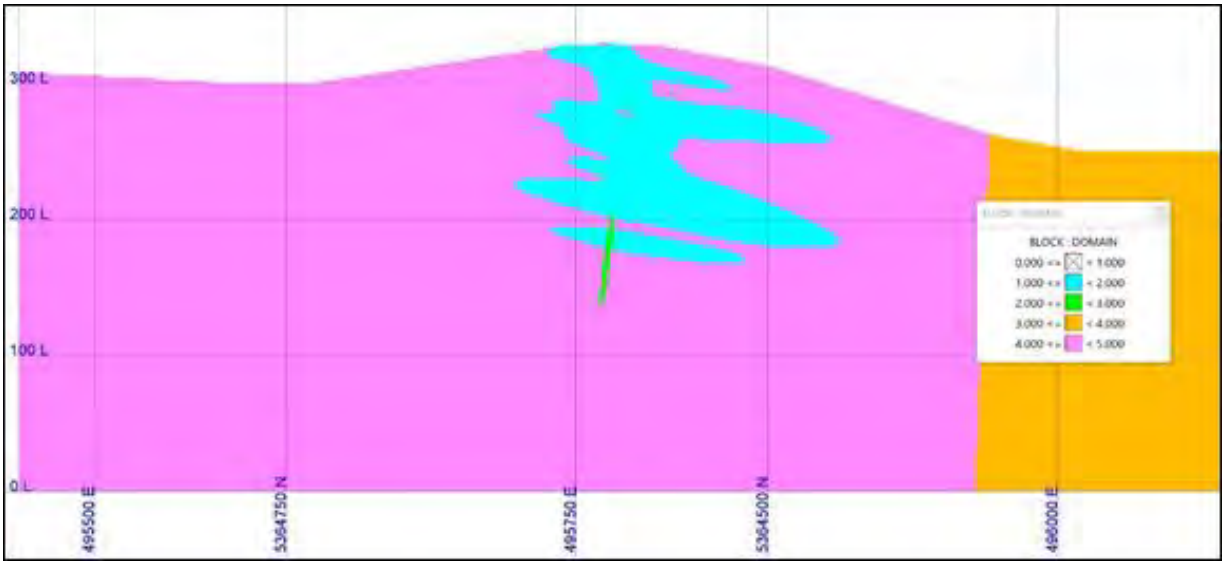
14.3.3 Victory Deposit Block Model

Table 14.25 shows the Victory deposit block model extents. Figure 14.33 shows a typical block model section of the mineralized domain.

Table 14.25 Block Model Extents

Item	X	Y	Z
Origin	495,849.968	5,364,004.741	-
Offset Minimum	-	-	-
Offset Maximum	1,104	900	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 14.33 Victory Deposit Typical Mineralized Domain Block Model Cross-Section



14.3.4 Victory Deposit Grade Estimation

A 3D block model was constructed in Vulcan that was constrained by the mineralized 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. A 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 optimization 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 mineralized domain. Grade interpolation runs were set up for only that material within the mineralized domain for gold. All domains were run for gold with the exception of the overburden domain which is assumed to not be mineralized.

Using the composited assays (described above), block grade interpolations were run in each mineralized 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 mineralized domain were considered in the grade estimation. The block model interpolation parameters are shown in Table 14.26 and Table 14.27.

Table 14.26 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 14.27 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

14.3.5 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 four is considered as waste material.

14.3.6 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.

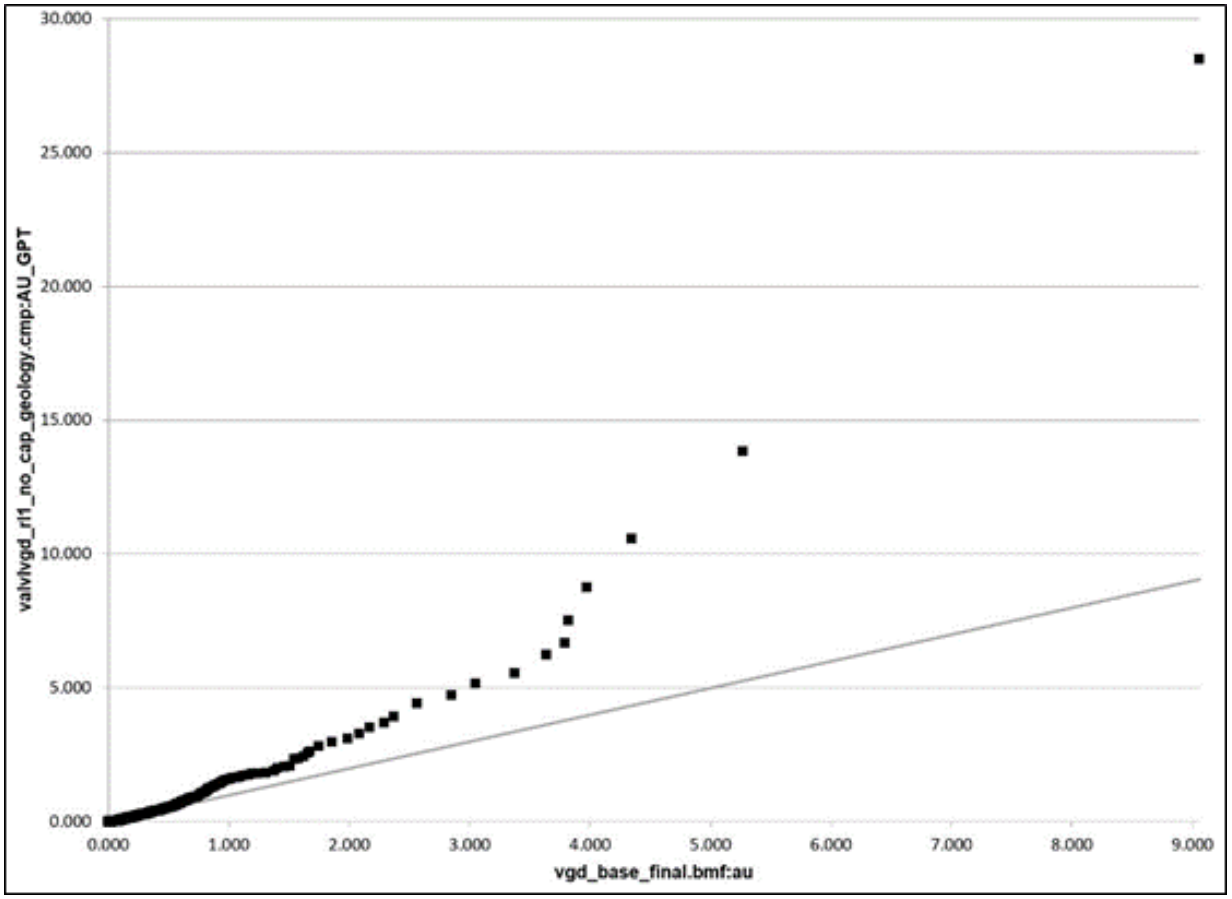
The overall block metal grades were examined to confirm that all the estimation parameters were honoured, as well as staying within the individual mineralized domains. A visual check on a sectional basis showed this to be true with block grades being consistently below the underlying drillhole assay value. Each of the cross-sections were 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 below in Table 14.28.

Table 14.28 Victory Deposit Mineral Resource Estimation Model Statistics

Item	Drillholes	1-m Comps	Block Model
Number of Samples	4,169	2,854	122,354
Minimum	0.002	0.010	0.010
Maximum	46.882	34.444	25.677
Range	46.880	34.434	25.667
Average	0.331	0.523	0.284
Standard Deviation	1.834	1.908	0.782
Variance	3.364	3.641	0.612

The overall QQ plot of the block model estimated gold grades versus the composites are shown below in Figure 14.34.

Figure 14.34 Victory Deposit Overall QQ Plot



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.

14.3.7 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 pit shell") using the Lerchs-Grossman method as provided by the GEOVIA Whittle software (Whittle) 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.

Economic Assumptions

The operating assumptions (economic and gold recovery) used for the Whittle economic open pit optimization are shown in Table 14.29, and the operating assumptions (economic and gold recovery) used for the calculation of an underground cut-off grade are shown below in Table 14.30.

Table 14.29 Victory Deposit Open Pit Economic Assumptions

Item	Value	Units
Waste Mining Cost	2.00	$/Waste t
Millfeed and Heap Leach Mining Cost	2.50	$/Millfeed and Heap Leach t
Mill Processing Cost	12.00	$/Millfeed t
Heap Leach Processing Cost	3.00	$/Heap Leach t
G&A Cost	1.50	$/Millfeed and Heap Leach t
Mill Gold Recovery (at Cut-off)	94.6	%
Heap Leach Gold Recovery (at Cut-off)	53.6	%
Royalty	-	%
Gold Price	1,250.00	$/troy oz
Mill/Heap Leach Calculated Cut-off Grade	0.700	g/t
Mill Calculated Cut-off	0.425	g/t
Incremental Mill Cut-off Grade	0.372	g/t
Heap Leach Calculated Cut-off Grade	0.328	g/t
Incremental Heap Leach Cut-off Grade	0.266	g/t

Table 14.30 Victory Deposit Underground Economic Assumptions

Item	Value	Units
Mining Cost	52.00	$/All Material t
Processing Cost	12.00	$/Material t
G&A Cost	1.50	$/Material t
Recovery (at cut-off)	94.9	%
Royalty	-	%
Gold Price	1,250.00	$/troy oz
Calculated Cut-off	1.731	g/t

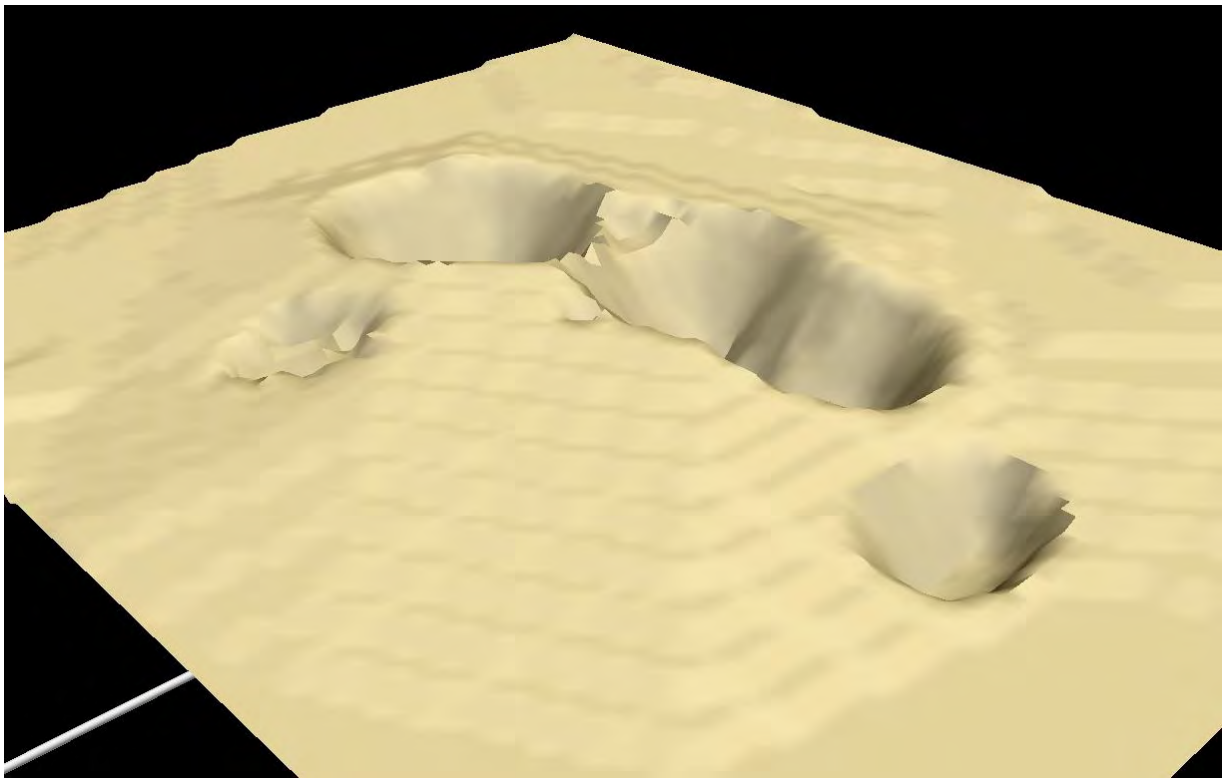
For mineral resources estimation, a cut-off grade of 0.328 g/t gold was used for open pit, and a cut-off grade of 1.731 g/t gold was used for underground. The assumed overall pit slope in Whittle was assumed to be 54.3°, not including ramps.

Please note that gold recovery is variable and is determined using the following:

- Millfeed:
  - For gold grades less than 0.5 g/t a recovery of 94.6% is used.
  - For gold grades from 0.5 g/t to 8.0 g/t a formula is used: Recovery = 0.003 x Au + 0.944.
  - For gold grades 8.0 g/t or grater a recovery of 96.8% is used.
- Heap Leach:
  - Gold grades less than 0.2 g/t are not recovered.
  - For gold grades from 0.2 g/t to 2.0 g/t a formula is used: Recovery = 0.110 x Au + 0.500.
  - For gold grades 2.0 g/t or grater a recovery of 72.0% is used.

Using these assumptions, a Whittle economic pit optimization was completed and economic pit shell generated. This pit shell was used to design the conceptual pit design shown below in Figure 14.35.

Figure 14.35 Victory Deposit PEA Open Pit Shell



Mineral Resource Estimate

BOYD's estimate of Mineral Resources for the Victory Deposit is shown below in Table 14.31.

Table 14.31 Mineral Resource Estimate for the Victory Deposit

Mining Method	Resource Classification	Gold Cut-off Grade (g/t)	Tonnes	Au g/t	Au Troy Ozs
Open Pit - Mill	Measured	0.700	0	0.000	0
Open Pit - Mill	Indicated	0.700	615,000	2.210	43,700
Open Pit - Mill	***Measured + Indicated***	***0.700***	***615,000***	***2.210***	***43,700***
Open Pit - Mill	Inferred	0.700	1,078,000	1.795	62,200
Open Pit - Heap Leach	Measured	0.328	0	0.000	0
Open Pit - Heap Leach	Indicated	0.328	394,000	0.487	6,200
Open Pit - Heap Leach	***Measured + Indicated***	***0.328***	***394,000***	***0.489***	***6,200***
Open Pit - Heap Leach	Inferred	0.328	743,000	0.494	11,800
Total Open Pit	Measured	-	0	0.000	0
Total Open Pit	Indicated	-	1,009,000	1.537	49,900
Total Open Pit	***Measured + Indicated***	***-***	***1,009,000***	***1.538***	***49,900***
Total Open Pit	Inferred	-	1,821,000	1.264	74,000
Underground	Measured	1.731	0	0.000	0
Underground	Indicated	1.731	2,000	1.848	100
Underground	***Measured + Indicated***	***1.731***	***2,000***	***1.555***	***100***
Underground	Inferred	1.731	155,000	3.174	15,800
Open Pit + Underground	Measured	-	0	0.000	0
Open Pit + Underground	Indicated	-	1,011,000	1.538	50,000
Open Pit + Underground	***Measured + Indicated***	***-***	***1,011,000***	***1.538***	***50,000***
Open Pit + Underground	Inferred	-	1,976,000	1.414	89,800

1. **The effective date for this mineral resource estimate is 4 October 2018 and is reported on a 100% ownership basis. This estimate is an update to the previous mineral resource estimate (11/2017) and is an update to economics only.**
2. **Mineral Resources are calculated at a gold price of $1,250 /troy oz.**
3. **The mineral resources presented above are global and do not include a detailed pit or underground design, only an economic 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 ID^3 methods for grade estimation. All mineral resources 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 mineralized 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.**

14.4 Sprite Deposit Mineral Resource Estimate

No additional exploration data were available to update the Sprite geologic model and mineral resource estimate. The estimates reported herein reflect changes to the underlying technical parameters (e.g. mining economics) from those previously reported and derived during the development of the PEA.

The description of that previous mineral resource estimate is duplicated below from the 4 January 2018 BOYD Technical Report.

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

Potentially economic gold mineralization is encountered in the QTPV and TRJ domains. There is minor mineralization 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.

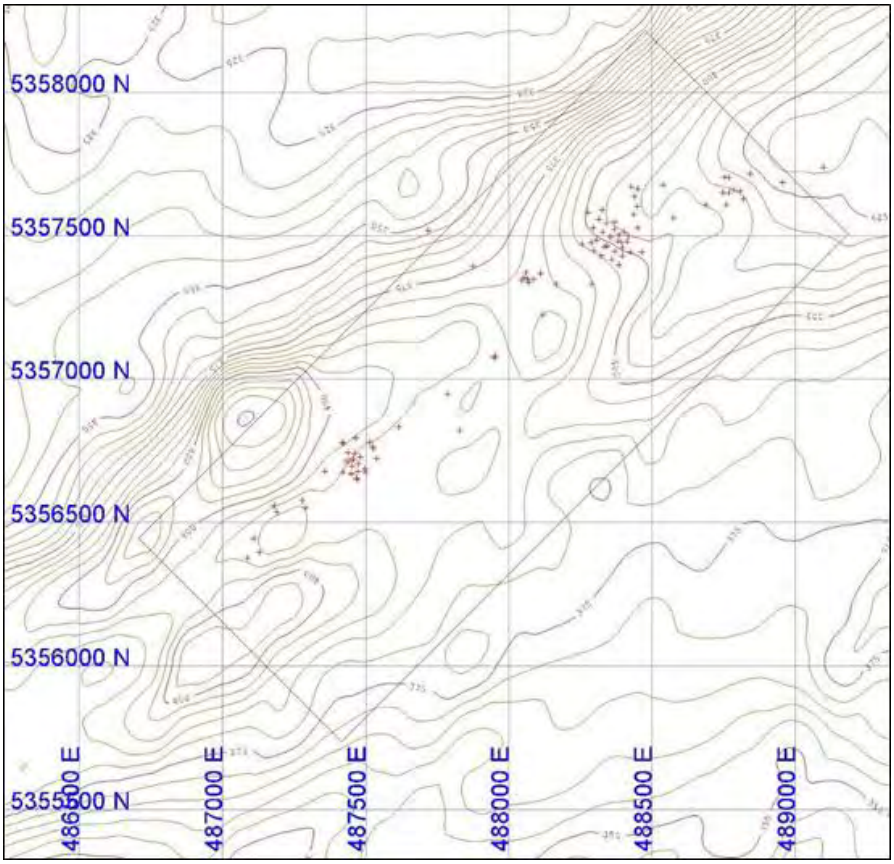
Previous mineral resource estimation work completed at the Sprite deposit assumed a series of steeply dipping gold bearing veins. This is not supported by the observed field geology and as a result, a new Mineral Resource estimate is warranted on the Sprite deposit.

14.4.1 Sprite Deposit Data

Drillholes

Geologic modelling of the Sprite deposit is based on all drillholes whose assays were available by 12 March 2015 (the most recent available data), and consists of 97 diamond core drillholes totalling approximately 13,134 m. Figure 14.36 shows the collars of these drillholes.

Figure 14.36 Sprite Deposit Drillhole Locations and Topography



Assays

Of the 6,635 gold assays available on 12 March 2015, all were used for the mineral resource estimation . For un-sampled intervals, values were set to zero. All assays used were fire or metallic sieved assays. Total assayed sample length is 9,463 m.

Density

To date, there have been 552 density measurements completed for the Sprite deposit. The results of these measurements are shown below in Table 14.32. Block densities were assigned based on the blocks domain of lithology type.

Table 14.32 Sprite Density Measurements

Lith. Code	Samples	Specific Gravity t/m³
Mafic Dikes (MD)	77	2.73
Quartz-Tourmaline- Pyrite Veins (QTPV)	120	2.64
Sediments (SED)	17	2.73
Trondhjemite (TRJ)	338	2.63
Overburden (OB)	-	1.50

Topography

The topography of the area around the Sprite deposit is shown on Figure 14.36. All contours are expressed as masl. 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.

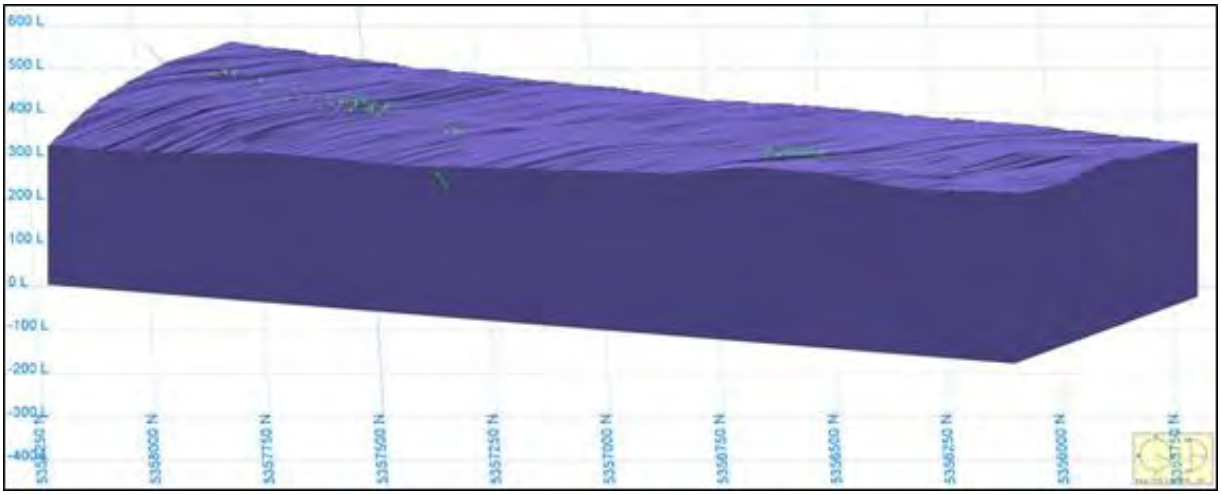
14.4.2 Sprite Deposit Data Analysis

Geological Modelling

The Sprite deposit contains four major potentially mineralized 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 mineralized host.

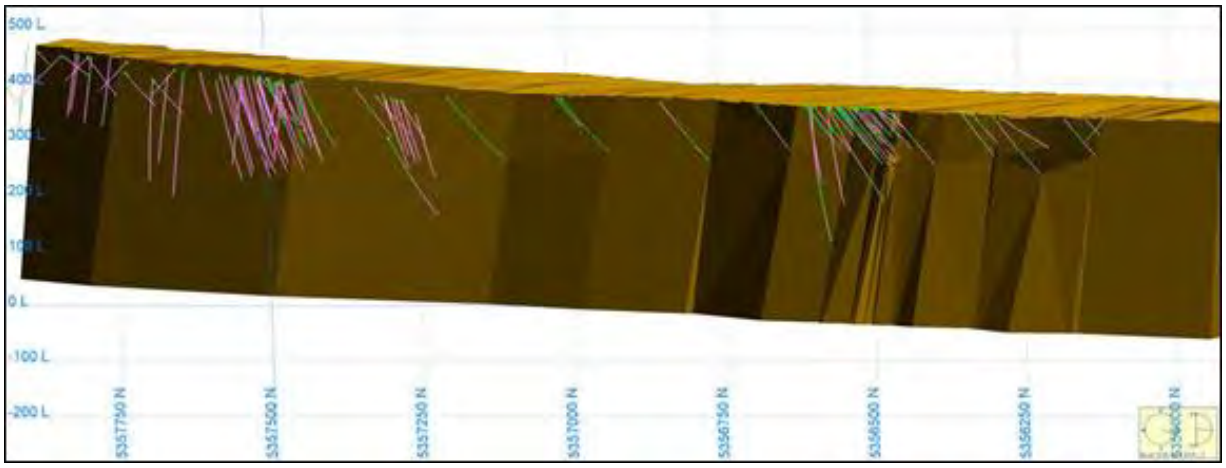
Geological modelling of these units is based on the logged geology as well as interpretations made by Marathon Gold staff. On every 10-m cross-section through the deposit, a line was drawn reflecting the actual or projected overburden surface below the topography. These lines were then used to construct the rock/overburden surface to constrain compositing, geologic implicit models, as well as block modelling. The overburden surface is shown below in Figure 14.37.

Figure 14.37 Sprite Deposit Sediment Domain



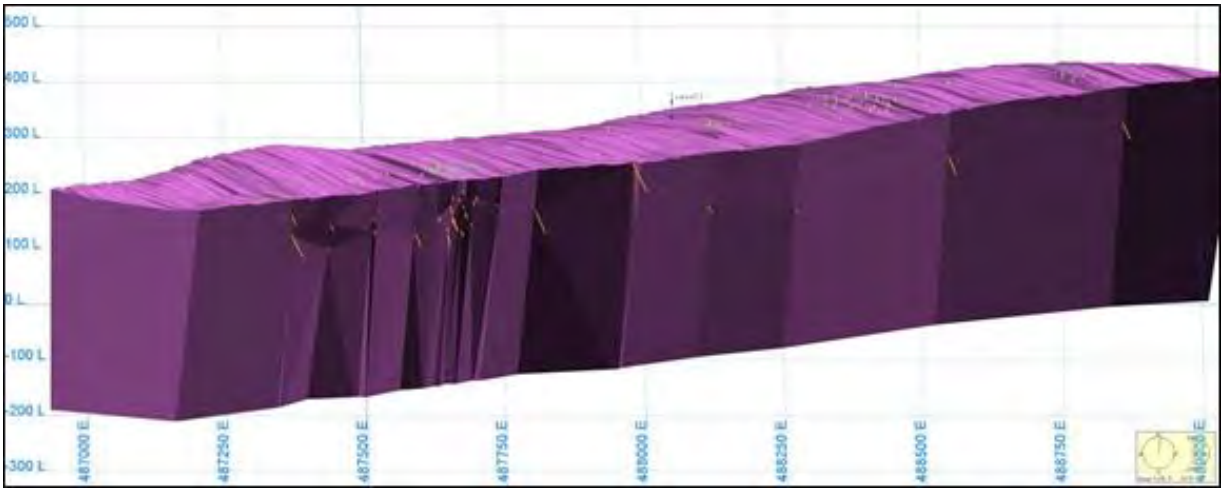
The SED/TRJ contact was determined by drillhole intercepts or projections between intercepts and a surface constructed to represent this geologic contact. This was completed on every 10-m section through the deposit where data were available. This contact was then used to construct a solid model of the SED domain below the overburden horizon. The SED unit is shown below in Figure 14.38.

Figure 14.38 Sprite Deposit Trondhjemite Domain



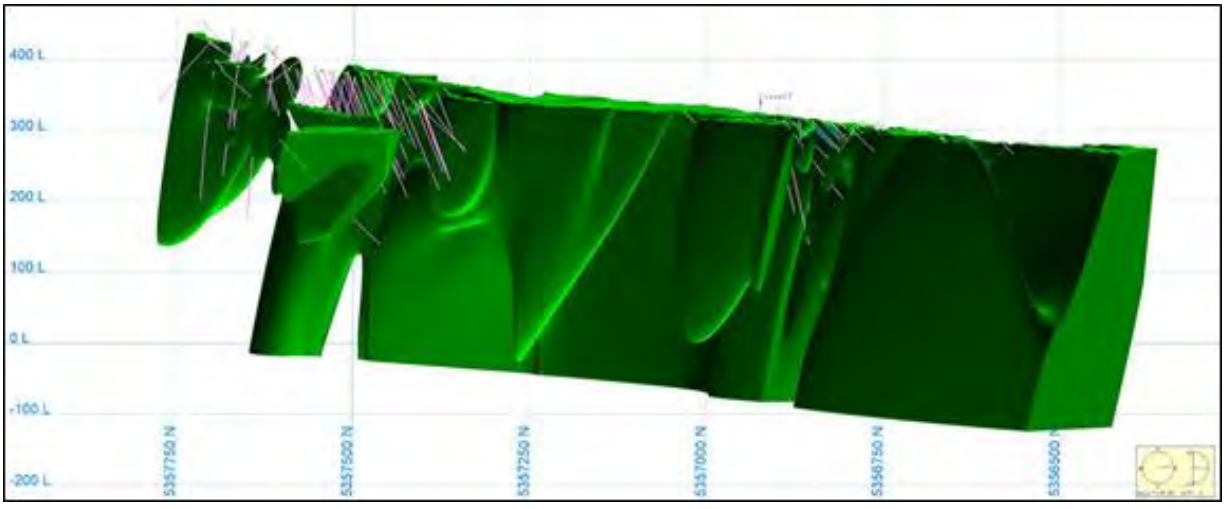
The TRJ domain is the remaining rock mass northwest of the sediment solid and below the overburden horizon. The TRJ domain is shown below in Figure 14.39.

Figure 14.39 Sprite Deposit Trondhjemite Domain



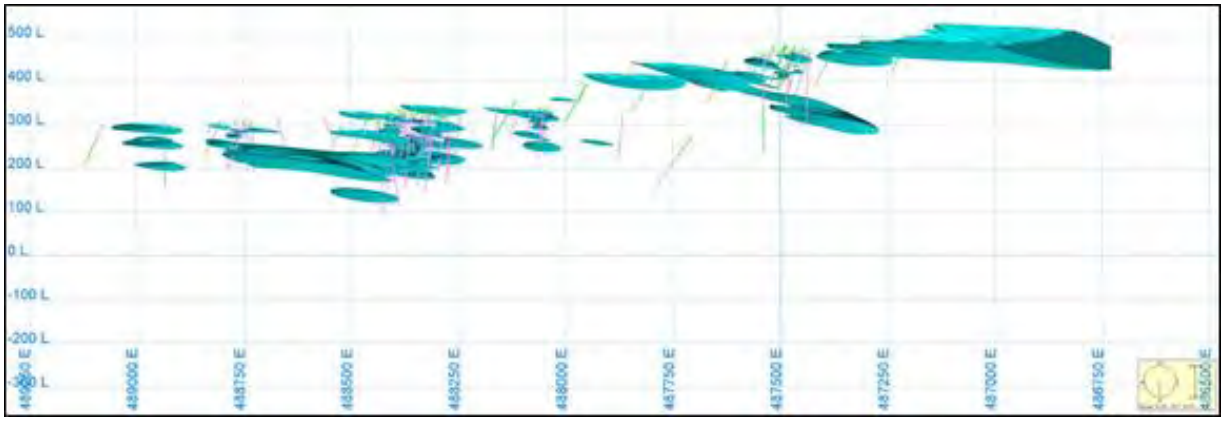
For the MD domain, implicit modelling was used to develop a geologic solid based on the drillhole intercepts within the Sprite gold deposit drillhole database. The implicit model used an azimuth of 235°, plunge of 0°, and a dip of -75°. Based on discussions with Marathon Gold geologic staff, the mafic 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 below in Figure 14.40.

Figure 14.40 Sprite Deposit Mafic Dike Domain



For the QTPV domain, the same implicit modelling approach was used to develop the mineralized 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 are shown below in Figure 14.41.

Figure 14.41 Sprite Deposit QTPV Domain



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

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 below in Table 14.33.

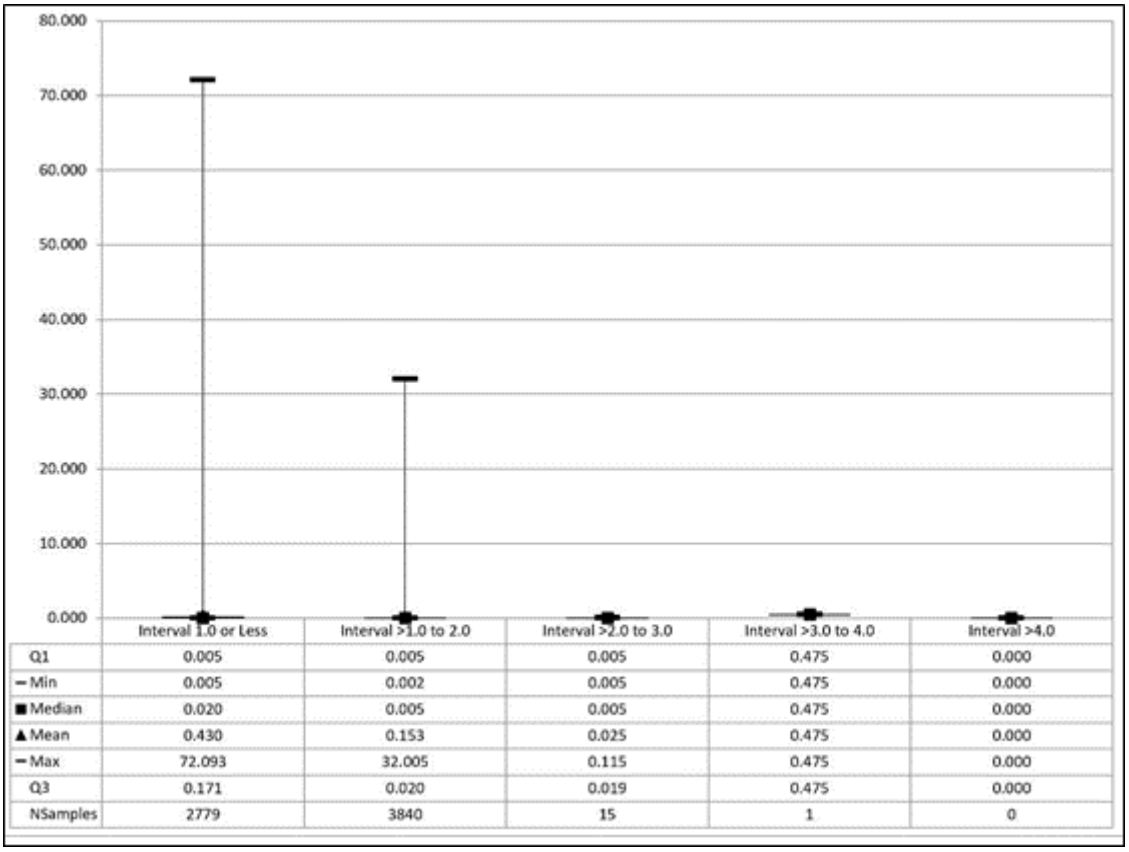
Table 14.33 Sprite Deposit Descriptive Statistics

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

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 box-plot in Figure 14.42 below shows the results of this analysis.

Figure 14.42 Sprite 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	0.475	0.000
– Min	0.005	0.002	0.005	0.475	0.000
■ Median	0.020	0.005	0.005	0.475	0.000
▲ Mean	0.430	0.153	0.025	0.475	0.000
– Max	72.093	32.005	0.115	0.475	0.000
Q3	0.171	0.020	0.019	0.475	0.000
NSamples	2779	3840	15	1	0

In examining the results of this analysis, it can be seen that most samples with potentially economic gold mineralization 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 mineralized 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 mineralization in the individual drillholes within each mineralized zone.

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 log-normal probability plot was generated for gold in each mineralized 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 log-normal probability plots for gold found in each mineralized domain are shown below in Figures 14.43 and 14.44.

Figure 14.43 Sprite QTPV Domain Log-Normal Plot

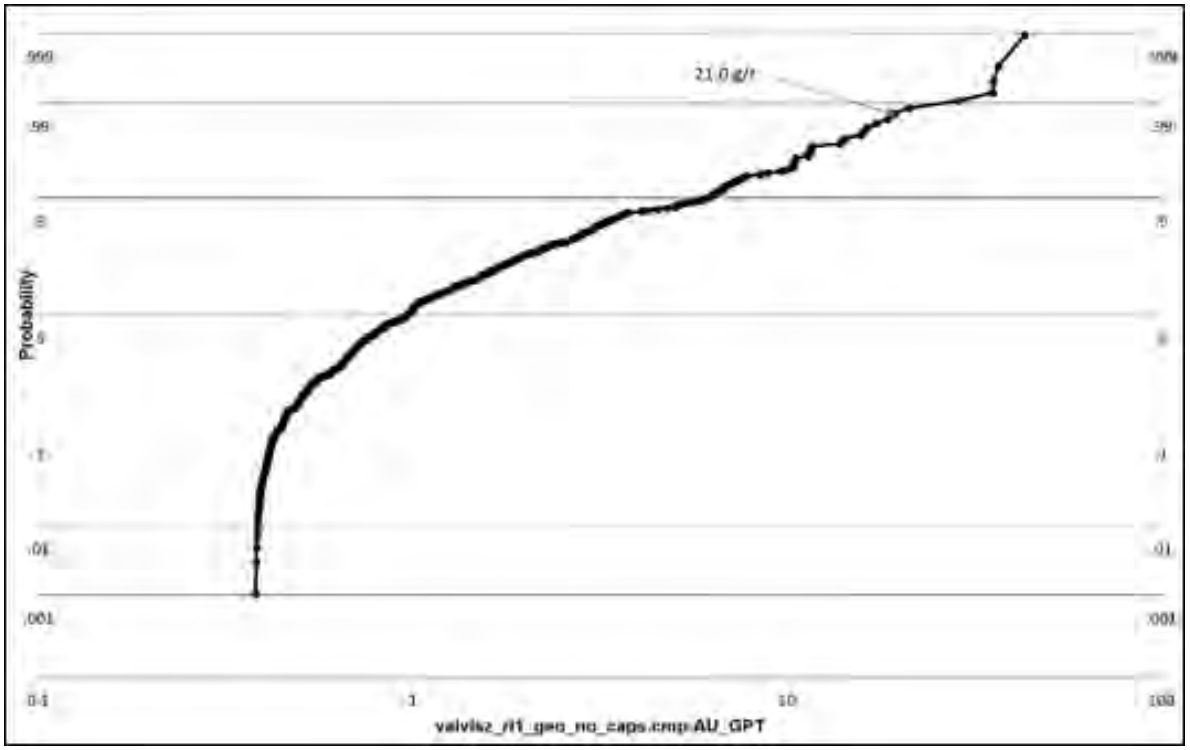
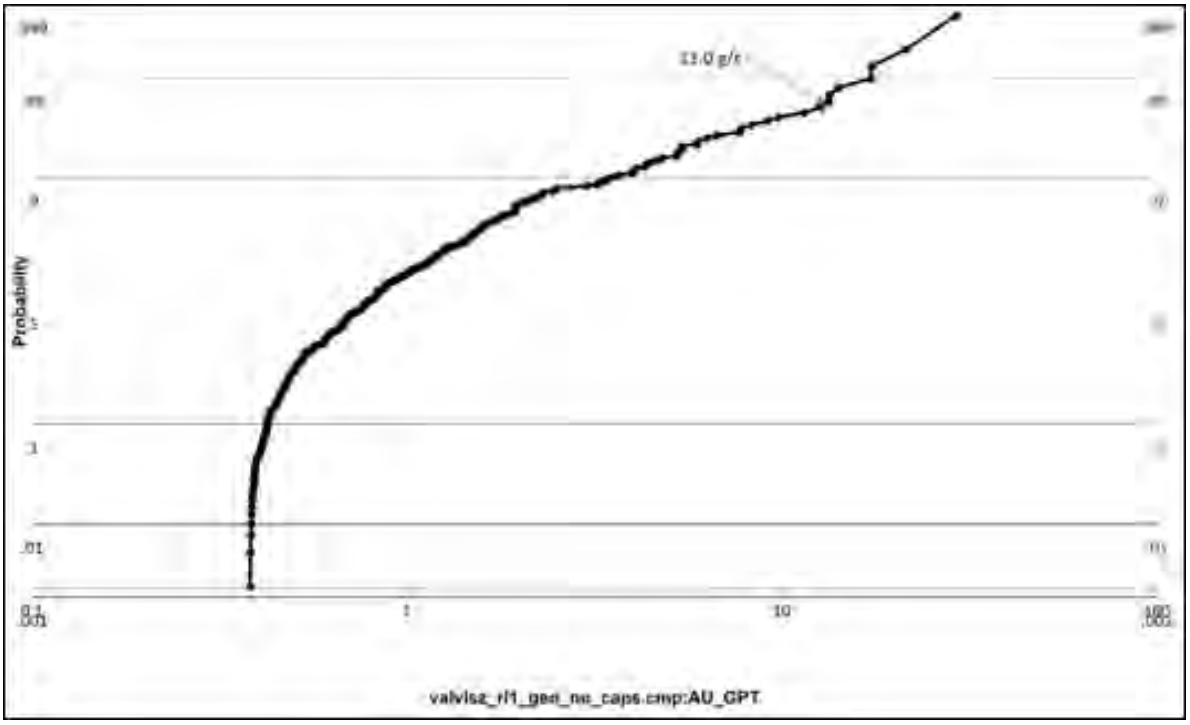


Figure 14.44 Sprite Trondhjemite Domain Log-Normal Plot



The log-normal 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 Modeler 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 mineralized domains, and the selected metal threshold grades are shown below in Table 14.34.

Table 14.34 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

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

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 mineralized solids. Gold grade variograms for each mineralized domain are shown below in Figures 14.45 and 14.46.

Figure 14.45 Sprite Deposit QTPV Variograms

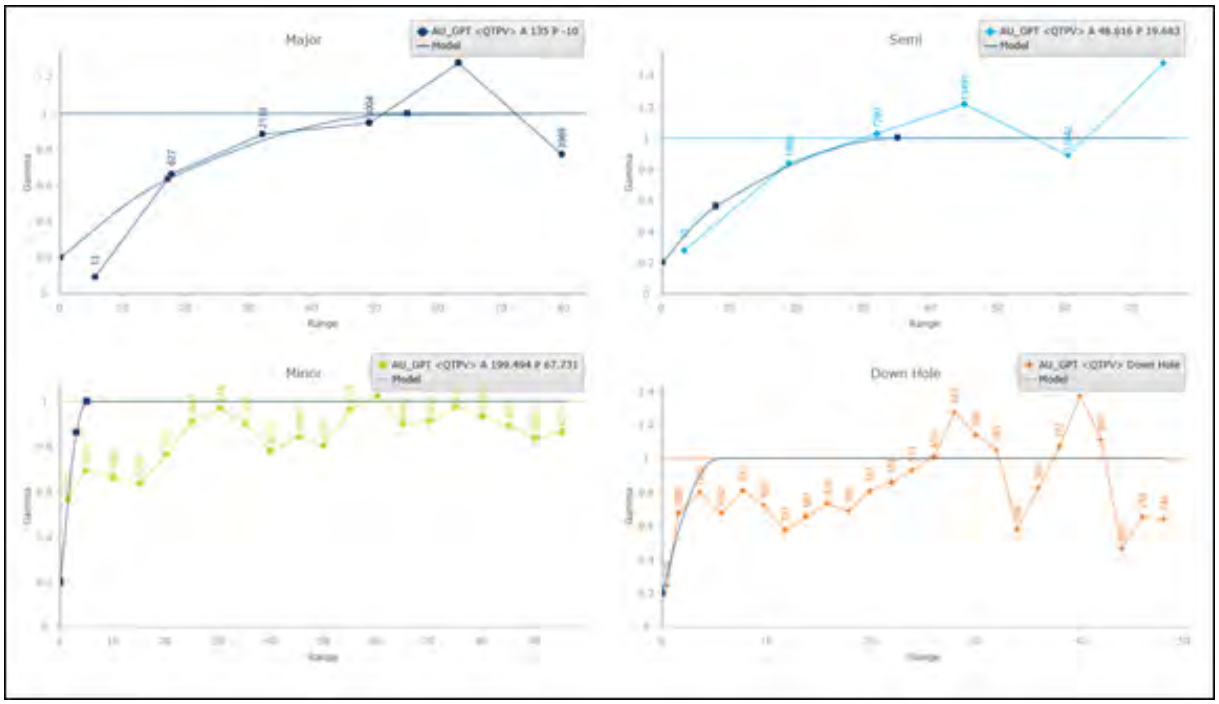
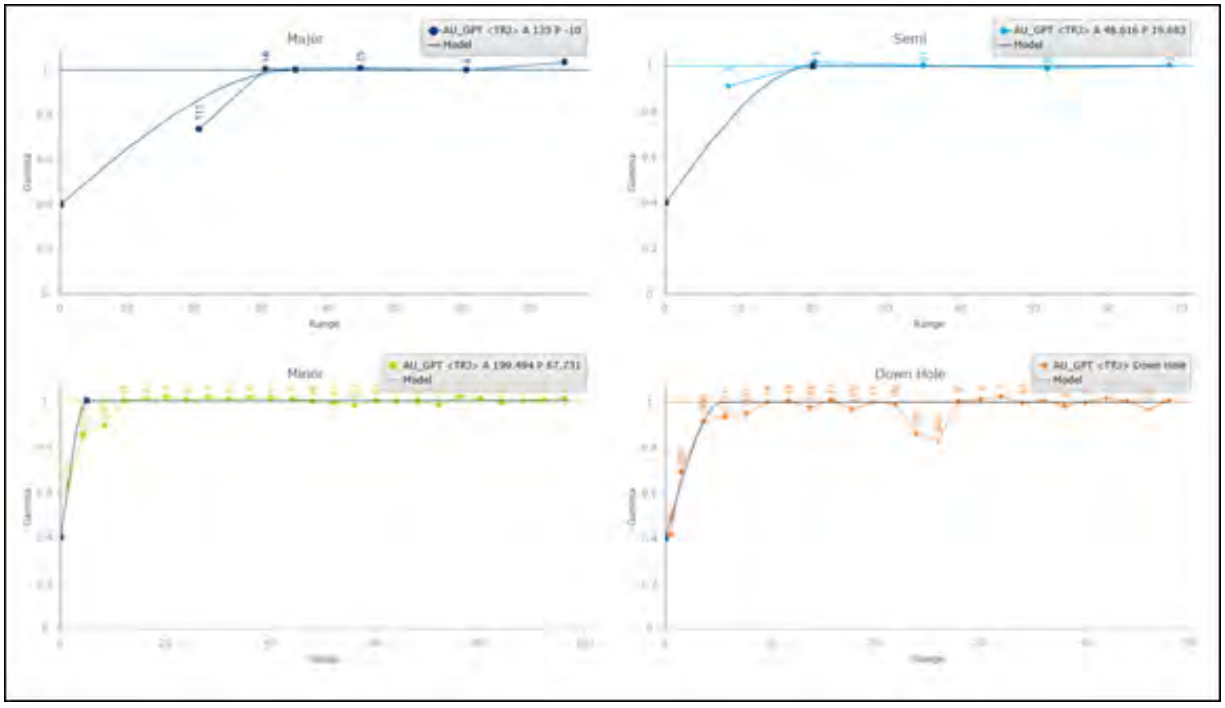


Figure 14.46 Sprite Deposit Trondhjemite Variograms



Based on these analyses, the search ellipsoid for each mineralized domain was established as shown below in Tables 14.35 and 14.36.

Table 14.35 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 14.36 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.

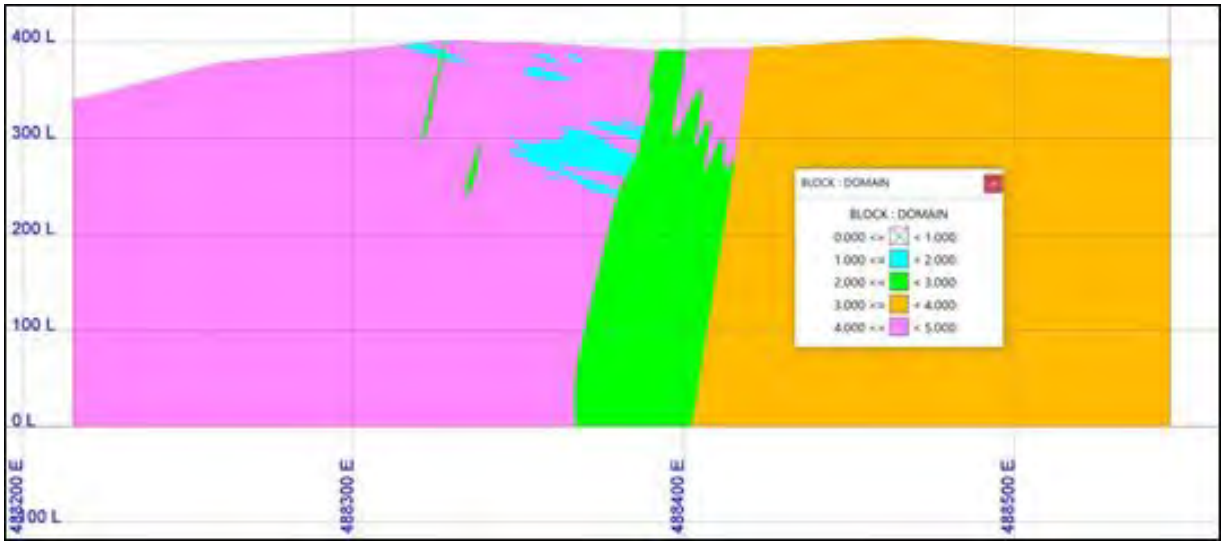
14.4.4 Sprite Deposit Block Model

Table 14.37 shows the Sprite block model extents. Figure 14.47 shows a typical block model section of the mineralized domain.

Table 14.37 Block Model Extents

Item	X	Y	Z
Origin	487,415.320	5,355,737.199	0.000
Offset Minimum	0	0	0
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	0.00	0.00

Figure 14.47 Sprite Deposit Typical Mineralized Domain Block Model Cross-Section



14.4.5 Sprite Grade Estimation

A 3D block model was constructed in Vulcan that was constrained by the mineralized 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. A 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 optimization 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 mineralized domain. Grade interpolation runs were set up for only that material within the mineralized domain for gold. All domains were run for gold, with the exception of the overburden domain which is assumed to not be mineralized.

Using the composited assays (described above), block grade interpolations were run in each mineralized 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 mineralized domain were considered in the grade estimation.

The block model interpolation parameters are shown in Table 14.38 and Table 14.39.

Table 14.38 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 14.39 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 four 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.

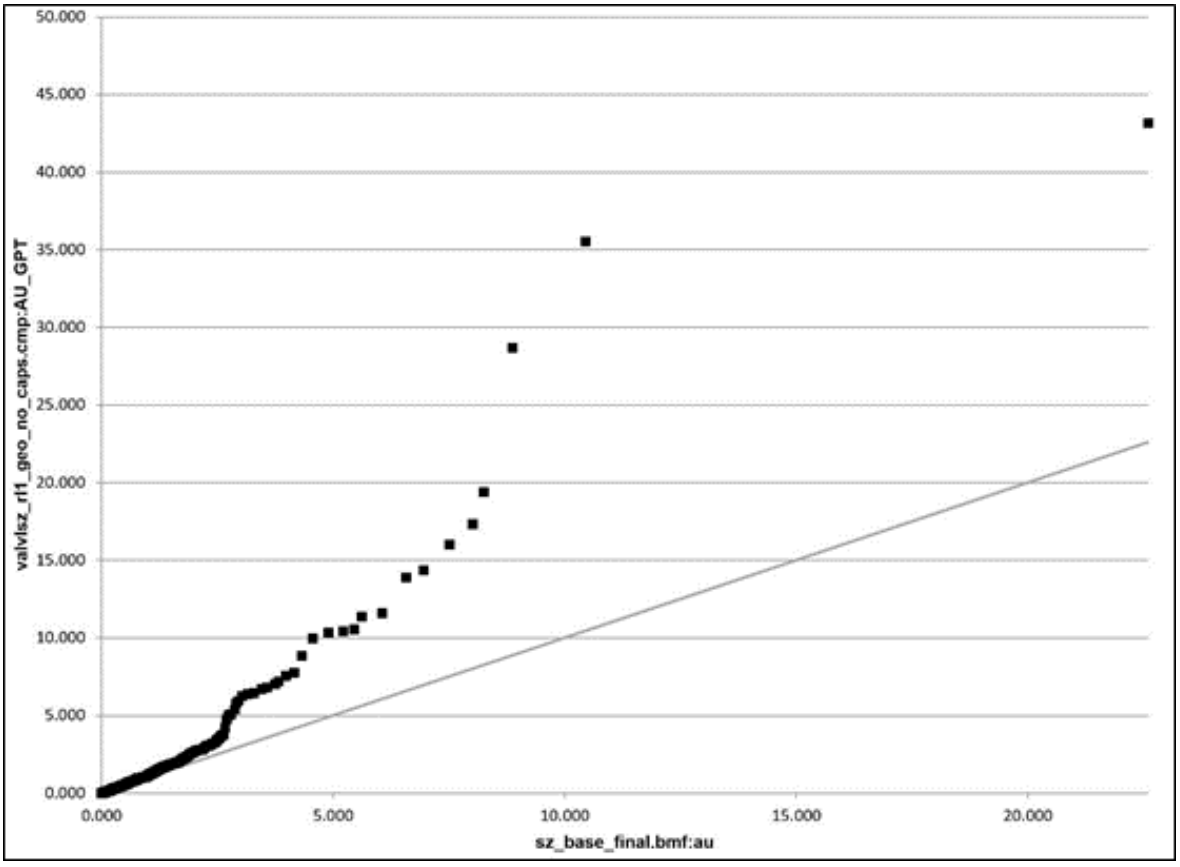
The block metal grades were examined to confirm that all the estimation parameters were honoured as well as staying within the individual mineralized domains. A visual check on a sectional basis showed this to be true with block grades being consistently below the underlying drillhole assay value. Each of the cross-sections were 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 below in Table 14.40.

Table 14.40 Sprite Deposit Mineral Resource Estimation Model Statistics

Item	Drillholes	1-m Comps	Block Model
Number of Samples	6,635	10,288	137,949
Minimum	0.002	-	-
Maximum	72.093	43.191	39.285
Range	72.091	43.191	39.285
Average	0.269	0.220	0.232
Standard Deviation	1.836	1.293	0.839
Variance	3.371	1.671	0.704

The overall QQ plot of the block model estimated gold grades versus the composites are shown below in Figure 14.48.

Figure 14.48 Sprite Deposit Overall QQ Plot



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.

14.4.8 Sprite Deposit Mineral Resource Estimate

The Sprite deposit Mineral Resources 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.

Economic Assumptions

The operating assumptions (economic and gold recovery) used for the Whittle economic open pit optimization are shown in Table 14.41, and the operating assumptions (economic and gold recovery) used for the calculation of an underground cut-off grade is shown below in Table 14.42.

