8.0 FISH AND FISH HABITAT

8.1 SCOPE OF ASSESSMENT

Fish and fish habitat have been assessed as a valued component (VC) because they provide ecological, cultural, recreational and economic value to stakeholders including the public, Indigenous groups, local businesses, and government agencies. As fish are valued by resource users for recreational fishing activities and as a source of country foods, it is important to maintain stable populations within the region. Fish and fish habitat occur within the Project Area and will be affected by planned Project activities. They are also protected by federal and provincial legislation, with the scope of the assessment being guided by the Federal Environmental Impact Statement (EIS) Guidelines (Appendix 1A), Provincial EIS Guidelines (Appendix 1B), as well as applicable legislation, policies and guidance protecting fish and fish habitat in Canada and Newfoundland and Labrador (NL).

For the purposes of the assessment, the Fish and Fish Habitat VC includes fish and fish habitat and fisheries, which are defined under the federal *Fisheries Act* as follows:

- Fish includes: (i) parts of fish, (ii) shellfish, crustaceans, marine animals and any parts of shellfish, crustaceans or marine animals, and (iii) the eggs, sperm, spawn, larvae, spat and juvenile stages of fish, shellfish, crustaceans and marine animals
- Fish habitat means waters frequented by fish and any other areas on which fish depend directly or indirectly to carry out their life processes, including spawning grounds and nursery, rearing, food supply and migration areas
- Fishery includes any place where of period during which fishing may be carried out; any method of fishing used, any type of fishing gear, equipment, or fishing vessel used; and any species, populations, assemblages and stocks, whether the fish is fished or not

Fish and fish habitat have the potential to be affected by Project-related changes to groundwater resources (Chapter 6), surface water resources (Chapter 7), and vegetation and wetlands (Chapter 9) through effects such as the direct removal of riparian vegetation (affecting water quality via reduced shade or increased nutrient/energy inputs), alterations to stream flow, the introduction of sediments and contaminants, direct injury or death from the presence of equipment, excavation of waste rock and subsequent alteration of groundwater, and water management activities that result in changes in water levels in surrounding waterbodies. Therefore, residual effects predicted for surface water, ground water, and vegetation and wetlands were used to inform potential Project effects on fish and fish habitat.

The Fish and Fish Habitat VC is also linked to:

- Land and Resource Use (Chapter 16) – while the Fish and Fish Habitat VC considers changes in fish and fish habitat that may affect fisheries, the Land and Resource Use VC considers Project-related changes to land uses (including fisheries) resulting from change in access to the Project Area and sensory disturbance to users

- Indigenous Groups (Chapter 17) – changes in fish and fish habitat have the potential to affect the current use of land and resources for traditional purposes by Indigenous groups (i.e., for fishing)
- Community Health (Chapter 14) – changes in fish and fish habitat can affect the availability of fish for consumption as a country food, which can indirectly affect the health of community members

8.1.1 Regulatory and Policy Setting

In addition to the *Canadian Environmental Assessment Act, 2012* (CEAA 2012) and the NL *Environmental Protection Act* (NL EPA), the Project is subject to other federal and provincial legislation, policies and guidance. This section identifies the primary regulatory requirements and policies which influence the scope of the assessment on fish and fish habitat and govern the management and protection of fish and fish habitat in Canada and NL.

8.1.1.1 Federal

Fisheries Act

The federal *Fisheries Act* is administered primarily by Fisheries and Oceans Canada (DFO) with some provisions administered by Environment and Climate Change Canada (ECCC). The *Fisheries Act* protects fish and fish habitat and addresses national interests in marine and fresh waters with the goal of protecting the long-term sustainability of aquatic resources. The *Fisheries Act* includes prohibitions against works, undertakings or activities that result in the harmful alteration, disruption or destruction (HADD) of fish habitat (section 35(1)). Works can be approved by and carried on in accordance with conditions established by the Minister of Fisheries, Oceans and the Canadian Coast Guard (Fisheries Minister) (section 35(2)(b)). Any such work requires an authorization with an appropriate offsetting of residual adverse effects after avoidance and mitigation steps have been taken.

HADD of fish habitat is defined under the *Fisheries Act* policies as “any temporary or permanent change to fish habitat that directly or indirectly impairs the habitat’s capacity to support one or more life processes of fish.”

The *Fisheries Act* also prohibits the carrying out of a work, undertaking or activity, other than fishing, that results in the death of fish (section 34.4(1)), subject to certain exemptions including under an authorization from the Fisheries Minister (section 34.4(2)(b)). Additionally, section 34.3(2) provides provisions for maintaining adequate flow and fish passage. DFO’s Fisheries Protection Policy Statement (DFO 2019) provides guidance on fish and fish habitat protection provisions, and the Framework for Assessing Ecological Flow Requirements to Support Fisheries in Canada (DFO 2013) provides guidance on the management of flows required to maintain the ecological functions that sustain fisheries in streams and rivers potentially affected by water withdrawals.

Sections 36(3) and (4) of the federal *Fisheries Act* prohibits the deposition of deleterious substances into waters frequented by fish in Canada unless authorized by regulation. The *Metal and Diamond Mining Effluent Regulations* (MDMER) under the *Fisheries Act* regulate the deposit of deleterious mine effluents, tailings and waste rock into waters frequented by fish, as authorized by ECCC. The MDMER applies to metal and diamond mines with an effluent flow rate of greater than 50 m^3/d based on effluent deposited from all final discharge points of the mine. Also pursuant to the MDMER, all mines and recognized closed mines are required to conduct acute lethality testing of final effluent, effluent characterization, and Environmental Effects Monitoring (EEM) in the downstream receiving environment.

Species at Risk Act

The federal *Species at Risk Act* (SARA) provides protection for species at risk (SAR) in Canada. The legislation provides a framework to facilitate recovery of species listed as Threatened, Endangered or Extirpated, and to prevent species listed as special concern from becoming threatened or endangered. SAR and their habitats are protected under SARA, which prohibits: 1) the killing, harming, or harassing of endangered or threatened SAR (sections 32 and 36), and 2) the destruction of critical habitat of an endangered or threatened SAR (sections 58, 60 and 61).

These species are listed in Schedule 1 of SARA. Species identified in Schedule 1 with the potential to occur in the Project Area are considered in this EIS. No approvals under SARA are likely to be required with respect to the Project.

8.1.1.2 Provincial

While the primary legislation protecting fish and fish habitat is the federal *Fisheries Act*, provincial legislation is also considered in the assessment of effects on fish and fish habitat. This includes the NL EPA, the NL *Water Resources Act,* and the NL *Endangered Species Act* (NL ESA).

A Certificate of Approval (CoA) under the NL EPA will be required from the NL Department of Environment, Climate Change and Municipalities (NLDECCM). The CoA sets concentration specific limits for specific parameters in the discharge effluent. These limits are typically in line with those provided in the MDMER and in the NL Environmental Control Water and Sewer Regulations, 2003.

The NL *Water Resources Act* gives the Water Resource Management Division (WRMD) of the NLDECCM the responsibility and legislative power for the management of water resources in the province. The *NL Water Resources Act* includes the *Environmental Control Water and Sewage Regulations*, which provides regulations surrounding the discharge of sewage and other effluent. Schedule C of the regulation specifies that the metal mining industry shall comply with the MDMER (formerly the Metal Mining Effluent Regulations).

The NL ESA provides protection for plant and animal species considered to be Endangered, Threatened or Vulnerable. The NL ESA applies to species, sub-species and populations that are native to NL, however not to marine fishes. The designation under the NL ESA follows the recommendations of the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) and the Species Status Advisory Committee.

8.1.2 The Influence of Engagement on the Assessment

As part of ongoing engagement and consultation activities, Marathon has documented interests and concerns about the Project received from communities, governments, Indigenous groups and stakeholders. An overview of Marathon's engagement activities is provided in Chapter 3. Documented interests and concerns have influenced the design and operational plans for the Project and the development of the EIS, including the scope of assessment on the VCs. Interests and concerns noted that specifically relate to fish and fish habitat or routine Project activities that could affect fish and fish habitat are provided below. Issues and concerns related to potential accidents or malfunctions are discussed in the assessment of accidental events (Chapter 21).

Questions and concerns raised by Qalipu through Marathon's engagement efforts include:

- Design and operation of the tailing management facility, including use of earthen dams, long-term plans for the tailings pond, nature of "detox tailings", use of a geo-membrane, and likelihood and consequences of a breach
- Processing onsite, including the use of cyanide and the heap leach process
- Whether Project infrastructure can be relocated to reduce the Project footprint
- Water quality and water treatment
- Interference with fish and fish habitat through use of culverts on water courses
- Interest in involvement in the environmental monitoring for the Project

Questions and concerns raised by Miawpukek through Marathon's engagement efforts include:

- The size of the Project footprint
- The need for treatment to protect water quality
- Tailings, including questions about treatment, accidental events, and rehabilitation and closure
- Potential impacts on pine marten and caribou migration as a result of increased industrial activity in the Central Region, and potential impacts of the Project on moose and salmon
- Potential impact on Miawpukek land and resource use
- Interest in involvement in environmental monitoring for the Project

Questions and concerns raised by communities and other stakeholders through Marathon's engagement efforts include:

- Project components and infrastructure including: if pits will be mined simultaneously; how many ponds there will be; if the mine will be open pit only or include underground; how ore will be transported to the mill and how and where it will be processed; use of cyanide; what will replace the heap leach process; whether other metals, like silver, are present; whether product will be tested at an on-site lab or externally; and what will happen to waste rock and overburden
- Tailings and potential risks, including how tailings will be managed, the treatment of effluent, understanding "detox tailings", the consideration of use of a geo-membrane liner, potential impact of the tailings pond and polishing pond on water resources, and the long-term plan [closure] for the tailings pond
- Potential long-term effects of the Project on fish and wildlife and downstream effects on tourism, and concerns related to the allotment of Project profits being set aside for harm prevention and remediation of the area

Questions and concerns raised by fish and wildlife and civil society organizations through Marathon's engagement efforts include:

- Project description, including the size of the Project footprint, pit stability, the source of power for the Project, use of cyanide, the process that will replace the heap leach process, how tailings will be transported, and tailings management (and consideration of alternatives)
- Water quality including the potential for contamination, the potential for acid rock drainage, and the need for the protection of small ponds near the Project Area
- Habitat compensation for loss of fish and fish habitat

8.1.3 Boundaries

The scope of the assessment is defined by spatial boundaries (i.e., geographic extent of potential effects) and temporal boundaries (i.e., timing of potential effects). Spatial boundaries for the Fish and Fish Habitat VC were selected in consideration of the geographic extent over which Project activities, and their effects, are likely to occur on the VC. Temporal boundaries are based on the timing and duration of Project activities and the nature of the interactions with the VC. The spatial and temporal boundaries associated with the effects assessment for the Fish and Fish Habitat VC are described in the following sections.

8.1.3.1 Spatial Boundaries

The following spatial boundaries were used to assess Project effects, including residual environmental effects, on fish and fish habitat in areas surrounding the mine site and access road (Figure 8-1). These spatial boundaries are consistent with the Surface Water Resources VC (Chapter 7).

Project Area: The Project Area encompasses the immediate area in which Project activities and components occur and is comprised of two distinct areas: the mine site and the access road. The mine site includes the area within which Project infrastructure will be located, and the access road is the existing road to the site, plus a 20-metre (m) wide buffer on either side. The Project Area is the anticipated area of direct physical disturbance associated with the construction, operation and decommissioning, rehabilitation and closure of the Project.

Local Assessment Area (LAA): The LAA for fish and fish habitat incorporates the Project Area and watersheds that intersect with the Project Area, as shown in Figure 8-1. The LAA also includes portions of Victoria Lake Reservoir in the expected effluent mixing zones, which are typically considered to be up to several hundred metres from points of discharge in the lake. The LAA includes Valentine Lake and Victoria River to the point downstream where Project-affected tributaries converge with the main branch of the river. A 500 m buffer has also been applied to the access road to capture potential upstream and downstream effects related to upgrading (i.e., replacement of culverts and bridges) and operation and maintenance of the access road.

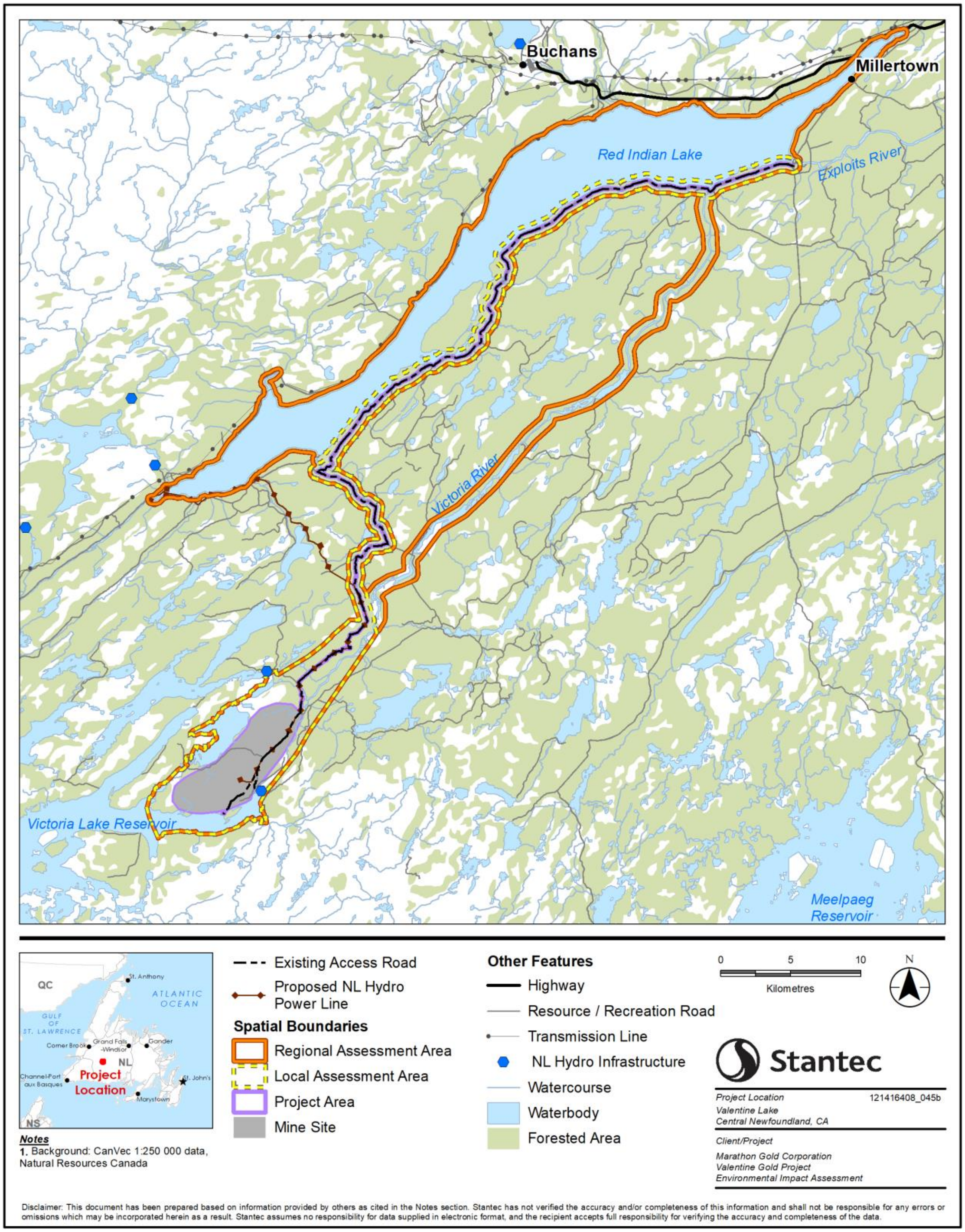


Figure 8-1 Local Assessment Area and Regional Assessment Area

Regional Assessment Area (RAA): The RAA for fish and fish habitat incorporates the Project Area and LAA, and extends to include where potential Project interactions may be observed, as shown in Figure 8-1 (Valentine Lake, a portion of Victoria Lake Reservoir, the Victoria River, and Red Indian Lake, including its discharge at the head of the Exploits River). This area encompasses the potential downstream receivers of surface water that may flow from the Project Area and is the area within which accidental events (Chapter 21) are assessed. The RAA also informs the assessment of cumulative effects (Chapter 20).

8.1.3.2 Temporal Boundaries

The temporal boundaries for the assessment of potential effects on the Fish and Fish Habitat VC include:

- Construction Phase – 16 to 20 months, beginning in Q4 2021, with 90% of activities occurring in 2022
- Operation Phase – Estimated 12-year operation life, with commissioning / start-up and mine / mill operation slated to start Q2 2023
- Decommissioning, Rehabilitation and Closure Phase – Closure rehabilitation to occur once it is no longer economical to mine or resources are exhausted

8.2 EXISTING CONDITIONS FOR FISH AND FISH HABITAT

A characterization of the existing conditions within the spatial boundaries defined in Section 8.1.3 is provided in the following sections. This includes a discussion of the influences of past and present physical activities on the VC, leading to the current conditions. An understanding of the existing conditions for the VC within the spatial area being assessed is a key requirement in the prediction of potential Project effects provided in Section 8.5.

8.2.1 Methods

To characterize the existing conditions for the Fish and Fish Habitat VC in the LAA and the RAA, existing literature and information was reviewed, public engagement sessions held, and field data were collected over multiple years and seasons in potentially affected aquatic environments.

8.2.1.1 Existing Information Sources

The review of existing literature and information included:

- Publicly available scientific information (Pippy 1966; Porter et al. 1974; Morry and Cole 1977)
- Project-specific LiDAR which was flown for the Project Area in 2019
- Engagement sessions with the communities and stakeholders, and responses to questions emailed to town councils, outfitters and salmonid groups related to fishing activity in the RAA
- Recreational fisheries data obtained from DFO reports and online databases

8.2.1.2 Field Studies

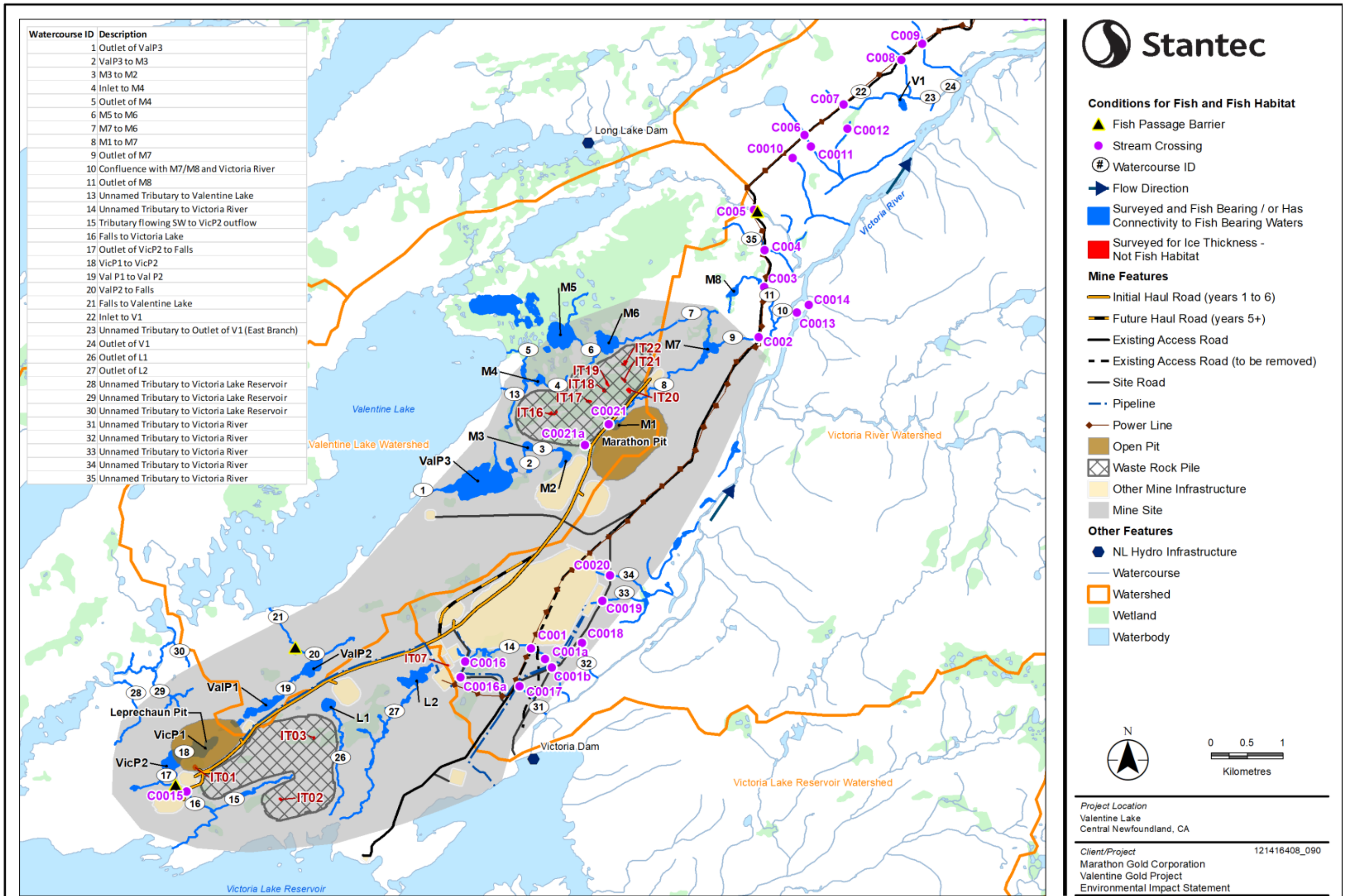
Field studies were completed in 2011, 2018, 2019 and winter 2020 to support the EA and the specific field study reports are found in Baseline Study Appendix 4 – Fish, Fish Habitat and Fisheries (BSA.4). The 2011 field study (BSA.4, Attachment 4-A) focused on the collection of fish presence/absence and fish habitat data in the vicinity of the Leprechaun deposit, while subsequent surveys in 2018 (BSA.4, Attachment 4-B), 2019 (BSA.4, Attachment 4-C) and 2020 (BSA.4, Attachment 4-D) focused on collection of fish presence/absence and fish habitat data in the vicinity of the Marathon deposit. The 2011 and 2018 field assessments also focused on watercourse crossing surveys along the portion of the access road closest to the mine site. The Aquatic Survey Area shown in Figure 8-2 encompasses survey areas for all four field programs.

Studies in 2011 and 2018 determined that pond and stream habitat within the Aquatic Survey Area were relatively homogeneous with respect to habitat type, hydrology and fish species present. Therefore, in 2019, representative pond and streams within each of the three major sub-watersheds within the LAA (Victoria Lake Reservoir, Valentine Lake and Victoria River) were sampled to provide information about primary and secondary productivity, sediment quality, water quality and fish productivity. The representative ponds and streams sampled within each sub-watershed and the type of survey completed are identified in Table 8.1. The survey components completed with each sub-watershed are provided in Table 8.1 and sampling locations within each sub-watershed area are shown in Figure 8-2.

Table 8.1 Survey Components Completed within each Sub-watershed in the Aquatic Survey Area

Major Watershed	Representative Ponds and Streams	Primary Productivity		Secondary Productivity		Fish and Fish Habitat Characterization		Water Quality		Sediment Quality	
		Lake/Pond	Stream	Lake/Pond	Stream	Pond	Stream**	Pond	Stream**	Pond	Stream**
Victoria Lake Reservoir	Ponds VIC P1, Vic P2 and associated streams	VicP2, L1	16	VicP2, L1	16	VicP1, VicP2, L1, L2	15, 16, 17, 18	L1	16	VicP2, L1	16
Victoria Lake Reservoir	Lake	VIC	NA	VIC	NA	VIC	NA	VIC	NA	VIC	VIC
Valentine Lake	Ponds ValP1 and Val P2 and associated streams	ValP2	20	ValP2	20	ValP1, ValP2	19, 20, 21	ValP2	20	ValP2	20
Valentine Lake	Pond VALP3 and associated streams	ValP3	1	ValP3	1	ValP3, M2, M3	1, 2, 3	ValP3	1	ValP3	-
Valentine Lake	Lake	VAL	NA	VAL	NA	VAL	NA	VAL	NA	VAL	VAL
Victoria River	Unnamed Tributary to Victoria River (C001 stream)	-	14	-	14	-	14*	-	14	-	14
Victoria River	Pond M1/M7 and associated streams	M7	8	M7	8	M1, M7, M8	8, 9*, 11*, 12	M7	8	M7	8

Notes:
* indicates stream crossing surveys were also conducted
** does not include other streams associated with the access road upgrades
"-" indicates no data collected; NA = Not Applicable



Watercourse ID	Description
1	Outlet of ValP3
2	ValP3 to M3
3	M3 to M2
4	Inlet to M4
5	Outlet of M4
6	M5 to M6
7	M7 to M6
8	M1 to M7
9	Outlet of M7
10	Confluence with M7/M8 and Victoria River
11	Outlet of M8
13	Unnamed Tributary to Valentine Lake
14	Unnamed Tributary to Victoria River
15	Tributary flowing SW to VicP2 outflow
16	Falls to Victoria Lake
17	Outlet of VicP2 to Falls
18	VicP1 to VicP2
19	Val P1 to Val P2
20	ValP2 to Falls
21	Falls to Valentine Lake
22	Inlet to V1
23	Unnamed Tributary to Outlet of V1 (East Branch)
24	Outlet of V1
26	Outlet of L1
27	Outlet of L2
28	Unnamed Tributary to Victoria Lake Reservoir
29	Unnamed Tributary to Victoria Lake Reservoir
30	Unnamed Tributary to Victoria Lake Reservoir
31	Unnamed Tributary to Victoria River
32	Unnamed Tributary to Victoria River
33	Unnamed Tributary to Victoria River
34	Unnamed Tributary to Victoria River
35	Unnamed Tributary to Victoria River

Disclaimer: This document has been prepared based on information provided by others as cited in the Notes section. Stantec has not verified the accuracy and/or completeness of this information and shall not be responsible for any errors or omissions which may be incorporated herein as a result. Stantec assumes no responsibility for data supplied in electronic format, and the recipient accepts full responsibility for verifying the accuracy and completeness of the data.

Figure 8-2 Aquatic Survey Area

8.2.1.3 Fish Habitat

Data were collected to support the description of fish habitat as part of fish habitat characterization, water quality and sediment quality surveys. The methods associated with each survey component are described below. Detailed methods and results of these studies are contained in the field study reports (BSA.4, Attachments 4-A, 4B, 4-C).

Fish Habitat Characterization

Habitat characterization surveys were conducted for lacustrine (steady water) and riverine (stream, river) habitats within the Aquatic Survey Area in 2011, 2018, 2019 and 2020.

Lacustrine habitat characterization was conducted in lakes, ponds and small, isolated waterbodies known as bog holes. Lacustrine habitat classification in lakes and ponds was conducted according to methods described in the *Standard Methods Guide for the Classification/ Quantification of Lacustrine Habitat in Newfoundland and Labrador* (Bradbury et al. 2001) and included classification based on water depth, substrate type, and amount of aquatic vegetation. Lacustrine habitat classification surveys were completed as ground surveys (boat and snowmobile) or aerial surveys (helicopter) depending on how readily accessible the areas were.

In 2020, an ice thickness survey was conducted to assess the potential for fish habitat in 27 bog holes; eleven bog holes within the physical footprint of the Project and 16 bog holes within close proximity of the Project footprint. Bog holes are isolated, small, waterbodies and are common within the LAA. The bog holes surveyed in 2020 were approximately 0.06 to 0.32 hectares (ha) in size. Survey methods for the 2020 bog hole survey were developed in consultation with DFO to determine whether there was sufficient water depth remaining below the ice within the bog holes to potentially provide overwintering habitat for fish (BSA.4, Attachment 4-D).

Riverine habitat classification surveys, both aerial and ground based, were conducted according to methods outlined in *Standard Methods Guide for the Classification of Riverine Habitats in Newfoundland and Labrador* (McCarthy et al. 2007). Potential barriers to fish migration were noted, photographed and georeferenced during the habitat characterization surveys. During ground surveys conducted in 2011 and 2018, stream habitat was characterized in 50 or 100 m stream segments by recording stream velocity, depth, stream width, substrate type, meso habitat type, stream gradient, riparian vegetation and cover. Stream and river crossing locations were also surveyed by ground with habitat characterized to an approximate distance 50 m upstream and downstream of the crossing location. Stream crossings to be constructed along the access road and site haul roads will be surveyed in advance of construction.

In areas where ground surveys were difficult or impractical, due to access issues, aerial surveys were carried out. During the 2018 aerial survey, streams were characterized at approximately 100 m stream segments by flying over the stream at reduced speed and altitude and potential barriers to fish migration were noted, photographed and georeferenced in the same manner as ground surveys.

Water Quality

In situ water quality data were collected at a single sampling location from select ponds and streams in September 2019. Data collected included measurements of pH, dissolved oxygen, temperature, and conductivity. Water quality data was compared to the freshwater guidelines in the Canadian *Water Quality Guidelines for the Protection of Freshwater Aquatic Life* (CWQG-FAL; CCME 2014) to provide context for its quality in relation to aquatic ecosystems.

For Victoria Lake Reservoir and Valentine Lake, vertical lake water quality profiles were collected at a single sampling location in each lake during July, September, and November 2019. In addition, a secchi depth measurement was collected in each lake to assess water transparency.

Water chemistry sampling was conducted at 26 locations within the Aquatic Survey Area. Results are discussed in the Surface Water Resources VC, Chapter 7, and a high-level summary is provided in Section 8.2.2.1.

Water Quantity

The local hydrology assessment included a field hydrometric monitoring program combined with in situ flow measurements at twelve monitoring stations (Figure 7-2 in Chapter 7 – Surface Water Resources). Rating curves were developed for hydrometric stations that had a continuous water level logger and were used to convert the continuous water level data into discharge data. Additional information on water quantity can be found in Chapter 7.

Sediment Quality

Sediment samples were collected for select lakes, ponds, and streams in 2019. Samples were collected at a single location in ponds and streams and at three locations in Victoria Lake Reservoir and Valentine Lake. The sediment sample locations corresponded with the locations of the secondary productivity sampling stations. Sediment samples were analyzed for total organic carbon, trace metals, mercury, and particle size.

8.2.1.4 Primary Productivity

Primary productivity was determined by collecting chlorophyll "a" samples in lakes and ponds and periphyton samples in streams during the 2019 Aquatic Survey (BSA.4, Attachment 4-C). Primary productivity in streams was assessed according to methods outlined in the *Rapid Bioassessment Protocols for Use in Streams and Wadeable Rivers* (Barbour et al. 1999). Sampling was conducted in both summer and fall to provide an indication of seasonal variability.

8.2.1.5 Secondary Productivity

Secondary productivity in lakes, ponds, and streams was determined through the collection and analysis of benthic invertebrate community (BIC) samples. The methods for determination of secondary productivity in streams and ponds is consistent with the sampling approach described in the *Metal Mining*

Technical Guidance for Environmental Effects Monitoring (Environment Canada 2012). Secondary productivity BIC samples were collected in the same lakes, ponds and streams from which primary productivity (periphyton and chlorophyll “a”) samples were collected, however only during fall 2019. Assessing the seasonal variability for secondary productivity in the spring is inherently difficult as the emergence periods for different species may be short (i.e., immediately after ice out and prior to emergence of adult insects), subject to fluctuations influenced by weather and water temperature, and less diversity (Davies 1984). Late summer or early fall is the optimal time to assess benthic invertebrates because diversity is at its peak, they are large enough to be collected by sampling equipment, and they have grown sufficiently for taxonomic identification (Environment Canada 2012).

8.2.1.6 Fish Community

To assess fish communities, a variety of fishing methods were used, including minnow traps, gillnets or fyke nets to assess lacustrine habitat, and backpack electrofishing to assess riverine habitats. Fishing was conducted according to methods described in the *Standard Methods Guide for Freshwater Fish and Fish Habitat Surveys in Newfoundland and Labrador: Rivers and Streams* (Sooley et al. 1998) and *A Review of Fish Sampling Methods Commonly Used in Canadian Freshwater Habitats* (Porter et al. 2006). The fishing effort and location were recorded. Captured fish were identified to species and released alive. A representative number were measured and weighed prior to release.

8.2.1.7 Species at Risk

To assess the potential for the occurrence of species at risk (SAR), fish community studies were undertaken as described in Section 8.2.1.6 and literature was reviewed on the distribution of SAR within the LAA and RAA.

8.2.1.8 Fisheries

In support of the EIS, a literature review, public engagement efforts, and information requests to outfitters, local town councils and Indigenous groups were completed to determine the existence of commercial, recreational and/or Indigenous fisheries in the LAA and RAA.

8.2.2 Overview

The following provides a summary of fish and fish habitat information from existing information and field data which were collected in 2011, 2018 and 2019. More detailed information is provided in BSA.4.

The LAA has been subject to substantial changes in water flow since the late 1960s. Prior to 1969, Victoria Lake was part of the Exploits River watershed and flowed to Red Indian Lake via the Victoria River. In 1968, the Victoria Dam was constructed at the extreme northeastern end of the lake at the former outlet (Victoria River). The Victoria Canal was constructed in 1969 on the southern side of Victoria Lake Reservoir to divert water through hydroelectric generating stations for the Bay d’Espoir Hydro Electric Development. Due to these changes, Victoria Lake Reservoir is now part of the White Bear Watershed to the south of the Project. Prior to the creation of the Victoria Lake Reservoir, the surface area of Victoria Lake was approximately 4,200 ha; the surface area of Victoria Lake Reservoir is 16,660 ha.

Valentine Lake is 820 ha in extent and drains into the Victoria River, which flows northeast to Red Indian Lake, through the Millertown Dam, and into the Exploits River. Valentine Lake and Victoria River are part of the Exploits River Watershed.

8.2.2.1 Fish Habitat

Fish Habitat Characterization

Fish habitat was characterized for lacustrine (ponds, lakes and bog holes) and riverine (rivers, streams) habitats. Results of studies for each habitat type are described below.

Ponds

A total of 15 ponds were surveyed within the Aquatic Survey Area and were estimated to have a maximum depth of 2 m and contain a high proportion of fines and low amounts of aquatic vegetation (Table 8.2). Where aquatic vegetation was present, it was often immediately adjacent to shore or sparsely distributed through the pond. The ponds surveyed contain littoral (shallow) habitat only and no profundal (deep) habitat. Ponds within the Aquatic Survey Area were small, with surface areas ranging from 0.5 to 26 ha. Photos of each pond and representative habitats are provided in BSA.4 (Attachments 4-A and 4-C).

Based on methods for rating fish habitat provided in Bradbury et al (2001), habitat quality of the ponds in the Aquatic Survey Area was determined to be generally poor for spawning, young of the year (YOY), juvenile, and adult life stages of brook trout (*Salvelinus fontinalis*) and landlocked Atlantic salmon (ouaninache) (*Salmo salar*) as a result of the large quantity of fine grain substrates. However, habitat quality in ponds was determined to be generally excellent for threespine stickleback (*Gasterosteus aculeatus*) spawning, YOY, juvenile and adult life stages, as a result of the large quantity of fine grain substrates and the presence of aquatic vegetation.

