

Monitoring Program

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Abbreviations

AEP	Annual Exceedance Probability
Ag	silver
Al	aluminum
As	arsenic
Bq/L	Becquerel per litre
BOD	Biochemical Oxygen Demand
CaCO ₃	calcium carbonate
CALA	Canadian Association for Laboratory Accreditation
CBOD ₅	5-day Carbonaceous Biochemical Oxygen Demand
CCME	Canadian Council of Ministers of the Environment
CEAA	Canadian Environmental Assessment Act
Cd	cadmium
CFU	Coliform forming unit
CN ⁻	cyanide
CN ⁻ WAD	weak acid dissociable cyanide
C of A	Certificate of Approval
Cr	chromium
Cu	copper
CWQG-FAL	Canadian Water Quality Guidelines for the Protection of Freshwater Aquatic Life
DO	dissolved oxygen
DOC	dissolved organic carbon
EA	Environmental Assessment
ECCC	Environment and Climate Change Canada
ECWSR	Environmental Control Water and Sewage Regulations
EIS	Environmental Impact Statement
EPP	Environmental Protection Plan
ESC	erosion and sediment control
F	fluoride
FDP	Final Discharge Point
Fe	iron

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HADD	harmful alteration, disruption, or destruction
Hg	mercury
IAAC	Impact Assessment Agency of Canada
IR	Information Requirements
kg	kilogram
m	metre
mm	millimetre
m/s	metre per second
m ³ /s	cubic metre per second
MBq	MegaBecquerel
MeHg	methyl mercury
MDMER	<i>Metal and Diamond Mining Effluent Regulations</i>
mg/L	milligrams per litre
Mn	manganese
NA	not applicable
ND	no data
NH _{3 T} as N	total ammonia as nitrogen
NH _{3 UN} as N	un-ionized ammonia as nitrogen
NL	Newfoundland and Labrador
NLDECC	Newfoundland and Labrador Department of Environment and Climate Change
NLDMAE	Newfoundland and Labrador Department of Municipal Affairs and Environment
NO ₂ -N	nitrite as nitrogen
NO ₃ -N	nitrate as nitrogen
NTU	nephelometric turbidity unit
PAG	potentially acid generating
Pb	lead
POPC	Parameters Of Potential Concern
QA/QC	quality assurance and quality control
RDL	Reportable Detection Limit
RQP	Reference Quality Point
RQFP	Reference Quality and Flow Point
Se	selenium
SO ₄	sulphate

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SOP	standardized operation procedure
TCU	true color unit
TDS	total dissolved solids
TMF	tailings management facility
TP	total phosphorus
TSS	total suspended solids
Ur	uranium
WFP	Water Flow Point
WQP	Water Quality Point
WQFP	Water Quality Flow Point
WSER	Wastewater Systems Effluent Regulations
WWTP	wastewater treatment plant
Zn	zinc
°C	degrees Celsius
µg/L	micrograms per litre

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1.0 INTRODUCTION


Marathon Gold Corporation (Marathon) submitted an Environmental Impact Statement (EIS) for the Valentine Gold Project (the Project) to the Impact Assessment Agency of Canada (IAAC) on September 29, 2020, and to the Environmental Assessment (EA) Division of the Newfoundland and Labrador of Environment and Climate Change (NLDECC) on November 3, 2020. The Project was released from the provincial and federal EA processes, with conditions, on March 17, 2022, and August 24, 2022, respectively.

The purpose of the Surface Water Follow-up Monitoring Program (SWFMP) is to verify predictions and address commitments made in the EIS (Marathon 2020) as well as those developed through Information Requirements (IR) received as part of the regulatory review process. This document describes follow-up and monitoring activities for the construction, operation, and decommissioning/closure phases of the Project, based on regulatory compliance requirements and Project approvals and authorizations, and has been developed concurrently with other programs to provide consistency and efficiency in monitoring and discharge criteria¹. This is a living document that will be reviewed, updated, and improved upon based on policy and technology changes as the Project progresses through permitting, construction, operation and decommissioning of the Project.

The construction and operation of the Project are governed by an Environmental and Social Management System, which includes tools such as the corporate environmental and social policies, construction and operational environmental protection plans (EPPs), environmental management plans, and follow-up and monitoring programs, which will be updated as applicable throughout the life of the Project. An EPP for the construction phase of the Project has been approved by the NL Minister of Environment and Climate Change. The Construction EPP outlines protection and response measures associated with potential environmental effects related to Project construction activities, providing general environmental protection procedures related to Project construction activities and infrastructure such as air and greenhouse gas emissions, erosion and sedimentation control, rock and soils management, and traffic management, as well as specific protection procedures for caribou, avifauna, and other wildlife including bats and American marten; fish and fish habitat; historic resources; and the Victoria Dam.

The EPP is closely linked to the follow-up monitoring programs as it describes practical procedures to reduce or eliminate potential adverse environmental effects, as well as instructions for addressing planned and unplanned activities/events associated with Project construction. A process for the communication to Indigenous groups of potential adverse effects of planned Project activities upon the use of land and resources by Indigenous persons (including hunting, trapping, fishing and gathering, and access to lands and resources) is provided in the Current Use of Lands and Resources for Traditional

¹ A Project Environmental Effects monitoring program is being developed under a separate cover and will be used in conjunction with this manual to execute the comprehensive monitoring program for the Project to meet federal Metal and Diamond Mine Effluent Regulation requirements.

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Purposes Indigenous Communications Plan. Response measures in the event of an accidental event are described in Section 4 of the Accidents and Malfunctions Prevention and Response Plan (AMPRP). Additionally, communications and reporting requirements are provided in the Section 5 of the AMPRP as well as Appendix A with respect to communication specific to Indigenous groups.

Marathon has developed a grievance mechanism to afford a process for addressing grievances on the part of non-Indigenous and Indigenous groups or Indigenous persons resulting from the effects of the Project to these users, such as effects to land and resource use, health, socio-economic conditions and heritage resources. In the event that grievances are received, these will be logged and investigated.

The follow-up monitoring program presented herein will be implemented throughout Project construction and operation and has been developed to meet the associated requirements identified during the environmental assessment process. The monitoring program is subject to refinements based on consultation with regulators, Indigenous groups, and conditions of authorization.


1.1 PROJECT OVERVIEW

Marathon is developing the Valentine Gold Project (the Project), an open pit gold mine to be located in the west-central region of the Island of Newfoundland (NL), near Valentine Lake. The Project will use standard surface mining techniques to mine gold ore from the Leprechaun and Marathon open pits. Ore material will initially be mined and processed at a nominal rate of 6,850 tonnes per day (Tpd), increasing to 10,960 Tpd in Year 4. Current estimates are for a total Project mine excavation of 453 million tonnes of combined ore and waste material. The total ore to be mined from the open pits is estimated to be approximately 41 million tonnes.

Ore will be processed through the mill, where it will be crushed, milled and put through flotation and cyanidation processes to recover the gold. Separate stockpiles will be established for high-grade ore for priority processing and low-grade ore for processing later in the mine life. Tailings will be treated in the process plant area to remove the cyanide and subsequently deposited in an engineered tailings management facility (TMF) in Years 1 to 9, then pumped to the exhausted Leprechaun open pit in Years 10 through 12. Gold will be formed into doré bars, which will be shipped from site to refiners in secured trucks.

1.2 GOALS AND OBJECTIVES

This document has been developed and prepared using currently available information. This monitoring program will require updates based on further details regarding Project design, sequencing, and methods as they become available. It is anticipated that this document will be updated during the permitting stage of Project planning (i.e., following regulatory review) and will be completed prior to the start of the monitoring program.

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1.2.1 Purpose

The purpose of the Surface Water Follow-up Monitoring Program is to:

- Identify the regulatory requirements and standards relevant to surface water
- Identify and describe the existing conditions for surface water
- Describe the management and mitigation measures that will be used to reduce the potential effects on surface water from Project construction and operation
- Describe the monitoring of surface water that will be conducted during Project construction and operation to meet regulatory requirements


1.2.2 Objectives

The objective of the monitoring program is to confirm compliance with regulatory requirements, support predictions of effects of the Project on water quality, identify changes in drainage patterns and surface water flow, and determine if additional mitigation or response measures are required.

In addition to this primary objective, the Surface Water Follow-up Monitoring Program will confirm compliance with the following:

- Reduction of flooding and scour through peak flow attenuation and mitigation of low flow conditions through baseflow augmentation
- Monitored surface water quantity changes from pre-development conditions are evaluated in comparison to predicted changes anticipated during construction and operation phases (e.g., watershed drainage area changes, pit dewatering, harmful alteration, disruption or destruction (HADD) via indirect loss in predicted watercourses)
- Mine activity water discharge meets effluent criteria set out in *Metal and Diamond Mining Effluent Regulations* (MDMER) and NL *Environmental Control Water and Sewage Regulations* (ECWSR).
- Sanitary wastewater treatment plant (WWTP) discharge meets effluent criteria set out in NL ECWSR and federal *Wastewater Systems Effluent Regulations* (WSER)
- Evaluate the following parameters at surface water quality monitoring sites that were identified to exceed long-term Canadian Water Quality Guidelines for the Protection of Freshwater Aquatic Life (CWQG-FAL) during baseline surface water quality monitoring (EIS Chapter 7, Section 7.3.5.2; Marathon 2020): aluminum (Al), arsenic (As), cadmium (Cd), copper (Cu), nitrite (NO₂ as N), iron (Fe), lead (Pb), and zinc (Zn)
- Evaluate the parameters at final discharge points (FDPs) and downstream monitoring sites listed in the MDMER as effluent characterization parameters (Schedule 3, Table 2) and the following that are predicted to exceed the long-term CWQG-FAL at some FDPs: As, total ammonia as nitrogen (NH₃ T as N), un-ionized ammonia as N (NH₃ UN as N), Cu, cyanide (CN⁻), weak acid dissociable cyanide (CN⁻WAD), fluoride (F), Pb, manganese (Mn), total phosphorus (TP), sulphate (SO₄) and Zn

The proposed monitoring program includes surface quality monitoring at effluent discharges (FDPs), downstream receivers (water quality points [WQPs]), WWTP inlets (inlet points [INPs]), WWTP outlets

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(outlet points [OUPs] and reference sites (reference quality points [RQPs]), surface water flow at FDPs, select downstream receivers (water quality and flow points [WQFPs] and (water flow points [WFPs]), and one reference site (reference quality and flow point [RQFP]), and visual inspections of facility infrastructure.

1.3 REGULATORY SETTING

In addition to the *Canadian Environmental Assessment Act, 2012* and the *NL Environmental Protection Act*, the Project is subject to other federal and provincial legislation, policies, and guidance. This section identifies the primary regulatory requirements and policies of the federal and provincial authorities that influence the scope of the monitoring program on surface water resources.

Furthermore, the surface water follow-up monitoring program described in this document has been developed to comply with the Minister’s terms and conditions in the Decision Letter. This includes the establishment of a real-time water resources monitoring network in partnership and consultation with NLECC, including surface water quantity and quality monitoring stations that will be installed prior to Project commencement to collect baseline data.

1.3.1 Federal Regulatory Requirements

1.3.1.1 Federal *Fisheries Act* (2019)

There are several sections and subsections of the *Fisheries Act* that pertain to surface water and potential interactions with the Project; these are listed below:

- Section 32, 35 and 36 – The federal *Fisheries Act* requires the protection of fish habitat and prohibits deposit of deleterious substance in all watercourses that are fish bearing
- MDMER – The MDMER, created under the *Fisheries Act*, provides exemptions to the general prohibition against depositing deleterious substances. The MDMER sets out the maximum allowable limits for specific metals and other parameter concentrations in discharge resulting from the Project. The MDMER also sets forth a variety of effluent monitoring requirements, as well as the Environmental Effects Monitoring criteria to be implemented and reported on during the operational phase of the Project. MDMER limits for new metal and diamond mines (effective June 1, 2021) from Table 1 of Schedule 4 were used in this assessment.

1.3.1.2 Canadian Water Quality Guidelines for the Protection of Freshwater Aquatic Life (CWQG-FAL), 1999

The Canadian Council of Ministers of the Environment (CCME) CWQG-FAL provide limits for contaminants in water and are intended to maintain, improve, and/or protect environmental quality, and human and ecological health for a variety of chemical parameters. The CCME *Canadian Water Quality Guidelines for the Protection of Aquatic Life* are applicable for freshwater at the site.

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1.3.2 Provincial Regulatory Requirements

1.3.2.1 NL Environmental Protection Act

A Certificate of Approval is issued by the Pollution Prevention Division of the NLDECC for both construction and operation phases and sets concentration limits for specific parameters in the discharge effluent. These limits are typically similar to those provided in the MDMER.

1.3.2.2 Water Resources Act (2002)

The *Water Resources Act* gives the Water Resource Management Division of the NLDECCM the responsibility for the management of water resources in the province. The *Environmental Control Water and Sewage Regulations*, under the *Water Resources Act* regulate the discharge of sewage and other effluent. Schedule C of the regulation also specifies that the metal mining industry shall comply with the MDMER.