Table 14.41 Sprite Open Pit Economic Assumptions

Item	Value	Units
Waste Mining Cost	2.00	$/Waste t
Millfeed and Heap Leach Mining Cost	2.50	$/Millfeed or Heap Leach t
Mill Processing Cost	12.00	$/Millfeed t
Heap Leach Processing Cost	3.00	$/Heap Leach t
G&A Cost	1.50	$/Millfeed or Heap Leach t
Mill Gold Recovery (at Cut-off)	92.4	%
Heap Leach Gold Recovery (at Cut-off)	62.5	%
Royalty	1.5	%
Gold Price	1,250.00	$/troy oz
Mill/Heap Leach Calculated Cut-off Grade	1.142	g/t
Mill Calculated Cut-off	0.435	g/t
Incremental Mill Cut-off Grade	0.380	g/t
Heap Leach Calculated Cut-off Grade	0.281	g/t
Incremental Heap Leach Cut-off Grade	0.203	g/t

Table 14.42 Sprite Underground Economic Assumptions

Item	Value	Units
Millfeed Mining Cost	52.00	$/Millfeed t
Processing Cost	12.00	$/Material t
G&A Cost	1.50	$/Material t
Recovery (at Cut-off)	93.0	%
Royalty	1.5	%
Gold Price	1,250.00	$/troy oz
Calculated Cut-off	1.767	g/t

For mineral resources estimation, a cut-off grade of 0.281 g/t gold was used for open pit, and a cut-off grade of 1.767 g/t gold was used for underground. The assumed overall pit slope in Whittle was assumed to be 54.3° not including ramps.

Please note that gold recovery is variable and is determined using the following:

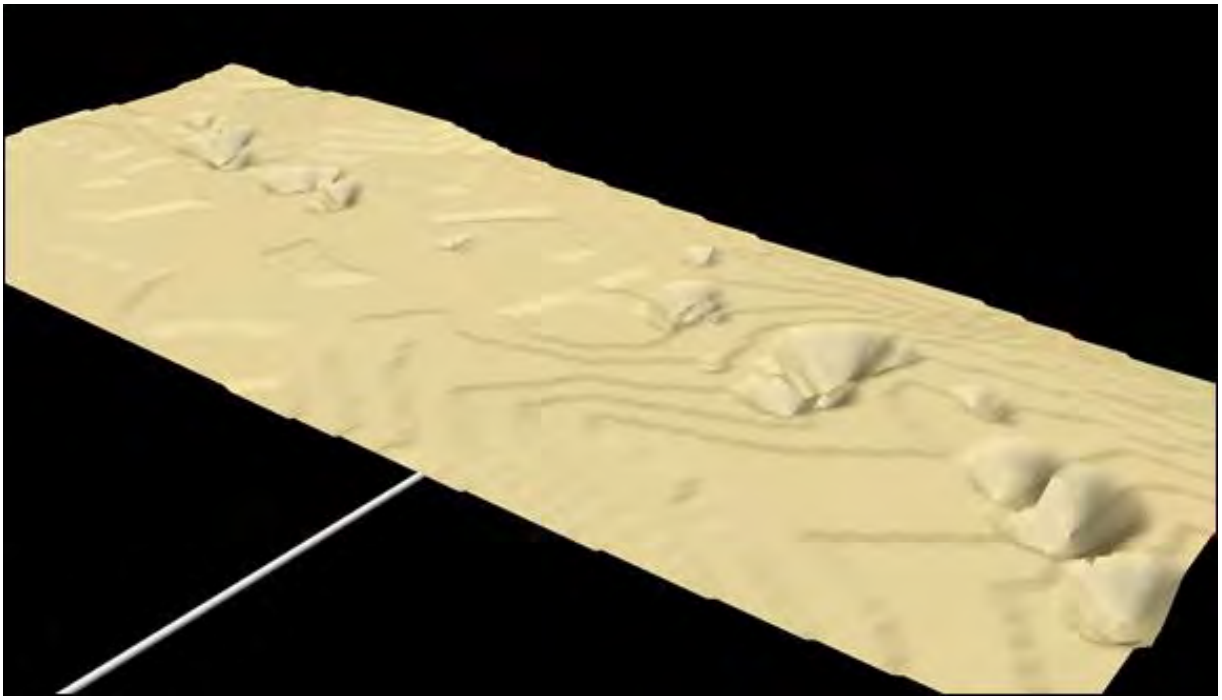
- Millfeed:
  - For gold grades less than 0.5 g/t a recovery of 92.4% is used.
  - For gold grades from 0.5 g/t to 8.0 g/t a formula is used: Recovery = 0.005 x Au + 0.921.

- For gold greater than 8.0 g/t or greater a recovery of 96.1% is used.

- Heap Leach:
  - Gold grades less than 0.2 g/t are not recovered.
  - For gold grades from 0.2 g/t to 2.0 g/t a formula is used: Recovery = 0.090 x Au + 0.600.
  - For gold grades 2.0 g/t or greater a recovery of 78.0% is used.

Using these assumptions, a Whittle economic pit optimization was completed, and an economic pit shell generated. This pit shell was used to design a final PEA pit which is shown below in Figure 14.49.

Figure 14.49 Sprite Deposit Whittle Pit Shell



Mineral Resource Estimate

BOYD's estimated Mineral Resources for the Sprite deposit are shown below in Table 14.43.

Table 14.43 Sprite Deposit Mineral Resources

Mining Method	Resource Classification	Gold Cut-off Grade (g/t)	Tonnes	Au g/t	Au Troy Ozs
Open Pit - Mill	Measured	1.142	0	0.000	0
Open Pit - Mill	Indicated	1.142	277,000	3.446	30,700
Open Pit - Mill	***Measured + Indicated***	***1.142***	***277,000***	***3.447***	***30,700***
Open Pit - Mill	Inferred	1.142	365,000	2.713	31,800
Open Pit - Heap Leach	Measured	0.281	0	0.000	0
Open Pit - Heap Leach	Indicated	0.281	431,000	0.584	8,100
Open Pit - Heap Leach	***Measured + Indicated***	***0.281***	***431,000***	***0.585***	***8,100***
Open Pit - Heap Leach	Inferred	0.281	926,000	0.566	16,900
Total Open Pit	Measured	-	0	0.000	0
Total Open Pit	Indicated	-	708,000	1.703	38,800
Total Open Pit	***Measured + Indicated***	***-***	***708,000***	***1.705***	***38,800***
Total Open Pit	Inferred	-	1,291,000	1.173	48,700
Underground	Measured	1.767	0	0.000	0
Underground	Indicated	1.767	9,000	2.403	700
Underground	***Measured + Indicated***	***1.767***	***9,000***	***2.419***	***700***
Underground	Inferred	1.767	46,000	2.702	4,000
Open Pit + Underground	Measured	-	0	0.000	0
Open Pit + Underground	Indicated	-	717,000	1.712	39,500
Open Pit + Underground	***Measured + Indicated***	***-***	***717,000***	***1.714***	***39,500***
Open Pit + Underground	Inferred	-	1,337,000	1.226	52,700

1. **The effective date for this mineral resource estimate is 4 October 2018 and is reported on a 100% ownership basis. This estimate is an update to the previous mineral resource estimate (11/2017) and is an update to economics only.**
2. **Mineral Resources are calculated at a gold price of $1,250 /troy oz.**
3. **The mineral resources presented above are global and do not include a detailed pit or underground design, only an economic 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 ID^3 methods for grade estimation. All mineral resources 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 which was applied during grade estimation by mineralized 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.**

14.5 Marathon Gold Deposit Mineral Resource Estimate

The Marathon gold deposit mineral resource is contained in a series of flat laying gold bearing QTPV with an azimuth of 125°, a plunge of -10°, and a dip of -30°. The highest-grade gold mineralization is located in the flat QTPV zones within a steeply dipping shear zone northwest of the contact with the sediment unit. Mineralization extends from this "corridor" within the QTPV zones towards the northwest and southeast along strike, as well as along the dip. Gold mineralization within the "corridor" 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 mineralization is encountered in all major rock units (SED, MD, quartz-eye porphyry [QEPOR], and trondhjemite [TRJ]) and although the clear majority of the mineral resource is contained in QTPV zones within these rock units, some mineralization occurs in areas with no significantly logged QTPV mineralization. In fact, these areas probably do include QTPV mineralization in that many of the areas included very minor occurrences of QTPV within the logging, but not enough to be considered significant

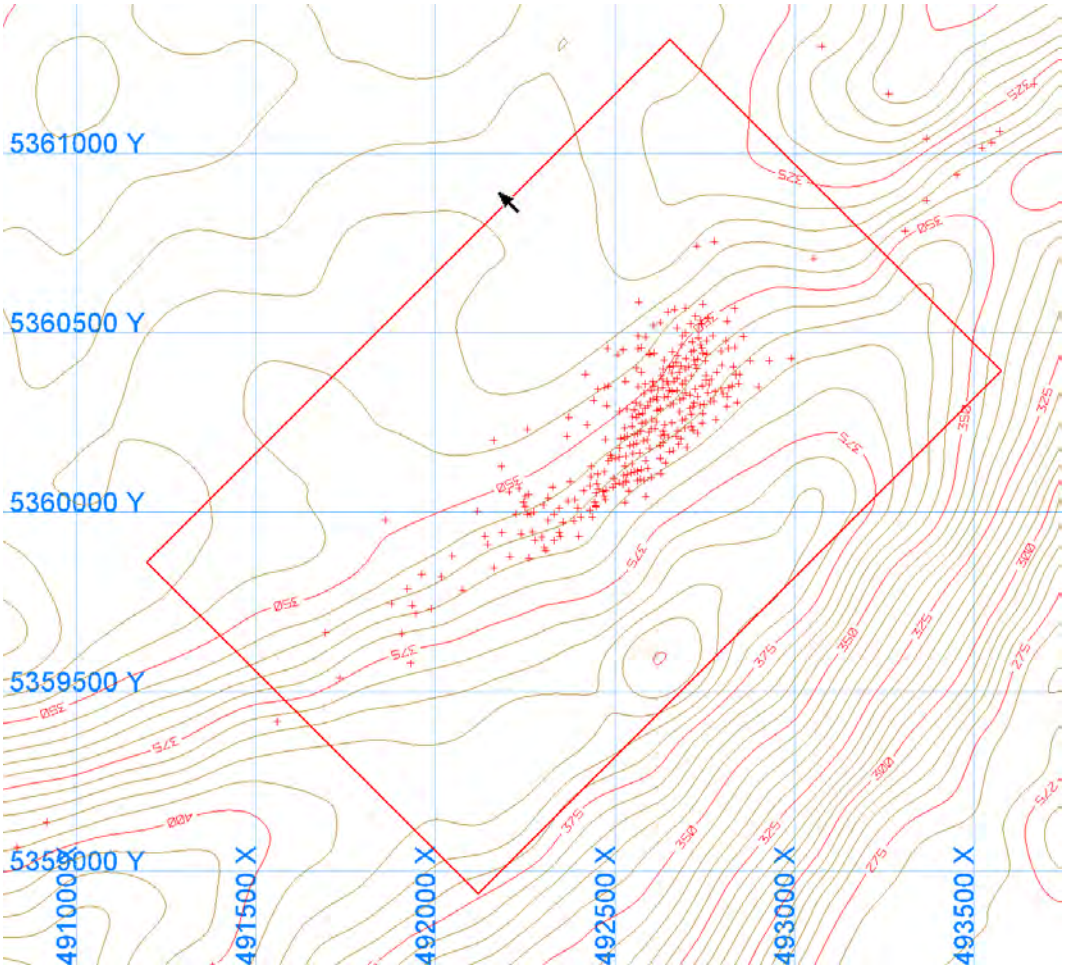
Extensive new drilling has been completed at Marathon since the previous mineral resource estimate. This new exploration drilling has expanded the potential resource area in all directions as well as improving the density of drilling in known mineral resource areas. As a result, a new Mineral Resource estimate is warranted for the Marathon gold deposit.

14.5.1 Marathon Gold Deposit Data

Drillholes

The estimates of mineral resources reported herein for the Marathon gold deposit is based on all drillholes whose assays were available by 6 October 2018, and consists of 333 diamond core drillholes totalling approximately 108,575 m. Active exploration drilling was ongoing at the cut-off date of 6 October 2018. Figure 14.50 shows the collars of these drillholes.

Figure 14.50 Marathon Drillhole Locations and Topography



Assays

Of the 72,973 gold assays available on 6 October 2018, all were used for the mineral resource estimation. Because of active exploration on the deposit, a number of exploration drillholes were used for geology but did not have assays available at the resource cut-off date of 6 October 2018. As a result, un-sampled intervals values were not included in the resource estimate. All assays used were fire or metallic sieved assays. Total assayed sample length is approximately 101,403 m.

Density

To date, there have been 1,755 density measurements taken at the Marathon gold deposit. The results of these measurements are shown below in Table 14.44. Block densities were assigned based on the block's domain of lithology type.

Table 14.44 Marathon Density Measurements

Lithology Type	Samples	Specific Gravity t/m³
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

Topography

The topography of the area around the Marathon gold deposit is shown on Figure 14.50. All contours are expressed as masl. 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.

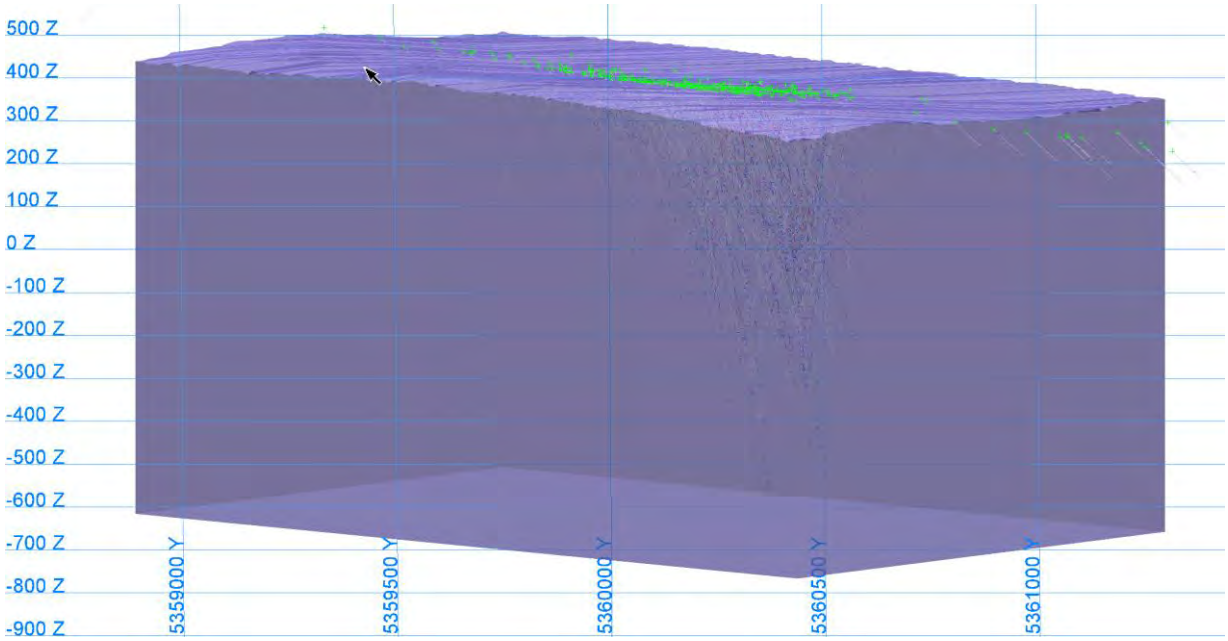
14.5.2 Marathon Gold Deposit Data Analysis

Geological Modelling

The Marathon gold deposit contains five major potentially mineralized domains. These domains are the SED, QEPOR, TRJ, QTPV, and MD intruding into the QEPOR, TRJ, and QTPV domains. Additionally, surface overburden was also noted in the drill logs but was not considered as a potentially mineralized host.

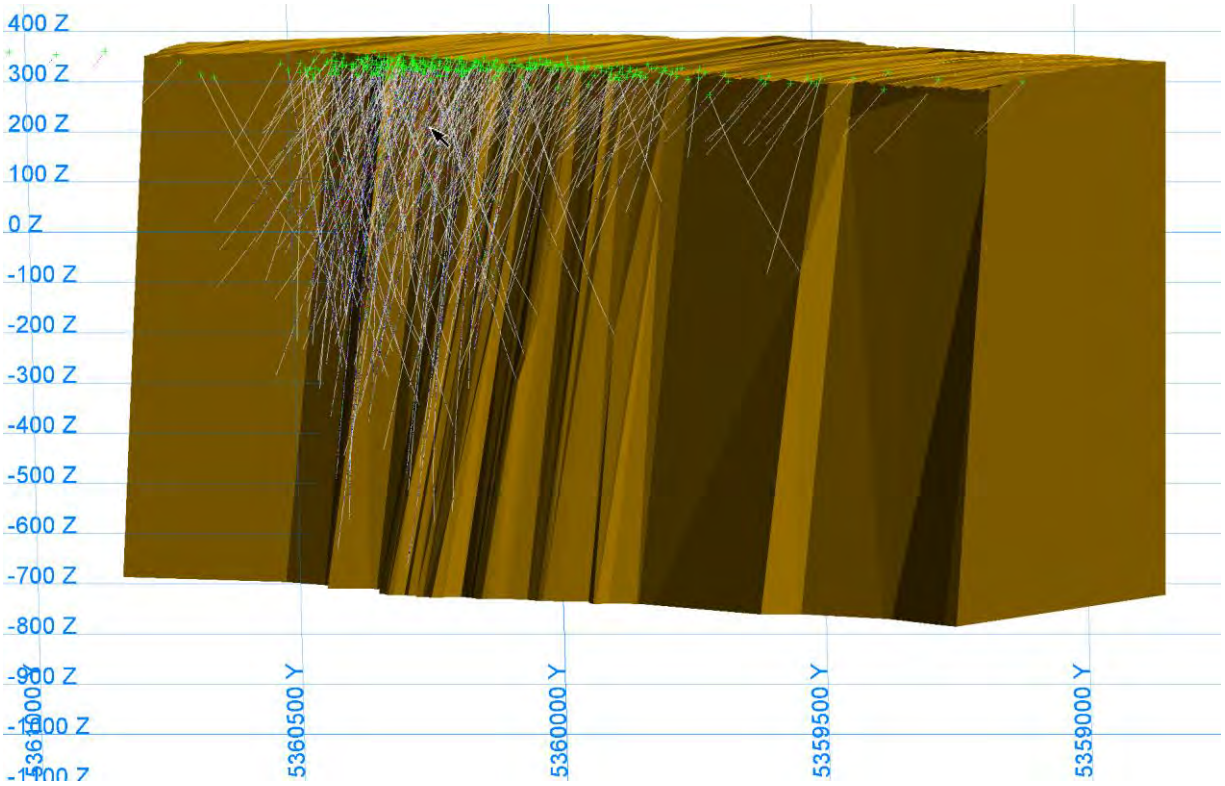
Geological modelling of these units is based on the logged geology as well as interpretations made by Marathon Gold staff. On every 10-m cross-section through the deposit, a line was drawn reflecting the actual or projected overburden surface below the topography. These lines were then used to construct the rock/overburden surface to constrain compositing, geologic implicit models, as well as block modelling. The overburden surface is shown below in Figure 14.51.

Figure 14.51 Marathon Base of Overburden



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 below in Figure 14.52.

Figure 14.52 Marathon Sediment Domain



The QEPOR domain is the rock mass northwest of the sediment solid and southeast of the TRJ contact and below the overburden horizon. The QEPOR domain is shown below in Figure 14.53.

Figure 14.53 Marathon Quartz-Eye Porphyry Domain

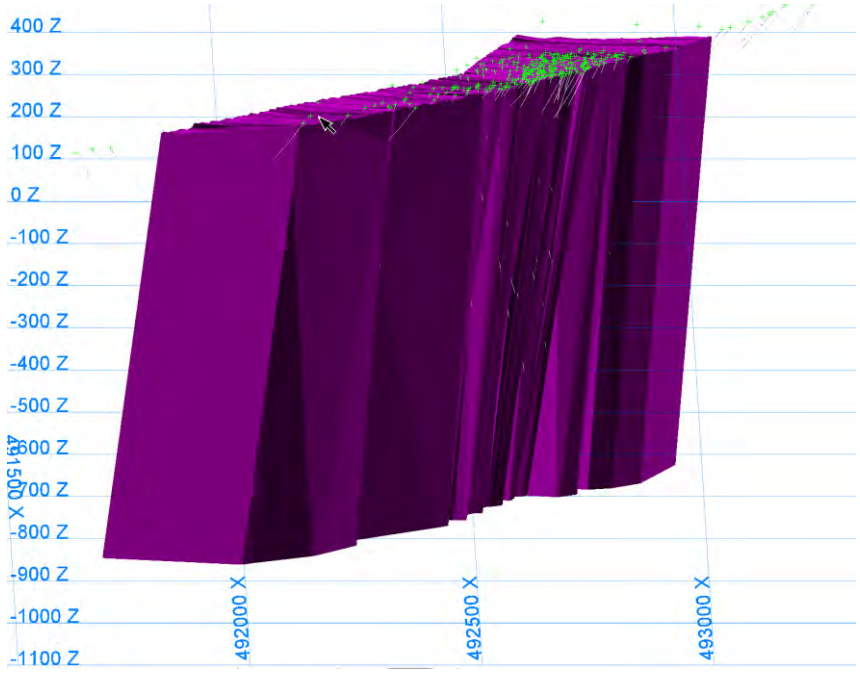
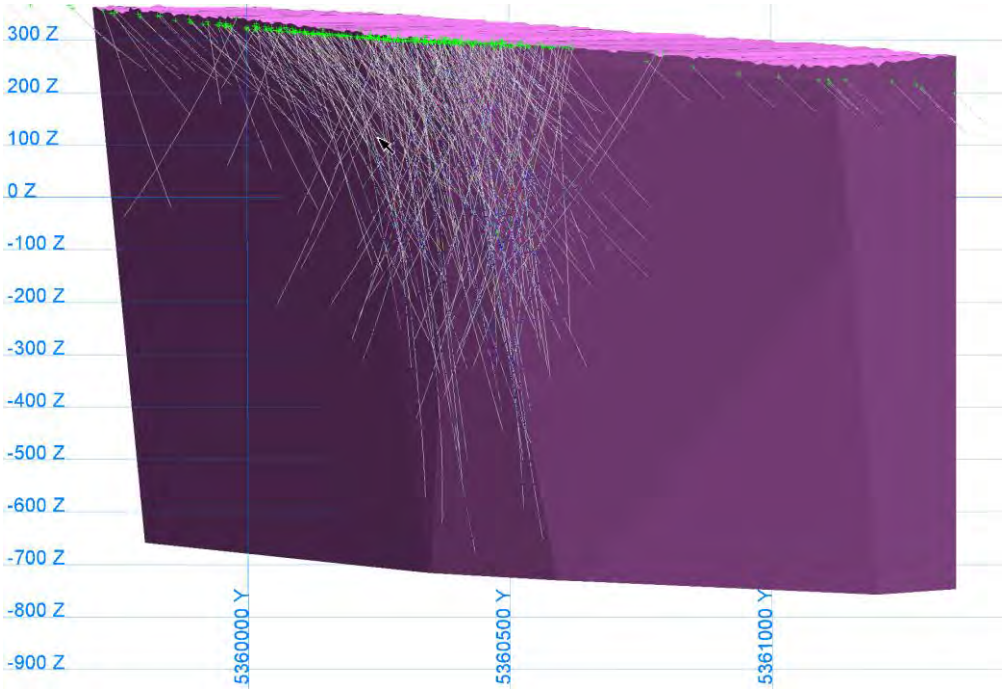
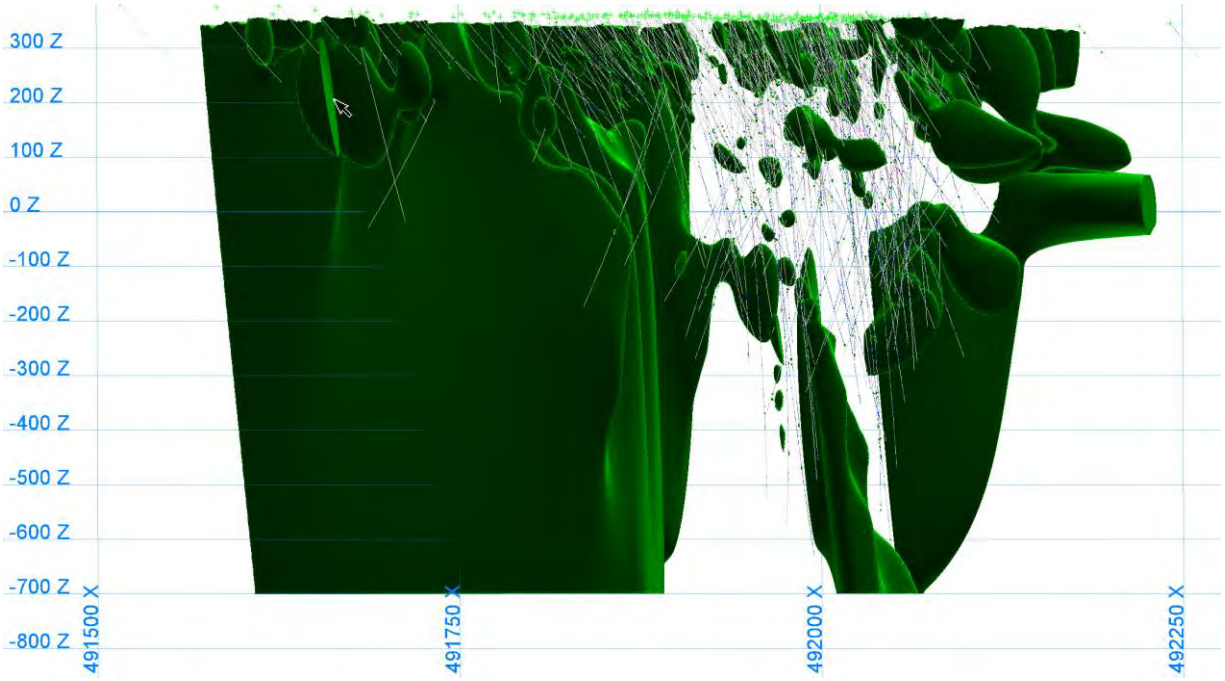


Figure 14.54 Marathon Trondhjemite Domain



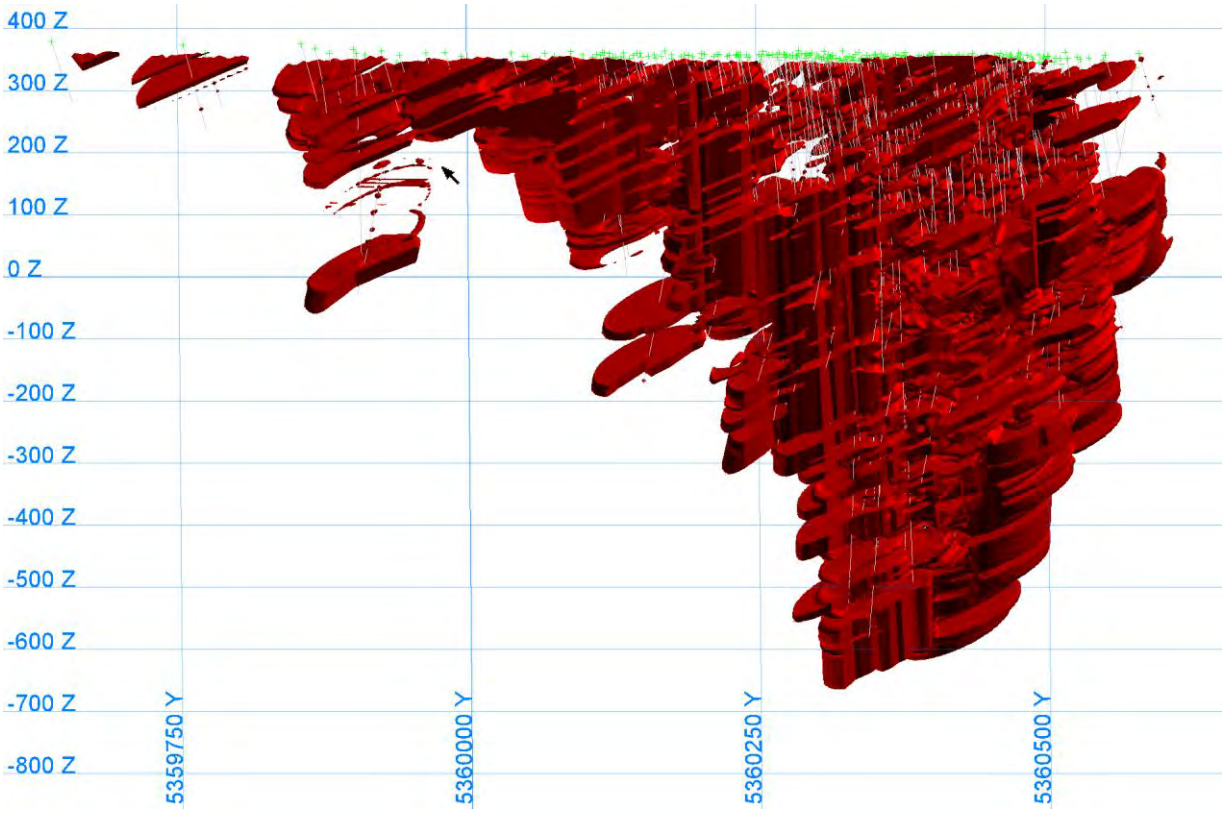
For the MD domain, implicit modelling was used to develop a geologic solid based on the intercepts within the Marathon drillhole database. The implicit model used an azimuth of 250°, plunge of 0°, and a dip of -80°. Based on discussions with Marathon Gold geologic staff, the mafic dikes have been truncated by the sediments and cut the QTPV zones; as such, MD solid is clipped by the sediments. The mafic dike domain is shown below in Figure 14.55.

Figure 14.55 Marathon Mafic Dike Domain



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 mineralized zone. Instead of using the logged QTPV zones, a 100-ppm gold grade threshold was used to generate a grade shell to limit mineralization. This threshold approximates the QTPV zones at Marathon. The implicit model used an azimuth of 125°, plunge of -10°, and a dip of -30°. The resulting solid was then clipped by the sediments. The zone is considered the QTPV domain for Marathon. The QTPV domains are shown below in Figure 14.56.

Figure 14.56 Marathon QTPV Domains



The SED, MD, QEPOR, TJR, and QTPV domains can be potentially mineralized, 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.

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 below in Table 14.45.

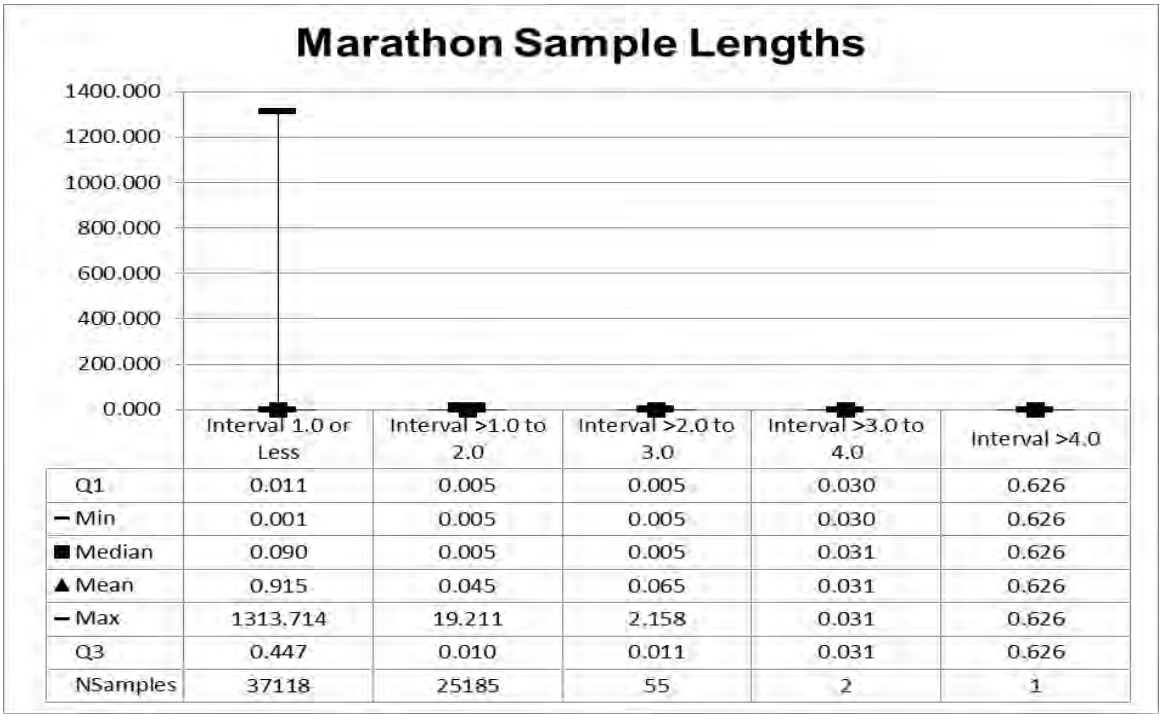
Table 14.45 Marathon Descriptive Statistics

Item	All	QTPV	Mafic Dikes	Quartz-Eye Porphyry
Number of samples	72,968	25,968	5,709	48,800
Minimum	0.001	0.001	0.005	0.001
Maximum	1313.714	1313.714	30.334	25.496
Range	1313.713	1313.713	30.329	25.495
Average	0.549	1.468	0.119	0.057
Standard deviation	7.897	13.186	0.821	0.260
Variance	62.363	173.871	0.674	0.068
Coef. of variance	14.383	8.984	6.903	4.566

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 box-plot in Figure 14.57 below shows the results of this analysis.

Figure 14.57 Marathon 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	0.011	0.005	0.005	0.030	0.626
– Min	0.001	0.005	0.005	0.030	0.626
■ Median	0.090	0.005	0.005	0.031	0.626
▲ Mean	0.915	0.045	0.065	0.031	0.626
– Max	1313.714	19.211	2.158	0.031	0.626
Q3	0.447	0.010	0.011	0.031	0.626
NSamples	37118	25185	55	2	1

In examining the results of this analysis, it can be seen that most samples with potentially economic gold mineralization 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 mineralized 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 mineralization in the individual drillholes within each mineralized zone.

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 log-normal probability plot was generated for gold in each mineralized 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 log-normal probability plots for gold found in each mineralized domain are shown below in Figures 14.58 through 14.60.

Figure 14.58 Log Normal Probability for the QTPV Domain

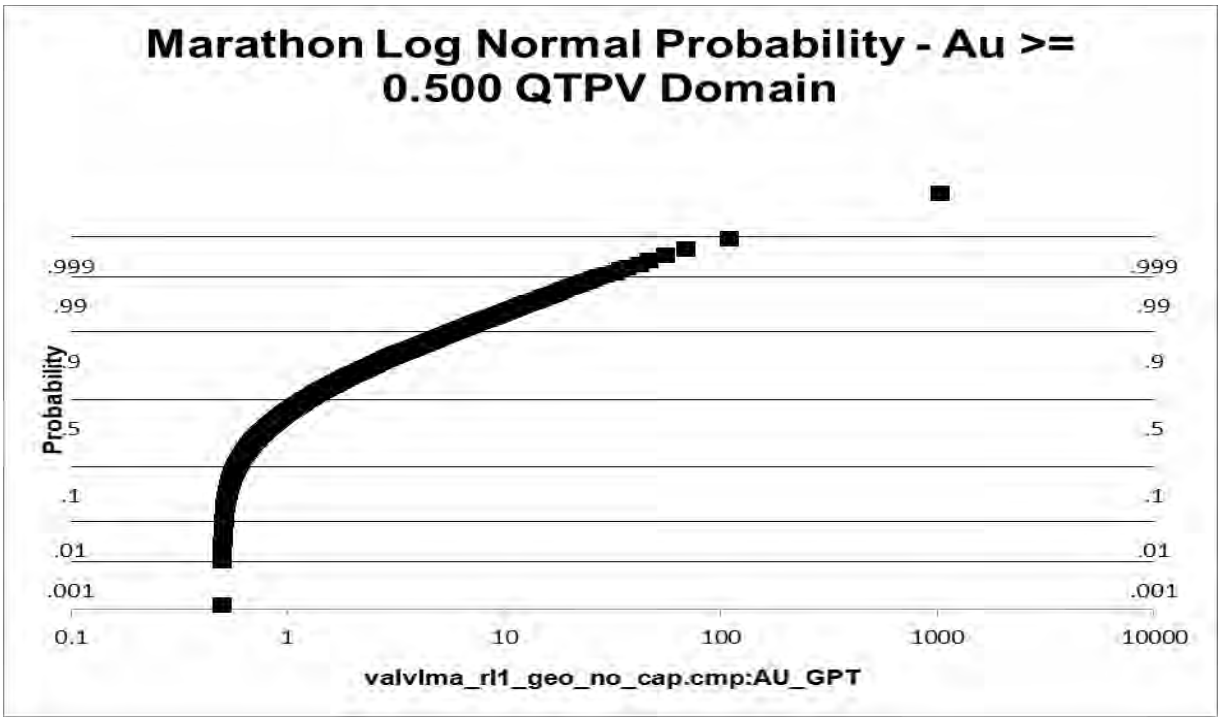


Figure 14.59 Log Normal Probability for the MD Domain

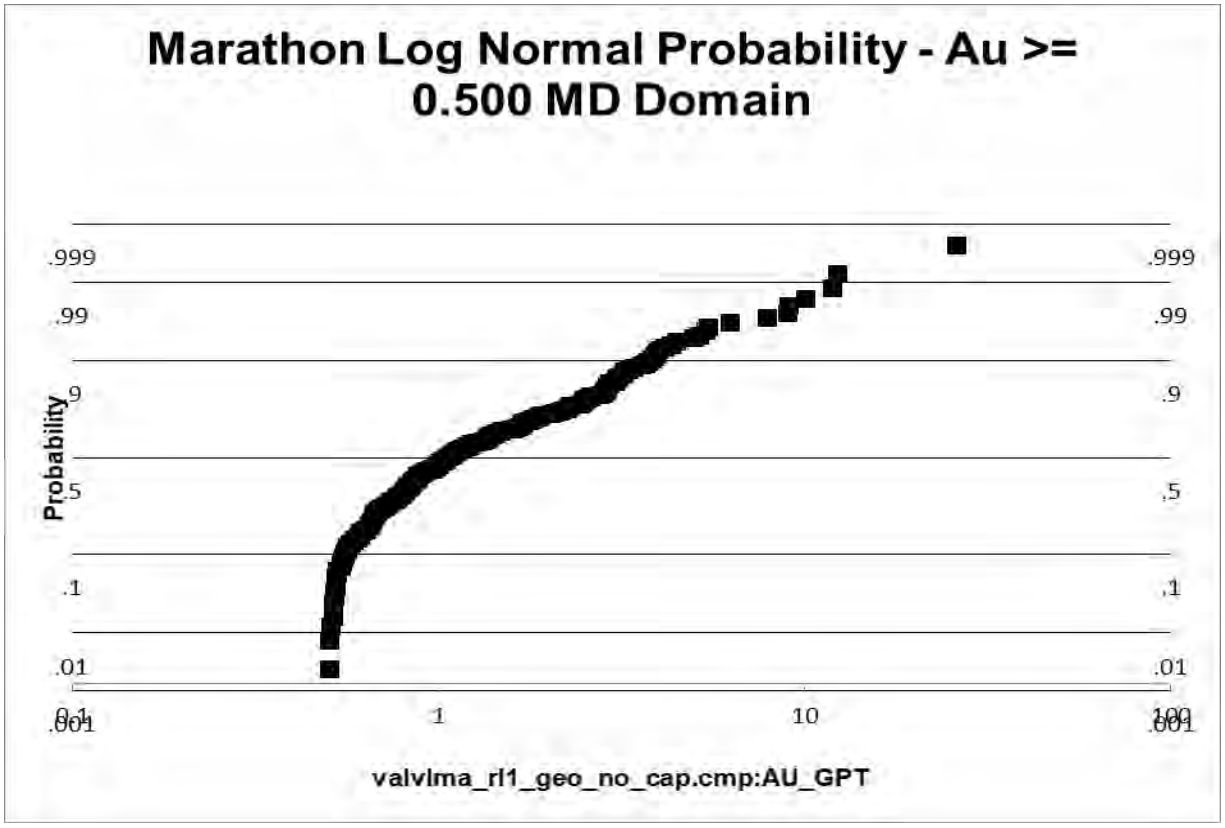
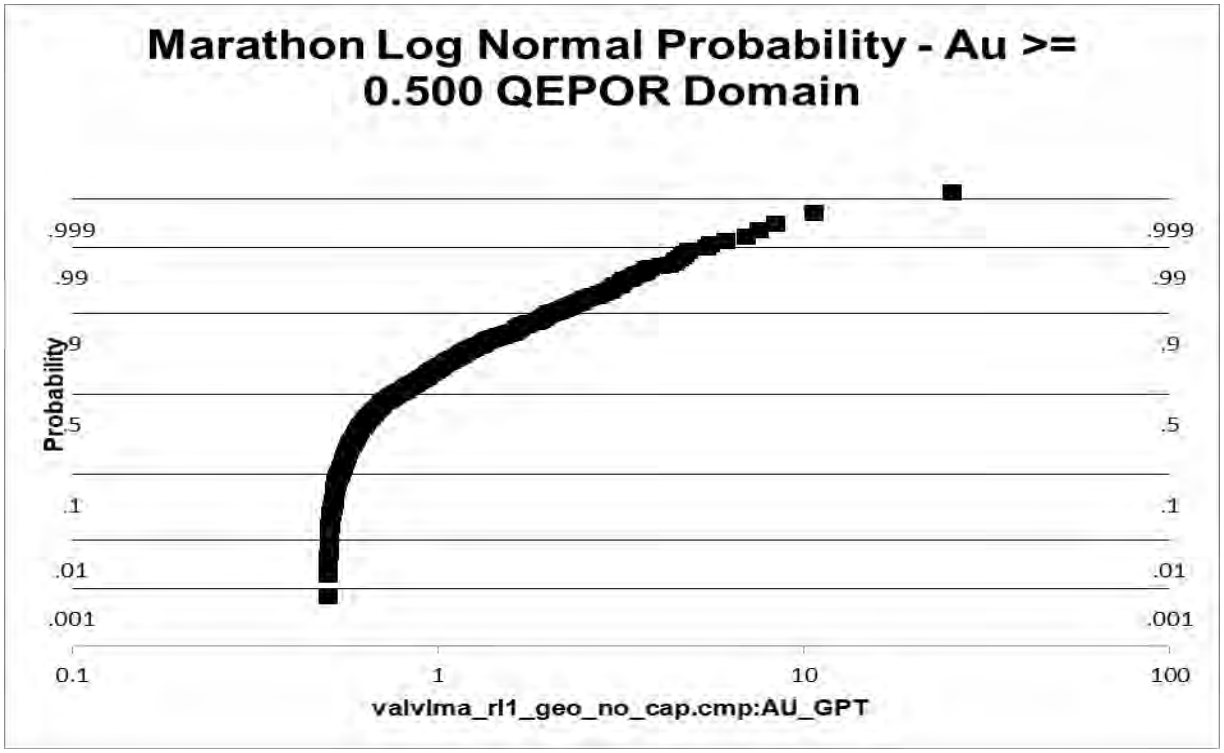


Figure 14.60 Log Normal Probability for the QEPOR Domain



The log-normal 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 mineralized domains and the selected metal threshold grades are shown below in Table 14.46.

Table 14.46 Marathon Gold Threshold Grades

Domain	Threshold (Au g/t)	Limited Search Ellipsoid		
		Major (m)	Semi-Major (m)	Minor (m)
QTPV	45.0	20.0	10.0	5.0
MD	6.0	15.0	15.0	5.0
QEPOR	5.0	10.0	20.0	5.0

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

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 mineralized solids. Gold grade variograms for each mineralized domain are shown below in Figures 14.61 through 14.63.

Figure 14.61 Marathon QTPV Variograms

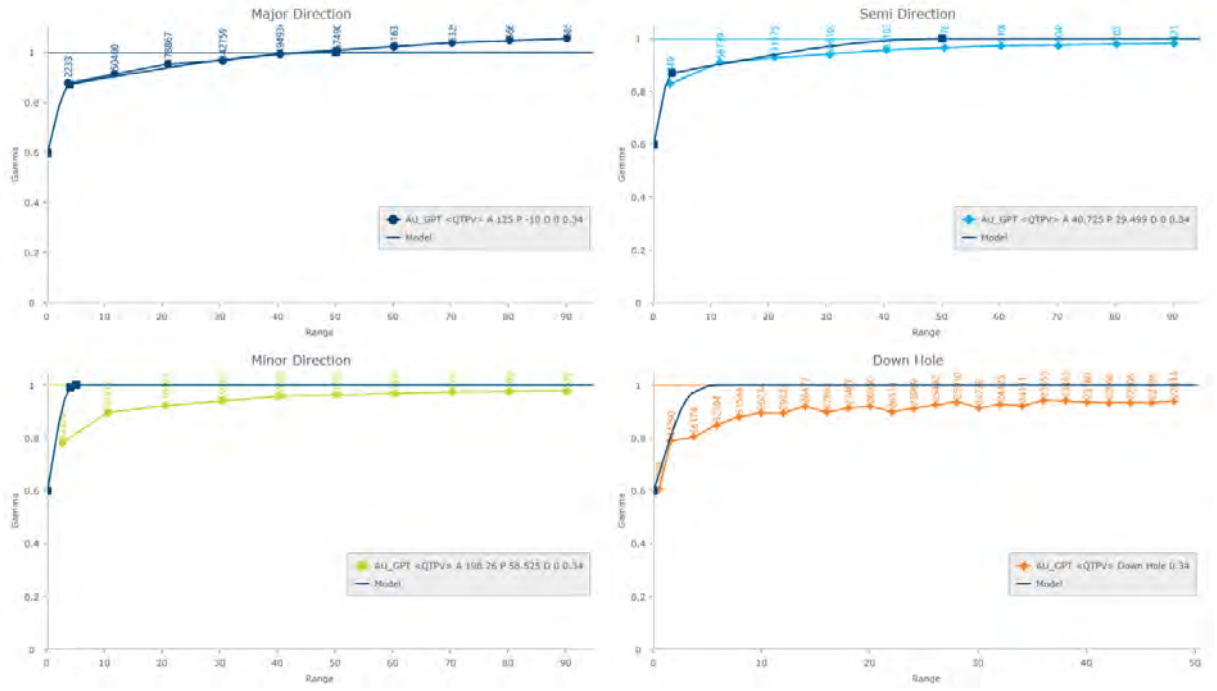


Figure 14.62 Marathon Mafic Dike Variograms

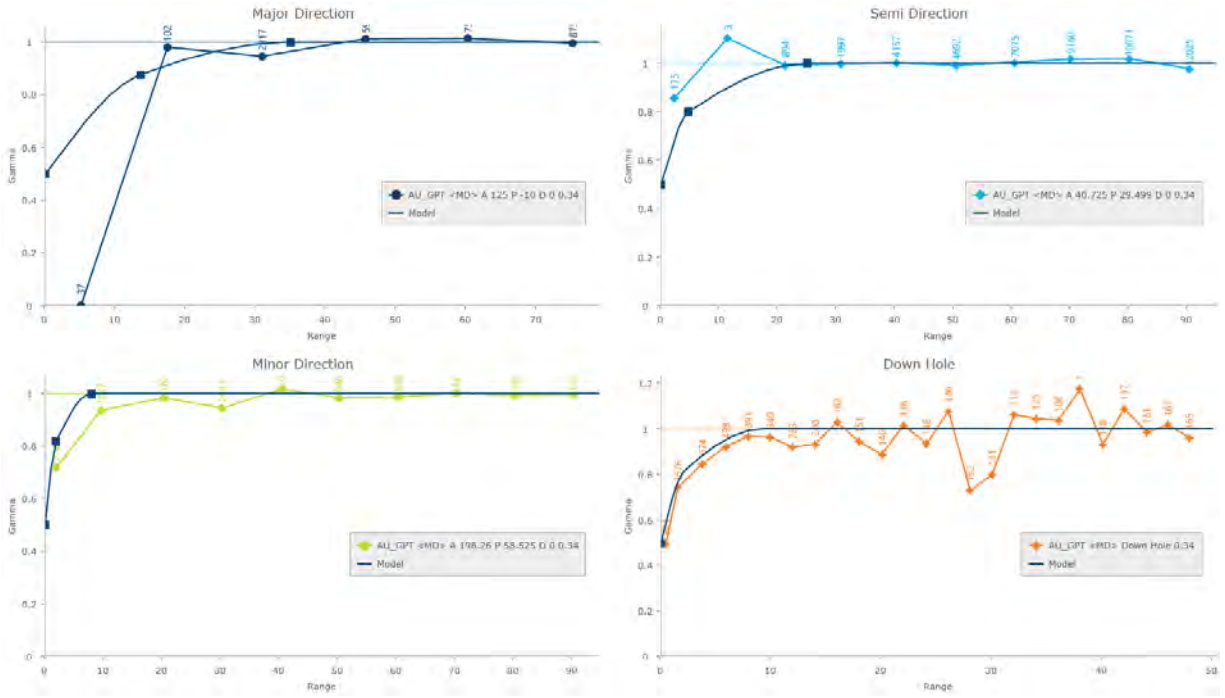
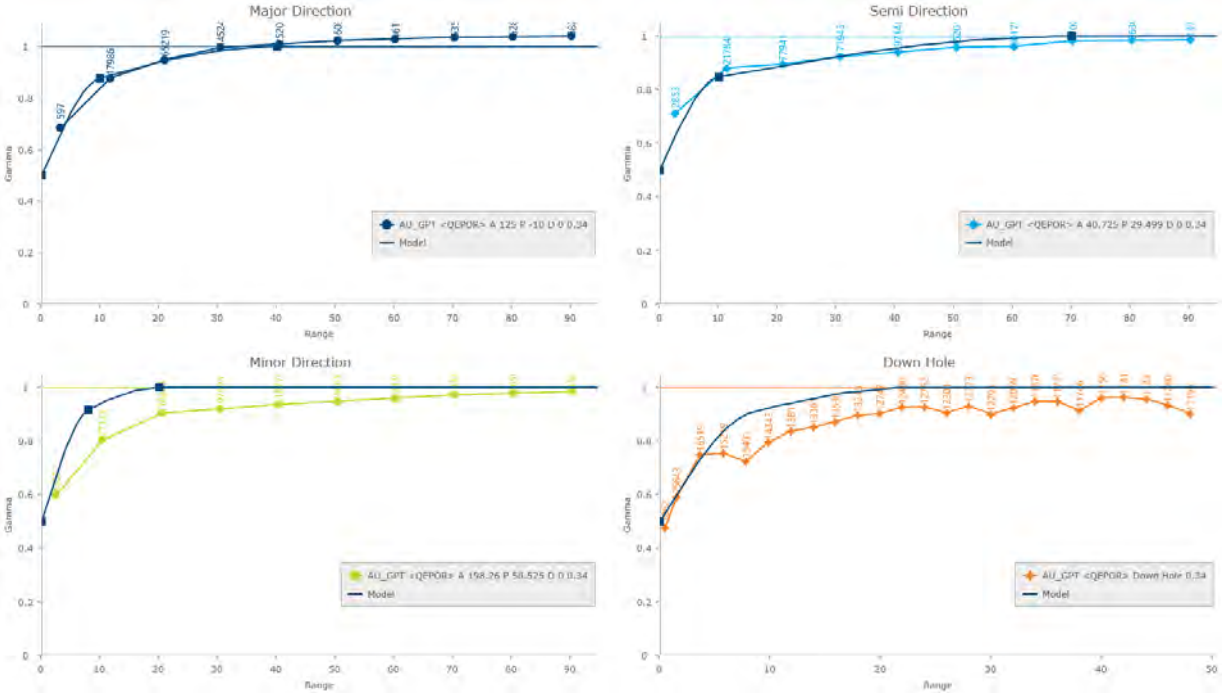


Figure 14.63 Marathon Quartz-Eye Porphyry Variograms



Based on these analyses, the search ellipsoid for each mineralized domain was established as shown below in Tables 14.47 through 14.49.

Table 14.47 Marathon QTPV Search Ellipsoid

Grade Estimation Pass	1	2	3	4
Major Range (m)	50.0	50.0	50.0	75.0
Semi-Major Range (m)	50.0	50.0	50.0	75.0
Minor Range (m)	5.0	5.0	5.0	7.5
Azimuth (degrees)	125.0	125.0	125.0	125.0
Plunge (plunge of the azimuth in degrees)	-10.0	-10.0	-10.0	-10.0
Dip (degrees	-30.0	-30.0	-30.0	-30.0

Table 14.48 Marathon Mafic Dike Search Ellipsoid

Grade Estimation Pass	1	2	3	4
Major Range (m)	35.0	35.0	35.0	52.5
Semi-Major Range (m)	25.0	25.0	25.0	37.5
Minor Range (m)	8.0	8.0	8.0	12.0
Azimuth (degrees)	125.0	125.0	125.0	125.0
Plunge (plunge of the azimuth in degrees)	-10.0	-10.0	-10.0	-10.0
Dip (degrees	-30.0	-30.0	-30.0	-30.0

Table 14.49 Marathon Quartz-Eye Porphyry Search Ellipsoid

Grade Estimation Pass	1	2	3	4
Major Range (m)	40.0	40.0	40.0	60.0
Semi-Major Range (m)	70.0	70.0	70.0	105.0
Minor Range (m)	20.0	20.0	20.0	30.0
Azimuth (degrees)	125.0	125.0	125.0	125.0
Plunge (plunge of the azimuth in degrees)	-10.0	-10.0	-10.0	-10.0
Dip (degrees	-30.0	-30.0	-30.0	-30.0

These search parameters were used in the block grade estimation described below.