Table 8.2 Summary of Pond Habitat Characteristics

Major Watershed	Pond	Surface Area (ha)	Dominant Substrate Grain Size[1]	Subdominant Substrate	Dominant Aquatic Vegetation
Victoria Lake Reservoir	L1	2.2	Fines (99%)	Medium (1%)	Emergent
Victoria Lake Reservoir	L2	5.6	Fines (100%)	-	Emergent
Victoria River	M1	0.5	Medium (57%)	Coarse (28%)	Submergent
Valentine Lake	M2	1.9	Fines (100%)	-	Submergent
Valentine Lake	M3	1.4	Fines (100%)	-	Emergent
Valentine Lake	M4	1.3	Fines (100%)	-	Submergent

Table 8.2 Summary of Pond Habitat Characteristics

Major Watershed	Pond	Surface Area (ha)	Dominant Substrate Grain Size[1]	Subdominant Substrate	Dominant Aquatic Vegetation
Victoria River	M5	10.2	Fines (85%)	Medium (14%)	None observed
Victoria River	M6	5.9	Fines (70%)	Medium (30%)	Submergent
Victoria River	M7	3.3	Fines (85%)	Coarse (14%)	Submergent
Victoria River	M8	1.1	Fines (96%)	Coarse (4%)	Emergent
Valentine Lake	ValP1	4.6	Fines (89%)	Coarse (9%)	ND
Valentine Lake	ValP2	4.2	Fines (93%)	Medium (7%)	ND
Valentine Lake	ValP3	26	Fines (87%)	Medium (10%)	Submergent
Victoria Lake Reservoir	VicP1	5.7	Fines (60%)	Medium (40%)	ND
Victoria Lake Reservoir	VicP2	6.6	Fines (61%)	Medium (39%)	ND

Note:
ND = no data
[1] Coarse = bedrock and boulder; Medium = rubble, cobble, gravel; Fine = sand, silt, clay, muck

Bog Holes

To assess the potential for fish habitat, 27 bog holes were surveyed in the winter of 2020 and 11 of these bog holes (IT01, IT02, IT03, IT07, IT16, IT17, IT18, IT19, IT20, IT21, and IT22) are within the Project footprint. The remainder are in close proximity, however outside the direct Project footprint. The average ice thickness for the eleven bog holes within the Project footprint was 55.3 centimetres (cm), ranging from 44.5 to 83.5 cm. Five of the eleven bog holes surveyed were frozen to the bottom (IT01, IT03, IT07, IT20, IT22) and were therefore assumed to not be fish habitat, since freezing of the entire water column and isolation from other waterbodies eliminates the ability of these bog holes to sustain fish life. Water depth between the ice and the substrate for the remaining six of eleven bog holes was 6 to 45.5 cm (IT02, IT16, IT17, IT18, IT19, and IT21). Substrate primarily consisted of organic material.

It was noted that ice thickness was less than in other years, as larger than normal snow accumulation in the winter of 2020 insulated the ice (N. Capps, pers. comm. 2020). If the maximum ice thickness measured during the 2020 survey (83.5 cm at IT20) occurred at each of the sampled bog holes, as would be expected during a typical winter, each of the surveyed bog holes would be frozen to the bottom, with the possible exception of Bog Hole IT18.

The results of the ice thickness survey were discussed with DFO on April 24, 2020. During consultation with DFO, it was determined that IT18 was the bog hole within the Project footprint most likely to contain fish habitat and that absence of fish at IT18 could be used as an indicator of fish absence at other bog hole locations within the Project footprint. It was agreed that bog hole IT18 would be fished during summer 2020 using multi-panel gillnets and minnow traps to determine fish presence or absence.

Fish sampling was conducted at bog hole IT18 during July 2020. Two minnow traps and two gillnets measuring 25 and 38 mm were set overnight and left to fish for 48 hours. The fishing effort resulted in no fish catches, demonstrating that the bog holes within the Project footprint are not fish habitat.

Lakes

Prior to construction of the Victoria Dam and Victoria Canal, water depths in Victoria Lake ranged from 26 m in the northeastern section, 30 m in the eastern section, 70 m in the western section, and 117 m at its deepest point (Pippy 1966). Currently, water depths in the reservoir are likely 35 m higher than pre-dam depths, and it has a surface area of 16,660 ha (Reid and Cole 1972).

Prior to the construction of the Victoria Dam and Canal, shorelines dropped steeply throughout Victoria Lake, limiting the extent of the littoral zone (Pippy 1966). Existing bathymetry and field observations during baseline field surveys confirmed that these observations are still relevant (BSA.4, Attachment 4-C), with shoreline substrates consisting mainly of rock with some areas of sand. In the eastern section of Victoria Lake, shallow wind-sheltered bays contained bark and wood chips (Pippy 1966) or sand substrates (BSA.4, Attachment 4-C). Prior to construction of the reservoir, the bottom of Victoria Lake consisted of extensive areas of large rock and considerable areas of bedrock, with several islands with near vertical sides, further supporting the evidence for bedrock (Pippy 1966). Depositional sediments were observed at depths of 12.5 m during BIC sampling conducted as part of baseline field studies (BSA.4, Attachment 4-C). Baseline field studies (BSA.4, Attachment 4-C) and studies prior to construction of the reservoir (Pippy 1966) indicate that the lake is naturally devoid of aquatic vegetation, which may be a result of the abundance of coarse substrates, prevailing winds, water fluctuations and steep slopes.

For Valentine Lake, a maximum water depth of 25.4 m was recorded during a bathymetry survey conducted at select locations along the southeast shoreline of the lake in 2019 (Baseline Study Appendix 3 – Water Resources (BSA.3), Attachment 3-E). During baseline studies, substrates in the littoral zone were found to be mainly medium and coarse in grain size (e.g., rubble and boulder), and there were a number of cobble/rubble shoals adjacent to islands or ascending from depths. Sand and finer sediments were present within sheltered bays. Substrates in the profundal zone consisted of clumps of fines (BSA.4, Attachment 4-C).

Prior to the creation of the reservoir, brook trout, landlocked Atlantic salmon (ouananiche), Arctic char (*Salvelinus alpinus*) and stickleback were known to occur in Victoria Lake (Pippy 1966). During that time, brook trout and Atlantic salmon (ouaninache) mainly used habitat within the upper 5 m of the water column in Victoria Lake and maximum depths used were found to be 15 m and 29 m, respectively (Pippy 1966). The occurrence of brook trout and Atlantic salmon (ouaninache) at depths less than 15 m was confirmed by baseline field sampling in 2018 and 2019 (BSA.4, Attachments 4-B and 4-C). Arctic char were found to mainly use depths of 10 to 30 m in summer and shift to the upper 5 m in fall, perhaps to seek an optimal temperature (Pippy 1966). It is expected that these species currently occupy depths similar to those they occupied before the reservoir was created.

Overall, based on methods for rating fish habitat provided in Bradbury et al (2001), Victoria Lake Reservoir and Valentine Lake contain generally good to excellent habitat for spawning, YOY, juvenile and adult life stages of brook trout, Atlantic salmon (ouaninache) and Arctic char as a result of the quantity of coarse substrates and varying habitat types. Spawning habitat and pelagic habitat for adult life stages of threespine stickleback is generally suitable while rearing habitat for YOY and juveniles of threespine stickleback is generally poor in Victoria Lake Reservoir and Valentine Lake (Bradbury et al. 2001).

Streams and Rivers

A summary of habitat attributes for the ground and aerial surveys conducted for baseline studies is provided in Table 8.3 and includes the average wetted and channel stream width, average velocity, depth, slope, overhead and instream cover, dominant habitat type, substrate and riparian vegetation. The complete habitat classification dataset is provided in BSA.4.

The most recent stream crossing fish habitat information from 2018 is presented in Table 8.4. The 2011 stream crossing dataset is provided in BSA.4 (Attachment 4-A) and correlates well with the 2018 data, particularly as it pertains to determinations of the presence of fish habitat (i.e., no visible channel or intermittent channels).

The streams that were surveyed were generally small (<5 m), shallow (<0.5 m), and slow flowing (<0.2 m/s). First order, low gradient streams that flowed through bog or wetland habitats were generally characterized by shallow flats with an undefined thalweg[1], slow/negligible velocities, and fine grain substrates. The upper reaches of some streams (i.e., 1, 3, 16) had intermittent flow, particularly during the summer low flow period in August to early September. The lower reaches of streams were generally more riffle/run habitat, associated with increased gradient and velocities, coarser substrates, well-defined channels and generally permanent flow characteristics.

The mapped streams and rivers that were surveyed as part of the watercourse crossings varied from no visible channel, to small streams and flowing rivers (e.g., C005). Fish habitat was confirmed to be present at 11 of the 15 proposed crossing locations (Table 8.4). Fish habitat was not present at C007, C010, C011 and C012 in 2018, nor was it confirmed for C007 in 2011.

Waterfalls that act as barriers to fish passage were noted immediately downstream of crossing C005 on the outlet of Valentine Lake, within the outlet of ValP2 (stream 20/21) and Vic P2 (stream 16/17) (Figure 8-2).

[1] A thalweg is defined as the lowest path along the entire length of a stream bed which defines its deepest channel

Table 8.3 Summary of Habitat Characteristics for Streams and Rivers Surveyed in 2011 and 2018

Major Sub-Watershed	Location (Identifier #)[3]	Stream Order	Stream Length (m)	Field Assessment Method	Wetted Stream Width (m)	Channel Stream Width (m)	Mean Depth (m)	Mean Velocity (m/s)	Average Slope (%)	Dominant Habitat Type	Dominant Substrate Type	Dominant Riparian Vegetation	Average Overhead Cover (%)	Average Instream Cover (%)	Comments
Victoria Lake Reservoir	(15) Tributary	1	460	Ground	1.62	-	0.15	0.15	-	Riffle/Run (100%)	Cobble (43%)	Grass (50%)	-	0	Stream begins ~75m upstream of confluence, riffle/run
Victoria Lake Reservoir	(16) Barrier to Victoria Lake Reservoir	2	1,940	Ground	1.62	-	0.15	0.15	-	Riffle/Run	Cobble (41%)	Shrubs (53%)	-	1	Riffle/run with some drop pools
Victoria Lake Reservoir	(17) VicP2 to barrier	2	220	Ground	1.24	-	0.12	0.15	-	Flat	Cobble (34%)	Shrubs (41%)	-	13	Steady flow through wetlands from VicP2 to barrier to fish passage 225m DS of VicP2
Victoria Lake Reservoir	(18) VicP1 to VicP2	1	40	Ground	2.10	-	0.10	0.04	-	Flat	Cobble (55%)	Trees (50%)	-	0	Flat and small riffle flowing into VicP2
Valentine Lake	(19) ValP1 to ValP2	1	470	Ground	1.53	-	0.28	0.04	-	Flat/Riffle (100%)	Fines (40%)	Grass (66%)	-	12	Flow is steady, channel is narrow at ValP1 then deepens and widens closer to ValP2
Valentine Lake	(20) ValLK to ValP2 falls	1	340	Ground	1.67	-	0.13	0.10	-	Riffle/Run	Boulder (47%)	Shrub (53%)	-	0	Series of riffles and runs, drop runs and cascades. Barrier to fish passage at 435m and 575m US from Valentine Lake

Table 8.3 Summary of Habitat Characteristics for Streams and Rivers Surveyed in 2011 and 2018

Major Sub-Watershed	Location (Identifier #)[3]	Stream Order	Stream Length (m)	Field Assessment Method	Wetted Stream Width (m)	Channel Stream Width (m)	Mean Depth (m)	Mean Velocity (m/s)	Average Slope (%)	Dominant Habitat Type	Dominant Substrate Type	Dominant Riparian Vegetation	Average Overhead Cover (%)	Average Instream Cover (%)	Comments
Valentine Lake	(21) Falls to ValP2	1	780	Ground	1.40		0.22	0.14	-	Riffle/Run	Boulder (73%)	Shrub (60%)	-	8	Riffle/run with series of drop runs, large beaver pond/steady at 775 m and 1000m DS of VICP2; flows through wetland closer to Victoria Lake Reservoir
Valentine Lake	(1) Outlet of ValP3[1,2]	1	280	Ground	4.34	-	0.21	0.3	1	Riffle/Run	Cobble/ Rubble (64%)	Shrub (49%)	-	8	Series of riffles and pools, old water level dam at the end of the lake
Valentine Lake	(2) ValP3 to M3[1]	1	190	Ground	10.9	11.6	0.33	0.00	0.5	Flat (53%)	Fines (74%)	Grass (40%) /Shrub (40%)	22	42	Streams connect series of small ponds
Valentine Lake	(3) M3 to M2[1]	1	350	Ground	1.5	1.6	0.47	0.00	0.5	Flat (100%)	Fines (100%)	Grass (80%)	40	30	Stream is series of dry, intermittent channels which becomes defined closer to M2
Valentine Lake	(4) Inlet to M4[1]	1	500	Ground	4.5	4.5	0.13	-	0.5	Flat (100%)	Fines (100%)	Grass (60%)	2	40	Poorly defined channel which drains grassy wetlands
Valentine Lake	(5) Outlet of M4[1]	1	610	Ground	6.04	6.62	0.16	0.06	0.5	Flat (83%)	Fines (100%)	Grass (57%)	26	31	Series of defined channels and undefined channels through wetlands

Table 8.3 Summary of Habitat Characteristics for Streams and Rivers Surveyed in 2011 and 2018

Major Sub-Watershed	Location (Identifier #)[3]	Stream Order	Stream Length (m)	Field Assessment Method	Wetted Stream Width (m)	Channel Stream Width (m)	Mean Depth (m)	Mean Velocity (m/s)	Average Slope (%)	Dominant Habitat Type	Dominant Substrate Type	Dominant Riparian Vegetation	Average Overhead Cover (%)	Average Instream Cover (%)	Comments
Victoria River	(6) M6 to M5[1]	2	280	Aerial	10	ND	ND	ND	0.5	Flat (100%)	Fines (100%)	Shrub (39%)	0	45	Slow flowing with undefined thalweg
Victoria River	(7) M7 to M6[1]	2	2,000	Aerial	2.04	ND	ND	ND	0.5	Riffle/Run (57%)	Boulder (43%)	Shrub (54%)	4	15	Well-defined channel with shallow depths (<0.5 m)
Victoria River	(8) M1 to M7[1]	1	1,690	Ground	2.33	2.71	0.16	0.05	0.9	Riffle/Run (56%)	Boulder (40%)	Shrub (48%)	29	28	Upper reaches flow through bogs with defined channels, higher gradient courser substrates in lower reaches
Victoria River	(9) Outlet of M7[1]	2	1,070	Ground	2.5	3.42	0.18	0.17	2.7	Riffle/Run (91%)	Boulder (34%)	Shrub (47%)	28	9	Well defined channel with course substrates
Victoria River	(10) Confluence of M7/M8 to Victoria River[1]	2	350	Ground	3.43	4.13	0.16	0.07	1.5	Riffle/Run (87%)	Cobble/ Rubble (40%)	Shrub (48%)	15	6	Well defined channel with course substrates
Victoria River	(11) Outlet of M8[1]	1	1,100	Ground	2.36	2.69	0.18	0.05	1	Riffle/Run (47%)	Fines (48%)	Shrub (66%)	54	19	Well defined channel with reduced flow through bog
Victoria River	(12) Inlet to M1[1]	1	580	Ground	No defined channel										
Victoria River	(13) Unnamed Tributary to Valentine Lake[1]	1	890	Ground	2.0	2.4	0.25	0.00	0.5	Flat (75%0	Fines (98%)	Grass (48%)	39	43	Defined channel that flows out of a string bog

Table 8.3 Summary of Habitat Characteristics for Streams and Rivers Surveyed in 2011 and 2018

Major Sub-Watershed	Location (Identifier #)[3]	Stream Order	Stream Length (m)	Field Assessment Method	Wetted Stream Width (m)	Channel Stream Width (m)	Mean Depth (m)	Mean Velocity (m/s)	Average Slope (%)	Dominant Habitat Type	Dominant Substrate Type	Dominant Riparian Vegetation	Average Overhead Cover (%)	Average Instream Cover (%)	Comments
Victoria River	(14) Unnamed Tributary to Victoria River[1]	1	2,250	Ground	3.8	5.1	0.26	0.02	5	Riffle/Run (56%)	Fines (34%)	Grass (39%)	28	24	Stream is slow flowing and low gradient, changing to high gradient step pool habitat in lower reaches

Note:
[1] Surveyed in 2018 (BSA.4, Attachment 4-B)
[2] Surveyed in 2011 (BSA.4, Attachment 4-A)
[3] See Figure 8.30
DS = Downstream
US = Upstream

Table 8.4 Summary of Habitat Characteristics for Stream Crossings 2018

Major Sub-Watershed	Location	Stream Order	Wetted Stream Width (m)	Channel Stream Width (m)	Mean Depth (m)	Mean Velocity (m/s)	Average Slope (%)	Dominant Habitat Type	Dominant Substrate Type	Dominant Riparian Vegetation	Average Overhead Cover	Average Instream Cover
Victoria River	C001a	1	1.95	3.57	0.06	0.05	10	Riffle/Run (70%)	Boulder (45%)	Shrub (38%)	23	20
	C001	1	12.45	13	0.88	0.00	1	Pool (50%) / Pond (50%)	Fines (50%)	Shrub (65%)	8	20
	C002	2	2.55	4.00	0.08	0.41	2.5	Riffle/Run (90%)	Cobble/Rubble (58%)	Trees (68%)	35	10
	C003	2	1.57	2.07	0.1	0.07	2	Riffle/Run (90%)	Boulder (40%)	Shrub (70%)	58	5
	C004	2	1.15	1.95	0.05	0.03	1	Riffle/Run (50%) / Flat (50%)	Fines (40%)	Shrub (45%)	25	0
	C005	3	12.00	14.25	0.34	0.17	3.5	Riffle/Run (100%)	Boulder (55%)	Shrub (60%)	2	13
	C006	2	1.15	1.26	0.11	0.03	1	Riffle/Run (100%)	Boulder (40%)	Shrub (75%)	33	8
	C007	No defined channel										
	C008	1	0.65	0.98	0.07	0.00	0.05	Riffle/Run (50%) / Flat (50%)	Fines (38%)	Shrub (50%)	40	20
	C009	1	1.35	1.53	0.07	0.00	1	Flat (50%)	Fines (65%)	Shrub (75%)	70	20
	C010	No defined channel										
	C011*	1	0.76	0.91	0.06	0.01	0.75	Flat (85%)	Fines (60%)	Shrub (75%)	65	8
	C012	No defined channel										
	C013	-	14.50	17.75	0.5	0.00	5	Pool (95%)	Bedrock (70%)	Shrub (63%)	2	5
	C014	-	14	17	0.32	0.57	5.5	Pool (58%)	Bedrock (60%)	Shrub (53%)	1	5

Note:
* slight flow upstream of culvert, however downstream of culvert the stream is stagnant and dissipates into a wetland, iron floc present; unlikely to be fish habitat.

Photos of representative habitat of each stream and watercourse crossing are provided in BSA.4. Habitat quality in streams was highly variable. Small order streams that drained wetlands were generally poor for spawning, YOY, juvenile and adult life stages of brook trout and Atlantic salmon (ouaninache) due to the large quantity of fine grain substrates, while providing excellent habitat for threespine stickleback based on the habitat suitability indices in McCarthy et al. 2007. Rocky reaches of streams containing localized areas or reaches of flowing water containing sand, gravel and cobble, provided good to excellent habitat for spawning and rearing habitat for YOY, juvenile and adult life stages of brook trout. Higher order streams within flowing stream habitat and gravel and cobble substrates provided spawning habitat and rearing habitat for YOY and juvenile Atlantic salmon.

Victoria River is a part of the Exploits River watershed and formerly drained Victoria Lake prior to the construction of the Victoria Dam and the creation of the Victoria Lake Reservoir. As a result of a decrease in flow from Victoria Lake Reservoir after the construction of the Victoria Dam, Victoria River has narrowed, and shrubs dominate the riparian area within the former riverbanks in lower lying areas. Aerial imagery (Maxar 2016) of the first 5 km immediately downstream of Victoria Dam shows that the river is relatively narrow (from 10 m to 40 m) and beaver dams are abundant. Based on professional expertise in similar habitats, substrates in this area are likely to be predominantly fines with small quantities of coarser materials.

Farther downstream in Victoria River, the gradient increases, and riffles/runs and pools can be observed. The river width in this section (5 km to 11 km downstream of Victoria Dam) ranges from 20 m to 100 m. Based on aerial imagery, field surveys and literature review of the area, substrates are likely to be primarily medium and coarse (e.g., cobble to boulder) (Pippy 1966; unpublished in-field observations).

Stream crossing surveys conducted at proposed crossings C0013 and C0014, approximately 7.5 km downstream of Victoria Dam, documented that bedrock was the predominant substrate type at these locations (BSA.4, Attachment 4-B). Figures 8-3 to 8-11 show the habitat used by various life stages of fish within the LAA to carry out their life processes. The Habitat Suitability Index (HSI) values were derived from McCarthy et al. 2007, Grant and Lee 2004, Bradbury et al. 2001 and Stanley and Trial 1995, and are based on the habitat information collected in streams and ponds in 2011 and 2018. Suitable habitat for brook trout, threespine stickleback and Atlantic salmon (ouaninache) is denoted in green (HSI). Additional suitable habitat in Valentine Lake and Victoria Lake Reservoir was determined based on the depth preferences of brook trout, threespine stickleback and Atlantic salmon (ouaninache).

Suitable brook trout spawning and YOY habitat was generally patchy in distribution throughout the areas surveyed and limited to areas with coarser substrates that also contained small patches of gravel suitable for brook trout spawning (Figures 8-3 and 8-4). Juvenile and adult brook trout habitat is more widely available, since smaller (fine) substrates are considered suitable (Figures 8-5 and 8-6). Based on the depths in Valentine Lake, there is an abundance of brook trout habitat along the shoreline (Figures 8-3 to 8-6). Victoria Lake Reservoir also has suitable brook trout habitat along the shoreline in shallow water areas, however many shoreline locations have substantially deeper water than Valentine Lake; reducing the quantity of brook trout habitat available to the various life stages (Figures 8-3 to 8-6).

Suitable ouananiche spawning, YOY and juvenile habitat within the LAA is patchy and mainly limited to the downstream portions of streams containing gravel / cobble substrates, with increased stream flow and depth (Figures 8-7 to 8-9). Based on the depths in Valentine Lake, there is an abundance of ouananiche habitat along the shoreline (Figures 8-7 to 8-9). Victoria Lake Reservoir also has suitable ouaninache habitat along the shoreline in shallow water areas; however, many shoreline locations have substantially deeper water than Valentine Lake, reducing the quantity of ouaninache habitat available to the various life stages (Figures 8-7 to 8-9).

Suitable habitat for threespine stickleback spawning, YOY, juvenile and adult life stages within the LAA are similar, so the data of suitable habitat was pooled. Overall, all life stages of threespine stickleback were found in shallow depths with soft substrates (Figure 8-10). Based on depth, habitat for threespine stickleback was also associated with shallow habitat along the shoreline and was more abundant in Valentine Lake than in Victoria Lake Reservoir (Figure 8-10).

Lakes, ponds and beaver impoundments likely provide the majority of overwintering habitat for brook trout, ouaninache and threespine stickleback (Figure 8-11). Other smaller areas of groundwater input or seeps may also provide overwintering habitat in streams or ponds on a scale too small to be indicated on the figure.