2.0 BASELINE INFORMATION


2.1 HYDROLOGY

The Project is centered on a topographic ridge that divides the drainage between the Valentine Lake watershed to the west and the Victoria Lake Reservoir and Victoria River watersheds to the south and east, respectively. A series of large waterbodies form the Exploits and Bay d’Espoir watersheds, which are two of the largest watersheds on the island of Newfoundland and are substantially and controlled by hydroelectric developments. Valentine Lake historically drained north to the Victoria River to Red Indian Lake and then further downstream to the Exploits River. The construction of a series of dams and connecting channels associated with the Bay d’Espoir Hydroelectric facility diverted Victoria Lake from the Victoria River toward the hydroelectric facility to the east.

The Project facilities are located at the headwaters of several watercourses, waterbodies, and wetlands, as presented in Figure 2.1 with Victoria Lake Reservoir to the south, Victoria River to the east, Valentine Lake, a headwater tributary Lake to the Victoria River to the west and Victoria River tributaries to the north. Streams denoted in in dark blue in Figure 2.1 have been field surveyed as fish bearing or having connectivity to fish bearing waters.

2.2 SURFACE WATER QUALITY

Regional water quality reported at the Environment and Climate Change Canada (ECCC 2020) managed sites (ID NF02YN0001 Lloyds River at Bridge, RTE 480, Burgeo Road and NF02YO0107 Exploits River Approx. 0.5km Downstream from Dam) between 2003 and 2019 includes metals, nutrients, and physical parameters. Total alkalinity (as CaCO₃) ranges from below detection limit 1.22 mg/L to 11 mg/L. Low alkalinity values suggest limited acid buffering potential in streams. Parameters were generally below the

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applicable Canadian Council of Ministers of the Environment (CCME) CWQG-FAL (Freshwater) (CWQG-FAL; CCME 2021), with at least one reported exceedance of the maximum value for aluminum, cadmium, copper, iron, and lead reported at ECCC station NF02YO0107, and aluminum and selenium at station NF02YN0001.

As noted in the 2019 baseline water quality report in Chapter 7 of the EIS (Marathon 2020), surface water quality was monitored at 26 locations in the mine site between 2011 and 2019. The lab results indicated that pH ranged from 4.61 to 7.78 with a mean value of 6.94. A total of 18 of 26 water quality monitoring stations were lower than the CWQG-FAL lower limit of 6.5 for pH. Local water quality was found to be similar to regional water quality in that both were found to have low alkalinity, and therefore limited acid buffering potential. Some metals were also detected above CWQG-FAL guidelines at both the regional and local water quality monitoring locations (aluminum, cadmium, copper, iron, and lead). These results indicate that metals are found in naturally elevated levels both in local and regional surface water. Local surface water quality monitoring revealed consistent seasonal concentration trends, and that water quality in larger lakes such as Victoria Lake Reservoir and Valentine Lake was more dilute and lower in constituent concentrations than observed in tributary watercourses, ponds, and wetlands.

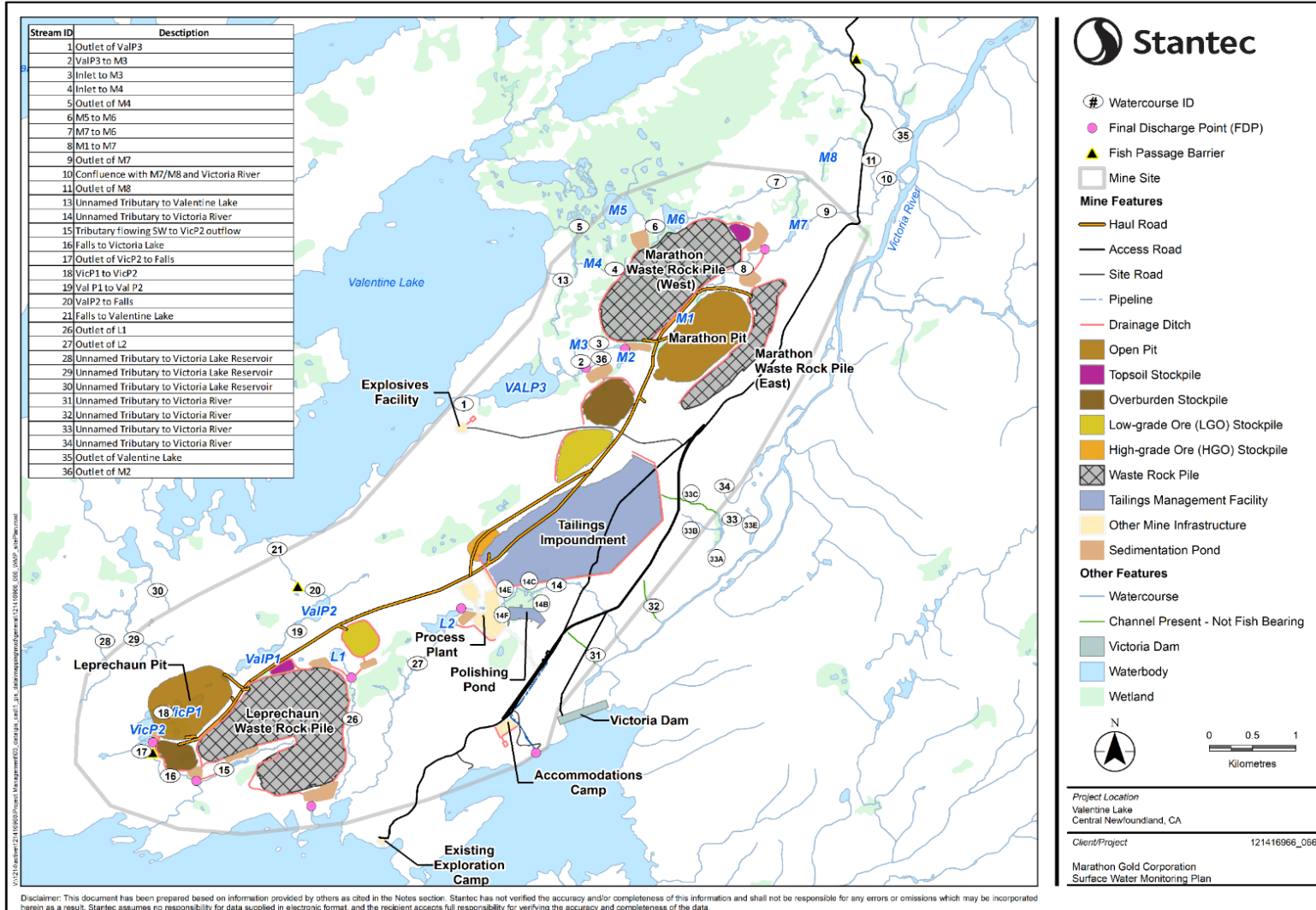


Figure 2-1 Overview of Project Watercourses, Waterbodies and Wetlands

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3.0 PROPOSED MITIGATION AND MANAGEMENT MEASURES

Mitigation measures that will be employed to avoid or reduce adverse environmental effects on surface water resources are presented in EIS Chapter 2, Appendix 2A, Water Management Plan and Chapter 7 (Marathon 2020) and the EPP (Marathon 2022a). The proposed measures address the following key mitigation categories:

- Project footprint and disturbed areas will be limited to the extent practicable
- Reduction of water inventory
- Progressive erosion and sediment control (ESC) measures
- Implementation of water management plan that incorporates standard management practices for the water management infrastructure
- Site water and tailings management and treatment
- Maintain flow to fish bearing streams and wetlands

A list of general mitigation measures to be applied during the construction and operation phases to meet the above measure categories of the Project is provided in Appendix A.

4.0 MONITORING PROGRAM

4.1 MEASUREABLE PARAMETERS AND THRESHOLDS

The Project will be registered under the MDMER. The MDMER, pursuant to the federal *Fisheries Act*, comes into force on the first day that a mine releases more than 50 cubic metres (m³) in a single day. It is assumed for the Project that following start of discharge from any of the sediment ponds or polishing pond that this release volume criteria will be met, and monitoring will be required to commence at applicable FDPs, WQPs/WQFPs and RQP/RQFPs. The MDMER sets a daily flow volume monitoring requirement at each FDP.

As described in the AMPRP, details of monitoring in the event of an accident or malfunction will be determined in consultation with regulatory authorities and Indigenous groups and will be informed by regulatory requirements pertaining to the accident or malfunction.

4.1.1 Surface Water Quality

The primary surface water quality criteria applicable to the Project FDPs are the following:

- Schedule 4 of the MDMER under the *Fisheries Act* when the mine discharges at an effluent flow rate of ≥ 50 m³/day, based on effluent deposited from all mine FDPs
- General provisions of Section 36(3) of the *Fisheries Act* regarding the deposition of deleterious substances in waters frequented by fish

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- During the period prior to the mine discharging effluent at ≥ 50 m³/day, based on effluent deposited from all mine FDPs; and/or
- When the mine has attained recognized closed mine (RCM) status under Part 4 of the MDMER
- Schedule C of NL Regulation 65/03 ECWSR, 2003 under the *Water Resources Act* (O.C. 2003-231)
- The conditions of a Certificate of Approval anticipated to be issued by Pollution Prevention Division of the NLDECC
- Environmental effects of mine effluent in relation to baseline water quality in receiving watercourses and waterbodies, to satisfy requirements of the federal and provincial EIS guidelines

Schedule C of NL Reg. 65/03, which applies to metal mining states:

“A person primarily in the Metal Mining Industry shall comply with sections 3 and 19.1 and 20 and Schedule 4 of the Metal Mining Effluent Regulations (Canada) SOR/2002-222, including any changes or amendments to those sections of and that schedule to those regulations over time.”

Therefore, the primary surface water quality criteria applied to mine activity effluent discharge at the site are those in MDMER Schedule 4 and Certificate of Approval conditions.

The sanitary WWTP discharge has the following applicable surface water quality criteria:

- Section 6 and *Schedule A of NL Regulation 65/03 ECWSR, 2003* under the *Water Resources Act*
- *Wastewater Systems Effluent Regulations (WSER)* under the *Fisheries Act*
- The conditions of a Permit to Operate anticipated to be issued by Water Resources Management Division of the NLDECC

Additionally, water quality results will be evaluated in comparison to the following criteria

- Canadian Water Quality Guidelines for the Protection of Freshwater Aquatic Life (CWQG-FAL)
- Baseline surface water quality results from EIS Chapter 7 (Marathon 2020)
- Predicted surface water quality information from EIS Chapter 7 (Marathon 2020)
- Reference surface water quality concentrations at appropriate Project RQP/RFQP sites

4.1.2 Surface Water Quantity

The primary surface water quantity criteria applicable to the Project are the following:

- Monitoring flows at the FDPs at a maximum margin of error of $\pm 15\%$ of the total discharge as required in the MDMER
- Monitoring flows at OUPs at a maximum margin of error of $\pm 15\%$ as required in the federal WSER
- Monitoring flows at WFPs and select WQFPs for comparison against predicted reductions (indirect loss) of fish habitat in watercourses as outlined in the anticipated *Fisheries Act* Authorization

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4.2 MONITORING LOCATIONS

In accordance with the MDMER, ECWSR and anticipated *Fisheries Act* Authorization requirements, Marathon intends to monitor the following locations with respect to surface water quality and quantity during the construction and operations phase, and at select stations below during the pre-construction phase:

- Surface water quality and quantity at each of the mine activity water 13 FDPs (Table 4.1)
- Surface water quality at eight WQPs and two WQFPs, which represent the exposure area 100 m downstream/offshore of the point of entry of effluent into water from each FDP (Table 4.2)
 - The two WQFPs (LP-WQFP-03 and MA-WQFP-45) will be installed during the pre-construction phase
- Surface water quantity at two WQFPs where two FDPs discharge into the same water system on opposite banks (Table 4.2)
- Surface water quantity at nine WFPs (Table 4.3)
 - All nine WFPs will be installed during the pre-construction phase
- Influent water quality to the sanitary WWTPs at the two INPs (Table 4.4)
- Effluent water quality from the sanitary WWTPs at the two OUPs (Table 4.4)
- Reference surface water quality at two RQPs and one RQFP, which represent related reference areas (Table 4.5)
 - The reference sites will be installed during the pre-construction phase
- Reference surface water quantity is monitored at one RQFP (Table 4.5)

As per the EA Decision Letter, establishment during the pre-construction phase of near real-time surface water quality and quantity monitoring station(s) instrumented with telemetry and linked to the provincial real-time monitoring network (in consultation with NLDECC) is required. Seven near real-time surface water quality and quantity monitoring sites are proposed by to be installed. Four of the stations are co-located with MDMER and/or *Fisheries Act* Authorization monitoring locations (Table 4.6).

Figures 1, 2 and 3 (Appendix B) present the monitoring point locations within the Marathon Pit Complex (MA), Leprechaun Pit Complex (LP) and Processing Plant (PP) Areas, respectively.