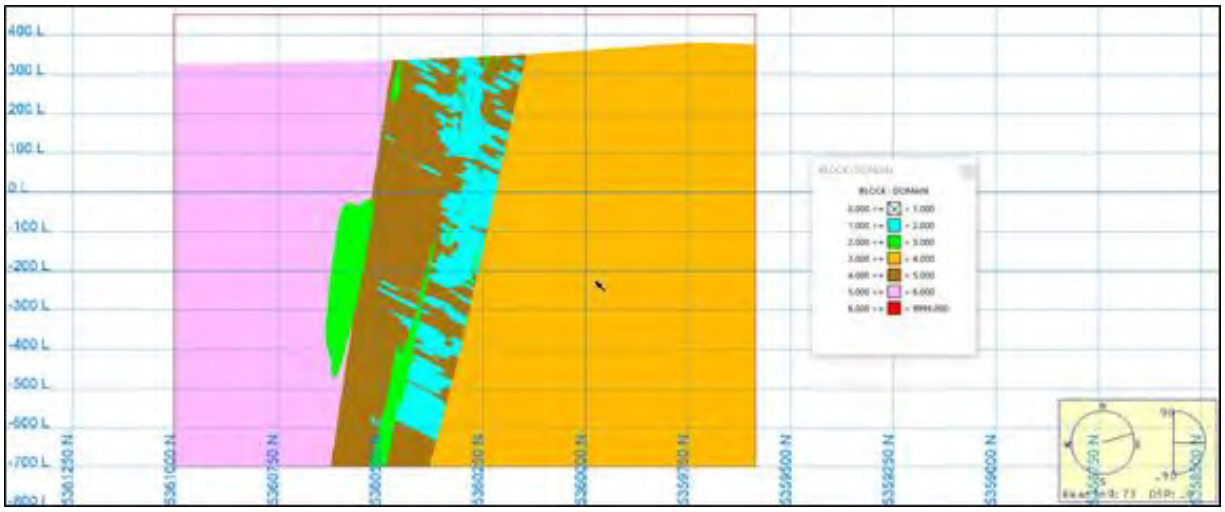
14.5.4 Marathon Gold Deposit Block Model

Table 14.50 shows the Marathon block model extents. Figure 14.64 shows a typical block model section of the mineralized domain.

Table 14.50 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	-	-

Figure 14.64 Typical Marathon Mineralized Domain Block Model Cross-Section



14.5.5 Marathon Gold Deposit Grade Estimation

A 3D block model was constructed in Vulcan that was constrained by the mineralized 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. A 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 optimization 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 mineralized domain. Grade interpolation runs were set up for only that material within the mineralized domain for gold. All domains were run for gold with the exception of the overburden domain, which is assumed to not be mineralized.

Using the composited assays (described above), block grade interpolations were run in each mineralized 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 mineralized domain were considered in the grade estimation. The block model interpolation parameters are shown in Table 14.51 through Table 14.53.

Table 14.51 Marathon QTPV Grade Estimation Parameters

Item	Pass			
	1	2	3	4
Search Parameters	1.00	1.00	1.00	1.50
Major Range (m)	50.0	50.0	50.0	75.0
Semi-Major Range (m)	50.0	50.0	50.0	75.0
Minor Range (m)	5.0	5.0	5.0	7.5
Azimuth (degrees)	125.0	125.0	125.0	125.0
Plunge (plunge of the azimuth in degrees)	-10.0	-10.0	-10.0	-10.0
Dip (degrees)	-30.0	-30.0	-30.0	-30.0
Search Ellipsoid				
Azimuth (degrees)	125.00	125.00	125.00	125.00
Plunge (plunge of the azimuth in degrees)	-10.00	-10.00	-10.00	-10.00
Dip (degrees)	-30.00	-30.00	-30.00	-30.00
Major (m)	75.00	75.00	75.00	112.50
Semi-Major (m)	55.00	55.00	55.00	82.50
Minor (m)	22.00	22.00	22.00	33.00
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
Maximum Distance to Nearest Neighbour (m)	10	25	-	-
Resource Classification	Measured	Indicated	Inferred	Speculative

Table 14.52 Marathon Mafic Dikes 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)	25.0	25.0	25.0	37.5
Minor Range (m)	8.0	8.0	8.0	12.0
Azimuth (degrees)	125.0	125.0	125.0	125.0
Plunge (plunge of the azimuth in degrees)	-10.0	-10.0	-10.0	-10.0
Dip (degrees)	-30.0	-30.0	-30.0	-30.0
Search Ellipsoid				
Azimuth (degrees)	125.00	125.00	125.00	125.00
Plunge (plunge of the azimuth in degrees)	-10.00	-10.00	-10.00	-10.00
Dip (degrees)	-30.00	-30.00	-30.00	-30.00
Major (m)	40.00	40.00	40.00	60.00
Semi-Major (m)	40.00	40.00	40.00	60.00
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
Maximum Distance to Nearest Neighbour (m)	10	25	-	-
Resource Classification	-	-	Inferred	Speculative

Table 14.53 Marathon Quartz-Eye Porphyry Grade Estimation Parameters

Item	Pass			
	1	2	3	4
Search Parameters	1.00	1.00	1.00	1.50
Major Range (m)	40.0	40.0	40.0	60.0
Semi-Major Range (m)	70.0	70.0	70.0	105.0
Minor Range (m)	20.0	20.0	20.0	30.0
Azimuth (degrees)	125.0	125.0	125.0	125.0
Plunge (plunge of the azimuth in degrees)	-10.0	-10.0	-10.0	-10.0
Dip (degrees)	-30.0	-30.0	-30.0	-30.0
Search Ellipsoid				
Azimuth (degrees)	125.00	125.00	125.00	125.00
Plunge (plunge of the azimuth in degrees)	-10.00	-10.00	-10.00	-10.00
Dip (degrees)	-30.00	-30.00	-30.00	-30.00
Major (m)	55.00	55.00	55.00	82.50
Semi-Major (m)	55.00	55.00	55.00	82.50
Minor (m)	25.00	25.00	25.00	37.50
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
Maximum Distance to Nearest Neighbour (m)	10	25	-	-
Resource Classification	-	-	Inferred	Speculative

14.5.6 Marathon Gold Deposit Resource Classification

The mineral resource classification used on the Marathon gold 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 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.

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 four is considered as waste material.

14.5.7 Model Validation

Following grade estimation, the grade populated block model was reviewed to ensure the resource estimation correctly populated the block model. 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.

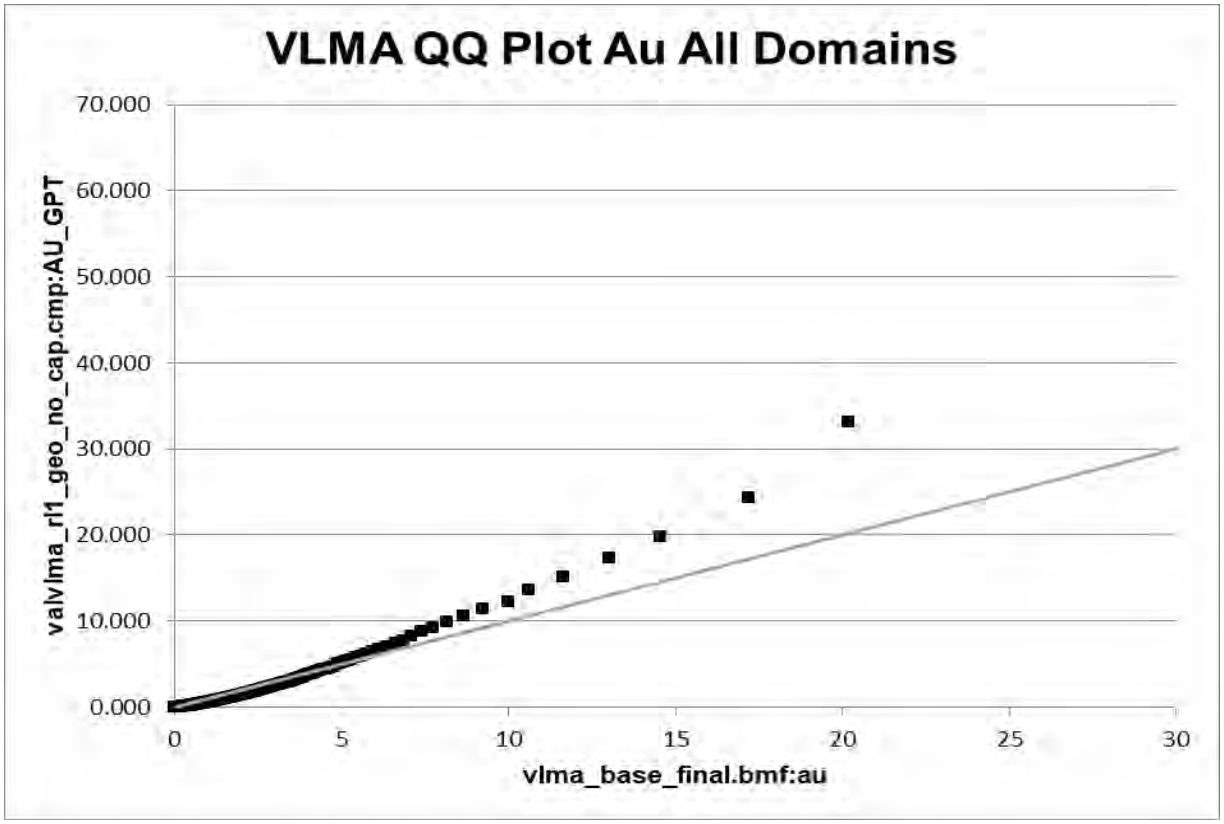
The overall block metal grades were examined to confirm that all the estimation parameters were honoured, as well as staying within the individual mineralized domains. A visual check on a sectional basis showed this to be true with block grades being consistently below the underlying drillhole assay value. Each of the cross-sections were 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 below in Table 14.54.

Table 14.54 Marathon Mineral Resource Estimation Model Statistics

Item	Drillholes	1-m Comps	Block Model
Number of samples	72,968	108,366	6,451,891
Minimum	0.001	0.001	0.002
Maximum	1313.714	1026.769	1016.002
Range	1313.713	1026.768	1016.000
Average	0.549	0.392	0.814
Standard deviation	7.897	5.190	3.654
Variance	62.363	26.935	13.354
Coef. of variance	14.383	13.230	4.489

The overall QQ plot of the block model estimated gold grades versus the composites are shown below in Figure 14.65.

Figure 14.65 Marathon Overall QQ Plot



The block model checks indicate that the Mineral Resource estimate underestimates the underlying composite at all grade levels.

For the Marathon Mineral Resource estimate, much of the exploration drilling used only has had fire assays completed to date while the other three deposits have had both fire assays and metallic screened assays completed. Some of the metallic screened assays for the Marathon deposit are pending, and were not available in time to be included in this report. Once all of these metallic screened assays are finalized, a new Mineral Resource estimate on the Marathon deposit should be completed. Based on the metallic screened assays completed to date across the entire property, the metallic screened assays provide a more reflective estimate of the total gold content in a sampled interval. Typically using the metallic screened assay returns a lower gold value at high grades while returning a higher gold value at low grades relative to fire assays.

The limited number of metallic screened assays completed to date on the Marathon deposit partially accounts for the underestimation of gold grades relative to the underlying composites. Incorporating metallic screened assays into the Marathon Mineral Resource estimate should help reduce the gold grade underestimation seen in the results presented in this technical report.

14.5.8 Marathon Gold 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 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.

Economic Assumptions

The operating assumptions (economic and gold recovery) used for the Whittle economic open pit optimization are shown in Table 14.55, and the operating assumptions (economic and gold recovery) used for the calculation of an underground cut-off grade is also shown below in Table 14.55.

Table 14.55 Marathon Open Pit and Underground Economic Assumptions

Item	Units	Marathon
Open Pit Waste Mining Cost	$/Waste t	2.00
Open Pit Material (Mill & Heap Leach) Mining Cost	$/Material t	2.50
Underground Mining Cost	$/Material t	52.00
Mill Processing Cost	$/Mill Material t	12.00
Heap Leach Processing Cost	$/Heap Leach Material t	3.00
G&A Cost	$/Feed t	1.50
Mill Recovery Formula	0.5 to 8 g/t	0.944+0.003X
Heap Leach Recovery Formula	0.2 to 2.0 g/t	0.500+0.110X
Mill Gold Recovery (at cut-off)	%	94.6
Heap Leach Gold Recovery (at cut-off)	%	53.6
Mill Annual Capacity	t	3,000,000
Heap Leach Annual Capacity	t	3,000,000
Gold Price	$/troy oz	1,250.00
Selling Cost	$/troy oz	10.00
Open Pit Calculated Mill Cut-off	g/t	0.425
Open Pit Incremental Mill Cu-toff	g/t	0.372
Open Pit Mill/Heap Leach Cut-off	g/t	0.700
Open Pit Heap Leach Calculated Cut-off	g/t	0.328
Open Pit Incremental Heap Leach Cut-off	g/t	0.239
Underground Calculated Cut-off	g/t	1.731

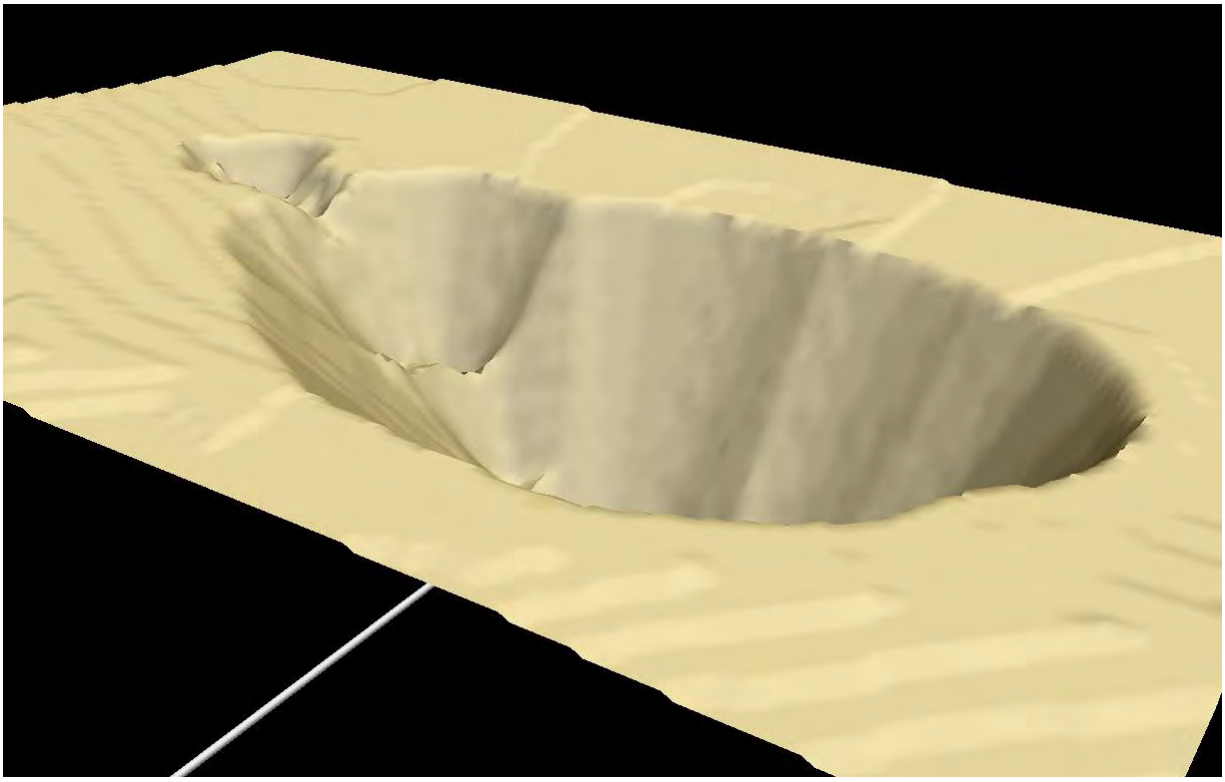
For mineral resources estimation, a cut-off grade of 0.328 g/t gold was used for open pit, and a cut-off grade of 1.731 g/t gold was used for underground. The assumed overall pit slope in Whittle was assumed to be 54.3° with no included ramps.

Please note that gold recovery is variable and is determined using the following:

- Millfeed:
  - For gold grades less than 0.5 g/t a recovery of 94.6% is used.
  - For gold grades from 0.5 g/t to 8.0 g/t a formula is used: Recovery = 0.003 x Au + 0.944.
  - For gold grades 8.0 g/t or grater a recovery of 96.8% is used.
- Heap Leach:
  - Gold grades less than 0.2 g/t are not recovered.
  - For gold grades from 0.2 g/t to 2.0 g/t a formula is used: Recovery = 0.110 x Au + 0.500.
  - For gold grades 2.0 g/t or grater a recovery of 72.0% is used.

Using these assumptions, a Whittle economic pit optimization was generated and a pit shell developed as shown below in Figure 14.66.

Figure 14.66 Marathon PEA Open Pit Shell



Mineral Resource Estimate

BOYD's Mineral Resource estimates for the Marathon gold deposit are provided in Table 14.56.

Table 14.56 Marathon Mineral Resources

Mining Method	Resource Classification	Gold Cut-off Grade (g/t)	Tonnes	Au g/t	Au Troy Ozs
Open Pit - Mill	Measured	0.700	6,467,000	2.951	613,500
Open Pit - Mill	Indicated	0.700	13,627,000	2.313	1,013,300
Open Pit - Mill	***Measured + Indicated***	***0.700***	***20,094,000***	***2.518***	***1,626,800***
Open Pit - Mill	Inferred	0.700	7,927,000	2.584	658,400
Open Pit - Heap Leach	Measured	0.328	4,170,000	0.488	65,500
Open Pit - Heap Leach	Indicated	0.328	9,584,000	0.488	150,400
Open Pit - Heap Leach	***Measured + Indicated***	***0.328***	***13,754,000***	***0.488***	***215,900***
Open Pit - Heap Leach	Inferred	0.328	5,857,000	0.487	91,700
Total Open Pit	Measured	-	10,637,000	1.985	679,000
Total Open Pit	Indicated	-	23,211,000	1.559	1,163,700
Total Open Pit	***Measured + Indicated***	***-***	***33,848,000***	***1.693***	***1,842,700***
Total Open Pit	Inferred	-	13,784,000	1.693	750,100
Underground	Measured	1.731	142,000	7.990	36,500
Underground	Indicated	1.731	513,000	4.797	79,100
Underground	***Measured + Indicated***	***1.731***	***655,000***	***5.489***	***115,600***
Underground	Inferred	1.731	1,839,000	3.862	228,300
Open Pit + Underground	Measured	-	10,779,000	2.064	715,500
Open Pit + Underground	Indicated	-	23,724,000	1.629	1,242,800
Open Pit + Underground	***Measured + Indicated***	***-***	***34,503,000***	***1.765***	***1,958,300***
Open Pit + Underground	Inferred	-	15,623,000	1.948	978,400

1. **The effective date for this mineral resource estimate is 9 October 2018 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.**
2. **Mineral Resources are calculated at a gold price of $1,250 /troy oz.**
3. **The mineral resources presented above are global and do not include a detailed pit or underground design, only an economic 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 ID^3 methods for grade estimation. All mineral resources 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 mineralized 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.**

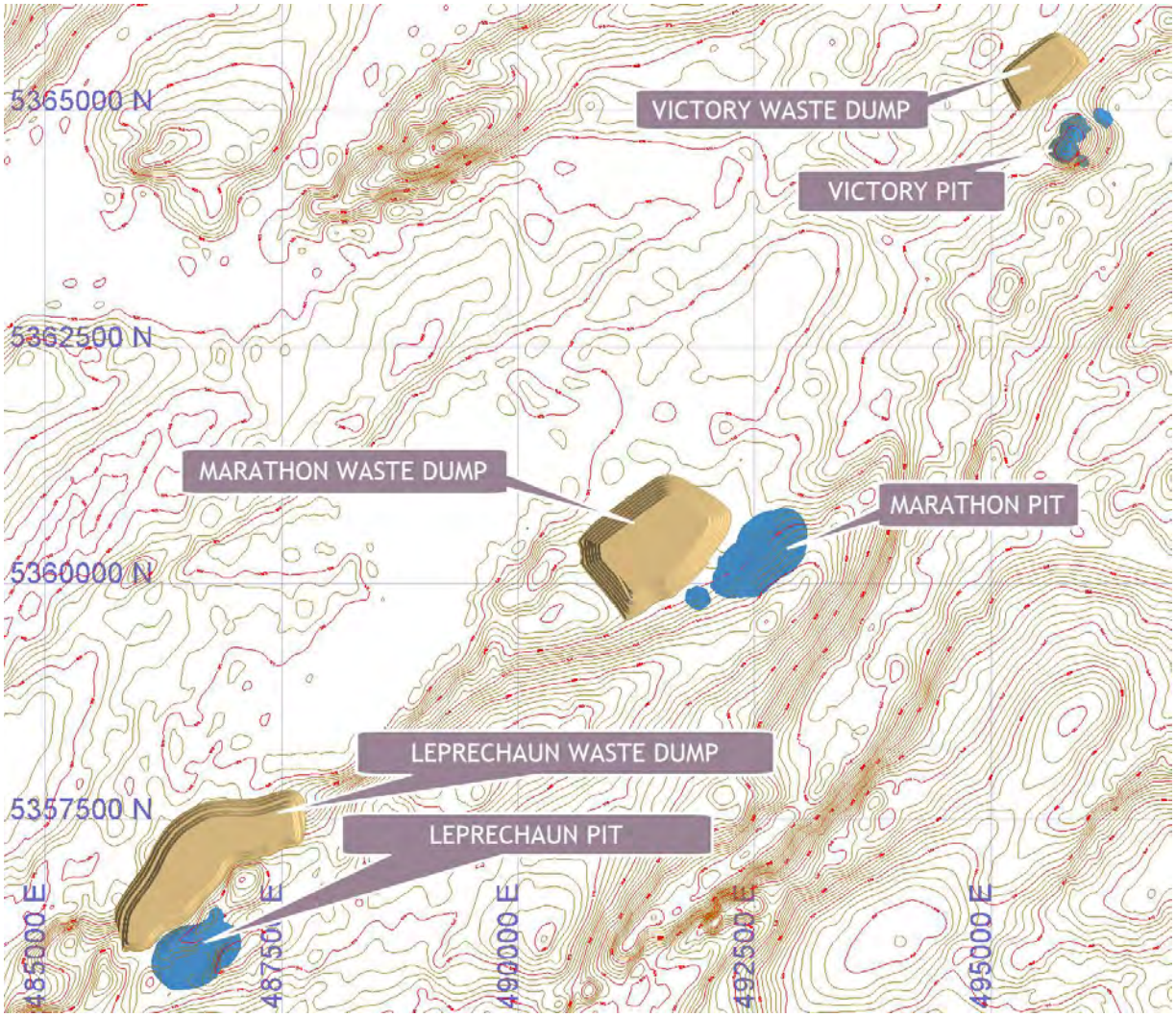
15.0 MINERAL RESERVE ESTIMATES

The Valentine Lake Gold Camp is an exploration stage project for which positive economic feasibility has yet to be demonstrated; as such, no Mineral Reserve estimates have been prepared for the Property.

16.0 MINING METHODS

The Project comprises four mining areas: Leprechaun in the southwest, the Sprite Zone adjoining Leprechaun towards the northeast, the Marathon deposit located about 4.1 km northeast of the Sprite Zone, and the Victory Deposit located 5.5 km northeast of the Marathon Deposit. These four mining areas are shown below in Figure 16.1.

Figure 16.1 Valentine Lake PEA Mining Locations



For this updated PEA, BOYD only considered surface mining methods for each of the deposits. In the previous PEA, BOYD determined that additional deep exploration drilling was required in order to complete an underground stope optimization. Since the completion of the last PEA, the additional exploration drilling has been confined to areas that would potentially be developed using surface mining techniques. As a result,

potentially underground-mineable mineral resources have been excluded from the PEA. Ultimate pit limits were developed for the four deposits using the pit optimization process described below. Based on these initial results, mineral resources for the Sprite Zone have been excluded from the PEA until further exploration drilling and resource modelling can be completed. As a result, only potentially surface-mineable mineral resources from the Leprechaun, Marathon, and Victory deposits have been considered in this PEA.

The PEA assumes that standard surface mining techniques will be utilized to create an open pit within each of the three mining areas. The Leprechaun pit design comprises four mining phases and has maximum approximate dimensions of 900 m southwest to northeast by 600 m southeast to northwest, and a maximum depth of 300 m below current ground level. The Marathon pit design includes seven mining phases with one phase being a small standalone pit slightly southwest of the main Marathon pit. The Marathon pit has approximate dimensions of 1,200 m southwest to northeast by 700 m southeast to northwest and a maximum depth of 400 m below current ground level. The Victory pit design consists of four mining phases with one small pit located slightly northeast of the main Victory pit. The Victory pit has approximate dimensions of 540 m southwest to northeast by 280 m southeast to northwest, and a maximum depth of 130 m below current ground level. Design of all of the pits was guided by the Whittle optimization process described.

Marathon Gold will have responsibility for site preparation, haul road construction and maintenance, production drilling and blasting, the excavation and haulage of material and waste, management of material stockpiles, oversize breakage, pit dewatering, and haul road maintenance. Marathon Gold will provide the open-pit equipment, operator training, supervision, pit technical support services, mine consumables, and the pit operations and maintenance facilities. The manufacturer, per the terms and conditions of a standard maintenance and repair (MARC) agreement, will supply mine maintenance personnel. Specialized contractors will provide explosives storage on site. Established suppliers will provide explosives, blasting agents, fuel, and other consumables.

16.1 Mine Design

The ultimate pit designs developed for each of the three mining areas of the Valentine Lake Gold Project are based on the results of the Whittle pit optimization work. To approximate the optimal extraction sequence, the three mining areas are planned to be developed using a total of 15 distinct mining phases. Pit design parameters, such as wall slope angles and bench dimensions, were provided by Stantec. A mine production schedule for the entire complex was prepared by BOYD using Maptek's Chronos scheduling software.

16.1.1 Mining Dilution

Block models for each of the potential mining areas utilize a variable block size ranging from 2 m x 2 m x 2 m up to 6 m x 6 m x 6 m. For the scoping-level mine designs and production schedule, a selective mining unit (SMU) size of 6 m x 6 m x 6 m was utilized to account for mining dilution and loss. Each of the resource block models was reblocked to the SMU size. The average gold grade for a SMU block is a tonnage-weighted average of the gold grades in all of the sub-blocks that fall within the parent block. Sub blocks that have no grade estimate (usually because they fall outside of the mineralized zones) were assigned a grade of zero before reblocking to the SMU scale used for reporting purposes. For example, a SMU block with 50% of the blocks having a gold grade of zero and 50% having a gold grade of 1.00 g/t would result in a SMU block grade of 0.50 g/t (assuming the same density).

16.1.2 Whittle Pit Optimization

BOYD used Whittle to develop ultimate pit and intermediate mining (phase) limits. This software uses the Lerchs-Grossmann algorithm, an industry standard method to determine an optimal pit shape using various economic, geotechnical, and metallurgical parameters. A number of scenarios were considered and completed in order to determine the conceptual intermediate and final pit shells for each gold deposit. These pit shells were then used for the PEA pit designs and production schedule.

Preliminary pit optimization work on the Sprite Zone generated small, isolated pits highlighting the need for additional exploration drilling and resource modelling before scoping-level planning could be performed. As such, the Sprite Zone has been excluded from the PEA.

Geotechnical Mine design parameters were provided by Stantec (15 January 2018) and are shown below in Table 16.1.

Table 16.1 Valentine Lake Project Geotechnical Parameters

Item	Leprechaun and Marathon		Victory
Geology Domain	Sediments	All Others	All
Inter-Ramp Slope (degrees)	47.5	54.3	54.3
Bench Height (m)	6.0	6.0	6.0
Catch Bench Width (m)	8.1	8.1	8.1
Benches Between Catch Benches	3	3	3
Vertical Distance Between Catch Benches (m)	18.0	18.0	18.0
Face Angle (degrees)	65.0	75.0	75.0

Preliminary operating costs were developed to provide the economic basis for the various Whittle scenarios that were considered. In order to ensure that the ultimate pit shell selected for each pit would provide significant economic robustness, Whittle shells were generated without consideration of the heap leach material. Once an economic shell was established for design, heap leach material would then be considered in the subsequent mine design and production scheduling. This ensured that the overall pit shapes were not driven by marginal, lower grade material, thereby improving the overall economic robustness of the project.

Annual mill capacity was set to 3 Mtpa during Whittle optimization and production scheduling. For later production scheduling, annual heap leach capacity was also set at 3 Mt. The scoping-level economics used is shown below in Table 16.2.

Table 16.2 Whittle Economic Assumptions

Item	Units	Marathon	Leprechaun	Victory
Open-Pit Waste Mining Cost	$/t waste	$2.00	$2.00	$2.00
Open-Pit Material (Mill & Heap Leach) Mining Cost	$/t material	$2.50	$2.50	$2.50
Mill Processing Cost	$/t millfeed	$12.00	$12.00	$12.00
G&A Cost	$/t mill feed	$3.30	$3.30	$3.30
Mill Recovery Formula	0.5 to 8 g/t	0.944+0.003X	0.921+0.005X	0.944+0.003X
Mill Gold Recovery (at Cut-off)	%	94.6%	92.4%	94.6%
Mill Annual Capacity	t	3,000,000	3,000,000	2,500,000
Gold Price	$/oz	$1,250.00	$1,250.00	$1,250.00
Selling Cost	$/oz	$10.00	$10.00	$10.00
Open-Pit Calculated Mill Cut-off	g/t	0.472	0.484	0.472
Open-Pit Incremental Mill Cut-off	g/t	0.419	0.429	0.419

Whittle optimizations were completed for Leprechaun, Marathon, and Victory using the economic parameters presented in Table 16.2, and the geotechnical parameters presented in Table 16.1 on the diluted block models. For both the mill feed and heap leach materials, variable recovery curves were utilized. The formulae for the curves used at each deposit is provided in Table 16.2 above.

Initial Whittle scenarios excluded the influence of ramps on the overall pit slopes. Results from these runs were examined and the overall slope was flattened to reflect the inclusion of ramps into the pit design. The impact of the reduced pit slopes was significant at all of the deposits. Table 16.3 below shows the no ramp and ramp reduced slopes for the project.

Table 16.3 Impact of Ramps on the Overall Whittle Slopes

Item	Leprechaun and Marathon		Victory
Geology Domain	Sediments	All Others	All
Inter-Ramp Slope (no ramps, degrees)	47.5	54.3	54.3
Inter-Ramp Slope (with ramps, degrees)	43.5	49.8	49.8

Whittle analyses using the ramp reduced slopes, as well as the economics presented in Table 16.2, were used to generate the pit shells that were then used for the phased and ultimate pit designs on each deposit. Figures 16.2, 16.3, and 16.4 show the resulting Whittle pit shells used for design.

Figure 16.2 Leprechaun Whittle Pit Shell, Revenue Factor = 1, Pit Shell 67

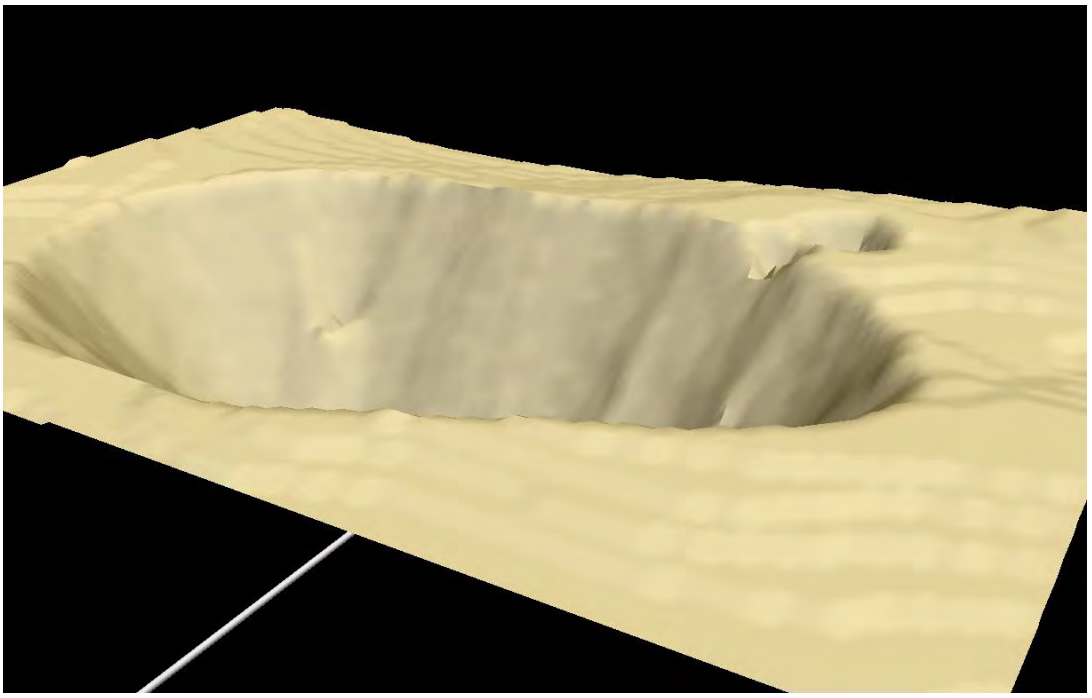


Figure 16.3 Marathon Whittle Pit Shell, Revenue Factor = 0.79, Pit Shell 50

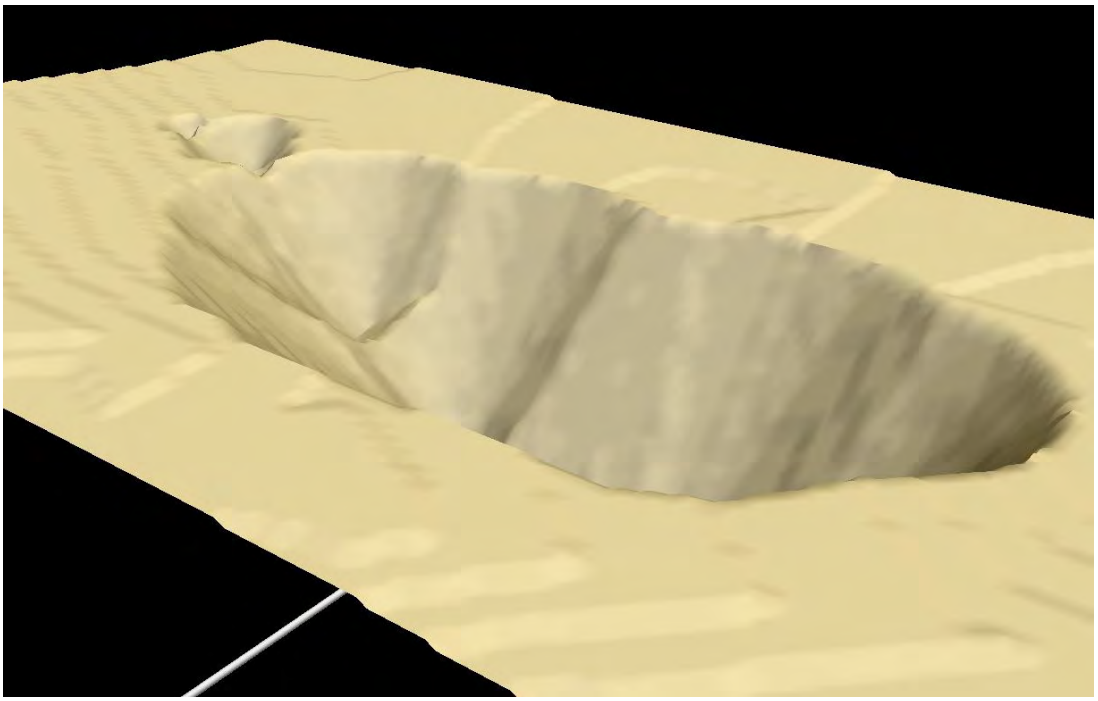


Figure 16.4 Victory Whittle Pit Shell, Revenue Factor 1, Pit Shell 70

16.1.3 Underground Mine Design

No underground-mineable mineral resources were considered as part of this updated PEA.

16.1.4 Design Criteria

Different mining phases were designed in accordance with the recommended bench configurations provided by Stantec (as tabulated above in Table 16.1). Triple benching of 6 m high production benches was determined to be suitable for all geologic units. Catch or safety benches with a width of 8.1 m were used in all designed phases. These safety benches are applied on every third bench (18 m vertically).

Two-way haul roads, 25 m wide at a 10% grade, were utilized in most cases where higher traffic may require extra width for safe and efficient passing of trucks. To maximize material recovery at depth, the final benches of each pit floor were designed with single-lane access (17 m width). Safety berms were designed in accordance with the recommendations provided by Stantec.

Waste dumps were designed according to Stantec recommendations and assume a final closure slope angle of 30°. To accomplish this, the waste dumps were constructed in single lifts with a 35° face angle and a 6.1 m safety bench.

16.1.5 Phased Designs

The Whittle pit shells described above were used to design intermediate mining phases at each of the three deposits. The phases were designed to provide early material extraction while balancing waste stripping over the entire life of the operation. All of the phased designs used the same geotechnical and design criteria described above.

Leprechaun Phased Pit Designs

The Leprechaun pit consists of four mining phases. Phases 1 and 2 are isolated starter pits, while Phase 3 connects and expands the previous two. Phase 4 is the final pit expansion for Leprechaun. Table 16.4 provides the estimates of in-pit mineral resources for each of the Leprechaun phases, while Figures 16.5 through 16.8 show the individual phase designs.

Table 16.4 Leprechaun In-Pit Phased Mineral Resources

Phase	Category	Millfeed				Heap Leach				Total		
		Cut-off (g/t)	Tonnes (t)	Grade (g/t)	Gold (troy ozs)	Cut-off (g/t)	Tonnes (t)	Grade (g/t)	Gold (troy ozs)	Tonnes (t)	Grade (g/t)	Gold (troy ozs)
1	Measured	1.142	235,000	4.145	31,300	0.25	221,000	0.661	4,700	456,000	2.456	36,000
1	Indicated	1.142	57,000	3.006	5,500	0.25	39,000	0.705	900	96,000	2.072	6,400
1	***M+I***	***1.142***	***292,000***	***3.923***	***36,800***	***0.25***	***260,000***	***0.668***	***5,600***	***552,000***	***2.390***	***42,400***
1	Inferred	1.142	112,000	2.248	8,100	0.25	434,000	0.533	7,400	546,000	0.885	15,500
1	Waste									4,846,000		
1	Total Tonnes									5,944,000		
1	Stripping Ratio									4.41		
2	Measured	1.142	227,000	3.165	23,100	0.25	255,000	0.588	4,800	482,000	1.802	27,900
2	Indicated	1.142	71,000	2.762	6,300	0.25	92,000	0.567	1,700	163,000	1.523	8,000
2	***M+I***	***1.142***	***298,000***	***3.069***	***29,400***	***0.25***	***347,000***	***0.582***	***6,500***	***645,000***	***1.731***	***35,900***
2	Inferred	1.142	246,000	2.556	20,200	0.25	730,000	0.539	12,600	976,000	1.047	32,800
2	Waste									8,699,000		
2	Total Tonnes									10,320,000		
2	Stripping Ratio									5.37		
3	Measured	1.142	907,000	3.623	105,600	0.25	1,551,000	0.571	28,500	2,458,000	1.697	134,100
3	Indicated	1.142	303,000	3.221	31,400	0.25	605,000	0.566	11,000	908,000	1.452	42,400
3	***M+I***	***1.142***	***1,210,000***	***3.522***	***137,000***	***0.25***	***2,156,000***	***0.570***	***39,500***	***3,366,000***	***1.631***	***176,500***
3	Inferred	1.142	927,000	2.986	89,000	0.25	2,617,000	0.529	44,500	3,544,000	1.172	133,500
3	Waste									50,173,000		
3	Total Tonnes									57,083,000		
3	Stripping Ratio									7.26		
4	Measured	1.142	1,359,000	3.240	141,600	0.25	1,974,000	0.571	36,200	3,333,000	1.659	177,800
4	Indicated	1.142	727,000	2.806	65,600	0.25	1,252,000	0.573	23,100	1,979,000	1.393	88,700
4	***M+I***	***1.142***	***2,086,000***	***3.089***	***207,200***	***0.25***	***3,226,000***	***0.572***	***59,300***	***5,312,000***	***1.560***	***266,500***
4	Inferred	1.142	1,463,000	2.926	137,600	0.25	3,674,000	0.527	62,300	5,137,000	1.210	199,900
4	Waste									96,901,000		
4	Total Tonnes									107,350,000		
4	Stripping Ratio									9.27		
All	Measured	1.142	2,728,000	3.439	301,600	0.25	4,001,000	0.577	74,200	6,729,000	1.737	375,800
All	Indicated	1.142	1,158,000	2.922	108,800	0.25	1,988,000	0.573	36,700	3,146,000	1.438	145,500

Phase	Category	Millfeed				Heap Leach				Total		
		Cut-off (g/t)	Tonnes (t)	Grade (g/t)	Gold (troy ozs)	Cut-off (g/t)	Tonnes (t)	Grade (g/t)	Gold (troy ozs)	Tonnes (t)	Grade (g/t)	Gold (troy ozs)
All	***M+I***	***1.142***	***3,886,000***	***3.285***	***410,400***	***0.25***	***5,989,000***	***0.576***	***110,900***	***9,875,000***	***1.642***	***521,300***
All	Inferred	1.142	2,748,000	2.885	254,900	0.25	7,455,000	0.529	126,800	10,203,000	1.164	381,700
All	Waste									160,619,000		
All	Total Tonnes									180,697,000		
All	Stripping Ratio									8.00		

1. **The effective date for this mineral resource estimate is 4 October 2018, and is reported on a 100% ownership basis. This estimate is a reblocking to a fixed block size of the undiluted mineral resource estimate presented in chapter 14 of this document.**
2. **Mineral Resources are calculated at a gold price of $1,250 /troy ounce.**
3. **The mineral resources presented above are global and do not include a detailed pit or underground design, only a designed economic pit shell was used to determine the in-pit mineral resources.**
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 fixed block size of 6 m x 6 m x 6 m from a reblocking of the original mineral resource estimate. All mineral resources are reported using an open-pit gold cut-off of 0.250 g/t Au. Material between a 0.250 Au g/t value and 1.142 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**
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.**

Figure 16.5 Leprechaun Phase 1 Design

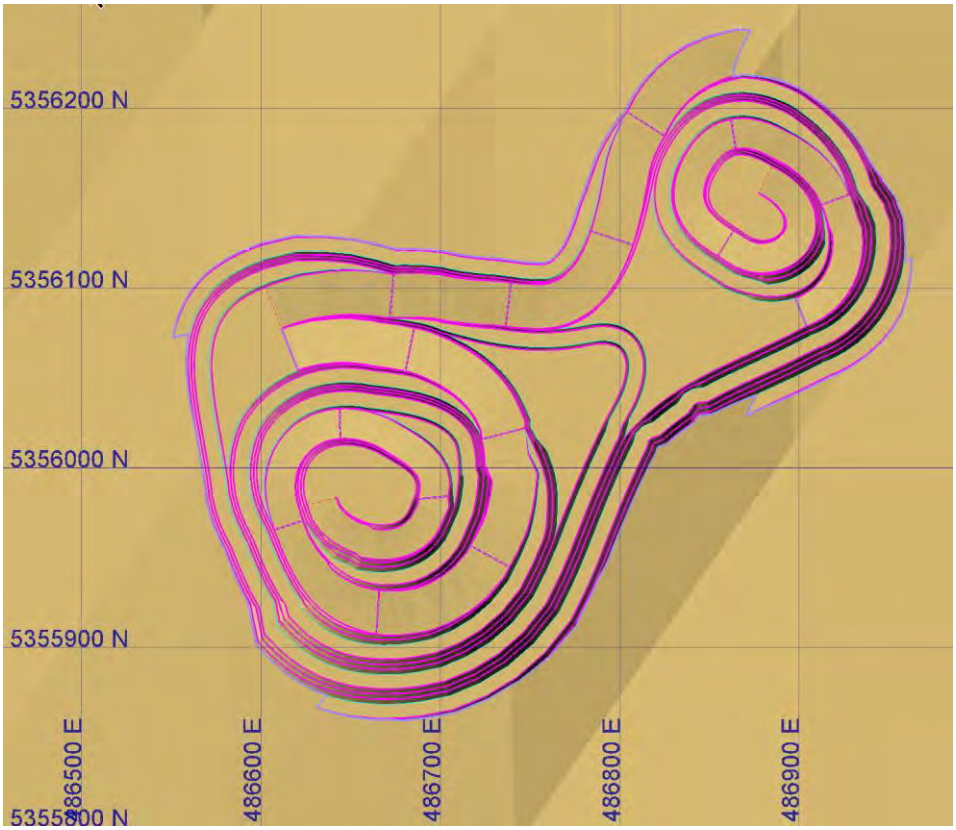


Figure 16.6 Leprechaun Phase 2 Design

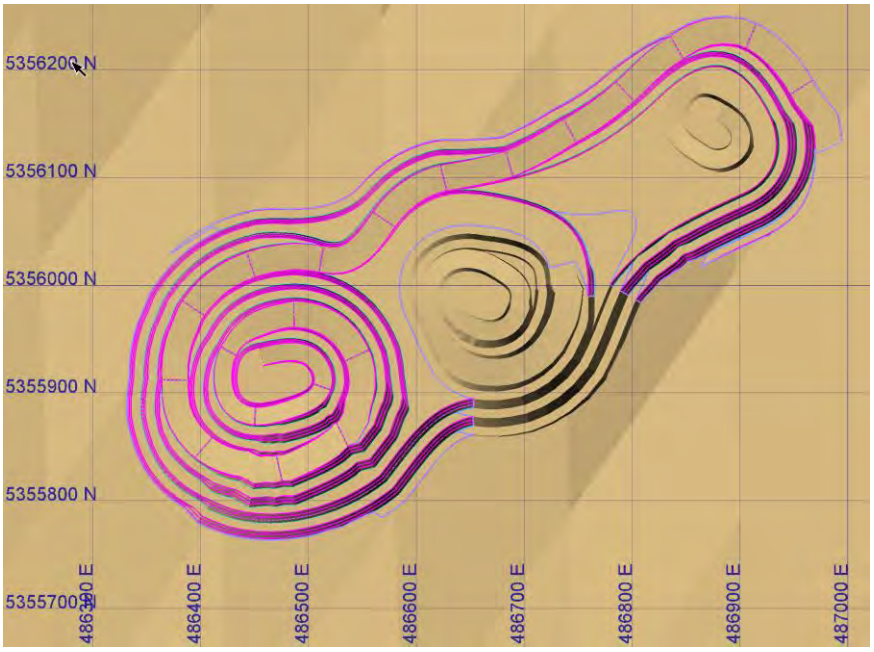


Figure 16.7 Leprechaun Phase 3 Design

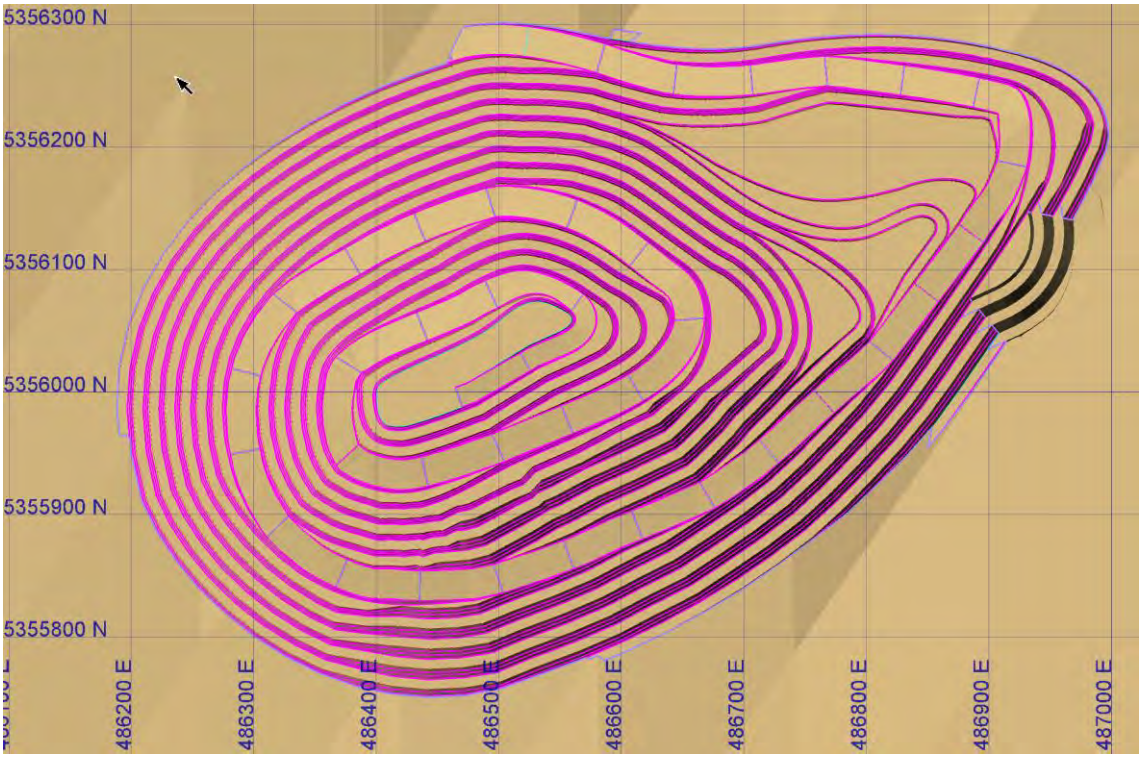
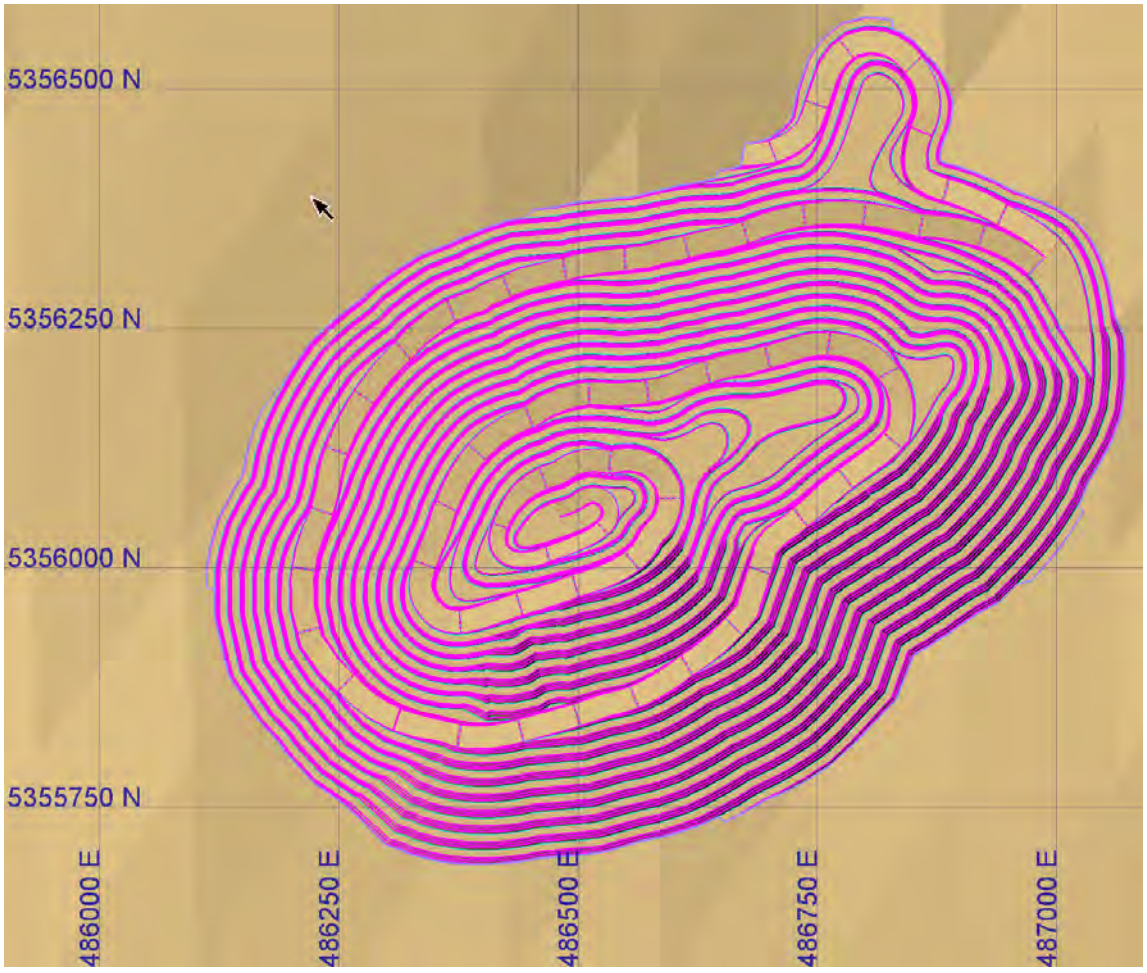


Figure 16.8 Leprechaun Phase 4 Design



Marathon Phased Pit Designs

The Marathon pit consists of seven phases. Phase 1 is the starter pit, with Phases 2, 3, 4, and 5 being expansions of that phase. Phase 6 is a small standalone pit to the southwest of the main Marathon pit. Phase 7 is the final expansion of the main Marathon pit. Table 16.5 describes the in-pit mineral resources for each of the Marathon phases, while Figures 16.9 through 16.15 show the individual phase layouts.