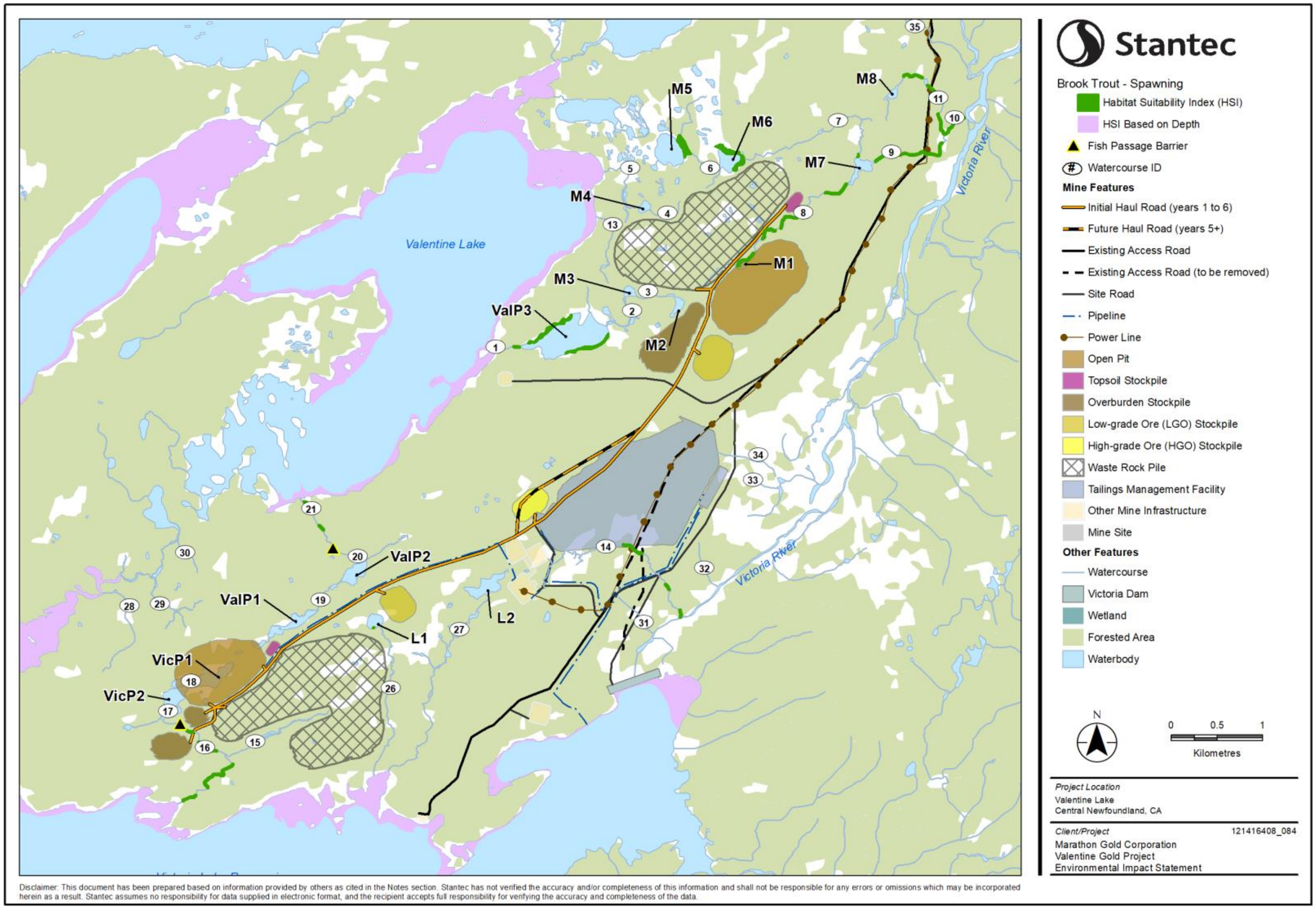


Figure 8-3 Suitable Habitat for Brook Trout - Spawning

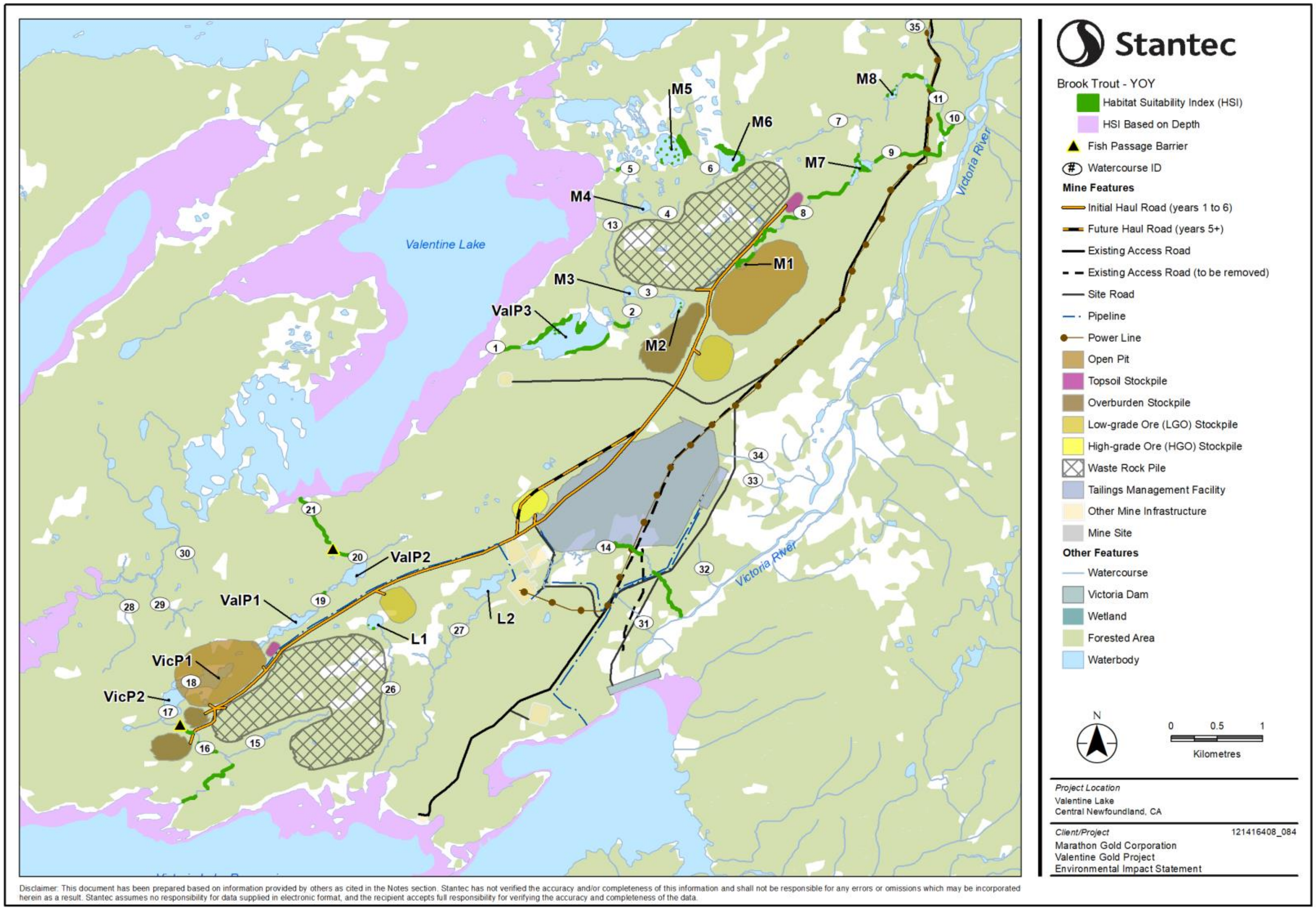


Figure 8-4 Suitable Habitat for Brook Trout - YOY

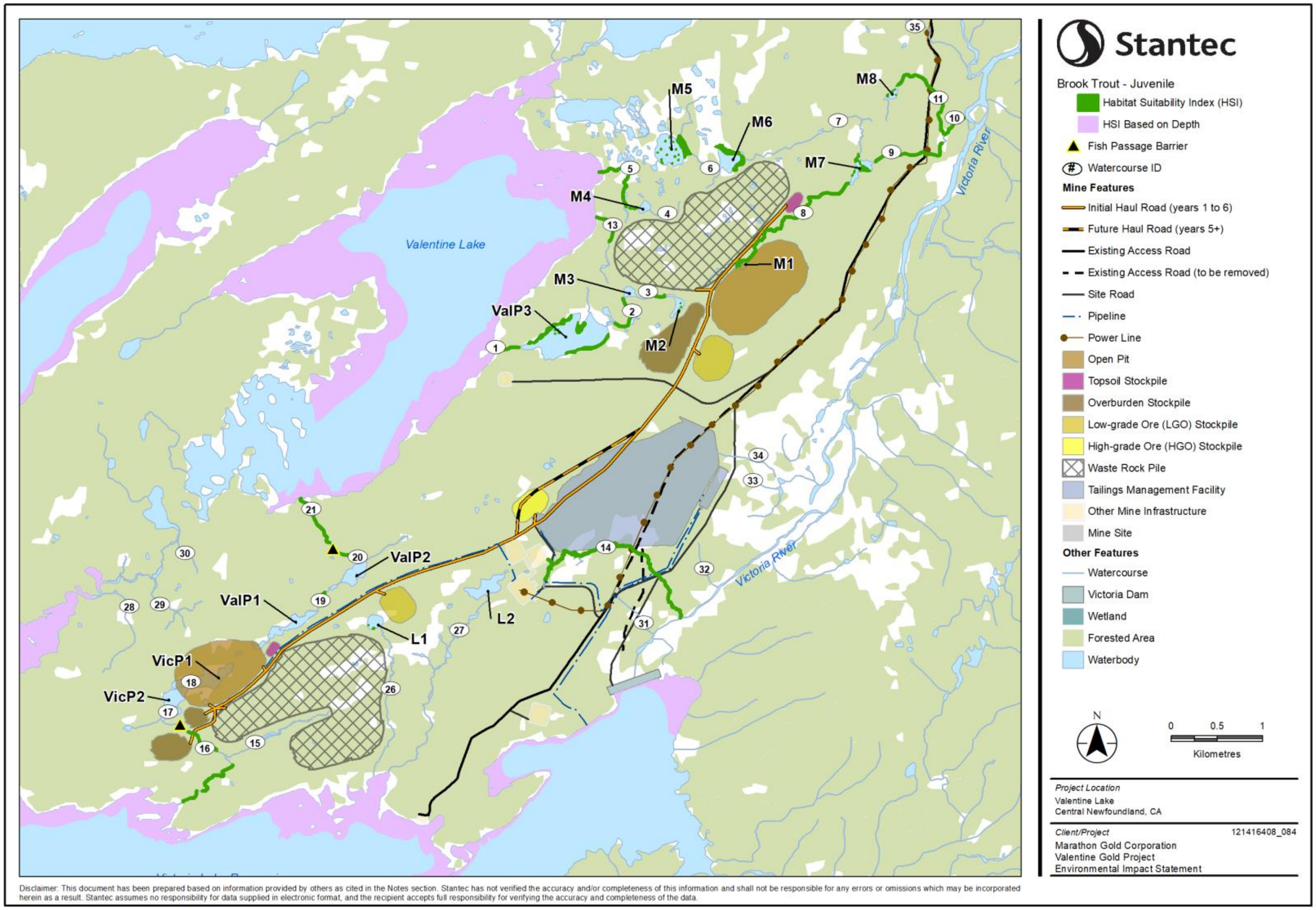


Figure 8-5 Suitable Habitat for Brook Trout - Juvenile

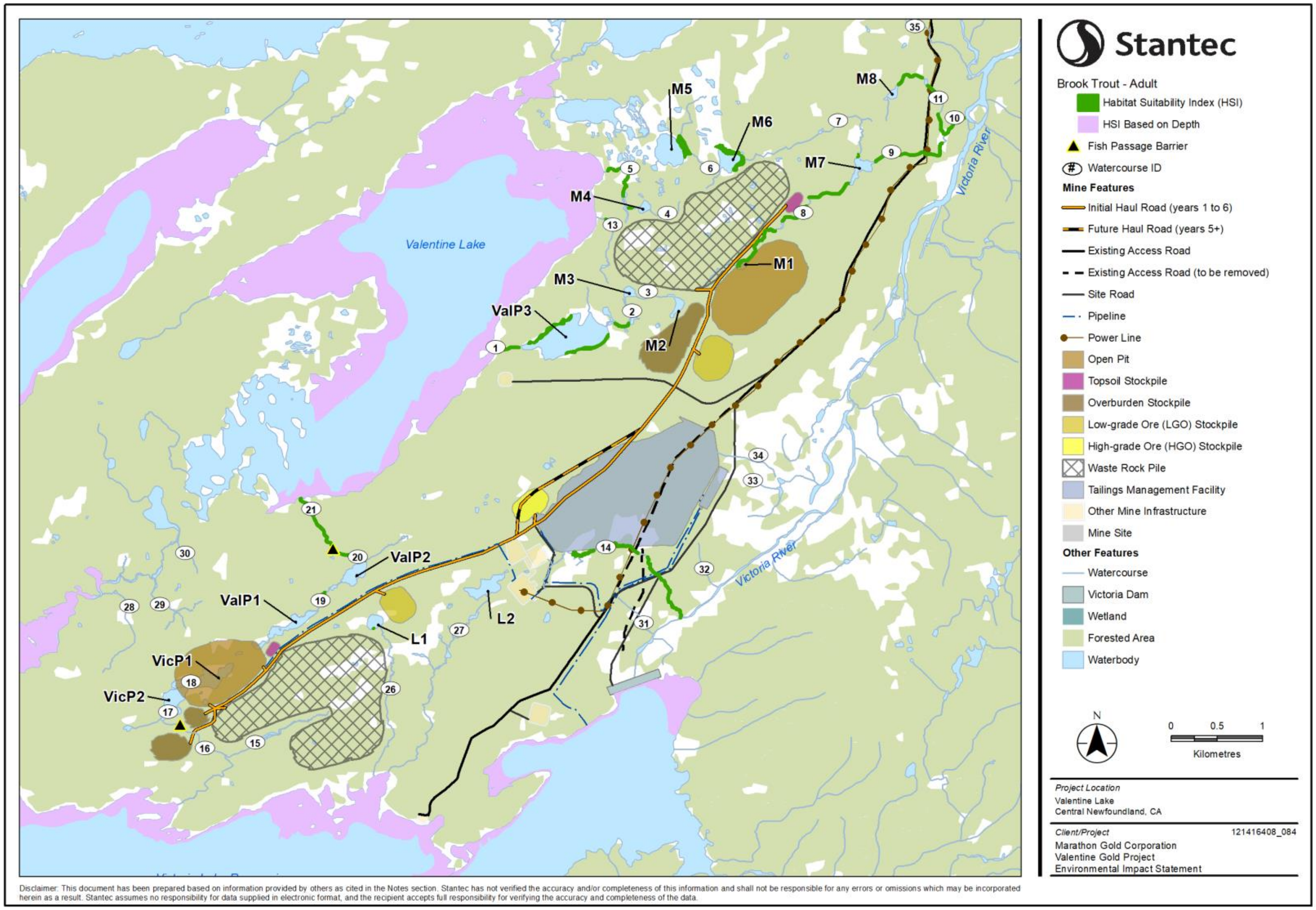


Figure 8-6 Suitable Habitat for Brook Trout - Adult

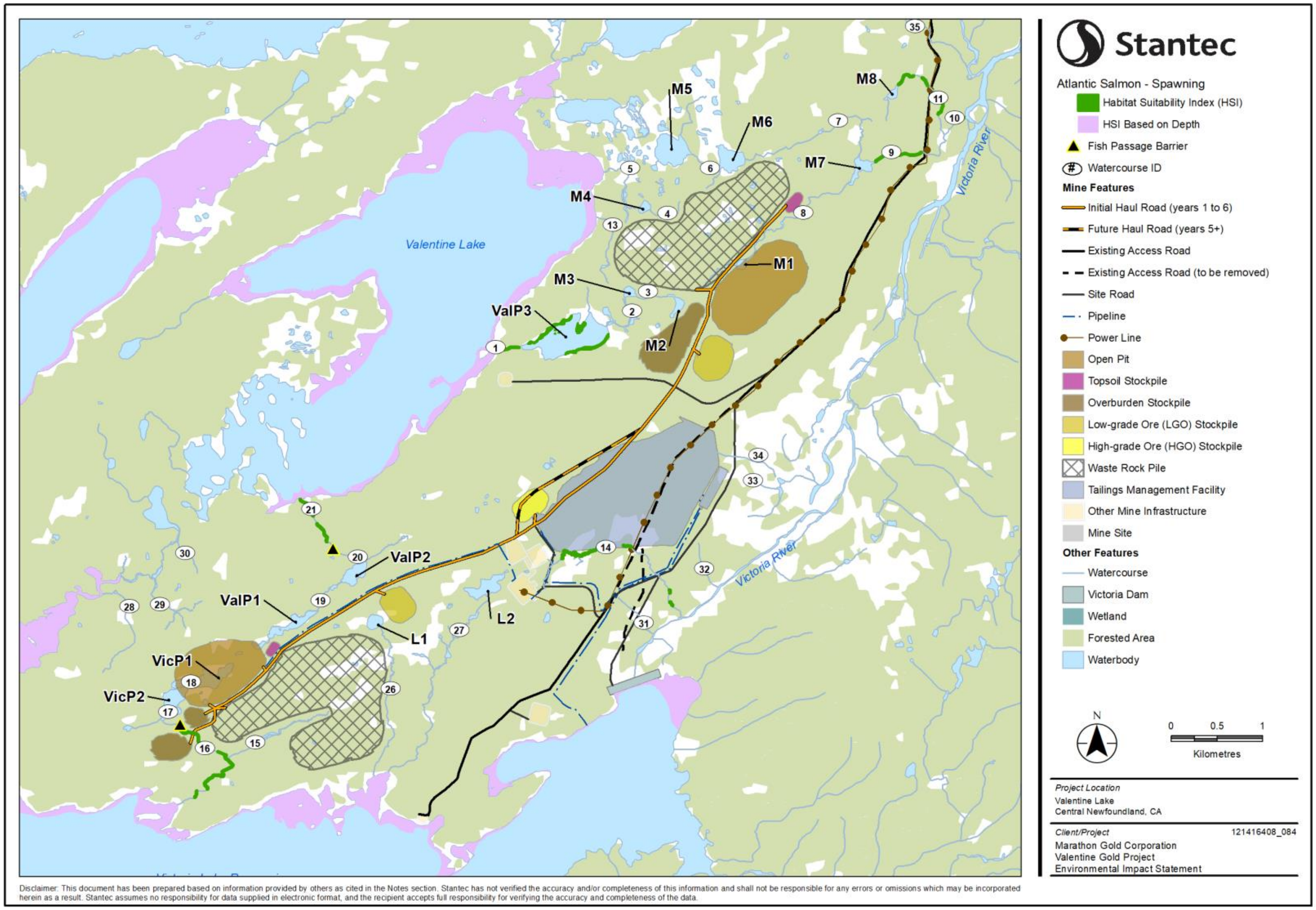


Figure 8-7 Suitable Habitat for Ouananiche - Spawning

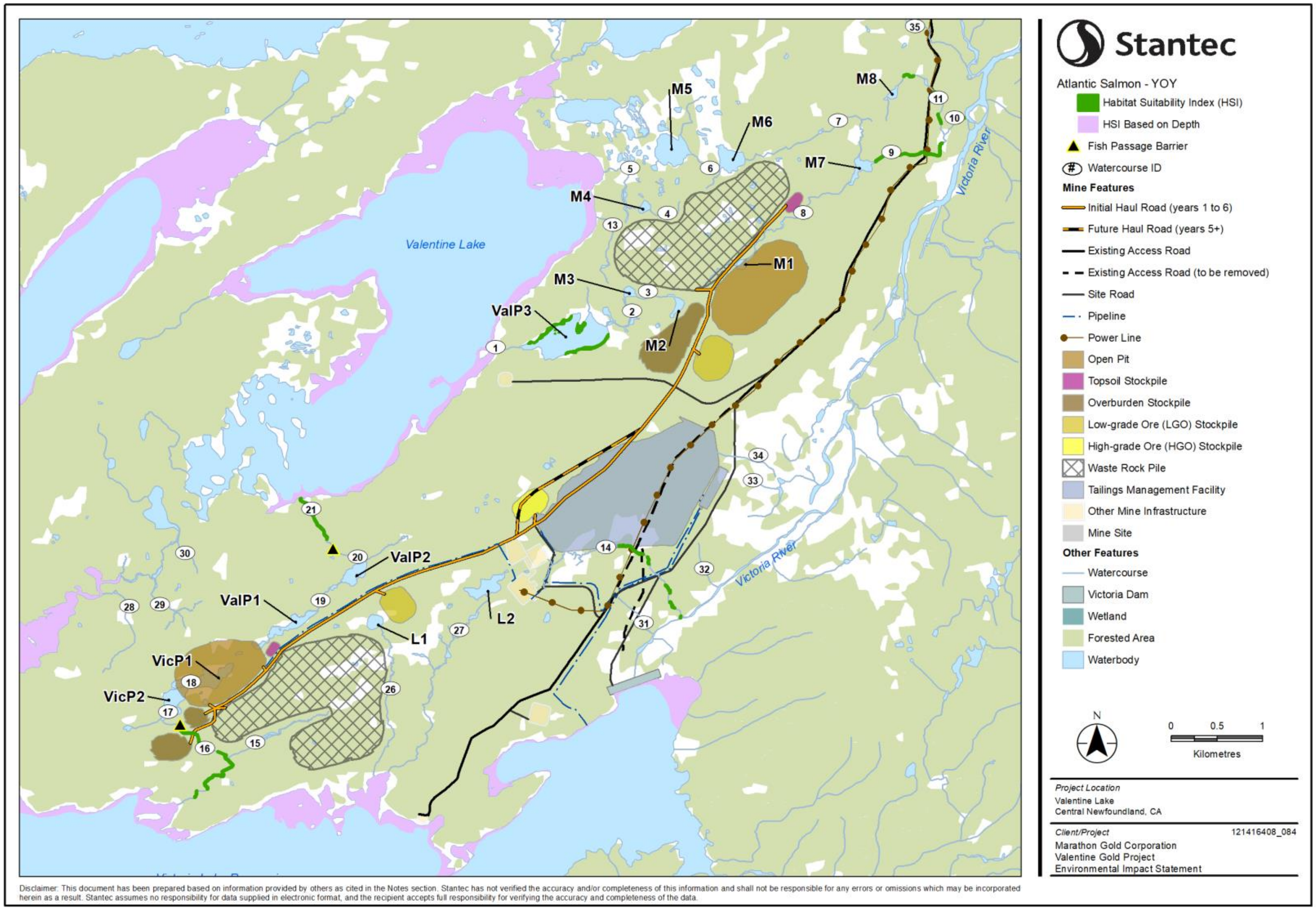


Figure 8-8 Suitable Habitat for Ouananiche - YOY

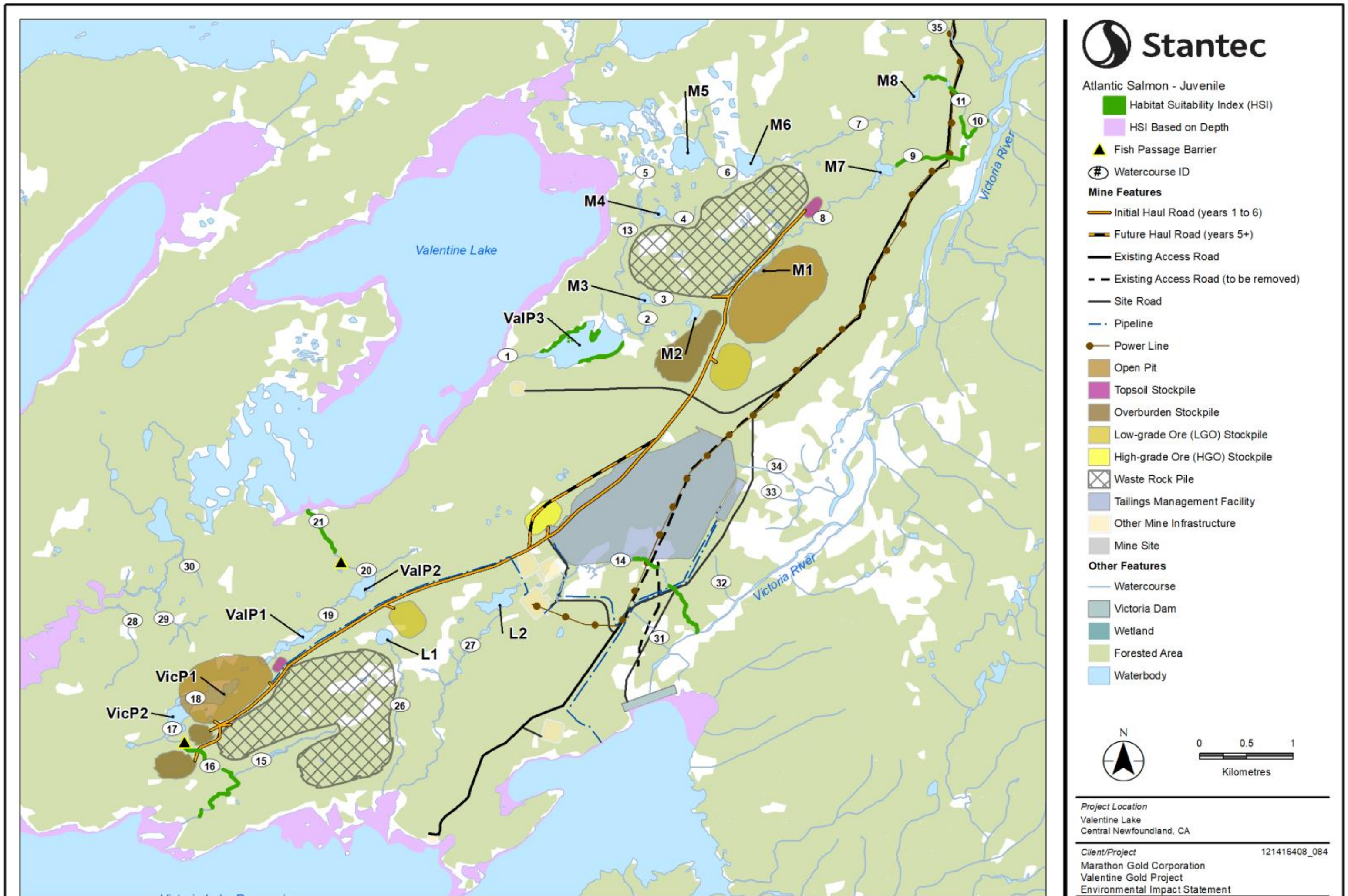


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Figure 8-9 Suitable Habitat for Ouananiche - Juvenile

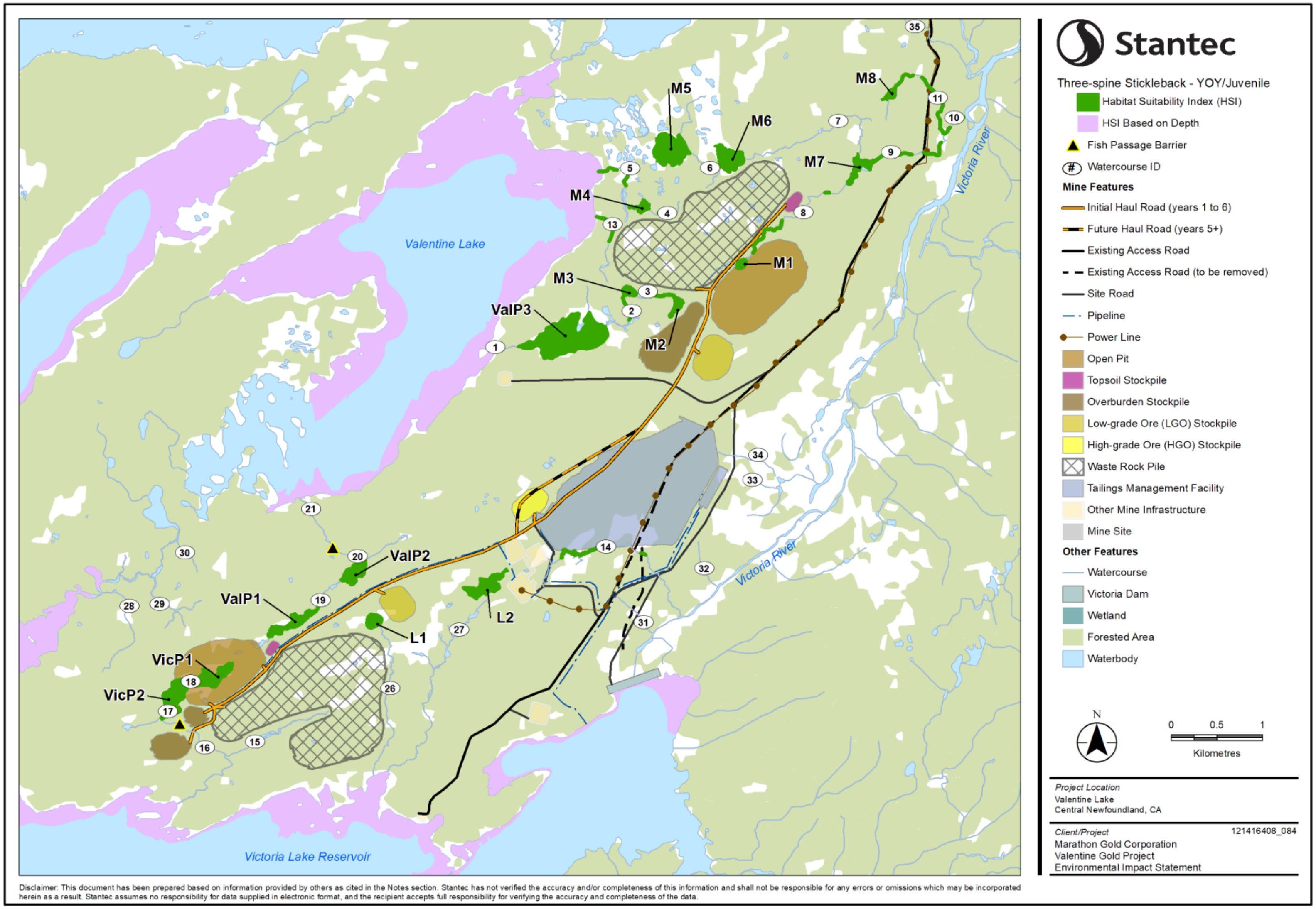

Figure 8-10 Suitable Habitat for Threespine Stickleback – YOY/Juvenile

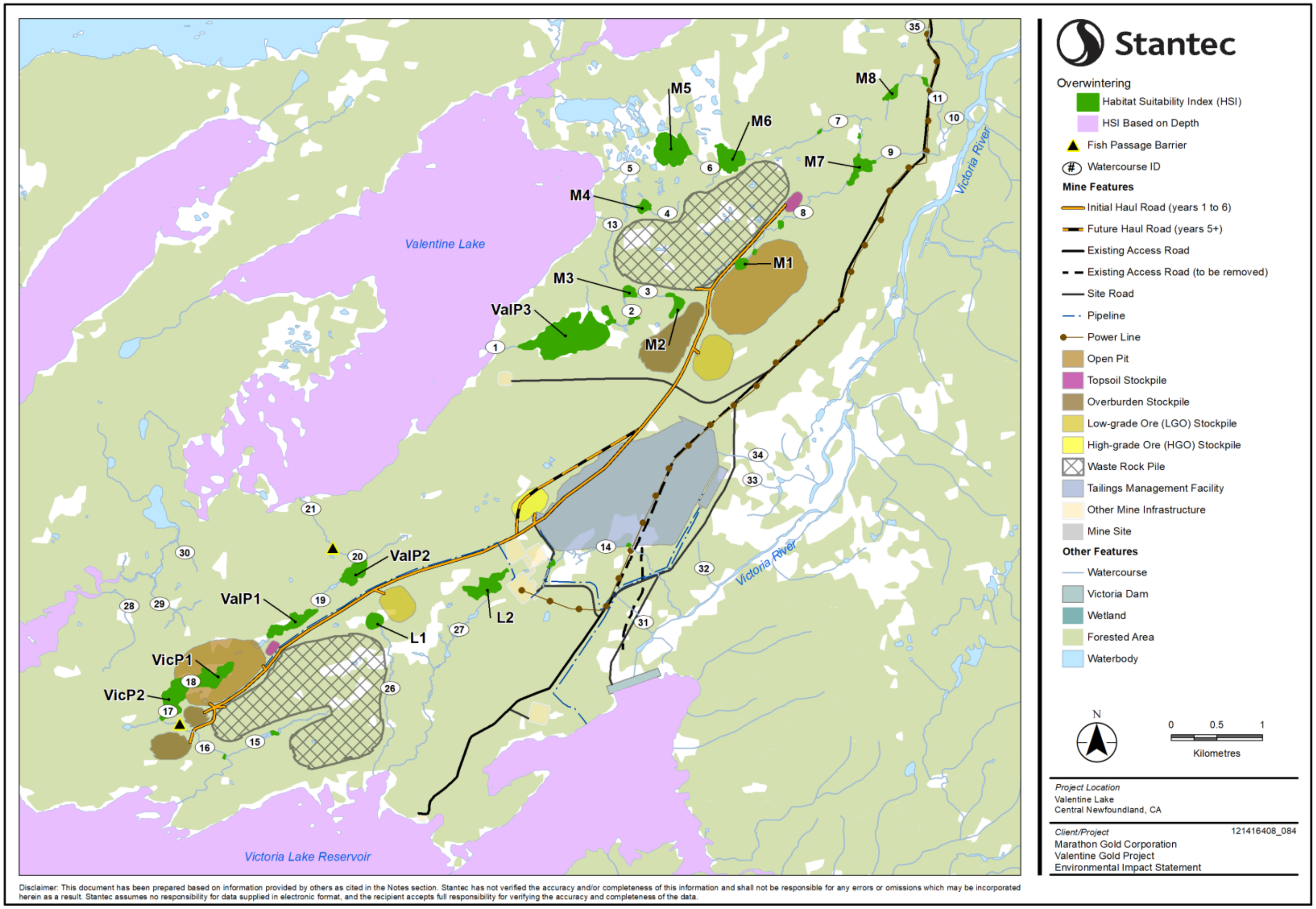

Figure 8-11 Suitable Habitat for Brook Trout, Ouananiche and Threespine Stickleback - Overwintering

Water Quality

In situ water quality results for ponds within the Aquatic Survey Area were within the acceptable ranges for supporting cold water fish communities (BSA.4, Attachment 4-C). Key findings are outlined below:

- In ponds, average water temperature ranged from 10.2°C to 16.7°C in September (BSA.4, Attachment 4-C)
- Average dissolved oxygen concentrations in ponds ranged from 8.3 mg/L to 9.5 mg/L. Four of five ponds sampled for dissolved oxygen were below the CWQG-FAL recommended minimum value of 9.5 mg/L for early life stages (ValP2, ValP3, VicP2 and M7); however, all stations were above the guidelines (6.5 mg/L) for all life stages (CCME 2014)
- The pH ranged from 6.1 to 7.1 and was below the CWQG-FAL recommended range (6.5 to 9.0) at two of five sampling locations (L1 and VALP2)
- Conductivity ranged from 47.9 µS/cm to 52.3 µS/cm

In situ water quality results in Valentine Lake were generally within the acceptable ranges for supporting cold water fish communities (BSA.4, Attachment 4-C):

- In 2019, conductivity levels for Valentine Lake varied between 24 µS/cm and 27 µS/cm
- The pH in Valentine Lake ranged from 6.04 to 7.79; the in-situ pH within the water column was generally within or slightly below the recommended guideline CWQG-FAL of 6.5
- Secchi depth ranged from 6.00 m to 7.12 m on Valentine Lake in August and September 2019, respectively
- Valentine Lake thermally stratifies in summer at depths of 10 to 11 m from the water's surface and dissipates prior to late September
- In August, water temperature in the epilimnion (above the thermocline) averaged 20.1ºC and dissolved oxygen concentrations averaged 8.5 mg/
- Below the thermocline water temperatures averaged 16.7ºC and dissolved oxygen concentrations averaged 8.3 mg/L
- During the mid-summer months, Valentine Lake has water temperatures and dissolved oxygen concentrations that are suitable for cold water fish species, such as Atlantic salmon and brook trout

In situ water quality results in Victoria Lake Reservoir were generally within the acceptable ranges for supporting cold water fish communities (BSA.4, Attachment 4-C):

- Conductivity levels for Victoria Lake Reservoir varied between 20 and 23 µS/cm
- The pH in Victoria Lake Reservoir ranged from 5.57 to 7.37; the in-situ pH within the water column was frequently below the recommended guideline CWQG-FAL of 6.5
- Secchi depth ranged from 3.9 m to 4.9 m on Victoria Lake Reservoir in August and September 2019, respectively
- Victoria Lake Reservoir thermally stratifies in summer and fall between depths of 16 to 25 m from the water's surface, although dissipates by November (BSA.4, Attachment 4-C)
- In August, during the warmest month sampled, water temperature in the epilimnion averaged 19.1ºC and dissolved oxygen concentrations averaged 8.8 mg/L

- Below the thermocline, water temperatures averaged 7.2ºC and dissolved oxygen concentrations averaged 10.3 mg/L. Water temperatures and dissolved oxygen concentrations are suitable for cold water fish species in Victoria Lake Reservoir during summer stratification

In situ water quality in streams is generally within the acceptable ranges for supporting cold water fish communities (BSA.4, Attachment 4-C):

- In streams, average water temperature ranged from 12.2°C to 22.3°C
- Average dissolved oxygen concentrations in streams ranged from 7.8 mg/L to 9.4 mg/L; all stations were below the CWQG-FAL recommended minimum value of 9.5 mg/L for early life stages, however, were above the guideline (6.5 mg/L) for all life stages (CCME 2014)
- The pH ranged from 6.1 to 6.9 and was below the CWQG-FAL recommended range (6.5 to 9.0) at one of six sampling locations
- Conductivity ranged from 39.4 µs/cm to 98.0 µS/cm

In general, the surface water quality in the LAA is within the acceptable ranges for supporting cold water fish communities:

- Surface water was soft; hardness averaged 16.3 mg/L
- Alkalinity was low and suggested limited acid buffering potential in local waterbodies; the pH ranged from acidic to slightly basic (4.61 to 7.8)
- Electrical conductivity was considered low and averaged approximately 40 µS/cm
- Concentrations of major cations such as calcium, sodium, potassium, magnesium, manganese, ammonium, iron and aluminum were low as were concentrations of major anions such as chloride, fluoride, sulphate and nitrate
- Waters were typically clear, with low total suspended solids concentrations (mean of 3 mg/L) and low turbidity (mean of 1.0 Nephelometric Turbidity unit)
- Total ammonia had a mean of 0.09 mg/L) and nitrate had a mean of 0.11 mg/L
- Nutrients such as total phosphorus had a mean of 54 mg/L, indicating that nutrients likely do not limit plant or algal growth in these freshwater streams
- Total metal concentrations for arsenic, cadmium, boron, copper, lead molybdenum, selenium, silver, thallium, uranium and zinc were typically within the CWQG-FAL at most sampling locations
- Total aluminum and iron were often above CWQG-FAL at most sampling stations

The complete results are provided in the Baseline Report (BSA.3, Attachment 3-A) and are described in more detail in Chapter 7 (Surface Water Resources).

Water Quantity

The streams within the Aquatic Survey Area are generally small because they drain wetlands or small ponds near the top of their respective watershed divides, with mean discharges ranging from 0.004 m^3/s to 0.352 m^3/s throughout the year (Table 8.5). Mean monthly flows are highest in June and July, with the lowest flows occurring in October and November. Flows were low during early August 2019 and some flows appeared negligible or streams had become intermittent (e.g., Stream 1 and 17). More detailed information on the discharge in ponds, lakes and streams within the Aquatic Survey Area can be found in

Chapter 7 (Surface Water Resources). The sampling locations referred to in Table 8.5 are shown on Figure 7-2.

Table 8.5 Range of Mean Monthly Flows Conditions at Select Locations within the Aquatic Survey Area Collected between 2011 and 2019

Major Watershed	Location	Mean Flow (m^3/s)		
		Low	High	Mean
Valentine Lake	Stream 19 (HS1)	0.004	0.026	0.014
Valentine Lake	Stream 20/21 (HS2)	0.011	0.069	0.035
Valentine Lake	Stream 1 (HS9)	0.031	0.2	0.097
Victoria Lake Reservoir	Stream 17 (HS3)	0.007	0.046	0.024
Victoria Lake Reservoir	Stream 16 (HS4)	0.01	0.066	0.034
Victoria Lake Reservoir	Stream 15 (HS5)	0.01	0.067	0.034
Victoria Lake Reservoir	Stream 16 downstream of 15 (HS6)	0.024	0.154	0.076
Victoria River	Stream 14 (HS7)	0.019	0.118	0.058
Victoria River	Stream (HS8)	0.055	0.352	0.167

Sediment Quality

In ponds, grain size distributions were variable; however, in general, grain size classes were distributed relatively equally between sand, silt, and clay (BSA.4, Attachment 4-C). In lakes, grain size distribution was more variable than in ponds. In lakes, silt was the predominant grain size class, except within the littoral area of Valentine Lake, which was sand. In pond and lake sediments there were no exceedances of the Canadian Sediment Quality Guideline Probable Effects Limit (CSQG PEL) identified for cadmium, chromium, copper, lead, mercury or zinc. Arsenic was above the CSQG PEL guidelines in 11 of 11 sediment samples collected from ponds and lakes and ranged from 56 mg/kg to 290 mg/kg (BSA.4, Attachment 4-C). In NL, naturally high arsenic levels are not uncommon and are influenced by bedrock geology, surficial and chemical processes and proximity to areas of mineralization (particularly copper and gold) (Serpa et al. 2009).

Grain size distribution sampled from soft sediments in streams was highly variable (BSA.4, Attachment 4-C). Sand was the predominant grain size at stations sampled in stream 14, stream 24 and stream16, while silt was the predominant grain size at stations sampled in stream 8 and 2. No exceedances of the CSQG PEL were identified for cadmium, chromium, copper, lead, mercury and zinc. Arsenic levels were naturally elevated and above the CSQG PEL guidelines in all four of the sediment samples collected from soft sediments in streams and ranged from 72 mg/kg to 240 mg/kg (BSA.4, Attachment 4-C).

8.2.2.2 Primary Productivity

Primary production is the production of chemical energy into organic compounds by living organisms. It occurs primarily through photosynthesis and provides the base of the aquatic food web (i.e., algae or plants for other organisms to eat). Chlorophyll “a” concentration from periphyton in surface water are often positively associated with nutrient availability and is used to assess primary productivity. Chlorophyll "a" produces a food supply at the base of the food chain for many aquatic organisms. Chlorophyll in lakes and ponds comes mostly from floating algae. In streams, chlorophyll is associated with periphyton, which includes a functionally defined assemblage of algae and other species, which live attached to solid surfaces, such as logs and rocks.

Water samples were collected from two lakes (Valentine Lake and Victoria Lake Reservoir), and five ponds (L1, M7, VicP2, ValP2, ValP3) for the determination of chlorophyll "a" concentration in both summer and fall, 2019 (BSA.4, Attachment 4-C). Primary productivity in these lakes varied little between summer and fall periods, with summer concentrations ranging from non-detect (<0.5) to 1.8 micrograms per litre (µg/L) and fall concentrations ranging from 0.6 µg/L to 1.7 µg/L (BSA.4, Attachment 4-C). These results indicate low primary productivity of these lakes based on chlorophyll "a" concentration <2 µg/L (Mackie 2001).

Periphyton samples were collected from five streams (L1, M7, VicP2, ValP2, ValP3) for the determination of chlorophyll "a" concentration in both summer and fall (BSA.4, Attachment 4-C). Primary productivity represented by chlorophyll "a" concentration in periphyton did not vary substantially between summer and fall sampling events, with summer concentrations ranging from 0.8 to 1.8 micrograms per square centimeter (µg/cm^2) and fall concentrations ranging from 0.8 to 2.5 µg/cm^2 (BSA.4, Attachment 4-C). Concentrations of chlorophyll "a" in periphyton indicated oligotrophic to mesotrophic conditions (low to moderate productivity) based on Barbour et al. (1999).

8.2.2.3 Secondary Productivity

Secondary productivity is the production of biomass by organisms that cannot produce their own food (i.e., heterotrophic). The BIC in waterbodies was sampled to determine secondary productivity. Benthic invertebrates consist of a wide range of feeding groups including shredders, gatherers, filter feeders, scrapers and predators. These organisms are responsible for converting non-living organic matter (e.g., coarse and fine particulate organic matter) and living organic matter (e.g., algal cells, microscopic multicellular animals, and other benthic invertebrates) into animal tissue. This animal tissue represents a major food resource for fish populations, particularly brook trout and Atlantic salmon (ouaninache) less than approximately 30 cm in length (Pippy 1966).

Secondary productivity can be quantified by the measurement of the density of benthic invertebrates in a given area (number of individuals per m^2). In general, areas of high density tend to have higher secondary productivity than areas of low density. Taxa richness and evenness are two metrics that, in combination, are generally used to estimate secondary production and determine how the productivity may be generated. Taxa richness includes the number of different types of organisms that may be present at a family or species level, and evenness provides a measure of how diverse a benthic community is.

In ponds, 32 different species from 20 different families were identified in the BIC samples collected (BSA.4, Attachment 4-C). The predominant benthic invertebrate taxon collected from ponds was Amphipoda (amphipods), except for VICP2, which had higher proportions of Diptera (true flies).

In lakes, 29 different species from 12 different families were identified in the BIC samples. The predominant benthic invertebrate taxon collected was generally Diptera (true flies) and consisted primarily of Chironomidae. Chironomidae made up between 40% and 85% of the individuals identified in lakes.

The density and taxa richness of benthic invertebrates were higher in BIC samples collected from ponds than from lakes. Evenness was low in ponds and moderate in lakes, while BIC diversity was moderate in both ponds and lakes (BSA.4, Attachment 4-C). Victoria Lake Reservoir had lower densities of benthic invertebrates in comparison to Valentine Lake (BSA.4, Attachment 4-C), which indicates lower secondary productivity in Victoria Lake Reservoir compared to Valentine Lake. This may be in part due to the wide and rapid fluctuations in lake level historically within Victoria Lake and currently within the Victoria Lake Reservoir in comparison to Valentine Lake (Pippy 1966, unpublished field observations). Rapid fluctuations in lake level are not conductive to bottom dwelling organisms because organisms that reside in shallow water within the littoral area may not survive as water levels drop (Pippy 1966).

In streams, 35 different species from 18 different families were identified in the BIC samples collected from soft substrates (BSA.4, Attachment 4-C). The predominant benthic invertebrate taxon collected from soft substrates in streams was generally Diptera (true flies) and consisted primarily of Chironomidae. Chironomidae made up between 39% and 100% of the individuals identified. In streams, 47 different species from 28 families were identified in the BIC samples collected from hard substrates. The predominant benthic invertebrate taxon collected from hard substrates in streams was generally Ephemeroptera (mayflies), except for Stream 1, which had higher proportions of bivalves (mussels). Ephemeroptera, Plecoptera, and Tricoptera (EPT) made up between 25% and 94% of the individuals identified from hard substrates and are indicators of good water quality. The density of benthic invertebrates was higher in stream samples collected from soft substrates than from hard substrates. Taxa richness was lower in samples collected from soft substrates than hard substrates. Evenness was low in samples collected from hard substrates and moderate in soft substrates, while diversity was moderate for samples collected from soft substrates and high for hard substrates (BSA.4, Attachment 4-C).

8.2.2.4 Fish Community

Within the RAA, sea-run Atlantic salmon and ouananiche, brook trout, Arctic char, American eel and threespine stickleback are known to occur (Cunjak and Newbury 2005; Porter et al. 1974). Brook trout, Arctic char, threespine stickleback and ouaninache comprise the resident fish species. The streams, rivers, lakes and ponds in the RAA provide adequate spawning, rearing, migratory and overwintering habitat for these species to carry out their entire life processes in freshwater.

Sea-run Atlantic salmon, American eel and possibly threespine stickleback comprise the diadromous species in the RAA, meaning that a portion of their life cycle is carried out in the marine environment. Sea-run Atlantic salmon migrate upstream to spawn and their offspring spend their early life stages in freshwater. Juvenile Atlantic salmon leave the freshwater environment as smolts to grow and mature in the marine environment before returning to their natal rivers to spawn. The sea-run Atlantic salmon are part of the Northeast Newfoundland Atlantic Salmon population and are designated as Not-at-Risk by COSEWIC (COSEWIC 2010). Fishway counts at the Bishops Falls counting facility on the Exploits River in 2019 indicate a decrease in salmon numbers from the previous year and from 2014 to 2018, which is consistent with other Atlantic salmon populations in Atlantic Canada. Like other Atlantic salmon populations, marine survival is considered to be a major factor limiting the abundance of Atlantic salmon within the NL Region (Veinott et al. 2018).

For American eel, which spawn within the marine environment in the Sargasso Sea, the RAA provides adequate rearing, overwintering and migratory habitat to carry out their life processes. American eel is considered a single breeding population and is classified as Threatened by COSEWIC (COSEWIC 2012). Threats to the population include habitat alteration, dams and turbines, fishery harvest, changes to ocean conditions related to climate change, contaminants, and parasites (COSEWIC 2012).

For both sea-run Atlantic salmon and American eel, their migratory habitat is interrupted with a number of hydroelectric dams which provide upstream passage, however, may not facilitate optimal downstream migratory passage.