By monitoring at these 39 locations, Marathon will confirm the absence of adverse water quality and water quantity effects from the Project from routine/planned Project activities. In the event of an accident or malfunction, additional sampling locations may be required; as described in the AMPRP, details of monitoring in the event of an accident or malfunction will be determined in consultation with regulatory authorities and Indigenous groups and will be informed by regulatory requirements pertaining to the accident or malfunction.

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Table 4.1 Final Discharge Points, Associated Water Management Infrastructure, Discharge Water System and Locations (NAD 1983 UTM Zone 21N)

Final Discharge Point	Easting	Northing	Discharge Location	Sedimentation Pond / Infrastructure	Mine Facility
Marathon Pit Complex (Appendix B, Figure 1)					
MA-FDP-01A	491203.78	5359907.89	Stream Val-2; Valentine Lake	MA-SP-01AB	Marathon Low-Grade Ore Stockpile
					Marathon Overburden Stockpile
MA-FDP-01C	491660.96	5360115.08	Stream VAL-3; Valentine Lake	MA-SP-01C	Marathon Waste Rock Pile
MA-FDP-03	491911.06	5361565.90	Stream VIC-6; Victoria River	MA-SP-03	Marathon Waste Rock Pile
MA-FDP-04	493237.17	5361274.34	Stream VIC-8; Victoria River	MA-SP-04	Marathon Waste Rock Pile
					Marathon Topsoil Stockpile
MA-FDP-05	493232.20	5361269.30	Stream VIC-8; Victoria River	MA-SP-05	Marathon Pit
Leprechaun Pit Complex (Appendix B, Figure 2)					
LP-FDP-01A	488478.96	5356326.96	Stream VIC-26; Victoria Lake Reservoir	LP-SP-01A	Leprechaun Low-Grade Ore Stockpile
LP-FDP-01B	488473.89	5356321.90	Stream VIC-26; Victoria Lake Reservoir	LP-SP-01B	Leprechaun Topsoil Stockpile
					Leprechaun South Waste Rock Pile
LP-FDP-02	488008.10	5354813.15	Victoria Lake Reservoir	LP-SP-02	Leprechaun South Waste Rock Pile
LP-FDP-03A	486705.52	5355125.29	Stream VIC-16; Victoria Lake Reservoir	LP-SP-03A	Leprechaun South Waste Rock Pile
LP-FDP-03C	486700.45	5355120.25	Stream VIC-16; Victoria Lake Reservoir	LP-SP-03C	Leprechaun South Waste Rock Pile
					Leprechaun Overburden Stockpile
LP-FDP-05	486104.84	5355576.01	Pond VIC-P2; Victoria Lake Reservoir	LP-SP-05	Leprechaun Pit
Process Plant Area (Appendix B, Figure 3)					
PP-FDP-01	490296.42	5356900.26	Victoria Lake Reservoir	Polishing Pond	TMF

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Table 4.1 Final Discharge Points, Associated Water Management Infrastructure, Discharge Water System and Locations (NAD 1983 UTM Zone 21N)

Final Discharge Point	Easting	Northing	Discharge Location	Sedimentation Pond / Infrastructure	Mine Facility
PP-FDP-02	489768.82	5357135.48	Pond L2; Victoria Lake Reservoir	PP-SP-01	Process Plant Pad

Table 4.2 Water Quality Points, Water Quality and Flow Points, Associated Final Discharge Points and Locations (NAD 1983 UTM Zone 21N)

Water Quality Point (WQP)/ Water Quality and Flow Point (WQFP)	Easting	Northing	Receiver Location	Associated Final Discharge Point(s)
Marathon Pit Complex (Appendix B, Figure 1)				
MA-WQP-01A	491120.07	5359877.09	Stream VAL-2	MA-FDP-01A
MA-WQP-01B	491561.50	5360151.09	Stream VAL-3	MA-FDP-01B
MA-WQP-03	492001.96	5361525.82	Stream VIC-6	MA-FDP-03
MA-WQFP-45 *	493334.24	5361264.10	Stream VIC-8	MA-FDP-04; MA-FDP-05
Leprechaun Pit Complex (Appendix B, Figure 2)				
LP-WQP-01	488458.32	5356252.94	Stream VIC-26	LP-FDP-01A; LP-FDP-01B
LP-WQP-02	488027.70	5354703.96	Victoria Lake Reservoir	LP-FDP-02
LP-WQFP-03 *	486687.54	5355082.23	Stream VIC-16	LP-FDP-03A; LP-FDP-03C
LP-WQP-05	486193.47	5355586.50	Pond VIC-P2	LP-FDP-05
Process Plant Area (Appendix B, Figure 3)				
PP-WQP-01	490681.13	5355379.57	Victoria Lake Reservoir	PP-FDP-01
PP-WQP-02	489700.22	5357083.08	Pond L2	PP-FDP-02
Note: * - Pre-construction monitoring station				

Table 4.3 Water Flow Points, Water Systems and Locations (NAD 1983 UTM Zone 21N)

Water Flow Point (WFP)	Easting	Northing	Water System
Marathon Pit Complex (Appendix B, Figure 1)			
WFP-05 *	490803.88	5361504.65	Stream VAL-5
WFP-HS8 *	494351.62	5361700.61	Stream VIC-9
WFP-HS9 *	489876.26	5359593.40	Pond VAL-P3 Outlet


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Table 4.3 Water Flow Points, Water Systems and Locations (NAD 1983 UTM Zone 21N)

Water Flow Point (WFP)	Easting	Northing	Water System
WFP-35 *	490568.27	5362789.97	Stream VIC-35
Leprechaun Pit Complex (Appendix B, Figure 2)			
WFP-HS4 *	486569.30	5355176.20	Stream VIC-17
WFP-HS5 *	486757.17	5355149.18	Stream VIC-15
WFP-26 *	488295.65	5354906.95	VIC-26
Process Plant Area (Appendix B, Figure 3)			
WFP-HS7 *	491128.63	5357376.11	VIR-32
WFP-33 *	493093.82	5358131.87	VIR-34
Note: * - Pre-construction monitoring station			

Table 4.4 Wastewater Treatment Plant Inlet and Outlet Point and Location (NAD 1983 UTM Zone 21N)

Inlet Point (INP)/Outlet Point (OUP)	Easting	Northing
Process Plant Area (Appendix B, Figure 3)		
AC-INP-01	490384.80	5355770.79
AC-OUP-01	490306.16	5355718.82
PP-INP-01	490173.82	5357218.43
PP-OUP-01	490218.88	5357212.75

Table 4.5 Reference Quality Points, Reference Quality and Flow Points, Water Systems and Locations (NAD 1983 UTM Zone 21N)

Reference Quality Point (RQP)/ Reference Quality and Flow Point (RQFP)	Easting	Northing	Water System
Marathon Pit Complex (Appendix B, Figure 1)			
RQP-VAL01	488960.12	5359582.96	Valentine Lake
Leprechaun Pit Complex (Appendix B, Figure 2)			
RQP-VIC01	485630.31	5353775.64	Victoria Lake
Victoria River/Beothuk Lake Watershed (Appendix B, Figure 4)			
RQFP-34	499052.01	5376755.39	Beothuk Lake

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Table 4.6 Provincial Real-Time Water Quality and Quantity Points, Water Systems and Locations (NAD 1983 UTM Zone 21N)

Provincial Real-Time Water Quality and Quantity Points	Easting	Northing	Water System
Marathon Pit Complex (Appendix A, Figure 1)			
WFP-HS9 †	489876.26	5359593.40	Pond VAL-P3 Outlet
WFP-HS8 †	494351.62	5361700.61	Stream VIC-9
NLECC-VL-Outlet	494167.78	5363518.75	Valentine Lake Outlet (Stream VIC-35)
NLECC-VR-Pit	494648.42	5361532.40	Victoria River
Leprechaun Pit Complex (Appendix A, Figure 2)			
LP-WQFP-03 †	486687.54	5355082.24	Stream VIC-16
Victoria River/Beothuk Lake Watershed (Appendix B, Figure 4)			
RQFP-34 †	499052.01	5376755.39	Unnamed tributary to Beothuk Lake
NLECC-VR-VRB	523622.92	5398903.38	Victoria River
Note: † - Stations co-located with Marathon MDMER and/or Fisheries Act Authorization monitoring locations			

4.3 PRE-CONSTRUCTION MONITORING

Baseline and predictive surface water quality and quantity studies were completed as part of the EIS. The MDMER establishes effluent discharge criteria during the construction and operations phases. The CWQG-FAL informs guideline values for comparative purposes.

Prior to construction, Marathon in partnership with the NLECC will install near real-time watercourse surface water quality and quantity monitoring stations at four sites presented in Table 4.6. The NLECC will monitor near real-time water levels along with period surface water flow measurements at the stations and develop a site specific stage: discharge relationship. The NLECC using near real-time continuous monitoring equipment will measure select water quality parameters (e.g., turbidity, temperature, dissolved oxygen, conductivity, pH). Marathon will conduct periodic surface water quality monitoring to meet MDMER requirements at one of the stations (RQFP-ZF01) following the measures in Section 4.3.2.1.

Marathon will also setup the other WFP and WQFP stations prior to the start of construction. The near real-time surface water quantity monitoring station installation with periodic flow monitoring will provide data to assist with establishing a site-specific rating curve to monitor changes in surface water quantity through construction and operation. The methodology for monitoring flow at these stations follows the measures described Section 4.3.2.2 (station flow rates estimated by periodic *in situ* channel velocity,

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depth and flow profiling measurements supported by near real-time continuous water level monitoring). The surface water quality monitoring methodology for MA-WQFP-45 will follow the measures described in Section 4.3.2.1.

4.4 METHODS

Marathon will monitor surface water quality, collect surface water quality samples for analysis and conduct surface water quantity monitoring. Frozen/dry water conditions or unsafe conditions may prevent monitoring events at some or all stations during the monitoring period.

4.4.1 Surface Water Quality

During construction, Marathon collects grab surface water samples at the FDPs, WQPs, WQFPs and RQPs according to the schedule presented in Table 4.7. The MDMER specify monitoring frequency and parameters with respect to monitoring at FDPs, WQPs/WQFPs and RQPs/RQFPs, which is the basis of the monitoring program. Sublethal toxicity testing is proposed for FDPs that receive mine activity water from waste rock piles, ore piles, pit dewatering and the TMF polishing pond. Additional parameter packages to be monitored at the sites, include parameters of potential concern (POPCs) identified in EIS Chapter 7, Section 7.3.5.2 (Marathon 2020) and typical monitoring parameters required by NL Certificate of Approvals. The specific parameters monitored in each package are presented in Table 4.8 along with the MDMER threshold criteria for assessing specific parameter results.

For the WWTP inlets (PP-INP-01, AC-INP-01) and outlets (PP-OUP-01, AC-OUP-01), monitoring parameter packages are presented in Table 4.8 that are typically part of a NL wastewater permit to operate and required by the federal WSER.

Table 4.7 Monitoring Site Types and Monitoring Frequency

Point Type	Parameter Package ¹	Sampling Frequency	Frequency Limitation	Notes
FDPs (final discharge points)	MDMER, Schedule 4, Table 1	Weekly	≥24 hours apart between samples	The analysis shall comply with analytical requirements set out in MDMER Schedule 3, Table 1
	MDMER Acute Lethality Test 2	Monthly	Sampling date selected and recorded ≥30 days in advance; if cannot sample on that date, must be done as soon as practicable; ≥15 days apart between samples	Collect sufficient sample that an aliquot can be submitted for laboratory analysis for MDMER effluent characterization and MDMER, Schedule 4, Table 1 (if analysis not done on same initial grab sample)
	MDMER Effluent Characterization ³	Four times per calendar year	≥1 month apart between samples	The analysis shall comply with analytical requirements set out in MDMER Schedule 3, Table 2
	NL Certificate of Approval - Typical	Four times per calendar year	≥1 month apart between samples	
	EIS Parameters of Potential Concern	Four times per calendar year	≥1 month apart between samples	
	MDMER Sublethal Toxicity Test ⁴	Semi-Annual (Operation Year 3 and onward – Quarterly; Tests with lowest geometric mean values producing a 25% effect or effective concentration of 25%)		
INPs (inlet points) and OUPs (outlet points)	NL ECWSR Schedule A	One time per calendar year		
	NL Wastewater Characterization	Quarterly		
OUPs (outlet points)	WSER	Monthly	≥10 days apart between samples	Grab or composite; Daily wastewater volume ≤2,500 m ³
WQPs/WQFPs (water quality points/water quality flow points)	MDMER, Schedule 4, Table 1	Four times per calendar year	≥1 month apart between samples	The analysis shall comply with analytical requirements set out in MDMER Schedule 3, Table 1
	MDMER Effluent Characterization ³	Four times per calendar year	≥1 month apart between samples	The analysis shall comply with analytical requirements set out in MDMER Schedule 3, Table 2
	NL Certificate of Approval - Typical	Four times per calendar year	≥1 month apart between samples	
	EIS Parameters of Potential Concern	Four times per calendar year	≥1 month apart between samples	
RQPs/RQFPs (reference quality points/reference quality flow points)	MDMER, Schedule 4, Table 1	Four times per calendar year	≥1 month apart between samples	The analysis shall comply with analytical requirements set out in MDMER Schedule 3, Table 1
	MDMER Effluent Characterization ³	Four times per calendar year	≥1 month apart between samples	The analysis shall comply with analytical requirements set out in MDMER Schedule 3, Table 2
	NL Certificate of Approval - Typical	Four times per calendar year	≥1 month apart between samples	
	EIS Parameters of Potential Concern	Four times per calendar year	≥1 month apart between samples	
<p>Note: ¹ Table 4.6 lists the specific parameters, detection limits and threshold criteria for each parameter package; ²MDMER, 14(1) & (2); ³MDMER, 4(1), (2) & (3); ⁴MDMER, 5(1) & 5(3), 6(1)</p>				