Table 16.5 Marathon In-Pit Phased Mineral Resources

Phase	Category	Millfeed				Heap Leach				Total		
		Cut-off (g/t)	Tonnes (t)	Grade (g/t)	Gold (troy ozs)	Cut-off (g/t)	Tonnes (t)	Grade (g/t)	Gold (troy ozs)	Tonnes (t)	Grade (g/t)	Gold (troy ozs)
1	Measured	0.7	1,904,000	3.021	184,900	0.292	849,000	0.480	13,100	2,753,000	2.237	198,000
1	Indicated	0.7	2,427,000	2.222	173,400	0.292	1,257,000	0.487	19,700	3,684,000	1.630	193,100
1	***M+I***	***0.7***	***4,331,000***	***2.573***	***358,300***	***0.292***	***2,106,000***	***0.484***	***32,800***	***6,437,000***	***1.890***	***391,100***
1	Inferred	0.7	313,000	1.723	17,300	0.292	495,000	0.442	7,000	808,000	0.938	24,300
1	Waste									11,918,000		
1	Total Tonnes									19,163,000		
1	Stripping Ratio									1.64		
2	Measured	0.7	1,000,000	2.025	65,100	0.292	556,000	0.477	8,500	1,556,000	1.472	73,600
2	Indicated	0.7	1,717,000	1.879	103,700	0.292	996,000	0.484	15,500	2,713,000	1.367	119,200
2	***M+I***	***0.7***	***2,717,000***	***1.932***	***168,800***	***0.292***	***1,552,000***	***0.481***	***24,000***	***4,269,000***	***1.405***	***192,800***
2	Inferred	0.7	232,000	1.627	12,100	0.292	382,000	0.445	5,500	614,000	0.891	17,600
2	Waste									13,282,000		
2	Total Tonnes									18,165,000		
2	Stripping Ratio									2.72		
3	Measured	0.7	939,000	2.036	61,500	0.292	481,000	0.489	7,600	1,420,000	1.512	69,100
3	Indicated	0.7	1,461,000	1.705	80,100	0.292	840,000	0.482	13,000	2,301,000	1.259	93,100
3	***M+I***	***0.7***	***2,400,000***	***1.835***	***141,600***	***0.292***	***1,321,000***	***0.485***	***20,600***	***3,721,000***	***1.355***	***162,200***
3	Inferred	0.7	351,000	1.418	16,000	0.292	444,000	0.450	6,400	795,000	0.878	22,400
3	Waste									19,744,000		
3	Total Tonnes									24,260,000		
3	Stripping Ratio									4.37		
4	Measured	0.7	1,349,000	1.883	81,700	0.292	938,000	0.474	14,300	2,287,000	1.305	96,000
4	Indicated	0.7	2,685,000	1.686	145,600	0.292	2,054,000	0.481	31,800	4,739,000	1.164	177,400
4	***M+I***	***0.7***	***4,034,000***	***1.752***	***227,300***	***0.292***	***2,992,000***	***0.479***	***46,100***	***7,026,000***	***1.210***	***273,400***
4	Inferred	0.7	756,000	1.522	37,000	0.292	882,000	0.452	12,800	1,638,000	0.946	49,800
4	Waste									37,736,000		
4	Total Tonnes									46,400,000		
4	Stripping Ratio									4.36		
5	Measured	0.7	0	0.000	0	0.292	1,000	0.387	0	1,000	0.387	0
5	Indicated	0.7	0	1.025	0	0.292	5,000	0.340	100	5,000	0.340	100
5	***M+I***	***0.7***	***0***	***0.000***	***0***	***0.292***	***6,000***	***0.348***	***100***	***6,000***	***0.348***	***100***
5	Inferred	0.7	107,000	1.102	3,800	0.292	95,000	0.460	1,400	202,000	0.800	5,200

Phase	Category	Millfeed				Heap Leach				Total		
		Cut-off (g/t)	Tonnes (t)	Grade (g/t)	Gold (troy ozs)	Cut-off (g/t)	Tonnes (t)	Grade (g/t)	Gold (troy ozs)	Tonnes (t)	Grade (g/t)	Gold (troy ozs)
5	Waste									788,000		
5	Total Tonnes									996,000		
5	Stripping Ratio									3.79		
6	Measured	0.7	1,000	1.874	100	0.292	1,000	0.429	0	2,000	1.151	100
6	Indicated	0.7	87,000	1.575	4,400	0.292	94,000	0.456	1,400	181,000	0.994	5,800
6	***M+I***	***0.7***	***88,000***	***1.578***	***4,500***	***0.292***	***95,000***	***0.455***	***1,400***	***183,000***	***0.995***	***5,900***
6	Inferred	0.7	337,000	1.352	14,600	0.292	420,000	0.451	6,100	757,000	0.852	20,700
6	Waste									5,525,000		
6	Total Tonnes									6,465,000		
6	Stripping Ratio									5.88		
7	Measured	0.7	2,162,000	1.985	138,000	0.292	1,634,000	0.465	24,400	3,796,000	1.331	162,400
7	Indicated	0.7	4,968,000	1.747	279,000	0.292	4,647,000	0.465	69,400	9,615,000	1.127	348,400
7	***M+I***	***0.7***	***7,130,000***	***1.819***	***417,000***	***0.292***	***6,281,000***	***0.465***	***93,800***	***13,411,000***	***1.185***	***510,800***
7	Inferred	0.7	4,955,000	2.126	338,600	0.292	4,979,000	0.453	72,600	9,934,000	1.287	411,200
7	Waste									158,701,000		
7	Total Tonnes									182,046,000		
7	Stripping Ratio									6.80		
All	Measured	0.7	7,355,000	2.246	531,300	0.292	4,460,000	0.474	67,900	11,815,000	1.577	599,200
All	Indicated	0.7	13,345,000	1.832	786,200	0.292	9,893,000	0.474	150,900	23,238,000	1.254	937,100
All	***M+I***	***0.7***	***20,700,000***	***1.979***	***1,317,500***	***0.292***	***14,353,000***	***0.474***	***218,800***	***35,053,000***	***1.363***	***1,536,300***
All	Inferred	0.7	7,051,000	1.939	439,400	0.292	7,697,000	0.452	111,800	14,748,000	1.163	551,200
All	Waste									247,694,000		
All	Total Tonnes									297,495,000		
All	Stripping Ratio									4.97		

1. **The effective date for this mineral resource estimate is 9 October 2018 and is reported on a 100% ownership basis. This estimate is a reblocking to a fixed block size of the undiluted mineral resource estimate presented in chapter 14 of this document.**
2. **Mineral Resources are calculated at a gold price of $1,250 /troy ounce.**
3. **The mineral resources presented above are global and do not include a detailed pit or underground design, only a designed economic pit shell was used to determine the in-pit mineral resources.**
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 fixed block size of 6 m x 6 m x 6 m from a reblocking of the original mineral resource estimate. All mineral resources are reported using an open pit gold cut-off of 0.292 g/t Au. Material between a 0.292 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.**
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 16.9 Marathon Phase 1 Pit Design

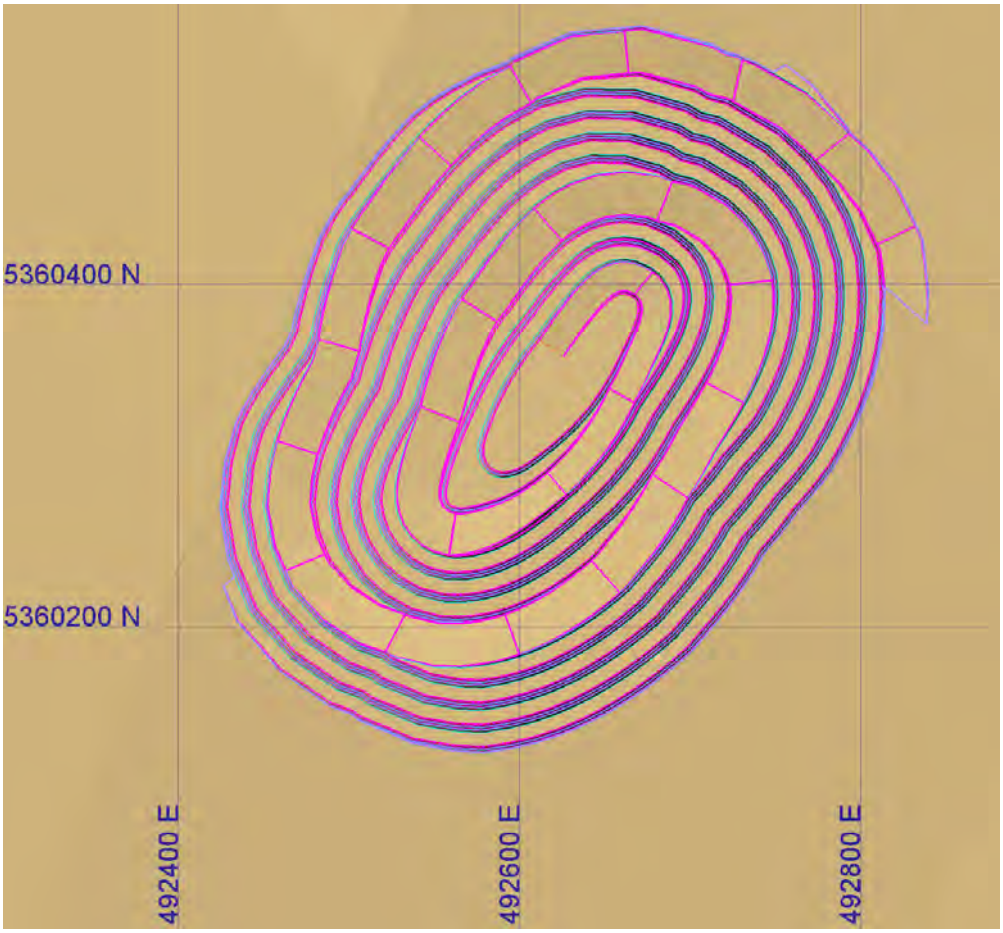


Figure 16.10 Marathon Phase 2 Pit Design

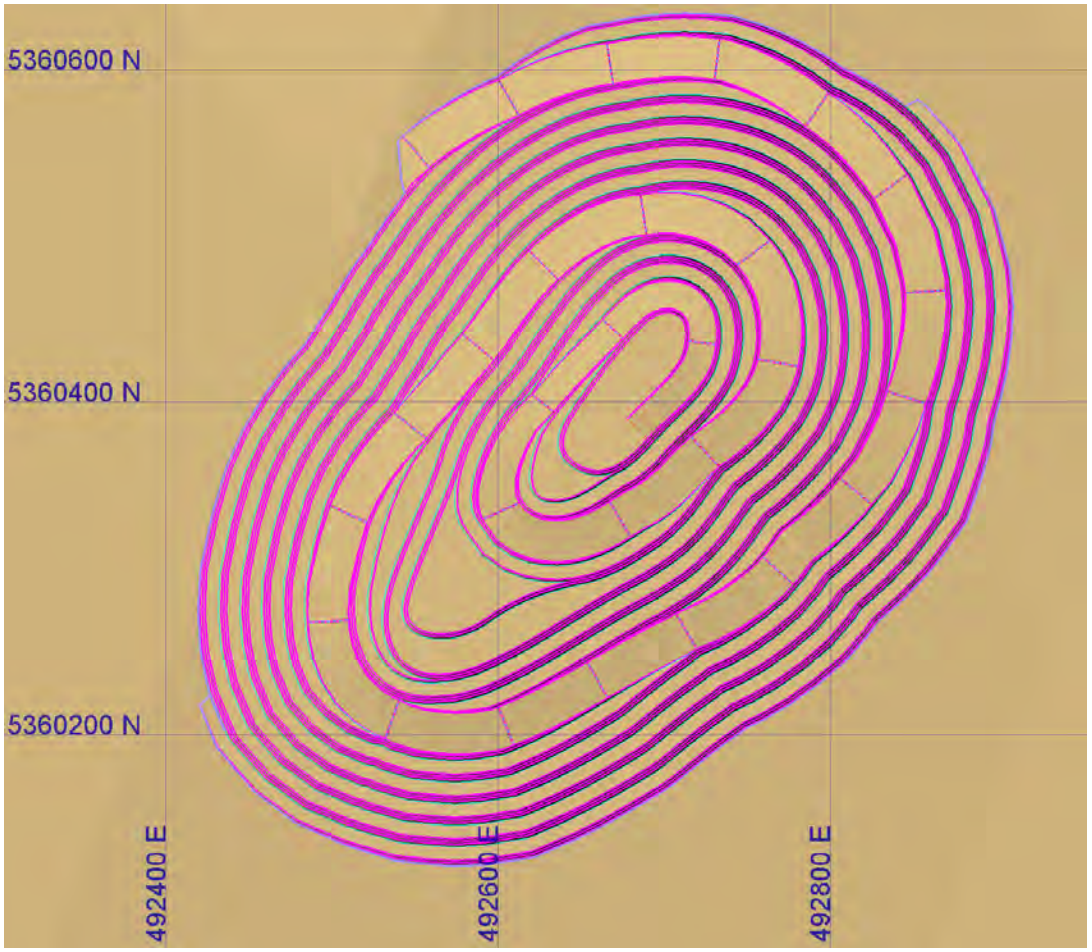


Figure 16.11 Marathon Phase 3 Pit Design

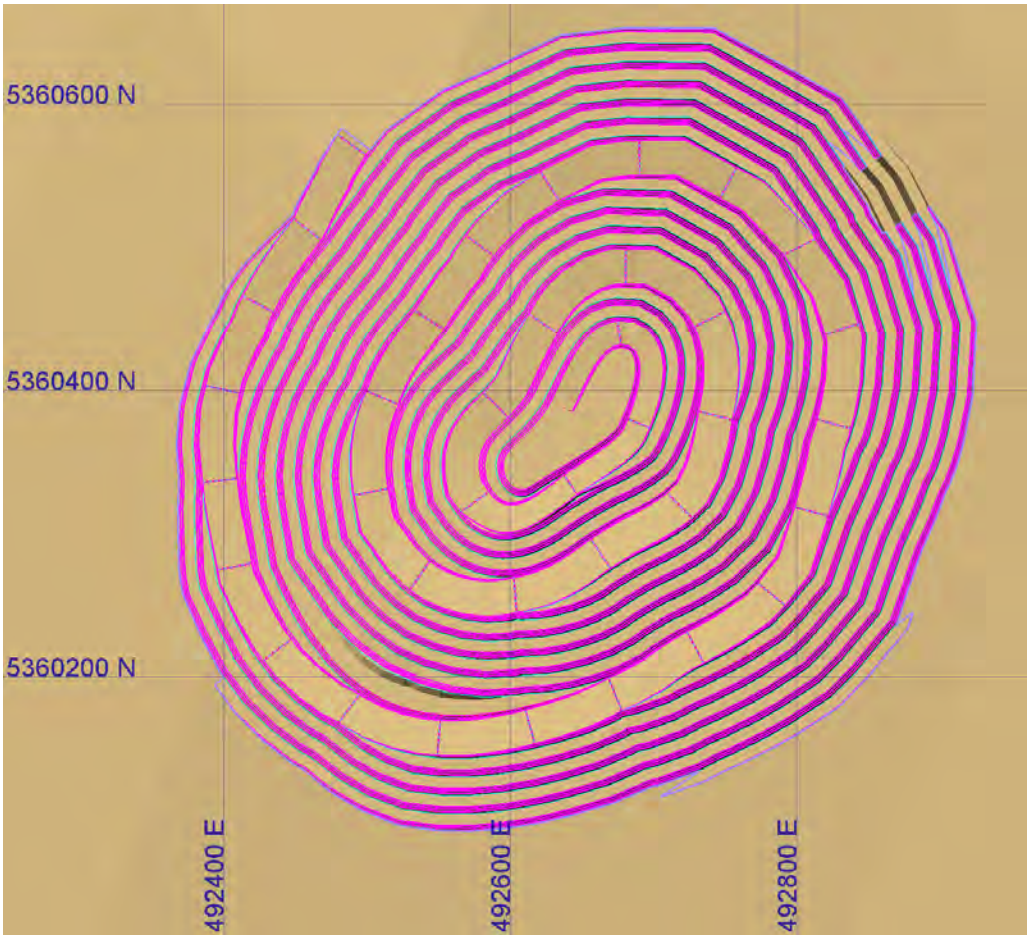


Figure 16.12 Marathon Phase 4 Pit Design

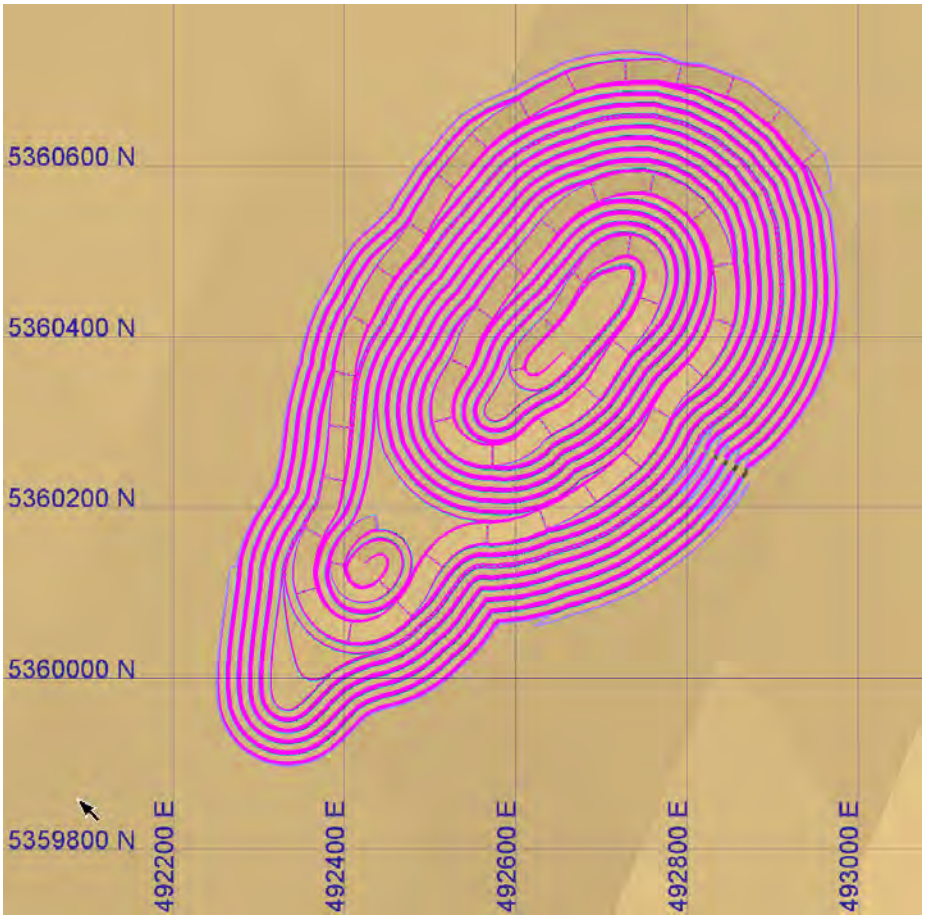


Figure 16.13 Marathon Phase 5 Pit Design

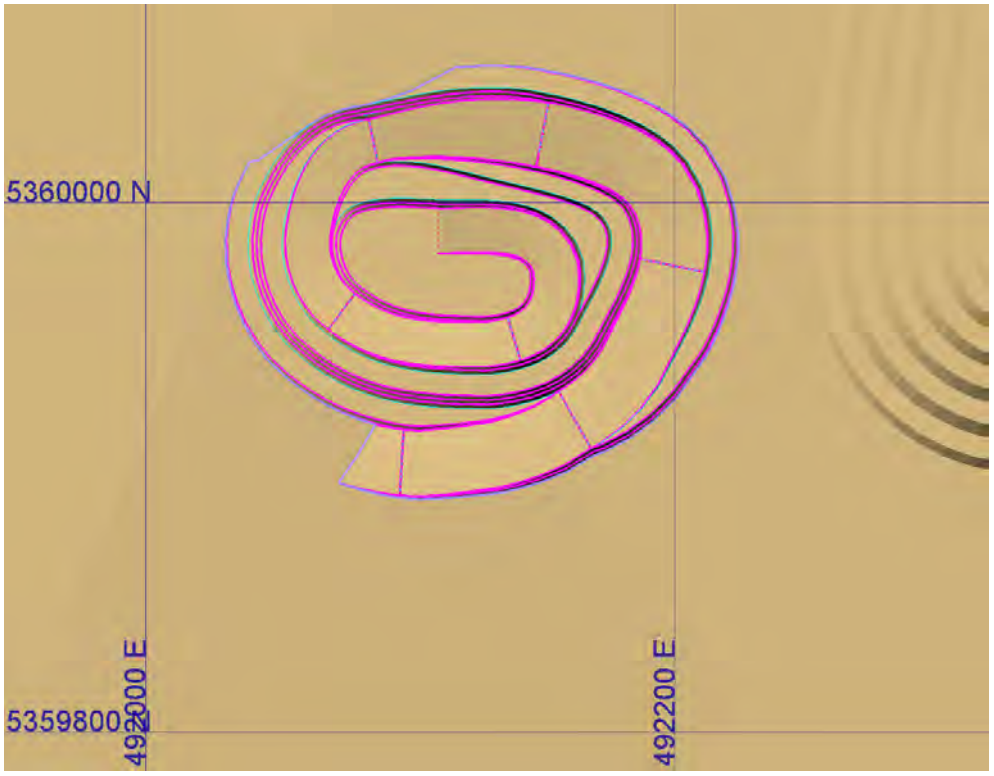


Figure 16.14 Marathon Phase 6 Pit Design

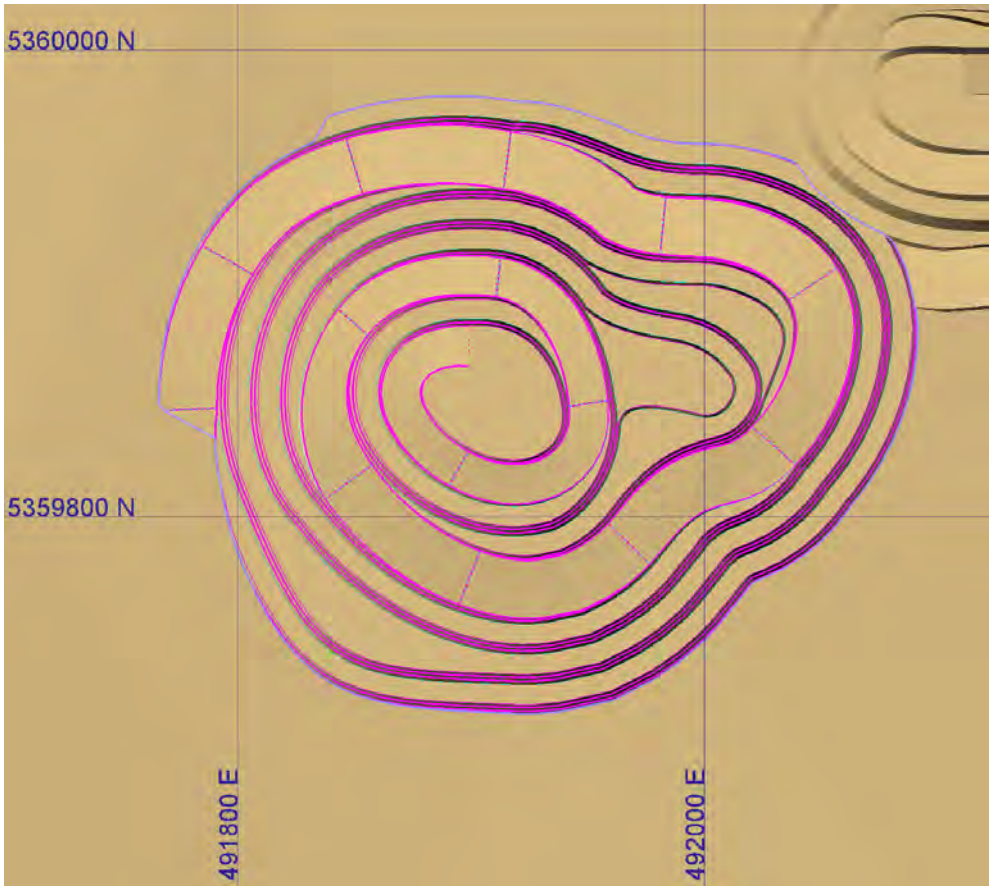
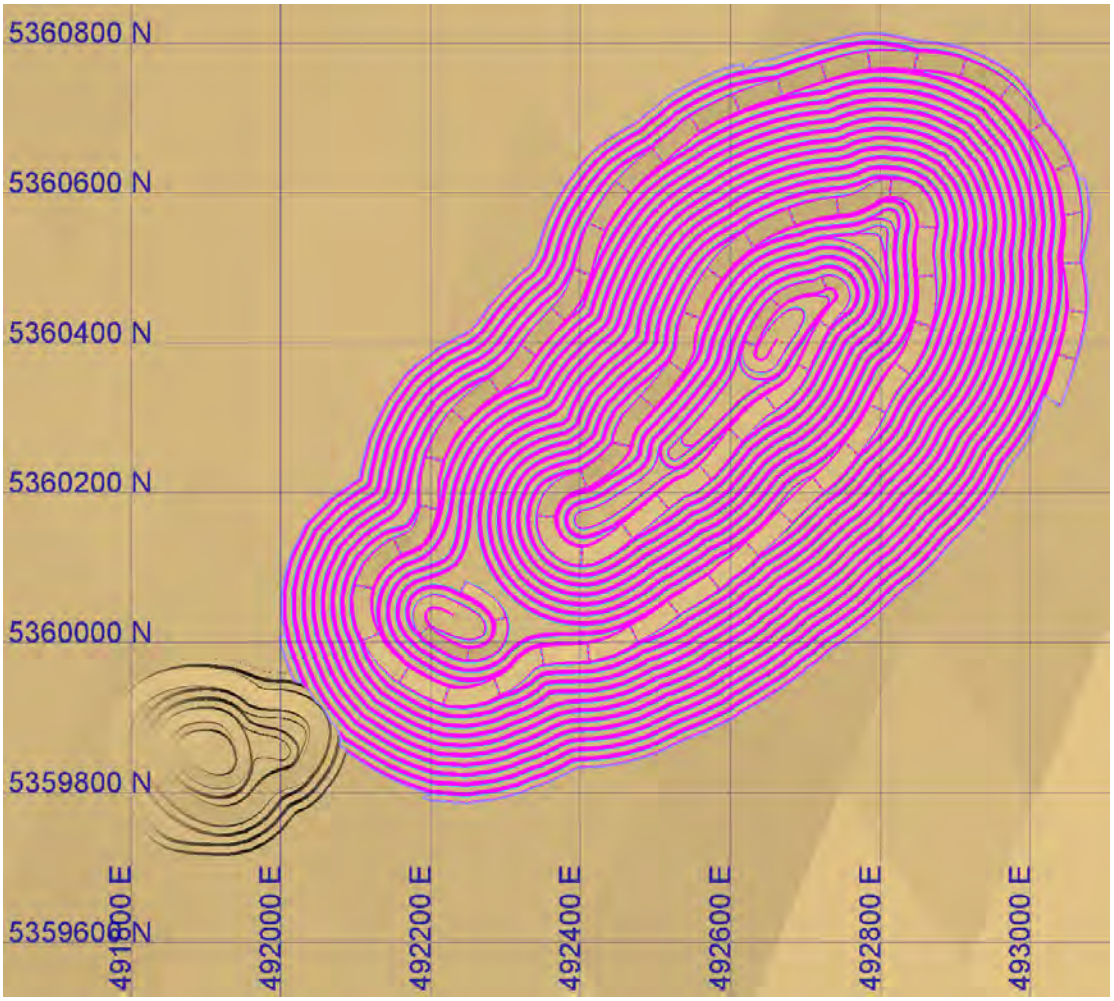


Figure 16.15 Marathon Phase 7 Pit Design



Victory Phased Pit Designs

The Victory pit consists of four phases. Phases 1 and 2 are starter pits, while Phase 3 expands these initial phases. Phase 4 is the final pit expansion for Victory.

Table 16.6 describes the in-pit mineral resources for each of the Victory phases while Figures 16.16 through 16.19 show the individual phase layouts.

Table 16.6 Victory In-Pit Phased Mineral Resources

Phase	Category	Millfeed				Heap Leach				Total		
		Cut-off (g/t)	Tonnes (t)	Grade (g/t)	Gold (troy ozs)	Cut-off (g/t)	Tonnes (t)	Grade (g/t)	Gold (troy ozs)	Tonnes (t)	Grade (g/t)	Gold (troy ozs)
1	Measured	0.700	0	0.000	0	0.292	0	0.000	0	0	0.000	0
1	Indicated	0.700	514,000	2.016	33,300	0.292	440,000	0.458	6,500	954,000	1.298	39,800
1	***M+I***	***0.700***	***514,000***	***2.016***	***33,300***	***0.292***	***440,000***	***0.458***	***6,500***	***954,000***	***1.298***	***39,800***
1	Inferred	0.700	312,000	1.649	16,500	0.292	385,000	0.456	5,600	697,000	0.990	22,100
1	Waste									8,564,000		
1	Total Tonnes									10,215,000		
1	Stripping Ratio									5.19		
2	Measured	0.700	0	0.000	0	0.292	0	0.000	0	0	0.000	0
2	Indicated	0.700	0	0.000	0	0.292	0	0.000	0	0	0.000	0
2	***M+I***	***0.700***	***0***	***0.000***	***0***	***0.292***	***0***	***0.000***	***0***	***0***	***0.000***	***0***
2	Inferred	0.700	30,000	1.651	1,600	0.292	10,000	0.518	200	40,000	1.368	1,800
2	Waste									496,000		
2	Total Tonnes									536,000		
2	Stripping Ratio									12.40		
3	Measured	0.700	0	0.000	0	0.292	0	0.000	0	0	0.000	0
3	Indicated	0.700	4,000	1.476	200	0.292	9,000	0.413	100	13,000	0.740	300
3	***M+I***	***0.700***	***4,000***	***1.476***	***200***	***0.292***	***9,000***	***0.413***	***100***	***13,000***	***0.740***	***300***
3	Inferred	0.700	70,000	1.852	4,200	0.292	70,000	0.423	1,000	140,000	1.137	5,200
3	Waste									2,019,000		
3	Total Tonnes									2,172,000		
3	Stripping Ratio									13.20		
4	Measured	0.700	0	0.000	0	0.292	0	0.000	0	0	0.000	0
4	Indicated	0.700	37,000	3.375	4,000	0.292	19,000	0.498	300	56,000	2.399	4,300
4	***M+I***	***0.700***	***37,000***	***3.375***	***4,000***	***0.292***	***19,000***	***0.498***	***300***	***56,000***	***2.399***	***4,300***
4	Inferred	0.700	404,000	1.670	21,700	0.292	394,000	0.477	6,000	798,000	1.081	27,700
4	Waste									8,661,000		
4	Total Tonnes									9,515,000		
4	Stripping Ratio									10.14		
All	Measured	0.700	0	0.000	0	0.292	0	0.000	0	0	0.000	0
All	Indicated	0.700	555,000	2.103	37,500	0.292	468,000	0.459	6,900	1,023,000	1.351	44,400
All	***M+I***	***0.700***	***555,000***	***2.103***	***37,500***	***0.292***	***468,000***	***0.459***	***6,900***	***1,023,000***	***1.351***	***44,400***
All	Inferred	0.700	816,000	1.677	44,000	0.292	859,000	0.464	12,800	1,675,000	1.055	56,800
All	Waste									19,740,000		
All	Total Tonnes									22,438,000		
All	Stripping Ratio									7.32		

1. The effective date for this mineral resource estimate is 4 October 2018 and is reported on a 100% ownership basis. This estimate is a reblocking to a fixed block size of the undiluted mineral resource estimate presented in chapter 14 of this document.

2. **Mineral Resources are calculated at a gold price of $1,250 /troy ounce.**
3. **The mineral resources presented above are global and do not include a detailed pit or underground design, only a designed economic pit shell was used to determine the in-pit mineral resources.**
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 fixed block size of 6 m x 6 m x 6 m from a reblocking of the original mineral resource estimate. All mineral resources are reported using an open-pit gold cut-off of 0.292 g/t Au. Material between a 0.292 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.**
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.**

Figure 16.16 Victory Phase 1 Pit Design

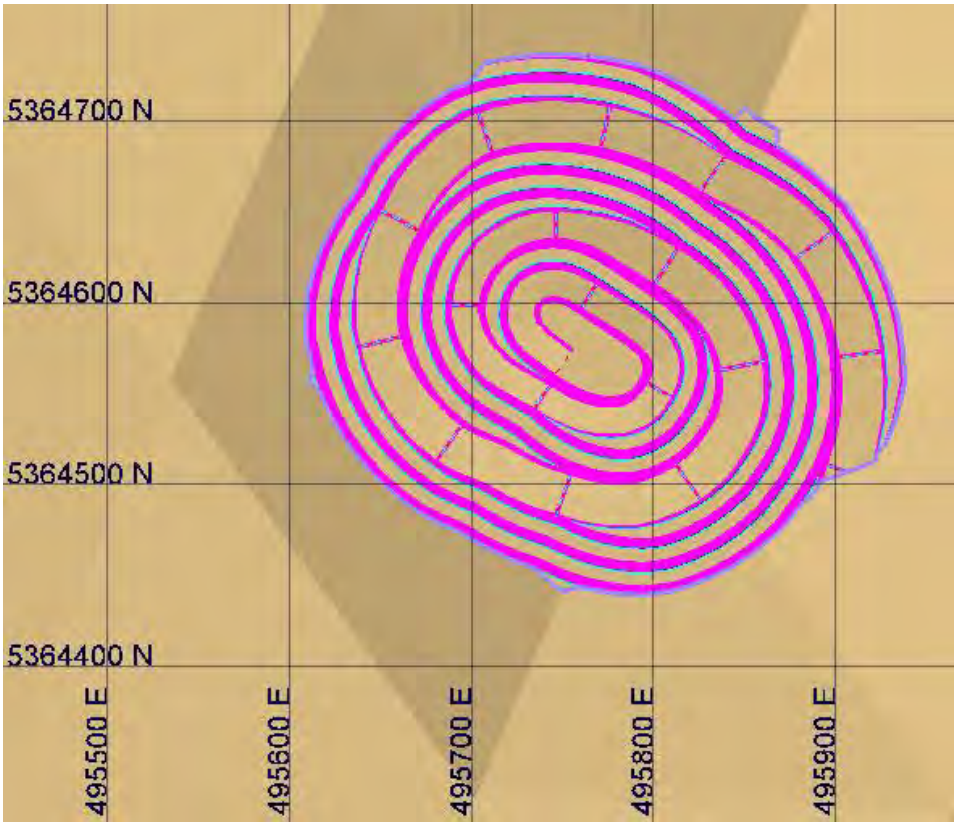


Figure 16.17 Victory Phase 2 Pit Design

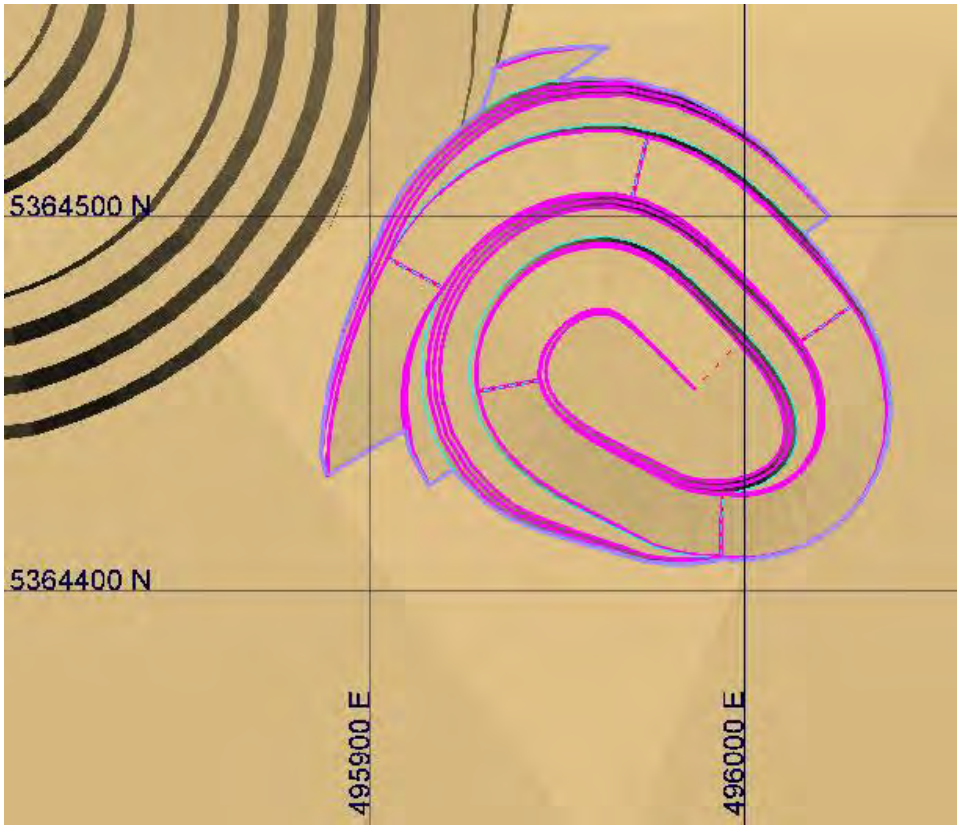


Figure 16.18 Victory Phase 3 Pit Design

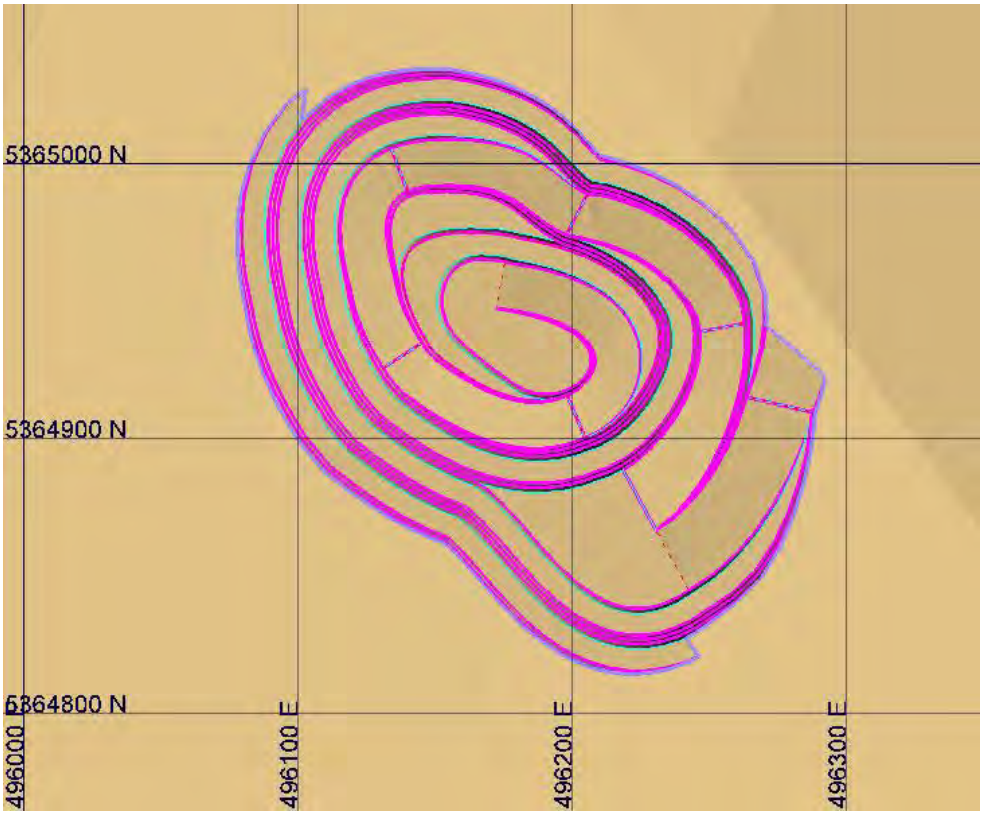
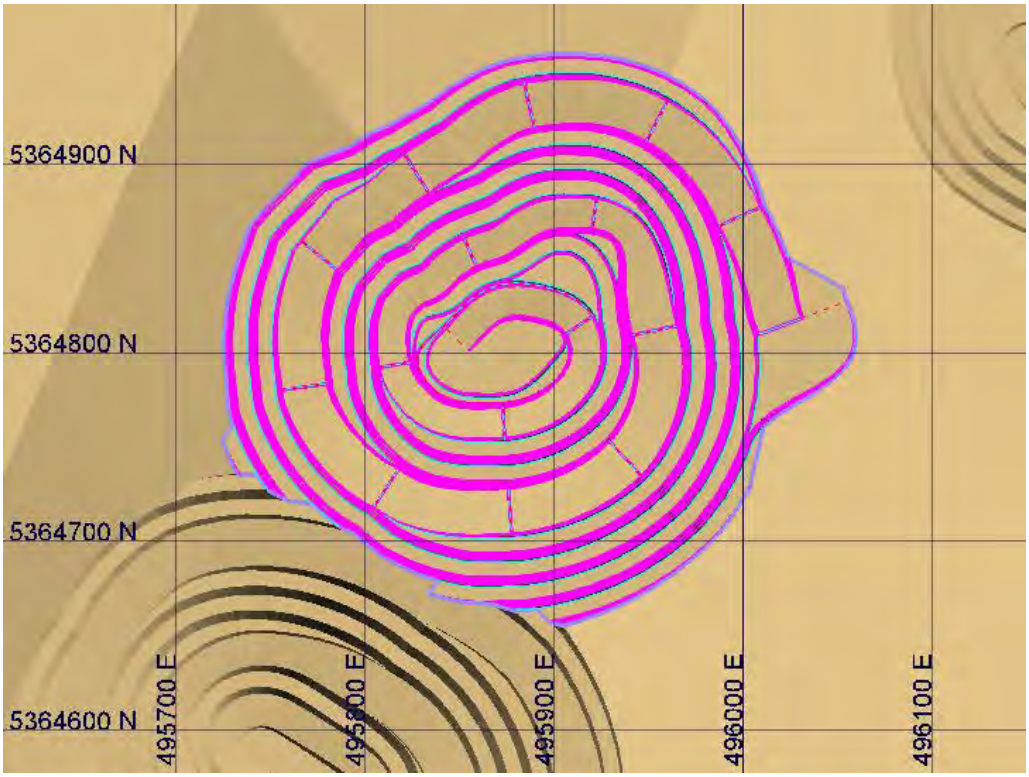


Figure 16.19 Victory Phase 4 Pit Design



16.1.6 Waste Storage Areas

Three waste storage areas are envisioned for the project. The Leprechaun waste storage area is located directly north of the Leprechaun pit. Waste rock produced within the Leprechaun pit would be stored in this area. The Leprechaun Waste storage area is shown below in Figure 16.20. The second waste storage area is located just north of the Marathon pit. Waste removed from the Marathon pit would be stored in this area. The Marathon waste storage area is shown in Figure 16.21 below. The third waste storage area is located north of the Victory pits. Waste removed from the Victory pits will be stored in this area. The Victory waste storage area is shown below in Figure 16.22.

Figure 16.20 Leprechaun Waste Storage Area

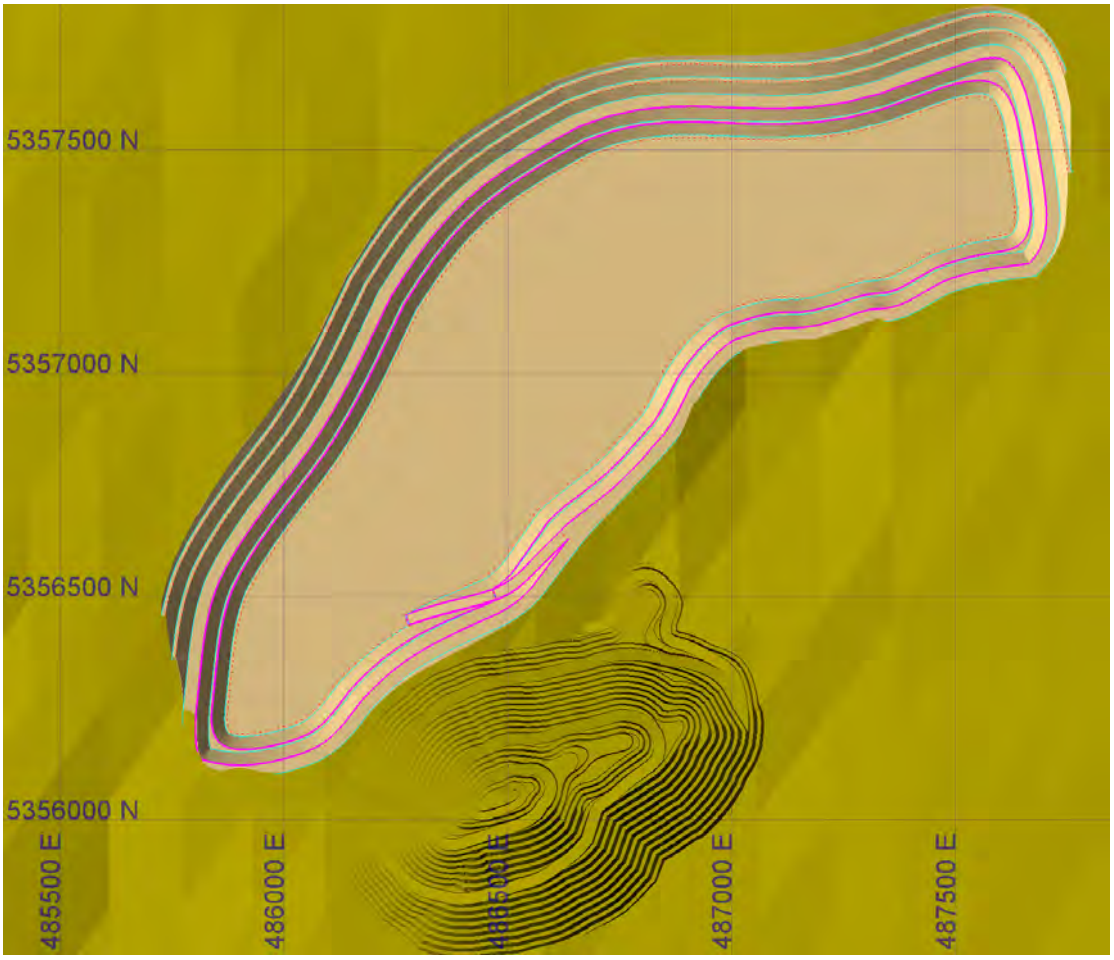


Figure 16.21 Marathon Waste Storage Area

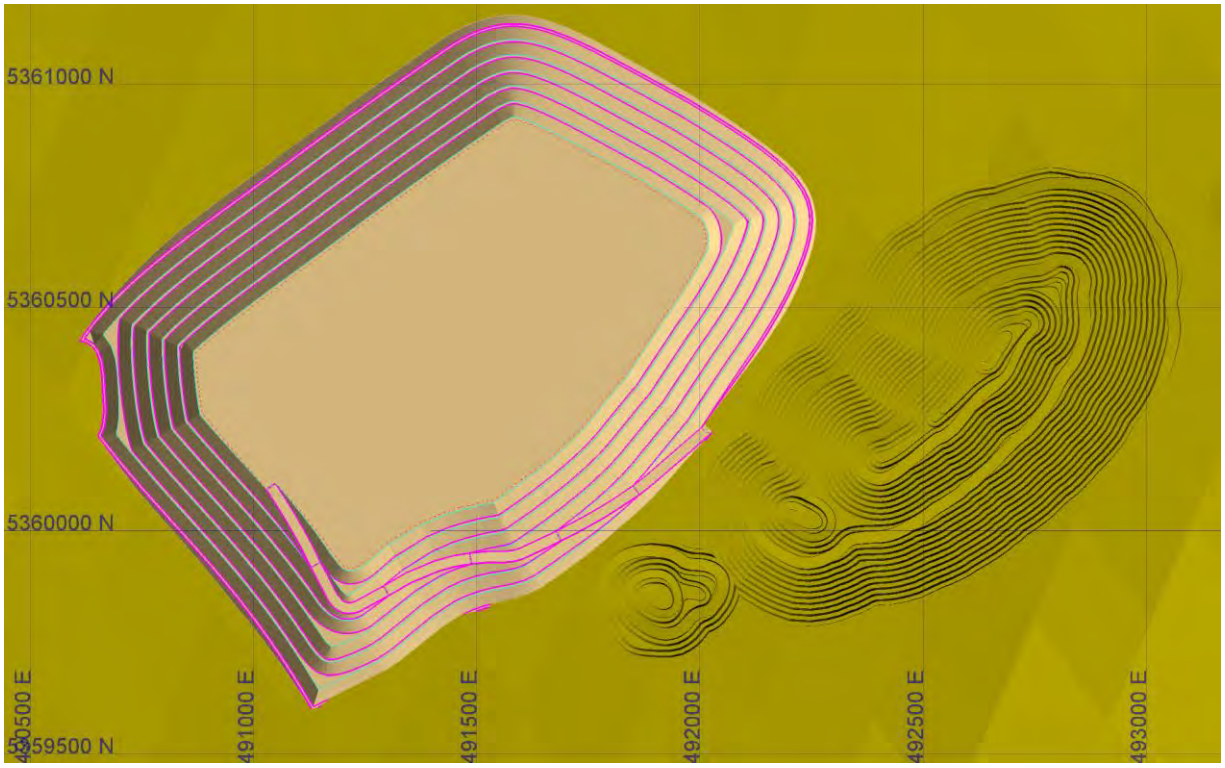
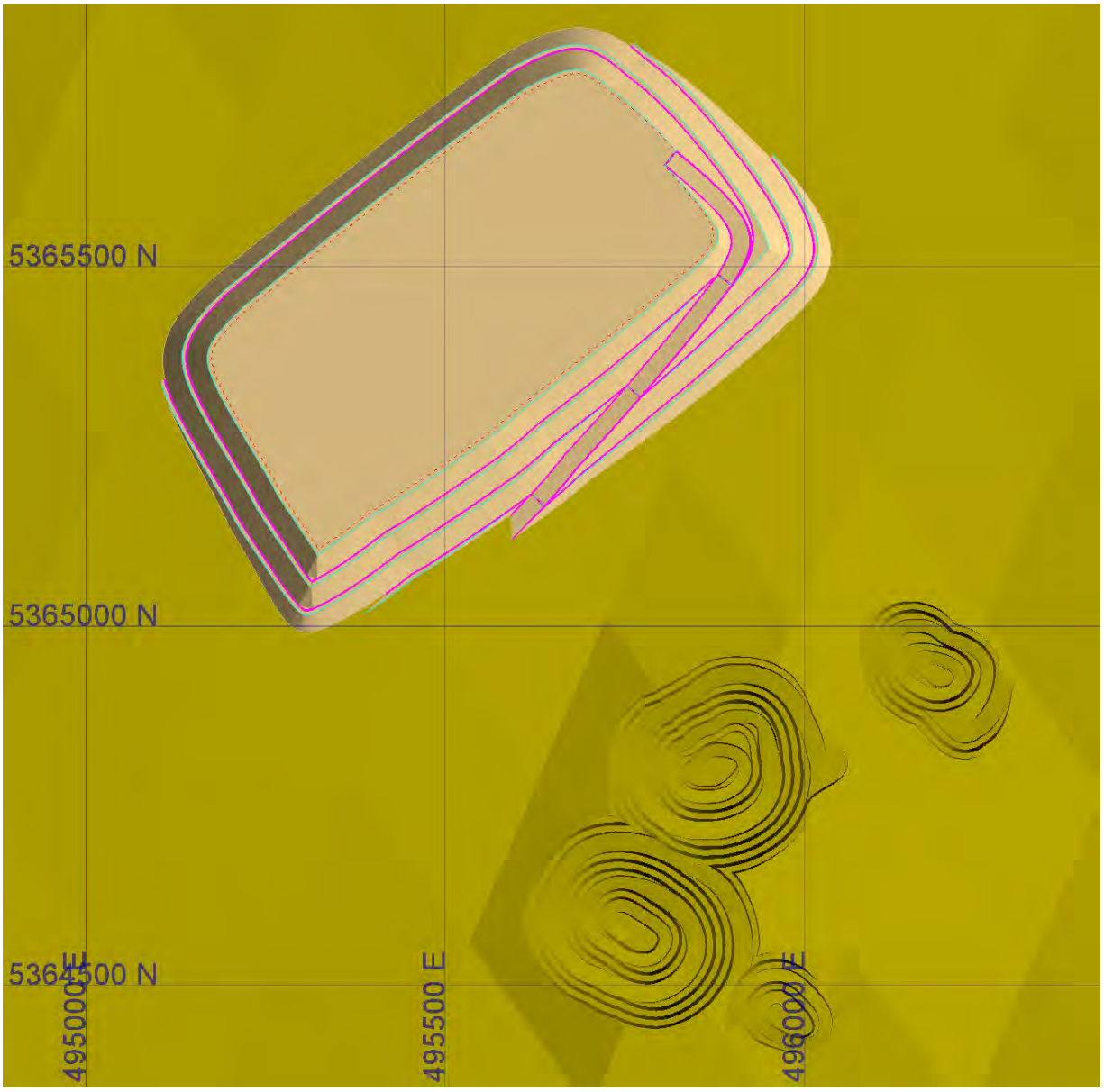


Figure 16.22 Victory Waste Storage Area



16.2 Mine Production Schedule

A life-of-mine production schedule was prepared using Maptek's Chronos scheduling software. Material selection was based on economic cut-offs described in Table 16.2 above. The production schedule assumes a short pre-production period as well as a reduced mill feed requirement during the first full year of production. Lower-grade mill feed and heap leach material is stockpiled to improve processing feed grades during the early years of the project.