Within the LAA, brook trout, Atlantic salmon (ouaninache), Arctic char and threespine stickleback are known to occur in the Victoria River watershed and Victoria Lake Reservoir (Pippy 1966; Porter et al. 1974). American eel is known to occur within the LAA along the access road on the south side of Red Indian Lake, however, is not known to occur in Victoria Lake Reservoir or Valentine Lake. Victoria Lake Reservoir and Valentine Lake are not accessible to sea-run Atlantic salmon. Atlantic salmon are landlocked due to numerous dams within the Exploits River and White Bear watersheds. A summer, randomized sampling program conducted in Victoria Lake Reservoir by Pippy, 1966, indicated the community composition of salmonids was, Atlantic salmon (ouaninache) 46%, brook trout 40% and Arctic char 14%. Based on the habitat preferences of Arctic char in Victoria Lake Reservoir, it is presumed they have the potential to occur in Valentine Lake as well.

Fish sampling was conducted within the Aquatic Survey Area to determine if fish were present and to provide additional information on the abundance (i.e., productivity) of fish in representative lakes, ponds, streams and bog holes. Brook trout, Atlantic salmon (ouaninache) and threespine stickleback were captured in ponds, lakes and streams, however, Arctic char were not captured. Despite substantial effort, no fish were captured in bog holes, indicating that bog holes are not fish bearing. For the fish species captured, YOY and adult life stages were confirmed present suggesting that the habitat within the Aquatic Survey Area provides adequate spawning, rearing, migratory and overwintering habitat on a local scale for fish to carry out their life processes.

Lakes, Ponds and Bog Holes

Salmonids were confirmed or are likely to be present in most lakes and ponds, except for VicP1, VicP2, ValP1 and ValP2 (BSA.4, Attachment 4-A). Extensive fishing effort demonstrated that salmonids were absent from these ponds and were only present downstream of substantial waterfalls located in the Val (P1 and P2) and Vic (P1 and P2) sub-watersheds. A summary of fish presence / absence in ponds and lakes within the Aquatic Survey Area is provided in Table 8.6. In lakes and ponds, Atlantic salmon (ouaninache) were only found in larger waterbodies (i.e., Valentine Lake and Victoria Lake Reservoir, and pond ValP3), whereas brook trout were confirmed or assumed to be present in all ponds with connectivity to downstream streams or ponds. Threespine stickleback were confirmed or assumed to be present in all lakes and ponds (Table 8.6). Bog holes in the Aquatic Survey Area were determined to be fishless.

Table 8.6 Summary of Fish Presence/Absence Results in Ponds, Lakes and Bog Holes within the Aquatic Survey Area

Fish Status	Salmonids	Threespine Stickleback
Ponds and Lakes		
Confirmed	Val Lake, Vic Lake, Val P3, L1, L2, M1, M2 and M6	Val Lake, Vic Lake, M5 and M6, ValP1, ValP2, VicP1, VicP2
Likely	M3, M4, M5, M7 and M8	Val P3, L1, L2, M1, M2, M3, M4, M7 and M8
Unlikely	-	-
Absent	Val P1, Val P2, Vic P1, Vic P2, bog holes	Bog holes

Notes:
Confirmed = fish presence confirmed (captured by fyke trap, electrofisher or gillnet)
Likely = suitable habitat is present, and the habitat is connected to habitat containing this species
Unlikely = no suitable habitat present and this habitat is not connected to habitat containing this species
Absent = substantial fishing effort expended, however, species not caught

A summary of catch per unit of effort (CPUE), by species, for each lake and pond fished in 2011, 2018 or 2019 is provided in Table 8.7. The CPUE for salmonids in Val P1, Val P2, Vic P1 and Vic P2 was zero for each pond despite substantial fyke netting and gillnetting effort, confirming that the falls downstream are barriers to upstream fish passage. The CPUE for threespine stickleback in these ponds ranged from 0.2 to 3.4 fish per hour for fyke traps. In the other ponds accessible to salmonids, CPUE for gillnets ranged from 0 to 5.5 fish per hour (salmonids only) and 0 to 0.5 fish per hour for minnow traps (sticklebacks only).

Based on the field surveys conducted in 2018 and 2019 in Victoria Lake Reservoir, brook trout average CPUE was 3.0 fish per hour for gillnets and 0.0 fish per hour for fyke nets (Table 8.7). Atlantic salmon CPUE in Victoria Lake Reservoir was 0.5 fish per hour for gillnets and 0.3 fish per hour for fyke nets. In Valentine Lake, brook trout average CPUE was 0.0 fish per hour for gillnets and 0.1 fish per hour for fyke nets (Table 8.7). Atlantic salmon in Valentine Lake CPUE was 0.0 fish per hour for gillnets and 0.1 fish per hour for fyke nets. CPUE for sticklebacks in Valentine Lake and Victoria Lake Reservoir ranged from 7.1 to 7.7 fish per hour for fyke nets. Arctic char was not captured in Victoria Lake Reservoir or Valentine Lake during any of the field studies.

Table 8.7 Catch Per Unit Effort and Descriptive Statistics for Fish Sampling in Lakes, Ponds and Bog Holes in Aquatic Survey Area

Major Sub-Watershed	Location	Sampling Method [1]	Total Effort (hours)	Brook Trout	Atlantic Salmon	Threespine Stickleback
Victoria Lake Reservoir	VicP1	Fyke (2)	57.0	0.0	0.0	1.2
Victoria Lake Reservoir	VicP1	Gillnets (2)	139.3	0.0	0.0	0.0
Victoria Lake Reservoir	VicP2	Fyke (2)	43.6	0.0	0.0	3.2
Victoria Lake Reservoir	VicP2	Gillnets (2)	140.7	0.0	0.0	0.0

Table 8.7 Catch Per Unit Effort and Descriptive Statistics for Fish Sampling in Lakes, Ponds and Bog Holes in Aquatic Survey Area

Major Sub-Watershed	Location	Sampling Method [1]	Total Effort (hours)	Brook Trout	Atlantic Salmon	Threespine Stickleback
Victoria Lake Reservoir	L1	Minnow trap	7.8	0.0	0.0	0.0
Victoria Lake Reservoir	L1	Gillnet	3.9	1.3	0.0	0.0
Victoria Lake Reservoir	L2	Minnow trap	7.3	0.0	0.0	0.0
Victoria Lake Reservoir	L2	Gillnet	3.7	0.3	0.0	0.0
Valentine Lake	ValP1	Fyke (4)	78.3	0.0	0.0	0.4
Valentine Lake	ValP1	Gillnets (2)	144.3	0.0	0.0	0.0
Valentine Lake	ValP2	Gillnet (8)	282.7	0.0	0.0	0.0
Victoria River	M1	Gillnet	0.6	5.5	0.0	0.0
Victoria River	M5	Minnow trap	7.2	0.0	0.0	0.1
Victoria River	M5	Gillnet	3.6	0.0	0.0	0.0
Victoria River	M6	Minnow trap	2.0	0.0	0.0	0.5
Victoria River	M6	Gillnet	1.0	5.0	0.0	0.0
Victoria River	M7	Gillnet	0.5	0.0	0.0	0.0
Victoria River	M8	Gillnet	0.5	0.0	0.0	0.0
Valentine Lake	ValP3	Gillnet	1.5	0.0	1.3	0.0
Valentine Lake	M2	Gillnet	0.5	0.0	0.0	0.0
Valentine Lake	M2	Gillnet*	-	-	-	-
Valentine Lake	M3	Gillnet	0.5	0.0	0.0	0.0
Valentine Lake	M4	Minnow trap	1.0	0.0	0.0	0.0
Valentine Lake	M4	Gillnet	0.5	0.0	0.0	0.0
Victoria Lake Reservoir	Victoria Lake Reservoir	Gillnets (2)	1.7	0.5	3.0	0.0
Victoria Lake Reservoir	Victoria Lake Reservoir	Fyke nets (2)	95.7	0.3	0.0	7.7
Valentine Lake	Valentine Lake	Gillnets (2)	1.9	0.0	1.1	0.0
Valentine Lake	Valentine Lake	Fyke nets (2)	94.5	0.1	0.0	7.1
Bog Holes	IT18	Minnow Trap	48	0	0	0
Bog Holes	IT18	Gillnets (2)	48	0	0	0

Note:
[1] Number in brackets is number of fyke or gillnet sets
* CPUE was artificially high so not included as fish were accidentally spooked

In Victoria Lake Reservoir and Valentine Lake, Atlantic salmon ranged from 40 mm to 322 mm and brook trout ranged from 75 mm to 243 mm (BSA.4, Attachments 4-B and 4-C). Prior to the creation of the Victoria Lake Reservoir, Atlantic salmon (ouaninache) ranged from 148 mm to 365 mm with a maximum age of 8, brook trout ranged from 152 mm to 276 mm with a maximum age of 5 and Arctic char ranged from 110 mm to 220 mm with a maximum age of 6, within Victoria Lake (Pippy 1966).

Streams and Stream Crossings

Salmonids were absent in streams 17, 18, 19 and 20, because of barriers to fish passage (Figure 8-2). Brook trout were found in most other streams within the Aquatic Survey Area. Atlantic salmon were found in streams connected to lakes and large ponds (i.e., Victoria Lake Reservoir, Valentine Lake, ValP3) and the Victoria River (i.e., streams 1, 9, 11, 16 and 21) (Table 8.8). Threespine stickleback were confirmed or likely present in all the streams within the Aquatic Survey Area (Table 8.8).

A summary of CPUE by species is provided in Table 8.9 for streams and Table 8.10 for stream crossings surveyed using backpack electrofishing in 2012 and 2018. For streams 17, 18, 19 and 20, the CPUE for salmonids was zero as they were absent due to downstream barriers to fish upstream passage (Figure 8-2). In streams accessible to salmonids, brook trout CPUE ranged from 0 to 92 fish/1,000 seconds (s), and Atlantic salmon CPUE ranged from 0 to 48 fish/1,000 s, and threespine stickleback ranged from 0 to 101 fish/1,000 s for streams and stream crossings (Table 8.9 and Table 8.10). Of all species captured, the highest overall CPUE was for brook trout.

In streams and at watercourse crossings, Atlantic salmon ranged from 50 mm to 166 mm (YOY to juvenile) and brook trout ranged from 34 mm to 200 mm (YOY to adult) (BSA.4, Attachments 4-B and 4-C).

Table 8.8 Summary of Fish Presence/Absence Sampling Results within Streams and Stream Crossings in the Aquatic Survey Area

Fish Assemblage	Stream and Stream Crossing Locations for Fish	
	Salmonids Present	Sticklebacks Present
Streams		
Confirmed	1, 2, 5, 8, 9, 10, 11, 14, 15, 16 and 21	4, 5, 11, 15, 16, 17, 18, 19, 20 and 21
Likely	3, 4, 6, 7, and 13	1, 2, 3, 6, 7, 8, 9, 10, 13 and 14
Unlikely	-	-
Absent	17, 18, 19 and 20	-
NFH (dry)	12	12
Stream Crossings		
Confirmed	C001, C001a, C002, C003, C005, C006, C009, C013, C014	C003
Likely	None	C001, C001a, C002, C013 and C014
Unlikely	C004, C008, C011	C004, C005, C006, C008, C009, C011
Absent	-	-
Not Fish Habitat (dry)	C007, C010, and C012	C007, C010, and C012

Notes:
Confirmed = fish presence confirmed (captured by fyke trap, electrofisher or gillnet)
Likely = suitable habitat is present, and the habitat is connected to habitat containing this species
Unlikely = no suitable habitat present and this habitat is not connected to habitat containing this species
Absent = substantial fishing effort expended, however, species not caught

Table 8.9 Summary of Catch Per Unit Effort for Fish Sampling in Streams

Major Sub-Watershed	Stream	Fishing Time (seconds)	Number of Fish Captured				Catch Per Unit Effort (# per 1000 seconds)			
			Brook Trout	Atlantic Salmon	Threespine Stickleback	All Species	Brook Trout	Atlantic Salmon	Threespine Stickleback	All Species
Victoria River Reservoir	(16) VicP2-VicLK	706	61	0	0	61	86	0	0	86
Victoria River Reservoir	(16) VicP2-VicLK	1,053	81	9	10	100	77	9	9	95
Victoria River Reservoir	VicP1-VicP2	388	0	0	0	0	0	0	0	0
Victoria River Reservoir	(17) VicP2-VicLK	769	0	0	5	5	0	0	7	7
Victoria River Reservoir	(15) Tributary	120	6	0	0	6	50	0	0	50
Victoria River	(12) Inlet to M1	No stream present at confluence with M1 at time of survey								
Victoria River	(8) M1 to M7	600	6	0	0	6	10	0	0	10
Valentine Lake	(20) ValLK-ValP2	927	0	0	5	5	0	0	5	5
Valentine Lake	(19) ValP1-ValP2	207	0	0	21	21	0	0	101	101
Valentine Lake	(21) ValLK-ValP2	844	50	9	1	60	59	11	1	71
Valentine Lake	(3) M3 to M2	114	0	0	0	0	0	0	0	0
Valentine Lake	(1) Outlet of ValP3	354	14	1	0	15	40	3	0	42
Valentine Lake	(4) Inlet to M4	138	0	0	2	2	0	0	14	14
Valentine Lake	(5) Outlet of M4	521	1	0	34	35	2	0	65	67
Valentine Lake	(2) ValP3 to M3	445	1	0	0	1	2	0	0	2
Valentine Lake	(1) ValP3-ValLK	338	20	2	0	22	59	6	0	65
Valentine Lake	(13) Unnamed Tributary to Valentine Lake	113	0	0	0	0	0	0	0	0
Victoria River	(14) C001/ Unnamed Tributary to Victoria River	780	34	0	0	34	44	0	0	44
Victoria River	(14) C001A/ Unnamed Tributary to Victoria River	280	11	0	0	11	39	0	0	39
Victoria River	(9) C002/ Outlet of M7	500	7	11	0	18	14	22	0	36
Victoria River	(11) C003/ Outlet of M8	663	5	9	1	15	8	14	2	23

Table 8.10 Summary of Catch Per Unit Effort, and Descriptive Statistics for Fish Sampling at Stream Crossings

Major Sub-Watershed	Stream	Total Fishing Effort (secs)	Average Catch Per Unit Effort (# per 1000 seconds)			
			Brook Trout	Atlantic Salmon	Threespine Stickleback	All Species
Victoria River	(14) C001	1,096	68	0	0	68
Victoria River	(14) C001A	280	39	0	0	39
Victoria River	(9) C002	635	7	15	0	22
Victoria River	(11) C003	814	14	7	1	22
Victoria River	C004	183	No fish present during 2011 or 2018 survey			
Victoria River	C005	776	3	46	0	49
Victoria River	C006	360	51	0	0	51
Victoria River	C007	No stream evident at this location				
Victoria River	C008	229	No fish present during 2011 or 2018 survey			
Victoria River	C009	561	1	0	0	1
Victoria River	C010	No fish sampling conducted as no stream present				
Victoria River	C011	No fish sampling conducted – not fish habitat				
Victoria River	C012	No fish sampling conducted as no stream present				
Victoria River	C013	729	3	4	0	7
Victoria River	C014	611	0	3	0	3

Population estimates based on quantitative electrofishing for all species of fish in the Aquatic Survey Area ranged from 33.9 fish per 100 m^2 to 38.6 fish per 100 m^2 and biomass for fish ranged from 29.6 g/100 m^2 to 240.6 g/100 m^2. The highest population estimate and biomass for fish was obtained in stream 8, with a catch comprised of brook trout and threespine stickleback. The lowest population estimate and biomass for fish was found in stream 20, which only contained threespine stickleback. Streams containing salmonids (e.g., brook trout and juvenile Atlantic salmon) had higher fisheries productivity than streams containing only threespine stickleback. Additional details on catch by species is provided in BSA.4, Attachment 4-C.

8.2.2.5 Species at Risk

There are no aquatic SAR known to occur with the Project Area, LAA or RAA. While American eel is listed as Threatened under COSEWIC, the species does not yet have a SARA designation (COSEWIC 2012). No American eel were captured during the field studies and no historical records indicate American eel presence in Victoria Lake Reservoir (Pippy 1966; Stantec 2012, 2019). American eel is found within the LAA and RAA upstream of the Red Indian Lake Dam (Cunjak and Newbury 2005).

8.2.2.6 Fisheries

Recreational salmon fishing occurs within the RAA, however only catch-and-release, Class 0 salmon rivers are present within the RAA. Class 0 rivers allow the catch and release of two sea run Atlantic salmon per day. The Exploits River has the highest runs of sea-run Atlantic salmon on the Island of Newfoundland (Veinott et al. 2018). In 2019, the angling effort for Atlantic salmon on the Exploits River was the highest of all the rivers on the Island (DFO 2020). Catch per unit effort on the Exploits River (1.8 fish per rod day) is within the range of other rivers on the Island (0 to 4.7 fish per rod day). The RAA comprises part of the Trout Angling Zone 1 and an outfitter operates within the RAA, offering guided land locked salmon and brook trout fishing tours on Red Indian Lake.

There are no known commercial fisheries in the area. There are no known Indigenous fisheries within the boundaries of the Fish and Fish Habitat LAA and RAA. Indigenous fishing activity in known to occur in other watercourses or waterbodies within 20 kilometers of the Project (Chapter 17 – Indigenous Groups). Fishing activity within the LAA and RAA is further discussed in Section 16.2.1.2 (Land and Resource Use).

8.3 ASSESSMENT CRITERIA AND METHODS

This section describes the criteria and methods used to assess environmental effects on fish and fish habitat. Residual environmental effects (Section 8.5) are assessed and characterized using criteria defined in Section 8.3.1, including direction, magnitude, geographic extent, timing, frequency, duration, reversibility, and ecological or socio-economic context. The assessment also evaluates the significance of residual effects using threshold criteria or standards beyond which a residual environmental effect is considered significant. The definition of a significant effect for Fish and Fish Habitat VC is provided in Section 8.3.2. Section 8.3.3 identifies the environmental effects to be assessed for fish and fish habitat, including effect pathways and measurable parameters. This is followed by the identification of potential

Project interactions with this VC (Section 8.3.4). Analytical assessment techniques used for the assessment of fish and fish habitat are provided in Section 8.3.5.

8.3.1 Residual Effects Characterization

Table 8.11 presents definitions for the characterization of residual environmental effects on fish and fish habitat. The criteria are used to describe the potential residual effects that remain after mitigation measures have been implemented. Quantitative measures have been developed, where possible, to characterize residual effects. Qualitative considerations are used where quantitative measurement is not possible.

Table 8.11 Characterization of Residual Effects on Fish and Fish Habitat

Characterization	Description	Quantitative Measure or Definition of Qualitative Categories
Direction	The long-term trend of the residual effect	**Neutral –** no net change in measurable parameters for fish and fish habitat relative to baseline **Positive –** a residual effect that moves measurable parameters in a direction beneficial to fish and fish habitat relative to baseline **Adverse –** a residual effect that moves measurable parameters in a direction detrimental to fish and fish habitat relative to baseline
Magnitude	The amount of change in measurable parameters or the VC relative to existing conditions	**Change in Fish Habitat Quality / Quantity** **Negligible –** no measurable change in habitat area (m^2) or monthly flows or habitat quality **Low –** a measurable change in habitat area or monthly flows or habitat quality that is within the range of natural variability **Moderate –** a measurable change in habitat area or monthly flows (<10%) or habitat quality that is greater than the range of natural variability, however, that does not affect the ability of fish to use this habitat to carry out one or more of their life processes **High –** a measurable change in habitat area or monthly flows (>10%) or habitat quality that is greater than the range of natural variability and large enough that fish can no longer rely on this habitat to carry out one or more of their life processes
		Change in Fish Health and Survival **Negligible –** no measurable change in the abundance or survival of local fish populations **Low –** a measurable change in the abundance or survival of local fish populations that is within the range of natural variability **Moderate –** a measurable change in the abundance or survival of local fish populations that is greater than the range of natural variability. however, does not affect the sustainability of fish populations **High –** a measurable change in abundance or survival of local fish populations that is greater than the range of natural variability and is large enough to potentially affect the sustainability of fish populations

Table 8.11 Characterization of Residual Effects on Fish and Fish Habitat

Characterization	Description	Quantitative Measure or Definition of Qualitative Categories
Geographic Extent	The geographic area in which a residual effect occurs	**Project Area –** residual effects are restricted to the Project Area **LAA –** residual effects extend into the LAA **RAA –** residual effects extend into the RAA
Frequency	Identifies how often the residual effect occurs and how often during the Project or in a specific phase	**Single event** **Multiple irregular event –** occurs at no set schedule **Multiple regular event –** occurs at regular intervals **Continuous –** occurs continuously
Duration	The period of time required until the measurable parameter or the VC returns to its existing (baseline) condition, or the residual effect can no longer be measured or otherwise perceived	**Short term –** residual effect restricted to construction or decommissioning, rehabilitation and closure phases **Medium term –** residual effect extends three to nine years (one to three generations of local salmonid species, based on fish being able to spawn at age 3 years) **Long term –** residual effect extends more than nine years (three generations) of local salmonid species or beyond the life of the Project **Permanent** – recovery to baseline conditions unlikely
Reversibility	Describes whether a measurable parameter or the VC can return to its existing condition after the project activity ceases	**Reversible –** the residual effect is likely to be reversed after activity completion and rehabilitation **Irreversible –** the residual effect is unlikely to be reversed
Ecological and Socio-economic Context	Existing condition and trends in the area where residual effects occur	**Change in Fish Habitat Quality / Quantity** **Undisturbed –** area is relatively undisturbed or not adversely affected by human activity **Disturbed –** area has been substantially previously disturbed by human development or human development is still present
		Change in Fish Health and Survival **Resilient –** VC populations are stable and able to assimilate the additional change **Not Resilient –** VC populations are not stable and are not able to assimilate the additional change because of having little tolerance to imposed stresses due to fragility or near a threshold

8.3.2 Significance Definition

For the purposes of this environmental assessment, a significant residual environmental effect on fish and fish habitat is defined as a Project-related environmental effect that results in:

- a Project-related HADD of fish habitat or the death of fish, as defined by the *Fisheries Act*, that cannot be mitigated, authorized or offset
- an unauthorized Project-related alteration of fish habitat

- a change to the productivity or sustainability of fish populations or fisheries within the LAA where recovery to baseline is unlikely

8.3.3 Potential Effects, Pathways and Measurable Parameters

Table 8.12 lists the potential Project effects on fish and fish habitat and provides a summary of the Project effect pathways and measurable parameters and units of measurement to assess potential effects. Potential environmental effects and measurable parameters were selected based on review of recent environmental assessments for mining projects in NL and other parts of Canada, comments provided during engagement, and professional judgment.

The potential environmental effect of a change in fish health and survival provides a means to evaluate section 34.4 of the *Fisheries Act* with respect to the death of fish. Fish habitat quality and quantity provide a means to evaluate section 35 of the *Fisheries Act* with respect to prohibitions for HADD. Potential environmental effects to fish and fish habitat are anticipated to occur in all phases of the Project, and the effect pathways are generally consistent across phases of the Project with a few exceptions (e.g., use of explosives and fishing pressure). The potential effects of environmental stressors on fish, fish habitat and fisheries are typically intertwined in that changes to the quality or quantity of fish habitat can influence fish populations and/or fisheries.

Table 8.12 Potential Effects, Effect Pathways and Measurable Parameters for Fish Habitat

Potential Environmental Effect	Effect Pathway	Measurable Parameter(s) and Units of Measurement
Change in fish habitat quality	• Alteration of riparian vegetation • Use of industrial equipment in or near water • Change in watershed area, water level or flow • Release of deleterious substances • Flooding of terrestrial vegetation • Mine waste / rock disposal • Wastewater management	• Habitat Suitability Index for fish (e.g., water depth, substrate, velocity, cover) • Water quality, including total suspended solids (TSS) (mg/L); dissolved oxygen (DO) (mg/L); water temperature (°C); pH; and trace metals • Monthly flows (m^3) and water level (m)
Change in fish habitat quantity	• Dewatering, infilling or road crossing installation • Fish passage issues • Change in watershed area, water level or flow	• Area (m^2) of lost habitat
Change in fish health and survival	• Use of industrial equipment in or near water • Placement of Project infrastructure (e.g., culverts) in water • Release of deleterious substances • Mine waste / rock disposal • Wastewater management • Use of explosives • Water extraction causing impingement • Increased recreational fishing pressure	• Abundance (numbers of fish) • Mortality (numbers of fish) • Sublethal effects to fish including reproduction and growth

8.3.4 Project Interactions with Fish and Fish Habitat

Table 8.13 identifies the physical activities that might interact with the VC and result in the identified environmental effect. These interactions are indicated by checkmark and are discussed in detail in Section 8.5, in the context of effects pathways, standard and project-specific mitigation/enhancement, and residual effects. Following the table, justification is provided for where no interaction (and therefore no resulting effect) is predicted.

Table 8.13 Project-Environment Interactions with Fish and Fish Habitat

Physical Activities	Environmental Effects to be Assessed		
	Change in Fish Habitat Quality	Change in Fish Habitat Quantity	Change in Fish Health and Survival
CONSTRUCTION			
Access Road Upgrade / Realignment: Where required, road widening and replacement / upgrades of roads and culverts.	✓	✓	✓
Construction related Transportation along Access Road	✓	–	✓
Mine Site Preparation and Earthworks: Clearing and cutting of vegetation and removal of organic materials, development of roads and excavation and preparation of excavation bases within the mine site, grading for infrastructure construction. For the open pits, earthworks include stripping, stockpiling of organic and overburden materials, and development of in-pit quarries to supply site development rock for infrastructure such as structural fill and road gravels. Also includes temporary surface water and groundwater management, and the presence of people and equipment on site.	✓	✓	✓
Construction / Installation of Infrastructure and Equipment: Placement of concrete foundations, and construction of buildings and infrastructure as required for the Project. Also includes: • Installation of water control structures (including earthworks) • Installation and commissioning of utilities on-site • Presence of people and equipment on-site	✓	✓	✓
Emissions, Discharges and Wastes[A]: Noise, air emissions / GHGs, water discharge, and hazardous and non-hazardous wastes.	✓	–	✓
Employment and Expenditures[B]	–	–	✓
OPERATION			
Operation-related Transportation Along Access Road	✓	–	✓
Open Pit Mining: Blasting, excavation and haulage of rock from the open pits using conventional mining equipment.	✓	✓	✓

Table 8.13 Project-Environment Interactions with Fish and Fish Habitat

Physical Activities	Environmental Effects to be Assessed		
	Change in Fish Habitat Quality	**Change in Fish Habitat Quantity**	**Change in Fish Health and Survival**
Topsoil, Overburden and Rock Management: Five types of piles: • Topsoil • Overburden • Waste rock • Low-grade ore • High-grade ore Rock excavated from the open pits that will not be processed for gold will be used as engineered fill for site development, maintenance and rehabilitation, or will be deposited in waste rock piles.	✓	✓	✓
Ore Milling and Processing: Ore extracted from the open pits will be moved to the processing area where it will either be stockpiled for future processing or crushed and milled, then processed for gold extraction via gravity, flotation and leach processes.	–	–	–
Tailings Management Facility: Following treating tails via cyanide destruction, tailings will be thickened and pumped to an engineered TMF in years 1 to 9, then pumped to the exhausted Leprechaun open pit in years 10 through 12.	✓	–	✓
Water Management (Intake, Use, Collection and Release): Recirculated process water and TMF decant water will serve as main process water supply, and raw water (for purposes requiring clean water) will be obtained from Victoria Lake Reservoir. Site contact water and process effluent will be managed on site and treated prior to discharge to the environment. Where possible, non-contact water will be diverted away from mine features and infrastructure, and site contact and process water will be recycled to the extent possible for use on site.	✓	✓	✓
Utilities, Infrastructure and Other Facilities • Accommodations camp and site buildings operation, including vehicle maintenance facilities • Explosives storage and mixing • Site road maintenance and site snow clearing • Access road maintenance and snow clearing • Power and telecom supply • Fuel supply	✓	–	✓
Emissions, Discharges and Wastes[A]: Noise, air emissions/GHGs, water discharge, and hazardous and non-hazardous wastes.	✓	–	✓
Employment and Expenditure[B]	–	–	✓

Table 8.13 Project-Environment Interactions with Fish and Fish Habitat

Physical Activities	Environmental Effects to be Assessed		
	Change in Fish Habitat Quality	Change in Fish Habitat Quantity	Change in Fish Health and Survival
DECOMMISSIONING, REHABILITATION AND CLOSURE			
Decommissioning of Mine Features and Infrastructure	✓	✓	✓
Decommissioning, Rehabilitation and Closure-related Transportation Along Access Road	✓	–	✓
Progressive Rehabilitation: Rehabilitating infrastructure or areas not required for ongoing operations (e.g., buildings, roads, laydown areas); covering and revegetating completed tailings areas, where practicable, including commencing closure of TMF beginning in Year 9 (when tailings deposition moves to Leprechaun open pit); erosion stabilization and re-vegetation of completed overburden and/or waste rock piles; infilling or flooding of exhausted mining areas; and completing revegetation studies and trials.	✓	–	✓
Closure Rehabilitation: Active rehabilitation based on successes of progressive rehabilitation activities. Includes: demolishing infrastructure (e.g., buildings, equipment, facilities, roads, laydown areas); grading and revegetating cleared areas, where practicable; breaching and regrading ponds to reestablish drainage patterns; completing closure of TMF (covering with overburden and revegetating); erosion stabilization and revegetation of completed overburden and/or waste rock piles; and infilling or flooding of open pits.	✓	✓	✓
Post-Closure: Long-term monitoring	–	–	–
Emissions, Discharges and Wastes[A]	✓	–	✓
Employment and Expenditures[B]	–	–	✓

Notes:
✓ = Potential interaction
– = No interaction
[A] Emissions, Discharges and Wastes (e.g., air, waste, noise, light, liquid and solid effluents) are generated by many Project activities. Rather than acknowledging this by placing a checkmark against each of these activities, “Wastes and Emissions” is an additional component under each Project phase
[B] Project employment and expenditures are generated by most Project activities and components and are the main drivers of many socio-economic effects. Rather than acknowledging this by placing a checkmark against each of these activities, “Employment and Expenditures” is an additional component under each Project phase

Avoidance measures will reduce potential direct interactions between Project components or activities and fish and fish habitat by physically relocating these components and activities away from fish and fish habitat, where practicable.

In the absence of mitigation, the Project may interact with fish and fish habitat in the following ways:

- Mine Site Preparation and Earthworks including clearing vegetation, stripping soils and grading for infrastructure construction may alter water quantity and quality related to runoff

- Construction / Installation of Infrastructure and Equipment including buildings, milling and processing plants, overburden stockpiles, waste rock piles, low-grade ore stockpiles, and high-grade ore stockpiles may result in indirect habitat loss due to a change in the quantity and quality of expected runoff
- Natural waterbodies may be lost as a result of open pit development at the Leprechaun and Marathon deposits, and through construction of other mine infrastructure; no direct habitat loss will occur due to mine waste disposal
- Construction-related Transportation Along the Access Road could result in suspended sediments from dust and the roadbed being carried into adjacent waterbodies, thereby affecting water quality; this interaction could also occur during operation and decommissioning, rehabilitation and closure
- Over the life of the Project, Employment and Expenditure could interact with fish health and survival if the presence of Project workers results in increased angling activity in the area
- Water Management, including contact water runoff and seepage, may affect water quantity and water quality
- Open Pit Mining will alter the surface water quantity and quality entering local watersheds; open pits will be dewatered during operation and allowed to fill during decommissioning, rehabilitation and closure
- For the Tailings Management Facility, discharges of surplus water via a treatment plant and polishing pond, and seepage through or beneath the TMF embankments, may affect surface water quality if not adequately contained or treated to acceptable standards prior to entering the receiving environment
- Progressive Rehabilitation and Closure Rehabilitation will alter water quantity and quality by changing runoff patterns, and by reducing the amount of exposed rock

The primary Project-related effects on fish and fish habitat will include the direct loss of fish habitat associated with pit development and the construction of mine infrastructure, changes to local drainage areas due to construction of stockpiles and open pits, dewatering during operation and flooding during closure of the open pits, and the introduction of treated contact water into the receiving environment through selected discharge points and indirectly through seepage.

The following Project activities and components are not expected to result in a change in fish habitat quality, quantity, or fish health and survival:

- Ore Milling and Processing during operation will occur on land, away from lakes and streams and will not interact with fish and fish habitat
- While the positive effects resulting from rehabilitation may continue following closure, the long-term post-closure monitoring activities during decommissioning, rehabilitation and closure are not anticipated to interact with fish and fish habitat in a substantive way

8.3.5 Analytical Assessment Techniques

Potential effects of the Project on fish and fish habitat were assessed quantitatively if information or model results were available, and qualitatively when information or model results were not available. Quantitative assessments included:

- GIS analysis of the Project footprint overlain on maps of watercourses and waterbodies to delineate potential habitat losses under the mine infrastructure using field measurements where available
- Comparison of water balance model predictions to baseline stream discharges in consideration of the federal "Framework for Assessing the Ecological Flow Requirements to Support Fisheries in Canada" (DFO 2013) to determine potential habitat loss associated with flow reduction
- Water Quality and Water Quantity Modelling Reports (Appendix 7A and 7B) to support the assessment of potential change in habitat quantity
- Assimilative Capacity Assessment (Appendix 7C) to determine the extent of potential change in habitat quality

Qualitative assessments were conducted using a weight-of-evidence approach. This entailed the use of professional judgement based on an understanding of the Project and potential effects, the habitat use and life history of potentially affected fish species in the LAA and RAA, and the likely effectiveness of mitigation measures, supported by scientific literature, industry best management practices, and regulatory guidelines, as available.

8.3.5.1 Assumptions and the Conservative Approach

Several assumptions were employed in the assessment of Project effects on fish and fish habitat, resulting in conservative predictions of residual effects:

- Substantial fishing effort was expended to determine if a given waterbody contained fish; when a fish species was confirmed present at a sampling location, that species was assumed present in all waters deemed to have connectivity to that location, unless a complete barrier to fish migration existed upstream and fish sampling confirmed the absence of that species upstream
- The most sensitive habitats, fish species and fish life stages were used to characterize potential effects to fish and fish habitat
- Predictions of change in fish habitat based on changes in hydrology and water quality used the conservative assumptions outlined in Section 7.3.5.3 (Surface Water Resources)

8.4 MITIGATION AND MANAGEMENT MEASURES

A series of environmental management plans will be developed by Marathon to mitigate the effects of Project development on the environment. A full list of mitigation measures to be applied throughout Project construction, operation and decommissioning, rehabilitation and closure is provided in Section 2.7.4. Project planning and design and the application of proven mitigation measures will be used to reduce adverse effects to fish and fish habitat. The following mitigation and standard practices in Table 8.14 will be used to reduce the potential for environmental effects of the Project on fish habitat, and fish health and survival. The mitigation measures below are recommended in consideration of the environmental effects pathways and include standard proven mitigation measures for sediment and erosion control, incorporate DFO standards and best management practices, and consider regulations and guidelines that govern fish and fish habitat protection.