Table 4.8 Monitoring Parameters, Guideline Values and Regulatory Criteria

Parameters	Units	Reportable Detection Limit (RDL)	CWQG-FAL Guidelines		Newfoundland and Labrador ECWSR	Federal Wastewater Systems Effluent Regulations Maximum Quarterly Mean Concentration (<2,500 m3/day discharge)	MDMER Effluent Criteria at Final Discharge Points		
			Short-term	Long-term			Maximum Authorized Monthly Mean Concentration	Maximum Authorized Concentration in a Composite Sample	Maximum Authorized Concentration in a Grab Sample
Metal and Diamond Mine Effluent Regulation (MDMER) Schedule 4, Table 1									
Total Arsenic (As) ²	mg/L	0.001	ND	0.005	MDMER		0.1	0.15	0.2
Total Copper (Cu) ²	mg/L	0.001	ND	0.002	MDMER		0.1	0.15	0.2
Total Cyanide (CN- Total)	mg/L	0.01	ND	ND	MDMER		0.5	0.75	1
Total Lead (Pb) ²	mg/L	0.0005	ND	0.001	MDMER		0.08	0.12	0.16
Total Nickel (Ni)	mg/L	2	ND	Equation ^a	MDMER		0.25	0.38	0.5
Total Zinc (Zn) ²	mg/L	0.005	Narrative ^b	Narrative ^b	MDMER		0.4	0.6	0.8
Total Suspended Solids (TSS)	mg/L	1	ND	Narrative ^c	MDMER		15	22.5	30
Radium 226	Bq/L	0.005	ND	ND	MDMER		0.37	0.74	1.11
Un-ionized Ammonia (as N) ¹ (NH3 UN as N)	mg/L	NA	ND	0.016	MDMER		0.5	NA	1
Total Ammonia (as N) (NH3 Tot as N)	mg/L	0.05	ND	Table ^d	2		-	-	-
Field pH	-	NA	ND	6.5 – 9	MDMER		6.5 – 9.5		
Field Temperature	°C	±0.5	-	-	<32		-	-	-
MDMER EFFLUENT CHARACTERIZATION									
Total Aluminum (Al) ²	µg/L	5	ND	Narrative ^e	-				
Total Cadmium (Cd) ²	µg/L	0.017	Equation ^f	Equation ^g	50				
Chloride (Cl)	mg/L	60	640	120	-				
Total Chromium (Cr)	µg/L	1	ND	(III) – 8.9; (VI) - 1 ^h	50 ^a				
Total Cobalt (Co)	µg/L	1.25	ND	ND	-				
Total Iron (Fe) ²	µg/L	50	ND	300	10,000				
Total Manganese (Mn) ³	µg/L	2	Equation ⁱ	Variable ^j	-				
Total Mercury (Hg)	µg/L	0.013	ND	0.026	5				
Total Molybdenum (Mo)	µg/L	36.5	ND	73	-				
Nitrate (as N) (NO ₃ -N)	µg/L	50	124,000	3,000	10				
Total Phosphorus (as P) (TP) ³	µg/L	4	ND	Guidance Framework ^k	-				
Total Selenium (Se)	µg/L	0.5	ND	1	10				
Total Thallium (Tl)	µg/L	0.4	ND	0.8	-				
Total Uranium (Ur)	µg/L	0.1	33	15	-				
Dissolved Oxygen (DO)	mg/L	0.05	-	Narrative ^l	-				

Table 4.8 Monitoring Parameters, Guideline Values and Regulatory Criteria

Parameters	Units	Reportable Detection Limit (RDL)	CWQG-FAL Guidelines		Newfoundland and Labrador ECWSR	Federal Wastewater Systems Effluent Regulations Maximum Quarterly Mean Concentration (<2,500 m3/day discharge)	MDMER Effluent Criteria at Final Discharge Points		
			Short-term	Long-term			Maximum Authorized Monthly Mean Concentration	Maximum Authorized Concentration in a Composite Sample	Maximum Authorized Concentration in a Grab Sample
Alkalinity	mg/L	2	-	-	-				
Hardness	mg/L	1	-	-	-				
Field Conductivity	µS/cm	1	-	-	-				
NL Certificate of Approval - Typical									
Nitrate + Nitrite as Nitrogen (NO ₃ + NO ₂ as N)	mg/L	0.05	-	-	-				
Colour	TCU	5	-	Narrative ^P	-				
Sodium (Na)	mg/L	0.1	-	-	-				
Potassium (K)	mg/L	0.1	-	-	-				
Calcium (Ca)	mg/L	0.1	-	-	-				
Total Sulphide (S ₂ ⁻)	mg/L	0.0018	-	-	-				
Magnesium (Mg)	mg/L	0.1	-	-	-				
Orthophosphate as P (PO ₄ ³⁻ as P)	mg/L	0.01	-	-	-				
Dissolved Organic Carbon (DOC)	mg/L	1	-	-	-				
Total Dissolved Solids (calculated)	mg/L	1	-	-	1,000				
Phenolics	mg/L	0.0015	-	-	0.1				
Carbonate alkalinity	mg/L	1	-	-	-				
Bicarbonate alkalinity	mg/L	1	-	-	-				
Reactive Silica (SiO ₂)	mg/L	0.5	-	-	-				
Total Antimony (Sb)	µg/L	1	ND	ND	-				
Total Barium (Ba)	µg/L	1	ND	ND	5,000				
Total Beryllium (Be)	µg/L	1	ND	ND	-				
Total Bismuth (Bi)	µg/L	2	-	-	-				
Total Boron (B)	µg/L	50	29,000	1,500	5,000				
Total Silver (Ag)	µg/L	0.1	No Reportable Guideline	0.25	50				
Total Strontium (Sr)	µg/L	2	ND	ND	-				
Tin (Sn)	µg/L	2	ND	ND	-				
Titanium (Ti)	µg/L	2	-	-	-				
Vanadium (V)	µg/L	2	ND	ND	-				

Table 4.8 Monitoring Parameters, Guideline Values and Regulatory Criteria

Parameters	Units	Reportable Detection Limit (RDL)	CWQG-FAL Guidelines		Newfoundland and Labrador ECWSR	Federal Wastewater Systems Effluent Regulations Maximum Quarterly Mean Concentration (<2,500 m3/day discharge)	MDMER Effluent Criteria at Final Discharge Points		
			Short-term	Long-term			Maximum Authorized Monthly Mean Concentration	Maximum Authorized Concentration in a Composite Sample	Maximum Authorized Concentration in a Grab Sample
Environmental Impact Statement (EIS) Parameters of Potential Concern (Marathon 2020)									
Weak Acid Dissociable Cyanide (CN ⁻ WAD) ³	µg/L	1	ND	5 (as Free CN ⁻)	-				
Total Fluoride (FI) ³	µg/L	60	ND	120	-				
Nitrite (as N) (NO ₂ ⁻ N) ²	µg/L	10	ND	60	-				
Sulphate (SO ₄) ³	µg/L	600	ND	Table ^m	-				
Acute Lethality Test							Maximum Grab Sample Result		
Rainbow Trout (EPS 1/RM/13 Section 5 or 6)	-	-	-	-	-		Acutely Lethal		
Daphnia magna (EPS 1/RM/13 Section 5 or 6)	-	-	-	-	-		Acutely Lethal		
Field pH	-	NA	ND	6.5 – 9	MDMER		6.5 – 9.5		
Field Temperature	°C	±0.5	-	-	-		-		
Sublethal Toxicity Test									
Test of Larval Growth and Survival Using Fathead Minnows (Report EPS 1/RM/22 or Toxicity Tests Using Early Life Stages of Salmonid Fish (Rainbow Trout) (Reference Method EPS 1/RM/28)	-	-	-	-	-				
Test of Reproduction and Survival Using the <i>Cladoceran Ceriodaphnia dubia</i> (Report EPS 1/RM/21)	-	-	-	-	-				
Test for Measuring the Inhibition of Growth Using the Freshwater Macrophyte, <i>Lemna minor</i> (Reference Method EPS 1/RM/37) as it applies to the biological endpoint based on the number of fronds	-	-	-	-	-				
Biological Test Method: Growth Inhibition Test Using a Freshwater Alga (Report EPS 1/RM/25) or Inhibition de la croissance chez l'algue <i>Pseudokirchneriella subcapitata</i> , (Méthode de référence MA 500 – P. sub. 1.0, rév. 3), published by the Centre d'expertise en analyse environnementale du Québec du ministère du Développement durable, de l'Environnement et de la Lutte contre les changements climatiques du Québec.	-	-	-	-	-				

Table 4.8 Monitoring Parameters, Guideline Values and Regulatory Criteria

Parameters	Units	Reportable Detection Limit (RDL)	CWQG-FAL Guidelines		Newfoundland and Labrador ECWSR	Federal Wastewater Systems Effluent Regulations Maximum Quarterly Mean Concentration (<2,500 m3/day discharge)	MDMER Effluent Criteria at Final Discharge Points		
			Short-term	Long-term			Maximum Authorized Monthly Mean Concentration	Maximum Authorized Concentration in a Composite Sample	Maximum Authorized Concentration in a Grab Sample
Newfoundland and Labrador (NL) Environmental Control and Wastewater System Regulation (ECWSR) Schedule A									
Biochemical Oxygen Demand (BOD)	mg/L				20				
Fecal Coliform	CFU/100 mL		ND	ND	1,000				
Total Dissolved Solids (TDS) ⁿ	mg/L	1	-	-	1,000				
Oils (Ether extract)	mg/L				15				
Boron (B)	mg/L	0.05	29	1.5	5				
Cadmium (Cd)	mg/L	0.000017	Equation ^f	Equation ^g	0.05				
Chromium VI (Cr VI)	mg/L				0.05				
Chromium III (Cr III)	mg/L				1				
Copper (Cu)	mg/L	0.001	ND	Equation ^q	MDMER		0.1	0.15	0.2
Cyanide (CN ⁻)	mg/L	0.01	ND	ND	MDMER		0.5	0.75	1
Iron (Fe)	mg/L	0.05	ND	300	10				
Lead (Pb)	mg/L	0.0005	ND	Equation ^r	MDMER		0.08	0.12	0.16
Mercury (Hg)	mg/L	0.000013	ND	0.000026	0.005				
Nickel (Ni)	mg/L	2	ND	Equation ^a	MDMER		0.25	0.38	0.5
Phenols	mg/L	0.0015	-	-	0.5				
Phosphates (as P ₂ O ₅)	mg/L	0.01	-	-	10				
Phosphorus (elemental)	mg/L		-	-	0.0005				
Zinc	mg/L	0.005	Narrative ^b	Narrative ^b	MDMER		0.4	0.6	0.8
Newfoundland and Labrador (NL) Wastewater Characterization									
Total Phosphorus	µg/L	4	ND	Guidance Framework ^k	-				
Total Coliforms	CFU/100 mL	1	-	-	5,000				
E. coli	CFU/100 mL	1	ND	ND	-				
field temperature	°C	±0.5	-	-	<32				