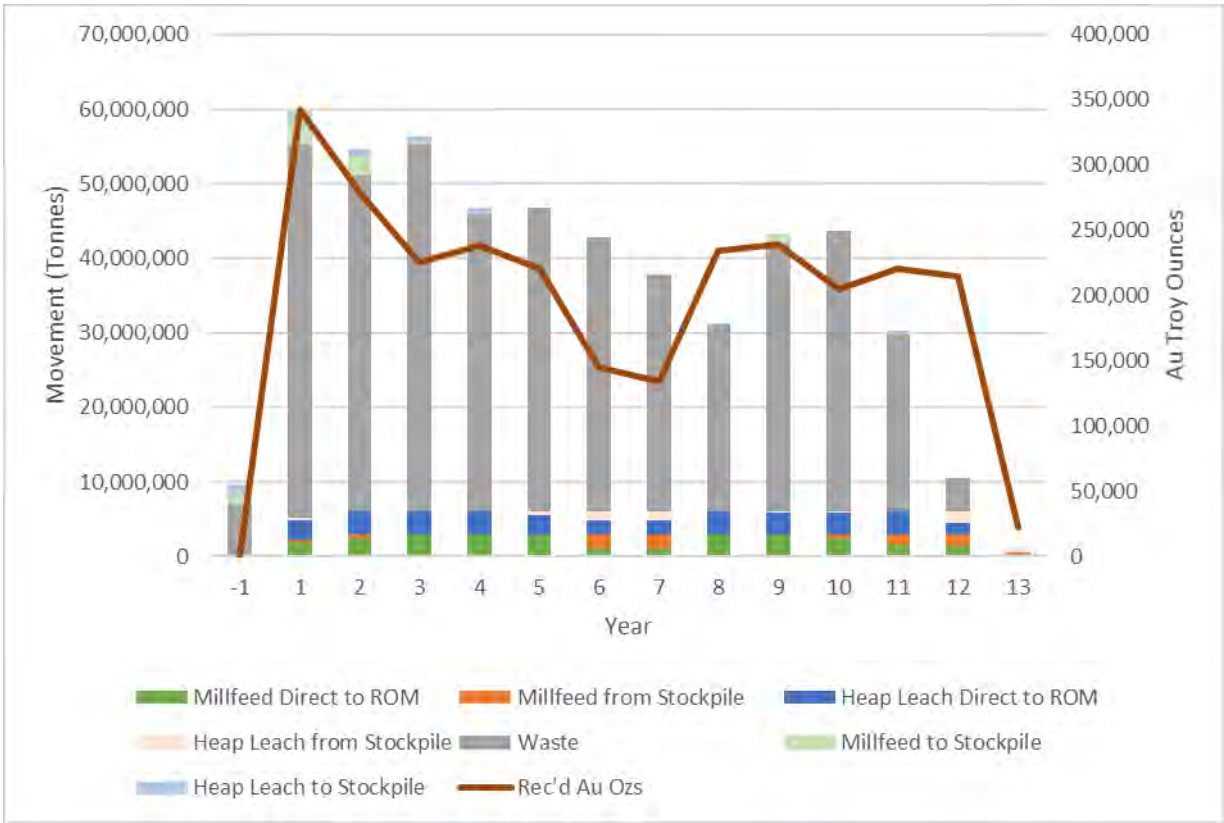
In determining haulage truck requirements, the Maptek Vulcan Haulage Profile software was used to analyze cycle times and haulage distances. This information was used to estimate the haul truck fleet size over the life of the mine.

Additionally, the production schedule was constrained to reduce large swings in required truck hours and total material movement. The detailed production schedule is presented in Table 16.7 and Figure 16.23.

Table 16.7 Valentine Lake Project Production Schedule

Period	-1	1	2	3	4	5	6	7	8	9	10	11	12	13	Totals
Material Movement															
Millfeed Direct to ROM Area	0	1,950,000	2,442,000	3,000,000	3,000,000	3,000,000	1,129,000	1,142,000	3,000,000	3,000,000	2,439,000	1,561,000	1,359,000	0	*27,022,000*
Millfeed From Millfeed Stockpile to ROM Area	0	300,000	558,000	0	0	0	1,871,000	1,858,000	0	0	561,000	1,439,000	1,641,000	508,000	*8,736,000*
Millfeed to Millfeed Stockpile	1,580,000	2,993,000	2,456,000	206,000	0	0	0	0	0	1,501,000	0	0	0	0	*8,736,000*
Heap Leach Direct to ROM Area	0	2,566,000	3,000,000	3,000,000	3,000,000	2,461,000	1,813,000	1,801,000	3,000,000	2,909,000	2,802,000	3,000,000	1,510,000	0	*30,862,000*
Heap Leach From Heap Leach Stockpile to ROM Area	0	434,000	0	0	0	539,000	1,187,000	1,199,000	0	91,000	198,000	0	1,490,000	820,000	*5,958,000*
Heap Leach to Heap Leach Stockpile	1,159,000	1,434,000	1,000,000	995,000	757,000	0	0	0	79,000	0	0	534,000	0	0	*5,958,000*
Waste Tonnes	7,000,000	50,000,000	45,159,000	49,265,000	40,000,000	40,808,000	36,793,000	31,893,000	25,137,000	35,934,000	37,672,000	23,810,000	4,582,000	0	*428,053,000*
Total Material Movement	9,739,000	59,677,000	54,615,000	56,466,000	46,757,000	46,808,000	42,793,000	37,893,000	31,216,000	43,435,000	43,672,000	30,344,000	10,582,000	1,328,000	*515,325,000*
Tonnes Per Day	27,053	165,769	151,708	156,850	129,881	130,022	118,869	105,258	86,711	120,653	121,311	84,289	29,394	3,689	-
Millfeed															
Tonnes	0	2,250,000	3,000,000	3,000,000	3,000,000	3,000,000	3,000,000	3,000,000	3,000,000	3,000,000	3,000,000	3,000,000	3,000,000	508,000	*35,758,000*
Gold Grade (g/t)	0.000	4.554	2.709	2.124	2.256	2.132	1.329	1.213	2.276	2.328	1.929	2.036	2.037	1.042	*2.178*
Recovery	0.00%	95.40%	94.88%	94.53%	94.37%	94.85%	94.75%	94.72%	95.04%	95.05%	94.61%	94.07%	94.19%	94.66%	*94.69%*
Recovered Au (t.ozs)	0	314,800	248,200	194,000	205,600	195,500	121,700	111,000	209,700	213,900	176,400	184,800	185,100	16,100	*2,376,800*
Heap Leach															
Tonnes	0	3,000,000	3,000,000	3,000,000	3,000,000	3,000,000	3,000,000	3,000,000	3,000,000	3,000,000	3,000,000	3,000,000	3,000,000	820,000	*36,820,000*
Gold Grade (g/t)	0.000	0.520	0.542	0.543	0.553	0.468	0.430	0.431	0.462	0.471	0.498	0.565	0.500	0.411	*0.497*
Recovery	0.00%	55.72%	59.16%	61.17%	61.52%	56.38%	55.91%	55.94%	55.09%	56.26%	60.20%	65.09%	62.09%	58.85%	*58.71%*
Recovered Au (t.ozs)	0	27,900	30,900	32,000	32,800	25,500	23,200	23,300	24,600	25,600	28,900	35,500	29,900	6,400	*346,500*
Total Processed															
Tonnes	0	5,250,000	6,000,000	6,000,000	6,000,000	6,000,000	6,000,000	6,000,000	6,000,000	6,000,000	6,000,000	6,000,000	6,000,000	1,328,000	*72,578,000*
Gold Grade (g/t)	0.000	2.249	1.625	1.333	1.404	1.300	0.880	0.822	1.369	1.400	1.213	1.301	1.269	0.653	*1.325*
Recovered Au (t.ozs)	0	342,700	279,100	226,000	238,400	221,000	144,900	134,300	234,300	239,500	205,300	220,300	215,000	22,500	*2,723,300*
Total Waste Tonnes	7,000,000	50,000,000	45,159,000	49,265,000	40,000,000	40,808,000	36,793,000	31,893,000	25,137,000	35,934,000	37,672,000	23,810,000	4,582,000	0	*428,053,000*
To Stockpiles	2,739,000	4,427,000	3,456,000	1,201,000	757,000	0	0	0	79,000	1,501,000	0	534,000	0	0	*14,694,000*
From Stockpiles	0	734,000	558,000	0	0	539,000	3,058,000	3,057,000	0	91,000	759,000	1,439,000	3,131,000	1,328,000	*14,694,000*
Total Material Tonnes	9,739,000	59,677,000	54,615,000	56,466,000	46,757,000	46,808,000	42,793,000	37,893,000	31,216,000	43,435,000	43,672,000	30,344,000	10,582,000	1,328,000	*515,325,000*
Stripping Ratio (Mined Waste/Mined Mill + Mined Heap)	2.56	5.59	5.07	6.84	5.92	7.47	12.50	10.84	4.14	4.85	7.19	4.67	1.60	-	*5.90*

Figure 16.23 Valentine Lake Production Schedule



16.2.1 Operating and Labour Assumptions

The proposed open pit will operate 24 hrs a day, seven days a week on a 12-hr shift basis. Material and waste will be extracted on all shifts. Blasting operations will be conducted on day shifts only. Productivity estimates are based on an assumed mechanical availability of 85 to 90% (90% for haul trucks, 85% for everything else), and a 90% utilization (for trucks and loaders) of available hours varied to reflect seasonal usage of equipment where appropriate.

A standard day-shift blasting crew will be required while four rotating labour crews will be scheduled to operate production equipment.

Mine capital and operating costs were estimated from vendor quotes or from similar sized operations in north-eastern Canada. Fuel costs were received from a local supplier, quoted at $0.943 /L, and powder is estimated to cost $0.77 /kg.

16.2.2 Preproduction Mining Operations

During the first year of mining operations, prior to the plant start-up, approximately 3,780,000 t of waste rock is required for construction of the mill and heap leach facilities. During this initial development, some mill feed and heap leach material will be mined and stockpiled as required. A total of 7,000,000 t of waste material rock,

1,580,000 t of millfeed material, and 1,159,000 t of heap leach material will be mined during the preproduction period. At the conclusion of the preproduction period, enough exposed mill feed and heap leach material as well as stockpiled material will be available to sustain processing operations.

16.3 Mine Equipment Selection

The Valentine Lake project will be developed using standard open-pit technology, scaled appropriately for the size of the operation. All mobile mining equipment is assumed to be owner-operated under a maintenance and repair contract (MARC). The required mining equipment is shown below in Table 16.8.

Table 16.8 Required Mining Equipment for the Valentine Lake Project

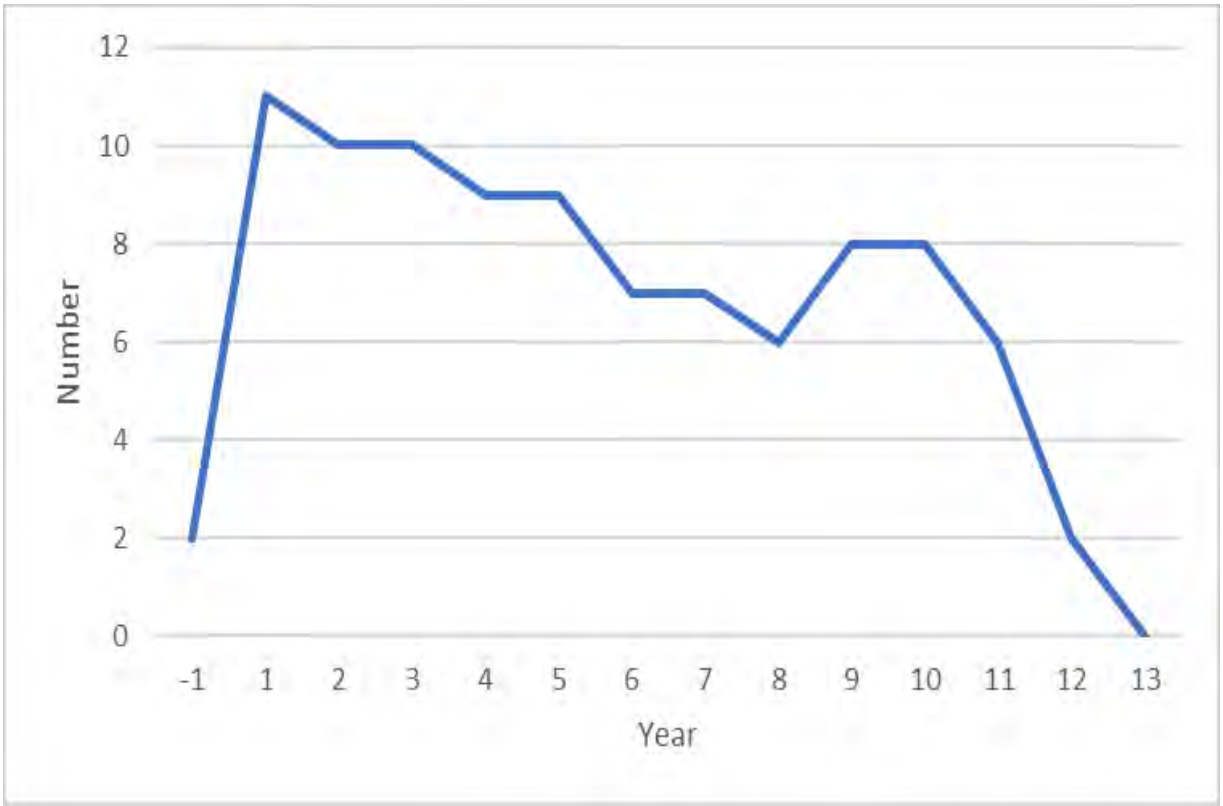
Description	Manufacture and Model	Units Required	Capital
Haul Truck	Cat 777G	37	$62,234,000
Wheel Loader	Cat 993K	6	$16,128,000
Production Drill	Epiroc Smartroc D65	11	$15,213,000
Wheel Dozer	Cat 834K	2	$4,831,000
Tracked Dozer	Cat D10T2	3	$5,358,000
Tracked Dozer	Cat D8T	2	$1,978,000
Motor Grader	Cat 16M	4	$5,308,000
Water Truck	Cat 777G	4	$6,728,000
Support Excavator	Cat 336D2	1	$444,000
Skidsteer Loader	Cat 242B	2	$132,000
Hydraulic Rock Breaker	-	1	$112,000
Fuel/Lube Truck	-	3	$1,503,000
Mechanics Truck	-	2	$588,000
Welding Truck	-	1	$282,000
Crane (25 t)	-	1	$165,000
Pick Up Trucks	-	8	$416,000
Crew Vans	-	4	$252,000
Tractor/Trailer with 50 t Lowboy	-	1	$396,000
Portable Light Towers	-	12	$204,000
Mine Planning/Surveying Equipment	-	1	$550,000
Total Mine Capital	**-**	**-**	**122,822,000**

16.3.1 Drilling and Blasting

Drilling demands will be met with up to 11 Epiroc Smartroc DM65 production drills. Explosive quantities are based on a 152 mm blasthole diameter and bench height of 6 m. Drill spacing is dependent on the assumed material properties. Burden and spacing is assumed to be 3.6 m x 4.2 m. Sub-drilling is estimated at 0.9 m with stemming columns of approximately 3.9 m. Productivity estimations are based on a mechanical availability of

85%, a utilization rate of 85%, an assumed re-drill rate of 5%, and an average set-up and move time of 4.15 mins per hole. The required number of production drills by period is shown below in Figure 16.24.

Figure 16.24 Production Drills Required by Period



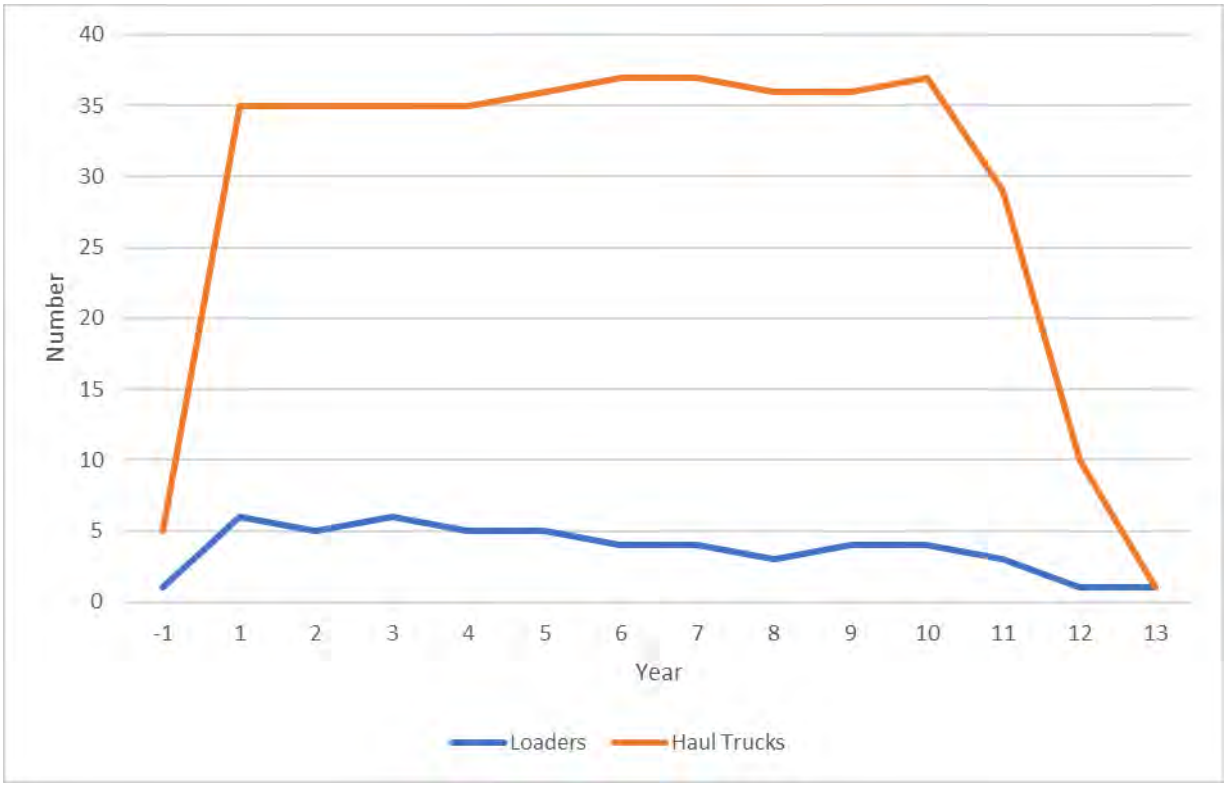
A powder factor of 0.25 kg/t was used to determine explosive requirements. Unit costs for explosives are based on similar sized projects in north-eastern Canada. Bulk explosives are assumed to be managed by an explosive's contractor and a cost for leasing explosive storage facilities, as well as required ANFO trucks, are included at a monthly charge. Actual loading and firing of the blasts will be handled by Marathon employees.

Grade control will be overseen by the mine geologist. Material control samplers are included as part of the Mine G&A costs. Samples collected are assumed to be delivered to an on-site laboratory for assaying. A cost of $10.00 /sample is included in the drill and blasting costs to cover sample assaying.

16.3.2 Loading and Hauling

A fleet of up to six Cat 993K wheel loaders and up to 37 Cat 777G haul trucks will be required. Millfeed, heap leach, and waste materials are assumed to be mined around the clock. Loading and hauling requirements include rehandle in addition to normal millfeed, heap leach, and waste operations. The required loaders and trucks by period are shown below in Figure 16.25.

Figure 16.25 Loaders and Haul Trucks Required by Period (Including Rehandle)



Trucking requirements were estimated using Maptek's Vulcan Haulage Profile software tools. Using performance data provided by the manufacturer, mechanical availability of 90% and utilization of 90% were used. The Haulage Profile program generates highly detailed cycle time estimates for a given haulage profile, taking into full account anticipated acceleration and deceleration, as well as any user-applied speed limits based on safety considerations. This program outputs the results for each block contained within the block model. Data calculated and stored include the total block productivity time (time required to excavate and move the block to its final destination) in minutes, total cycle time in minutes, and total one-way haul in meters. The block data are used later during schedule optimization as a constraint to level out haulage equipment requirements.

16.3.3 Support Equipment

An auxiliary fleet of dozers, graders, water trucks, and other support equipment will be required. Three Cat D10T2 track dozers will be staged on each waste disposal area. Two Cat 834K wheel dozers and two Cat D8T track dozer will support loading operations. Several Cat 16M motor graders will maintain haul roads in and out of the pit. A $0.10 /all material tonne has been allocated for water handling in the pits.

16.3.4 Labour Requirements

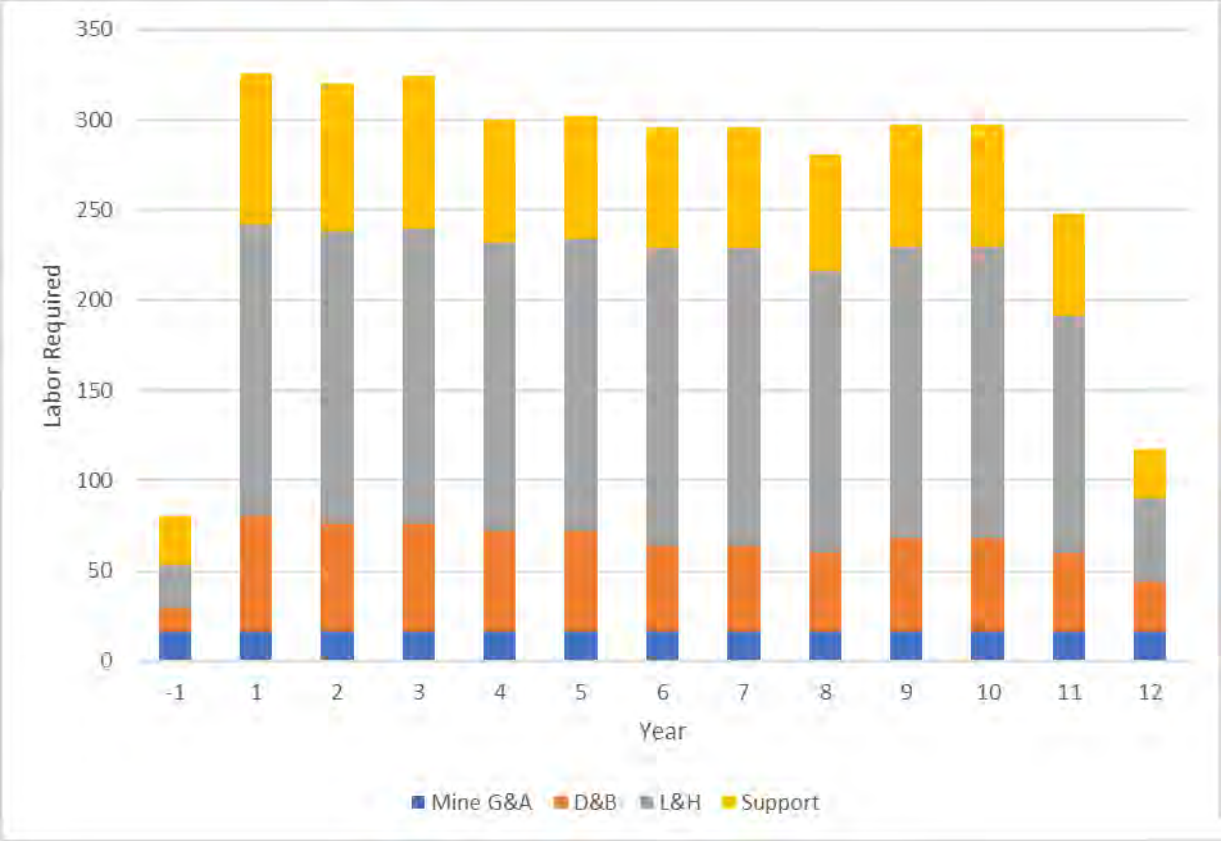
Total estimated labour requirements for the mine are shown below in Table 16.9 and Figure 16.26. Total mine labour ranges from a minimum of 80 during the pre-production period to a maximum of 326 during Year 1 of

the project's operation. Following Years 1 and 2 (326 and 320 employees respectively), total mine employment remains around 300 during active mine operations.

Table 16.9 Valentine Lake PEA Mine Labour Requirements by Period

Description\Period	-1	1	2	3	4	5	6	7	8	9	10	11	12
Mine G&A													
Manager Superintendent	1	1	1	1	1	1	1	1	1	1	1	1	1
Shift Foreman	4	4	4	4	4	4	4	4	4	4	4	4	4
Technical Services Manager	1	1	1	1	1	1	1	1	1	1	1	1	1
Chief Mine Engineer	1	1	1	1	1	1	1	1	1	1	1	1	1
Chief Geologist	1	1	1	1	1	1	1	1	1	1	1	1	1
Mine Engineer	1	1	1	1	1	1	1	1	1	1	1	1	1
Geologist	1	1	1	1	1	1	1	1	1	1	1	1	1
Surveyor	1	1	1	1	1	1	1	1	1	1	1	1	1
Surveyor Helper	1	1	1	1	1	1	1	1	1	1	1	1	1
Mine Technician	2	2	2	2	2	2	2	2	2	2	2	2	2
Material Control	2	2	2	2	2	2	2	2	2	2	2	2	2
Total Mine G&A	*16*	*16*	*16*	*16*	*16*	*16*	*16*	*16*	*16*	*16*	*16*	*16*	*16*
Drill and Blast													
Drillers	8	44	40	40	36	36	28	28	24	32	32	24	8
Lead Blaster	1	4	4	4	4	4	4	4	4	4	4	4	4
Blasting Crew	4	16	16	16	16	16	16	16	16	16	16	16	16
Total D&B	*13*	*64*	*60*	*60*	*56*	*56*	*48*	*48*	*44*	*52*	*52*	*44*	*28*
Loading and Haulage													
Loader Operators	4	25	21	24	20	21	18	18	12	17	17	13	6
Truck Drivers	20	137	141	140	140	141	147	147	144	145	145	118	40
Total L&H	*24*	*162*	*162*	*164*	*160*	*162*	*165*	*165*	*156*	*162*	*162*	*131*	*46*
Support													
Support Operators	27	84	82	84	68	68	67	67	65	67	67	57	27
Total All Labor	**80**	**326**	**320**	**324**	**300**	**302**	**296**	**296**	**281**	**297**	**297**	**248**	**117**

Figure 16.26 Valentine Lake Labour Requirements by Area and Period



17.0 RECOVERY METHODS

17.1 Overall Process Design

The process plant design is based on a robust metallurgical flowsheet developed for optimum recovery while minimizing initial capital expenditure and operating costs. The flowsheet is based on unit operations well proven in the industry.

The Project consists of two gold process plants, i.e. Heap Leach and Mill operations. Both plant designs are based on a 13-year mine life.

The Mill will process 3.0 Mtpa of high-grade material from open pit mines. The Mill will consist of crushing, milling, gravity recovery, flotation of gravity tails, flotation concentrate regrind, cyanidation of both flotation concentrate and flotation tailings via a CIL circuit, carbon elution and gold recovery circuit. CIL tails will be treated for cyanide destruction and disposed of as tails in the TSF. The Heap Leach plant will process 3.0 Mtpa of low-grade material from open pit mines and will consist of crushing, heap leaching and CIC gold adsorption. The loaded carbon from this heap leach facility will be sent in carbon transport vessels to the milling facility for further processing in the elution circuit.

The key project design criteria for the plants are:

- Nominal throughput of 9,000 t of material per day for milling facility and 9,000 t of material per day for heap leach facility, equivalent to 6.0 Mtpa.
- Crushing plant availability of 75% for both flotation and heap leach plants.
- Plant availability of 91.3% for heap leach solution circulation, CIC area, grinding, gravity concentration, flotation, and leach plant and gold recovery operations.

An overall process flow diagram depicting the unit operations incorporated in the selected process flowsheet is presented in Figure 17.1, and 3D images of the proposed plants are provided in Figure 17.2.

Figure 17.1 Overall Process Flow Diagram

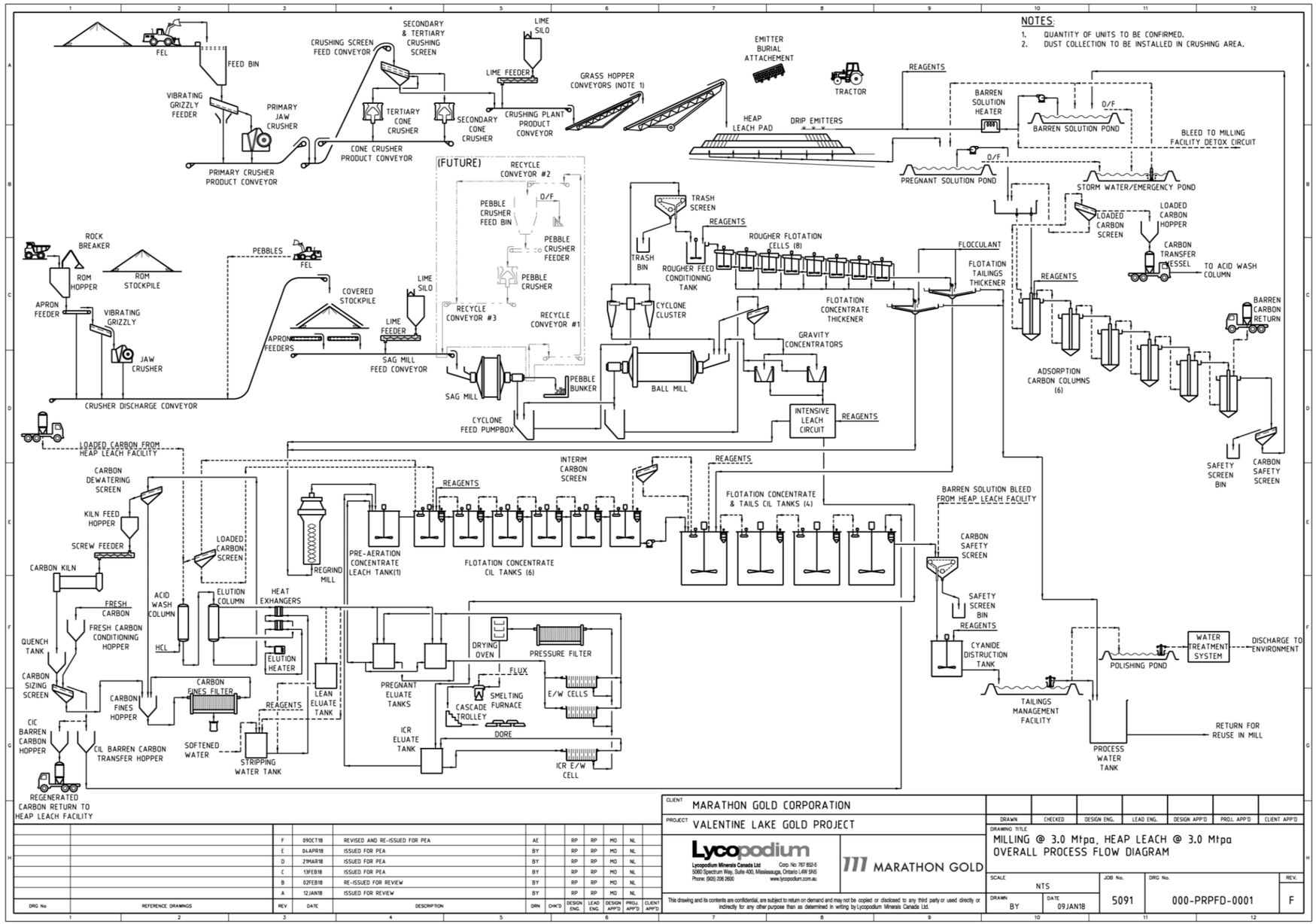


Figure 17.2 3D Image of the Proposed Primary Crushing and Stockpile for the Mill

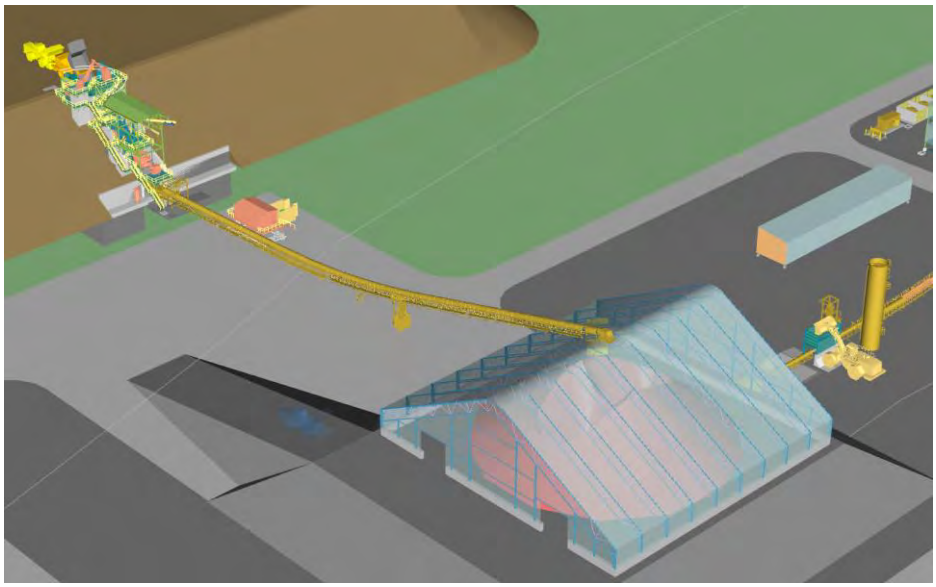


Figure 17.3 3D Image of the Proposed CIC Circuit

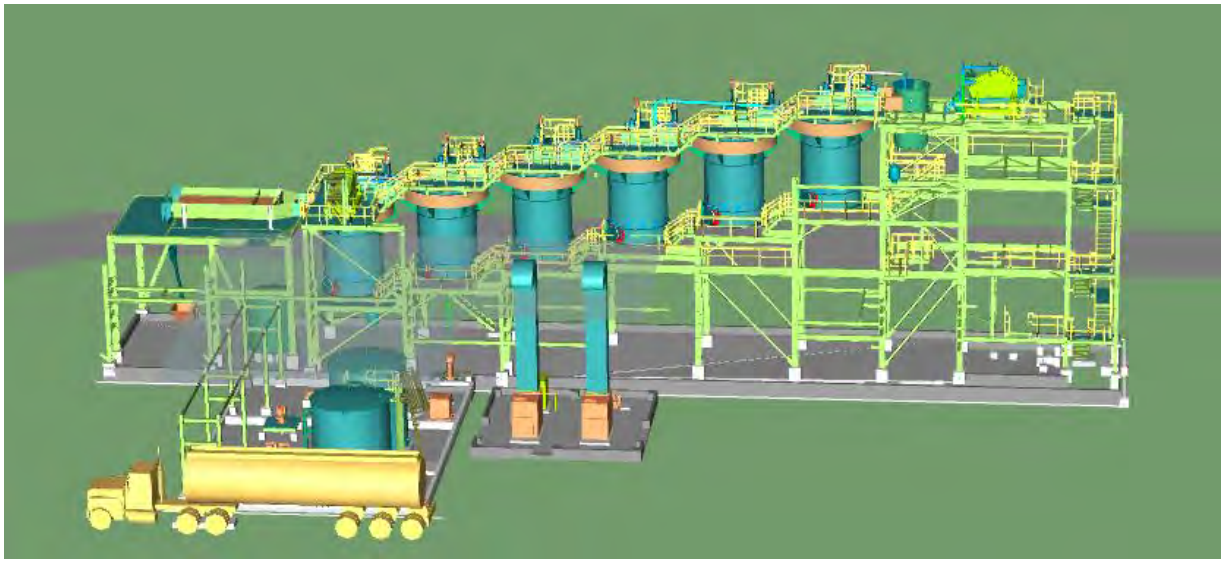
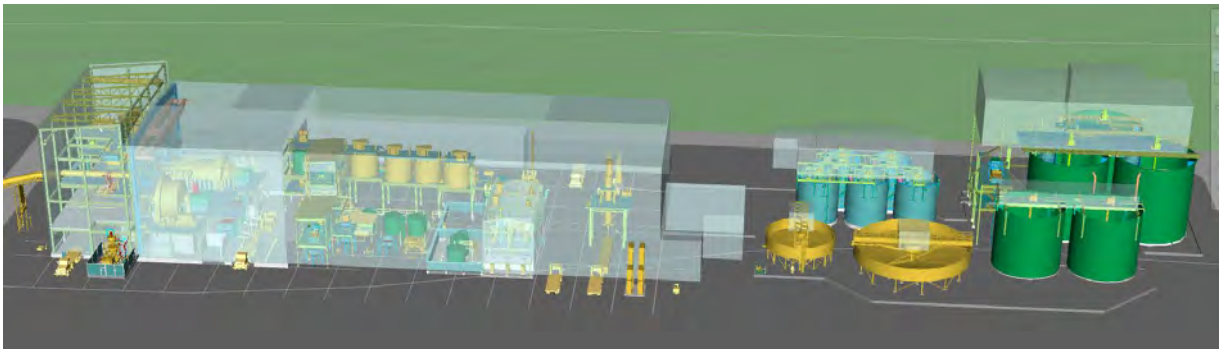


Figure 17.4 3D Image of the Proposed Mill, Flotation and CIL Plant



17.2 Heap Leach Process and Plant Description

The proposed process design is comprised of the following circuits:

- Primary, secondary and tertiary crusher.
- Conveyor, lime addition, transport to the leach pad.
- Heap leach conveying and stacking.
- Barren solution heater, pregnant solution pond, barren solution pond, emergency/storm water pond.
- Adsorption plant (CIC).

17.2.1 Heap Leach Design Criteria

The key process design criteria in heap leach process are listed in Table 17.1.

Table 17.1 Key Heap Leach Process Design Criteria

Parameter	Units	Value
Plant Throughput	tpd	9,000
Gold Head Grade – Range per Mine Plan	g/t Au	0.41 - 0.57
– Blended Average	g/t Au	0.49
– Design	g/t Au	0.57
Silver Head Grade	g/t Au	Trace (negligible)
Crushing Plant Availability	%	75
Leach and CIC Availability	%	91.3
Bond Crusher Work Index (CWi)	kWh/t	15.0
SMC Axb		87.5
Material Specific gravity	tonne/m^3	2.68
Angle of Repose	degrees	35
Material Moisture Content	%	5.0
Primary Crusher		C140 or Equivalent
Secondary Crusher		Metso HP6 or equivalent
Tertiary Crusher		Metso HP800 or equivalent
Secondary and Tertiary Screen		Metso MF4285-2 or equivalent
Feed Size	F100	800
Crushing Plant Product Size	P80	9.0
Crushing Plant Product Size	P100	13.0
Sodium Cyanide Addition	kg NaCN/t material	0.28[1]
Lime Addition	kg/t material	0.51
Estimated total pad area	m^2	887,364
No. of pads	#	1
Lift Height	m	10
No. of Lifts	#	3
Tonnes Carbon per Column	tonnes	2.5
Number Adsorption Column	#	6
Number of Carbon Strip /Day	#	0.25

[1]25% scale-up factor applied to testwork consumption

17.2.2 Crushing Plant

A three-stage crushing circuit has been proposed for the project to reduce the run-of-mine material (ROM) from 800 mm to a P_{80} of 9.0 mm (P_{100} of 13.0 mm). Feed to the crushing plant will be accomplished via a front-end loader dumping into a feed bin. ROM material will be drawn from the feed bin at a controlled rate of 460 t/h via a variable-speed vibrating grizzly feeder to feed the primary jaw crusher. ROM material that is at the primary crusher product size will bypass the jaw crusher to reduce the load and wear on it. Primary crushing product, together with secondary and tertiary crusher products, will be sent to a double deck screen. The oversize material is further crushed by the secondary cone crusher, midsize material is crushed in a tertiary cone crusher, and the undersize material from the screen is considered as the final crushed product which will be transferred onto a conveyor to the heap leach area for material stacking. A weightometer will be placed underneath the crushing plant product conveyor to track and monitor material tonnage being conveyed. The value will also be used to control the speed of the vibrating grizzly feeder and the rate at which lime is added.

The crushing plant will include the following key equipment:

- Feed bin.
- Vibrating grizzly feeder.
- Primary jaw crusher.
- Secondary cone crusher.
- Tertiary cone crusher.
- Secondary and tertiary crushing screen.
- Mill feed apron feeder (VSD).
- Material handling equipment.

17.2.3 Stacking

Crushed material from the crushing plant product conveyors will be discharged into a series of mobile grasshopper conveyors and stacked on the leach pad via a radial stacker. To control pH, pebble quicklime will be added onto the crushing plant product conveyor via a lime feeder suspended from a lime silo. The number of grasshopper conveyors in use will vary based on the distance from the end of conveyor to the exact location of material being stacked.

The stacking will include the following key equipment:

- Material handling equipment.
- Radial stacker.

17.2.4 Heap Leaching

A total of three lifts, each 10 m in height, will be used for heap leaching of the material. The design bulk density for the stacked material is 1.68 kg/m^3. The pad will be constructed to approximately 942 m x 942 m in size. An emergency/storm water pond will be constructed to capture precipitation and run-off from this area based on a 100-year rainfall.

Cyanide solution will be injected directly into the barren solution line discharging from the barren solution pond. The barren solution pump will be housed in a weather enclosure and pipeline will be installed below surface to avoid harsh cold winter weather. This solution will be indirectly heated in a barren solution heater before being applied to the heap leach pad. Anti-scalant will also be added to prevent scaling. The cyanide and anti-scalant bearing solution will be applied onto the leach pad at a rate of 5 L/m^2/h through a piping network consisting of drip irrigation systems. A tractor with an emitter burial attachment will bury the lines below the surface of the crushed material. Based on the preliminary column leach test results, a leach period of 130 days is required for optimal gold recovery. Pregnant solution drains from the leach pad to the Pregnant Solution pond, which in turn will pump the solution to the adsorption plant for further processing. This pregnant solution transfer pump will be housed in a weather enclosure and pipeline will be installed below surface. Barren solution from the adsorption plant will be returned to the barren solution pond via an insulated line. In the case of a rainstorm event, solution overflowing from the pregnant or barren solution pond will be directed to the emergency/storm water pond.

The heap leaching will include the following key equipment:

- Tractor with low ground pressure tracks.
- Emitter burial attachment.
- Barren solution heater.
- Distribution pumps and pipes.

17.2.5 Carbon Adsorption Circuit

The adsorption circuit will consist of a single train of six open, up-flow columns, each with a 2.5 t carbon capacity, and will operate as an expanded bed contactor.

Pregnant solution containing dissolved gold will be pumped from the pregnant solution pond to the carbon columns to remove gold via carbon adsorption. The adsorption circuit will be operated manually on a daily basis to allow counter-current contact with the carbon to achieve the targeted carbon loading. Solution will enter into the bottom of each column via an annular ring at the centre of column and exit from the top. Dart valves will be used to control flow to a column and to bypass the feed to the next column if required. The first column will contain solution with the highest gold concentration and carbon with the highest gold loading. As the solution passes through the next five columns, the gold concentration will drop off, leaving the weakest solution in contact with the freshest carbon (or most recently stripped carbon) in the last column. Solution exiting the last column will pass over the carbon safety screen to capture, and provide a visual check on, any carbon escaping from the columns. The screen underflow will flow to the barren solution pond. This line will be insulated or buried.

Carbon advancement between the columns will be manually controlled by the operator by using carbon advance pumps on each column. Loaded carbon will be transferred from the first column to pass over the loaded carbon screen prior to transport via mobile truck to the acid wash and elution columns at the mill. Subsequently, carbon advancement will progress up the carbon adsorption train from the last column, with regenerated and screened carbon trucked from the mill, added to the last column.

The carbon adsorption circuit will include the following key equipment:

- Six adsorption columns.
- Loaded carbon screen.
- Carbon safety screen.
- Carbon advance pumps.

17.3 Mill Process Plant Description

The proposed process design is comprised of the following circuits:

- Primary crushing of run-of-mine (ROM) material.
- A covered crushed material stock pile to provide buffer capacity ahead of the grinding circuit.
- Grinding circuit: semi-autogenous grinding (SAG) mill with trommel screen, ball mill and cyclones.
- Pebble recycle via FEL reclaim.
- Gravity recovery from ball mill discharge by two semi-batch centrifugal gravity concentrators, followed by intensive cyanidation of the gravity concentrate and electrowinning of the pregnant leach solution in a dedicated cell located in the goldroom.
- Trash screen and rougher flotation.
- Thickening of flotation concentrate and flotation tails prior to leaching.
- Regrind mill for the flotation concentrate.
- Flotation concentrate leach and CIL, and flotation tails CIL.
- Acid washing of loaded carbon and AARL type elution followed by electrowinning and smelting to produce doré. Carbon regeneration by rotary kiln.
- Cyanide destruction of tailings using Air/SO_2 process and tailing management facility.
- Polishing pond for water treatment prior to an effluent treatment plant before discharge into the environment.

17.3.1 Plant Design Criteria

The key process design criteria for the Mill are listed in Table 17.2.

Table 17.2 Key Milling Plant Process Design Criteria

Parameter	Units	Value
Plant Throughput	tpd	9,000
Gold Head Grade – Range per Mine Plan	g/t Au	1.04 – 4.56
– Blended Average	g/t Au	2.2
– Design	g/t Au	3.26
Silver Head Grade	g/t Au	Trace (negligible)
Crushing Plant Availability	%	75
Plant Availability	%	91.3
Bond Crusher Work Index (CWi)	kWh/t	15.0
Bond Ball Mill Work Index (BWi)	kWh/t	15.9
SMC Axb		87.5
Bond Abrasion Index (Ai)	g	0.235
Primary Crusher		C140 or Equivalent
Material Specific gravity	tonne/m^3	2.68
Angle of Repose	degrees	35
Moisture content	%	5.0
SAG Mill		6.70 m dia. x 3.75 m EGL
Ball Mill		Overflow type – 6.10 m dia. x 8.54 m EGL
Grind Size (P_{80})	µm	75
Cyclone Cluster	#	16 operating + 4 standby
Cyclone size	mm	400
Sodium Cyanide Addition	kg NaCN/t material	0.98
Lime Addition (90% purity)	kg/t material	0.25
Frother	kg/t material	0.025
Promotor (Aero 208)	kg/t material	0.06
PAX	kg/t material	0.11
Copper Sulphate	kg/t material	0.30
SMBS	kg/t material	0.70
Caustic	kg/t material	0.42
Flocculant	kg/t material	0.032
Flotation Conc. Pre-aer & CIL Tanks	#	1+6
Flotation Tails CIL Tanks	#	4
Tonnes Carbon per Column	t	5
Number of Carbon Strip /Day	#	1.0

17.3.2 Material Handling and Crushing

Material will be hauled from the mine and dumped on the ROM pad for blending and re-handling into the ROM hopper. Provision for direct tipping to the ROM hopper will be provided. Material from the ROM hopper will be crushed by a primary jaw crusher. A ROM hopper apron feeder will be used to regulate feed at 457 t/h into a vibrating grizzly and the jaw crusher. A fixed rock breaker will be utilized to break oversize rocks at the top of the feed bin. Pebbles from the SAG mill will be dumped on crusher discharge conveyor by a front-end loader (FEL). The crushed material is conveyed to a covered stockpile, which will provide approximately 24-hrs of storage. The crushing circuit is designed for 75% availability, whereas the milling operation is designed for an operating time of 8,000 h/yr or 91.3% availability, resulting in excess crushed material production while the crusher is operational. The excess crushed material produced will allow for routine crusher maintenance without interrupting feed to the mill.

The mill feed stockpile will be equipped with apron feeders to regulate feed at 375 t/h into the SAG mill. Crushed material drawn from the stockpile will feed the SAG mill and ball mill circuit via the mill feed conveyor. Lime will be added for pH control as required.

The material handling and crushing circuit will include the following key equipment:

- ROM hopper.
- Apron feeder (with variable-speed drive - VSD).
- Vibrating grizzly.
- Fixed rock breaker.
- Primary jaw crusher.
- Mill feed apron feeder (VSD).
- Material handling equipment.

17.3.3 Grinding Circuit

The grinding circuit will consist of a SAG mill followed by ball mill in closed circuit with hydro-cyclones. The SAG mill specific energy requirement is 6.1 kWh/t based on a F_{80} of 75 mm and a P_{80} of 1,000 – 3,000 µm, without the use of a pebble crusher.

The SAG mill grate aperture size will be 12.5 x 20 mm. The SAG mill will discharge through a trommel where the pebbles will be screened out and carried back to the crusher discharge conveyor via front end loader. Trommel undersize discharges into the cyclone feed pumpbox, along with ball mill discharge material. Water is added to the cyclone feed pumpbox to obtain appropriate density prior to pumping to the cyclones.

Cyclone overflow gravitates to the rougher flotation conditioning tank via a trash screen. Cyclone underflow, together with gravity circuit tails and gravity screen oversize, flow by gravity to the ball mill for further size reduction.

Ball mill specific energy requirement of 12.3 kWh/t was determined based on a F_{80} of 1,000 – 3,000 µm and a P_{80} of 75 µm. The Ball mill product will discharge onto a launder containing a slot to allow a portion of the stream to gravitate into a pumpbox to be pumped to the gravity circuit.

The grinding circuit will include the following key equipment:

- SAG mill – 3,000 kW VSD.
- Ball mill – 5,400 kW.
- Cyclone feed pumpbox.
- Classification cyclones.

17.3.4 Gravity Recovery Circuit

The gravity circuit comprises two parallel centrifugal concentrators complete with feed scalping screens. Feed to the circuit is extracted from the ball mill discharge launder and pumped to the scalping screens. Gravity scalping screen oversize at +2 mm will report by gravity to the ball mill feed, while the gravity tails will gravitate to the mill discharge pump box. Scalping screen undersize is fed to the centrifugal concentrator.

Operation of the gravity concentrator will be semi-batch and the gravity concentrate will be collected in the concentrate storage cone and subsequently leached by the intensive cyanidation reactor circuit (ICR).

The gravity recovery circuit will include the following key equipment:

- Gravity feed scalping screen.
- Gravity concentrators.

17.3.5 Intensive Cyanidation Reactor

Concentrate from the grinding circuit gravity concentrators (Section 17.3.4) will be sent to the intensive cyanidation reactor (ICR) to recover the contained gold by cyanide leaching.

The concentrate from the gravity concentrators will be discharged to the ICR gravity concentrate storage cone and de-slimed before transfer to the ICR.

ICR leach solution (2% NaCN, 2% NaOH and Leach Aid) will be made up within the heated ICR reactor vessel feed tank. From the feed tank the leach solution will be circulated though the reaction vessel for approximately 20 hrs, then drained back into the feed tank. The leached residue within the reaction vessel will be washed, with wash water recovered to the reaction vessel feed tank, and then the solids will be pumped to the flotation concentrate regrind mill.

The ICR pregnant leach solution will be pumped from the reaction vessel feed tank to the ICR pregnant solution tank, located near the goldroom.

ICR pregnant solution will be pumped to the goldroom for gold recovery as gold sludge using a dedicated electrowinning cell. The sludge will be combined with the sludge from the carbon elution electrowinning cells and smelted or may be smelted separately for metallurgical accounting purposes.

The ICR circuit will include the following key equipment:

- Gravity concentrate storage cone.
- Intensive cyanidation reactor.
- Reactor vessel feed tank heater.
- Leach Aid screw feeder.
- ICR pregnant solution tank.
- ICR electrowinning cell.

17.3.6 Flotation, Thickening and Concentrate Regrind Circuit

Cyclone overflow will gravitate over the trash screen, to remove foreign material prior to flotation. Trash will report to the trash bin which will be periodically removed for emptying. Screen undersize will gravitate to the rougher conditioner tank. Reagents will be added into the rougher conditioner tank and mixed thoroughly.

The rougher flotation cells will consist of eight 70 m^3 forced-air tank cells in series. Rougher concentrate will gravitate into the flotation concentrate thickener. The rougher tailings will gravitate to flotation tailings thickener. Flocculant will be added into each thickener.

Flotation concentrate thickener feed rate is 18.75 t/h while flotation tails thickener feed rate is 356 t/h. Flotation tails thickener underflow will report to number seven CIL tank, and flotation concentrate thickener underflow and ICR residue will report to the concentrate regrind mill. The target product size from the regrind mill is P_{80} of 15 µm. Regrind mill specific energy requirement is 21.7 kWh/t based on a F_{80} of 75 µm and a P_{80} of 15 µm. Fine grinding will be achieved via attrition and abrasion of the particles in a vertical, agitated, mill containing small ceramic beads as the grinding medium.

The flotation, thickening and regrinding circuit will include the following key equipment:

- Trash screen.
- Rougher flotation tank cells.
- Flotation concentrate thickening.
- Flotation tails thickening.
- Regrind mill.

17.3.7 Leach and Adsorption Circuit

CIL tanks consists of two sets of adsorption tanks. The first set of CIL tanks accepts regrind mill discharge together with barren solution from electrowinning cells; these streams will be discharged into the leaching circuit pre-leach tank before CIL tanks. The second set of tanks accepts tails from first set of tanks as well as flotation tails thickener underflow. One interim carbon screen is used between these two CIL circuits to prevent slurry from the large CIL tank from going to the small CIL tanks.

The first leach circuit for processing ground concentrate will consist of one pre-aeration tank and five carbon-in-leach (CIL) tanks. The CIL tanks will be identical in size, with a total circuit residence time of 48 hrs at 46% w/w density in the tanks with solids flowrate of 18.8 t/h. The second set is three identical CIL tanks, larger in size than the concentrate CIL tanks, with total residence time of 24-hrs at 53% w/w and 375.2 t/h solids flowrate. Air will be sparged to each of the tanks to maintain adequate dissolved oxygen levels for leaching.

Quicklime will be added to ensure that the slurry pH is suitable for cyanidation. Cyanide solution will be added into the first tank of the reground concentrate CIL tanks.

Fresh/regenerated carbon from the carbon regeneration circuit will be returned to the last tank of the CIL circuit, and will be advanced counter currently to the slurry flow by pumping slurry and carbon from last CIL tank to previous CIL tank, and so on. The intertank screen in each CIL tank will retain the carbon whilst allowing the slurry to flow by gravity to the downstream tank. This counter-current process will be repeated until the carbon, by then loaded with gold, reaches the first CIL tank. Recessed impeller pumps will be used to transfer slurry between CIL tanks and from the lead tank to the loaded carbon screen mounted above the acid wash column in the elution circuit.