Marathon has already completed some early mitigation with respect to potential effects of the Project on fish and fish habitat. Early in the EA process, and based on consultation with regulators, Indigenous groups, stakeholders, and DFO and ECCC in particular, Marathon completed a review and update of the Project design and layout to address specific concerns and issues raised. The following changes in the Project design and layout were implemented to, at least in part, reduce potential effects on fish and fish habitat:

- The overall footprint of the Project has been reduced, and the related potential effects on fish and fish habitat, via the removal of the heap leach pad and process and the Victory and Sprite deposits from the Project scope
- The TMF location alternatives study considered fish and fish habitat as a key aspect in the evaluation of location options
- The waste rock piles have been reconfigured, primarily to avoid fish habitat

Table 8.14 Mitigation Measures: Fish and Fish Habitat

Category	Mitigation	C	O	D
Site Clearing, Site Preparation and Erosion and Sediment Control	• Project footprint and disturbed areas will be limited to the extent practicable.	✓	-	-
	• Standard construction practices will be used, such as erosion and sediment control measures, placement and stabilization of excavated material, and seepage cutoff collars (pipes and culverts).	✓	-	-
	• Construction areas will be routinely monitored to identify areas of potential erosion and to apply appropriate mitigation. Progressive erosion and sediment control measures will be implemented, as required.	✓	-	-
	• Where waste rock will be used for site earthworks and grading during construction and operational development, necessary test work will be conducted to avoid potentially acid generating materials from being used in construction.	✓	-	-
	• Cross drainage will be maintained to allow water to move freely from one side of the road to the other in areas of permanent or temporary access roads.	✓	✓	-
	• Movement of equipment / vehicles will be restricted to defined work areas and roads, and specified corridors between work areas.	✓	✓	✓
Soil Management	• Soil stockpiles will be easily accessible, on well-drained ground, and away from bodies of water (minimum of 30 metres) and standing timber. A working space of at least 5 metres will be maintained around soil stockpiles.	✓	✓	-
	• Sediment control fences will be installed in areas where topsoil is exposed to erosion and siltation, such as slopes and embankments and approaches to stream crossings or water bodies. Sediment control fences will be inspected and maintained over the course of the construction phase until the disturbed area has stabilized and natural revegetation has occurred. Non-biodegradable materials used for Sediment control fences will be removed following revegetation.	✓	✓	✓

Table 8.14 Mitigation Measures: Fish and Fish Habitat

Category	Mitigation	C	O	D
Works In or Near Fish Habitat	• In-water work will be planned to respect DFO timing windows to protect fish in Newfoundland and Labrador (DFO 2019).	✓	-	-
	• Siting of Project infrastructure will be designed to avoid fish habitat to the extent practicable. Where Harmful Alteration, Disruption or Destruction (HADD) of fish habitat cannot be avoided, the habitat will be offset, as required by the *Fisheries Act*, through the development and implementation of a Fish Habitat Offsetting Plan.	✓	-	-
	• Waste material (i.e., organic waste material, waste rock or construction debris) material will be stabilized or contained.	✓	✓	✓
Works In or Near Fish Habitat	• Weather advisories will be followed, and work will be scheduled to avoid high precipitation and runoff events or periods, which could increase potential for erosion/sedimentation.	✓	-	✓
	• The duration of instream works will be minimized. In-water worksites will be isolated from flowing water (i.e., by using a cofferdam) to contain or reduce suspended sediment where possible. Clean, low permeability material and rockfill will be used to construct cofferdams. When possible, machinery will be operated above the high-water mark or inside of isolated areas.	✓	-	-
	• Minimum flows will be maintained in watercourses where practicable. Where HADD of fish habitat cannot be avoided, habitat alternation, disruption or destruction will be offset. New culverts will be sized appropriately and designed to be passable to fish to maintain fish passage as described in Chapter 2.	✓	-	-
	• Use of explosives in or near water will be avoided, however, if required, will follow DFO blasting guidelines.	✓	-	-
	• Best efforts will be made by a qualified environmental professional to relocate fish from areas of in-water works or areas of water drawdown to an appropriate location in the same watershed.	✓	-	-
	• Fish screens and/or other barriers will be installed and maintained to prevent fish from entering water withdrawal intakes.	✓	✓	✓
Air Emissions	• An Air Quality Management Plan will be developed and implemented as part of the EPP. The Air Quality Management Plan will specify the mitigation measures for the management and reduction of air emissions (including fugitive dust) during Project construction and operation.	✓	✓	✓
Vehicles / Equipment / Roads	• 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.	✓	✓	✓

Table 8.14 Mitigation Measures: Fish and Fish Habitat

Category	Mitigation	C	O	D
Site Water Management	• Marathon will implement a Water Management Plan (Appendix 2A) for the site which will incorporate standard management practices, including drainage control, excavation and open pit dewatering which collectively comprise the water management infrastructure currently designed as part of the Project scope (Section 2.3.5). The Water Management Plan provides detail on runoff and seepage collection strategies and systems (e.g., local seepage collection ponds, berms, drainage ditches, pumps) to collect and contain surface water runoff and groundwater discharge from major Project components (open pit, waste rock piles, TMF, ore stockpile and overburden storage areas, process plant) during climate normal and extreme weather conditions.	✓	✓	✓
	• Progressive water management will be implemented over the life of the mine. This includes construction of water management infrastructure as an area is developed and decommissioning / rehabilitation of water management infrastructure as an area is decommissioned.	✓	✓	✓
	• Existing drainage patterns will be maintained to the extent feasible with the use of culverts and bridges.	✓	✓	-
	• Project water storage features (i.e., sedimentation ponds) will be used to attenuate peak discharges to the environment.	✓	✓	✓
	• Precipitation runoff from waste rock piles and other developed areas of the site will be collected via ditches and channels and directed to downstream sedimentation ponds.	✓	✓	-
	• Site ditching will be designed to reduce erosion and sedimentation through use of rock check dams, silt fences, plunge pools, and grading as appropriate.	✓	✓	✓
	• Snow will be cleared from ditches prior to the spring thaw, as practicable, to maintain the designed capacity of ditches and ability to convey surface runoff.	✓	✓	-
	• Culverts will be inspected periodically to remove accumulated material and debris upstream and downstream of the culverts.	✓	✓	✓
	• 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.	✓	✓	✓
	• Non-contact water will be diverted away from developed areas, where possible. Channels and berms will be constructed around the crest of the open pits or uphill of waste rock piles and other developed areas to divert natural precipitation and surface runoff away from contact with mining operations, where practicable.	✓	✓	✓

Table 8.14 Mitigation Measures: Fish and Fish Habitat

Category	Mitigation	C	O	D
Site Water Management	• 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.	-	✓	-
	• Pond inlet and outlet structures will be configured to reduce inlet velocity and scour, and to meet sedimentation requirements. Pond outlets will be designed with subsurface inlets to mitigate against chemical stratification in ponds, thermal heating of discharge and ice blockage of outlets.	✓	✓	✓
	• Contact water sedimentation ponds will be designed to provide onsite storage of local runoff with the size and residence times designed to provide sediment removal to meet the MDMER effluent total suspended solids criterion of 15 mg/L (monthly mean concentration limit), with removal of particles down to 5 micron (μ) in size for up to the 1:10 Annual Exceedance Probability (AEP) flows.	✓	✓	✓
	• Sedimentation ponds will be designed to contain (without discharge) runoff resulting from storm events up to the 1:100 year AEP with spring snowmelt event, including emergency spillways and maintaining minimum freeboard of 0.5 m. The emergency spillways will accommodate flows up to the 1:200 AEP flow.	✓	✓	✓
	• Sedimentation ponds will be designed with 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 to protect the collection ponds.	✓	✓	✓
	• Effluent will be treated prior to discharge to the receiving water environment, as required, to meet regulatory effluent criteria as well as criteria developed through the receiving water Assimilative Capacity Assessment (Appendix 7C).	✓	✓	✓
	• Effluent discharge rates will be maintained to below the highest rate used in the Assimilative Capacity Assessment (Appendix 7C).	✓	✓	✓
Tailings Management	• The dams required for the tailings impoundment will be designed, constructed, operated and closed in accordance with the Canadian Dam Association (CDA) and Mining Association of Canada guidelines, Global Industry Standards on Tailings Management, as well as all applicable provincial requirements.	✓	✓	✓
	• 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.	✓	✓	✓

Table 8.14 Mitigation Measures: Fish and Fish Habitat

Category	Mitigation	C	O	D
Tailings Management	• Shallow groundwater seepage from the TMF will be intercepted by seepage collection ditches and pumped back to the TMF via sump pumps.	✓	✓	✓
	• Cyanide detoxification within the mill using the sulphur dioxide / air oxidation process will result in the degradation of cyanide and precipitation of metals prior to discharge to the TMF.	-	✓	-
	• 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.	-	✓	-
	• As required by MDMER, a tailings / effluent emergency response plan will be developed, which will outline how a failure or malfunction of the TMF resulting in a release of tailings or tailings effluent will be managed.	-	✓	-
Materials Handling and Waste Management	• Sewage effluent will be treated and monitored in accordance with the NL *Environmental Control Water and Sewage Regulations* 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.	✓	✓	-
	• 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.	✓	-	-
	• Reagents will be stored and handled within containment areas designed to hold more than the content of the largest tank, in the event of a leak or spill. Where required, each reagent system will be located within its own containment area to avoid mixing of incompatible reagents. Storage tanks will be equipped with level indicators, instrumentation, and alarms to prevent spills.	-	✓	-
	• Fuel will be obtained from a licensed contractor who will be required to comply with federal and provincial regulations including federal *Sulphur in Diesel Fuel Regulations*, and provincial *Storage and Handling of Gasoline and Associated Products Regulations.*	✓	✓	✓
	• Fuel and hazardous materials storage on site will be a minimum of 200 m from a salmon river or tributary and 100 m from other waterbodies.	✓	✓	✓
	• Disposal and handling of waste oils, fuels and hazardous waste will be as recommended by the suppliers and/or manufacturers in compliance with federal, provincial and municipal regulations.	✓	✓	✓

Table 8.14 Mitigation Measures: Fish and Fish Habitat

Category	Mitigation	C	O	D
Materials Handling and Waste Management	• Fuels and lubricants will be stored according to regulated containment methods in designated areas. Refueling, servicing, and equipment and waste storage will not take place within 30 m of watercourses to reduce the likelihood that deleterious substances will enter watercourses. Spill kits will be maintained at locations on-site during all Project phases.	✓	✓	✓
Employment and Expenditures	• Hunting / fishing / harvesting of wildlife will be strictly prohibited on the mine site. Workers will not be permitted to hunt / fish / harvest while staying at the accommodations camp and will not be permitted to bring firearms or angling gear to site.	✓	✓	✓
Rehabilitation and Closure	• Marathon will develop a Rehabilitation and Closure Plan that meets the requirements of the NL Department of Industry, Energy and Technology, Department of Environment, Climate Change, and Municipalities, and Department of Fisheries, Forestry and Agriculture. The plan will be reviewed and updated regularly until implemented.	✓	✓	✓
Rehabilitation and Closure	• At closure, following water quality testing, sedimentation ponds will be breached to allow drainage to the surrounding areas. These features will then be graded, contoured to re-establish drainage patterns and revegetated as required.	-	-	✓
	• Pre-mining site drainage patterns will be re-established to the extent practicable.	-	-	✓
	• Passive water quality treatment technologies will be employed, where and if required, for closure / post-closure including engineered wetlands to treat site seepage and runoff, as practicable.	-	-	✓
Notes: C – Construction Activities O – Operation Activities D – Decommissioning, Rehabilitation and Closure Activities				

8.5 ASSESSMENT OF ENVIRONMENTAL EFFECTS ON FISH AND FISH HABITAT

For each potential effect identified in Section 8.3.3, specific Project activities that may interact with the VC and result in an environmental effect (i.e., a measurable change that may affect the VC) are identified and described. The following sections first describe the pathways by which a potential Project effect could result from Project activities (i.e., the Project-effect pathway) during each Project phase (i.e., construction, operation and decommissioning, rehabilitation and closure). Mitigation and management measures (Section 8.4) are proposed to avoid or reduce these potential pathways and resulting environmental effects. Residual effects are those remaining following implementation of mitigation, which are then characterized using the criteria defined in Section 8.3.1. A summary of predicted residual effects is provided in Section 8.5.

8.5.1 Change in Fish Habitat Quantity

8.5.1.1 Project Pathways

Construction

Placement of infrastructure and equipment in streams or lakes may result in a direct loss of fish habitat and reduce the available habitat for fish to carry out their life processes. The development of the Leprechaun and Marathon open pits and the construction of other mine infrastructure and equipment may result in the direct loss of pond and stream habitat. The construction of these mine features may also result in an indirect loss of fish habitat due to a reduction in stream flows associated with pond loss and changes in drainage area or flow patterns.

Road development and upgrades could reduce the quantity of fish habitat if there is a direct footprint in the habitat. Stream crossings have the potential to result in an obstruction to fish passage if not properly designed, which could limit access to upstream habitats that are required to carry out life processes (Khan and Colbo 2008; Dunham et al. 1997).

Operation

Excavation and dewatering activities associated with operation of the open pits can lower groundwater elevations and change groundwater discharge to local waterbodies, resulting in the alteration or loss of fish habitat by reducing flow in streams and water levels in ponds.

Indirect losses of fish habitat may also occur due to upstream changes in the timing, duration and frequency of stream flows that may result from changes in watershed area or changes in water management.

Water extraction from Victoria Lake Reservoir may be required for mine operation, which could affect fish habitat quantity by lowering water levels, thereby removing fish habitat.

Decommissioning, Rehabilitation and Closure

Changes to fish habitat quantity could occur during flooding of the open pits due to alterations of groundwater and surface water flows, which could affect geomorphology, water velocity, habitat type (e.g., riffles, runs), wetted channel perimeter and water quality (e.g., temperature). Filling of the open pits using diversion of site contact water, groundwater and water extracted from lakes could affect fish habitat quantity by reducing surface water flows and stream flows that affect wetted area and flow type.

8.5.1.2 Residual Effects

The residual effects on fish habitat quantity and quality are dependent on the results of the assessment of Project effects on Surface Water Resources (Chapter 7). For Surface Water Resources, residual effects for construction and operation were considered together, as changes to surface water quantity are anticipated to be minimal through construction activities, with the largest changes captured during the operation phase. In addition, as the primary concern related to this effect is loss of fish habitat, all Project phases have been assessed together to determine the total predicted extent of HADD, irrespective of Project phase.

Pathways that affect fish habitat quantity as outlined in 8.5.2.1 are related to pit development, direct placement of infrastructure in fish habitat, changes to watershed areas, fish passage, and water extraction.

The Project has been designed to avoid loss of fish habitat through careful planning of the placement of infrastructure and shifting locations of activities away from waterbodies. Where avoidance was not feasible, mitigation will be employed to reduce the potential for effects as described below. Residual Project-related effects to fish habitat quantity are reduced through the application of best practices in accordance with DFO's "Measures to Protect Fish and Fish Habitat". The installation of water crossing structures at road crossings will be conducted and designed to allow fish passage. When working near water, DFO standards and codes of practice will be used to reduce the potential for change in fish habitat quantity.

Where residual adverse effects remain, these must be counterbalanced by offsetting through an authorization pursuant to the *Fisheries Act*. A cautionary approach to offsetting will be taken in developing a Fish Habitat Offsetting Plan to account for uncertainty in predicting the loss of fish habitat; it will aim for a net gain of fish habitat. The Fish Habitat Offsetting Plan will take into account input from consultation and engagement, and will be developed and implemented in consultation with DFO and in consideration of the "Policy for Applying Measures to Offset Adverse Effects on Fish and Fish Habitat Under the Fisheries Act" (DFO 2019).

The Fish Habitat Offsetting Plan will address the direct loss (destruction) of fish habitat associated with:

- Dewatering and excavation of the Leprechaun and Marathon open pits
- Placement of the water intake pipe and/or effluent diffuser in Victoria Lake Reservoir
- Placement of pipes or diffusers in streams or lakes associated with sedimentation ponds
- Placement or extension of culverts or other water crossing structures during access and site road development and upgrading
- Placement of Project components and infrastructure in streams and waterbodies. Note, direct loss at Stream 14 under the TMF is associated with the tailings dam only

The Fish Habitat Offsetting Plan will also address the indirect loss (harmful alteration or disruption) of fish habitat associated with:

- Loss of flow resulting from the direct loss of fish habitat upstream
- Changes in flow due to changes in watershed area
- Changes in flow due to water management (e.g., pit infilling, sedimentation ponds)

Changes to stream flow may occur in all Project phases. As described in Chapter 7 (Surface Water Resources), changes in stream flow are anticipated during construction due to changes in watershed area and the direct loss of fish habitat upstream. During operation, changes in flow are anticipated due to water management through Project components. During closure, changes in flow are anticipated due to infilling of the open pits and as some watersheds are restored to pre-development conditions post-closure.

Streams with changes in mean annual flow (MAF) of less than 10% were considered to not result in adverse effects to fish habitat. While some streams are anticipated to have reductions in flow, a few streams may have increased flow as a result of increased discharge via sedimentation ponds or changes in watershed area. These flows will be attenuated through the sedimentation ponds to reduce peaks and extend baseflows during low flow periods, as described in the Water Management Plan (Appendix 2A). Attenuated flows from the sedimentation ponds that result in an increase in stream flow may result in a small localized positive effect of the Project on fish habitat. Increased stream flow may increase habitat quality, primary and secondary productivity, and fisheries productivity, thereby increasing the quantity of suitable fish habitat.

Streams with decreases in MAF greater than 10% were considered to result in adverse effects to fish habitat. The effects to fish habitat were predicted to be greatest during the summer low flow period when stream discharges are typically below 30% of MAF. For streams and ponds, adverse effects to fish and fish habitat are anticipated as a result of decreases in stream flows during construction and operation, or decommissioning, rehabilitation and closure. Streams experiencing indirect loss are anticipated to continue to support fisheries at a reduced level of productivity for the duration of the Project. These streams will likely be less productive and contain primary (e.g., periphyton) and secondary (e.g., benthic invertebrates) producers, representative of low flow headwater communities. Pre-development, many of the Project Area streams are small headwater streams with intermittent flows during the summer low flow period, which may currently limit primary, secondary and fisheries productivity. The magnitude of changes in MAF through the various Project phases in comparison to pre-development conditions for each watershed are described in more detail in Chapter 7.

A summary of the anticipated direct and indirect loss of fish habitat due to the Project is provided in Table 8.15, and areas of predicted habitat loss are shown on Figure 8-12.

Table 8.15 Summary of Anticipated Loss of Fish Habitat Quantity (Direct and Indirect) in the LAA during All Project Phases

Loss	Type of Loss	Feature	Location	Amount (m^2)
Direct	Destruction	Ponds	VicP1, VicP2, M1, ValP1	79,498
Indirect	Harmful Alteration or Disruption	Ponds	VicP2, M1	55,403
Direct	Destruction	Lakes	Victoria Lake Reservoir	4,000
Direct	Destruction	Streams	Site and Access Roads, 8, 14	6,801
Indirect	Harmful Alteration or Disruption	Streams	3, 4, 5, 8, 13, 14, 15, 16, 26, 32, 33 and Outlet of Valentine Lake	41,003
Total				**186,705**
Note: Direct loss at Stream 14 under the TMF is associated with the tailings dam only				

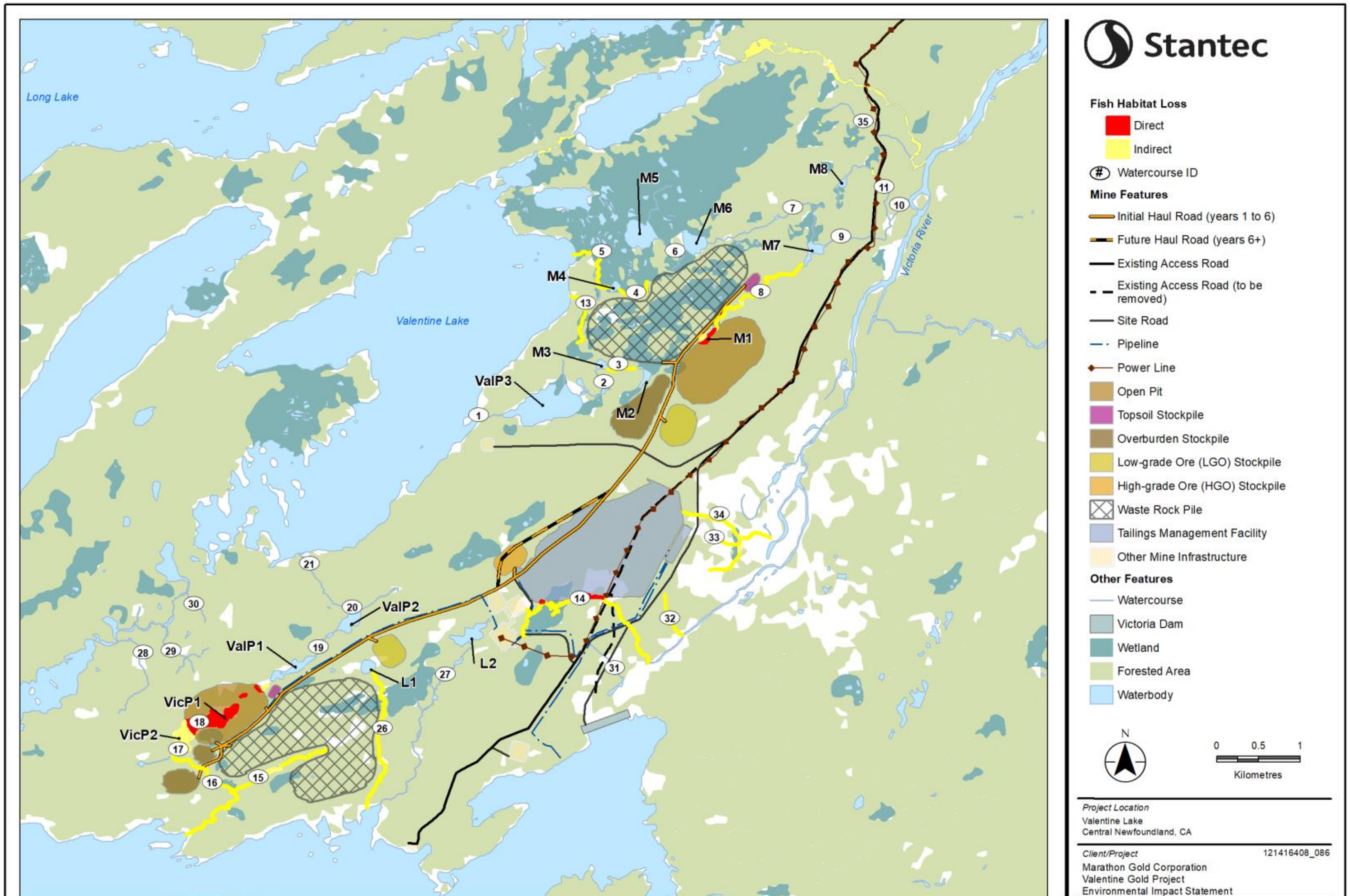

Figure 8-12 Fish Habitat Loss

With standard mitigation, and based on the existing Project design, the Project is conservatively anticipated to result in the direct and indirect loss of 186,705 m^2 of fish habitat within the LAA. The potential HADD associated with the access road has not yet been determined. Of the fish habitat lost, 30% is used by salmonids to carry out their life processes, with the remaining 70% used by sticklebacks. The HADD of fish habitat will occur during site construction in 2022, during operation, and during decommissioning when the open pits are being flooded.

The Fish Habitat Offsetting Plan will be developed in consultation with DFO and submitted to DFO as part of the *Fisheries Act* Authorization process, and will be implemented to counterbalance the loss of fish habitat in the LAA, such that no significant residual effects to fish habitat are anticipated. The quantity of fish habitat offset will be based on the quantity and quality of fish habitat lost within the Project Area. Should the location of Project components shift, the loss of the habitat associated with the Project may be revised, as required, and the offset adjusted accordingly.

8.5.1.3 Summary

Project-related components and activities will result in direct and indirect loss of fish habitat, some of which will be permanent. This fish habitat supports SAR and species which contribute to recreational fisheries. This will be counterbalanced through a Fish Habitat Offsetting Plan for the Project; however, adverse effects are predicted. The magnitude of effects is considered moderate based on the amount of direct and indirect loss of fish habitat. Effects to fish habitat are not expected to affect sustainability and productivity of the fisheries, and fish habitat loss will be offset with habitat of similar quality, and equal or higher quantity. Habitat loss will be within the Project Area. Habitat will be permanently lost in some areas and indirect losses will occur for the long term and be continuous throughout the Project phases. While the loss of fish habitat is permanent and irreversible in some areas, areas of indirect loss may be reversible post-closure. Given that the local area has been subject to disturbance from historical activities, the ecological and socio-economic context of effects will occur within disturbed areas.

With careful Project planning and implementation of proven standard mitigation measures to protect fish habitat quantity and given the conservative "worst-case scenario" approach, residual, adverse Project effects during all Project Phases will be adverse. The effects are anticipated to be moderate in magnitude, long-term in duration, continuous in frequency and irreversible. However, effects occur within the Project Area, and occur within a disturbed area.

8.5.2 Change in Fish Habitat Quality

8.5.2.1 Project Pathways

Construction

Several Project-related activities could affect fish habitat quality during mine site preparation and earth works including the use of industrial equipment, vegetation clearing, excavating and grading near streams or lakes, access road upgrades, construction and installation of infrastructure and equipment, and water and effluent management. These activities can increase the potential for change in stream flow, runoff, sedimentation, and the introduction of deleterious substances into fish habitat.

The timing of construction can also influence the potential environmental effects of the Project on fish habitat quality. For example, conducting instream work during high flow or increased rainfall can increase the potential for runoff and the amount of sediment entering fish habitat. The effect of increased sediment reaching fish habitat may be compounded if it occurs during the spawning, incubation or hatching period of a fish species (DFO 2019).

An increase in erosion due to removal of riparian vegetation or topsoils, exposed soils, changing slopes or drainage patterns could affect fish habitat quality by depositing sediment in fish habitat, thus reducing habitat quality (e.g., siltation of spawning beds) (Greig et al. 2007; Wood et al. 1997; Kemp et al. 2011). Removal of riparian vegetation may reduce shade and/or increase nutrient and energy inputs, which could affect water quality, in turn affecting the quality of fish habitat through changes in temperature and food availability (i.e., primary and secondary productivity) (Zalewski et al. 2001). In addition, changes in stream flow due to loss of watershed area or a direct loss of fish habitat upstream can impact streamflow and therefore affect habitat suitability or quality. During construction of the TMF, flooding of organic soils or terrestrial vegetation may result in release of methylmercury to waterbodies which, if untreated, has the potential to affect habitat quality.

Construction-related transportation along the access road could result in suspended sediments from dust and roadbed being carried into adjacent waterbodies, thereby affecting water quality. Machinery coming into contact with water could introduce deleterious substances (e.g., oil, fuel) into streams, lakes and ponds during mine site preparation and earth works, and access road upgrade. The use of industrial equipment in or near fish habitat can also result in sedimentation and direct alteration of fish habitat such that habitat quality is reduced (Sweka and Hartman 2001; Herbert and Merkens 1961; Kjelland et al. 2015).

During construction of sedimentation ponds, discharges into the aquatic environment could affect fish habitat quality if suspended sediments and/or contaminants are released, which could affect the suitability of habitat for fish, SAR or fisheries (Sweka and Hartman 2001; Herbert and Merkens 1961; Kjelland et al. 2015). Once constructed, sedimentation ponds will capture runoff and release treated discharge to streams towards Victoria Lake Reservoir, Valentine Lake and Victoria River.

Operation

Transportation along the access road, site roads and haul roads during operation could result in suspended sediments from dust and roadbed being carried into adjacent waterbodies, thereby affecting water quality.

Runoff from overburden and waste rock piles could affect water quality and thereby affect fish habitat quality (Jennings et al. 2008). Open pit mining may alter the quality of surface water and ground water entering local watersheds, resulting in a reduction in water quality and consequently habitat quality.

Discharge to the aquatic environment from sedimentation ponds and the TMF may affect fish habitat quality through the addition of deleterious substances and contaminants (e.g., metals, cyanide, nutrients), and/or changes in water temperature, which could affect the suitability of fish habitat. Effluent discharged from the TMF into Victoria Lake Reservoir could affect thermal stratification if released near the thermocline, thereby affecting mixing and quality of fish habitat. During operation, changes in flow are anticipated due to water management through Project components, which can affect water quality and, therefore, habitat quality.

Decommissioning, Rehabilitation and Closure

Transportation along the access road and site roads during decommissioning, rehabilitation and closure could result in suspended sediments from dust and roadbed being carried into adjacent waterbodies, thereby affecting water quality.

Changes to fish habitat quality could also occur during flooding of the open pits due to alterations of groundwater and surface water flows, which could affect geomorphology, water velocity, habitat type (e.g., riffles, runs), wetted channel perimeter and water quality. Filling of the open pits using diversion of site contact water, groundwater, and water extracted from lakes or ponds could affect fish habitat quality and quantity by reducing surface water flows and stream flows, which in turn could affect wetted area and flow type, and potentially temperature. The release of point source and non-point source discharges could affect fish habitat quality due to the introduction of contaminants, nutrients, changes in water temperature, and changes in dissolved oxygen concentration.

Following closure, pit lakes are expected to become stratified and waters in the bottom layers may become anoxic and contain high concentrations of dissolved trace metals. If the pit lake turns over such that the water column becomes vertically mixed, the surface water that discharges may affect fish habitat quality in the receiving environment due to lower levels of dissolved oxygen and elevated concentrations of metals.

8.5.2.2 Residual Effects

Construction and Operation

The residual effects on fish habitat quantity and quality are dependent on the results of the assessment of Project effects on Surface Water Resources (Chapter 7). For Surface Water Resources, residual effects for construction and operation were considered together, as changes to surface water quality are anticipated to be minimal through construction activities, with the greatest changes occurring during the operation phase. The assessment of residual effects on fish habitat quality has therefore taken a similar approach.

Pathways that affect fish habitat quality as outlined in 8.5.1.1 are related to surface runoff from areas of disturbance, direct discharges of wastewater to waterbodies, changes to watershed areas, and work within water.

The Project has been designed to avoid these pathways to the extent practicable through shifting the placement of infrastructure and locations of activities away from waterbodies. Where avoidance is not feasible, mitigation (Table 8.14) will be used to reduce the potential for effects as outlined below. When working near water, interactions for fish and fish habitat are well known and documented, and DFO standards and codes of practice will be followed. Consequently, with the application of best practices in accordance with DFO's *Measures to Protect Fish and Fish Habitat,* residual Project related effects are anticipated to be low in magnitude for fish habitat quality.

The assessment of residual Project-related effects to fish habitat quality as a result of emissions, discharges and wastes released into the aquatic environment are reliant on the results of the Assimilative Capacity Assessment (Appendix 7C) completed in support of the Surface Water Resources VC (Chapter 7).

During the operation and closure phases, residual Project-related effects to the quality of fish habitat are anticipated to occur due to changes in water quality from discharge of effluent containing contaminants above the CWQG-FAL into streams or lakes. Water-based discharges will be managed and treated to meet authorized limits prior to discharge. Sublethal effects that could compromise fish health are not expected if parameters in effluent meet the CWQG-FAL at the discharge point, or within a short distance of mixing in the receiving environment. Five years of water quality monitoring post-closure is currently planned, as described in the Water Management Plan (Appendix 2A). Following the results of the water quality monitoring, adaptive management, including additional monitoring or mitigation, may be implemented as required. An EEM program will also be implemented in accordance with the MDMER, including during the closure phase.

The assimilative capacity of watercourses to receive discharge from sedimentation ponds is limited for aluminum and iron, because these parameters are already elevated above the CWQG-FAL as a baseline condition. In general for the regulatory scenario (i.e., "worst case"), the Assimilative Capacity Assessment (Appendix 7C) suggests that all parameters except WAD cyanide will exceed the CWQG-FAL 100 and 250 m downstream of the effluent discharge points within stream receiving environments. These parameters are predicted to generally meet the guidelines within 100 m of mixing within a larger receiving body (i.e., Victoria Lake Reservoir, Valentine Lake) for the majority of sedimentation pond discharge points. Water quality monitoring will be conducted during construction and operation to verify these assumptions.

With regards to the outflow from the polishing pond during operation, the capacity of Victoria Lake Reservoir to assimilate aluminum and iron is limited because these parameters are elevated above the CWQG-FAL as a baseline condition. Assimilative capacity modelling (described in Chapter 7) suggests that copper, lead and zinc, will exceed the CWQG-FAL during operation at 100 m and generally meet the CWQG-FAL within 300 m of mixing within Victoria Lake Reservoir for the regulatory scenario. For the normal operating scenario all parameters will be below CWQG-FAL during operation at 100 m. Water quality monitoring will be conducted during operation to verify these assumptions, and adaptative management strategies may be implemented as required.

Residual effects on the quality of fish habitat from Project effluents and discharges are anticipated to be negligible to low, as these will be authorized and in compliance with applicable regulatory requirements. Biological monitoring programs (EEM) will be established to assess potential effects to fish, benthic invertebrates and fish habitat, including water quality and sediment quality. A Water Management Plan will be followed and modified if required using an adaptive management process.

Residual Project-related effects to fish habitat quality from methylmercury production in organic soils or terrestrial vegetation (resulting from flooding the TMF) are anticipated to be negligible to low. Prior to flooding, vegetation in the TMF will be cleared to reduce the potential for methylmercury production. The tailings will cover the base of the TMF early in the operation phase. Water collected in the TMF will be treated prior to release to meet authorized limits. If methylmercury production occurs, it is anticipated to peak in the first two years following anaerobic inundation and is predicted to return to pre-existing levels approximately 10 years later (St. Louise et al. 2004). The TMF will also have a seepage collection system that cycles seepage back to the TMF, thus mitigating potential concerns and reducing effects on fish habitat quality.

Changes to stream flow may occur in all Project Phases, as described in Section 8.5.1 in relation to change in habitat quantity. These changes in habitat quantity can result in indirect effects to habitat quality.

Decommissioning, Rehabilitation and Closure

Seepage from the TMF is predicted to have exceedances of the CWQG-FAL for copper and cyanide WAD once mixed with Victoria River. Water quality monitoring will be conducted to verify these assumptions, and adaptative management strategies may be implemented as required.

Given their depth, pit lakes are expected to be stratified following closure, with the deepest stratified layer (i.e., hypolimnion) expected to be anoxic and containing elevated levels of dissolved metals. The surface water layer (i.e., epilimnion) is expected to be well oxygenated and will be discharged from the pit lakes to streams post-closure, once the water quality discharge limits are met.

Outflowing water from the Leprechaun pit lake is predicted to meet MDMER for the parameters of potential concern during closure. Exceedances of the CWQG-FAL are predicted for aluminum, copper, zinc, ammonia, unionized ammonia, fluoride and sulphate (Appendix 7C). The discharge is expected to meet the CWQG-FAL following mixing in Victoria Lake Reservoir.

Based on the groundwater flow model (Appendix 6A) and following closure, groundwater seepage (non-point) from the Leprechaun waste rock pile is predicted to resurface in Victoria Lake Reservoir. The seepage water quality is anticipated to exceed the CWQG-FAL for parameters of potential concern including aluminum, arsenic, cadmium, copper, iron, lead, manganese, zinc, fluoride and sulphate. The seepage is expected to mix with the Victoria Lake Reservoir.

The outflowing water from the Marathon pit lake is predicted to meet MDMER for the parameters of potential concern during closure. Exceedances of the CWQG-FAL are predicted for aluminum, and copper at the overflow of the pit. The discharge is expected to meet CWQG-FAL following mixing with the Victoria River. Based on the groundwater flow model (Chapter 6), post-closure groundwater seepage (non-point) from the Marathon waste rock piles is predicted to resurface in Victoria River. The seepage water quality is anticipated to exceed the CWQG-FAL for aluminum, copper fluoride following mixing with Victoria River.

Given that discharge is predicted to meet MDMER limits for parameters of potential concern, residual adverse effects on fish habitat quality resulting from release of deleterious substances during this phase are anticipated to be negligible to low.

8.5.2.3 Summary

Several Project-related activities could affect fish habitat quality, which includes habitat that supports SAR and species which contribute to recreational fisheries. Discharge of treated effluent and non-point source contributions will result in localized, Project-related increases in concentrations of potential contaminants to levels that could affect fish habitat; therefore, potential adverse effects are predicted. Given the geographic range of fish, long-term exposure is not anticipated. Although concentrations of specific parameters may exceed applicable guidelines at some locations, effects to fish habitat are not expected to affect sustainability and productivity of recreational fisheries. The magnitude of effects will, therefore, be low. Effects will occur within the LAA. Concentrations of potential contaminants from treated effluent at discharge points are expected to decrease rapidly within the mixing zones, such that effects to fish habitat should have a limited spatial extent within the LAA (i.e., in relatively close proximity to discharge locations). Likewise, non-point sources of potential contaminants would be localized. The duration of effects is predicted to be long term and continuous, given that contributions of potential contaminants of concern will occur continuously throughout all Project phases. The potential effects are considered irreversible because there may be localized exceedances of guidelines established for the protection of aquatic life that continue following active closure. Finally, given that the local area has been subject to disturbance from historical activities, the ecological and socio-economic context of effects will occur within disturbed areas.