Table 4.8 Monitoring Parameters, Guideline Values and Regulatory Criteria

Parameters	Units	Reportable Detection Limit (RDL)	CWQG-FAL Guidelines		Newfoundland and Labrador ECWSR	Federal Wastewater Systems Effluent Regulations Maximum Quarterly Mean Concentration (<2,500 m3/day discharge)	MDMER Effluent Criteria at Final Discharge Points		
			Short-term	Long-term			Maximum Authorized Monthly Mean Concentration	Maximum Authorized Concentration in a Composite Sample	Maximum Authorized Concentration in a Grab Sample
Wastewater Systems Effluent Regulations (WSER)									
5-day Carbonaceous Biochemical Oxygen Demand (CBOD ₅)	mg/L	2	-	-	-	25			
Total Suspended Solids (TSS)	mg/L	1	ND	Narrative ^c	WSER	25			
Total Residual Chlorine	mg/L	0.01	-	-	1	0.02			
Total Ammonia (as N) (NH ₃ Tot as N)	mg/L	0.05	ND	Table ^d	2	-			
Un-ionized Ammonia (as N) ¹ (NH ₃ UN as N)	mg/L	NA	ND	0.016	WSER	1.25 ^o			
field pH	-	-	NA	ND	5.5 to 9.0	-			
<p>Notes:</p> <ul style="list-style-type: none"> - no value NA not applicable ND no data MDMER Metal and Diamond Mining Effluent Regulation ¹ Un-ionized ammonia is calculated using the following equation: $A / (1 + 10^{pK_a - pH})$ where A is the concentration of total ammonia — which is the sum of un-ionized ammonia (NH₃) and ionized ammonia (NH₄⁺) — expressed in mg/L as nitrogen (N); pH is the pH of the effluent sample; and pK_a is a dissociation constant calculated in accordance with the following formula: $0.09018 + 2729.92/T$ where T is the temperature of the effluent sample in kelvin. (MDMER 12(4)) ² EIS baseline surface water quality program CWQG-FAL exceedance parameter (EIS Chapter 7, Section 7.3.5.2 (Marathon 2020)) ³ EIS mine effluent characterization CWQG-FAL exceedance parameter (EIS Chapter 7, Section 7.3.5.2 (Marathon 2020)) ^a Ni equation: Hardness ≤60 mg calcium carbonate (CaCO₃)·L-1, CWQG-FAL is 0.025 mg/L, Hardness >60 to ≤180 mg CaCO₃·L-1 use equation $e^{(0.76[\ln(\text{hardness})] + 1.06)}$, Hardness >180 mg CaCO₃·L-1, CWQG-FAL is 0.15 mg/L ^b Zn (dissolved) equation: short-term = $\exp(0.833[\ln(\text{hardness mg} \cdot \text{L}^{-1})] + 0.240[\ln(\text{DOC mg} \cdot \text{L}^{-1})] + 0.526)$ for hardness 13.8 and 250.5 mg CaCO₃·L-1 & DOC 0.3 and 17.3 mg·L-1, long-term = $\exp(0.947[\ln(\text{hardness mg} \cdot \text{L}^{-1})] - 0.815[\text{pH}] + 0.398[\ln(\text{DOC mg} \cdot \text{L}^{-1})] + 4.625)$ for hardness 23.4 and 399 mg CaCO₃·L-1, pH 6.5 and 8.13 and DOC 0.3 to 22.9 mg·L-1 ^c TSS narrative "clear flow: Maximum increase of 25 mg/L from background levels for any short-term exposure (e.g., 24-h period). Maximum average increase of 5 mg/L from background levels for longer term exposures (e.g., inputs lasting between 24 h and 30 d)." ^d Total Ammonia as N table is temperature and pH dependent. Measurements of total ammonia in the aquatic environment are often expressed as mg/L total ammonia-N. The present guideline values (mg/L NH₃) can be converted to mg/L total ammonia-N by multiplying the corresponding guideline value by 0.8224. Consult the CWQG-FAL factsheet for specific table. ^e Al CWQG = 5 µg/L if pH <6.5, 100 µg/L if pH ≥6.5 ^f Cd short-term: 0.11 µg/L if hardness 0 to <5.3 mg CaCO₃·L-1, $10^{(1.016[\ln(\text{hardness})] - 1.71)}$ if hardness ≥5.3 mg CaCO₃·L-1 to ≤360 mg CaCO₃·L-1, 7.7 µg/L if hardness >360 mg CaCO₃·L-1 ^g Cd long-term: 0.04 µg/L if hardness 0 to <17 mg CaCO₃·L-1, $10^{(0.83[\ln(\text{hardness})] - 2.46)}$ if hardness ≥17 to ≤280 mg CaCO₃·L-1, 0.37 µg/L if hardness >280 mg CaCO₃·L-1 ^h Chromium, trivalent (Cr(III)) = 8.9 µg/L; Chromium, hexavalent (Cr(VI)) = 1 µg/L; Chromium, total = no guideline ⁱ Mn (dissolved) short-term: benchmark calculator in Appendix B of Scientific Criteria Document for the Development of the Canadian Water Quality Guidelines for the Protection of Aquatic Life: Manganese ^j Mn (dissolved) long-term: CWQG calculator in Appendix B of the Scientific Criteria Document for the Development of the Canadian Water Quality Guidelines for the Protection of Aquatic Life: Manganese. ^k TP narrative = Trigger Ranges for Total Phosphorus (mg/L) (see Guidance Framework for Phosphorus factsheet): ultra-oligotrophic <0.004, oligotrophic 0.004-0.01, mesotrophic 0.01-0.02, meso-eutrophic 0.02-0.035, eutrophic 0.035-0.1, hyper-eutrophic >0.1. ^l DO Narrative = Lowest acceptable DO concentrations for the protection of freshwater organisms; 6 mg/L or greater for early life stages of warmwater species, 5.5 mg/L or greater for other life stages of warmwater species, 9.5 mg/L or greater for early life stages of cold water species, and 6.5 mg/L or greater for other life stages of cold water species ^m Sulphate guideline value is from British Columbia Ministry of Environment and Climate Change Strategy for the protection of aquatic life (Guideline: 128 mg/L for hardness 0 to 30 mg CaCO₃·L-1; 218 mg/L for hardness 31 to 75 mg CaCO₃·L-1, 309 mg/L for hardness 76 to 180 mg CaCO₃·L-1, 429 for hardness 181 to 250 mg CaCO₃·L-1) (Meays and Nordin 2013) ⁿ if water is abstracted from a watercourse, used, treated and subsequently returned to the same watercourse, these solids data mean that the effluent should not contain 1000 mg TDS/L or 30 mg TSS/L more than was in the water originally abstracted (adapted from ECWSR) ^o at 15°C ± 1°C ^p The mean absorbance of filtered water samples at 456 nm shall not be significantly higher than seasonally adjusted expect value for the system under consideration. ^q Cu long-term: 2 µg/L if hardness 0 to <82 mg CaCO₃·L-1, $0.2 \cdot e^{(0.8545[\ln(\text{hardness})] - 1.465)}$ if hardness ≥82 to ≤180 mg CaCO₃·L-1, 4 µg/L if hardness >180 mg CaCO₃·L-1 ^r Pb long-term: 1 µg/L if hardness 0 to <60 mg CaCO₃·L-1, $e^{(1.273[\ln(\text{hardness})] - 4.705)}$ if hardness ≥60 to ≤180 mg CaCO₃·L-1, 7 µg/L if hardness >180 mg CaCO₃·L-1 									

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When collecting samples at the monitoring sites, field meter readings (i.e., pH, electrical conductivity, water temperature, DO) are measured and recorded at the time of collection. Samples are collected in clean laboratory-prepared containers specific to each analysis and stored and shipped in coolers at approximately 4 degrees Celsius (°C). The water samples collected at FDPs, WQPs, WQFPs, INPs, OUPs, RQPs and RQFPs are submitted to a Canadian Association for Laboratory Accreditation (CALA)-accredited laboratory following chain of custody protocols for analysis or to conduct acute or sublethal testing. The field and laboratory analysis method detection limits meet the requirements presented in Table 4.8.

Composite sampling may be conducted at the FDPs using either of the following collection techniques:

- Collect a minimum of three volumes of effluent (equal or flow proportionate) at equal time intervals over a sampling period ≥ 7 hours and ≤ 24 hours
- Collect a volume of effluent continuously at a constant rate or flow proportionate rate over a sampling period ≥ 7 hours and ≤ 24 hours

Only grab samples are to be collected at WQPs, WQFPs, INPs, OUPs, RQPs and RQFPs.

After three years of operation, Marathon will conduct sublethal toxicity tests at an increased frequency of once per quarter for each of the Table 4.8 four different species test results that produce the lowest geometric mean, accounting for the inhibition concentration, producing a 25% effect or an effective concentration of 25% (MDMER, Section 6(3)).

4.4.1.1 *In Situ* Water Quality

The proposed NLECC partnership monitoring sites will monitor near real-time *in situ* surface water quality to meet Provincial EA Decision Letter requirements. A multi-parameter probe that monitors pH, DO, electrical conductivity, temperature and turbidity is instrumented with telemetry and linked to the provincial real-time monitoring network at each site.


4.4.1.2 Quality Assurance and Quality Control

Quality Assurance and Quality Control (QA/QC) is an integral component of proper field and laboratory analysis procedures, and a requirement for surface water quality monitoring in the MDMER (Schedule 5, Section 7).

Field Procedures

Quality controls for field water quality monitoring activities include the following:

- Staff have appropriate education and training to conduct monitoring
- Field monitoring activities follow a standardized operation procedure (SOP), including sample collection, sample labeling, equipment maintenance and cleaning
- Sampling equipment are calibrated and maintained as per manufacturer's specifications and protocols with appropriate standards (if applicable) (Section 5.0)

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- Detailed standardized field collection forms are completed during each sample event
- Samples are collected in clean laboratory-prepared containers specific to each analysis
- Field blank and duplicate, and trip blank samples will be collected at a frequency of 10% of the total number of samples for a monitoring event at the FDPs, WQPs, WQFPs, INPs, OUPs, RQPs and RQFPs
- Chain of custody forms are completed along with custody seals for collected laboratory submitted samples
- Samples are stored and shipped in coolers at approximately 4 degrees Celsius (°C), and following appropriate methods outlined by the receiving CALA accredited laboratory

Quality assurance practices for field water quality monitoring activities include the following:

- Duplicate readings using field instruments (e.g., pH, water temperature, DO) and measuring appropriate standards
- The field monitoring SOP will include review of bottle labels to check prior to submission for quality problems (e.g., mislabeling); Use of a detailed field collection form with comments section to record monitoring activity deviations/issues
- Routine auditing and review of field forms as per Marathon QA/QC processes
- Chain of custody retained for each sample event submission to the laboratory for analysis

Laboratory Procedures

Water quality samples will be submitted to a CALA accredited laboratory for analysis, which includes an accredited QA/QC program. Received laboratory analysis results will include QA/QC program results (e.g., laboratory duplicate samples, calibration control results, detection limits).

4.4.2 Surface Water Quantity

Surface water quantity is monitored at the 13 FDPs, two WQFPs, nine WFPs, one watercourse RQFP (RQFP-34) and two OUPs. The NLECC will monitor surface water quantity at four stations as part of the provincial real-time monitoring network (RQFP-34, WFP-HS9, WFP-HS8 and LP-WQFP-03). Monitoring by Marathon includes measuring water levels at the 12 sedimentation pond outfall FDPs, one watercourse WQFP and seven WFPs. Within the sedimentation pond outfall FDPs, water levels are monitored within outlet maintenance holes with flow rates estimated for these sites using open pipe flow equations based on water level, pipe diameter, pipe slope and pipe material roughness. Pond outflows for when stored pond water reaches elevations that enter the spillway channel estimates spillway flow via total water depth in the maintenance hole/pond, spillway dimensions, spillway slope and spillway material roughness. Total outfall flow for the ponds is estimated by summing together outfall pipe and spillway flow estimates.

The polishing pond outfall will have a flow totalizing meter installed on the discharge pump that records on a continuous basis the volume discharged at PP-FDP-01. The two WWTP discharge outflows will also have flow totalizing meters installed that record on a continuous basis the volumes discharged at AC-OUP-01 and PP-OUP-01.

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The flow rates at watercourse stations (WQFP and WFPs) are estimated using a combination of periodic *in situ* channel velocity, depth and flow profiling measurements, supported by continuous water level monitoring. *In situ* water level and velocity measurements are collected monthly throughout construction and operation at the riverine monitoring stations. Velocity measurements are collected using a portable velocimeter. Watercourse transects are divided into a number of manageable panels (minimum of 20 or panel spacing of 20 cm), and the velocity is measured at the depth that corresponds to 60% of the total depth when the total depth is less than 0.75 m. When total depths exceed 0.75 m, velocity measurements are taken at 20 and 80% of the total depth. The measured velocity at each section and corresponding water depths are used to estimate the total watercourse flow using the Mid-Section Method recommended and used by the Water Survey of Canada (Lane 1999). Similarly, methods outlined by Pelletier (1990) are used for under ice measurements during winter monitoring, when safe to do so. *In situ* water level and velocity data are used to refine the rating curves (stage: discharge relationships) for existing watercourse stations and to develop rating curves for the new watercourse monitoring stations. Flow hydrographs for each watercourse monitoring location are to be developed based on monitored water level data and generated rating curves.

Using datalogging instrumentation (level loggers), water level and water temperature are monitored on a continuous basis at the Marathon managed monitoring sites. These loggers are set to measure water level on a continuous basis by measuring at a 15-minute frequency. A barologger will also be deployed at one of the monitoring stations to collect barometric pressure. Level logger and barologger data is downloaded monthly at the time of the *in situ* watercourse measurements or water quality monitoring. Monitored atmospheric pressure and ambient temperature is used to barometrically compensate level logger water level data. Subsequently, this enables conversion of level data to flow using either the station rating curves discussed above or the pond outfall pipe/spillway equations.

Staff gauges are installed at each water level monitoring site and levels recorded at the time of level logger data retrieval.