Slurry from the last CIL tank will gravitate to the vibrating carbon safety screen to recover any carbon leaking from worn screens or overflowing tanks. Screen underflow will gravitate to the cyanide destruction unit. Screen oversize (recovered carbon) will be collected in a fine carbon bin for potential return to the circuit.

The leach and carbon adsorption circuit will include the following key equipment:

- Flotation concentrate pre-aeration tank.
- Flotation concentrate CIL tanks.
- Flotation concentrate and tails CIL tanks.
- Loaded carbon screen.
- Intermediate carbon screen.
- Carbon safety screens.

17.3.8 Cyanide Destruction

Plant tailings from the CIL circuit is detoxified to a weak acid dissociable cyanide (CN_{WAD}) concentration of <1 ppm, to comply with environmental requirements, prior to deposition in the TSF.

The CIL tails at 52% solids will flow by gravity to the cyanide destruction tank. An allowance is included in the detoxification circuit to treat bleed from the heap leach facility in case there is a build-up of metals in the circulating solution. The washdown water is also included in the feed to detoxification circuit as well. As a result, the % solids in the feed to the detoxification circuit is estimated to be closer to 48% solids. The tank will operate with a total residence time of approximately 120 mins to reduce CN_{WAD} design levels from approximately 150 ppm to less than 1 ppm.

Cyanide destruction is undertaken using the SO_2/air method. The reagents required being air, caustic, copper sulphate, and sodium metabisulphite (SMBS). The cyanide destruction tanks are equipped with air addition points and an agitator to ensure that the air and the reagents are thoroughly mixed with the tailings slurry.

Detoxified tailings will be pumped to the TSF for final deposition with decant water from the TSF returned for use as process water. Overflow from the TSF will be discharged to a polishing pond for further treatment and monitoring before discharge into the environment.

The main equipment in this area includes:

- One agitated cyanide destruction tank.
- Air supply system.
- Reagent supply systems.

17.3.9 Carbon Acid Wash, Elution and Regeneration Circuit

Carbon Acid Wash

Prior to carbon stripping (elution), loaded carbon will be treated with a 3% hydrochloric acid solution to remove calcium, magnesium and other salt deposits that would otherwise render the elution less efficient or be 'baked on' in the subsequent elution and carbon regeneration steps and ultimately foul the carbon.

Loaded carbon from the loaded carbon recovery screen will flow by gravity to the acid wash column. Additionally, loaded carbon from the heap leach facility will be brought by truck and hydraulically transferred into the same acid wash column.

Entrained water will be drained from the column and the column then refilled with a 3% hydrochloric acid solution, from the bottom up. Once the column is filled with the carbon, it will be left to soak in the acid for 30 mins after which the spent acid will be rinsed from the carbon and discarded to the cyanide destruction tank.

The acid washed carbon will then be transferred to the elution column for carbon stripping.

The acid wash circuit includes the following key equipment.

- Acid wash column – 5 t capacity.

Carbon Stripping (Elution)

Carbon stripping (elution) will use a split Anglo-American Research Laboratory (AARL) process.

The elution sequence will commence 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 2% w/w NaOH and 2% w/w NaCN solution. Once the prescribed volume has been added, the pre-soak period will commence. During the pre-soak, the caustic/cyanide solution will be circulated through the column and the elution heater until a temperature of 95°C is achieved.

Upon completion of the pre–soak period, the last four bed volumes (4 BV) of low grade (lean) eluate from the previous elution will be pumped through the heat exchanger and elution heater, then through the elution column to the pregnant eluate tank at a rate of 2 BV/hr. At this stage the temperature of the eluent passing through the column will be raised to 125° - 130°C and the gold will be stripped off the loaded carbon.

Eluate will flow up and out of the top of the column, passing through the heat exchanger via the elution discharge strainers and to the pregnant eluate tank.

Once the lean eluate storage volume is exhausted, heated incoming strip water (4 BV) will be used to continue the strip, followed by 2 BV of water to cool the carbon. The last 4 BV will be directed to the lean eluate tank for use in the next strip.

Upon completion of the cool down sequence, the carbon will be hydraulically transferred to the carbon regeneration kiln feed hopper via a de-watering screen.

The stripping circuit includes the following key equipment:

- Elution column – 5 t capacity.
- Strip solution heater with heat exchangers.
- Strip water, lean eluate and pregnant eluate tanks.

Carbon Reactivation

Carbon will be reactivated in a diesel fired rotary kiln. Dewatered barren carbon from the stripping circuit will be held in a 10 t kiln feed hopper. A screw feeder will meter the carbon into the reactivation kiln, where it will be heated to 650° - 750°C in an atmosphere of superheated steam to restore the activity of the carbon. Carbon discharging from the kiln will be quenched in water and screened on a carbon sizing screen to remove undersized carbon fragments. The undersize fine carbon will be collected in a filter and bagged to be sold or disposed, depending on its residual gold loading. Reactivated carbon will be returned to the CIL circuit or trucked to the heap leach adsorption circuit.

As carbon is lost by attrition, new carbon is added to the circuit after attritioning in a carbon conditioning hopper to remove fines. The new carbon will then be transferred via the carbon sizing screen into the circuit the same way as reactivated carbon.

The carbon reactivation circuit includes the following key equipment:

- Carbon dewatering screen.
- Regeneration kiln including feed hopper and screw feeder.

- Carbon quench tank.
- Carbon sizing screen.
- CIL barren carbon hopper.
- Carbon fines hopper.
- Carbon fines filter.
- Fresh carbon conditioning hopper.

17.3.10 Electrowinning and Goldroom

Gold will be recovered from the pregnant eluate by electrowinning and smelted to produce doré bars.

The pregnant eluate is pumped through two electrowinning cells with stainless steel mesh cathodes. Gold will be deposited on the cathodes and the resulting barren solution will gravitate back into the barren solution tank for reuse or pumped to the leach circuit. One additional electrowinning cell will be dedicated for processing ICR pregnant solution.

The gold-rich sludge will be washed off the steel cathodes in the electrowinning cells using high pressure water sprays and will gravitate to the sludge hopper. The sludge will be drained, filtered, dried, mixed with fluxes and smelted in an induction furnace to produce gold doré.

The electrowinning and smelting process will take place within a secure and supervised goldroom equipped with access control, intruder detection and closed-circuit television equipment.

The electrowinning circuit and goldroom includes 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.
- Goldroom security system.

17.4 Reagent Handling and Storage

For the management of unexpected reagent spills, the reagent preparation and storage facilities will be located within containment areas designed to accommodate more than the content of the largest tank. Where required, each reagent system will be located within its own containment area to facilitate its return to its respective storage vessel and to avoid the mixing of incompatible reagents. Storage tanks will be 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 will be located throughout the facilities. Sumps and sump pumps will be provided for spillage control.

The following reagent systems are required for the process: quicklime, sodium cyanide, frother, promoter, PAX, hydrochloric acid, copper sulphate pentahydrate, sodium metabisulphite, sodium hydroxide, flocculant, activated carbon, and smelting fluxes.

17.4.1 Quicklime

There will be one lime silo system at the heap leach facility and another at the milling facility. Quicklime will be delivered to each facility in a tanker and will be pneumatically conveyed from the tanker to the lime silo. Quicklime will be extracted from the lime silo and fed onto the crushing plant product conveyor in the heap leach facility and to the SAG mill feed conveyor in the milling facility. Quicklime will be distributed as solid form.

17.4.2 Sodium Cyanide (NaCN)

Sodium cyanide will be delivered in a portable ISO container that can contain 18 Mt of solid briquettes. ISO container are designed with an internal jet mixing system. Raw water will be added to the cyanide mixing tank to the level required for achieving the stock solution concentration. A recirculating pump will be used to transfer cyanide from the ISO container to the mixing tank. The unloading process will require approximately four to six hours to complete to ensure the briquettes are completely dissolved. Plant air will then be used to flush or press out any residual cyanide from the ISO container to the mixing tank. Caustic (sodium hydroxide) will also be added to the mixing tank to provide protective alkalinity to avoid generation of hydrogen cyanide gas. After the mixing period is complete, cyanide solution will be transferred to the cyanide storage tank using the same pump as the recirculating pump used in the mixing cycle. Two ISO container mixing system will be installed, one for the heap leach and one for milling facility.

Sodium cyanide will be delivered to the heap leach area, CIL circuit, intensive leach circuit and elution circuit. Automatic control valves will provide the required cyanide flowrates at a number of locations around the two plants.

17.4.3 Frother (MIBC)

MIBC will be delivered as a liquid in drums and stored in the reagent shed until required. A permanent bulk box will be installed to provide storage capacity local to the flotation area. MIBC will be used as-received and without dilution. Diaphragm style dosing pumps will deliver the reagent to the required locations within the flotation circuit. Top-up of the permanent bulk boxes will be carried out manually as required.

17.4.4 Promotor (AERO 208)

Aero 208 will be delivered as a liquid in drums and stored in the reagent shed. Aero will be used as-received and without dilution. Diaphragm style dosing pumps will deliver the reagent to the required locations within the flotation circuit. Top-up of the permanent bulk boxes will be carried out manually as required.

17.4.5 Collector (PAX)

PAX will be delivered in granular powder form in bags and stored in the reagent shed. Raw water will be added to the agitated PAX mixing tank. Bags will be lifted into the PAX bag breaker, located on top of the tank, using a lifting frame and hoist. The solid reagent will fall into the tank and be dissolved in water to achieve the required dosing concentration. PAX solution will be transferred to the PAX storage tank using the PAX transfer pump. Both the mixing and storage tanks will be ventilated using the PAX tank fan to remove any carbon disulphide gas.

PAX will be delivered to the flotation circuit using the PAX circulating pump and a ring main system. Actuated control valves will provide the required PAX flowrates at a number of locations around the flotation circuit.

17.4.6 Copper Sulphate

Copper sulphate will be delivered in solid crystal form in bulk bags and stored in the reagent shed. Raw water will be added to the agitated copper sulphate mixing tank. Bags will be lifted into the copper sulphate bag breaker, located on top of the tank, using the lifting frame and hoist. The solid reagent will fall into the tank and be dissolved in water to achieve the required dosing concentration. Copper sulphate solution will be transferred to the copper sulphate storage tank using the copper sulphate transfer pump.

Copper sulphate will be delivered to cyanide destruction circuits using the copper sulphate circulation pump and ring main.

17.4.7 Sodium Metabisulphite (SMBS)

SMBS will be delivered in the form of solid flakes in bulk bags and stored in the reagent shed. Raw water will be added to the agitated SMBS mixing tank. Bags will be lifted into the SMBS bag breaker, located on top of the tank, using a lifting frame and hoist. The solid reagent will fall into the tank and be dissolved in water to achieve the required concentration. After mixing for a pre-set time, SMBS solution will be transferred to the SMBS storage tank using the SMBS transfer pump.

SMBS will be delivered to the cyanide destruction circuit using the SMBS circulation pump and ring main. An extraction fan will be provided over the SMBS mixing tank to remove SO_2 gas that may be generated during mixing. The SMBS mixing area will be ventilated using the SMBS area roof fan.

17.4.8 Sodium Hydroxide (NaOH)

Sodium hydroxide (caustic soda) will be delivered as solid pearls/beads in bulk bags and stored in the reagent shed. Raw water will be added to the agitated sodium hydroxide mixing tank. Bags will be lifted into the sodium hydroxide bag breaker, located on top of the tank, using a lifting frame and hoist. The solid reagent will dissolve in water to achieve the required concentration. After mixing for a pre-set time, sodium hydroxide solution will be ready to transfer using the sodium hydroxide transfer pump.

Sodium hydroxide will be delivered to gravity concentrate leach circuit, elution circuit, electrowinning, cyanide mixing, acid neutralization, and cyanide destruction circuit using the sodium hydroxide circulation pump and ring main.

17.4.9 Hydrochloric Acid (HCl)

Hydrochloric acid will be delivered in intermediate bulk containers (IBCs) as a solution and stored in a dedicated section of the reagent shed until required. Hydrochloric acid will be mixed with raw water (inline) to achieve the required 3% concentration.

Hydrochloric acid will be delivered to the acid wash circuit using the hydrochloric acid dosing pump.

17.4.10 Flocculant

Powdered flocculant will be delivered to site in 50 kg bulk bags and stored in the reagent shed. A vendor supplied mixing and dosing system will be installed, which will include flocculant storage hopper, flocculant blower, flocculant wetting head, flocculant mixing tank, and flocculant transfer pump. Powder flocculant will be loaded into the flocculant storage hopper using the flocculant hoist. Dry flocculant will be pneumatically transferred into the wetting head, where it will be contacted with water. Flocculant solution, at 0.50% w/v will be agitated in the flocculant mixing tank for a pre-set period. After a pre-set time, the flocculant will be transferred to the flocculant storage tank using the flocculant transfer pump.

Flocculant will be dosed to the flotation concentrate thickener and flotation tails using variable speed helical rotor style pumps. Flocculant will be further diluted just prior to the addition point.

17.4.11 Activated Carbon

Activated carbon will be delivered as solid granular form in bulk bags. The carbon is introduced into the carbon conditioning tank in the flotation/CIL plant, where it is slurried and agitated to remove the friable edges of the carbon particles and the adhering carbon dust generated in transport. The slurry is pumped over the sizing screen where the carbon fines discharge to the fine carbon hopper, and the coarse carbon particles can be transferred to the CIL circuit in milling or trucked to the heap leach carbon columns.

17.4.12 Anti-scalant

Anti-scalant will be delivered as solution form in bulk boxes and stored in the reagent shed until required. Permanent bulk boxes will be installed to provide storage capacity local to each dosing point. Anti-scalant will be dosed neat, without dilution. Positive displacement style dosing pumps will deliver the anti-scalant to the required locations around the heap and milling plants. Top up of the permanent bulk boxes will be carried out manually as required.

17.4.13 Goldroom Smelting Fluxes

Borax, silica sand, sodium nitrate and soda ash will be delivered as solid crystals/pellets in bags or plastic containers and stored in the reagent shed until required.

17.5 Services and Utilities

17.5.1 High and Low Pressure Air

High pressure air at 700 kPag will be required in the plant and produced by compressors. The entire high-pressure air supply will be dried and used to satisfy both plant air and instrument air demand. Dried air will be distributed via the air receivers located throughout the plant.

Low pressure air for the leach tanks, cyanide destruction tanks and flotation will be supplied by air blowers.

17.5.2 Diesel Fuel

The diesel fuel area will contain the following equipment:

- Diesel unloading pump.
- Diesel storage tank.
- Diesel supply pumps.
- Light vehicle bowsers.
- Heavy vehicle bowsers.

A vertical spindle sump pump will be provided to remove any rainwater from the diesel fuel bund area.

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, primarily as follows:

- Fire water for use in the sprinkler and hydrant system.
- Cooling water for mill motors and mill lubrication systems.
- Gland water for pumps.
- Reagent make-up.
- Feed for the potable water plant.
- Raw water will be treated and stored in the potable water storage tank for use in safety showers and other similar applications.

17.6.2 Process Water Supply System

Flotation concentrate and tails thickeners overflow and TSF decant water will meet the main process water requirements. Raw water will provide any additional make-up water requirements.

18.0 PROJECT INFRASTRUCTURE

18.1 Overall Site

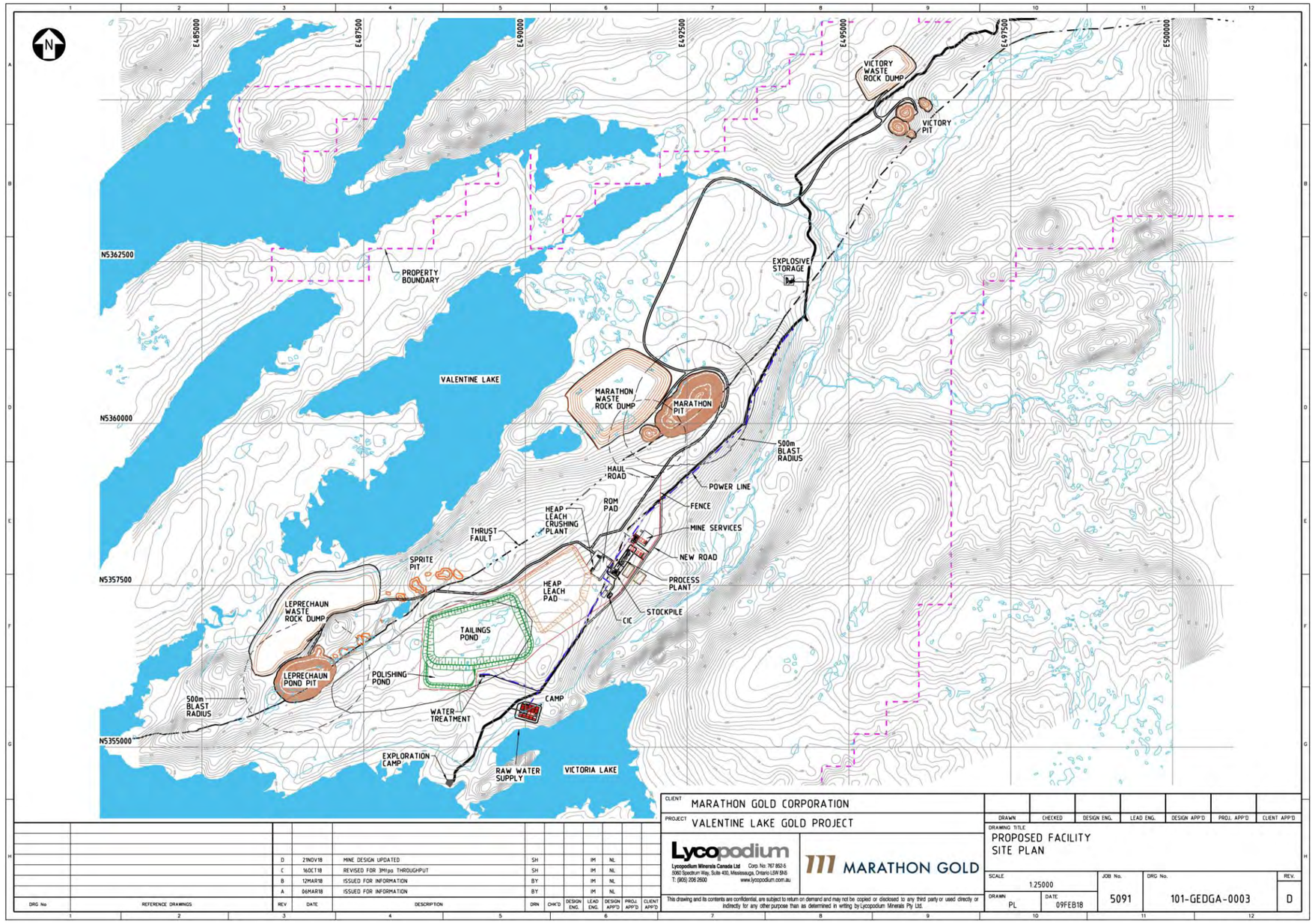
The overall site plan is shown in Figure 18.1 and includes major facilities of the Project including open pit mines, heap leach, mill, TSF, heap leach pad, waste rock facilities, polishing pond, mine services, access road, accommodations camp and waste water treatment plant.

Access to the facility is from the northeast side of the property off the existing access road. Main access will be via the main security gate near the process plant.

Grid power will be provided from an incoming HV line from the northwest side of the property.

The site as a whole will be fenced to clearly delineate the mine area and deter access by unauthorized people.

Figure 18.1 Overall Site Plan



18.2 Roads

18.2.1 Access to Site

Access to the project is from the existing access road. The existing 88 km of class D gravel road will be upgraded to class A standard 24 ft wide driving surface, and include ditching on both sides and roadside drainage by HDPE pipe. Rock and gravel will be sourced from three strategically located borrow pits along the 88 km route, assuming quarry permits will be approved to mine at these locations.

It is proposed to replace five existing bridges with new structures. The bridge at Baily is assumed to be adequate and no allowance has been made to upgrade this bridge. The bridge at Victor River requires an engineering review to identify the scope and cost of upgrades, if required.

18.2.2 Project Site Roads

Plant internal roads will provide access between the administration area, process plant facilities, and mine services area. These roads will generally be 6 m wide and will be constructed flush with bulk earthworks pads to ensure that storm water sheet flow is achieved across the site, thereby avoiding the need for deep surface drains and culvert crossings within the plant area.

18.2.3 Access Tracks

A number of new tracks will be constructed to access infrastructure such as the TSF. The access tracks will be cleared and graded natural earth tracks. Exact routes will be determined during construction of the Project to best fit local terrain and vegetation density.

18.3 Power Supply

Site power will be provided from a HV line at the project's boundary that will be provided by the local power authority. A peak demand of 23 MW is required for the facility.

The SAG and ball mills at the flotation plant are the largest loads. The SAG and ball mills have been specified with a variable frequency drives to reduce the load surge during start-up.

18.3.1 Electrical Distribution

The plant electrical system is based on 13.8 kV, 2,000 A, 60 Hz distribution. The 66 kV feed from local power authority will be stepped down to 13.8 kV at the plant main substation, and will supply the plant main 13.8 kV switchgear housed in the switchroom of the plant main substation. The SAG mill, ball mill, and cyclone feed pumps variable frequency drives (VFDs) will have 13.8 kV input, fed by plant main 13.8 kV switchgear, for their phase shifting input transformer and 4.16 kV output. Separate 13.8 kV/600 V distribution transformers at the plant various substations will be fed from the plant main 13.8 kV switchgear. The following substations with switch rooms will be provided:

- Plant main substation.
- Heap leach plant feed preparation substation.
- Heap leach plant (CIC) substation.

- Flotation plant main substation.
- Floatation plant feed preparation substation.
- Floatation plant services and buildings substation.

Switchrooms will house 13.8 kV switchgear (plant main substation only), MV VFDs (flotation plant main substation only), 600 V motor control centres (MCCs), LV VFDs, plant control system cabinets, lighting transformers, various distribution boards, and UPS power distribution.

Overhead power lines of 13.8 kV will provide power to various remote facilities. Pole mounted transformers will step down the voltage at each location, and supply an outdoor 480 V switchboard local to each equipment area.

18.3.2 Electrical Buildings

Electrical buildings will be pre-fabricated 'flat pack' panel buildings to minimize installation time on site. Buildings will be installed on a structural framework over 2 m above ground level to allow for bottom entry of cables into electrical cabinets. The electrical buildings will be installed with HVAC units and suitably sealed to prevent ingress of dust.

18.3.3 Transformers and Compounds

Plant main transformer 66 kV/13.8 kV will be of oil natural air natural (ONAN), with provisions for future oil natural air forced (ONAF), cooling configuration and will have either OLTC (on-line tap changer) or external voltage regulators. SAG mill, ball mill and cyclones feed pumps VFD phase shifting input transformers (13.8/4.16 kV) will be dry type and part of concerned VFD panel line-up. All plant 13.8 kV/600 V distribution transformers will be of ONAN, with provisions for future ONAF, cooling configuration and will have de-energized tap changer.

Fire rated concrete walls will be constructed around the oil filled transformers.

18.3.4 Fuel Supply

Diesel fuel will be stored on site near the mine services area for heavy and light vehicle refuelling. Diesel fuel storage and supply will be provided by a fuel supplier and include three 90 m^3 fuel storage tanks, offloading pumps, dispensing pumps, associated piping and electronic fuel control/tracking.

A fuel price of $0.778 /L has been quoted for the preproduction period and $0.943 /L for commercial production. Fuel prices include taxes.

18.4 Support Buildings

The following support buildings will be provided for the facility:

- Primary Crushing Buildings.
- Stockpile Cover.

- Flotation Plant Building.
- CIC Building
- Reagent Building.
- Truck Shop.
- Warehouse.
- Maintenance Shop.
- Explosives Storage and Handling.
- Fuel Station.
- Plant Administration Building.
- Laboratory.
- Security Gate/Change Facility.
- Main Power Stations.
- MCCs.

18.5 Site Geotechnical

Limited site wide geotechnical information has been collected for the Project, and specific geotechnical investigations have yet to be completed. The Project will require significant development throughout the property to support the infrastructure such as roads, buildings, camp, tailings dams, heap leach pad, sedimentation ponds, etc.

Based on available mapping information, it is known that the surface elevations across the site vary and the soil conditions vary from boggy areas, thin to thick till layers, and bedrock outcrops.

It is assumed that the foundations will be constructed on dense native tills and/or bedrock. In general, the foundations throughout the Project will require a soil cover of 1,800 mm or equivalent for frost protection. All surficial organic materials will be required to be removed from the footprint of the Project structures before placing foundations or structural fills.

To advance the project into pre-feasibility and feasibility stages, further geotechnical investigations through the overburden and bedrock are recommended. These investigations should include both test pit and borehole methods to establish the subsurface conditions. From this information, assessments can be completed to provide appropriate foundation recommendations for the various infrastructure components for the site.

18.6 Tailings Storage Facility

18.6.1 Design Requirements and Concept

The TSF has a preliminary design to accommodate 30 Mm^3 of tailings material that will be produced over the life of the mine, and is based on an annual throughput of 3.0 Mtpa for the Mill. The preliminary layout for the TSF, Stage 1 and Final Stage, is shown in Figure 18.2.

The overall design objective of the TSF is to protect the regional groundwater and surface water resources during both operations and long term (post-closure), and to achieve effective reclamation upon mine closure. The design of the TSF has taken into account the following:

- Minimizing the impact and risks to the surrounding environment.
- Permanent, secure, and total confinement of all solid waste materials within the engineered TSF.
- Control, collection, and removal of free draining liquids from the tailings during operations for recycling as process water to the maximum practical extent.
- The inclusion of monitoring features for the facility to demonstrate performance goals are achieved and design criteria and assumptions are met.
- Staged development of the TSF over the life of the project to defer capital cost and allow for efficient use of waste materials from pit stripping as construction materials for the TSF.

The TSF was designed based on the following information:

- Material Specific Gravity 2.68 sg
- Tailings Particle Size P_{80} = 72 µm
- Tailing Slurry Density 45% (after cyanide destruction circuit)
- Assumed Void Ration of Deposited Tailings 1.0
- Calculated Density of Deposited Tailings 1.34 t/m^3
- Calculated Maximum Volume of Tailings 30 Mm^3

A conventional downstream embankment TSF concept was used based on the proposed mine plan and assessment of site topography. The TSF is currently sited in the middle of the Project property, southwest of both the proposed mill and heap leach pad sites.

The preliminary design has the TSF embankments being raised in five stages and will be constructed out of mine waste rock, and locally sourced borrow materials. The proposed final crest elevation of the TSF is 410.0 m.

18.6.2 Design and Construction

The TSF embankment will be constructed in five stages by implementing downstream methods. The TSF will be constructed using mine waste rock materials and local borrow materials as required. Each stage will be raised based on storage requirements and waste rock production.

The embankment design concept includes layering of rockfill, a coarse filter material, a fine filter material, a clay core, upstream clay blanket, and rip rap protection. A typical cross-section is shown in Figure 18.3.

A crest width of 7.0 m was assumed to allow for vehicle and equipment movement around the TSF. The slopes for the embankment are assumed to be 2.5H:1V upstream and 1.8H:1V downstream for stability. It should be noted that the downstream slopes will require re-grading upon closure to achieve 2H:1V for long term stability.

Diversion ditches are proposed along the toe of the embankment as well as a perimeter access road.

Figure 18.2 Tailings Storage Facility Stage 1

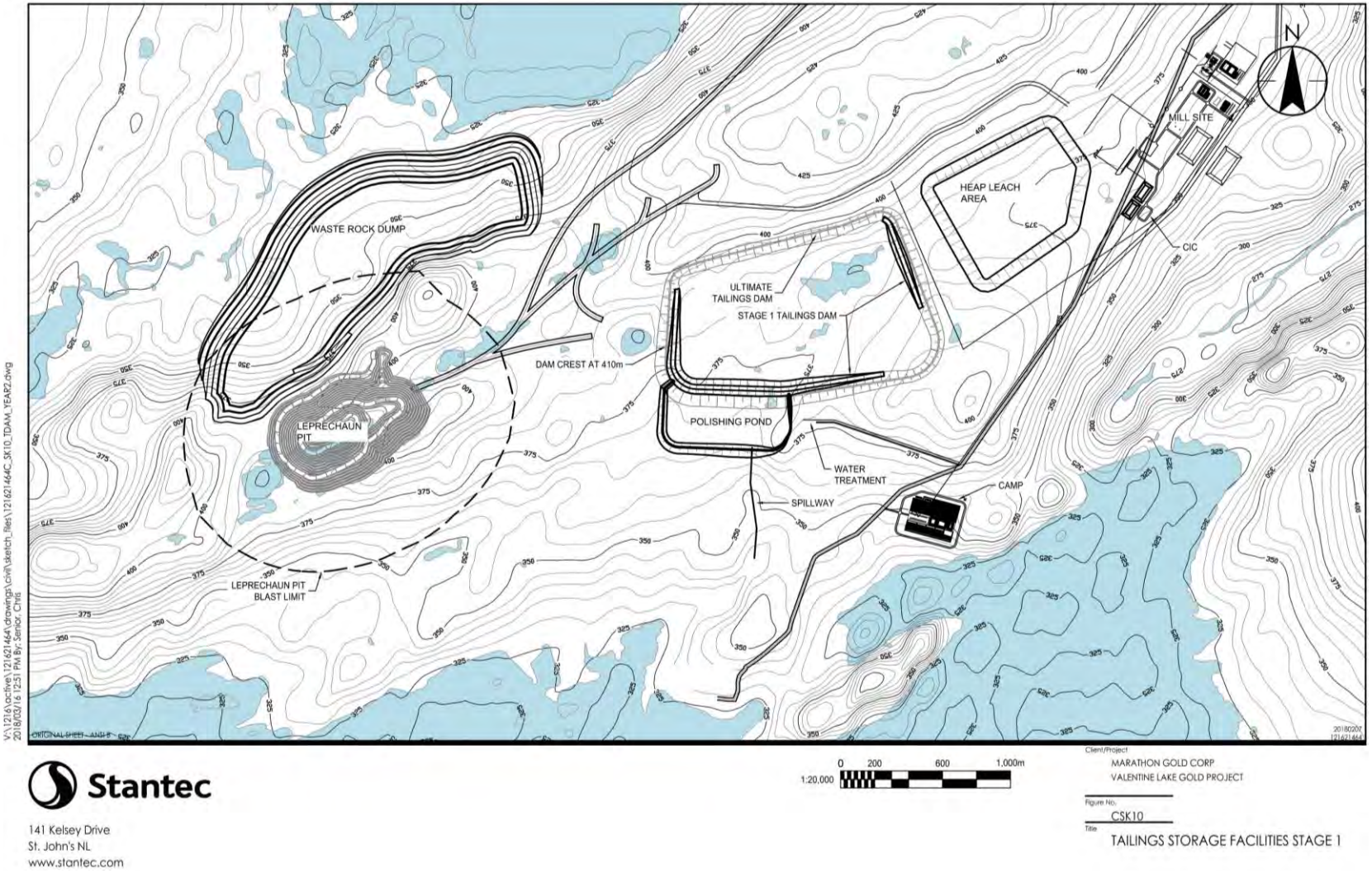
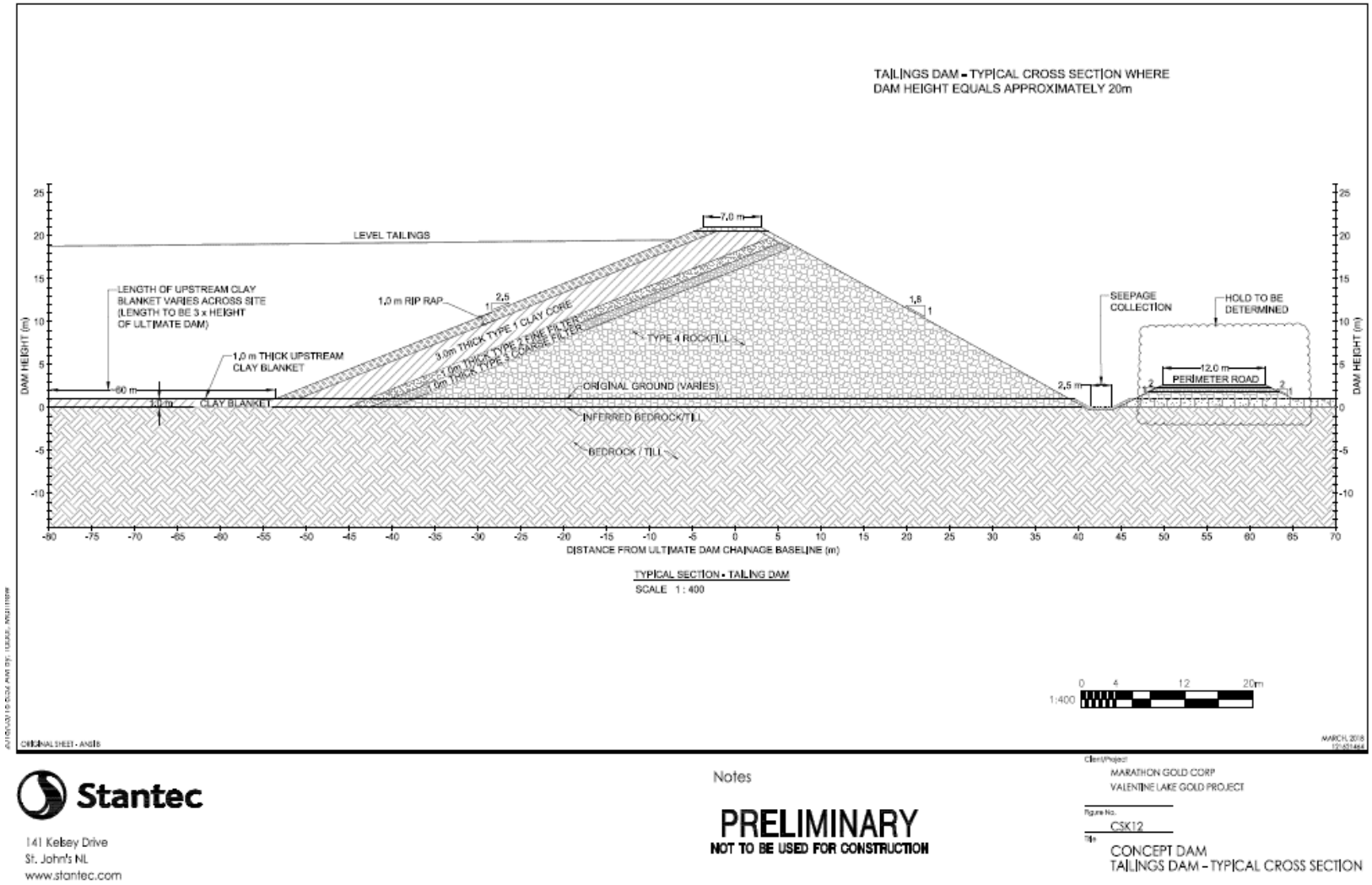


Figure 18.3 Tailings Dam – Typical Cross-Section



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Notes

PRELIMINARY
NOT TO BE USED FOR CONSTRUCTION

Client/Project
MARATHON GOLD CORP
VALENTINE LAKE GOLD PROJECT

Figure No.
CSK12

Title
CONCEPT DAM
TAILINGS DAM - TYPICAL CROSS SECTION

18.6.3 Operation of TSF

The preliminary operational plan for the TSF is to deposit slurry from the embankment, along the perimeter of the storage area. This will optimize tailings storage capacity while reducing other risks, such as stability and seepage. It is assumed that the TSF will be able to store up to three months' worth of process water, the rest of the water will be reclaimed for re-use in the mill.

18.6.4 Considerations

Environmental Considerations

The location of the TSF was based on the following aspects:

- It has the smallest apparent impact on fish and fish habitat.
- Furthest distance from a major body of water.
- Has additional real estate downstream to install monitoring system and mitigation plans in case of a dam breach.
- Closest to the mill and heap leach pad – reducing the overall processing footprint.
- Less supporting infrastructure required – shorter tailings pipeline length, access roads, powerlines, etc.

The waste rock from the Leprechaun Pit has low acid rock drainage potential, however waste rock from the Marathon Pit could be potentially acid generating material. It is currently proposed to use waste rock in the construction of the TSF embankments. Care will be required to ensure that potentially acid generating materials will not be used in the TSF construction, unless it can be shown that these materials can be placed in construction that will result in permanent water and/or soil cover to prevent acid generation.

Operational Considerations

The TSF construction and operation should align with the rest of the Project site development and operation. The storage capacity and accessibility for equipment, distance and elevation form the mill for tailings pumping and availability of construction materials.

18.7 Polishing Pond

A polishing pond is associated with the TSF and is adjacent to the structure along the southern embankment. The polishing pond has similar construction as the TSF minus the upstream clay blanket. The polishing pond will be constructed in Stage 1 and the crest will have an elevation 380.0 m.

18.8 Heap Leach Pad

18.8.1 Design Requirements and Concept

The proposed heap leach pad (HLP) is an expanding pad concept located adjacent to the mill and TSF sites. The HLP is designed to contain 21.5 Mm^3 of material to be treated in the current life of mine plan. The preliminary layout of the heap leach pad is shown in Figure 18.2.

The HLP design incorporates surface water diversion ditching, a double lined containment system, and a network of drainage piping underneath the material for solution collection. The HLP will be constructed in stages to meet the production requirements. The footprint of the HLP was selected based on site topography and proximity to the proposed mine infrastructure.

The material for the heap leach will be transported from the open pits to the ROM pad adjacent to the heap leach crushing facility via haul trucks. The crushed material will be loaded onto the heap leach pad in nominal lift thicknesses of 10 m.

The design was developed based on the environmental setting of the Project, similar operations, and designs within Canada. Geotechnical and environmental site investigations were not completed to support the preliminary design.

18.8.2 Design and Construction

Storage Ponds

A series of storage ponds are associated with the heap leach process; these include:

- Pregnant Solution Pond.
- Barren Solution Pond.
- Emergency Pond.
- Stormwater Pond.

The pregnant and barren ponds are storage ponds for the solutions that will be used throughout the heap leach process. The emergency pond is to collect surface run-off from the heap leach pad during precipitation events, and the stormwater pond is an overflow pond for the emergency pond. These ponds are sized to handle the 100-year rain event for 24 hrs. These ponds will be lined to reduce any potential environmental impacts.

Collection and Containment Design

The heap leach pad will be a fully double lined system to facilitate the effective pregnant solution recovery and mitigate any potential environmental impacts.

The overburden in the pad area will be stripped and stockpiled for future use. It is assumed that there will be suitable material within the footprint of the facility to use for foundation materials. However, any soils deemed unsuitable will be removed from the foundation area and stockpiled for future rehabilitation use. Once the stripping of overburden is completed and sub-grade properly compacted, a layer of local borrow and sand

cushion will be installed in preparation for the liner. An 80-mil high density polyethylene (HDPE) liner will be installed over the footprint of the heap facility. Due to the environmental conditions of the site, it is proposed to have a double synthetic liner system that will have a leak detection sand layer, a geotextile, and a low permeability soil between the two HDPE liners.

Above the liner system, there will be 0.9 m layer of low-grade crushed material covering the entire footprint of the heap leach pad. There will also be a network of collection pipes installed in a herringbone pattern throughout this layer. The main purpose of this layer is to collect the pregnant solution to the storage pond. It will also protect the liner system and the collection pipes.

Underdrain and Containment Berm

A drainage system such as a French drain will be required underneath the heap leach foundation to remove any seepage from below the liners. This drainage will be non-contact water and will be released to other water treatment areas unless water monitoring indicates the presence of process solution in the seepage water. Monitoring of the under-liner drainage system will be a performance indicator of the liner system.

A containment berm will be constructed around the heap leach facility to keep run-off from the heap leach pad from entering the surrounding environment. A diversion ditch will be on the outside of the containment berm to convey any surface water run-off around the facility.

18.8.3 Operation

The heap leach pad will be constructed in two phases. The first phase will be constructed during the construction stage of the Project and will have capacity for 60% of the life of mine heap leach material. The second phase will be constructed approximately during the fifth year of operation for the balance of capacity.

The overall heap leach pad is designed to contain 21.5 Mm^3 of material. The material will be placed on the pad in lifts of 10 m, and will ultimately be terraced with maximum terrace heights of 40 m. The slopes of the terraces will be 2H:1V which fulfil the closure slope stability requirement.

18.9 Water Systems

18.9.1 Raw Water Supply System

It is assumed that raw water will be obtained from Lake Victoria. Fresh water will be supplied by the raw water pumps to an atmospheric vented fresh water tank. Raw water will be provided from the raw water tank for use as fire water, feed to the potable water treatment plant and other users at the process plants.

18.9.2 Fire Water Supply System

Fire water will be piped to all main facilities via buried underground fire water ring mains around each of the facilities. In addition, all buildings will be equipped with hose cabinets and supplemented with hand held fire extinguishers of two types—general purpose extinguishers for inside plant areas, and dry type extinguishers for inside electrical and control rooms. Ancillary buildings will be provided with automatic wet sprinkler systems throughout the buildings.

18.9.3 Potable Water Supply

The potable water treatment plant will be designed to local drinking water guidelines. The plant is expected to include multimedia filtration for reduction of turbidity, followed by ultraviolet disinfection for primary disinfection, and the addition of sodium hypochlorite for secondary disinfection. Treatment residuals from the potable water treatment plant (e.g. multimedia filtration backwash), will be sent to the tailings thickener for ultimate disposal within the TSF. Treated potable water from the potable water treatment plant will be stored in the plant potable water tank and the safety shower water tank. Treated potable water from the plant potable water tank will be distributed via the plant potable water pump in a piping ring main to serve all potable water users in all facilities. Treated potable water from the safety shower water tank will be distributed via the safety shower water pumps to drinking fountains, eye wash stations, and safety showers.

Potable water piping in the plant area will either be buried below the frost line, routed through heated buildings, or heat traced and insulated. Manual drain points will be included to allow emptying of pipelines, should conditions dictate.

18.9.4 Process Water Supply

Process water from the flotation concentrate and tailings thickeners overflow and TSF decant water will meet the main process water requirements. Raw water will provide any additional make-up water requirements.

18.10 Sewage Treatment

Sewage generated within the project site will be collected via an underground sanitary sewer network to a common location, where it will be treated by an above grade mechanical sewage treatment plant (vendor package). Treated sewage effluent will be discharged to the environment meeting local permit requirements. Sludge generated as a by-product of the treatment of sewage will be disposed off-site by a licensed contractor.

18.11 Waste Water Treatment Plant

A dedicated waste water treatment facility is required for the Project to treat suspended solids, pH, and other water quality issues. Based on the preliminary site water balance, the water treatment facility will treat a nominal flow rate of 997 m^3/h and a peak flow rate of 1,396 m^3/h. It will use proven treatment processes to handle the effluent water to meet the applicable requirements and regulation.

18.12 Accommodation Camp

A permanent 200-person accommodation camp with associated services will be provided and will be located to the south of the process plant, and will provide accommodation for operating and maintenance staff.

A 300-person temporary construction camp will be built for the peak load workforce levels during construction. This camp will use the common facilities in the permanent camp.

19.0 MARKET STUDIES AND CONTRACTS

19.1 Market Studies

No formal market studies have been undertaken.

A gold price of $1,250 /oz from Marathon Gold has been used for the Mineral Resource estimate and the economic analysis.

Valentine Lake Project will produce gold doré which is readily marketable on an 'ex-works' or 'delivered' basis to a number of refineries in North America and Europe. There are no indications of the presence of penalty elements that may impact the price or render the product unsalable.

19.2 Contracts

There are no material contracts or agreements in place as of the effective date of this report. Refining contracts are typically put in place with well recognized international refineries and sales are made based on spot gold prices. These contracts typically include fees for transportation of the product from the site, insurance, assaying, refining and an allowance for metal losses during refining. The ability to get a contract in place for the sale of doré prior to start of production is not seen as a risk to the Project.

20.0 ENVIRONMENTAL STUDIES, PERMITTING AND SOCIAL OR COMMUNITY IMPACT

Information presented in this Section is based on publicly available information and supplemented with environmental baseline studies conducted within the Project property boundary and surrounding area. 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 rural central Newfoundland, in the Central Newfoundland Forest Ecoregion, which covers most of the central and north-eastern portions of the Island. This part of the Island is characterized by boreal forest, i.e., mainly coniferous trees, and a continental climate, i.e. colder winters and warmer summers than coastal areas. The Project is in relatively undisturbed wilderness[1].

The following sections summarize the terrestrial and aquatic ecosystems present in the vicinity of the Project, and are based on literature reviews and baseline surveys carried out in support of the Project. This is followed by a summary of the social, cultural, and economic environment in the region.

20.1.1 Terrestrial Ecology

The Project is located in the Red Indian Lake Subregion of the Central Newfoundland Forest. Annual precipitation averages around 1,200 mm, and the average annual temperature is approximately 3.8˚C, ranging from -8.2˚C in January to 16.3˚C in July. Mean annual runoff in the Project boundaries ranges between 51% to 86% of climate normal precipitation (Stantec 2017a). The Red Indian Lake Subregion, and overall Central Newfoundland Forest, has relatively warm and dry summers and, as a result, experiences a high number of forest fires compared with other parts of the Island (PAA 2008).

The landscape in the vicinity of the Project is characterized by remote upland forests dominated by softwood forests [i.e. balsam fir (*Abies balsamea*) and black spruce (*Picea mariana*)], interspersed by lowlands [i.e. wetlands (e.g. peatlands and treed wetlands)], krummholtz, barrens, and open water habitats (Stantec 2015). Hardwood and mixedwood stands are also present, with the dominant species being white birch (*Betula papyrifera*) and trembling aspen (*Populus tremuloides*) (Stantec 2015).

The region is home to a variety of typical boreal forest wildlife and bird species (PAA 2008). Wildlife identified during field surveys include Woodland Caribou (*Rangifer tarandus*), moose (*Alces alces*), black bear (*Ursus americanus*), Canadian lynx (*Lynx canadensis*), eastern coyote (*Canis latrans*), red fox (*Vulpes vulpes*), river otter (*Lontra canadensis*), muskrat (*Ondatra zibethicus*), ermine (*Mustela erminea*), Newfoundland marten (*Martes americana Americana*), mink (*Neovison vison*), snowshoe hare, American red squirrel (*Tamiasciurus hudsonicus*), red-backed vole (*Myodes rutilus*), and meadow vole (*Microtus pennsylvanicus*) (Stantec 2014a, 2014b). Perhaps the most notable of these, in terms of its cultural and economic importance, as well as its role in the ecosystem, is Woodland Caribou. This species has always been a valuable hunting resource for local residents, as well as potential prey for other wildlife species. Bird (avifauna) species identified during field surveys include raptors [e.g. Northern Harrier (*Circus hudsonicus*) and Bald Eagle (*Haliaeetus leucocephalus*)],

[1] The Project Ecological Land Classification determined that 0.5% of the area analysed (1,831 km² centred on the property boundary) is classified as “anthropogenic” (Stantec 2015).

woodpeckers [Northern Flicker (*Colaptes auratus*), Yellow-shafted Flicker (*Colaptes auratus*) and Black-backed Woodpecker (*Picoides arcticus*)], shorebirds [e.g. Killdeer (*Charadrius vociferus*), Wilson's Snipe (*Gallinago delicata*), and Greater Yellowlegs (*Tringa melanoleuca*)], upland game birds [Ruffed Grouse (*Bonasa umbellus*), Spruce Grouse (*Falcipennis canadensis*), and Willow Ptarmigan (*Lagopus lagopus*)], songbirds [e.g. White-throated Sparrow (*Zonotrichia albicollis*), Ruby-crowned Kinglet (*Regulus calendula*), Swainson's Thrush (*Catharus ustulatus*), Olive-sided Flycatcher (*Contopus cooperi*), Common Nighthawk (*Chordeiles minor*), and Yellow-bellied Flycatcher (*Empidonax flaviventris*)] and waterfowl (Stantec 2014b, 2015). Waterfowl are common in wetland and open water habitats in the Project area during spring breeding and fall staging, particularly Canada Goose (*Branta canadensis*), Ring-necked Duck (*Aythya collaris*), American Black Duck (*Anas rubripes*), and Green-winged Teal (Anas crecca) (Stantec 2017e). A Sensitive Wildlife Area along the Victoria River has been identified as containing important waterfowl habitat (see Section 20.1.3).

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 of special concern under the Newfoundland and Labrador *Endangered Species Act* (NL ESA; Government of Newfoundland and Labrador 2001), the federal *Species at Risk Act* (SARA; Government of Canada 2002), 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).

Three plant SOCC were identified during 2017 field surveys of the Project area, including the nodding water nymph (*Najas flexilis*), identified at a single location within the footprint of the proposed Marathon Pit, and short-scaled sedge (*Carex deweyana*) and perennial bentgrass (*Agrostis perennans*), both outside of the Project footprint (as it was proposed in Summer 2017) (Stantec 2017d). The provincial status rank (S-rank) for these three species is S2 (imperilled). Four grammanoid (grass) species of SOCC were identified during regional surveys conducted in 2014 in support of the Project's Ecological Land Classification (ELC). Wildlife SAR identified during surveys of the Project area include Newfoundland Marten, Olive-sided Flycatcher, and Common Nighthawk. These three species are listed as 'Threatened' under provincial and federal species at risk legislation (Stantec 2014a, 2014b). While not detected during baseline ecological surveys, additional SAR and SOCC have the potential to occur in the Project area, based on available habitats, including Gray-cheeked Thrush (*Catharus minimus*), Rusty Blackbird (*Euphagus carolinus*), Red Crossbill (*Loxia curvirostra*), Short-eared Owl (*Asio flammeus*), and Bank Swallow (*Riparia riparia*) (Stantec 2014a). Critical habitat, as defined by SARA, for these species has not been identified in the Project area.

20.1.2 Aquatic Ecosystem

Atlantic Salmon (*Salmo salar*), Brook Trout (*Salvelinus fontinalis*) and Three-spine Stickleback (*Gasterosteus aculeatus*) are known to occur in the Project area. During baseline field surveys for the Project, Atlantic Salmon and Brook Trout were only captured in stream habitats, and were absent from the four ponds investigated near the Leprechaun Deposit in 2011 (Stantec 2012). Substantial barriers (i.e. water falls) exist in two areas near the proposed Leprechaun Pond Pit, upstream from which there were no salmonids captured.

The Project is situated in the Exploits River Watershed, adjacent to Victoria Lake and Victoria River, which feed into the Exploits River, one of the most important Atlantic Salmon Rivers on the Island in terms of numbers of salmon returning. However, based on 2016 population surveys, the returns of Atlantic Salmon to the Exploits River system have declined in comparison to previous five-year means (2011 - 2015). This is consistent with

Province-wide data, which shows declines in total returns greater than 30% for more than half the rivers monitored in the Province in 2016 (DFO 2017). The presence of the Project in the headwaters of the Exploits River watershed has the potential to result in increased public interest given the existing declines in the regional Atlantic Salmon population.

Atlantic Salmon fisheries in Newfoundland and Labrador are currently recreational or subsistence (i.e. no commercial fisheries for Atlantic Salmon). Angling retention limits are assigned to rivers by DFO. The waterbodies in the vicinity of the Project are classified by DFO as "Class 0", which permits only catch-and-release of Atlantic Salmon; however, retention is permitted in downstream portions of the Exploits River system (DFO 2017b).

20.1.3 Social, Cultural and Economic Environment

The Valentine Lake Project is located approximately 45 km south of the nearest community of Buchans, and approximately 60 km southwest of Millertown.

The economy of this rural region of central Newfoundland has been shaped primarily by natural resource-based industries, including mining, forestry, and hydroelectric developments.

The region has a long history of mineral exploration and development, and the Towns of Buchans and Millertown were primarily developed to serve the local mining industry. 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 1928. 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. The first phase of decommissioning the site (2015 – 2018) includes infrastructure removal and reclamation. The second phase of decommissioning (2018 – 2024) involves water management and treatment. The third and final phase of Duck Ponds decommissioning (2024) will see the end of most activities at the site (Teck 2016). There are currently no operating mines in the region, although mineral exploration has continued and there are many mineral licences surrounding the Project area. It is Marathon's hope that development of the Valentine Lake Project into an operational mine will fill the void in employment and local procurement opportunities in the region.

Forestry and logging were important economic driver 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.

The hydrology of the region was altered in the late 1960s with construction of the Victoria Reservoir Dam and Spillway, built as part of the Bay D'Espoir Hydroelectric Generating Facility. Built in 1967, the Victoria Reservoir Dam and Spillway are within the Project area and remain operational. Victoria Reservoir commonly referred to as Victoria Lake, as well as Valentine Lake, are headwater regions of the larger Exploits River Watershed, the largest watershed on the island of Newfoundland.

Today the region is used primarily for recreational activities, including big-game hunting (e.g. moose and caribou), trapping (e.g. beaver) and angling (e.g. salmon fishing on the Exploits River). Numerous gravel roads, formerly Abitibi forestry access roads that are now maintained by government, provide access to the area for

recreational and other users. The region contains private cabins and is used by outfitters. Marathon Gold reported that there are currently nine Crown Land surface rights applications within the boundary of the Valentine Lake mineral licences area. None of these applications has been granted. Only one of these applications occurs on land currently considered by Marathon for mining and infrastructure. Additionally, there are other cabins and approximately 50 outfitters that operate within a 60 km radius of the Project. The Provincial Wildlife Division has identified a Waterfowl Sensitivity Area at Victoria Steadies, which is part of Victoria River between Victoria Reservoir and Red Indian Lake, and is within the Project area but outside the proposed footprint. This Waterfowl Sensitivity Area was established for the protection of wetland habitat used as breeding, brood rearing, and staging grounds for waterfowl (J. Fenske, pers comm); however, it is not identified in the Newfoundland and Labrador Crown Land Atlas, a publicly available geodatabase published and updated by the provincial government. The Provincial Wildlife Division recommends a minimum 50 m naturally vegetated buffer be maintained along all wetlands and water bodies within the Victoria Steadies Wildlife Area for cabin owners and mineral exploration activities (J. Fenske, pers. comm.).