In summary, with careful Project planning and implementation of proven standard mitigation measures to protect fish habitat quality, and given the conservative worst-case scenario approach, residual, adverse Project effects during all Project Phases will be adverse. The effects are anticipated to be low in magnitude, long-term in duration, continuous in frequency and irreversible. However, effects occur within the LAA, and within a disturbed area.

8.5.3 Change in Fish Health and Survival

8.5.3.1 Project Pathways

Construction

Several Project-related activities could affect fish health and survival during mine site preparation and access road works. In general, effects to fish habitat quality and quantity can also affect fish health and survival.

As indicated in Section 8.5.2.1, the timing of construction could influence the environmental effects of the Project on fish health and survival, hence work should be conducted outside of the DFO timing windows for the Island of Newfoundland, to protect fish and avoid direct mortality of fish larvae or eggs (DFO 2019). Fish survival could also be affected by dewatering of areas for in-water works (e.g., culvert installations, construction of infrastructure) or areas of passive water drawdown resulting from pumping the open pits (DeBoer et al. 2016; Benejam et al. 2008). Fish health and survival could be affected directly or indirectly through injury due to industrial equipment working in or near streams and ponds, and also could be affected if fish passage to essential habitat (e.g., for rearing, spawning) becomes blocked (Khan and Colbo 2008; Dunham et al. 1997).

Introduction of sediments and contaminants from point sources and non-point sources into fish habitat could affect fish health and survival. Conducting work during periods of high rainfall could lead to siltation events, which could inhibit the ability of fish to forage and cause behavioural or physiological changes in fish and smothering of eggs (Sweka and Hartman 2001; Herbert and Merkens 1961; Kjelland et al. 2015). Fish eggs and larvae have been shown to be the life stage most sensitive to increased sedimentation through the reduction of water flow and oxygen delivery to eggs (Greig et al. 2007; Wood et al. 1997; Kemp et al. 2011). Introduction of deleterious substances (e.g., grease, fuel) from machinery operating in or near waterbodies could also affect fish health and survival.

Removal of riparian vegetation during road work and mine site preparation could affect fish health due to changes in shade, protective cover, and/or external nutrient/energy inputs (Zalewski et al. 2001). Changes in fish habitat may affect predation rates, alter water temperature to exceed species specific thermal tolerances, or affect primary and secondary productivity upon which fish rely as food sources (Zalewski et al. 2001).

The use of explosives in or near water during mine site preparation, and earthworks and access road upgrade could result in instantaneous changes in pressure, and changes to fish health and survival through injury or instantaneous death.

Improved road access to the Project Area and more workers on site during construction may result in an increase in recreational fishing that could cause increased pressures on fish populations.

Operation

A change in fish health and survival could result from the introduction of sediments or contaminants from surface water runoff due to access road maintenance, overburden and rock management, and water management, which could result in lethal or sublethal effects to fish.

The use of explosives in or near water during open pit mining has the potential to cause sudden changes in pressure and result in changes to fish survival through injury or instantaneous death.

Open pit mining could directly or indirectly affect fish health and survival by altering groundwater flows to surface waters. Direct changes could result from the stranding of fish due to groundwater drawdown, while indirect changes could result from changes to fish habitat quality (e.g., water temperature) (DeBoer et al. 2016; Benejam et al. 2008).

Water extraction activities could cause impingement and thereby affect fish health and survival.

Improved road access to the Project Area and more workers on site during operation may result in an increase in recreational fishing that could cause increased pressure on fish populations.

Decommissioning, Rehabilitation and Closure

Filling the open pits using diversion of site contact water, groundwater, and water extracted from Valentine Lake could affect fish health and survival directly by stranding fish in areas where stream flows have been reduced. Indirect effects could also occur if fish habitat quality is affected, such as through increased water temperatures in streams due to decreased groundwater inputs (DeBoer et al. 2016; Benejam et al. 2008). Discharges from point and non-point contaminant sources during this phase could affect fish health and survival through changes in fish habitat quality (Jennings et al. 2008; Herbert and Merkens 1961; Kjelland et al. 2015).

Pit lakes are expected to become stratified following closure, and waters in the bottom layers may become anoxic and may contain high concentrations of dissolved trace metals. If the pit lake turns over, the pit lake water that discharges may affect fish health and survival by reducing levels of dissolved oxygen and introducing elevated concentrations of metals (Jennings et al. 2008).

Improved road access to the Project Area and more workers on site during decommissioning, rehabilitation and closure may result in an increase in recreational fishing that could cause pressure on fish populations.

8.5.3.2 Residual Effects

Construction

During the construction phase, water withdrawal structures are not expected to result in residual effects, because these structures will be designed to avoid impingement and entrainment of fish, thereby preventing harm. For in-water works along the access road (e.g., for culvert installation) and the construction and installation of infrastructure, fish will be rescued from the site area in advance of in-water work to avoid the death of fish. Stream crossing structures will be designed to allow fish passage, allowing fish to access the necessary habitat required for life processes. Construction for in-water works will be conducted outside of the DFO timing windows for the Island of Newfoundland, thereby protecting fish and avoiding direct mortality of fish larvae or eggs.

To reduce the potential risk to fish populations in the area, angling will be prohibited on the mine site. Workers will not be permitted to angle during their rotation and will not be permitted to bring angling gear to site. This mitigation will reduce the potential residual effect on fish health and survival to negligible throughout the life of the Project.

Operation

During operation, residual Project-related effects to fish health and survival, are anticipated to occur due to changes in water quality from discharge of effluent containing contaminants above the CWQG-FAL into streams or lakes. Water-based discharges are not expected to result in direct mortality of fish because water will be managed and treated to meet authorized limits prior to discharge. Sublethal effects that could compromise fish health are not expected if parameters in effluents meet the CWQG-FAL at the discharge point or within a short distance of mixing in the receiving environment (i.e., within 300 m). An

EEM program will also be implemented in accordance with the MDMER. Further information on the results of the Assimilative Capacity Assessment (Appendix 7C) have been presented in the discussion of change in fish habitat quality (Section 8.5.2.2).

Blasting has the potential to affect fish survival indirectly through changes in fish behaviour due to vibrations, which could affect activities such as spawning and fish migration (Wright 1982; Dunlap 2009, Faulkner et al. 2006). The impact of blasting on fish depends on the size and location of the blast, the timing of the blast in relation to the fish life history, the density of surfaces bounding the water (e.g., bedrock stream beds reflect the shockwave while organic stream beds would absorb some of the impact), the detonation method, and the species, size, and life history stage of the fish (Wright and Hopky 1998). Use of explosives in or near water will be avoided and, if required, will follow DFO blasting guidelines. This approach is expected to result in few, if any, fish mortalities in nearby waterbodies; therefore, residual effects on the abundance of fish in any of these waterbodies are anticipated to be negligible. The change in fish health and survival due to blasting will end with the cessation of blasting at the end of operation (i.e., is reversible).

Water intake during site operation has the potential to impinge and entrain fish and affect fish health and survival. Young, small-bodied fish with poor swimming (avoidance) ability are more susceptible to impingement and entrainment than are larger adult fish (DFO 1995). Intake design will be based on site-specific parameters, including anticipated fish use and resident fish species. Intakes will be placed at a depth where young fish are unlikely to be present and will be designed following the *Freshwater Intake End-of-Pipe Fish Screen Guideline* (DFO 1995).

To reduce the potential risk to fish populations in the area, angling will be prohibited on the mine site. Workers will not be permitted to angle while staying at the accommodations camp and will not be permitted to bring angling gear to site. This mitigation will reduce the potential residual effect on fish health and survival to negligible throughout the life of the Project.

Decommissioning, Rehabilitation and Closure

Following closure, pit lakes are expected to be stratified because of their depth, with the deepest stratified layer (i.e., hypolimnion) expected to be anoxic and contain elevated levels of dissolved trace metals. The surface water layer (i.e., epilimnion) is expected to be well oxygenated and will be discharged from the pit lakes to streams once the discharge limits are met post-closure. As discussed in Section 8.5.2.2, given that discharge is predicted to meet MDMER limits for parameters of potential concern, residual adverse effects on fish health and survival resulting from release of deleterious substances during this phase are anticipated to be negligible to low. A five-year post-closure water quality monitoring program is currently planned, as described in the Water Management Plan (Appendix 2A). Based on results of the water quality monitoring, adaptive management, including additional monitoring or mitigation, may be implemented as required. An EEM Plan will also be implemented in accordance with the MDMER, during the closure phase.

To reduce the potential for stranding of fish during filling of the open pits in this phase, water will be sourced from areas where withdrawal should not cause stranding, and stream flows will be monitored.

To reduce the potential risk to fish populations in the area, angling will be prohibited on the mine site. Workers will not be permitted to angle while staying at the accommodations camp and will not be permitted to bring angling gear to site. This mitigation will reduce the potential residual effect on fish health and survival to negligible throughout the life of the Project.

8.5.3.3 Summary

Several Project-related activities could affect fish health and survival, which includes species which support recreational fisheries and SAR. These include:

- use of industrial equipment in or near water
- placement of Project infrastructure (e.g., culverts) in water
- water and effluent management
- use of explosives
- water extraction causing impingement
- increased recreational fishing pressure

Therefore, residual adverse effects are predicted. The magnitude of effects is considered low based on the application of mitigation, and given that potential contaminants in the mixing zones are not expected to be acutely lethal to fish and long-term exposure is not anticipated due to the geographic range of fish. Concentrations of specific parameters may be above applicable guidelines at some locations; however, the sustainability of fisheries is not expected to be affected. Effects on fish health and survival will occur within the LAA and will occur continuously throughout all Project phases. The potential effect is considered irreversible, because there may be localized exceedances of the guidelines established for the protection of aquatic life that continue following active closure. Finally, given that the fish populations in the local area are expected to be healthy and resilient to change such that the sustainability and productivity of recreational fisheries are not expected to be affected by the Project, the ecological and socio-economic context of effects is considered resilient.

In summary, with careful Project planning and implementation of proven standard mitigation measures to protect fish health and survivability, and given the conservative “worst-case scenario” approach, residual adverse Project effects during construction, operation, and decommissioning, rehabilitation and closure is predicted to be adverse, of low magnitude. Adverse effects are anticipated to occur within the LAA, be long-term in duration, continuous in frequency and irreversible. Effects occur within a resilient ecological and socio-economic context.

8.5.4 Summary of Project Residual Environmental Effects

Residual environmental effects that are likely to occur as a result of the Project are summarized in Table 8.16. The significance of residual adverse effects is considered in Section 8.6.

Table 8.16 Project Residual Effects on Fish Habitat

Residual Effect	Residual Effects Characterization							
	Project Phase	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological and Socio-economic Context
Change in Fish Habitat Quantity	C	A	M	PA	LT	C	I	D
	O	A	M	PA	LT	C	I	D
	D	A	M	PA	LT	C	I	D
Change in Fish Habitat Quality	C	A	L	LAA	LT	C	I	D
	O	A	L	LAA	LT	C	I	D
	D	A	L	LAA	LT	C	I	D
Change in Fish Health and Survival	C	A	L/M	LAA	LT	C	I	R
	O	A	N/L	LAA	LT	C	I	R
	D	A	L/M	LAA	LT	C	I	R

KEY
See Table 8.11 for detailed definitions
Project Phase:
C: Construction
O: Operation
D: Decommissioning

Direction:
P: Positive
A: Adverse
N: Neutral

Magnitude:
N: Negligible
L: Low
M: Moderate
H: High

Geographic Extent:
PA: Project Area
LAA: Local Assessment Area
RAA: Regional Assessment Area

Duration:
ST: Short term
MT: Medium term
LT: Long term

N/A: Not applicable
Frequency:
S: Single event
IR: Irregular event
R: Regular event
C: Continuous

Reversibility:
R: Reversible
I: Irreversible

Ecological/Socio-Economic Context (Fish Habitat):
D: Disturbed
U: Undisturbed

Ecological/Socio-Economic Context (Fish Health and Survival):
R: Resilient
NR: Not Resilient

8.6 DETERMINATION OF SIGNIFICANCE

For the purposes of this environmental assessment, a significant residual environmental effect on fish and fish habitat is defined as a Project-related environmental effect that results in:

- a Project-related HADD of fish habitat or the death of fish, as defined by the *Fisheries Act* that cannot be mitigated, authorized or offset
- an unauthorized Project-related alteration of fish habitat, which exceeds regulatory requirements or site-specific guidelines
- a change to the productivity or sustainability of fish populations or fisheries within the LAA where recovery to baseline is unlikely

With mitigation, offsetting and environmental protection measures in place, the residual adverse environmental effects on fish and fish habitat are predicted to be not significant. Best management practices and the use of standard mitigation will be followed for work in or near water during construction. The habitat loss is primarily in small streams and ponds containing stickleback, although some salmonid habitat will also be lost. Fish habitat that is lost as a result of the Project will be counterbalanced through implementation of a Fish Habitat Offsetting Plan to be developed in consultation with DFO. The Plan will include follow-up monitoring to confirm that the required offset is achieved, and contingency measures in the event that the offsetting is not as successful as planned.

During all phases of the Project, discharges will meet regulatory requirements and/or site-specific guidelines. Following rehabilitation and closure, a change to the productivity or sustainability of fish populations or fisheries within the LAA is not anticipated. Given the planned mitigation measures, the direct mortality of individual fish that may result from the Project is not anticipated to affect the likelihood of their long-term survival or sustainability.

8.7 PREDICTION CONFIDENCE

The overall determination of significance is made with a high level of confidence for the direct loss of fish habitat quantity and a moderate level of confidence for indirect loss of fish habitat quantity. A high level of confidence is applied to the direct loss of fish habitat, since the direct loss of habitat is equal to the surface area of the Project features responsible for the habitat loss. A moderate level of confidence is applied to the indirect loss of fish habitat, since the flow reductions used to calculate indirect habitat loss are predicted from modelling. With the requirement for a Fish Habitat Offsetting Plan to counterbalance the residual HADD of fish habitat resulting from the Project, there is a high level of confidence that there will be an overall gain in fish habitat and no significant effect on fisheries productivity and sustainability. Following closure, several streams will return to their pre-development flows, with primary and secondary productivity and fish populations anticipated to return quickly to restore the streams to baseline productivity levels.

For change in fish habitat quality, the overall determination is made with a high level of confidence, given that best management practices and standard mitigation will be in place when working in and around water, and effects are known and well documented. A moderate level of confidence is associated with the assessment of potential effects to water quality, where results of predictive models are relied upon.

A moderate level of confidence is associated with the assessment of change in fish health and survival, since the anticipated effects are based on water quality modelling results. The modelling results are considered conservative and the contaminants of concern in the aquatic environment and their potential effects to salmonids are well understood. Overall, the potentially affected fish species are well studied, and their habitat preferences are well known to allow for prediction of effects.

8.8 PREDICTED FUTURE CONDITION OF THE ENVIRONMENT IF THE UNDERTAKING DOES NOT PROCEED

The Project is located in an area with a long history of mining and mineral exploration, and it is likely that other mining projects would occur in this area if this Project were not to proceed. Future projects are anticipated to have similar effects on fish and fish habitat. Should mineral reserves associated with the Project remain undeveloped, the predicted future condition of fish and fish habitat would be relatively unchanged from that discussed in the existing environment portion of this assessment (Section 8.2).

The productivity of fish and fish habitat within the Project Area is dependent on the quantity and quality of fish habitat available. Fisheries productivity and populations of fish in the Project area are anticipated to remain stable over the long-term; however, changes in the distribution of salmonids, particularly brook trout, may be influenced in the long term by climate change and associated increases in water temperature, which may approach their maximum thermal tolerances. The fish species that are present within the LAA make localized movements to carry out their life processes. These species are widely dispersed and abundant in streams, ponds and lakes on the Island of Newfoundland.

8.9 FOLLOW-UP AND MONITORING

Follow-up and monitoring are intended to verify the accuracy of predictions made during the EA, to assess the implementation and effectiveness of mitigation and the nature of the residual effects, and to manage adaptively, if required. Compliance monitoring will be conducted to confirm that mitigation measures are properly implemented. Should an unexpected deterioration of the environment be observed as part of follow-up and/or monitoring, intervention mechanisms will include the adaptive management process. This may include an investigation of the cause of the deterioration and identification of existing and/or new mitigation measures to be implemented to address it. Additional information collected following submission of the EA will be provided to the IAAC, DFO and other applicable regulators as required. Follow-up and monitoring plans to be implemented include:

- Environmental monitoring during construction and operation to follow up on effectiveness of the Erosion and Sediment Control Plan
- Surface water quality monitoring, as described in the Surface Water Monitoring Plan and Water Management Plan
- Plans related to monitoring sources of parameters of potential concern that can affect water quality, such as the Soil and Rock Management Plan, Water Management Plan, Erosion and Sediment Control Plan
- Compliance and effectiveness monitoring of the Fish Habitat Offsetting Plan upon implementation, as authorized under the *Fisheries Act*; should the monitoring program indicate that the offsetting objectives are not met, remedial actions or additional offsets as described in the Habitat Offsetting Plan would be considered following consultation with DFO
- An EEM program as required under the MDMER when the effluent flow rate of 50 m^3 per day is exceeded, based on the effluent deposited from all the final discharge points of the mine
- Monitoring of pit lake water quality to demonstrate that closure strategies are performing as intended

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9.0 VEGETATION, WETLANDS, TERRAIN AND SOILS

9.1 SCOPE OF ASSESSMENT

Vegetation, wetlands, terrain and soils were selected as a valued component (VC) because of their important ecological (i.e., habitat, forage) and hydrological (i.e., erosion and flood control, groundwater control and recharge) functions that are essential to maintaining the health of natural ecosystems, as well as cultural benefits (i.e., recreational and spiritual values). Project activities have the potential to affect:

- Distribution and abundance of vegetation species (including species at risk [SAR] and species of conservation concern [SOCC]) and communities
- Wetlands and their functions
- Terrain (landforms)
- Terrain stability
- Soils (quality and quantity)

The assessment of vegetation focuses on plant species and community diversity, including SAR and SOCC. Wetlands are defined in the federal and provincial policies as land such as bogs, fens, marshes, swamps, and shallow waters that are permanently or temporarily submerged or saturated by water near the soil surface, for long enough that the area maintains aquatic processes (Government of Canada 1991; NLMAE 2001). These aquatic processes are characterized by plants that are adapted to saturated soil conditions, wet or poorly drained soils, and other biotic conditions found in wet environments. Terrain refers to landforms associated with the general physiography of the natural landscape such as topography, surficial geology and unique landforms. Unique landforms are features associated with fragile / sensitive ecosystem or habitat areas, such as eskers and wetlands. Terrain stability refers to mass movement processes (i.e., landslides) and erosion potential hazards that exist in the areas planned for the Project facilities and infrastructure. Soils are considered with respect to the physical and chemical suitability of soils (or suitable overburden) for rehabilitation purposes. Both soil quality and quantity are assessed to address the potential for admixing, compaction, erosion and changes to moisture and nutrient status during the salvage, storage, and replacement of peat, topsoil and upper subsoil horizons.

The assessment of vegetation, wetlands, terrain and soils is closely linked to and/or informed by the effects assessment for:

- Atmospheric Environment (Chapter 5) given that Project-related activities may result in an increase in dust that may affect plant growth and development
- Groundwater and Surface Water Resources (Chapters 6 and 7) through changes to groundwater and surface water, which can change plant community composition in uplands and wetlands
- Avifauna, Caribou and Other Wildlife (Chapters 10 to 12) through effects to vegetation and wetlands, which represent habitat for these species
- Land and Resource Use (Chapter 16) associated with trapping and hunting activities for species assessed in Chapters 10 to 12 (Avifauna, Caribou and Other Wildlife)

- Indigenous Groups (Chapter 17) and Community Health (Chapter 14) through the collection and use of plant species

9.1.1 Regulatory and Policy Setting

In addition to the *Canadian Environmental Assessment Act, 2012* (CEAA 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 assessment on vegetation, wetlands, terrain and soils.

9.1.1.1 Vegetation

Species at Risk

SAR species include those listed as Endangered, Threatened, or Special Concern by the federal *Species at Risk Act* (SARA), the Newfoundland and Labrador *Endangered Species Act* (NL ESA), or by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). COSEWIC assesses and designates the status of species and recommends this designation for legal protection under SARA. On lands under provincial jurisdiction, federal SARA goals are typically reflected through provincial legislation, policy and guidelines.

While some species included as SAR in this assessment currently have regulatory protection under Schedule 1 of SARA or the NL ESA, the definition above also includes those species listed by COSEWIC that are candidates for further review and may become protected within the timeframe of this Project.

Federally, SARA serves several purposes:

- To prevent the extirpation or extinction of wildlife species
- To provide recovery strategies for species that are Extirpated, Endangered, or Threatened due to human activity
- To manage species of Special Concern so they do not become Threatened or Endangered

There are three main prohibitions in SARA relevant to Extirpated, Endangered or Threatened plant SAR and their critical habitat:

- Section 32, which prohibits killing, harming, or taking SAR
- Section 33, which prohibits damage or destruction of residences of SAR
- Subsection 58(1), which prohibits destruction of critical habitat of SAR

SARA-listed species designated as Special Concern are not protected by the prohibitions of SARA; however, it is required that provincial or regional management plans be developed to protect these species. SARA is one part of a three-part Government of Canada strategy for the protection of plant SAR. The other two parts of this strategy include commitments under the Accord for the Protection of Species at Risk and activities under the Habitat Stewardship Program for SAR, which protect SAR on federal land.

Provincially, designation under the NL ESA follows the recommendations of the Species Status Advisory Committee (SSAC) on the appropriate assessment of a species and referring concerns about the status of species to COSEWIC, where the species is of national importance.

The purpose of NL ESA is to:

- Prevent listed species from being Extirpated from NL
- Provide for the recovery of species listed as Extirpated, Endangered, or Threatened as a result of human activity
- Conserve species listed as Special Concern to prevent them from becoming Endangered or Threatened

Prohibitions of the NL ESA include section 16, which states "a person shall not disturb, harass, injure, or kill an individual of a species designated as Threatened, Endangered or Extirpated. The *Endangered Species List Regulations* under the NL ESA identifies those species protected by the Act. Last amended in 2016, the regulation lists 20 Endangered plant species (of 27 species total), four Threatened plant species (of 12 species total) and three Vulnerable plant species (of 13 species total).

Species of Conservation Concern

While SOCC are not specified under federal or provincial legislation, in NL these are species that are considered rare in the province, or ones for which the long-term sustainability of their populations has been evaluated as tenuous. Following direction previously provided by the NL Department of Fisheries, Forestry and Agriculture– Wildlife Division (NLDFFA-Wildlife Division) for studies conducted in support of the Project, vascular plant SOCC are defined herein as those species:

- Ranked S1 (Critically Imperiled), S2 (Imperiled), or combinations thereof (e.g., S1S2) on the Island of Newfoundland by the Atlantic Canada Conservation Data Centre (AC CDC) (AC CDC 2015)
- Recommended for listing by the SSAC as Endangered, Threatened, Vulnerable, or Special Concern but not yet listed under the NL ESA or SARA

Unlike some SAR, SOCC are not afforded direct protection by either federal or provincial legislation. SOCC are included in this VC as a precautionary measure, reflecting observations and trends in their provincial population status, as they are often important indicators of ecosystem health and regional biodiversity. Rare species are often an indicator of the presence of unusual and/or sensitive habitat and their protection as umbrella species can confer protection on their associated unusual habitats and co-existing species.

9.1.1.2 Wetlands

There is no specific federal legislation for wetlands, however, depending on their characteristics, wetlands may be protected under other legislation including SARA if they contain critical habitat for SAR, the *Migratory Birds Convention Act* (MBCA) if they contain nests of migratory birds, or the *Fisheries Act* if they contain habitat for fish species.

A federal mandate for wetland conservation is provided by the *Federal Policy on Wetland Conservation (*Government of Canada 1991). This policy has been adopted to help meet the objectives of wetland conservation as outlined in the *Ramsar Convention Manual, 6th Edition* (Ramsar Convention Secretariat 2013), and the *Canadian Biodiversity Strategy* (Government of Canada 1995). Policy goals are intended to apply on federal lands and waters or to federal programs where wetland loss has reached critical levels. They also apply to federally designated wetlands, such as Ramsar sites; no federally designated wetlands will be affected by the Project.

The *Newfoundland and Labrador Policy for Development in Wetlands* (NLMAE 2001) describes developments that are not permitted within wetlands and defines activities that require permitting under section 48 of the *Water Resources Act*. Those developments that are not permitted include:

- Infilling, drainage, dredging, channelization, removal of vegetation cover or removal of soil or organic cover of wetlands which could aggravate flooding problems, or have unmitigable adverse water quality, water quantity or hydrologic impacts
- Development in wetlands which are located within the recharge zones of domestic, municipal or private groundwater wells
- Placing, depositing or discharging any raw sewage, refuse, municipal or industrial wastes, fuel or fuel containers, pesticides, herbicides or other chemicals or their containers, or any other material which impairs or has the potential to impair the water quality of wetlands

Under the provincial policy, developments which require permitting include disturbances to wetlands for the extraction of peat, for agricultural or forestry operations, construction of linear corridors, and infilling, dredging or other disturbance of wetlands for the construction of residential, commercial, industrial and institutional facilities, or extension and upgrading of existing buildings and facilities within wetland areas.

9.1.1.3 Terrain, Terrain Stability and Soils

There is no direct federal or provincial legislation related specifically to terrain, terrain stability and soils. Inclusion of these components is identified in the Federal EIS Guidelines (Appendix 1A) and Provincial EIS Guidelines (Appendix 1B) as they relate to the incorporation of terrain, terrain stability and soils information, specifically associated with potential effects on landforms, slope stability, soil suitability for rehabilitation, and erosion. Unique landforms may be protected under other legislation depending on their characteristics. General requirements related to terrain, terrain stability and soils for mining projects are outlined in the NL *Mining Act* and the NL EPA. The *Mining Act* requires the implementation and documentation of progressive rehabilitation and a Rehabilitation and Closure Plan including applicable records.

As per requirements of the Federal and Provincial EIS Guidelines, the EIS describes existing geology, terrain and soils and terrain stability at the mine site and in the immediate vicinity, as well as potential Project-VC interactions and impacts to the quality and quantity of soils, terrain and terrain stability.

9.1.2 The Influence of Engagement on the Assessment

As part of ongoing engagement and consultation activities, Marathon has documented interests and concerns about the Project received from communities, governments, Indigenous groups and stakeholders. An overview of Marathon's engagement activities is provided in Chapter 3. Documented interests and concerns have influenced the design and operational plans for the Project, and the development of the EIS, including the scope of assessment on the VCs. Interests and concerns noted that specifically relate to vegetation, wetlands, terrain or soil or routine Project activities that could affect vegetation, wetlands, terrain or soil are provided below. Issues and concerns related to potential accidents or malfunctions are described in the assessment of accidental events (Chapter 21).

Questions and concerns raised by Qalipu through Marathon's engagement efforts include:

- Design and operation of the tailing management facility, including use of earthen dams, long-term plans for the tailings pond, nature of "detox tailings", use of a geo-membrane, and likelihood and consequences of a breach
- Whether Project infrastructure can be relocated to reduce the Project footprint
- Decommissioning, rehabilitation and closure of the Project, including disposition of camp infrastructure at end of mine life and ensuring remediation of the Project Area takes place
- Terrestrial environment including the disturbance of caribou migration routes and the potential for the introduction of invasive plant and wildlife species
- Interest in involvement in the environmental monitoring for the Project

Questions and concerns raised by Miawpukek through Marathon's engagement efforts include:

- The size of the Project footprint
- Tailings, including questions about treatment, accidental events, and rehabilitation and closure
- Acknowledgement that interests of Miawpukek extend beyond caribou and include plants and waterfowl
- Need to consider buffers as a potential mitigation measure for Species at Risk
- Potential impact on Miawpukek land and resource use
- Interest in involvement in the environmental monitoring for the Project

Questions and concerns raised by communities and other stakeholders through Marathon's engagement efforts include:

- Project components and infrastructure including: if pits will be mined simultaneously; how many ponds there will be; if the mine will be open pit only or include underground; how ore will be transported to the mill and how and where it will be processed; use of cyanide; what will replace the heap leach process; whether other metals, like silver, are present; whether product will be tested at an on-site lab or externally; and what will happen to waste rock and overburden
- Tailings and potential risks, including how tailings will be managed, the treatment of effluent, understanding "detox tailings", the consideration of use of a geo-membrane liner, potential impact of the tailings pond and polishing pond on water resources, and the long-term plan [closure] for the tailings pond

Questions and concerns raised by fish and wildlife and civil society organizations through Marathon's engagement efforts include:

- Project description, including the size of the Project footprint, pit stability, the source of power for the Project, use of cyanide, the process that will replace the heap leach process, how tailings will be transported, and tailings management (and consideration of alternatives)

9.1.3 Boundaries

The scope of the assessment is defined by spatial boundaries (i.e., geographic extent of potential effects) and temporal boundaries (i.e., timing of potential effects). Spatial boundaries for the Vegetation, Wetlands, Terrain and Soils VC were selected in consideration of the geographic extent over which Project activities, and their effects, are likely to occur to the VC. Temporal boundaries are based on the timing and duration of Project activities and the nature of the interactions with the VC. The spatial and temporal boundaries associated with the effects assessment for the Vegetation, Wetlands, Terrain and Soils VC are described in the following sections.

9.1.3.1 Spatial Boundaries

The following spatial boundaries were used to assess Project effects, including residual environmental effects, on vegetation, wetlands, terrain and soils in areas surrounding the mine site and access road (Figure 9-1):

Project Area: The Project Area encompasses the immediate area in which Project activities and components occur and is comprised of two distinct areas: the mine site and the access road. The mine site includes the area within which Project infrastructure will be located, and the access road is the existing road to the site, plus a 20-metre (m) wide buffer on either side. The Project Area is the anticipated area of direct physical disturbance associated with the construction, operation and decommissioning, rehabilitation and closure of the Project.

Local Assessment Area (LAA): The LAA is comprised of a 1 kilometre (km) buffer around the mine site and a 500 m buffer around the access road. The LAA has been selected to capture the area where effects on vegetation, wetlands, terrain and soils are likely to be most prevalent (e.g., effects to species / community diversity, wetland function, terrain stability, and soil quality and quantity).

Regional Assessment Area (RAA): The RAA includes the Project Area, LAA and a 35 km buffer around the Project Area (Figure 9-1) encompassing Victoria River and Red Indian Lake, as well as the communities of Millertown, Buchans and Buchans Junction. The RAA informs the assessment of cumulative effects (Chapter 20). Accidental events (Chapter 21) are also assessed within the context of the RAA.

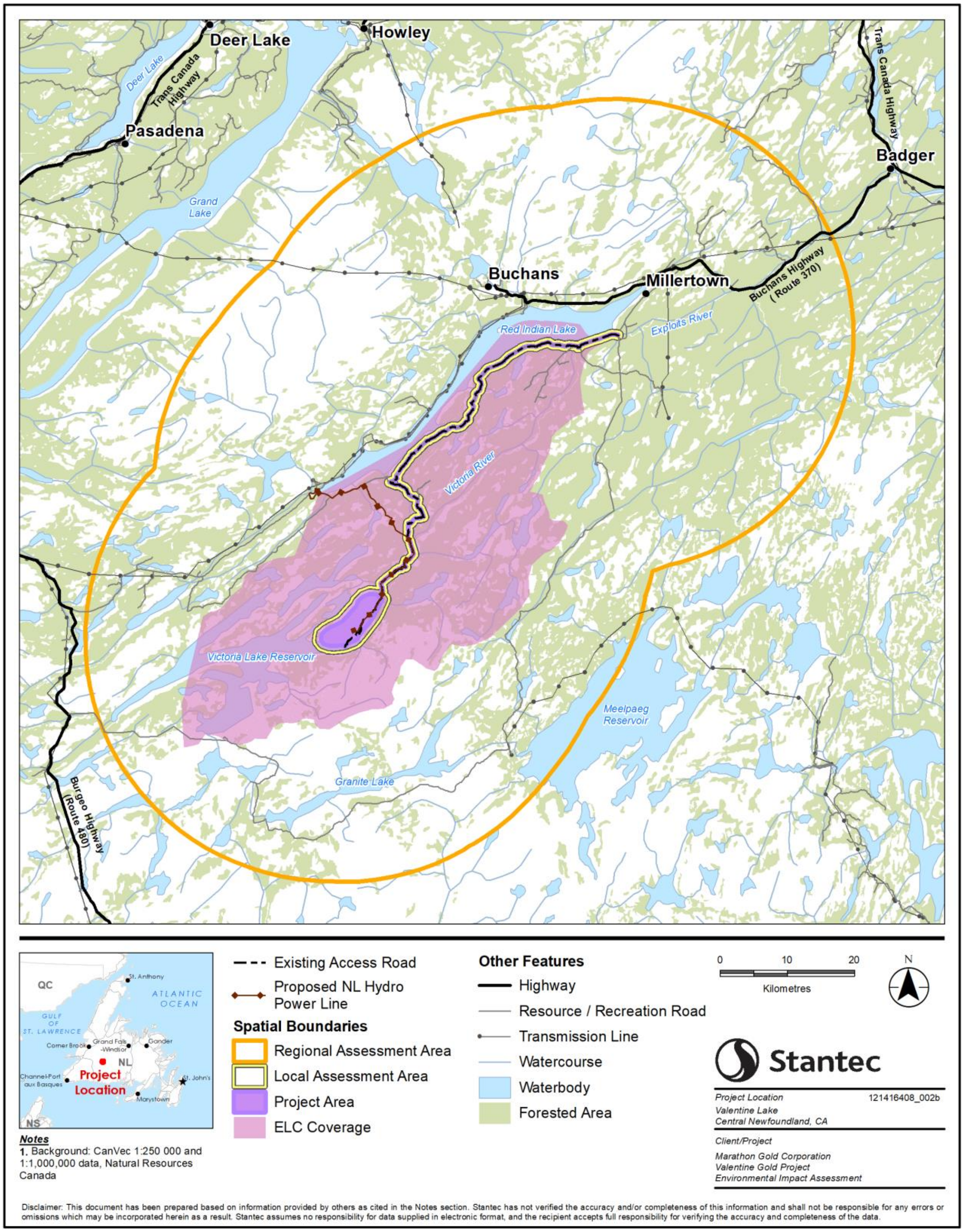

Figure 9-1 Spatial Boundaries for Vegetation, Wetlands, Terrain and Soils

This assessment also refers to the Ecological Land Classification Area (ELCA), which is the area within which detailed habitat data have been collected (Baseline Study Appendix 7: Avifauna, Other Wildlife and Their Habitats [BSA.7], Attachment 7-D). While the extent of the ELC data does not fully cover the Project Area, LAA or RAA (Figure 9-1), the ELCA is used to assess quantitative effects on habitat. In particular, the magnitude of residual effects has been characterized in relationship to the ELCA (i.e., the percentage of the ELCA in which a loss or change will occur). In this context, the ELCA has been used as a surrogate for the RAA, as it is an area sufficiently large enough to provide regional context and is the area for which comparable ecological land classification data is available. Refer to Section 9.2.1 for further information on the ELCA.

9.1.3.2 Temporal Boundaries

The temporal boundaries for the assessment of potential effects on the Vegetation, Wetlands, Terrain and Soils VC include:

- Construction Phase – 16 to 20 months, beginning in Q4 2021, with 90% of activities occurring in 2022
- Operation Phase – Estimated 12-year operation life, with commissioning / start-up and mine / mill operation slated to start Q2 2023
- Decommissioning, Rehabilitation and Closure Phase – Closure rehabilitation to occur once it is no longer economical to mine or resources are exhausted

9.2 EXISTING CONDITIONS FOR VEGETATION, WETLANDS, TERRAIN AND SOILS

A characterization of the existing conditions within the spatial boundaries defined in Section 9.1.3.1 is provided in the following sections. This includes a discussion of the influences of past and present physical activities on the VC, leading to the current conditions. An understanding of the existing conditions for the VC within the spatial area being assessed is a key requirement in the prediction of potential Project effects provided in Section 9.5.