Marathon records, in cubic metres, the total volume of effluent deposited from each FDP for each month for which there was a deposit with the required MDMER Section 19 (3)(a) accuracy of within $\pm 15\%$ of the flow rate/volume. The daily volume, in cubic metres, of wastewater discharge for each OUP with the required WSER Section 9(4) accuracy of within $\pm 15\%$ of the flow rate/volume will also be recorded.

4.4.2.1 General Site Surface Water Quantity Monitoring

As part of routine operation, effluent discharge, mine water, tailings water reclaim, freshwater makeup, process water, and potable water volumes is recorded on a daily basis. Gauges are installed in distribution lines for process reclaim water, spigoted tailings, and process water discharge to facilitate the monitoring of flows. Records include a monthly total and average volumes. Fresh water make-up and potable water withdrawal is gauged and recorded.

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Flow monitoring of pumping equipment on site is conducted using flow totalizing meters, this includes the open pit dewatering rates, water withdrawal rates from Victoria Lake Reservoir, effluent treatment plant rates, effluent discharge from the polishing pond, reclaim and tailings deposition rates.

4.4.2.2 Quality Assurance and Quality Control

Marathon has developed QA/QC measures to confirm the accuracy of the water quantity monitoring data. As part of QC, SOPs will be developed for flow monitoring within riverine systems and recording staff gauge heights at riverine and sedimentation pond outfall FDP sites. Staff involved in surface water quantity field monitoring will have the appropriate education and training to conduct the tasks. Field measurements will record measurements in detailed standardized collection forms.

Quality assurance practices for the level loggers, include staff gauge measurements for comparative evaluation to detect station disturbance and potential drift in the loggers that may require data adjustments or logger replacement. Velocity meters used for measuring flow in riverine systems will be calibrated as per manufacturer requirements and recorded as per Section 5.0. Flows will be monitored periodically in duplicate (i.e., two flow measurements in a riverine system using the mid-section method in immediate succession) to compare flow readings. Field forms will be routinely audited and reviewed as per Marathon QA/QC processes.

4.5 EQUIPMENT AND CALIBRATION RECORDS

Marathon will keep records for the surface water quality and quantity monitoring equipment that contains, at a minimum:

- Description of equipment, including year and model number
- Manufacturer’s specifications
- Calibration test results

Calibration testing will be conducted following equipment manufacturer manual methods, using appropriate standards (if applicable) and at the manufacturer recommended calibration frequency. The date, methods and results of each calibration test will be recorded.

5.0 REPORTING

For each month that effluent is discharged from each FDP, Marathon will calculate and record the mean monthly concentration for each parameter with a monthly threshold criterion in the MDMER, Schedule 4, Table 1 package (Table 4.8). When the analytical result for a parameter is less than the RDL, the analysis result will be considered equal to one half the detection limit when calculating the mean monthly concentration. The mean monthly concentrations at each FDP will be multiplied by the monthly FDP flow volume and appropriate conversion ratios to calculate monthly parameter loads (kg or MBq) for the Schedule 4, Table 1 parameters with threshold criterion. For each calendar quarter, the FDP quarterly

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load for the Schedule 4, Table 1 parameters with threshold criterion will be calculated using the quarterly FDP flow volume.

The results of the surface water monitoring activities will be reviewed, analyzed, and presented in an annual report to document the following:

1. Results of the monitoring program for Table 4.8 parameters, including date, locations (latitude and longitude) and detection limits
2. Mean annual concentration for each FDP of Hg and Se
3. Methods used to conduct sampling at FDPs, WQPs/WQFPs and RQP/RQFPs
4. Description of QA/QC measures implemented and applicable results data for water quality and quantity monitoring activities
5. Conformity with specified water quality thresholds
6. Causes of non-conformity results and planned or implemented remedial measures
7. Relative trends of parameters with discussion of significance of findings
8. Effectiveness of the surface water quality mitigation measures
9. Additional mitigation measures employed, if required

Reports or information referenced in Sections 7, 21, and 22 of the MDMER will be submitted electronically in the format requested by ECCC, or if no format is provided, submitted in writing.

A summary of the reporting deliverables is presented in Table 6.1.

The results of the surface water quantity monitoring activities at the WFPs and select WQFPs will be reviewed, analyzed, and incorporated into anticipated *Fisheries Act* Authorization reporting requirements. Further details of the reporting requirements are in the Valentine Gold Project: Fish and Fish Habitat Follow-up Monitoring Program (Marathon 2022b).

For the WWTP influent and effluent quality and effluent quantity, the monitoring report must contain the following information:

1. The number of days effluent was deposited
2. The volume of effluent deposited in m³
3. The average CBOD₅, TSS in the effluent for the monitoring period
4. The maximum NH₃ UN as N for the monitoring period
5. Other reporting requirements in the Permit to Operate issued by NLDECC

The report must be sent electronically in the form and format specified by the NLDECC and bear the electronic signature of the owner or operator, or their duly authorized representative.

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Table 5.1 Surface Water Monitoring Reports

Deliverable	Parameters	Pre-Construction	Construction	Operations
Monthly FDP Water Quality Results	MDMER Schedule 4, Table 1 monthly mean concentrations and monthly loads	NA	Technical memo – submitted to ECCC	Technical memo – submitted to ECCC
Quarterly Water Quality and Quantity Results (within 45 days of each quarter)	Table 4.8 results; monthly mean concentrations and monthly flow volumes and loads (MDMER Schedule 4, Table 1); Quarterly loads; Sampling type (composite or grab); # of days of discharge	NA	Technical memo with Laboratory Certificates of Analysis and Results Spreadsheet to ECCC and NLDECC	Technical memo with Laboratory Certificates of Analysis and Results Spreadsheet to ECCC and NLDECC
Annual Surface Water Quality and Quantity Report (submit no later than March 31 in each year for previous calendar year)	Table 4.7 and Table 4.8 results; non-compliance results with causes and remedial measures (planned or implemented)	NA	Technical memo – submitted to IAAC, ECCC and NLDECC	Technical memo – submitted to IAAC, ECCC and NLDECC
Water Quality Exceedances (as defined by the trigger thresholds described in Table 4.8) (without delay)	MDMER, Schedule 4, Table 1 results; Acute Lethality Test results	NA	Reported to IAAC, ECCC inspector and NLDECC upon occurrence.	Reported to IAAC, ECCC and NLDECC upon occurrence.
Water Quality Exceedances Follow-up Report (within 30 days after tests completed)	MDMER, Schedule 4, Table 1 results; Acute Lethality Test results; Other applicable parameter results from Table 4.8	NA	Technical memo – submitted to IAAC, ECCC and NLDECC	Technical memo – submitted to IAAC, ECCC and NLDECC
Quarterly WWTP Water Quality Results (within 45 days after the end of each quarter)	WWTP Permit to Operate; WSER	NA	Technical memo – submitted to NLDECC	Technical memo – submitted to NLDECC

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5.1 WATER QUALITY EXCEEDANCE RESPONSE

5.1.1 Mine Activity Water

The trigger threshold for the FDPs is an exceedance of the MDMER Schedule 4, Table 1 maximum authorized monthly mean concentration or maximum authorized concentration in a composite sample or maximum authorized concentration in a grab sample. A pH range exceedance (Table 4.8) or the effluent tests as acutely lethal also trigger the threshold. Should an exceedance be detected then the following actions will be implemented as follows:

- Marathon will notify IAAC, the ECCC inspector and NLDECC without delay of the exceedance (Table 6.1)
- Sampling will be repeated to confirm the exceedance
- A QA/QC review of sampling methods, laboratory reporting and Chain of Custody will be conducted, including re-analysis of the sample if within the hold time to determine if exceedance was due to potential laboratory analysis error
- If confirmed, the cause of the exceedance will be investigated
- If the cause was not short-term or a temporal incident that has not already been corrected, further water quality remediation measures (e.g., sedimentation ponds or drainage ditch adaptations, containerized water treatment system) will be developed and implemented in the source zones in consultation with regulatory authorities
 - Descriptions of the measures will be submitted to IAAC before implementation
- Monitoring at the FDP will be continued to confirm the exceedance has been addressed
- Marathon will provide a written report of the test results to IAAC, the ECCC inspector and NLDECC within 30 days after tests have been completed (Table 6.1)

The following additional steps will be taken if an FDP sample is determined to be acutely lethal:

- Without delay, submit the aliquot saved from the initial grab sample for MDMER Schedule 4, Table 1 analysis (Table 4.8)
 - Using the total ammonia, field pH and field temperature results, calculate the concentration of un-ionized ammonia
 - Record the concentrations of MDMER Schedule 4, Table 1 parameters
- Collect a grab sample twice per month from the FDP that was identified as acutely lethal
 - First sample without delay from receiving acutely lethal result
 - Not less than 7 days apart between sample events
 - Record the temperature and pH of each sample
 - Submit samples for acute lethality test, and save an aliquot of sample for potential chemical analysis:
 - o If either sample is determined to be acutely lethal, submit the aliquot of sample saved for MDMER Schedule 4, Table 1 and effluent characterization (Table 4.8) analysis
 - o Using the total ammonia, field pH and field temperature results, calculate the concentration of un-ionized ammonia

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- o Record the analysis results concentrations
- o If the effluent is determined to not be acutely lethal in three consecutive tests, then acute lethality testing can resume the schedule in Table 4.7

5.1.2 Sanitary Wastewater

As a requirement of the anticipated WWTP permit to operate, if a WWTP shutdown or other condition results in untreated wastewater being discharged into the environment, Marathon will immediately notify NLDECC by telephone or email. A written report will be prepared and submitted within seven days to NLDECC.

5.2 MONITORING PROGRAM CHANGES

When the mine site FDPs are operational, a request can be submitted to ECCC to reduce the sampling frequency for arsenic, copper, cyanide, lead, nickel, zinc and/or un-ionized ammonia, if that parameter's monthly mean concentration at an FDP is less than 10% of the maximum authorized monthly mean concentration (Table 4.8; MDMER Schedule 4, Table 1, Column 2) for 12 consecutive months. For radium 226, if the concentration at the FDP is less than 0.037 Bq/L for 10 consecutive weeks a request can be made to reduce the sampling frequency. For acute lethality tests, if the result is not acutely lethal for 12 consecutive months a request can be submitted to reduce the sampling frequency. The requested reduction in sampling frequency cannot be less than once per each calendar quarter and notification must be provided in writing to ECCC at least 30 days in advance of the planned reduction. With the notification, planned sampling dates not less than 30 days in advance will be provided. The sample will be collected that planned date or as soon as practicable if it cannot be safely sampled. For acute lethality tests, the samples cannot be collected less than 45 days apart.

If subsequent FDP monitoring results for the above approved parameters on a reduced sampling frequency are equal to or exceed 10% of the maximum authorized monthly mean concentration (or 0.037 Bq/L for radium 226), Marathon will increase the sampling frequency to weekly. If an acute lethality test result is acutely lethal, Marathon will increase the sampling frequency to monthly.

If Marathon fails to monitor the above parameters according to the reduced prescribed frequency or submit a report within the prescribed time (Table 6.1), then the sampling frequency at all FDPs will be increased to weekly.

If Marathon changes the location of an FDP, the frequency of sampling will be increased to weekly for Table 4, Schedule 1 parameters with an approved reduced sampling frequency and monthly for acute lethality tests.

RQP sampling results will be evaluated after the first year of mine operation, and a request submitted to ECCC and NLDECC to potentially reduce sampling frequencies for select parameters.

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6.0 RELATED DOCUMENTS

Other environmental management plans and monitoring programs related to this follow-up monitoring program are described in Table 6.1.

Table 6.1 Related Management Plans and Monitoring Programs

Plan/Program	Details
Construction EPP	The Construction EPP provides general environmental protection procedures related to Project construction activities and infrastructure such as air and greenhouse gas emissions management; erosion and sedimentation control; rock and soils management; and traffic management. Also included are protection procedures specific to caribou, avifauna, and other wildlife (including bats and American marten); fish and fish habitat; historic resources; and the Victoria Dam. The Construction EPP also includes contingency plans for fuel and hazardous materials spills, failure of erosion and sediment control measures and/or dams, and forest fires.
Accidents and Malfunctions Prevention and Response Plan	The Accidents and Malfunctions Prevention and Response Plan outlines the mitigation measures and response measures for potential accidents and malfunctions. The Plan provides direction for communication and reporting requirements following an accident or malfunction. Potential accidents or malfunctions addressed include tailings management facility malfunction, stockpile slope failure, fuel and hazardous materials spill, unplanned release of contact water, fire/explosion, and vehicle accidents.
MDMER Emergency Response Plan	The MDMER Emergency Response Plan describes the measures to be taken to prevent any unauthorized deposit of a deleterious substance or to mitigate the effects of such a deposit. The MDMER Emergency Response Plan identifies potential unauthorized deposits that can reasonably be expected to occur at the mine that may result in damage or danger to fish habitat or fish or the use by man of fish. It provides a description of the measures to be used to prevent, prepare for, respond to, and recover from an unauthorized deposit. In addition, it provides the alerting and notification procedures including the measures to be taken to notify members of the public who may be adversely affected by an unauthorized deposit.
Fish and Fish Habitat Follow-up Monitoring Program	The Fish and Fish Habitat Follow-up Monitoring Program describes the monitoring of fish and fish habitat that will be conducted during Project construction and operation to meet regulatory requirements and verify predicted Project effects made in the EIS. There are several sections and subsections of the <i>Fisheries Act</i> that pertain to surface water and potential interactions with the Project.
Water Management Plan	The Water Management Plan describes the water management design for the Project, which has been developed to reduce operational risks and environmental effects of the Project.