Marathon Gold, through their Community Engagement Strategy, will engage potentially affected stakeholders at various stages of the Project's evolution. The Qalipu Mi'kmaq First Nation and the Miawpukek First Nation are Indigenous groups with members residing in communities across the island of Newfoundland, and in and near a Reserve at Conne River. These two groups will be consulted through standard public engagement activities under the provincial EA review process. If a federal EA Project review is required as well, the CEA Agency will provide guidance on the extent of engagement activities required relative to these two groups.

A review of regional archaeological data indicates the potential for archaeological remains from the pre-contact period relative to the historic Beothuk and Mi'kmaq occupations of interior south-western Newfoundland. However, no known archaeological sites have been identified within the Project area. The potential for these areas to contain archaeological sites may have been reduced by the previous impacts of flooding from commercial logging and hydroelectric development (Stantec 2017b).

20.2 Jurisdiction, Applicable Laws and Regulations

The primary environmental regulatory requirement of provincial and federal governments is environmental assessment ("EA"). This section therefore focusses on the EA processes that currently apply for the province of Newfoundland and Labrador, and for Canada. Necessary and standard environmental permits and approvals are either captured within the EA processes or will be fulfilled once a release is granted from the EA review processes. Some of these permits and approvals include water use authorizations, fish and fish habitat authorization, emissions and discharge approvals, approvals for placement of some project components (e.g. tailings pond, water control structures, etc.), and other related items. Each of these permits or authorizations are applied for separately with relevant information included in the applications. Permits can only be issued after the Project is released from EA. A list of permits that may apply to the Project is provided in Section 20.4.

The proposed Project components and ancillary infrastructure are exclusively located within the province of Newfoundland and Labrador. As such, it is subject to the environmental assessment ("EA") provisions of Part X of the Newfoundland and Labrador *Environmental Protection Act*, and the *Environmental Assessment Regulations* (Section 33 (2)). As the proposed production rate is currently planned to be greater than 600 t/day, the Project will also be subject to the *Canadian Environmental Assessment Act 2012* (CEAA 2012) (Section 16 (c) of the Regulations Designating Physical Activities). In early February 2018, the federal government announced a new *Impact Assessment Act* to replace CEAA 2012 as early as 2019; please refer to Section 20.2.1 for more information on proposed changes to federal EA legislation.

Although there is no formal harmonization agreement between the province 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. Both the provincial and federal EA processes are stepped processes with provisions for public review and decisions being made at select points. Although both processes have legislated timelines for the review periods and decision steps, extensions are often implemented.

The initial step for each process is to register or file a project description containing information on the proposed project, surrounding environment, surrounding land and resource use, potential pollutants and discharges, potential interactions with the environment, applicable permitting and regulatory requirements, schedule, and labour force requirements with the EA Division of the provincial Department of Municipal Affairs and Environment, and with the Canadian Environmental Assessment Agency ("CEA Agency").

Based on government agency and public review, the Minister of the Department of Municipal Affairs and Environment (DMAE) and the CEA Agency issue decisions regarding the need for further EA review to allow for informed decision-making in their respective EA processes. If the Minister of DMAE identifies information gaps and is unable to make an informed decision based on the Registration document submitted, the proponent will be directed to prepare an Environmental Preview Report (EPR) or an Environmental Impact Statement (EIS). Under the federal process, an EIS or panel review may be called if the CEA Agency determines on their initial review of the project description that there is a potential for adverse environmental effects. Based on the current project description it is anticipated that both governments will require an EIS for this Project. Prior to drafting an EIS document, Marathon will be issued Project-specific Guidelines, to which the EIS must conform. Although there is a potential that two sets of EIS guidelines may be issued, generally one EIS document is developed to satisfy both sets of guidelines.

The EIS is prepared by the proponent. One of the first tasks in the preparation of an EIS is the identification of issues, determined in consultation with government and public stakeholders and, where applicable, with Indigenous groups. The identified issues are then addressed in the EIS and will include a description of the existing environmental and socioeconomic baseline conditions, and a predictive assessment of the effects of the proposed project on those biophysical and socioeconomic conditions. Commitments to implement mitigation measures and monitoring programs are typically required as well. Upon its completion, the EIS is submitted by the proponent to the provincial and federal governments for review by government agencies, public stakeholders, and by Indigenous groups under CEAA 2012. In the federal process, if any part of the EIS requires clarification, the CEA Agency will issue Information Requests (IR) to the proponent, who will provide responses until the items are adequately clarified. A formal IR process does not exist in the provincial process and in the past where substantial issues have required clarification, the provincial Minister has required proponents to do one of the following: amend the EIS, revise and submit another EIS or submit an amendment to the original EIS. In some cases, where a joint provincial and federal EIS submission is made by a proponent, the provincial government will issue IRs to follow the federal process. Once adequate information is available relative to the Project, i.e. complies with the EIS guidelines, both levels of government will then make their respective decisions regarding the potential for adverse environmental effects and whether the proposed project may be allowed to proceed.

20.2.1 New and Changing Regulations

CEAA 2012 and the Proposed Impact Assessment Act

As indicated above in Section 20.2, a new Act has been proposed to replace CEAA 2012, which may come into effect in 2019. Depending on the timing of promulgation, the status of the Project within CEAA 2012, and government determinations regarding transition guidance for Projects started under CEAA 2012, the Project

may be subject to the new *Impact Assessment Act* as it is currently understood. As proposed, the *Impact Assessment Act* differs from CEAA 2012 with respect to several key features: increased requirements for pre-filing consultation and on-going engagement with Indigenous groups, requirements to consider Indigenous rights, expertise and Traditional Knowledge, requirement for gender-based assessments, and revisions to decision-making criteria and authority. Although there is some uncertainty as to what the final *Impact Assessment Act* will prescribe, the duration of the federal EA process will likely be longer and the requirements to prepare an EIS are likely to generally be more rigorous compared to CEAA 2012.

The Fisheries Act and the Navigation Protection Act

The federal government has proposed to amend the *Fisheries Act* and the *Navigation Protection Act*, as early as 2019, renaming the latter, the *Canadian Navigable Waters Act*. As proposed, many of the provisions from a previous version of the *Fisheries Act* will be re-instated, reverting in large part to the concept of fish habitat protection, prohibiting harmful alteration, disruption or destruction of fish habitat (HADD) as prescribed in the *Fisheries Act* prior to 2012. Applications for HADD authorization and proposed compensation in the event of a HADD will likely be required. Other key amendments include strengthening the role of Indigenous peoples in application reviews, introduction of a new permitting framework and codes of practice, and the introduction of new decision-making criteria. The proposed amendments to the *Navigation Protection Act* will apply to all waters that have the potential for navigation, rather than a prescribed list of waterways, and will have provisions for increased Indigenous input into applications for use of navigable waters by project proponents. Similar to the proposed *Impact Assessment Act*, it is expected that there will be increased information requirements and a longer application review process as compared to the current situation.

Metal Mining Effluent Regulations

Regulations Amending the *Metal Mining Effluent Regulations* (MMER) were proposed in 2017 to strengthen effluent quality standards, improve the efficiency of environmental effects monitoring (EEM), and make diamond mines subject to the MMER. The following description is based on recently available information, and, as with any proposed Regulation, the final provisions may differ from those that are proposed. The majority of the proposed Amendments would come into force on the day on which they are registered, which is expected to take place in 2018. The proposed concentration limits for deleterious substances, i.e. more stringent limits for arsenic, copper, cyanide, lead, nickel, and zinc, as well as limits for un-ionized ammonia, and the requirement that effluent not be acutely lethal to Daphnia magna, or in cases of marine discharge, rainbow trout and/or threespine stickleback, would come into force three years after the date of registration, in 2021.

The allowable limits for deleterious substances have been 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. The proposed Amendments would strengthen the MMER’s performance measurement and evaluation requirements by adding a fish tissue study for selenium, as well as new substances to be monitored, i.e. chloride, chromium, cobalt, sulphate, thallium, uranium, phosphorus, and manganese. Sublethal toxicity testing will focus on the most sensitive test species, and biological monitoring studies will focus on aquatic communities facing situations of higher risk for environmental effects. The mercury in fish tissue threshold would also be amended to reduce the number of studies required in situations with low risk of effects on fish tissue. Exemptions may be allowed from some biological monitoring requirements for mines with effluent presenting lower risks of affecting fish and fish habitat. The proposed Amendments would also remove the current requirement for mines to conduct magnitude and geographic extent studies. In accordance with the amending regulations, the long title of the MMER will be changed to the *Metal and Diamond Mining Effluent Regulations*.

Carbon Emissions Pricing

The federal government announced in 2016 that a price will be imposed on carbon pollution throughout Canada by 2018; the date for implementation was subsequently clarified to be the end of 2018. Each province or territory is expected to design and implement its own carbon pricing system, as either a direct price on carbon pollution or as a cap-and-trade system. 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, which Newfoundland and Labrador signed in December 2016.

Although Newfoundland and Labrador have yet to come to an agreement with the federal government on which approach the province will take, a provincial carbon pricing plan is expected to be unveiled in the first or second quarter of 2018. The implications on resource development in Newfoundland and Labrador are not known at this time. Related to this, the Newfoundland and Labrador *Management of Greenhouse Gas Act* was introduced in 2016. It applies to industrial facilities, including mines that emit 15,000 tonnes of carbon dioxide equivalent or more of greenhouse gases (GHG) per year. Although its purpose is not explicitly stated within the Act, it appears to impose unspecified annual GHG emission reduction targets for industrial facilities that emit 25,000 t of carbon dioxide equivalent or more of GHGs per year, and the establishment of a GHG Reduction Fund, e.g. “cap and trade”. Uncertainty remains about how the provisions in the Act and associated Regulations will be implemented in practice.

20.3 Environmental Studies

The following lists the environmental baseline studies completed in support of the Project, between 2011 and 2017. All baseline studies listed below were conducted by Stantec Consulting Ltd. Additional surveys and studies are planned, including the continued assessment of acid rock drainage/metal leaching, pine marten hair snag surveys, fish and fish habitat surveys, hydrology, and hydrogeology.

- Fish and Fish Habitat (2011).
- Forest Songbirds (2011).
- Hydrology and Surface Water Quality Monitoring (2011 - 2016).
- Waterfowl (2011, 2017).
- Winter Wildlife (2013).
- Ecological Land Classification (2014, 2015).
- Historic Resources (2017).
- Hydrogeology (2017).
- Vegetation – Rare Plants (2017).
- Land and Resource Use (2017).
- Phase I Acid Rock Drainage/Metal Leaching (ARD/ML) Assessment (2017/2018).

20.4 Environmental Permitting

Upon release from the provincial and federal EA processes, numerous approvals, authorizations, and permits will be required prior to initiation of the Project[1]. Table 20.1 provides a list of approvals Marathon Gold already has in place. Table 20.2 provides a preliminary list of approvals, authorizations, and permits that may be required from various provincial and federal agencies.

Table 20.1 Key Environmental Approvals, Authorizations, and Permits Currently in Place

Environmental Permit, Approval or Authorization Activity	Issuing/Approval Agency
Surface and Mining Lease	Department of Natural Resources – Mineral Lands Division
Mineral Licence	

Table 20.2 Preliminary Environmental Approvals, Authorizations, and Permits that May Be Required

Environmental Permit, Approval or Authorization Activity	Issuing/Approval Agency
Provincial	
Release from EA Process	Department of Municipal Affairs and Environment (DMAE)– Minister
Approval of Environmental Protection Plan	
Monitoring Plan for C of A	DMAE – 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	DMAE – 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 Licence	
Permit to Construct a Potable Water System	
Permit to Occupy Crown Land	Department of Fisheries and Land Resources (DFLR) – Crown Lands Division
Permit to Control Nuisance Animals	DFLR – Wildlife Division

1 Municipal approvals, authorizations, and permits are not anticipated, as the Project is not located within a municipality.

Environmental Permit, Approval or Authorization Activity	Issuing/Approval Agency
Operating Permit to Carry out an Industrial Operation During Forest Fire Season on Crown Land	DFLR – Forestry and Agrifoods Agency
Permit to Cut Crown Timber	
Permit to Burn	
Development Plan	DNR – Mineral Development Division
Rehabilitation and Closure Plan	
Financial Assurance	
Mill Licence	
Quarry Development Permit	DNR – Mineral Lands Division
Blasters Safety Certificate	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)	
C of A for a Waste Management System	
C of A for a Sewage/Septic System	
Application to Develop Land for Septic	
Federal	
Release from EA Process	Canadian Environmental Assessment Agency*
Fisheries Act Authorization permitting serious harm to fish	Fisheries and Oceans Canada (DFO)
Tailings Impoundment Area Designation	Environment and Climate Change Canada (ECCC)
Initiate Metal Mining Effluent Regulations (MMER) process with ECCC including notification, identification of final discharge point, effluent monitoring, and environmental effects monitoring (EEM)	
Approval of MMER Emergency Response Plan	
Approval to Interfere with Navigation	Transport Canada
License to Store, Manufacture, or Handle Explosives (Magazine Licence)	Natural Resources Canada
*Depending on when the Project enters the EA process, the federal CEAA 2012 may be replaced by the recently proposed federal *Impact Assessment Act*	

Marathon Gold cannot apply for Project approvals, authorizations, or permits prior to release from the EA processes. However, some long-lead items can be initiated and discussed with regulators so that applications can be filed immediately upon release from the EA processes to reduce potential schedule delays. Compliance with terms and conditions of approvals, standards contained in federal and provincial legislation, regulations, and commitments made during the EA processes will need to be addressed throughout Project planning, construction, operation, and decommissioning.

20.5 Baseline Hydrology

Baseline hydrology studies for the Project site were completed by Stantec from 2012 – 2017. The following paragraphs provide a summary of the study.

The Valentine Lake Project has primarily focused on two locations, the Leprechaun Deposit and Marathon Deposit. The Leprechaun Deposit is comprised of two watersheds; one flowing north to Valentine Lake and the other flowing south to Victoria Lake. The Leprechaun Deposit consists of three ponds (Middle, East and West Ponds), small creeks, and wetlands. The Middle Pond and East Pond drains to Valentine Lake and the West Pond drains to Victoria Lake. The Marathon Deposit contains a series of small streams which drain east to the Victoria River and west to Valentine Lake. Valentine Lake and Victoria Lake drain to the Exploits River via Victoria River and Red Indian Lake. The total watershed area of the Exploits River is 10,241 km^2. Water discharge from the Exploits River is highly regulated by three dams located in Millertown, Grand Falls, and Bishops Falls. The mouth of Red Indian Lake was controlled by a dam located in Millertown. Victoria Lake is controlled by a dam at its outlet.

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. The mean annual flow per unit area was 0.028 $m^3/s/km^2$ with standard deviation of 0.003 $m^3/s/km^2$, and ranged from 0.020 $m^3/s/km^2$ to 0.034 $m^3/s/km^2$. Stream flow tends to peak twice a year in April - 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 provided for annual flows, low flows, and peak flows.

Local hydrologic conditions were assessed using the continuous water level data collected at three hydrometric monitoring stations from October 16, 2012 to July 16, 2017 and manual water discharge measurements at six hydrometric stations. Two hydrometric stations are located in a tributary to Valentine Lake, one at the outlet of Middle Pond and the other one at East Pond. Four hydrometric stations are located in a tributary to Victoria Lake including one at the West Pond outlet. Drainage areas of the monitoring stations range from 0.416 to 2.33 km^2. The mean annual flows ranged from 0.017 to 0.040 $m^3/s/km^2$ and agrees very well with regional estimates. The low flows ranged from 0.0001 to 0.008 $m^3/s/km^2$ and the peak flows ranged from 0.247 to 1.75 $m^3/s/km^2$. The monitored flows are controlled by the ponds as all the monitoring stations are located at pond outlets.

20.6 Hydrogeology

A preliminary baseline hydrogeology assessment was conducted in November 2017 to begin characterization of current groundwater conditions at the Valentine Lake site in support of mine development (the Project). The results of the baseline surveys will be used to support Registration and Project Description documents for the Project.

Based on a review of geological maps and aerial photographs, the overburden material in the vicinity of the Project generally consists of a discontinuous layer of till of variable thickness over exposed bedrock. 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 in the Valentine Lake intrusive complex (Van Staal et. al. 2005). A well-defined northeast trending thrust fault crosses the center of the Leprechaun Deposit.

Regional hydrogeological data was collected from "The Hydrogeology of Eastern Newfoundland" (AMEC 2013) and the majority of the Leprechaun and Marathon Deposits are located in what is referred to as hydrogeological Unit 5. The yields of wells drilled in Unit 5 are typically low to moderate with a median sustainable pumping rate of 14 L/min.

The direction of groundwater flow in the area is assumed to follow topography, which regionally would be to the south towards Victoria Lake. Locally, drainage from the Marathon Deposit is expected to travel east to northeast to Victoria River, draining into Victoria Lake to the south. Groundwater is thought to be recharging along the topographic highs and discharging along local surface water bodies including Victoria Lake. It is expected that the shallow groundwater system in the area will be largely controlled by surface runoff and local recharge, while at moderate depths the flow system may be influenced by recharge at higher elevations. Groundwater levels are generally assumed to be close to ground surface and to be a subdued reflection of the topography. Measured groundwater levels at the site ranged from surface (zero meters below ground surface (mbgs)) to approximately 2 mbgs. The movement of groundwater through the underlying bedrock can be expected to mainly occur within secondary openings, such as fractures and joints, and will be variable depending on the frequency and interconnection of these structural features. The underlying bedrock aquifer is likely to be under semi-confining conditions with recharge dominantly from lateral inflow of groundwater from adjacent upland areas.

Initial information on the hydrogeology of the area was through completing testing in existing exploration boreholes. Hydraulic conductivities calculated for the Marathon Deposit, based on preliminary hydraulic testing of three boreholes, range from 1.2 E-08 m/s to 1.5 E-07 m/s with an average K value of 7.8 E-08 m/s. Hydraulic conductivities were slightly lower in the Leprechaun Deposit, ranging from 5.1 E-09 m/s to 6.0 E-08 m/s and an average K value of 3.4 E-08 m/s.

To progress the project to pre-feasibility and feasibility stages, it is recommended to complete additional hydrogeological studies such as heat pulse flow meter, packer testing and piezometer installations.

20.7 Acid Rock Drainage

Preliminary key findings for Phase 1 ARD/ML assessment are:

- Material from the Leprechaun deposit can potentially contain up to 13% PAG material based on testing of eight samples. No MMER exceedances were observed in SFE leachates from materials. Exceedances of CWQG for aluminium (0.1 mg/L) were found in 66% of samples.

- Marathon material was conservatively classified as PAG and could potentially contain from 50% to 75% PAG materials. Additional testing of Marathon material is recommended to better define percentages of PAG materials. No MMER exceedances were observed in SFE leachates. Exceedances of CWQG for aluminium (0.1 mg/L) were found in 67% of samples.

- Tailings from Leprechaun deposits, are expected to be non-PAG and have excess of NP. This excess of NP can be used to offset ARD potential of tailings from Marathon if materials from Marathon and Leprechaun deposit are processed at the same time and mixed.

- Mine rock from the Leprechaun deposit has low ARD potential (less than 2% of samples are PAG). No MMER exceedances were observed in SFE leachates. Exceedances of CWQG for Al (0.1 mg/L) were found in 74% of SFE tests. Copper, arsenic and lead exceeded CWQG in 2 - 6% of samples indicating that these elements could be PPoC.

- Mine rock form the Marathon deposit could contain between 4% and 15% PAG material. MMER exceedances were observed in SFE leachates. Aluminium concentration exceeded CWQG (0.1 mg/L) in all SFE tests indicating that this element could be a PPoC.

20.8 Rehabilitation and Closure Planning

A complete Rehabilitation and Closure Plan has not been developed for the Valentine Lake Project at the time of document writing. The following sections describe the general rehabilitation and closure philosophies that will be used in the development of the Project's Rehabilitation and Closure Plan. The rehabilitation and closure costs estimated for this PEA are based on the current Project description, and is considered a Class D estimate ± 30%. The cost estimate is based on previous plans and experience on similar projects and complies with the current guidelines and accepted practices within Newfoundland and Labrador.

20.8.1 Rehabilitation Planning

For mining projects, a Rehabilitation and Closure Plan is a requirement under the *Newfoundland and Labrador Mining Act* (Chapter M-15.1 Section 8, 9 and 10). The plan will describe the process of rehabilitation for the project at any stage, up to and including closure. 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 Newfoundland and Labrador Department of Natural Resources. 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 possible or practicable to do so. This will include 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 operations cease, 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 ensure 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 NLDNR and an application to relinquish the property back to the Crown.

20.8.2 Proposed Approach to Rehabilitation and Closure

As the planning and design stages of the Project continue, consideration for the future closure issues and requirements will be incorporated into final plans. 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 area absolutely necessary to complete the required work as defined by the Project.
- Organic soils, mineral soils, glacial till, and excavated rock will be stockpiled separately wherever possible, and protected for future use.
- Stabilization of disturbances will be completed to reduce erosion and promote natural re-vegetation.
- Natural re-vegetation will be encouraged throughout the Project.

20.8.3 Progressive Rehabilitation

As the mine advances from development to operational stages, opportunities for progressive rehabilitation are possible. Some such opportunities include but are not limited to the following:

- Demolishing and rehabilitation of construction or exploration related buildings, roads, laydown areas, etc.
- Grading and revegetation of completed tailings areas, if possible.
- Erosion stabilization and re-vegetation of completed overburden and/or waste rock dump area.
- Infilling or flooding of exhausted mining areas.
- Completing re-vegetation studies and trials.

20.8.4 Closure Rehabilitation

Closure rehabilitation activities will be carried out, as previously described, at the mine site once it is no longer economical to mine or all resources have been exhausted. These activities are based on the assumption that progressive rehabilitation will be completed by Marathon Gold, and final closure activities will be completed by a third-party contractor as required by the *Mining Act* and associated guidelines. The costing is based on a third party completing and managing the work. Any associated credit for salvageable materials and equipment is not accounted for in the cost estimate, as outlined in the *Mining Act*. However, these options will be pursued upon closure. The preliminary closure activities associated with the major components of the Project are described in the following sections. In general, the closure activities that will be completed for the site include but not limited to the following:

- Removal of all hazardous chemicals, reagents, and similar materials for re-sale or disposal at an approved facility as per provincial regulations.

- All equipment will be disconnected, drained and cleaned, disassembled, and where possible, sold for re-use to a licensed scrap dealer. If this is not achievable, equipment will be removed from site for disposal or recycled at an approved facility.
- Dismantling and removal of all site buildings and surface infrastructure, for disposal or recycled at approved facilities.
- Demolishing all concrete foundations to a minimum of 0.3 m below the surface grade and covering with natural materials to promote re-vegetation. The demolished concrete will be removed from site for disposal in an appropriate facility.
- Removal and rehabilitation of fuel and explosive storage and dispensing facilities. This will include a Phase I and potentially a Phase II Environmental Site Assessment (ESA).
- Breaching of sedimentation, stormwater, and emergency event 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.
- Decommissioning of all wells on site; includes dewatering wells, groundwater monitoring wells, potable drinking water wells and/or industrial water wells. The decommissioning will be in compliance with Government of Newfoundland and Labrador Department of Environment and Conservation Water Resources Management Division Guidelines for Sealing Groundwater Wells.
- Re-establishment of pre-mining site drainage patterns.
- Grading and/or scarification of all disturbed areas to promote natural re-vegetation. This may include placement and grading of overburden materials in areas where natural re-vegetation is not rapid enough to control site erosion and sedimentation.

Open Pits

Upon closure, all dewatering infrastructure will be removed and the open pit(s) will be allowed to naturally infill with surface water run-off, precipitation and groundwater seepage ultimately flooding the pit creating ponds. Berms 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 signage will be erected at regular intervals along the berm notifying pedestrians of the open pit. The berms will be constructed such that, it will promote natural re-vegetation.

Waste Rock Dumps

Two waste rock dumps will be created throughout the operational life of the Project. These dumps are terraced and will be constructed to a slope of three horizontal to one vertical (3H:1V) to promote stability upon closure. Where required, the waste rock dump will be graded, and overburden placed to promote natural re-vegetation.

Tailings Storage Facility

The tailings that are produced as part of the mineral extraction process will be stored on site in an impounded TSF. The TSF embankment will be constructed with a downstream slope of 1.8 horizontal to one vertical

(1.8H:1V) and preliminary designs have the maximum elevation upon closure at 410.0 m, approximately 36 m at the highest point of the embankment.

Upon closure, the TSF will be capped with material to fill in the freeboard on the tailings embankment and a layer of overburden will be placed over the surface to promote re-vegetation. The slopes will be re-graded to achieve the required 2H:1V closure slopes. This may require the placement of additional rockfill material. Once the closure slopes are achieved, they will be re-vegetated to reduce erosion and promote long-term stability.

Heap Leach Pad

Low grade material mined at the Project will be placed on a Heap Leach Pad (HLP). Preliminary designs for the HLP has slopes of two Horizontal to one Vertical (2H:1V) and will be terraced with each terrace being a maximum height of 40 m

Once economic leaching has been completed, the HLP will be rinsed with fresh water to remove residual cyanide and meet the required water quality requirements. The water can be recirculated through the HLP and it may be necessary for the water to go through the water treatment facility prior to final discharge. It is assumed that the rinsing of the HLP will take a maximum of a year to complete, however further analysis will be required to determine the actual rinsing requirements. Once the rinsing is completed, and where necessary, the slopes will be re-graded to form uniform slopes. Overburden will be placed on the HLP and graded to promoted natural re-vegetation, or placement of seed mix.

20.8.5 Post-Closure and Long-Term Monitoring

The post-closure monitoring program will continue after final closure activities are completed for an estimated 10 years. However, the monitoring period could be shortened based on the satisfaction of the regulatory bodies that all physical and chemical characteristics are acceptable and stable. When the Project is deemed physically and chemically stable, the site will be relinquished to the Crown.

The post-closure and long-term monitoring plans are yet to be developed. These programs will be developed once the Project is designed and operations have been sufficiently advanced. 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 post closure time increases the monitoring requirements will decrease until ultimately, they will no longer be required.

20.8.6 Cost Estimate for Closure

The estimated cost to complete the closure activities for the Valentine Lake Project is based on the current level of detail for the Project and is equivalent to a Class D Estimate (+ 30%). The preliminary cost for closure is estimated to be CAD22.2M, excluding HST. This cost includes the applicable percentages for project management, engineering, and contingency, as outlined in the Mining Act and is based on currently available Project details.

20.8.7 Financial Assurance

As defined in the *Mining Act*, a lessee shall provide Financial Assurance as part of a Rehabilitation and Closure Plan. The Financial Assurance 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 Lake Project. It is understood that it is required in future assessment studies.

20.9 Community Relations and Consultation

20.9.1 Community and Indigenous Relations

Marathon understands that exploring and developing Newfoundland and Labrador's rich resource potential sustainably requires building long-term relationships and investment in people and communities. While industrial activity often brings much needed economic growth and opportunity to communities and regions, it is important that stakeholders most likely to be affected by the activities understand the potential impacts and have confidence that any impact mitigations have incorporated their concerns. Consultation with members of the public, communities, Indigenous groups, associations, and government regulators who may have an interest in, or be affected by the Project, is key to operating within a sustainable development framework.

Marathon has engaged consultants with experience in consultation and engagement for similar projects in NL to develop strategies with respect to stakeholder engagement that Marathon will implement based on recent Project planning and definition. Marathon has conducted relatively informal stakeholder consultation to date, however with a better-defined Project scope, Marathon will now formally engage stakeholders as part of the Project planning and regulatory stage of Project development.

Marathon maintains stakeholder engagement and procurement policies that will be used to guide these activities as the Project advances. It is Marathon's objective to pursue positive and constructive relationships with all stakeholders throughout the life of the Valentine Lake Project.

Marathon is developing a Consultation Strategy to guide in building these relationships, and this Strategy in turn is guided by Marathon's Community Relations Policy (Figure 20.3). This Strategy also includes drafting a potential stakeholder list, which will be dynamic and modified as necessary throughout the life of the Project (Table 20.3). Part of the Consultation Strategy will be the maintenance of a tracking system to record stakeholder consultation and engagement activities. In addition to recording specific engagement events and participants, the tracking system will also serve as a repository of issues, concerns, and questions raised, as well as a record of Marathon's responses (where applicable). The tracking system will be maintained throughout the life of the Project, from the planning stages through to decommissioning.

Figure 20.1 Marathon Gold Community Relations Policy

Community Relations Policy

Exploration and mining activity can bring much needed social and economic benefit to communities and regions when potential environmental and socioeconomic impacts are understood and well-managed in collaboration with those communities.

Marathon Gold is committed to community engagement and we believe that social and economic considerations respecting local communities and stakeholders are integral to all stages of exploration and mining projects. Early development of meaningful relationships and maintaining respectful dialogue with local community leaders and members of the community will benefit Marathon Gold's projects and the surrounding communities, and will help to ensure our projects are sustainable and successful in all aspects.

Engagement activities that acknowledge, consider, and respond to the concerns of local people, communities, and other stakeholders in a timely manner, as well as provide regular project information updates, aid to alleviate and mitigate concerns relative to issues such as environmental protection, human health, land use, employment and economic development opportunities, as well as local services and infrastructure.

Marathon Gold will conduct community engagement activities in a transparent and culturally appropriate manner, and will endeavour to provide simple and safe mechanisms whereby individuals, groups, and communities can provide input and voice their concerns. Marathon Gold's engagement process will ensure that community concerns are respected and considered for incorporation into key decision-making processes.

Marathon Gold believes that community engagement is a normal part of doing business, as is building community trust and support. Marathon Gold is committed to working with local communities to develop sustainable projects which create value for our stakeholders and shareholders.

Table 20.3 Preliminary Stakeholder List

Category	Sub-Category	Stakeholder
Government	Provincial	Department of Advanced Education, Skills, and Labour
		Executive Council – Intergovernmental and Indigenous Affairs Secretariat
		Executive Council – Women's Policy Office
		Department of Finance
		Department of Fisheries and Land Resources (DFLR) – Lands Branch
		DFLR – Wildlife Division
		DFLR – Forestry and Agrifoods
		Department of Health and Community Services
		Department of Justice and Public Safety
		Department of Municipal Affairs and Environment (DMAE) – Fire, Emergency, and Corporate Services Branch
		DMAE – Water Resources Management Division
		DMAE – Pollution Prevention Division
		DMAE – Environmental Assessment Division
		DMAE – Climate Change Branch

Category	Sub-Category	Stakeholder
		Department of Natural Resources (DNR) – Executive Support Branch
		DNR – Mines Branch
		Service NL – Regulatory Affairs Branch
		Service NL – Government Services Branch
		Department of Tourism, Culture, Industry and Innovation (DTCII)– Business Branch
		DTCII – Regional Development and Diversification Branch
		DTCII – Provincial Archaeology Office
		Department of Transportation and Works
		Provincial Advisory Council on the Status of Women Newfoundland and Labrador
		Workplace NL
	Federal	Canadian Environmental Assessment Agency (CEA Agency)
		Environment and Climate Change Canada (ECCC)
		Fisheries and Oceans Canada (DFO)
		Transport Canada (TC)
	Municipal	Town of Buchans
		Town of Millertown
		Town of Badger
		Town of Grand Falls-Windsor
Community Groups	Indigenous	Qalipu Mi'kmaq First Nation
		Miawpukek First Nation
	Economic Development and Industry Groups	Newfoundland and Labrador Organization of Women's Entrepreneurs (NLOWE)
		Exploits Regional Chamber of Commerce
	Outfitters and Recreation	Local Cabin Owners
		Newfoundland and Labrador Outfitters Association (NLOA)
		Salmonid Association of Eastern Newfoundland (SAEN)
		The Salmon Preservation Association for the Waters of Newfoundland (SPAWN)
	Education, Social Services, and Health	College of the North Atlantic
		Central Health
		Royal Newfoundland Constabulary
		Royal Canadian Mounted Police

20.9.2 Industry Relations

Marathon has been an active member of the NL mining industry community for more than eight years. This time has been spent fostering relationships with supply and service companies in support of Marathon Gold's on-going exploration activities. Marathon Gold has maintained a presence at local and provincial industry conferences, including being an active participant at the Mineral Resources Review, held annually in St. John's, and the Baie Verte Mining Conference, held annually on the Baie Verte Peninsula. In addition, Marathon Gold has held a seat on the Mining Industry Newfoundland and Labrador's Board of Directors for the past three years.

20.9.3 Government Consultation

Marathon has consulted, and will continue to consult, with provincial and federal departments to discuss plans and activities occurring on-site since initiating exploration activities at the Valentine Lake site in 2010. Since that time, Marathon Gold has maintained an internal tracking table of interactions with regulators. This table will form the initial version of the tracking system described in Section 20.9.1. Since 2010, Marathon Gold has met with officials from the following provincial and federal departments and divisions:

- Provincial Government:
  - Department of Natural Resources:
    - Mines Branch
    - Forestry and Agrifoods Agency (now part of the Department of Fisheries and Land Resources).
  - Department of Environment and Conservation/Department of Municipal Affairs and Environment:
    - Wildlife Division (now part of the Department of Fisheries and Land Resources)
    - Environmental Assessment Division.
  - Service NL, Occupational Health and Safety Division
- Federal Government:
  - Fisheries and Oceans Canada.

21.0 CAPITAL AND OPERATING COSTS

21.1 Capital Cost Summary

The capital estimate for the Project is summarized in Table 21.1 by area and Table 21.2 by discipline.

All costs are expressed in United States Dollars unless otherwise stated, and are based on Q3 2018 pricing and deemed to have an overall accuracy of ±35%. The capital cost estimate conforms to AACEI (Association for the Advancement of Cost Engineering International) Class 5 estimate standards as prescribed in recommended practice 47R11.

The capital cost estimate was based on an engineering, procurement and construction management ("EPCM") implementation approach and typical construction contract packaging. Equipment pricing was based on quotations and actual equipment costs from recent similar Lycopodium projects considered representative of the Project.

Table 21.1 Capital Estimate Summary by Area (Q3 2018, ±35%)

Area	$ Including Contingency/Excluding Duties and Taxes
000 Construction In-directs	$21,257,000
100 Treatment Plant Costs - Heap Leach Circuit	$47,626,000
100 Treatment Plant Costs - Milling Circuit	$92,739,000
200 Reagents & Plant Services - Heap Leach Circuit	$4,030,000
200 Reagents & Plant Services - Milling Circuit	$21,355,000
300 Infrastructure	$73,192,000
400 Mining[#]	$56,231,000
500 Management Costs	$22,434,000
600 Owners Project Costs	$16,440,000
Subtotal Directs	**$355,303,000**

[#]Mining capital costs are based on leased mining equipment and the initial capital is a 30% down payment of the mine fleet. This cost includes mine services and pre-production stripping.

Table 21.2 Capital Estimate Summary by Discipline (Q3 2018, ±35%)

Table Title	Supply Cost ($)	Freight Cost ($)	Installation Cost ($)	Contingency ($)	Total ($)
A General	$231,000	$23,000	$83,000	$101,000	$438,000
B Earthworks	$29,127,000	-	$4,786,000	$3,716,000	$37,629,000
C Concrete	$11,713,000	-	$8,538,000	$4,253,000	$24,504,000
D Steelwork	$5,849,000	$737,000	$5,633,000	$2,566,000	$14,785,000
E Platework	$2,802,000	$4,000	$2,530,000	$1,121,000	$6,456,000
F Mechanical	$58,607,000	$6,697,000	$18,839,000	$17,856,000	$101,999,000
G Piping	$6,076,000	$129,000	$5,911,000	$2,632,000	$14,748,000
H Electrical	$10,779,000	-	$3,312,000	$2,981,000	$17,071,000
J Instrumentation & Control	$1,225,000	-	$816,000	$429,000	$2,470,000
M Buildings & Architectural	$30,583,000	$1,090,000	$4,168,000	$7,527,000	$43,367,000
N Mining[#]	$52,960,000	-	-	-	$52,960,000
O Owners*	$13,865,000	$146,000	$538,000	$1,891,000	$16,440,000
P EPCM	$18,852,000	-	-	$3,582,000	$22,434,000
Subtotal Directs	**$242,669,000**	**$8,826,000**	**$55,154,000**	**$48,654,000**	**$355,303,000**

***The owner costs shown in Table 21.2 above include an additional cost for spares, first fills and mobile equipment.**
[#]Mining capital costs are based on leased mining equipment and the initial capital is 30% down payment of the mine fleet. This cost includes pre-production stripping.

The following exchange rates have been used in the compilation of the estimate:

Table 21.3 Currency Exchange Rates

Table Title	USD
AUD	0.78
USD	1.00
Euro	1.23
Rand	0.09
CAD	0.77

21.2 Mine Capital Costs

Capital costs for the proposed mining operations are based on the equipment requirements described in Chapter 16. The capital costs are estimated from vendor quotes (for major equipment) and BOYD's experience with similar-sized surface mining operations. As it is anticipated that the life-of-mine will be shorter than the productive life of the equipment, no replacement capital is included in our economic analysis. Marathon plans on leasing the mining fleet described below.

The capital cost estimate (not including any finance or interest charges) for the mining operation comprises purchase costs for the mobile equipment shown in Table 21.4.

Table 21.4 Required Mining Equipment for the Valentine Lake Project

Description	Manufacture & Model	Units Required	Capital ($)
Haul Truck	Cat 777G	37	$62,234,000
Wheel Loader	Cat 993K	6	$16,128,000
Production Drill	Epiroc Smartroc D65	11	$15,213,000
Wheel Dozer	Cat 834K	2	$4,831,000
Tracked Dozer	Cat D10T2	3	$5,358,000
Tracked Dozer	Cat D8T	2	$1,978,000
Motor Grader	Cat 16M	4	$5,308,000
Water Truck	Cat 777G	4	$6,728,000
Support Excavator	Cat 336D2	1	$444,000
Skidsteer Loader	Cat 242B	2	$132,000
Hydraulic Rock Breaker	-	1	$112,000
Fuel/Lube Truck	-	3	$1,503,000
Mechanics Truck	-	2	$588,000
Welding Truck	-	1	$282,000
Crane (25 Ton)	-	1	$165,000
Pick Up Trucks	-	8	$416,000
Crew Vans	-	4	$252,000
Tractor/Trailer with 50t Lowboy	-	1	$396,000
Portable Light Towers	-	12	$204,000
Mine Planning/Surveying Equipment	-	1	$550,000
Total Mine Capital (LOM)			**$122,822,000**

21.3 Process Plant and Infrastructure Capital Cost

21.3.1 Overview

The capital costs for the process plant and infrastructure capital are based on the facilities described in Chapters 17 and 18, and prepared by Lycopodium with input from Stantec on the TSF and heap leach pad.

The purpose of the capital cost estimate is to provide substantiated costs which can be utilized to assess the preliminary economics of the Project. The capital cost estimate is based on an engineering, procurement and construction management (EPCM) implementation approach and horizontal (discipline based) construction contract packaging.

Equipment pricing was based on quotations and actual equipment costs from other recent similar Lycopodium projects considered representative for the Project.

The capital and operating cost estimates are expressed in United States Dollars unless otherwise stated, are based on the Q3 2018 pricing and are deemed to have an overall accuracy of ±35% respectively. The capital cost estimate conforms to AACEI (Association for the Advancement of Cost Engineering International) Class 5 estimate standards, as prescribed in recommended practice 47R11.

The various elements of the Project estimate have been subject to internal peer review by Lycopodium and have been reviewed for scope and accuracy.

Cost details per area are provided in Table 21.5.

Table 21.5 Capital Estimate Summary by Plant Area Code (Q3 2018, ±35%)

Main Area Code/Plant Area	Supply Cost ($)	Freight Cost ($)	Installation Cost ($)	Contingency ($)	Total ($)
000 Construction In-directs	**$6,187,535**	**-**	**$10,541,916**	**$4,527,651**	**$21,257,102**
001 Construction In-directs Contractors	$6,187,535	-	$10,458,839	$4,502,728	$21,149,102
040 Construction Operations	-	-	$83,077	$24,923	$108,000
100 Treatment Plant Costs - Heap Leach Circuit	**$33,449,158**	**$1,109,498**	**$6,020,446**	**$7,046,501**	**$47,625,604**
120 Feed Preparation	$12,520,182	$220,539	$3,222,199	$3,352,213	$19,315,133
130 Heap Leach	$16,544,174	$426,333	$466,243	$2,186,606	$19,623,357
140 Pregnant and Barren Solution	$1,805,260	$152,389	$1,185,155	$659,989	$3,802,793
160 Leaching	$2,579,542	$310,238	$1,146,848	$847,692	$4,884,321
100 Treatment Plant Costs - Milling Circuit	**$49,279,414**	**$4,883,275**	**$22,439,595**	**$16,136,314**	**$92,738,597**
120 Feed Preparation	$5,005,379	$379,001	$2,848,659	$1,728,938	$9,961,977
130 Milling	$19,024,838	$2,170,725	$6,925,336	$5,905,389	$34,026,287
140 Pregnant and Barren Solution	$1,742,680	$211,420	$592,032	$534,688	$3,080,821
140 Screening / Tailings	$9,014,119	$883,430	$4,571,006	$3,038,397	$17,506,952
150 Flotation	$8,534,317	$649,107	$4,810,220	$2,938,665	$16,932,309
160 Leaching	$2,440,622	$275,205	$921,701	$763,881	$4,401,408
170 Desorption	$3,517,459	$314,386	$1,770,642	$1,226,357	$6,828,844
180 Refining	$5,005,379	$379,001	$2,848,659	$1,728,938	$9,961,977

Main Area Code/Plant Area	Supply Cost ($)	Freight Cost ($)	Installation Cost ($)	Contingency ($)	Total ($)
200 Reagents & Plant Services - Heap Leach Circuit	**$1,557,101**	**$104,552**	**$1,668,904**	**$699,417**	**$4,029,974**
210 Reagents	$550,409	$40,466	$427,394	$213,836	$1,232,105
220 Ponds	$391,985	$5,423	$835,547	$258,920	$1,491,875
230 Water Services	$282,306	$18,545	$259,595	$117,694	$678,140
250 Air Services	$332,401	$40,117	$146,369	$108,966	$627,854
200 Reagents & Plant Services - Milling Circuit	**$13,061,787**	**$1,438,915**	**$3,771,033**	**$3,083,391**	**$21,355,126**
210 Reagents	$1,832,566	$128,759	$1,156,616	$654,768	$3,772,709
230 Water Services	$6,443,056	$700,206	$1,922,454	$1,903,800	$10,969,517
240 Water Services	$3,730,877	$518,077	$365,702	$215,404	$4,830,060
250 Air Services	$893,077	$76,256	$287,722	$263,982	$1,521,037
260 Fuels	$162,210	$15,617	$38,540	$45,437	$261,804
300 Infrastructure	**$51,612,058**	**$927,579**	**$9,533,146**	**$11,119,590**	**$73,192,374**
301 Infrastructure - General	$2,811,841	$23,077	$2,708,832	$1,106,264	$6,650,015
330 Power Supply	$7,814,000	-	$1,335,317	$1,943,407	$11,092,724
340 Tailings Dam	$12,176,877	$20,367	$1,947,281	$1,090,529	$15,235,054
350 Plant Buildings	$8,040,844	$884,135	$3,541,717	$2,618,006	$15,084,701
370 Base Camp	$20,768,496	-	-	$4,361,384	$25,129,880
400 Mining	**$54,805,621**	**$216,125**	**$641,255**	**$567,546**	**$56,230,548**
451 Mine Equipment (30% downpayment)	$35,837,400	-	-	-	$35,837,400
452 Prestrip Costs	$17,123,000	-	-	-	$17,123,000
410 Mine Services	$1,845,221	$216,125	$641,255	$567,546	$3,270,148
500 Management Costs	**$18,851,889**	**-**	**-**	**$3,581,859**	**$22,433,747**
510 EPCM	$18,851,889	-	-	$3,581,859	$22,433,747
600 Owners Project Costs	**$13,864,837**	**$146,160**	**$537,831**	**$1,891,348**	**$16,440,175**
610 Owners Costs - General	$10,243,727	$146,160	$537,831	$1,420,603	$12,348,321
620 Plant & Admin Pre-Production	$1,256,955	-	-	$163,404	$1,420,359
640 Spare Parts	$2,094,924	-	-	$272,340	$2,367,265
660 Vendor Representatives	$269,231	-	-	$35,000	$304,231
Grand Total	**$242,669,400**	**$8,826,104**	**$55,154,127**	**$48,653,617**	**$355,303,247**

21.3.2 Estimating Methodology

General arrangement drawings have been produced at a PEA level to permit the assessment of preliminary engineering quantities for earthworks, concrete, steelwork, mechanical and electrical for the processing plant and infrastructure.

The layouts have been based on recently completed facility designs, modified construction and as-built drawings of past project facilities, as well as initial concept drawings.

Unit rates were established for bulk materials, capital equipment and labour from current in-house data. Stantec provided some unit rates for the TSF and heap leach pad.

21.3.3 Quantity Development

The Project works were quantified to represent the defined scope of work and to enable the application of rates to determine costs.

Quantity information was derived from a combination of sources and categorized to reflect the maturity of design information as follows:

- Study Engineering: includes quantities derived from concept or preliminary engineering for the purpose of the study.
- Estimated: includes quantities derived from sketches or redline mark-ups of previous project drawings/data by estimating or similar projects.
- Factored: quantities derived from percentages applied as a factor based on experience.

The derivation of quantities is provided in Table 21.6 below, weighted by value of the direct permanent works (i.e. excluding temporary works, construction services, commissioning assistance, engineering costs, escalation and contingency).

Table 21.6 Derivation of Quantities

Classification	Approximated Quantity	Unit	Study Engineering %	Estimated %	Factored
Earthwork	n/a	m^3	31%	69%	-
Concrete	12,555	m^3	-	73%	27%
Structural Steel	1,186	t	-	97%	3%
Platework	723	t	-	63%	37%
Mechanical Equipment	570	pieces	79%	21%	-
Piping	n/a	lot	38%	-	62%
Electrical	n/a	lot	-	16%	84%
Instrumentation and Control	n/a	lot	-	-	100%

21.3.4 Scope of Work - WBS Areas 000 through 600

Areas 000 through 200 – Process Plant areas

Process Plant capital costs include for all labour, bulk materials, freight spares for complete process plant construction. Both Milling and Heap Leach plants include: construction in-directs, freight and project in-directs.

Heap Leach pad – preliminary design concept was developed by Stantec and estimated costs were included in overall process plant construction. The Heap Leach Pad was quantified and quoted by multiple vendors.

Areas 300 – Infrastructure

The infrastructure included in the capital cost includes: Camp and Catering (for permanent 200 person camp to be utilized during construction including a temporary construction camp for 300 persons), potable water and wastewater, communications, recreation facilities and mess hall, reagents storage shed, office buildings and control rooms, crushed material stockpile dome (55.4 m dia.), main warehouse and office, medical centre, administration building, wet and dry laboratory, gatehouse, substation buildings, plant ablutions, overhead power line, and access road upgrade. The main access road upgrade consists of an initial upgrade intended to be constructed in pre-production phase. Subsequent road upgrades or maintenance will be assessed within the first two to three years of commercial production.

The first stage of the TSF and Polishing Pond Dam was designed by Stantec and estimated costs were included in overall process plant construction. Both Tailings Storage Facility and Polishing Pond were quantified and quoted by multiple vendors.

Area 400 – Mining

Mining initial capital costs were developed by John T. Boyd Company. All material movement, preproduction costs including drill and blast, load and haul, support, rehandle costs and Mine G&A has been accounted for in initial capital. Any capital equipment such as production drills, loaders, and haul trucks necessary for preproduction has also been included.

Area 500 – Management Costs

The estimate for Engineering, Procurement and Construction Management (EPCM) includes labour costs, living expenses, travel expenses, specialist consultants, communication, computer charges and engineering fees.

21.3.5 Pricing Basis

Estimate pricing was derived from a combination of the following sources:

- Budget Quotation: Budget pricing solicited specifically for the study or project estimate.
- Database: Historical database pricing that is less than six months old.
- Estimated: Historical database pricing older than six months, escalated to the current estimate base date.
- Factored: Factored from costs with a basis.

Table 21.7 summarizes the source of supply pricing by major commodity, weighted by value of the direct permanent works (excluding temporary works, construction services, commissioning assistance, EPCM costs, installation and contingency).

Table 21.7 Source of Pricing

Classification	Budget Quotation %	Database %	Estimated %	Allowance/ Factored %
Earthwork	54%	43%	2%	1%
Concrete	61%	1%	23%	15%
Structural Steel	-	93%	-	7%
Platework	-	59%	-	41%
Mechanical Equipment	2%	82%	14%	2%
Piping	-	23%	-	77%
Electrical	-	-	72%	28%
Instrumentation and Control	-	-	-	100%
Buildings & Architectural	69%	13%	18%	-

Bulk Materials

This component covers all other materials, normally purchased in bulk form, for installation on the project. Costs include the purchase price ex-works, any off-site fabrication, and transport to site (unless otherwise stated), and over-supply for anticipated wastage.

Plant Equipment

This component represents prefabricated, pre-assembled, off-the-shelf types of mechanical or electrical equipment item. Pricing is inclusive of all costs necessary to purchase the goods ex-works; generally excluding delivery to site (unless otherwise stated) but including operating and maintenance manuals. Vendor representation and commissioning spares have been allowed for separately in the estimate.

Installation

This component represents the cost to install the plant equipment and bulk materials on site or to perform site activities. Installation costs are further divided between direct labour, equipment and construction indirect costs.

The labour component reflects the cost of the direct workforce required to construct the Project scope. The labour cost is the product of the estimated work hours spent on site multiplied by the cost of labour, inclusive of overtime premiums, statutory overheads, and payroll burden.

The equipment component reflects the cost of the construction equipment and running costs required to construct the Project. The equipment cost also includes cranes, vehicles, small tools, consumables, and Personal Protective Equipment (PPE).

The labour rates and equipment costs estimated were built up using first principles and validated against local contractor's quotation wherever possible.

Field In-directs

Construction indirect costs encompass the remaining cost of installation and include items such as offsite management, onsite staff and supervision above trade level, crane drivers, equipment and labour mobilization and demobilization.

Construction indirect costs for all direct labour is included for all works in the capital estimate. This is inclusive of PPE, travel and clothing. Earthworks rates are inclusive of fuel, maintenance and running costs of machinery. Construction equipment and project cranes are included in the capital cost estimate.

Rest and Recreation (R&R), meals and accommodation costs were considered as part of the camp operation costs.

Freight

The freight estimate was derived from the following:

- The most likely country of origin.
- By calculation as a percentage of supply costs for items where freight tonnes and bulk volumes are yet to be determined.
- By benchmarking against similar projects.

21.3.6 Engineering Services

The estimate for engineering design and construction management services was factored based on previous Lycopodium experience for similar sized projects, and based on percentage of plant project costs and is about 10%.

21.3.7 Owner's Costs

An Owner's cost allowance has been included to cover the following:

- Permits and Licences.
- Project Team and expenses.
- Pre-production labour.
- Head office fees, expenses and consultants.
- First fills (grinding media, lubricants, fuel, and reagents).
- Plant mobile equipment.
- Project spares.

- Vendor representative and training costs for the process plant.
- Only the preproduction years are included in the initial capital cost, future owner's costs are not carried in initial capital.

21.3.8 Duties and Taxes

The capital estimate generally excludes all federal and state taxes and duties.

21.3.9 Project Insurances

Project insurances have been excluded from the estimate.

21.3.10 Contingency

An amount of contingency has been provided in the estimate to cover anticipated variances between the specific items allowed in the estimate and the final total installed project cost. The contingency does not cover scope changes, etc., or the listed qualifications and exclusions.

Contingency has been applied to the estimate on a line-by-line basis as a deterministic allowance by assessing the level of confidence in each of the defining inputs to the item cost, these being engineering, estimate basis and vendor or contractor information, and then applying an appropriate weighting to each of the three inputs. It should be noted that contingency is not a function of the specified estimate accuracy which should be measured against the project total that includes contingency.

The resultant contingency for the project is 16% before taxes, duties and inspection.

21.3.11 Escalation

There is no allowance for project escalation in the Capital Cost Estimate.

21.3.12 Qualifications and Assumptions

The capital estimate is qualified by the following assumptions:

- The base date for the bulk of pricing for the estimate is Q3 2018.
- Prices of materials and equipment with an imported content have been converted to USD at the rates of exchange stated previously in this document. All pricing received has been entered into the estimate utilizing native currencies wherever possible.
- The bulk earthworks commodity rates that include imported material are based on the assumption that suitable construction/fill materials will be available from borrow pits within 2 km of the work fronts.
- Engineering quantities and rates for the TSF and Heap Leach Pad have been provided by Stantec. Sub-consultant design costs related to these work scopes for project implementation have also been included.

- There is no allowance for unforeseen blasting in the bulk earthworks cost estimates, given the results of the site geotechnical investigation.
- The estimate allows for supply of structural steel and minor platework from Eastern Canada.
- It has been assumed mobile equipment purchased and used by the owner's construction team will be handed over to the owner's operations team upon completion of construction. No allowance for additional mobile equipment has been made for operations.
- Mining Costs have been provided by BOYD. The mining fleet comprises of 95 t haul trucks.
- The camp costs have been estimated for 500 people, in which 300 people will be working for nine months and the remainders will be using it for the two years of the entire period of engineering and construction.

21.3.13 Exclusions

The following items are specifically excluded from the capital cost estimate:

- Permits and licences.
- Project sunk costs.
- Federal and state taxes and duties.
- Exchange rate variations.
- Sustaining Capital Costs.

21.4 Total Operating Costs

The process plant operating is $7.87 /t of material processed, mining operating cost $14.45 /t of material for a total operating cost of $22.49 /t of material. The annual rate of material mining is 6.0 Mtpa, the average rate of heap leaching is 3 Mtpa and the average rate of milling is 3.0 Mtpa.

The operating costs for the facilities are summarized in Table 21.8.