9.2.1 Methods

9.2.1.1 Existing Data

Information regarding vegetation, wetlands, terrain and soils existing conditions in the Project Area and the LAA are derived from data collected in support of the Project and existing publicly available regional terrestrial information. This includes use of existing data for terrain and soil summaries, and interpretation of existing data for terrain stability and soil suitability for rehabilitation purposes. The relevant Project-specific field programs completed in support of the Project are found in BSA.7. The following publicly available data and reports were reviewed and used to characterize baseline conditions for vegetation and wetlands in the Project Area, LAA and RAA:

- AC CDC report for a 5 km buffer around the Project Area (AC CDC 2020a)
- The Ecological Land Classification (ELC) study (BSA.7, Attachment 7-D), including generalized parent material-types and soils assigned to ecotype map units of the ELC study

- Valentine Lake Project: Vegetation Baseline Study (BSA.7, Attachment 7-F)
- Valentine Gold Project: 2019 Vegetation Baseline Study (BSA.7, Attachment 7-I)
- 2015 Land Cover of Canada Data (Natural Resources Canada 2019)

Additional information used in support of the terrain and soils overview was derived from:

- Environmental Assessment Registration / Project Description, Valentine Gold Project, Newfoundland and Labrador (Marathon Gold 2019)
- Pre-Feasibility Geotechnical Investigation: Marathon and Leprechaun Deposits (Terrane Geoscience Inc. 2020, Appendix 2C)
- Valentine Project Pre-Feasibility Study Report (Ausenco 2020)
- Select laboratory analysis for geotechnical test pit (TP) data from GEMTEC Consulting Engineers and Scientists (GEMTEC) preliminary geotechnical and acid rock drainage (ARD) test pit program records (BSA.3, Attachment 3-D)
- Regional surficial geology and soils mapping information via the GeoScience OnLine application through the Newfoundland and Labrador Department of Industry, Energy and Technology (NLDIET) (NLDNR 2019)
- Land Capability Mapping for Forestry from the Canada Land Inventory (CLI) website (Canadian Soil Information Service (CanSIS 2018)

The historical information and existing data were used to describe existing terrain and soils conditions, and to describe soil suitability for rehabilitation parameters with respect to soil quality (i.e., as a growth medium and in support of the air quality / dust assessment) and soil quantity (i.e., volume available). The objective of the terrain and soils sections is to provide an overview of existing conditions such that they can be used to assess terrain related changes and soil quality and quantity changes through the measurable indicators.

Data Limitations

As noted in Section 9.1.3, discussion of habitat type in this chapter refers to the ELCA. The ELCA covers more than 99% of the Project Area and 97% of the LAA (Figure 9-2, Table 9.1). The area of the Project Area and LAA outside the ELCA is restricted to a small portion of the access road at its northern-most reach (i.e., furthest from the mine site) and is negligible in the context of assessing potential Project effects on the VC.

Table 9.1 Amount of Project Area and LAA within the ELCA

ELCA	Project Area[A] (km2 / %)	LAA[A] (km2 / %)
Amount of Project Area and LAA in the ELCA	34.7 / 99.6	127.0 / 97.0
Amount of Project Area and LAA outside the ELCA	0.1 / 0.4	3.9 / 3.0
Total	**34.9 / 100**	**130.9 / 100**

Note:
[A] Numbers are rounded to one decimal place. Areas and percentages may not add up to total amounts due to rounding

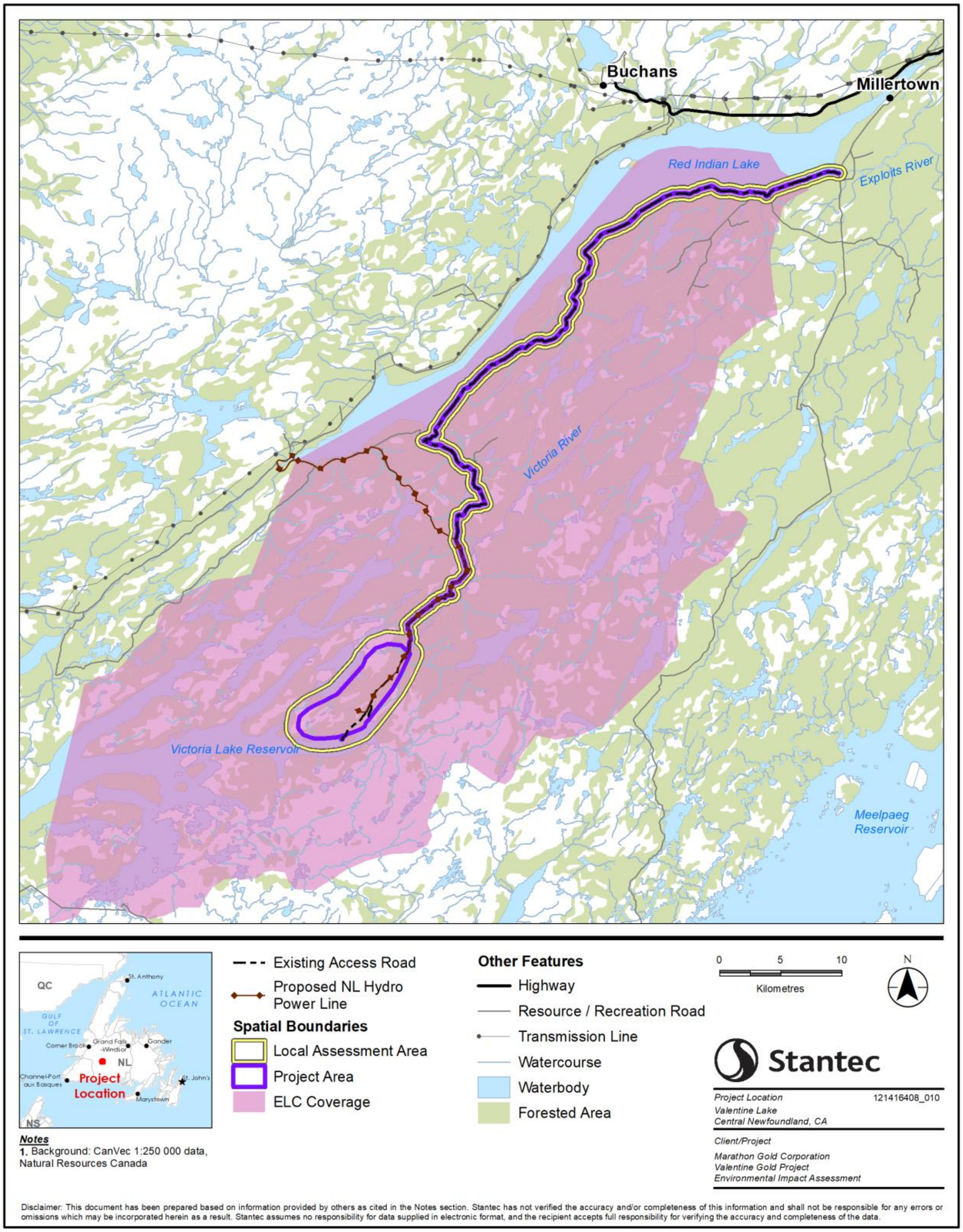

Figure 9-2 ELC Coverage within Project Area and LAA Boundaries

While the portions of the Project Area and LAA that do not have ELC data (approximately 0.1 km^2 of the Project Area [0.4%)] and 3.9 km^2 of the LAA [3.0%]) are small, a desktop classification of habitat types was completed using available remote data. ESRI World Imagery was obtained for the area (ESRI 2014) and classified. The process used to classify habitat in this portion of the LAA is not directly comparable to the ELC as the methods differed. The types of satellite imagery differed between both processes, and the classification of this remaining portion of the LAA was not calibrated with field surveys, as was the ELC. Therefore, the habitat classification of the remaining LAA is not combined with the ELC results and are presented separately. Discussion regarding the amounts of habitat types in the Project Area and LAA in this chapter refer to the portions of the study areas with ELC data.

The ELC data do not cover the entire RAA. As such, 2015 Land Cover of Canada Data (Natural Resources Canada 2019) were used to describe the RAA. This national system was started in 2010 and is planned to be repeated every five years. The system has a 30 m spatial resolution, and the 2010 version was determined to be 76.6% accurate. Full details of the methods used to create the 2010 Land Cover of Canada Data (which are assumed to have been repeated for 2015 data) are described in Latifovic et al. (2017).

Although the ELCA does not cover the entire RAA, it has been used as a surrogate for the RAA, as it is an appropriately large enough area to provide regional context and is the area for which comparable ecological land classification data is available. The benefit of the detail of the ELCA over the Land Cover of Canada Data is considered to outweigh the reduction in area.

No spatial files or standalone terrain / soils mapping / datasets were completed for the ELC or as standalone Project-related reports. Terrain (soil and bedrock) stability mapping or geophysical hazard identification has not yet been conducted for the LAA or Project Area. Therefore, summaries of the terrain (parent material and geomorphological processes), terrain stability (e.g., ground movement, landslides), and soils described here are based primarily on interpretation of ecotype map unit information and generalized text provided in the ELC report (BSA.7, Attachment 7-D) and the existing data sources listed above. Recommendations for further scope definition for the 73 km access road and bridges, and additional geotechnical studies for the Project Area and associated infrastructure are outlined in the Valentine Gold Project Pre-feasibility Study Report (Ausenco 2020). Soil suitability for rehabilitation is based on general interpretation of existing data sources as a complete Rehabilitation and Closure Plan has not yet been developed for the Project (Ausenco 2020).

9.2.1.2 Vegetation and Wetland Communities Mapping

Information on vegetation communities (including wetlands) in the Project Area and LAA is derived from the ELC completed for the Project in 2015 (BSA.7, Attachment 7-D). Ecosystem mapping was produced for the ELCA using an iterative approach. A computer-based algorithm was developed using satellite images and remote sensing technologies (i.e., data collected from a distance, typically from satellite or aircraft, such as multispectral reflection) to delineate, although not identify, habitats. The output of this algorithm was then classified using field data collected from 74 sites that had been sampled in August 2014. Some post-processing was conducted to correct errors. The accuracy of the ELC mapping was also assessed using field data collected from 106 sites visited in 2014 and 2015 and was determined to be 83%. Full details on the methods are available in the ELC report (BSA.7, Attachment 7-D). This process was intended to produce an appropriate representation of the regional landscape rather than detailed site-specific information.

Detailed vegetation surveys were conducted at approximately 30 of the sites surveyed in 2014. These surveys collected data on site conditions including site soil profile characteristics (Section 9.2.1.5), terrain conditions, overstory species and characteristics, forest seral stage, and understory vascular plant species. Data were used to classify vegetated areas into ecosystem units and ecotypes according to the *Forest Site Classification Manual: A Field Guide to the Damman Forest Types of Newfoundland* (Meades and Moores 1994).

9.2.1.3 Rare Vascular Plant Species

Information on vascular plants that exist within the Project Area and surrounding area has been obtained through multiple sources, including an AC CDC data request for the area, and field surveys conducted in support of the Project from 2014 to 2019. Field surveys include those completed in 2014 and 2015 in support of the ELC (BSA.7, Attachment 7-D) and two focused rare plant surveys (RPSs) conducted within the Project Area in 2017 and 2019 (BSA.7, Attachments 7-F and 7-I).

During the ELC field work, vascular plants were recorded in plots surveyed to describe various vegetated habitats. The two RPSs were conducted at the time during the growing season considered suitable for identification of those rare plants with potential to be encountered in the area. The first RPS was completed from July 17 to 21, 2017. The second RPS was completed from June 25 to 29, 2019. This 2019 survey was conducted at a time when many plants would be flowering and was also planned to be conducted simultaneously with forest songbird breeding surveys and was thus conducted earlier in the growing season than the 2017 survey. Surveys used a floristic habitat sampling method and focused on the planned locations (as of the time of the field surveys, not the current site layout) of the Leprechaun pit and northern associated waste rock pile, the tailings management facility (TMF), the Marathon pit and associated waste rock pile, and other areas that were previously planned for components of the Project, as well as the portion of the access road closest to the previously-mentioned Project components.

Floristic habitat sampling is done in areas where plant community types are known and applies the greatest search effort in those habitats with the highest potential to support rare vascular plant species. Plant taxa were recorded using ArcGIS data collection tools developed by Stantec and a Bluetooth-paired submeter GPS (Global Positioning System). Encountered species were recorded once, and rare plants [i.e., SAR or SOCC] were recorded whenever they were encountered. When rare species were encountered, information was recorded on the location of the species, the population boundaries, and the number of individuals within the population. A single GPS point location was taken if the plant species or population was less than 10 m in diameter and more than 10 m from the next nearest occurrence of the same species.

9.2.1.4 Invasive Vascular Plants

There is no list of invasive vascular plants of concern in NL. To determine the presence of potentially invasive vascular plant species, the list of vascular plant species observed through field surveys conducted in support of the Project was reviewed and considered against published literature and lists of invasive species from other areas within the Atlantic Provinces, and the past observations and experience of the Project team.

9.2.1.5 Terrain and Soils

Methods for describing existing terrain and soils for the Project Area, LAA and RAA are provided below.

Terrain

Terrain refers to landforms associated with the general physiography of the natural landscape, such as topography, surficial geology and unique landforms.

Topography and Surficial Geology

Topography summaries are based on existing reports and desktop ESRI ® ArcMap data review (i.e., elevation and slope data, imagery). Key sources included the generalized parent material-types assigned to ecotype map units in the ELC report (BSA.7, Attachment 7-D) and the existing regional surficial geology mapping (NLDNR 2019). The available information was supplemented with a 2020 desktop review of the existing data with imagery and topographic information using ESRI ® ArcMap analysis tools.

Terrain-related (i.e., dominant parent material) and soils field data presented in the ELC report (BSA.7, Attachment 7-D) originated from existing regional surficial geology-soils mapping and limited 2014 soil survey data, and 2015 to 2016 vegetation field data. As presented in the ELC report (BSA.7, Attachment 7-D), multiple parent material types and generalized soil characteristics were assigned to each ecotype map unit.

Unique Landforms

Unique landforms are features associated with fragile / sensitive ecosystem or habitat areas, such as eskers and wetlands. A review of potential unique landforms and features was completed by summarizing existing information from the following sources:

- Environmental Assessment Registration / Project Description (Marathon Gold 2019) - general topography and wetlands
- ELC report (BSA.7, Attachment 7-D) – surficial material summaries, limited geomorphic processes / landform descriptions (no spatial / location information)
- Desktop review of regional surficial geology mapping (NLDNR 2019)

Terrain Stability

Terrain stability refers to mass movement processes (i.e., landslides) and erosion potential hazards that may lead to potential for slope or ground / bedrock instability in the areas planned for Project activities and infrastructure. For this assessment, 'ground' terrain stability refers to surficial materials including soils and underlying parent material. A baseline ground-based terrain stability classification / detailed erosion potential / geohazard assessment (i.e., identification of potentially unstable ground) has not been completed for the Project Area or the LAA. Therefore, the potential for ground-based terrain (i.e., soil and surficial material) instability was identified by interpreting the ELC report (BSA.7, Attachment 7-D) and geotechnical test pit (TP) data from GEMTEC (BSA.3, Attachment 3-D) during the desktop review. Bedrock instability is specific to geotechnical assessments and is presented as a desktop review of pit locations noted in geotechnical reports (Terrane Geoscience Inc. 2020, Appendix 2C).

This summary does not represent a detailed terrain stability classification / geohazard assessment for the Project Area. Refer to Section 9.2.1.1 (Data Limitations) for details.

Effects of the environment on the Project, including climate change, extreme weather events and the potential for rockslides, landslides, seismic events and fire, are described and assessed in Chapter 22 (Effects of the Environment on the Project).

Soils

Soils are described in terms of conditions that can affect vegetation growth; this includes a soil description for the Project Area, soil suitability for rehabilitation, soil quality and soil quantity. Methods for describing each of these are provided below.

Soil Description

Key sources for soil descriptions in the Project Area were obtained from soil information assigned to ecotype map units in the ELC report (BSA.7, Attachment 7-D), Project Area soil summaries in the Registration / Project Description (Marathon Gold 2019) and TP records (BSA.3, Attachment 3-D).

Soil Suitability for Rehabilitation

Soil suitability for rehabilitation refers to materials that are suited for salvage and replacement and are characterized by soil quality and quantity. Changes to soil characteristics (i.e., soil quality and quantity) can affect rehabilitation success and the ability to meet end land use capability objectives. Soil quality and quantity characteristics are described in the following sections. Ratings of soil suitability for rehabilitation were qualitatively derived by combining the existing CLI land capability ratings (CanSIS 2018) and select soil rehabilitation suitability criteria (Table 9.2). Ratings for the Project Area were applied to soils for each of the ecotype map units identified in the ELC report (BSA.7, Attachment 7-D). Soil suitability for rehabilitation ratings are:

- **Good** - none to slight soil limitations that affect use as a plant growth medium (generally conforms to CLI Class 1-2 lands)
- **Good (Wetlands**) - organic material associated with wetlands
- **Fair -** moderate soil limitations that affect use, which can be overcome by proper planning and good management (generally conforms to CLI Class 3 lands)
- **Poor** - severe soil limitations that can make use questionable; this does not mean the soil cannot be used, but rather carefully planning and very good management are required (generally conforms to CLI Class 4-6 lands)

- **Unsuitable** - chemical or physical properties of the soil are so severe rehabilitation would not be economically feasible or in some cases impossible (generally conforms to CLI Class 7 lands)

Table 9.2 Select Soil Rehabilitation Suitability Criteria

Rating / Property	Good (G)	Fair (F)	Poor (P)	Unsuitable (F)
Reaction (pH)[A]	5.0 to 6.5	4.0 to 5.0 6.5 to 7.5	3.5 to 4.0 7.5 to 9.0	<3.5 and >9.0
Coarse Fragments[B] (% Vol)	<30[C] <15[D]	30 to 50[C] 15 to 30[D]	50 to 70[C] 30 to 50[D]	>70[C] >50[D]
Texture	L, SiCL, SCL, SL, FSL	CL, SiL, VFSL, SC, SiC	LS, S, Si, C, HC	Consolidated bedrock
Moist Consistency	Very friable, friable	Loose, firm	Very firm	Extremely firm

Notes
Table criteria adapted from the Alberta Agriculture, Food and Rural Development (AAFRD) (AAFRD 2004).
[A] pH values presented are most appropriate for trees, primarily conifers.
[B] 0.2 to 25 cm diameter fragments in the soil material.
[C] Matrix texture (modal) finer than sandy loam.
[D] Matrix texture (modal) sandy loam and coarser.
Texture classification according to the Canadian System of Soil Classification (Agriculture and Agri-Food Canada 1998)
S = Sand; SiCL = Silty Clay Loam; LS = Loamy Sand; SiL = Silt Loam; SL = Sandy Loam; FSL = Fine Sandy Loam; VFSL = Very Fine Sandy Loam; CL = Clay Loam; SCL = Sandy Clay Loam; Si = Silt; L = Loam; C = Clay; SiC = Silty Clay; HC = Heavy Clay

Soil Quality

Soil quality refers to the physical and chemical properties of soil that make it a productive medium for supporting healthy ecosystems (i.e., biological diversity in soil and vegetation). Soil quality can be affected by admixing, compaction / rutting and changes in soil chemistry (contamination and alteration of soil fertility). Sixteen geotechnical borehole overburden samples collected between 0.4 m to 3.7 m depths were reviewed to describe soil quality in the Project Area (BSA.3, Attachment 3-D).

Available soil physical and chemical parameters were compared to the Canadian Environmental Quality Guidelines provided by the Canadian Council of Ministers of the Environment (CCME). Specifically, available analytical data was compared to thresholds presented in the *Soil Quality Guidelines for the Protection of Environmental and Human Health* (CCME 1999).

Soil Quantity

Soil quantity is measured by the total area and volume of soil. Potential soil volume loss was measured by erosion potential from bare land surfaces created during mining and by areas where soil will not be salvaged due to mining activities, such as burial of soils under waste rock piles. Erosion potential ratings provide an estimate for potential sediment loss due to surface erosion as the result of exposure through clearing vegetative cover and re-contouring activities. Preliminary erosion potential class descriptions presented in Table 9.3 were incorporated with soil characteristics presented in the ELC report (BSA.7, Attachment 7-D).

Table 9.3 Preliminary Erosion Potential Class Descriptions

Class	Rating	Criteria	Management Implications
VL	Very Low	• Level sites (0 to 2% slope) • Competent bedrock • Very thin veneers (2 to 20 cm) of colluvial decaying bedrock or morainal material • Organic material on slopes <0.5%	None or only very minor for surface erosion
L	Low	• Veneers (20 to 99 cm) of colluvial, decaying bedrock or morainal material with high coarse fragment content • Colluvial or morainal material at least 100 cm thick with 41 to 80% coarse fragments • Morainal material under 5% slope • Organic or fine fluvial material on 0.5 to 2% slopes	Expect minor erosion of fines in ditch line and disturbed soils
M	Moderate	• Colluvial, or morainal material at least 100 cm thick with up to 40% coarse fragments on slopes 5 to 49% • Organic or fine fluvial material on 2 to 5% slope	Expect moderate erosion when water is channeled (e.g., down road surfaces and ditches)
H	High	• Organic or fine fluvial material on 5 to 9% slope • Colluvial or morainal material with up to 40% coarse fragments on slopes over 49%	Potential for substantial erosion problems when water is channeled onto or over exposed soil
VH	Very High	• Slopes in excess of 70% with bedrock exposures or lower slopes where gullies occur	Potential for severe surface and gully erosion problems when water is channeled onto these sites

Notes:
Table adapted from the Mapping and Assessing Terrain Stability Guidebook, British Columbia Ministry of Forests (BC MOF 1999). Criteria modified based on soils information presented in the Project ELC (BSA.7, Attachment 7-D)
Criteria applies to bare soil conditions (i.e., site clearing, soil stripping and salvage) when soils are most vulnerable to erosion and do not apply to areas with open water, disturbance, organic soils or bedrock

Proposed water or tailings storage areas and/or other permanent mine features exempt from rehabilitation (e.g., pit walls) will result in loss of soil area. The loss of soil volume associated with soil burial was assessed quantitatively as a percentage of salvageable soil volume not recovered within the mine site. Salvageable soil is defined as suitable material for rehabilitation (as a growth medium) and represents the upper productive layer where most vegetation rooting occurs. As warranted, a soil management plan, to be developed as part of the Environmental Protection Plan (EPP) will provide further information on the magnitude of soil volume and cover loss.

9.2.2 Overview

9.2.2.1 Vegetation and Wetland Communities

The Project is located within the Central Newfoundland Forest (CNF) Ecoregion (Figure 9-3), one of nine ecoregions on the Island of Newfoundland [Newfoundland and Labrador Department of Fisheries and Land Resources (NLDFLR) 2019a]. The CNF Ecoregion is primarily inland and has a more continental climate than other surrounding ecoregions. The CNF Ecoregion has the warmest summers and coldest winters on the Island, with the potential for night frost year-round, which excludes some hardwood tree species from the area (NLDFLR 2019b). The Project Area and LAA are also entirely within the Red Indian Lake Subregion, which is slightly cooler than other subregions (Figure 9-3). Balsam fir (*Abies balsamea*), paper birch (*Betula papyrifera*), and black spruce (*Picea mariana*) are dominant tree species. Some rich, somewhat productive soils are present in this subregion, which can succeed to alder (*Alnus* spp.) thickets following disturbances such as logging and fire, which is a recognized silvicultural issue (NLDFLR 2019b).

The RAA extends into the Long Range Barrens Ecoregion to the north and the Maritime Barrens Ecoregion to the south (NLDFLR 2019a). The Long Range Barrens is a mountainous ecoregion above the tree line, dominated by arctic-alpine species and tree species only occurring in krummholz form (stunted and deformed trees resulting from continued exposure to freezing winds, locally referred to as “tuckamore”) (NLDFLR 2019c). The Maritime Barrens Ecoregion is a temperate, wet region primarily made up of pure stands of balsam fir interspersed with large open heathlands dominated by rhodora (*Rhododendron canadense*) (NLDFLR 2019d).

The ELC divided the ELCA into polygons representing 12 ecosystem units, two of which were further divided during field surveys, resulting in 14 ecotypes (Table 9.4).

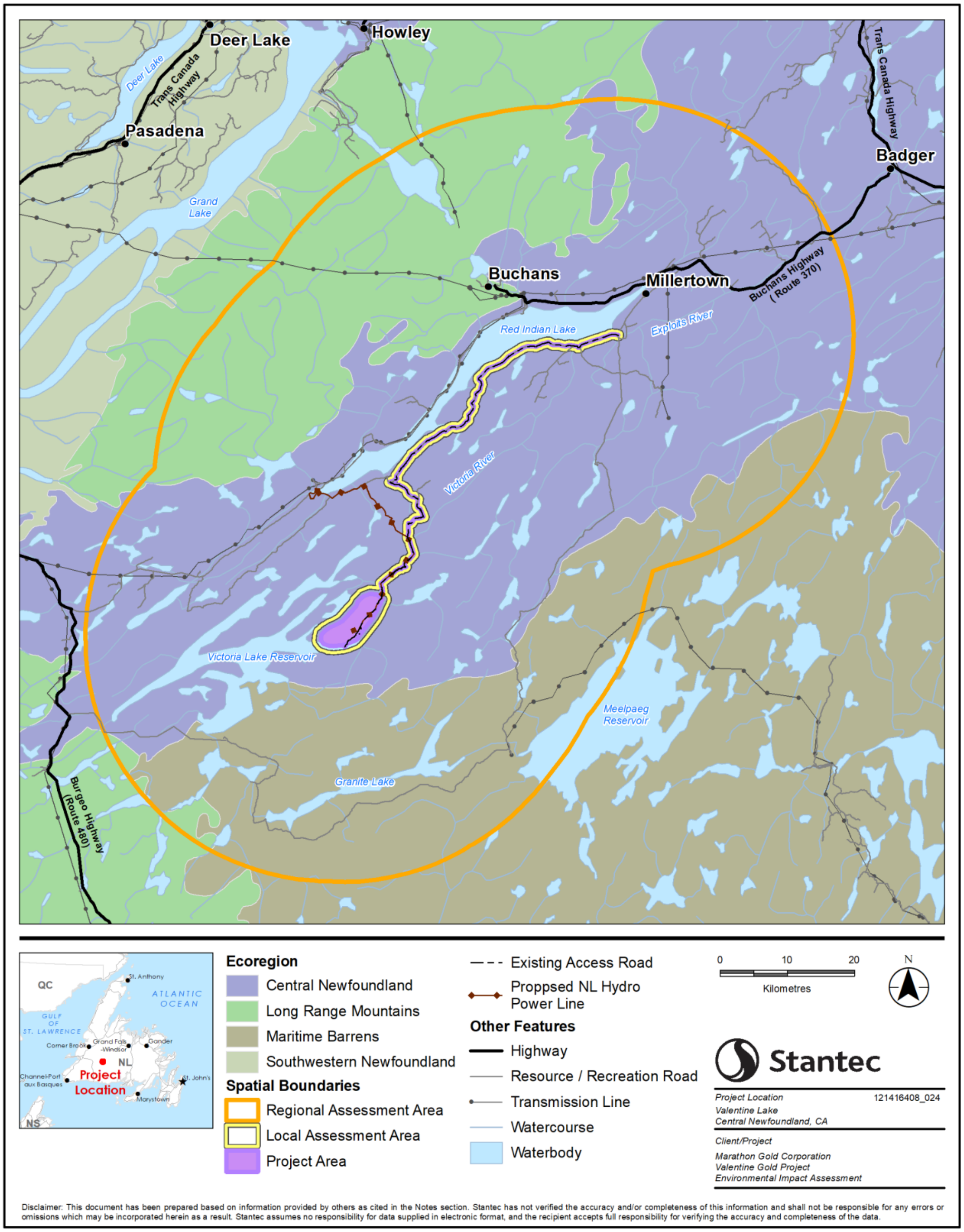

Figure 9-3 **Ecoregions and Subregions Surrounding the Project Area and LAA**

Table 9.4 Area and Percentage of Ecosystem Units within Study Areas

Ecosystem Unit	Ecotype	Description	Area in Project Area (km^2)	Percentage of Project Area	Area in LAA (km^2)	Percentage of LAA	Area in ELCA (km^2)	Percentage of ELCA
Balsam Fir Forest	Balsam Fir Forest (BF)	Dry to moist and sometimes wet conifer-dominated forests	6.2	18.0	15.1	11.9	126.9	6.9
Black Spruce Forest	Black Spruce Forest (BS)	Moist and moist to somewhat wet conifer-dominated forests	4.3	12.5	17.6	13.9	233.1	12.7
Kalmia-Black Spruce Woodland	Kalmia-Black Spruce Forest (KB) Kalmia Heath (KH)	Dry to moist and sometimes wet stunted tree and shrub / heath dominated communities	3.6	10.3	8.6	6.8	208.8	11.4
Mixedwood Forest	Mixedwood Forest (MW)	Mesic to moist forests with high hardwood component	6.0	17.3	18.9	14.9	179.3	9.8
Regenerating Forest	Regenerating Forest (RF)	Forests regenerating such as a result of harvesting, fire, windthrow	2.0	5.6	12.5	9.9	139.5	7.6
Alder Thicket	Alder Thicket (AT)	Alder-dominated communities on moist seepage slopes and riparian areas	2.2	6.5	11.9	9.3	97.4	5.3
Riparian Thicket	Riparian Thicket (RT)	Shrub thickets located in transitional areas and subject to periodic flooding	0.2	0.4	0.6	0.5	15.1	0.8
Wet Coniferous Forest	Wet Coniferous Forest (WC)	Very moist to wet conifer forests	2.5	7.2	5.7	4.5	130.7	7.1
Open Wetlands	Shrub / Graminoid Fen (SF) Shrub Bog (SB)	Very moist to wet shrub / herb dominated peatlands	4.6	13.3	11.2	8.8	280.3	15.3
Open Water	Open Water (OW)	Waterbodies (lakes, ponds, rivers and streams)	1.3	3.7	21.8	17.2	408.5	22.3

Table 9.4 Area and Percentage of Ecosystem Units within Study Areas

Ecosystem Unit	Ecotype	Description	Area in Project Area (km²)	Percentage of Project Area	Area in LAA (km²)	Percentage of LAA	Area in ELCA (km²)	Percentage of ELCA
Exposed Sand / Gravel Shoreline	Exposed Sand / Gravel Shoreline (ES)	Sparsely vegetated and/or un-vegetated shorelines	-	-	0.6	0.5	2.8	0.2
Anthropogenic	Anthropogenic (AN)	Areas currently or historically subject to intense levels of human disturbance and use (does not include areas regenerating from forest management)	1.9	5.4	2.5	1.9	8.2	0.5
Total (of Area with ELC Coverage)			**34.7**	**100.0**	**127.0**	**100.0**	**1,830.6**	**100.0**

Notes:
Ecotype descriptions from BSA.7, Attachment 7-D
Numbers are rounded to one decimal place. Areas and percentages may not add up to total amounts due to rounding
Values pertain to the portion of the Project Area and LAA within the ELCA

In the ELC, balsam fir forest, black spruce forest, kalmia-black spruce woodland (kalmia-black spruce forest and kalmia heath), mixedwood forest, regenerating forest, and alder thicket were considered forested ecosystem units; riparian thicket was listed as a riparian ecosystem unit; and wet coniferous forest, shrub / graminoid fen, and shrub bog were classified as wetland ecosystem units. The remaining three ecosystem units (exposed sand / gravel shoreline, open water and anthropogenic) were grouped as 'sparsely vegetated, naturally non-vegetated, and anthropogenically altered / disturbed' ecosystem units. Based on the descriptions of these habitats and the nationally accepted definition of wetlands [National Wetlands Working Group (NWWG) 1997], the majority of both alder thicket and riparian thicket are likely wetlands, and wetlands are present within black spruce forest and likely other forest types, although typically in localized areas that are difficult to differentiate using remote sensing. Therefore, the percentage of wetland within the Project Area and LAA is likely over 30%, rather than 22.4%, as indicated by the results of the ELC. Although discrete boundaries for wetlands within the Project Area are not known, general wetland functions in the Project Area and LAA have been described below. A brief overview of the vegetation within the ecotypes is also provided in subsections below. A complete description of the ecotypes can be found in the ELC report (BSA.7, Attachment 7-D).

The 2015 Land Cover of Canada Data (Natural Resources Canada 2019) within the RAA identifies 11 different land cover classes (Table 9.5). These are generalized classes which are not described for the Island of Newfoundland. Habitat descriptions in this EIS are for those sampled during the ELC field surveys. As the RAA extends into other ecoregions, it is presumed to contain additional habitats, such as those dominated by arctic / alpine species, which were not captured in the ELC study.

Table 9.5 Area and Percentage of 2015 Land Cover of Canada Classes within the RAA

Land Cover Class	Area in RAA[A] (km^2 / %)
Temperate or sub-polar needleleaf forest	3,468.3 / 38.7
Temperate or sub-polar broadleaf deciduous forest	665.1 / 7.4
Mixed forest	951.9 / 10.6
Temperate or sub-polar shrubland	1,800.2 / 20.1
Temperate or sub-polar grassland	34.1 / 0.4
Sub-polar or polar grassland-lichen-moss	258.7 / 2.9
Sub-polar or polar barren-lichen-moss	4.6 / 0.1
Wetland	502.6 / 5.6
Barren lands	27.5 / 0.3
Urban	21.9 / 0.2
Water	1,219.0 / 13.6
Total	**8,953.8 / 100.0**

Note:
[A] Numbers are rounded to one decimal place. Areas and percentages may not add up to the total due to rounding.

Balsam Fir Forest

The Balsam Fir Forest (BF) Ecotype is dominated by balsam fir, though black spruce is typically also an important component of the tree canopy, and paper birch is also often present as a minor component. White spruce (*Picea glauca*) was occasionally present in the overstory of the BF Ecotype. The shrub layer is characteristically dominated by balsam fir, lesser amounts of black spruce and scattered occurrences of other regenerating tree species. Ericaceous, deciduous and dwarf shrubs, such as creeping snowberry (*Gaultheria hispidula*) and twinflower (*Linnaea borealis*), are often common yet typically of low abundance. The understory vegetation is typically composed of sparse vascular plant growth and a well-developed bryophyte layer. The presence of forbs and graminoids is dependent on the local moisture regime, which typically ranges from fresh to moist, as the soils are moderately well to imperfectly drained. Dominant herbaceous species in this ecotype typically include bunchberry (*Cornus canadensis*) and mountain wood-fern, and can also include stiff clubmoss (*Lycopodium annotinum*), one-sided wintergreen (*Orthilia secunda*), dewberry (*Rubus pubescens*), northern oak fern (*Gymnocarpium dryopteris*), threefruit sedge (*Carex trisperma*) and hoary sedge (*Carex canescens*). This ecotype is characterized by an almost continuous layer of bryophytes on the forest floor, the majority of which is stairstep moss (*Hylocomium splendans*) and/or Schreber's feathermoss (*Pleurozium schreberi*), with lesser amounts of plume moss (*Ptilium crista-castrensis*), common broom moss (*Dicranum scoparium*), wavy-leaved broom moss (*Dicranum polysetum*) and three-lobed whipwort (*Bazzania trilobata*). Peatmoss (*Sphagnum* spp.) may also be abundant in localized wetland areas with imperfect drainage, however it does not typically comprise an important component of understory vegetation in this ecotype.

As the wetland areas within the BF Ecotype are generally small inclusions, likely on slopes, their functions are likely somewhat limited. These wetland areas increase landscape habitat heterogeneity, and along with the surrounding forest, contribute to carbon sequestration. Balsam fir-dominated wetlands are often associated with groundwater discharge sites, and in those cases, wetlands would contribute to stream flow support, water cooling, and organic nutrient export (New Brunswick Department of Environment and Local Government [NBDELG] 2018). These wetlands contribute to overall avifauna and mammal habitat, and to overall diversity.

The BF Ecotype is the most abundant ecotype in the Project Area, representing approximately 18.0%. The ecotype is slightly less common in the LAA, representing approximately 11.9%.