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Table 6.1 Related Management Plans and Monitoring Programs

Plan/Program	Details
	<p>Objectives of the Plan include reducing water inventory requiring management through perimeter berms (to divert external noncontact runoff; reducing the number of FDPs through grading of ditches and construction of diversion channels to combine discharge points water management ponds); maintaining flow to fish bearing streams and wetlands by maintaining pre-development catchments to the extent feasible; and reducing pumping requirements during operation through grading and gravitational drainage.</p> <p>The plan includes a summary of surface water monitoring activities for the Project that are outlined in this program.</p>
Avifauna Follow-up Monitoring Program	<p>The Avifauna Follow-up and Monitoring Program has been developed to verify Project EIS predictions and evaluate the effectiveness of mitigation strategies for the environmental effects on avifauna and avifauna habitat (i.e., change in habitat and mortality risk), particularly as they relate to uncertainty in the assessment. In addition, the program establishes a framework for adaptive management that can be used to modify or enhance mitigation strategies for wildlife and wildlife habitat. The Avifauna program will consider surface water quality results from the sedimentation ponds and TMF to assist with identifying the need for further mitigation and adaptive management measures.</p>

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7.0 REFERENCES

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APPENDIX A

Mitigation Measures

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Appendix A MITIGATION MEASURES

The following are general mitigation measures adapted from the EIS Chapter 2, Appendix 2A and Chapter 7 (Marathon 2020). Additional detailed site-specific surface water resources mitigation measures are in the Construction EPP (Marathon 2022a).

A.1 GENERAL

The water management plan (EIS Appendix 2A; Marathon 2020) will have the primary objectives to mitigate operational risks and environmental effects of the Project:

- Reduce water inventory through perimeter berms and promote overland flow of non-contact runoff
- Maintain flow to fish bearing streams and wetlands by maintaining pre-development catchments and/or flows
- Reduce water management costs during operation through grading and gravitational drainage, thus reducing pumping requirements

Sedimentation ponds have been designed with the following water quality criteria applied to reduce POPCs:

- Collect runoff from the Project component areas for storm events up to 1:10 Annual Exceedance Probability (AEP) (identified as the water quality design storm) to allow settlement of sediments to meet MDMER discharge criteria
- Treat a silt sized particle of 5.0×10^{-3} mm in diameter (British Columbia Ministry of Environment and Climate Change Strategy 1996), which is a typical particle size in design of a sedimentation pond
- Primarily meet the minimum residence time required for sediment to settle 1 m, reaching a trapping efficiency of 80%
- Detain runoff from the water quality design storm event in the sedimentation pond for a minimum of 24 hours
- Have a submerged type low-level outlet that will act as a hydrocarbon and Light Non-Aqueous Phase Liquids containment feature, reduce thermal discharge effects and mitigate ice blockage
- A minimum pond length to width ratio of 2:1 to reduce short circuiting

If FDP effluent quality doesn't meet MDMER limits through sedimentation ponds, implement further effluent treatment.

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The sedimentation ponds have been designed with the following criteria to manage surface water quantity:

- Pond inlet and outlet structures configured to reduce inlet velocity and scour
- Contain (without discharge) runoff resulting from storm events up to the 1:100 year AEP with spring snowmelt event, including emergency spillways and maintaining a minimum freeboard of 0.5 m
- The emergency spillways will accommodate flows up to the 1:200 AEP flow
- Have active water storage that considers ice thickness during winter
- Under an extreme storm event, only the stormwater in excess of the available storage at that time will be discharged to the environment via the emergency spillway

Drainage at the Project site has been designed with the following criteria to manage surface water quality and quantity:

- Existing drainage patterns will be maintained to the extent feasible with the use of culverts and bridges
- Contact water collection ditches will be installed around the overburden stockpiles, ore stockpiles and waste rock piles to collect toe seepage. Contact water collection ditches will be designed to convey the 1:100-year storm event, and with positive gradients to limit standing water and maintain positive flow
- Ditches will be lined with rip-rap for erosion protection in high gradient areas and seeded with locally indigenous aquatic grasses in low gradient area
- In areas with ditch gradients steeper than 8%, sediment traps (i.e., check dams) will be installed at a spacing of 200 m per ditch grade % to provide energy dissipation and reduce erosional flow velocities in the ditch
- Energy dissipation pools will be installed at the change in ditch gradient from slopes of 10% or higher to shallower slopes
- Where possible, contact water will be recycled for use on-site (e.g., dust suppression)
- Sewage effluent will be treated and monitored in accordance with the NL ECWSR prior to discharge to the environment. Sludge generated as a by-product of the treatment of sewage will be disposed off-site by a licensed contractor

Roads have been designed with the following criteria to manage surface water quality and quantity:

- Haul roads, site roads and the access road will be maintained in good condition. This will include periodically regrading and ditching to improve water flow, reduce erosion, and to manage vegetation growth
- Existing culverts along the site access road will be maintained or upgraded as necessary. This will include placement of culverts of the same size or larger, at the same inlet and outlet elevations, and in a manner to not cause flooding or ice jams

Where waste rock will be used for site earthworks and grading during construction and operational development, necessary test work will be conducted to prevent potentially acid generating (PAG) materials from being used in construction.

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A.2 CONSTRUCTION PHASE

Construction phase mitigation measures will primarily consist of ESC measures and mine dewatering. The principles to be applied to the ESC measures, include:

- Direct runoff away from active work areas before construction commences, reducing the volume of sediment-laden water to be managed
- Limit the amount and timing of exposed soil left open at any one time to reduce the potential for erosion
- Control sediment-laden runoff leaving the site by following erosion and sediment control measures put in place for the construction of the Project
- Protect sensitive receptors from sediment-laden runoff by directing untreated runoff away from these areas

The primary water management activities during construction for the process plant are expected to include collection, treatment, and discharge of surface runoff from the construction area, as well as collection, treatment and discharge of surface runoff and groundwater inflow to foundation excavations.

TMF construction will include the following measures:


- Vegetation will be cleared within the TMF tailings containment zone prior to filling/flooding to reduce potential generation of methyl mercury (MeHg) water quality concerns
- Construction of the polishing pond in advance of the TMF dam to act as a sedimentation basin for upgradient construction of the TMF
- Shallow groundwater seepage from the TMF will be intercepted by seepage collection ditches and pumped back to the TMF via sump pumps

Stockpiles during construction will apply the following general measures:

- Topsoil, overburden, and bedrock removed for construction will be stored for rehabilitation and closure purposes in the designated pile areas at each complex
- Prior to development of the waste rock piles, perimeter ditches and water collection ponds will be constructed to collect and store surface runoff. The drainage ditches will be constructed to drain by gravity to the sedimentation ponds, where practicable. In low areas where gravity flow to the sedimentation ponds is not practical, sumps will be constructed to collect water and pump it to the water management ponds. Water quality in the ponds will be monitored, treated via sedimentation as necessary, and discharged to the environment once water quality meets regulatory criteria

Open pits constructed during the construction phase will apply the following:

- During clearing and grubbing activities associated with the open pits, surface water runoff and seepage will be collected in excavation sumps and pumped to either temporary water management ponds (and discharged to the environment if discharge criteria are met) or further treated using additional ponds and/or filter bags prior to discharge

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Sewage will be managed according to the following:

- Temporary use of existing sanitary sewage system at the exploration camp will be supplemented with mobile sanitary sewage storage facilities until the mine site system is operational

Roads will be designed and constructed applying the following measures:

- Temporarily divert flow in the watercourses, to replace existing bridges and culverts in the site access road and construct the haul road. Water will be discharged to a vegetated area through a perforated PVC pipe, or alternatively into a filter bag
- Additional cross culverts under the site access and haul road may be installed as localized drainage dictates

A.3 OPERATIONS PHASE

The operations phase will have decentralized treatment and control at each of the three mine complexes.

- Water retained in the tailings pond will be exposed to sunlight to facilitate natural cyanide degradation and provide further sedimentation
- Excess tailings water will be treated in an effluent treatment plant prior to discharge to the polishing pond during approximately 8 months of the year
- Runoff and groundwater seepage will be collected from the open pits, with water pumped to sedimentation ponds before being discharged to each pits' pre-development watershed area.

The TMF will be designed applying the following measures:

- The TMF dam will be designed to maintain water storage to contain the Environmental Design Flood with no discharge through the spillway
- To address extreme weather events, an emergency spillway will be maintained to safely pass the Inflow Design Flood while maintaining minimum freeboards requirements to protect the structural integrity of the dam
- Contact and process water from the TMF will be recycled for ore processing to the extent possible
- The tailings deposition strategy to deposit thickened tailings as beaches will reduce porewater lock-up in comparison to sub-aqueous deposition and will reduce the quantity of porewater seepage in closure
- A water treatment plant will receive discharge water from the tailings pond and use proven processes to treat the water to meet MDMER limits prior to discharge to the polishing pond and subsequent discharge to the environment
- A polishing pond will receive discharge from the water treatment plant to further advance the treatment of water prior to discharge to the environment
- Reclaim water will be taken from the TMF during Years 10 to 12 and will subsequently be pumped to Leprechaun pit as part of the tailings slurry for deposition. Using reclaim water from the TMF in the process plant will reduce the amount of freshwater needed to be taken from Victoria Lake Reservoir

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Waste rock will be managed by:

- Blending PAG and non-PAG rock with excess of neutralization potential and/or encapsulation of PAG waste by non-PAG rock is recommended to neutralize acidity potentially generated in PAG lithologies and zones


During operation, progressive rehabilitation will be applied via the following measure:

- Progressive rehabilitation (e.g., placement of soil cover and vegetation over waste rock piles, erosion stabilization and temporary vegetation of completed organics, topsoil, and overburden stockpiles) will be implemented

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APPENDIX B

Construction and Operation Surface Water Monitoring Locations

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Appendix B CONSTRUCTION AND OPERATION SURFACE WATER MONITORING LOCATIONS

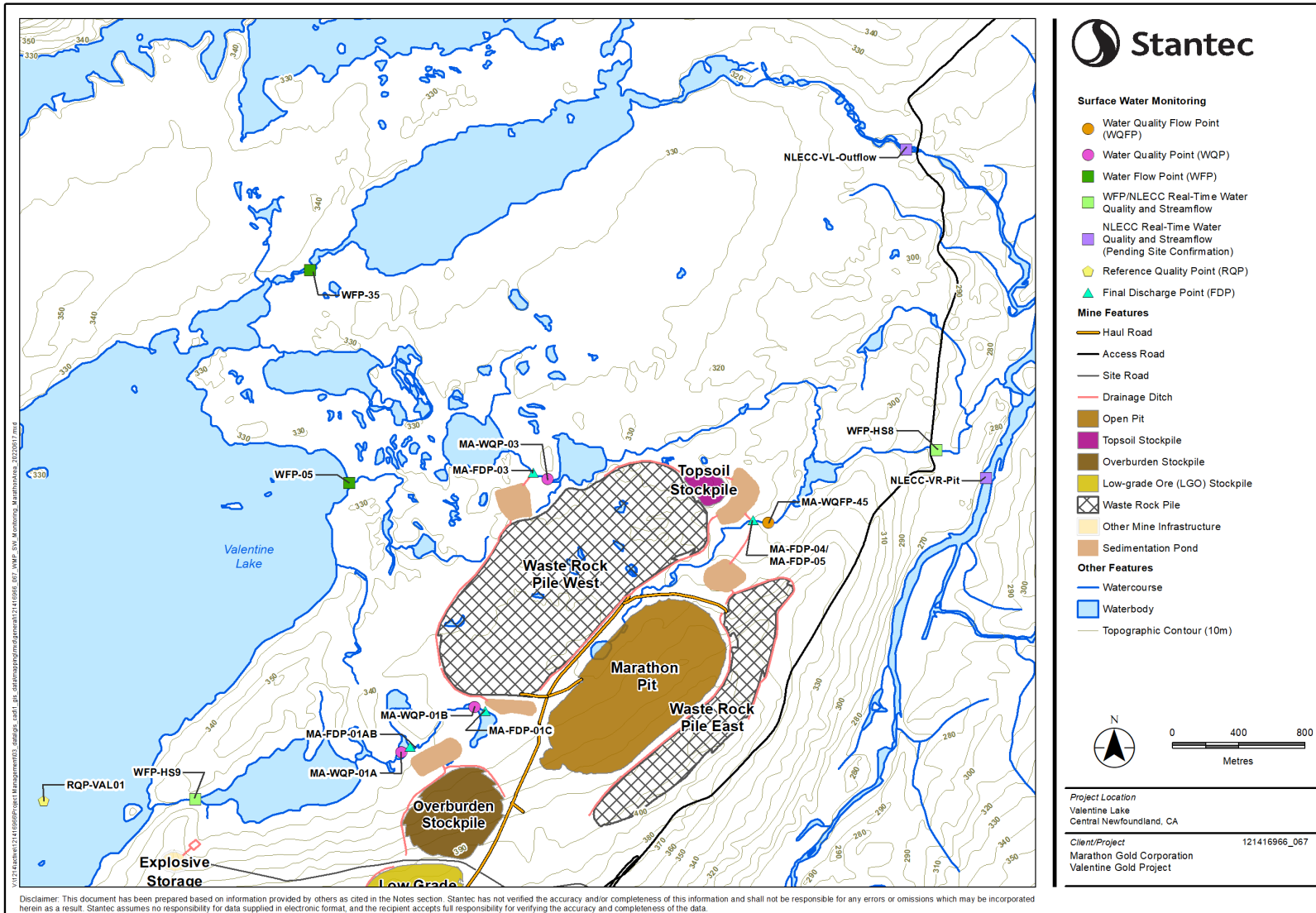


Figure B-1 Marathon Pit Complex Surface Water Quality and Quantity Monitoring Sites