Table 21.8 Total Operating Cost Summary (Q3 2018, +35%)

Cost Centre	Total Operating Cost		Proportion of Operating Cost
	$/y	$/t Processed	
Plant: Milling[1]			
Operating Consumables [4]	$22,367,756	$7.46	16.6%
Plant Maintenance	$1,649,092	$0.55	1.2%
Power [5]	$5,514,058	$1.84	4.1%
Laboratory	$82,202	$0.03	0.1%
Labour (O & M)	$3,443,952	$1.15	2.6%
Subtotal - Milling	$33,057,060	$11.02	24.5%
Plant: Heap Leach[2]			
Operating Consumables	$3,745,846	$1.25	2.8%
Plant Maintenance	$787,950	$0.26	0.6%
Power	$592,031	$0.20	0.4%
Laboratory	$20,641	$0.01	0.0%
Labour (O & M)	$2,899,369	$0.97	2.1%
Subtotal - Heap Leach	$8,045,838	$2.68	6.0%
Common[3]			
Labour (G & A)	$1,000,113	$0.17	0.7%
G&A - Expenses	$1,946,840	$0.32	1.4%
Plant Maintenance	$689,953	$0.11	0.5%
Permanent Camp Catering	$2,362,668	$0.39	1.8%
Permanent Camp Power	$98,279	$0.02	0.1%
Subtotal Common Plant	$6,097,854	$1.02	2.7%
Subtotal - Plant Operating Cost	$47,200,751	$7.87	35.0%
Mining[3]			
Total	$86,683,000	$14.45	64.2%
Subtotal - Mine Operating Cost	$86,683,000	$14.45	64.2%
Water Treatment Plant[3]			
Plant Maintenance	$100,000	$0.02	0.1%
Labour (O & M)	$236,775	$0.04	0.2%
Power	$4,449	$0.00	0.0%
Others including Consumables	$721,580	$0.12	0.5%
Subtotal - Water Treatment Plant	$1,062,804	$0.18	0.8%
Grand Total Operating Cost [3]	$134,946,555	$22.49	100.0%

Notes:

1. **$/t is based on milling material throughput of 3.0 Mtpa.**
2. **$/t is based on heap leach material throughput of 3.0 Mtpa.**
3. **$/t is based on total throughput of 6.0 Mtpa.**
4. **Includes consumables for common elution, carbon regeneration and gold room areas.**
5. **Includes power for elution and carbon regeneration of carbon from heap leach and mill, gold room, and mine surface loads.**
6. **Figures are rounded, and totals may not add correctly.**

21.5 Mine Operating Costs

21.5.1 Overview

Mine operating costs were calculated from first principals using vendor-supplied estimates and BOYD's experience with similar mining operations. Fuel costs were calculated based on vendor-provided fuel consumption and a vendor quote for diesel of $0.943 /L. Over the life of the project, overall mining operating costs are estimated to be $2.10 /t material and waste. Mine operating costs are shown below in Table 21.9.

Table 21.9 Mine Operating Costs ($ Material and Waste)

Section	-1	1	2	3	4	5	6	7	8	9	10	11	12	13	Average
Drilling and Blasting	$0.58	$0.57	$0.57	$0.57	$0.58	$0.58	$0.58	$0.60	$0.60	$0.58	$0.50	$0.53	$0.55	$0.00	$0.57
Loading and Hauling	$0.56	$0.84	$0.91	$0.89	$1.04	$1.05	$1.22	$1.37	$1.50	$1.12	$1.11	$1.28	$1.30	$0.00	$1.07
Support	$0.44	$0.36	$0.37	$0.37	$0.37	$0.37	$0.41	$0.45	$0.48	$0.38	$0.69	$0.46	$0.59	$0.00	$0.40
Rehandle*	$0.00	$0.54	$0.60	$0.00	$0.00	$0.60	$0.46	$0.46	$0.00	$1.81	$0.53	$0.49	$0.48	$0.50	$0.50
Mine G&A	$0.18	$0.05	$0.05	$0.05	$0.05	$0.06	$0.06	$0.07	$0.07	$0.06	$0.06	$0.06	$0.08	$0.00	$0.06
Total Cost	**$1.76**	**$1.81**	**$1.91**	**$1.87**	**$2.04**	**$2.06**	**$2.27**	**$2.49**	**$2.66**	**$2.14**	**$2.06**	**$2.33**	**$2.51**	**$0.00**	**$2.10**

***Rehandle cost is not included in the Total Cost.**

21.5.2 Operating and Labour Cost Assumptions

The proposed open pit will operate 24-hrs a day and seven days a week on a 12-hr shift basis. Material and waste will be produced on all shifts. Blasting operations will be devoted to day shift only. Productivity estimates were based on an assumed mechanical availability of 85% and utilization of available hours varied to reflect seasonal usage of equipment where appropriate.

A standard day-shift blasting crew will be required while four rotating labour crews will be scheduled to operate production equipment. No maintenance labour is included since all maintenance will be provided by a Maintenance and Repair Contract (MARC). Labour costs are based on actual labour costs from mining operations in Newfoundland. Labour costs are shown below in Table 21.10.

Table 21.10 Valentine Lake Estimated Labour Costs

Mine Labour	Class	Rotation	Annual Base with Overtime ($)	Burden (%)	Burdened Annual Rate ($)
Mine Management					
Manager Superintendent	Staff	5&2	$110,000	18	$130,000
Shift Foreman	Hourly	7&7	$87,000	23	$107,000
Technical Services					
Technical Services Manager	Staff	5&2	$118,000	18	$139,000
Chief Mine Engineer	Staff	5&2	$106,000	18	$125,000
Chief Geologist	Staff	5&2	$106,000	18	$125,000
Mine Engineer	Staff	5&2	$79,000	18	$93,000
Geologist	Staff	5&2	$79,000	18	$93,000
Surveyor	Staff	5&2	$59,000	18	$70,000
Surveyor Helper	Hourly	4&4	$43,000	23	$53,000
Mine Technician	Hourly	4&4	$57,000	23	$70,000
Material Control	Hourly	4&4	$57,000	23	$70,000
Drilling and Blasting					
Drill Operators	Hourly	7&7	$67,000	23	$82,000
Blaster	Hourly	7&7	$67,000	23	$82,000
Blaster Assistance	Hourly	7&7	$39,000	23	$48,000
Load/Haul/Support/Other Mine Operations					
Loading Operators	Hourly	7&7	$59,000	23	$73,000
Haul Truck Drivers	Hourly	7&7	$49,000	23	$60,000
Support Operators	Hourly	7&7	$53,000	23	$65,000
General Labourer	Hourly	7&7	$39,000	23	$48,000

21.5.3 Drilling and Blasting Costs

A powder factor of 0.25 kg/t was used to determine explosive requirements. Unit costs for explosives were based on similar sized projects in Newfoundland. Bulk explosives are assumed to be managed by an explosives contractor and a cost for leasing explosive storage facilities, as well as required ANFO trucks are included at a monthly charge. Actual loading and firing of the blasts will be handled by Marathon employees.

Grade control will be overseen by the mine geologist. Material control samplers are included as part of the Mine G&A costs. Samples collected are assumed to be delivered to an on-site laboratory for assaying. A cost of $10.00 per sample is included in the drill and blasting costs to cover assaying. Costs were calculated from first principals based on vendor quotes, as well as operating experience in similar sized mining operations. Overall drilling and blasting cost over the life of the project is estimated to be $0.569 /t.

21.5.4 Loading and Hauling Costs

Loading and haulage costs were determined based on the required trucking hours as well as total material movement. Costs were calculated from first principals based on vendor quotes, as well as operating experience in similar sized mining operations. Overall loading and hauling costs averaged $1.074 /t over the mine life.

21.5.5 Support Costs

An auxiliary fleet of dozers, graders, water trucks and other support equipment will be required. Three Cat D10T2 track dozers will be staged on each waste disposal area. Two Cat 834K wheel dozers and two Cat D8T track dozer will support loading operations. Several Cat 16M motor graders will maintain haul roads in and out of the pit. A $0.10 per all material tonne has been allocated for water handling in the pits. Costs were calculated from first principals based on vendor quotes, as well as operating experience in similar sized mining operations. Overall support equipment operating cost over the life of the project is estimated to be $0.3397 /t material.

21.5.6 Rehandle Costs

Since lower grade mill feed and heap leach material will be stockpiled early in the production schedule, rehandle costs were calculated to determine the economic impact of loading and hauling this material at a point later in the production schedule. The costs used the same economic basis as the loading and hauling section costs but included an assumed fixed haul (maximum 1.0 km) to the ROM pile from the stockpile area. The estimated cost to rehandle stockpiled material is $0.500 per rehandled tonne.

21.5.7 Mine G & A Costs

Mine G&A costs include non-operating labour, training, and supplies to maintain the mine operation. The estimated cost for the mine G&A is $0.059 /t.

21.6 Plant Operating Costs

21.6.1 Overview

The process plant operating costs have been developed based on a design processing rate of 3.0 Mtpa of material for heap leach circuit and 3.0 Mtpa of material for milling circuit. The plant will normally operate 24 hrs/d, and 365 d/y with 75% (6,570 hrs/y) crushing plant availability and 91.3% plant utilization (nominal 8,000 hrs/y).

The operating cost estimate has been compiled from a variety of sources and is based on heap leaching material from the mine with an average head gold grade of 0.5 g/t material and milling material with an average head gold grade of 2.2 g/t material.

The operating cost estimates are expressed in $ in Q3 2018 terms and are expected to be accurate within ±35%.

The process operating costs for the Project have been developed according to typical industry standards applicable to gold material processing plants.

Quantities and cost data were compiled from a variety of sources including:

- Metallurgical testwork.
- Consumables price from supplier.
- Advice from Marathon Gold.
- Lycopodium data.
- First principles.

21.6.2 Qualifications and Exclusions

The process operating cost estimate includes all direct costs associated with the project to allow production of doré from heap leaching and milling as well as cyanide destruction. Each cost estimate is presented with the following exclusions:

- Process operating costs battery limits are the ROM pad ahead of the crushing circuits to the TSF. All costs associated with areas beyond the battery limits of the Project are excluded. Loaded and barren carbon hauling between heap leach circuit and milling circuit are included.
- All taxes and import duties.
- Any impact of foreign exchange rate fluctuations.
- Any business interruption costs.
- Any escalation beyond the date of the estimate.
- First fill and opening stocks costs (included in the capital cost estimate).
- Tailings storage, rehabilitation or closure costs (included in the capital cost estimate).
- Land lease or other compensation costs.
- Product costs (transportation, refining, marketing and insurance), however, are included in the financial model.
- Licence fees or royalties (included in cash flow model).
- Contingency.

21.6.3 Cost Categories

The operating cost estimate includes the following major categories as defined below:

1. Operating Consumables.

2. Plant Maintenance.
3. Power.
4. Plant Laboratory.
5. Labour (Operation and Maintenance).
6. Labour (General and Administration).
7. General and Administration cost including camp.
8. Water Treatment Plant.

A description of each cost category is provided in the following sections.

21.6.4 Operating Consumables

The consumables category covers all wear parts and consumable materials in the process plant. Consumables include liners for equipment such as crushers and mills, reagents, as well as diesel fuel.

Consumption rates for each plants and pricing for consumables and reagents are summarized in Table 21.11. The tables have been based on the following:

- Comminution consumables (crusher liners, mill liners and grinding media) were evaluated for each material type due to the difference in equipment operating conditions. Crusher liner, SAG mill liner, ball mill liner, as well as steel ball consumption rates, are based on calculations and vendor supplied data.
- Laboratory testwork results are used, wherever possible to determine the reagent consumption rates. In the absence of testwork data, reagent consumption rates are assumed based on first principle calculations, Lycopodium experience and generally accepted practice within the industry.
- Diesel fuel consumption rates for the mobile equipment are based on first principles calculations and Lycopodium experience. Diesel consumption was estimated based on the plant mobile equipment, usage at the elution circuit, carbon regeneration and furnace. A gasoline and diesel price of $0.943 /L are used in the estimate, provided by a fuel supplier in Newfoundland.
- Consumables and reagents prices are obtained through supplier quotes and Lycopodium database.
- Water treatment plant consumables are based on Lycopodium experience.
- Laboratory costs are allocated on a per sample basis.

Table 21.11 Consumables Cost by Major Area

Area	Consumables Cost $/y	Consumable Cost $/t Material
Heap Leach	$3,745,846	$1.25
Milling (includes common elution, carbon regen., and goldroom areas)	$22,367,756	$7.46
Water Treatment Plant	$721,580	$0.12
Total	**$23,572,581**	**$3.93**

21.6.5 Maintenance

Maintenance material costs were estimated by applying factors to the mechanical equipment supply cost in each area of the plant. Crusher and mill wear parts are included in the consumables allowance. The factors applied are based on Lycopodium's database and experience, and are average costs over the life of the mine. As such, actual spares costs may be lower during the initial years but rise later. An overall factor of 4.8% is applied to the mechanical equipment supply cost for the process plant areas. The estimated annual maintenance cost for process plant and mobile equipment is $3.2M. The maintenance costs are summarized in Table 21.12.

Table 21.12 Process Plant Maintenance Cost

Area	Maintenance Cost $/y	Maintenance Cost $/t Material
Heap Leach	$787,950	$0.26
Milling	$1,649,092	$0.55
Water Treatment Plant	$100,000	$0.02
Others	$689,953	$0.11
Total	**$3,226,995**	**$0.54**

21.6.6 Power

The process plant electricity consumption is determined based on the installed power excluding standby equipment. Electrical load factors and utilization factors are applied to the installed power to arrive at the annual average power draw, which is then multiplied by total hours operated per annum and the electricity price to obtain the plant power cost.

Power consumptions and costs per plant area are summarized in Table 21.13.

Electricity is provided by grid power. The power unit cost of $0.039 /kWh is used in the calculations, and is based on industrial firm rates obtained by NL Hydro. The estimated annual power cost for process plant including camp is $6.2M or $1.72 /t of material.

Table 21.13 Process Plant Power Cost by Plant Area

Area	Average Power (kW)	Annual Power Consumption (kWh)	Total Annual Power Cost ($)	Cost, $/t Material
Heap Leach @ 3.0 Mtpa	1,755	15,377,441	592,031	0.197
Milling @ 3.0 Mtpa	10,469	91,712,656	3,530,937	1.177
Elution, Refinery, Mining Services @ 6.0 Mtpa	5,855	51,292,970	1,974,779	0.329
TSF @ 3.0 Mtpa	25	216,663	8,342	0.003
Permanent Camp	291	2,552,704	98,279	0.016
Waste Water Treatment Plant	13	115,569	4,449	0.001
Total	**18,410**	**161,268,003**	**6,208,818**	**1.723**

The overall average power consumption is estimated at 18,410 kW. The installed power, maximum continuous draw and the average power consumptions by plant area are provided in detail in the electrical load list.

21.6.7 Plant Laboratory

The operating cost for the plant laboratory is estimated based on the number of samples required to operate the process plant. The cost for each sample is estimated to be $1.11 per sample to $40.70 per sample. The total estimated annual laboratory cost for heap leach is $21k, milling is $82k and total is $102k including environmental follow-up sample or $0.023 /t material. Note that the environmental follow-up cost is included as part of the G&A costs.

Table 21.14 summarizes respectively the heap leach and milling laboratory costs.

Table 21.14 Plant Laboratory Cost

Area	Laboratory Sample/y	Laboratory Cost $/y	Laboratory Cost $/t Material
Heap Leach	6,926	$20,641	$0.01
Milling	20,601	$82,202	$0.03
Total	**27,527**	**$102,843**	**$0.02**

21.6.8 Process Plant Labour

The process labour is divided into the following areas - process plant operations, metallurgy and maintenance. The process labour includes a combination of day and shift work. The estimated annual process plant labour cost is $6.3M or $1.31 /t material. Table 21.15 summarizes the annual labour costs for each position.

Table 21.15 Process Plant Labour Compensation

Item	Number	Total $/y	Total $/t Material
Process Plant Manager (Heap & Milling)	1	$127,204	$0.02
Shift Supervisor	4	$255,717	$0.09
Chief Assayer	1	$65,419	$0.01
Lab Technicians	8	$416,724	$0.07
Sample Preparation Technicians	4	$208,362	$0.03
Maintenance Superintendent	1	$77,231	$0.01
Maintenance Supervisor	2	$127,859	$0.02
Maintenance Planner/Trainer	1	$68,145	$0.01
Metallurgist	4	$381,612	$0.06
Crushing Operators/Labourer	8	$378,840	$0.13
Heap leach area operator	4	$236,775	$0.08
Loader Operators	8	$568,260	$0.09
Adsorption Operator	4	$236,775	$0.08
Milling Operator	4	$236,775	$0.08
Flotation/Regrind/CIL	4	$189,420	$0.06
Elution/Regeneration Operator/Labourer	4	$189,420	$0.03
Carbon Transport Operator	4	$236,775	$0.04
Refinery Operator	2	$118,388	$0.02
Security personnel [1]	0	-	-
Instrumentation/Control Technician	4	$265,491	$0.04
Welder	4	$274,659	$0.05
Electrical Supervisor	1	$63,929	$0.01
Electrician	4	$274,659	$0.05
Boilermakers/Fitters	4	$284,130	$0.05
Housekeeping, cleaning maintainer	4	$161,007	$0.03
Maintenance Apprentices	8	$378,840	$0.06
Reagent/Daycrew/Relief Operators	4	$236,775	$0.04
Goldroom Lead Person	4	$284,130	$0.05
Total	**105**	**$6,343,321**	**$1.31**

[1] - Security contracted out

Labour rates are based on similar operations in Newfoundland and provided by Marathon Gold. The labour rate includes 18-23% for burdens, over time and bonuses where applicable.

21.6.9 General and Administration

The G&A are divided into labour and administration cost including the permanent camp. The estimated annual labour cost is $1.0M or $0.17 /t material. Table 21.16 summarizes the annual labour costs for each position.

Table 21.16 G&A Labour Compensation

Item	Number	Total $/y	Total $/t Material
General Manager	1	$181,720	$0.03
Executive Assistant	1	$45,430	$0.01
Safety Manager	1	$95,403	$0.02
Environmental Manager	1	$95,403	$0.02
Environmental Technician	1	$58,076	$0.01
Human Resources Manager	1	$111,304	$0.02
Accountant Manager	1	$111,304	$0.02
Accountants Clerk	1	$40,887	$0.01
Payroll Clerk	1	$45,430	$0.01
Purchasing Officer	1	$54,516	$0.01
Warehouse Supervisor	1	$43,159	$0.01
Communications/IT Technician	1	$77,231	$0.01
Warehouse Labour	1	$40,252	$0.01
Total	**13**	**$1,000,113**	**$0.17**

The estimated annual administration cost is $4.3M including annual camp costs of $2.4M. Table 21.17 summarizes the administration costs.

Table 21.17 Administration Costs

Item		Allowance	Basis	Annual Costs ($)
Site Office	Telecommunications (Satellite + cell phone)	annually	annually	$100,000
	Licence	annually	annually	$100,000
	Stationery	3,500	per month	$42,000
	Computer Supplies	1,000	per month	$12,000
Insurances	Light Vehicle Insurance		annually	$5,000
	Security (Bullion)		annually	$75,000
	Damage, Breakdown + Business Interruption		annually	$1,000,000
Financial	Banking Charges		annually	$20,000
	Legal Fees	670	per month	$8,040
	Auditing Costs	5,000	per month	$60,000
Personnel	First Aid and Medical Costs	100	per person	$12,200
	Safety Clothing, PPE	500	per person	$61,000
	Recruiting/Relocation		allowance	$15,000
	Training	800	per person	$97,600
Contracts	IT Service Contract	5,000	per month	$60,000
	Security Contract (guardians on site)	15,000	per month	$180,000
	Camp, Catering & Cleaning Contract		annually	$2,362,700
Environmental	Fees		annually	$5,000
	Compliance Monitoring		annually	$30,000
General	Health security expenses		annually	$10,000
	Shop miscellaneous expenses		annually	$5,000
	Community Relations Expenses	2,000	per month	$24,000
	Environmental Follow-up Samples/Analyses	25,000	annually	$25,000
Total				**$4,309,540**

21.7 Water Treatment Plant Operating Costs

Waste water treatment plant (WWTP) operating costs were derived from a combination of first principle calculations with an in-house equipment database for all major and supporting equipment operating parameters, and include power, consumables, rentals, labour, and general maintenance and parts costs. The WWTP operating cost averages at $1.1M annually or $0.18 /t material over the life of the project.

22.0 ECONOMIC ANALYSIS

22.1 Introduction

A preliminary economic assessment of the Valentine Lake Project has been conducted using a simple pre and after-tax cash flow model prepared by Lycopodium on behalf of Marathon Gold. The model was structured using an EXCEL workbook.

The PEA was prepared in accordance with National Instrument 43-101 Standards of Disclosure for Mineral Projects ("NI 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 categorized as mineral reserves, and there is no certainty that the PEA will be realized. 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.

Input data was provided from a variety of sources, including the various consultants' contributions to this PEA, pricing obtained from external suppliers and contractors, and exchange rates and project specific financial data such as the expected project taxation regime received from Marathon Gold. The assessment was based upon:

- Capital cost estimates and expenditure schedules prepared by Lycopodium and BOYD.
- Mine schedule and mining operation cost estimates based on the mining operations being owner-operated, as developed by BOYD for the study.
- Process operating and general and administration costs estimates prepared by Lycopodium, with contributions from Marathon Gold.
- Preliminary metallurgical performance characterised by previous and on-going testwork.
- Sustaining capital cost estimates for the mine development provided by BOYD, TSF and heap leach pad based on stage development supplied by Stantec.
- Owners capital cost estimates prepared by Lycopodium and Marathon Gold.
- Royalty, tax, discount rates and other model inputs provided by Marathon Gold.
- Closure costs of the TSF estimated by Stantec.
- Salvage costs estimated by Lycopodium.
- The cash flow analysis excludes any effects due to inflation and all dollars are expressed in real USD as at Q3 2018.
- The forecast gold price of $1,250 /oz for the life of mine was agreed with Marathon Gold.
- The cash flow analysis is based on full equity funding and any cost of borrowing is excluded.

The cash flow model reports:

- All costs in real USD exclusive of escalation or inflation.
- A net present value (NPV) at a 5% discount rate.
- An internal rate-of-return (IRR) based on pre and post-tax net cash flows.
- Payback.

Table 22.1 presents a summary of the production information on which the cash flow model is based.

The life of mine capital cost for the project is estimated at $508M, with an initial capital expenditure of $355M.

Table 22.2 shows the project cash flow summary. At a gold price of $1,250 /oz, the project is estimated to have an after-tax IRR of 30.3% and a pay-back period of 2.48 years after start of production. At a discount rate of 5%, the after tax NPV is estimated at $493M. The project economics have been summarized in Table 22.3

Table 22.1 Production Summary

	Value
Material processed	72.6 Mt
Total tonnes mined	500.6 Mt
Average head grade	1.33 g/t Au
Contained gold in material	3.09 Moz
Total gold produced	2.7 Moz
Average gold recovery	88%
Production life (processing)	13 years
Nominal annual processing rate	6.0 Mtpa

Table 22.2 Net Profit after Tax Summary

	$M	$/t Processed	$/oz Au
Revenue	$3,404	$46.90	$1250
Mine Operating Cost[1]	$1,058	$14.58	$388
Processing Cost	$493	$6.79	$181
G&A Cost	$87	$1.21	$32
Refining Costs	$5	$0.07	$2
Total Operating Cost	**$1,643**	**$22.64**	**$603**
EBITDA	**$1,761**	**$24.26**	**$647**
Capital Costs[2]	$338	$4.66	$124
Gross Profit before tax	**$1,253**	**$17.26**	**$460**
Newfoundland Mining Tax	$148	$2.03	$54
Income Tax Payable	$332	$4.58	$122
Net Profit after tax	**$773**	**$10.65**	**$284**

Note:
1. **Includes pre-strip costs during pre-production**
2. **Excludes pre-strip costs during pre-production**

Table 22.3 Financial Summary

	Value
Revenue from gold	$3,404M
AOC	$603/oz Au
Initial Capital	$355M
Sustaining capital	$150M
Closure costs/salvage	$20M
Pre-tax economics:	
IRR	44.0%
NPV (5%)	$834M
Payback	1.68 years
After-tax economics:	
IRR	30.3%
NPV (5%)	$493M
Payback	2.48 years

22.2 Assumptions and Qualifications

The cash flow analysis is based on the following:

- The cash flow model has been based on a two-year project development period but all cash-outflows commence in Year -1, and that gold production commences in month one of Year 1. The model has considered only cash flows from project 'go-ahead'. Any previous expenditure (sunk costs) have not been carried forward or included in the model.
- Sunk costs have been included in the tax model.
- Annual mined tonnage and head grade have been based on the mining schedule as presented in Chapter 16, and process plant throughput and production rates as presented in Chapter 17.
- The mining, processing and administration costs are based on the operating cost estimates presented in Chapter 21.
- Gold recovery is based on testwork and interpretation presented in Chapter 13.
- The capital costs are based on the estimates presented in Chapter 21.
- A provision for closure and rehabilitation costs of $30M has been allowed.
- An estimated asset residual sale value of $10M has been included.
- No provision was made for HST or custom duties.
- The treatment of depreciation and company taxes are based on Marathon Gold's understanding of current Federal and Newfoundland tax laws.

22.2.1 Depreciation

- All capital expenditure is depreciated depending on the class of asset.

22.2.2 Company Tax

- Provision has been made for Newfoundland mining tax at 15% of taxable income and corporate income tax at 30% of taxable income as advised by Marathon Gold.

22.2.3 Gold Price

- A gold price of $1,250 /oz has been applied in the cash flow model.
- Refining costs have been included in the operating cost estimate at $1.8 /oz.

22.2.4 Royalties

- NPI of Reed property was calculated.

22.2.5 General

- The cash flow model assumes full equity funding.
- No provision has been made for interest on cost of capital.
- No provision has been made for corporate head office costs during operations.
- No provision has been made for escalation or inflation.
- No provision has been made for HST payable.
- No provision has been made for Customs import duty.
- The NPV calculation is based on payments occurring at the end of each year.

22.3 Sensitivity Analysis

The project value was assessed by undertaking sensitivity analyses on gold price, gold recoveries, operating costs and capital costs. The results of all sensitivity analyses are presented in Tables 22.4 and 22.5, and in Figures 12.1 and 12.2.

The project is most sensitive to changes in capital and operating costs because of the large range used in measuring their sensitivity. These ranges were chosen to align with the intended accuracy of the capital and operating costs. However, a ±10% change in gold price has a significant impact on the project revenue.

Table 22.4 NPV Sensitivity Analysis (Pre-Tax)

	Lower	Base Case	Higher
Gold Price (±10%)	$577,820,437	$833,705,894	$1,089,591,351
CAPEX (±35%)	$996,491,550	$833,705,894	$670,920,238
OPEX (±35%)	$1,267,486,498	$833,705,894	$399,925,290
Mill Recovery (±2%)	$788,962,601	$833,705,894	$878,449,187
HL Recovery (±10%)	$801,905,376	$833,705,894	$865,506,412

Table 22.5 IRR Sensitivity Analysis (Pre-Tax)

	Lower	Base Case	Higher
Gold Price (±10%)	32%	44%	56%
CAPEX (±35%)	80%	44%	28%
OPEX (±35%)	64%	44%	24%
Mill Recovery (±2%)	42%	44%	46%
HL Recovery (±10%)	43%	44%	45%

Figure 22.1 NPV Sensitivity Analysis (Pre-Tax)

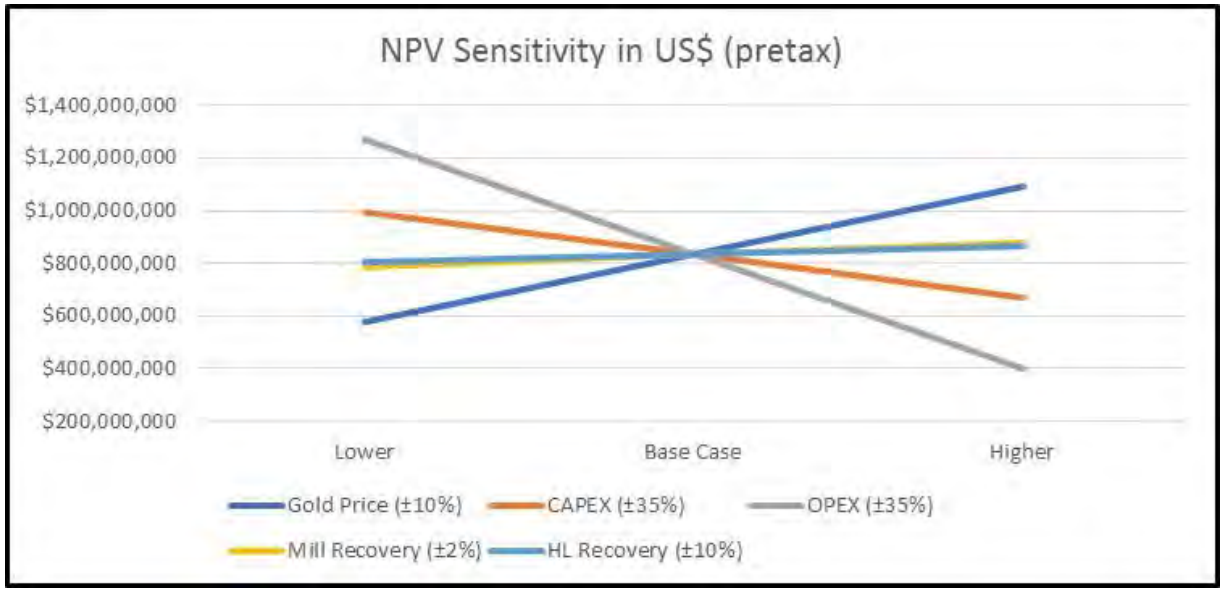
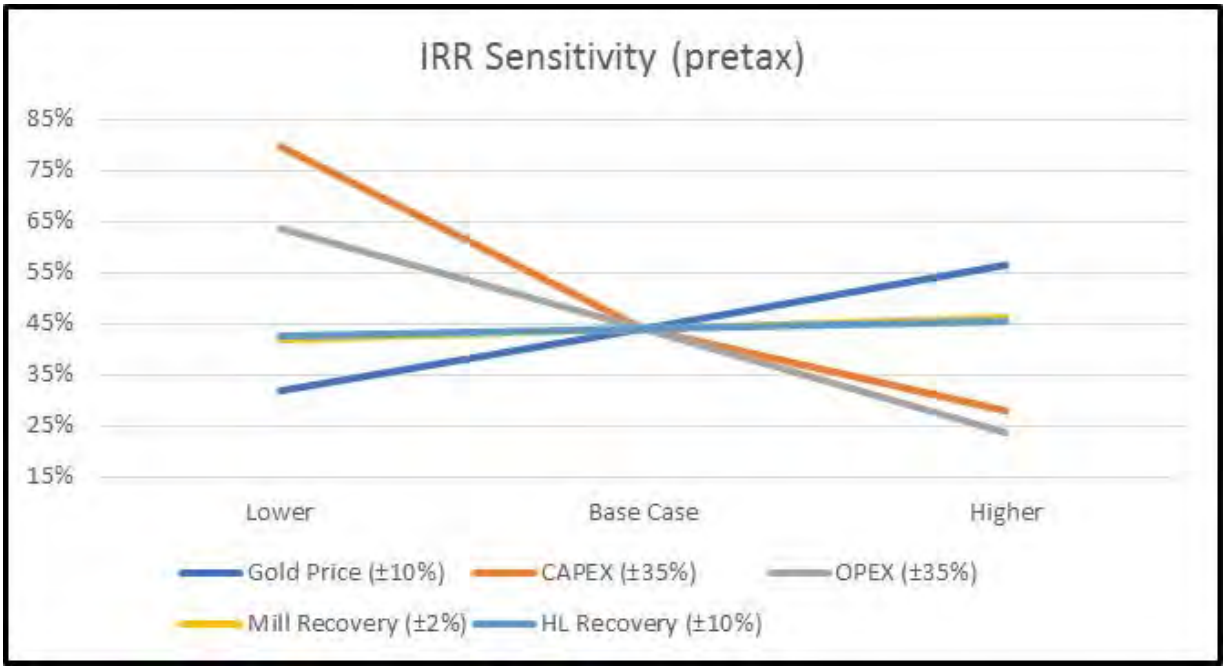


Figure 22.2 IRR Sensitivity Analysis (Pre-Tax)

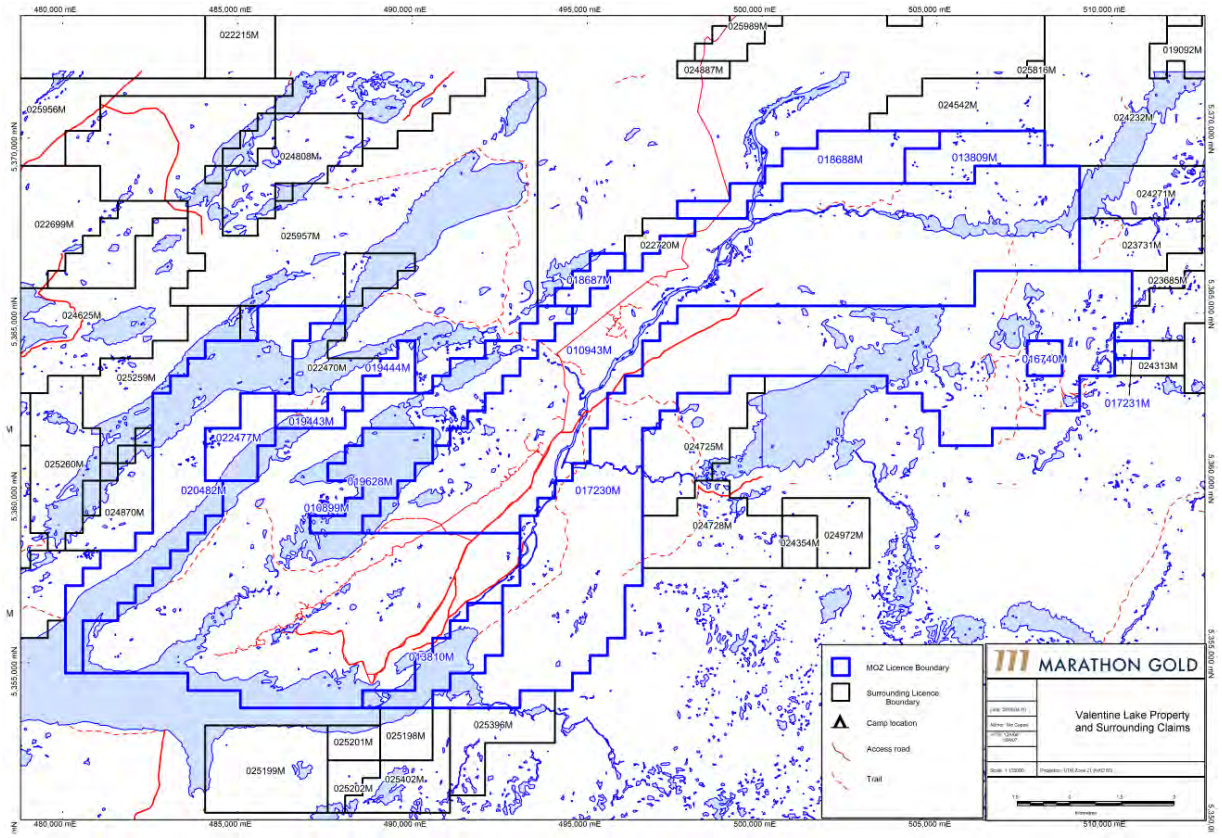


23.0 ADJACENT PROPERTIES

From the Micon Technical Report (Murahwi, 2017):

The Valentine Lake property is almost surrounded by other mineral claims belonging to various companies as shown on Figure 23.1, not all of which have gold as the primary metal of interest.

Figure 23.1 Valentine Lake Property and Adjacent Claims



Source: www.geoatlas.gov.nl.ca/default.htm

Figure 23.1 is based on publicly available information. Micon has not verified the information or the styles of mineralization on properties held by other companies. The mineralization on other properties is not necessarily indicative of the mineralization at the Valentine Lake Property.

BOYD concurs with the above statements.

24.0 OTHER RELEVANT DATA AND INFORMATION

As far as Lycopodium is aware, there is no other relevant data or information pertaining to this Technical Report.

25.0 INTERPRETATION AND CONCLUSIONS

25.1 Property Description and Location

Mineral rights to the Property are 100% controlled by Marathon Gold; the mineral licenses are reportedly held in good standing 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 property is located in a waterfowl sensitive area and Marathon Gold are undertaking a baseline study to characterize the species and locations of waterfowl within and proximal to the property.

To BOYD'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 at the Project since taking over the project in 2010. 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 expedited the advancement and/or discovery of four main gold deposits at the Project: the Leprechaun, Marathon, Sprite, and Victory deposits. In addition, several other exploration targets have been identified by Marathon Gold across the property and require future drill testing, namely the Frank and Rainbow prospects.

It is recommended that a detailed interpretation of the amalgamated aeromagnetic and ground geophysical surveys data is conducted to identify additional potential structural targets for channel sampling and exploratory drill testing.

This work should focus in areas along strike extension of known mineralization and in areas of low magnetic intensity west of, and proximal to, the Valentine Lake Thrust Fault, primarily between the Sprite and Marathon deposits. 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.

25.3 Drilling

BOYD considers that 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.

Given the coarse nature of gold, as evidenced by the presence of visible gold in the drill core, consideration should be given to investigating the potential for reducing sample variance through the use of a wider diameter drill core, thereby producing a larger sample size.

25.4 Sample Preparation, Analyses, and Security

BOYD reviewed and compared hardcopy laboratory certificates and drill logs against the electronic spreadsheets provided by Marathon Gold and found no issues. BOYD 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.

Marathon Gold does not routinely analyze 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 which assays greater than 100 ppb gold was used to increase the accuracy of gold analytical results.

BOYD recommends that Marathon Gold consider the following in relation to their QA/QC procedures:

- Investigate the cause of weak negative bias inferred from the results of CRM assays, which may indicate that some fire assay results are weakly underestimated.
- Conduct a check analysis program by way of re-assay of select pulp duplicates at an alternative, independent laboratory to provide additional verification of analytical results and to aid in the investigation into the weak negative bias observed.

25.5 Data Verification

The site inspection allowed the authors to confirm the geological interpretations made in support of mineral resource estimation, and 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 the author 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 NI 43-101, which is the purpose of this report.

25.6 Metallurgical Testwork and Processing

A number of metallurgical testwork programs were conducted on mineralized samples from the Valentine Gold Camp. The majority of the testwork programs has been carried out for the Leprechaun deposit, with Marathon deposit included only in more recent testwork. Thus far, no representative samples from the Sprite or the Victory deposits have been tested, although all the gold occurrences for these deposits share similar general characteristics, where gold mineralization is associated with quartz-tourmaline-pyrite (QTP).

The proposed heap Leach plant and flotation/CIL plant designs were based on a robust metallurgical flowsheet developed for optimum recovery while minimizing initial capital expenditure and operating costs. The flowsheet is based on unit operations well proven in the industry.

25.7 Site Infrastructure

The site infrastructure for the Project includes open-pit mines, processing plants, TSF, heap leach pad, waste rock facilities, polishing pond, mine services, access road, accommodations camp, and waste water treatment plant. Access to the facility is from the northeast side of the property off the existing access road. Main access will be via the main security gate near the process plant. Grid power will be provided from an incoming HV line from the northeast side of the property. Although further development is required to firm up the site infrastructure, sufficient definition has been provided to support this PEA and capital cost estimates.

25.8 Capital and Operating Costs

Scoping-level capital and operating costs were developed for the Project and based on the proposed mine plan, processing routes, vendor quotations, historical information, and consultants' experience. Further engineering is required to improve the accuracy of the capital and operating costs, but is currently sufficient for this PEA.

26.0 RECOMMENDATIONS

26.1 Overall

The financial analysis of this PEA demonstrates that the Valentine Lake Project has robust economics and it is recommended to continue developing the project through further engineering and de-risking. Table 26.1 summarizes the proposed budget to advance the project through the PFS stage.

Table 26.1 Proposed Budget Summary

Item	Category	Activity	Area	Drilling (m)	Est. Cost*
26.1	Pre-Feasibility Study (PFS)				$745,000
26.2	Exploration	Exploration Drilling	Sprite to Marathon Trend	13,000	$2,925,000
		Exploration Drilling	Marathon to Victory Trend	6,000	$1,350,000
		Infill Drilling	Marathon Deposit	25,000	$5,625,000
		Infill Drilling	Leprechaun Deposit	12,000	$2,700,000
		Infill Drilling	Victory Deposit	4,000	$900,000
		Prospecting/Trenching	Marathon to Victory Trend		$100,000
		Prospecting/Trenching	Humby to South Quinn Lake Area		$150,000
		Aerial Drone Survey	Mining license		$200,000
26.3	Road Access	Upgrade study	88 km road upgrade		$21,000
26.4	Metallurgical Testwork	Comminution	Marathon, Leprechaun Deposits		$50,000
		Flotation/Gravity			$280,000
		Heap Leach			$173,000
26.5	Heap Leach Pad	Design			N/A
		Condemnation			$50,000
26.6	Tailings Storage Facility	Design			N/A
		Condemnation			$90,000
26.7	Geotechnical Studies	Phase 1 - Data compilation and training			$555,000
		Phase 2 - Pit slope / underground mine design			
26.8	Environmental, Permitting and Community Relations				$245,000
			Totals	**60,000**	**$16,159,000**

***Cost Estimates based upon budgeted numbers**

26.2 Exploration

It is recommended that additional focused prospecting as well as detailed interpretation of the amalgamated aeromagnetic and ground geophysical surveys data is conducted to identify additional potential structural targets for channel sampling and exploratory drill testing.

This work should focus in areas along strike extension of known mineralization and in areas of low magnetic intensity west of, and proximal to, the Valentine Lake Thrust Fault, primarily between the Sprite and Marathon deposits. Ground and downhole IP surveys have been of little to no use to date in identifying new QTP mineralization as there is no distinct chargeability or resistivity signature to the QTP zones relative to host rock. The use of detailed magnetic surveys is much more useful in identifying mag-low alteration zones and brittle deformation zones potentially associated with mineralized systems.

Marathon has planned additional drilling to expand and upgrade the resources at depth and along strike. Geological and geophysical studies indicate the structure hosting gold mineralization may continue both east and west of the current resources as well as down plunge. Addition of further resources through drilling has the potential to increase the life of mine and resulting economics.

26.3 Access Road

It is recommended to further define the scope of the 88 km access road and associated bridges, particularly the bridges over Victoria River. The schedule and sequencing of the road and bridge upgrades is to be defined. A trade off study with an alternative shorter access road east of the current route should be conducted before entertaining a PFS.

26.4 Metallurgical Testwork

The following metallurgical testwork is recommended for the high and low-grade material at Marathon and Leprechaun deposits:

Comminution:

- Regrinding tests should be consulted with vendors to confirm sample quantities and mass requirement.

Metallurgical:

- Continue with ongoing detailed gravity tests to evaluate the benefits of incorporating gravity into the grinding circuit. Conduct planned extended GRG testwork with input from the vendors.
- Carbon-in-leach modelling for both flotation concentrate and tailings.
- Bulk flotation testwork with thickening tests on the concentrate and tailings.
- Evaluate the response of the gravity/flotation/leach process to feedstock variability.
- Complete ongoing column leach tests in 3 m columns, evaluate results and consider larger-scale, on-site tests.

- Include load and permeability testing as part of any future heap leach testwork.
- Investigate process conditions to improve on reagent and grinding power consumptions while maintaining or improving gold recoveries.
- Complete program of environmental studies, including cyanide destruction in tailings (including heap leach residue) and more detailed tailings disposal stability tests.

26.5 Heap Leach Pad

It is proposed to construct a heap leach pad at the Project site to use for mineral extraction. There have not been any geotechnical site investigations or design studies completed at this time to support this infrastructure on site. It is recommended for the Project to proceed to the PFS stage, that specific geotechnical investigations and design studies be completed.

26.6 Tailings Storage Facility

The following activities are recommended to support the design of the TSF for the PFS:

- Further fish sampling to be conducted to confirm fish presence/absence in the waterbodies of interest.
- Condemnation drilling for the selected site to verify the absence of mineralization.
- Geotechnical site investigations at the preferred site to characterize the foundation conditions and potential borrow sources.
- In-situ permeability tests of the overburden soils and bedrock.
- Tailings assessment to help characterize the geotechnical properties in order to understand the deposition characteristics.
- Refinement and further study of the proposed dam alignment and configuration.
- Further evaluation of the dam requirements such as allowable seepage gradients and management of seepage water.

26.7 Geotechnical Input for Mine Design

A drill program is recommended to provide geotechnical and hydrogeological data to support a pre-feasibility level of design for open-pit and underground mining.

Phase 1 – Geotechnical data collection:

- Training of Marathon staff in geotechnical data collection.
- Testing of relevant core from different lithologies.

- Compilation of the collected geotechnical data into a format suitable for rock slope stability analysis and underground ground control.

Phase 2 – Pit Slope and Underground Mine Design:

- Recommendations for face and inter-ramp pit slope angles.
- Geotechnical input for mining method selection.
- Ground support recommendations.
- Crown pillar assessment between open-pit and underground workings.

26.8 Environment, Permitting, and Community Relations

- Pursue environmental approvals, authorizations, and permits required to develop and initiate a mining operation.
- Develop a consultation strategy to engage with all stakeholders of the Project.
- Develop a tracking system to record stakeholder consultation and engagement activities.

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Lycopodium

Certificate of Qualified Person

I, Neil Lincoln, of Mississauga, Ontario, Canada, do hereby certify that as the author of "NI 43-101 Technical Report, Valentine Lake Gold Project, Newfoundland, NL, Canada" prepared for Marathon Gold Corporation, dated November 26 2018, with an effective date of October 30 2018 that:

1. I am employed as the VP Business Development and Studies with Lycopodium Minerals Canada Ltd, 5060 Spectrum Way, Suite 400, Mississauga, ON, Canada.

2. I graduated from the University of the Witwatersrand, South Africa, in 1994 with a Bachelor of Science in Metallurgy and Materials Engineering (Minerals Process Engineering) degree.

3. I am a professional engineer in good standing with the Professional Engineers and Geoscientists Newfoundland and Labrador (PEGNL) in Canada (No. 08053).

4. I have practiced my profession continuously as a metallurgist for 23 years and with Lycopodium Minerals since 2011.

5. I am responsible for Sections 1.1, 1.5, 1.8, 1.9, 1.11 - 1.13, 2, 13, 17, 18 (except 18.5 - 18.8), 19, 21 (except 21.2 and 21.5), 22, 24, 25.6 - 25.8, 26 and 27.

6. I have read the definition of "qualified person" set out in National Instrument 43-101 (NI 43-101) and certify that, by reason of my education, affiliation with a professional association (as defined in NI 43-101) and past relevant work experience, I am "qualified person for the purpose of NI 43-101.

7. I visited the site during 11 - 12 December 2017, and inspected the proposed open pits, process plants, tailings storage facility, and infrastructure and access road.

8. I am independent of the issuer in accordance with the application of Section 1.5 of National Instrument 43-101.

9. I have not had any prior involvement with the Property.

10. I have read National Instrument 43-101 and Form 43-101F1, and the Technical Report has been prepared in compliance with same.

11. At the effective date of the Technical Report, to the best of my knowledge, information and belief, the Technical Report contains all scientific and technical information that is required to be disclosed to make the Technical Report not misleading.

Dated at Mississauga, Ontario, Canada, this 26th day of November 2018.

(signed) "Neil J. Lincoln"

Neil Lincoln, P.Eng

John T. Boyd Company

Certificate of Qualified Person

I, Robert J. Farmer, of Canonsburg, Pennsylvania, USA, do hereby certify that as the author of "NI 43-101 Technical Report, Valentine Lake Gold Project, Newfoundland, NL, Canada" prepared for Marathon Gold Corporation, dated November 26 2018, with an effective date of October 30 2018, that:

1. I am employed as the Vice President with John T. Boyd Company, 4000 Town Center Boulevard, Suite 300, Canonsburg, PA, USA, 15317.

2. I graduated in 1994 with a B.Sc. in Mining Engineering from Queen's University in Kingston, Ontario.

3. I am a professional engineer in good standing with the Professional Engineers of Ontario (No. 100025756) since 2000, and with the Professional Engineers & Geoscientists Newfoundland and Labrador (No. 09046) since 2017.

4. I have worked as a Mining Engineer for more than 23 years and have extensive knowledge of computerized geologic modelling, mineral resource and reserve estimation, underground and surface mine design and operations, production scheduling, and financial modelling. Deposit and mine commodity expertise includes coal, industrial minerals, base metals, and gold.

5. I am responsible for Sections 1.6, 1.7, 1.11, 14, 15, 16, 21.2, 21.5, 23, 25 and 26.

6. I have read the definition of "qualified person" set out in National Instrument 43-101 (NI 43-101) and certify that, by reason of my education, affiliation with a professional association (as defined in NI 43-101) and past relevant work experience, I fulfill the requirements to be a "qualified person for the purpose of NI 43-101.

7. I did not visit the site.

8. I am independent of the issuer in accordance with the application of Section 1.5 of National Instrument 43-101.

9. I have not had any prior involvement with the Property.

10. I have read National Instrument 43-101 and Form 43-101F1 and the Technical Report has been prepared in compliance with same.

11. At the effective date of the Technical Report, to the best of my knowledge, information and belief, the Technical Report contains all scientific and technical information that is required to be disclosed to make the Technical Report not misleading.

Dated at Canonsburg, Pennsylvania, USA, this 26th day of November 2018.

(signed

Robert J. Farmer, P.Eng.

APEX Geoscience Ltd.

Certificate of Qualified Person

I, Roy Eccles, of Edmonton, Alberta, Canada, do hereby certify that as the author of "NI 43-101 Technical Report, Valentine Lake Gold Project, Newfoundland, NL, Canada" prepared for Marathon Gold Corporation, dated November 26 2018, with an effective date of October 30 2018 that:

1. I am employed as the Senior Consulting Geologist and Chief Operations Officer with APEX Geoscience Ltd, Suite 110, 8429 – 24th Street, Edmonton, Alberta, Canada T6P 1L3.

2. I graduated with a B.Sc. in Geology from the University of Manitoba in Winnipeg, Manitoba in 1986 and with a M.Sc. in Geology from the University of Alberta in Edmonton, Alberta in 2004.

3. I am a professional geologist in good standing with the Association of Professional Engineers and Geoscientists of Alberta ("APEGA") since 2003, and Newfoundland and Labrador Professional Engineers and Geoscientists ("PEGNL") since 2015.

4. I have practiced my profession continuously as a geologist for 25 years and and have been involved in all aspects of mineral exploration, mineral research and mineral resource estimations for metallic, industrial, specialty and rare-earth element mineral projects and deposits in Canada.

5. I am responsible for Sections 1.2 - 1.4, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 25.5 and 26.

6. I have read the definition of "qualified person" set out in National Instrument 43-101 (NI 43-101) and certify that, by reason of my education, affiliation with a professional association (as defined in NI 43-101) and past relevant work experience, I fulfill the requirements to be a "qualified person for the purpose of NI 43-101.

7. I visited the site during 11 - 14 October 2017 and can verify: (1) the Property is active and in good standing; (2) material work has been conducted since the last technical disclosure; and (3) the physical and analytical characteristics of the geology and gold mineralization at the Valentine Lake Gold Camp.

8. I am independent of the issuer in accordance with the application of Section 1.5 of National Instrument 43-101.

9. I have not had any prior involvement with the Property.

10. I have read National Instrument 43-101 and Form 43-101F1 and the Technical Report has been prepared in compliance with same.

11. At the effective date of the Technical Report, to the best of my knowledge, information and belief, the Technical Report contains all scientific and technical information that is required to be disclosed to make the Technical Report not misleading.

Dated at Edmonton, Alberta, Canada, this 26th day of November 2018.

(signed) "Donald Eccles"

D. Roy Eccles, M.Sc., P.Geo.

LICENSED PROFESSIONAL GEOSCIENTIST
08287
Donald Eccles
"Donald Eccles"
SIGNATURE
26/11/18
DATE
NEWFOUNDLAND & LABRADOR

Stantec

Certificate of Qualified Person

I, Paul D. Deering, of St. John's, Newfoundland, Canada, do hereby certify that as the author of "NI 43-101 Technical Report, Valentine Lake Gold Project, Newfoundland, NL, Canada" prepared for Marathon Gold Corporation, dated November 26 2018, with an effective date of October 30 2018, that:

1. I am employed as a Senior Geotechnical Engineer, Senior Principal with Stantec Consulting Ltd, 141 Kelsey Drive, St. John's, Newfoundland, Canada.

2. I graduated from Memorial University with a B.Sc. (hon) in Earth Sciences in 1987, and the University of New Brunswick with a B.Sc. Eng. in Engineering 1995.

3. I am a professional engineer and a professional geoscientist in good standing with the Professional Engineers and Geoscientists of Newfoundland and Labrador (No. 03088).

4. I have practiced my profession continuously as a professional engineer and/or professional geoscientist with Stantec Consulting Limited for 22 years since 1996.

5. I am responsible for Sections 1.10, 18.5 - 18.8, 20, and 26.5 - 26.8

6. I have read the definition of "qualified person" set out in National Instrument 43-101 (NI 43-101) and certify that, by reason of my education, affiliation with a professional association (as defined in NI 43-101) and past relevant work experience, I fulfil the requirements to be a "qualified person" for the purpose of NI 43-101.

7. I did not visit the site.

8. I am independent of the issuer in accordance with the application of Section 1.5 of National Instrument 43-101.

9. I have not had any prior involvement with the Property.

10. I have read National Instrument 43-101 and Form 43-101F1 and the Technical Report has been prepared in compliance with same.

11. At the effective date of the Technical Report, to the best of my knowledge, information and belief, the Technical Report contains all scientific and technical information that is required to be disclosed to make the Technical Report not misleading.

Dated at St. John's, Newfoundland, Canada, this 26th day of November 2018.

(signed) "Paul D. Deering"

Paul D. Deering, P.Eng., P.Geo.