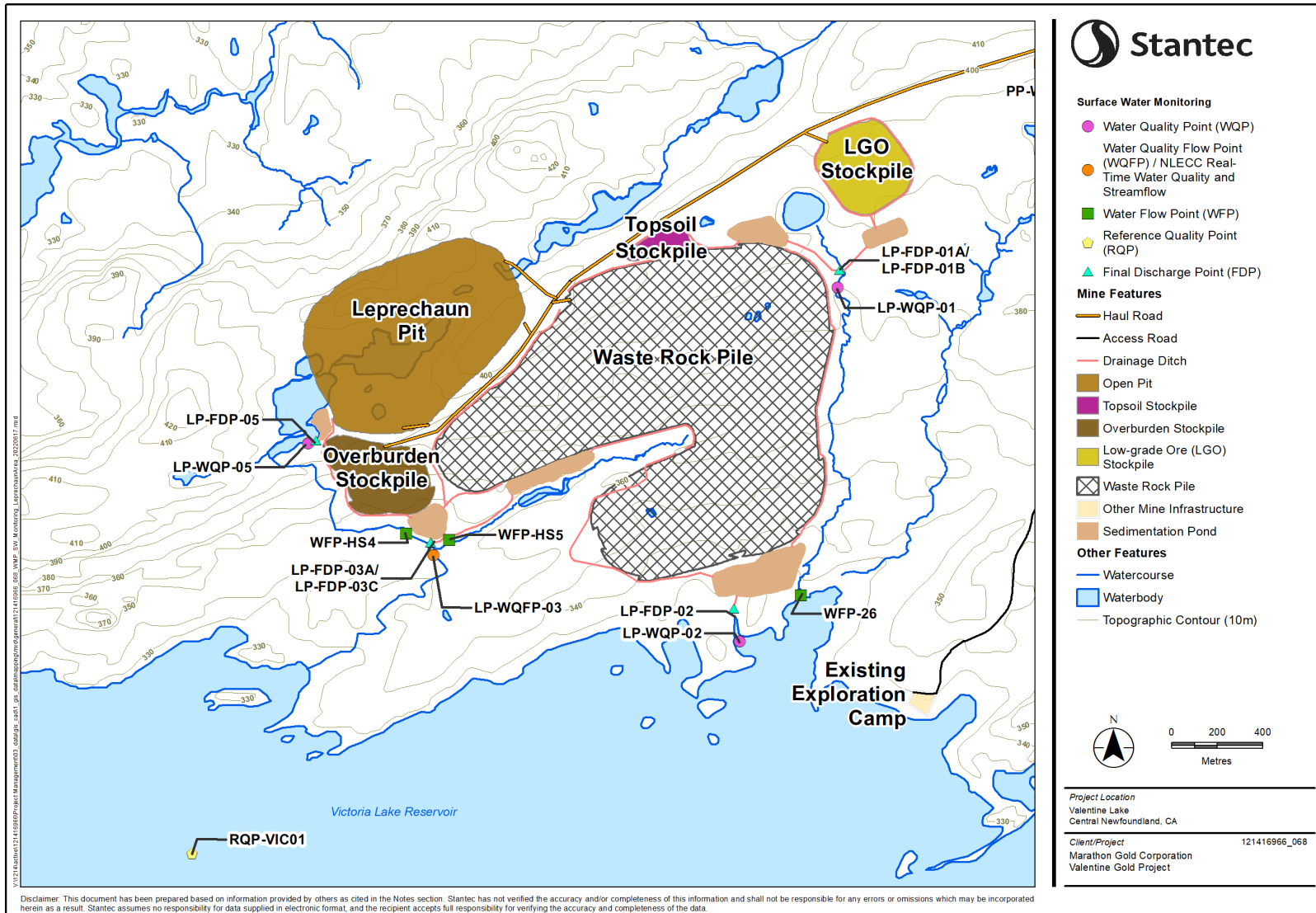


Figure-B-2 Leprechaun Pit Complex Surface Water Quality and Quantity Monitoring Sites

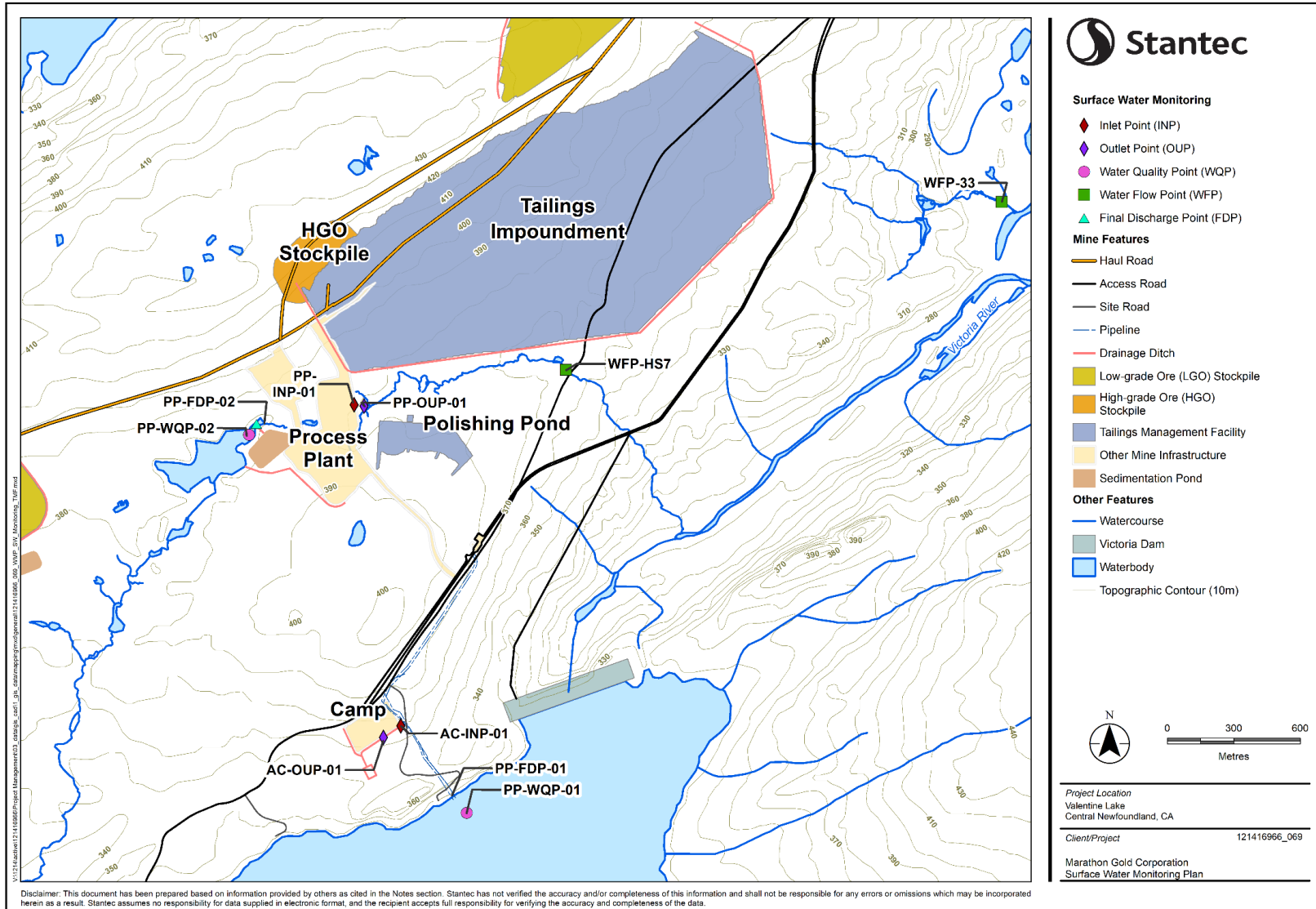


Figure B-3 Processing Plant Area Surface Water Quality and Quantity Monitoring Sites

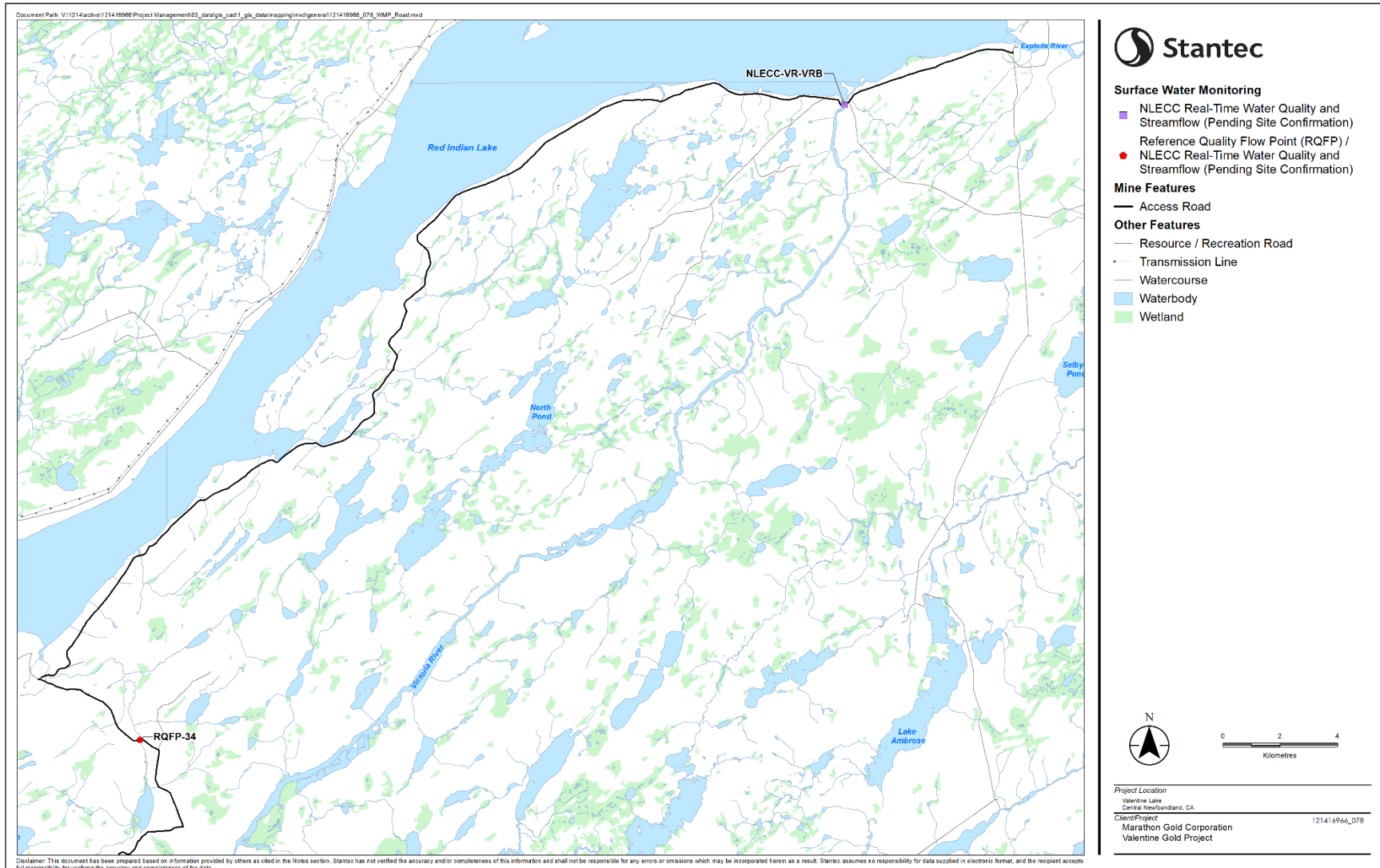


Figure B-4 Victoria River/Beothuk Lake Area Surface Water Quality and Quantity Monitoring Sites