Black Spruce Forest

The Black Spruce Forest (BS) Ecotype is common in central Newfoundland and has an overstory characterized by moderately dense black spruce, with typically minor presence of balsam fir and paper birch. The shrub layer in the BS Ecotype is typically well-developed and dominated by black spruce of various heights, as well as an abundance of sheep laurel (*Kalmia angustifolia*) and lesser amounts of species such as rhodora, balsam fir, and the dwarf shrubs creeping snowberry and trailing arbutus (*Epigaea repens*). The herbaceous layer is usually moderately to well-developed and typically dominated by bunchberry. The presence of other understory species is typically dependent on local soil moisture and can include threefruit sedge, dewberry, little prickly sedge (*Carex echinata*), northern oak fern, goldthread (*Coptis trifolia*) and yellow clintonia (*Clintonia borealis*). Well-drained sites tend to contain a bryophyte carpet of stairstep moss and Schreber's feather moss; these species are also present in lesser amounts at imperfectly drained sites.

Wetlands are likely common within this ecotype. These black spruce-dominated wetlands are likely important for carbon sequestration and wildlife habitat (NBDELG 2018).

The BS Ecotype is relatively common, both in the Project Area where it comprises approximately 12.5%, and the LAA where it accounts for approximately 13.9%.

Kalmia-Black Spruce Forest

The Kalmia-Black Spruce Forest (KB) Ecotype is an open forest dominated in the overstory by black spruce, with occasional balsam fir and tamarack (*Larix laricina*). The tree layer is often stunted as soils are typically shallow and stony with exposed bedrock. The shrub layer is dominated by scrubby black spruce and sheep laurel, with rhodora, late lowbush blueberry (*Vaccinium angustifolium*) and creeping snowberry often present in lesser amounts. The herbaceous layer is typically sparse, dominated by bunchberry, and typically containing goldthread and threefruit sedge. The bryophyte layer is well developed and dominated by Schreber's feathermoss in upland areas, with some wavy-leaved broom moss and three-lobed whipwort present. Peatmoss dominates localized wetland areas, although wetlands are uncommon in this ecotype. Several species of reindeer lichen (*Cladina* spp.) are present in patches throughout the ecotype, particularly in areas with exposed bedrock.

The KB Ecotype is not differentiated from the Kalmia Heath (KH) Ecotype in the remote sensing mapping. Together, they comprise the Kalmia-Black Spruce Woodland Ecosystem Unit, which accounts for approximately 10.3% of the Project Area and 6.8% of the LAA.

Kalmia Heath

The Kalmia Heath (KH) Ecotype typically occurs in association with the KB Ecotype yet lacks tree canopy and occurs where bedrock is near the surface or fully exposed. Areas with intermediate characteristics between these two ecotypes are common. KH Ecotype sites are typically dry and exposed to desiccating winds with little protective snow cover in winter. These factors typically influence vegetation species composition and structure. Shrubs are abundant in this ecotype, and are dominated by sheep laurel, stunted black spruce and rhodora. Other common yet less-abundant shrubs include late lowbush blueberry, black crowberry (*Empetrum nigrum*), leatherleaf (*Chamaedaphne calyculata*), balsam fir and creeping snowberry. Herbaceous species, which are scattered and typically of low abundance, include bunchberry, northern pitcher-plant (*Sarracenia purpurea*), goldthread, cloudberry (*Rubus chamaemorus*), stiff clubmoss, northern starflower (*Trientalis borealis*), deergrass (*Trichophorum caespitosum*), threefruit sedge, few-flowered sedge (*Carex pauciflora*) and few-seeded sedge (*Carex oligosperma*). Feather mosses and reindeer lichens are present throughout upland areas.

Although this ecotype is largely dry, pockets of wetland are present where peatmoss dominates the bryophyte layer. These would represent small inclusions of bog vegetation and would have similar wetland functions.

The KH Ecotype is mapped together with the KB Ecotype to make the Kalmia-Black Spruce Woodland Ecosystem Unit, which accounts for approximately 10.3% of the Project Area and 6.8% of the LAA.

Mixedwood Forest

The Mixedwood Forest (MW) Ecotype has an overstory dominated by balsam fir and paper birch. The understory species composition is largely related to the density of the overstory and related soil conditions. Areas with open tree canopy typically have a shrub layer dominated by red raspberry (*Rubus idaeus*), and a more closed tree canopy leads to a shrub layer dominated by regenerating tree species. Other shrubs that may be found scattered within this ecotype include Canada yew (*Taxus canadensis*), mountain maple (*Acer spicatum*), and the dwarf shrubs twinflower (*Linnaea borealis*) and creeping snowberry. The composition of the herbaceous understory is also largely dependent on the density of the tree layer. Common herbaceous species present in the MW Ecotype include ferns, such as mountain wood-fern (*Dryopteris campyloptera*) and to a lesser extent, evergreen woodfern (*Dryopteris intermedia*), as well as bunchberry, wood reedgrass (*Cinna latifolia*), northern starflower, dewberry, northern oak fern and small enchanter's nightshade (*Circaea alpina*). Bryophyte cover is typically patchy and dominated by stairstep moss and wavy-leaved broom moss. Schreber’s feathermoss, common broom moss and other species (e.g., *Rhytidiadelphus* sp.) may also be present. Wetlands are uncommon within this ecotype.

The MW Ecotype is common, representing approximately 17.3% of the Project Area and 14.9% of the LAA.

Regenerating Forest

The Regenerating Forest (RF) Ecotype occurs in areas where disturbance has resulted in greatly reduced tree cover. Such disturbances within the LAA typically include timber harvesting and mineral exploration and extraction, and can include fire, windthrow and insect epidemics. Tree cover is generally absent in the RF Ecotype. The shrub layer is composed of isolated patches of regenerating trees, typically black spruce and balsam fir with some paper birch, and the ericaceous shrubs sheep laurel and late lowbush blueberry. Other ericaceous shrubs can also be present, including partridgeberry (*Vaccinium vitis-idaea*) and creeping snowberry, along with scattered hardwood shrubs, particularly speckled alder (*Alnus incana*) and fire cherry (*Prunus pensylvanica*). The herbaceous layer is dominated by bunchberry. Other species which are occasionally abundant include stiff clubmoss, bristly sarsaparilla (*Aralia hispida*) and yellow clintonia. Feathermosses are common and crustose lichens are common on drier sites. Isolated wetlands likely occur sparsely within this ecotype.

The RF Ecotype is less common in the Project Area, where it represents approximately 5.6%, than in the LAA, where it accounts for approximately 9.9%.

Alder Thicket

The Alder Thicket (AT) Ecotype is frequently associated with groundwater seepage or discharge. These sites are wetter and more nutrient rich than many of the previously described ecotypes. This ecotype was included in a grouping of forested ecosystem units in the ELC (BSA.7, Attachment 7-D) because it typically develops following commercial tree harvest and can represent an intermittent phase prior to a slow reversion back to forested stands. The subsequent forest stands are often wetter resulting from raised water tables, an effect commonly seen in harvested stands. Although scattered trees of a variety of species are not uncommon, this ecotype is typically dominated by speckled alder; occasionally green alder (*Alnus viridis*) dominates. Other species common in the shrub layer include red raspberry, currant (*Ribes* sp.), balsam fir and sweet gale (*Myrica gale*). Herbaceous vegetation is typically dominated by ferns, including evergreen woodfern and mountain wood-fern. Other species common in the herbaceous understory include dewberry, bluejoint reedgrass (*Calamagrostis canadensis*), purplestem aster (*Symphyotrichum puniceum*) and hoary sedge. Bryophytes are largely shaded out by leaf litter, except for peatmoss, which is prominent at wetter AT Ecotype sites.

This ecotype is composed largely of wetland. These wetlands provide habitat for a variety of wildlife species, particularly as a food source. Alder thickets typically occur at groundwater discharge sites and may be stream headwaters. These wetlands would provide water storage and delay functions, reducing flooding in downstream areas, and would provide stream flow support and water cooling. However, alder thicket wetlands are likely not important for fish habitat (NBDELG 2018).

The AT Ecotype represents approximately 6.5% of the Project Area and 9.3% of the LAA.

Riparian Thicket

The Riparian Thicket (RT) Ecotype occurs largely on active floodplains that flood annually or periodically, typically along the shores of larger rivers and lakes. The tree canopy is typically lacking, and if present, sparse. The dominant shrub species in the RT Ecotype is sweet gale. Other common shrub species include narrow-leaved meadow-sweet (*Spiraea alba*), leatherleaf and green alder. The composition of the herbaceous layer is largely dependent on distance to the water's edge, and is primarily dominated by graminoids, such as cottongrass bulrush (*Scirpus cyperinus*), inflated sedge (*Carex vesicaria*), little prickly sedge, red-tinged bulrush (*Scirpus microcarpus*) and slender sedge (*C. lasiocarpa*). Common forbs include water horsetail (*Equisetum fluviatile*), blueflag (*Iris versicolor*), marsh St. John's-wort (*Triadenum fraseri*), sensitive fern (*Onoclea sensibilis*) and white turtlehead (*Chelone glabra*).

This ecotype is composed primarily of wetland. These wetlands assist in shoreline stabilization and amelioration of flooding by slowing the flow of river water and providing some water storage and delay function. The RT Ecotype can provide some organic nutrient export function. More densely vegetated sites contribute to sediment retention and water cooling and may provide fish habitat during periods of flooding. Riparian thickets provide habitat for aquatic invertebrates, as well as songbirds, some mammals such as beavers, and some waterfowl (NBDELG 2018).

The RT Ecotype is not common. It accounts for approximately 0.4% of the Project Area and 0.5% of the LAA.

Wet Coniferous Forest

The Wet Coniferous Forest (WC) Ecotype is rich and diverse, primarily composed of treed fens and bogs that often occur in a transitional zone adjacent to open peatland communities. The tree canopy is dominated by typically stunted black spruce with some scattered balsam fir and tamarack. The shrub stratum is also dominated by the same regenerating tree species, with some alder, sweet gale and leatherleaf. The understory layer in the WC Ecotype is primarily dominated by some dwarf shrubs, including creeping snowberry, twinflower and late lowbush blueberry; forbs such as three-leaf Solomon's-plume (*Maianthemum trifolium*), bunchberry and dewberry; and a high diversity of graminoids, including threefruit sedge, little prickly sedge, Atlantic sedge (*Carex atlantica*), Buxbaum's sedge (*C. buxbaumii*) and bristlestalk sedge (*C. leptalea*). The bryophyte layer is a well-developed carpet of peatmoss, with some feathermosses and other more upland bryophytes present on raised hummocks. Based on the field work conducted at sample sites, coniferous treed fen is more common than coniferous treed bog in the ELCA.

This ecotype is wetland, possibly with small upland inclusions. The WC Ecotype provides several hydrologic functions, including water storage and delay, stream flow support, water cooling, and habitat for fish where watercourses are associated with the wetlands. They can also function to retain and stabilize sediments, sequester carbon, and export organic nutrients through watercourses or other outlets. These wetlands provide habitat for wildlife, such as avifauna and mammals, including moose, black bear and American marten (Newfoundland population) (NBDELG 2018).

The WC Ecotype is more common in the Project Area, where it represents approximately 7.2%, than in the LAA, where it accounts for approximately 4.5%.

Shrub / Graminoid Fen

The Shrub / Graminoid Fen (SF) Ecotype occurs on flat areas and in poorly drained basins, on neutral to moderately alkaline substrates, and is typically associated with other wetland ecotypes. This ecotype is characterized by no tree cover and a shrub layer dominated by low-lying shrubs and some taller shrubs, including sweet gale, Michaux's dwarf birch (*Betula michauxii*) and shrubby cinquefoil (*Dasiphora fruticosa*), with lesser amounts of tamarack, black spruce and purple chokeberry (*Photinia* spp.). The herbaceous layer is dominated by graminoids, including deergrass, white beakrush (*Rhynchospora alba*), few-seeded sedge and Pickering's reedgrass (*Calamagrostis pickeringii*). Other common species include bottlebrush (*Sanguisorba canadensis*), coast sedge (*Carex exilis*) and bog goldenrod (*Solidago uliginosa*). Peatmoss dominates the continuous bryophyte layer, occasionally interspersed by other species such as feathermosses on raised hummocks. The fens in the ELCA are relatively nutrient-poor and as a result their species assemblages resemble the Shrub Bog (SB) Ecotype, however they can be distinguished by the presence of some species typically associated with nutrient enrichment, such as Michaux's dwarf birch, shrubby cinquefoil, bottlebrush, balsam groundsel (*Packera paupercula*) and Michaux's sedge (*Carex michauxiana*).

This ecotype is entirely wetland. Fens are typically associated with groundwater and/or flowing surface water, and therefore these wetlands may act as headwaters and likely contribute to stream flow support, water cooling, organic nutrient export, and fish habitat. The dense vegetation and prevalence of peat allows this wetland ecotype to store water and retain and stabilize sediments. The SF Ecotype contributes to carbon sequestration, though likely not to the same extent as bog ecotypes. Many wildlife species use this ecotype as habitat (NBDELG 2018).

The SF Ecotype is not differentiated from the Shrub Bog (SB) Ecotype on remote sensing mapping. Together they compose the Open Wetlands Ecosystem Unit, which accounts for approximately 13.3% of the Project Area and 8.8% of the LAA.

Shrub Bog

The SB Ecotype, much like the SF Ecotype, occurs on flat areas and in poorly drained basins, yet is on neutral to moderately acidic substrates rather than alkaline. It is typically associated with other wetland types as part of larger wetland complexes. The SB Ecotype has no tree or tall shrub cover, and the low shrub layer is intermixed with herbaceous species. Sheep laurel and leatherleaf are the two dominant species; other common species include black spruce, bog rosemary (*Andromeda polifolia*), rhodora, black chokeberry (*Photinia melanocarpa*), black crowberry, northern blueberry (*Vaccinium boreale*), common Labrador tea (*Ledum groenlandicum*) and bog laurel (*Kalmia polifolia*). The herbaceous layer is dominated by graminoids such as deergrass, coast sedge, and white beakrush, and includes northern pitcher-plant and roundleaf sundew (*Drosera rotundifolia*), which are common although less abundant. As with the SF Ecotype, peatmoss forms a continuous carpet, with some other bryophytes present on drier hummocks. Reindeer lichens, particularly gray and green reindeer lichens, are abundant, and other lichens are present in more discrete patches. Although the dominant species of the SB Ecotype are similar to the SF Ecotype, the SB Ecotype has a higher occurrence of species associated with acidic conditions, such as sheep-laurel, leatherleaf, black spruce and blueberry (*Vaccinium* spp.), and species that indicate a drier surface layer, such as the ground lichens.

This ecotype is entirely wetland. The SB Ecotype performs some nitrate removal and retention, contributes to carbon sequestration, and provides wildlife habitat (NBDELG 2018).

The SB and SF Ecotypes are combined in the remote sensing mapping. Together they compose the Open Wetlands Ecosystem Unit, which accounts for approximately 13.3% of the Project Area and 8.8% of the LAA.

Open Water

The Open Water (OW) Ecotype includes lakes, ponds, and rivers within the Project Area and LAA. Lakes and ponds are naturally occurring bodies of water, the boundary of which is the natural high-water mark. Rivers include watercourses formed when water flows between continuous, definable banks.

The OW Ecotype is much less common in the Project Area where it accounts for approximately 3.7%, than in the LAA where it accounts for 17.2%.

Exposed Sand / Gravel Shoreline

The Exposed Sand / Gravel Shoreline (ES) Ecotype includes areas with less than 20% vegetated cover that are generally elongated and running parallel to a shoreline, such as that of Red Indian Lake and Victoria Lake Reservoir. These ecotype areas tend to be generated by waves and currents, and are composed of unconsolidated small, rounded cobbles, pebbles, stones and sand. Typically, erosive action limits vegetation along the shoreline within the ecotype, however, further from the water some early succession can be seen in the sparse presence of species such as dwarf ericaceous shrubs, lichens and some bryophytes, followed by some willows, grasses, sedges and horsetails.

The ES Ecotype is uncommon. It is not mapped within the Project Area, however it is found within the larger LAA, where it accounts for approximately 0.5%.

Anthropogenic

The Anthropogenic (AN) Ecotype includes areas of exposed soil and less than 5% vegetation cover that are not included in any previous ecotype definition. This ecotype primarily reflects anthropogenic disturbances, such as access roads and borrow pits, and can also include recent disturbances such as slumping, mass wasting and flooding. Although vegetation cover is limited, some ruderal herbs can be present, including species such as rough bentgrass (*Agrostis scabra*), poverty oatgrass (*Danthonia spicata*), pearly everlasting (*Anaphalis margaritacea*), flat-top fragrant-golden-rod (*Euthamia graminifolia*), and low hop clover (*Trifolium campestre*). As the ELC was conducted in 2015, some areas classed as AN Ecotype at that time may have additional vegetative cover at present, however, most AN sites have been subject to regular disturbance since that time and would likely still fall within this ecotype.

Likely because of past exploration work associated with the Project, the AN Ecotype makes up approximately 5.4% of the Project Area, although only 1.9% of the LAA.

9.2.2.2 Rare Vascular Plant Species

Through the three field surveys, 290 vascular plant species were observed within the Project Area and adjacent portions of the LAA. During surveys conducted in support of the ELC, 205 vascular plants were observed. During the 2017 RPS, 255 vascular plant species were observed, and 176 vascular plant species were observed during the 2019 RPS. No vascular plant SAR were observed during the surveys conducted in support of the Project. Several vascular plant SOCC were observed (Figure 9-4), including:

- Short-scale sedge (*Carex deweyana*, S2)
- Nodding water nymph (*Najas flexilis*, S2)
- Perennial bentgrass (*Agrostis perennans*, S2)

Nine species ranked S3 (Vulnerable) were also observed during surveys (BSA.7, Attachment 7-F and 7-I). Although ranked Vulnerable by the AC CDC, these plants are typically not considered SOCC in NL, a determination at the discretion of the NLDFFA-Wildlife Division. The remainder of plants observed during surveys are ranked S3S4 (between Vulnerable and Apparently Secure), S4 (Apparently Secure), S4S5, S5 (Secure), or SNA (species not ranked, typically because it is considered exotic) on the Island of Newfoundland.

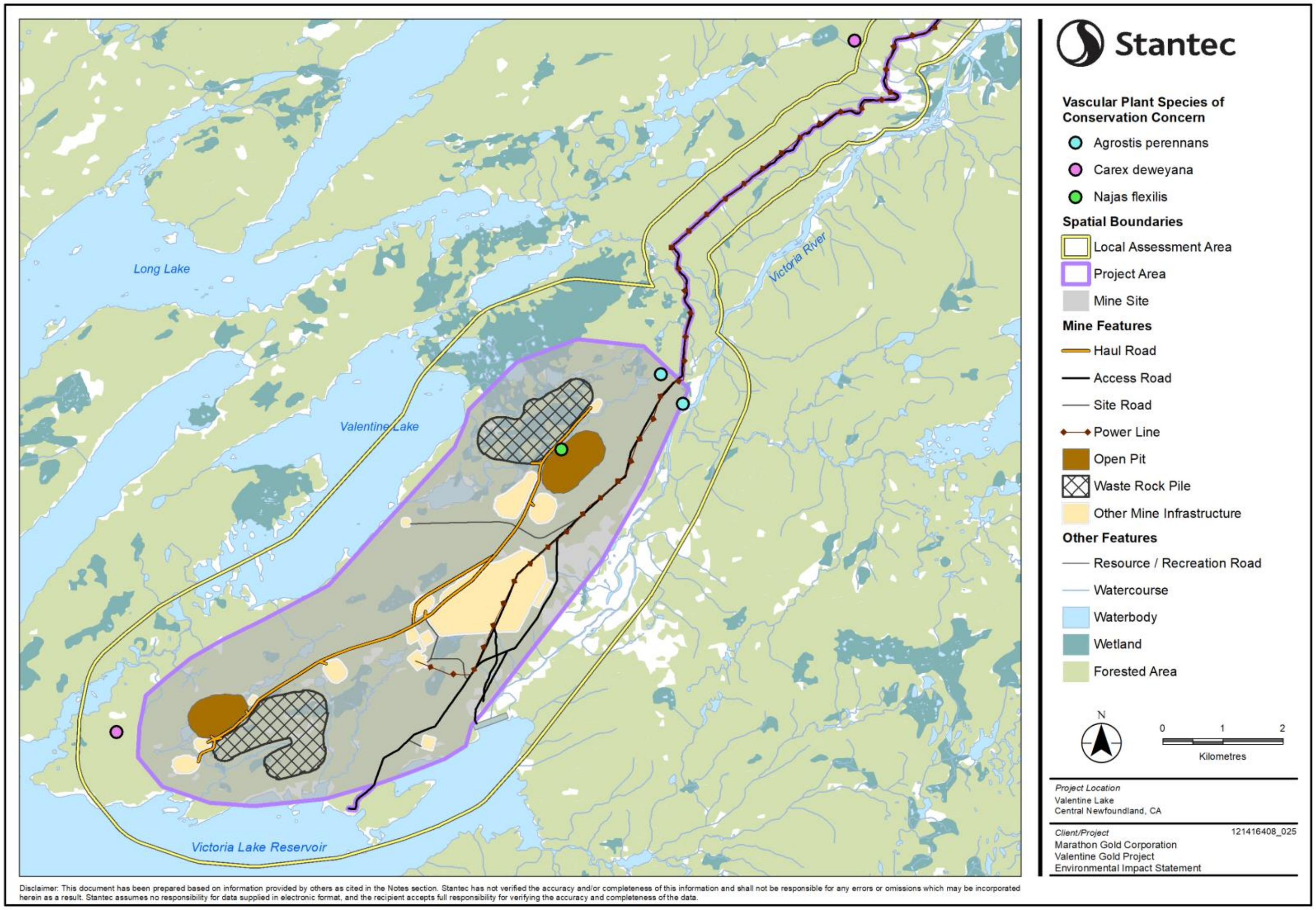

Figure 9-4 Locations of Observed Vascular Plant SOCC

Short-Scale Sedge

Short-scale sedge is a low-growing, perennial sedge in the Cyperaceae family. It has a relatively small inflorescence that has a silvery appearance resulting from the translucent pistillate scales (Gleason and Cronquist 1991). The inflorescence is typically subtended by a long bract (Hinds 2000). It can grow densely to loosely clumped to a height of 120 cm, although it is typically shorter. Short-scale sedge has been reported from all Canadian provinces and territories except Nunavut (United States Department of Agriculture (USDA) n.d.a). Its range on the Island of Newfoundland includes western, southwestern, northwestern and eastern Newfoundland (BSA.7, Attachment 7-F). This species is ranked S2 on the Island of Newfoundland (AC CDC 2015), yet is common (S4 to S5) in other Atlantic provinces (AC CDC 2020b) and other parts of its range.

The habitat preferences of short-scale sedge are reported as open hardwood or hardwood and mixedwood forests (Hinds 2000; Haines 2011). This species was observed in two locations during ELC field surveys conducted in 2015 (Figure 9-4). Both observations were of small numbers of plants located in alder thicket habitat (AT Ecotype). One observation was within the LAA yet outside of the Project Area, west of the Leprechaun pit, with the other adjacent to the portion of LAA associated with the access road. No additional populations were observed or located during the 2017 or 2019 RPSs, suggesting that plants may be restricted to a small range.

Nodding Water Nymph

Nodding water nymph is an aquatic monocot that grows in shallow water (Hinds 2000). It is a submerged and rooted annual plant, and its many-branched stems can range from 5 to 50 cm in length and 0.2 to 0.6 mm in width. Its minutely serrated leaves are 1 to 4 cm long and 0.2 to 0.6 mm wide (Gleason and Cronquist 1991). Nodding water nymph produces many fruits and is known to be a food source for waterfowl. This species is known from all Canadian provinces and Northwest Territories (USDA n.d.b). In NL, its range includes western, northern and central Newfoundland (Meades et al. 2000). This species is ranked S2 on the Island of Newfoundland (AC CDC 2015). It is considered common (S5) in New Brunswick and Nova Scotia, although is ranked S1 in Prince Edward Island (AC CDC 2020b).

Nodding water nymph is typically found on the margins of lakes and rivers, although is also known from pools in bogs (Gleason and Cronquist 1991; Reznicek et al. 2011). This species was observed during the 2017 RPS, in a pool of water within an Open Wetland Ecosystem Unit within the planned Marathon pit (Figure 9-4).

Perennial Bentgrass

Perennial bentgrass is a graminoid that grows in tufts, from 50 to 100 cm in height. Its leaves are flat and from 2 to 6 mm wide (Gleason and Cronquist 1991). Perennial bentgrass has an elongated, pale inflorescence from 10 to 25 cm in length. This is an eastern species, known within Canada from the Island of Newfoundland, west to Ontario (USDA n.d.c). On the Island, its range includes northern to western-central Newfoundland (Meades et al. 2000). This species is ranked S2 on the Island of Newfoundland (AC CDC 2015). It is relatively common in New Brunswick and Nova Scotia (where it is ranked S5 and S4S5, respectively), although it is considered Vulnerable (ranked S3) in Prince Edward Island (AC CDC 2020b).

Perennial bentgrass has various reported preferred habitats. Hinds (2000) states this species is found in moist woods and on flooded shores, while Gleason and Cronquist (1991) report it from various dry habitats. It was observed in two locations during the ELC surveys, both within AT Ecotype habitat, one in the northeastern end of Project Area outside the planned Project components, and the other within the LAA, adjacent to the LAA near Victoria River (Figure 9-4).

AC CDC Rare Vascular Plant Records

AC CDC data was obtained for a five km buffer around the Project Area (AC CDC 2020a). Two vascular plant SOCC have been previously recorded in this area: red pine (*Pinus resinosa*) and pinesap (*Hypopitys monotropa*). Neither species was observed during field surveys of the mine site portion of the Project Area, and neither has been previously recorded within the mine site portion of the Project Area.

Red pine, which is ranked S2 on the Island of Newfoundland by the AC CDC, was recorded three times: twice in 1962 and once in 1965. The exact locations of these observations are not known as the provided coordinates, which have an accuracy of 1,000 m, place them near Victoria River. However, the descriptions associated with the records describe the locations as Overflow Pond and near Noel Paul's Brook, which are approximately 50 km and over 18 km, respectively, from Victoria River. Regardless of the true locations, if the red pines are still present, they appear to be located outside of the LAA.

Pinesap is ranked S3 on the Island of Newfoundland by the AC CDC. It is a non-photosynthetic, mycotrophic forb that was recorded in 1999 along the road from Millertown to the mine site portion of the Project Area. While this observation has an accuracy of 1,000 m, if this species is still present at this location it is within the LAA and is also likely within the Project Area.

9.2.2.3 Invasive Vascular Plants

Of the species recorded during past work completed in support of the Project, 38 have an S Rank of SNA, which is given when a species is not considered a suitable target for conservation activities). The SNA rank typically indicates a species is exotic, or not native to an area. Of these 38 SNA-ranked species, most are ruderal species that are typically found along roadsides or in other disturbed habitats and are not considered invasive. Although there is no official list of invasive species for Newfoundland and Labrador, four species have potential to be invasive, based on their growth form and status in other parts of the Atlantic Provinces:

- Reed canary grass (*Phalaris arundinacea*)
- Creeping buttercup (*Ranunculus repens*)
- Coltsfoot (*Tussilago farfara*)
- Broad-leaved cattail (*Typha latifolia*)

Reed canary grass is a problematic species in open minerotrophic wetlands, ditches and shorelines where it can form monocultures and is believed to negatively affect rare plant populations (Anderson

2012; Hill and Blaney 2010). Although considered a native species with an exotic and invasive subspecies throughout much of its range, there is no native subspecies in NL (AC CDC 2015). This species was observed along the side of a gravel road in the AN Ecotype near an unnamed lake within the planned Leprechaun pit.

Although creeping buttercup is not listed officially as an invasive species, it is an exotic species that is known to be common within forest ecosystems where it can form monocultures and outcompete native plants [Invasive Plant Atlas of the United States (IPAUS) 2018; Hill and Blaney 2010]. This species was observed within the WC Ecotype in the planned Marathon pit and within the MW Ecotype outside of the processing plant footprint.

Coltsfoot, though common along roadsides and in ditches, is also known to inhabit shorelines, rock outcrops or sandy and gravelly bars (Hill and Blaney 2010). This species is considered an invasive species in other parts of Atlantic Canada (HRM n.d.). It was observed within a disturbed exploratory area in the planned Marathon pit in what was previously the BS Ecotype, along the shore of an unnamed lake in the RT Ecotype within the planned Leprechaun pit, and roadside in the AN Ecotype within the planned Leprechaun waste rock pile. While broad-leaved cattail is native throughout much of its range, it is not considered native on the Island of Newfoundland (AC CDC 2015). This species commonly becomes dominant in disturbed wetlands where its dense growth form and tall height can exclude many other native species (Hill and Blaney 2010). Broad-leaved cattail was observed in several places, including within the RF Ecotype, located in a disturbed exploratory area in the planned Marathon pit.

9.2.2.4 Indigenous Plant Use

As detailed in Chapter 17 (Indigenous Groups), the Mi’kmaq have traditionally harvested plant species, such as wild berries (Emera Newfoundland and Labrador 2013). The Miawpukek First Nation (Miawpukek) are known to harvest plants for medicinal purposes, including cherry (*Prunus* spp.), lily pad (also known as yellow cowlily, *Nuphar variegata*), and alder (*Alnus* spp.). White pine (*Pinus strobus*) is also used for a variety of purposes (MFN 2020; Chapter 17). Several species of wild berries have been recorded during vegetation surveys, as well as fire cherry and yellow cowlily. Miawpukek has noted that, while in the past its members harvested for traditional purposes in the area in which the Project is located, use of land and resources in this area has declined in recent years (MFN 2020; Chapter 17). The Qalipu Mi’kmaq First Nation (Qalipu) are known to continue to use traditional plants, including alder bush, balsam fir, bunchberry, cedar (likely the species also known as creeping juniper, *Juniperus horizontalis*), coltsfoot, Labrador tea, yarrow (*Achillea millefolium*), yellow birch (*Betula alleghaniensis*), fireweed (*Chamerion angustifolium*) and partridgeberry (Qalipu First Nation n.d.(b)).

All species other than white pine and yellow birch have been observed during vascular plant surveys conducted in support of the Project and observed traditional use plants are common within the Project Area.

9.2.2.5 Terrain

Terrain, or landforms, includes an overview of topography, unique landform features and the surficial geology within the LAA.

Topography

The LAA is located within the Red Indian Lake Subregion consisting of rolling hills, dense forest and organic deposits occurring in valleys and basins. Terrain (i.e., topography and landforms) varies across the LAA ranging from boggy areas, thin to thick till layers and bedrock outcrops. Soils across the LAA are complexes of organic and mineral soils reflecting the underlying topography and subsequently will require various rehabilitation strategies.

Elevation within the Project Area ranges from 160 m above sea level (m asl) to 437 m asl; within the mine site, it ranges from 270 m asl to 437 m asl. Maximum elevations are located near the centre of a ridge that runs southwest to northeast throughout the mine site. Lower elevations within the mine site are primarily along Victoria Lake Reservoir in the southwestern part of the Project Area.

Unique Landforms and Features

The topography, elevation and terrain conditions of the LAA are generally common within the CNF Red Indian Lake subregion. The landscape is characterized by upland forests and interspersed lowlands [i.e., wetlands (e.g., peatlands and treed wetlands)], and open water habitats (BSA.7, Attachment 7-D). Most landforms within the LAA and Project Area are not unique, as the terrain consists of gently undulating, rolling and sloping topography, with slopes typically less than 30%. The terrain is controlled by bedrock that is predominantly overlain by medium textured till of variable thickness (typically greater than 1m depth in the Project Area). Scattered wetlands (specifically patterned fens and bogs) are common in the LAA and Project Area. Wetlands and other ecosystems are discussed further in Section 9.2.2.1 and Section 9.2.2.2.

Wetland ecosystems (bogs and fens) occupy 280.3 km^2 (15.3%) of the ELCA (BSA.7, Attachment 7-D). The WC Ecotype is also characterized by a unique and diverse flora with a rich herbaceous layer and well-developed moss carpet (BSA.7, Attachment 7-D). The WC Ecotype primarily represents treed wetlands that may occur as extensive areas or in the transitional zone of more open peatland communities (i.e., bogs and fens). This Ecotype often occurs in association with other adjacent wetland types as part of larger wetland complexes. These areas are common throughout the LAA.

Two small glaciofluvial ridges were observed on regional surficial geology mapping, located just south of the existing exploration camp along the Victoria Lake Reservoir shoreline. These features are just outside of and adjacent to the Project Area. Glaciofluvial deposits of varying depth were noted in the ELC report (BSA.7, Attachment 7-D). Glaciofluvial ridges can sometimes represent eskers. Eskers are sinuous glaciofluvial ridges typically composed of sand and gravel. Depending on sediment texture and coarse fragment content, eskers may provide aggregate materials for construction purposes and can provide wildlife habitat (i.e., for denning species). Eskers were not noted in the ELC report.

Surficial Geology

Surficial geology is summarized in terms of dominant parent material within the Project Area and LAA, as provided in Table 9.6. Dominant parent materials are associated with the formation of the landform and/or the steepness of the representative slopes (e.g., upland soils formed on terrain with noticeable relief that is a result of morainal till material).

Table 9.6 Area and Percentage of Dominant Parent Material and Soil Subgroups within the Portion of Project Area and LAA (Ecotypes Mapped within the ELCA)

Ecotypes	Dominant Parent Material	Soil Subgroups	Descriptions	Area in Project Area[A] (km^2 / %)	Area in LAA[A] (km^2 / %)
Upland Ecosystems					
Balsam Fir Forest	Morainal (till), Colluvium, Weathered Bedrock	Orthic Humo-Ferric Podzols; Gleyed Ferro-Humic Podzols; Orthic Gleysols; Rego Gleysols	Dry to moist, sometimes wet conifer dominated forests dominated by variable thickness till deposits.	6.2 / 17.9	15.1 / 11.9
Black Spruce Forest	Morainal (till), Colluvium	Orthic Humo-Ferric Podzols; Gleyed Ferro-Humic Podzols; Orthic Gleysols; Rego Gleysols	Typically found on gently sloping to level terrain. Wetter (i.e., imperfect drainage) soils, dominated by variable thickness till deposits.	4.3 / 12.5	17.6 / 13.9
Kalmia-Black Spruce Forest	Morainal (till), Colluvium	Orthic Humo-Ferric Podzols, Organic Folisols	Located along upper slopes and ridges, through to level valley bottom. Dry to moist and sometimes wet stunted tree and shrub / heath dominated communities.	3.6 / 10.3	8.6 / 6.8
Kalmia Heath	Morainal (till), Colluvium	Organic Folisols, Orthic Humo-Ferric Podzols	Found along ridges / crests and upper slopes as well as hummocky to gentle slopes. Dry to moist and sometimes wet stunted tree and shrub / heath dominated communities; includes fragmental colluvial deposits.		
Mixedwood Forest	Morainal (till), Colluvium, Fluvial	Orthic Humo-Ferric and Ferro-Humic Podzols;	Range of slope positions (upper slopes to valley bottom) with undulating, rolling and hummocky topography. Mesic to moist forests with high hardwood component.	6.0 / 17.3	18.9 / 14.9
Regenerating Forest	Morainal (till), Colluvium	Orthic and Orstein Humo-Ferric and Ferro-Humic Podzols		2.0 / 5.6	12.1 / 9.9
Alder Thicket	Morainal (till), Fluvial	Orthic Gleysol; Rego Gleysol; Orthic Humic Gleysol; Orthic Regosol; Gleyed Regosol	Semi-stable thickets form on gently sloping, level to lightly depressed areas on seepage slopes derived from morainal (till) deposits. Also mapped near watercourses.	2.2 / 6.5	11.9 / 9.3
Riparian Thicket	Fluvial, Lacustrine, Morainal (till)	Orthic Gleysol; Rego Gleysol; Orthic Humic	Shrub thickets located in transitional areas and subject to periodic flooding variable depth to bedrock 0-30 cm rooting depth.	0.2 / 0.4	0.6 / 0.5

Table 9.6 Area and Percentage of Dominant Parent Material and Soil Subgroups within the Portion of Project Area and LAA (Ecotypes Mapped within the ELCA)

Ecotypes	Dominant Parent Material	Soil Subgroups	Descriptions	Area in Project Area[A] (km^2 / %)	Area in LAA[A] (km^2 / %)
		Gleysol; Orthic Regosol; Gleyed Regosol;			
Organic / Wetland Ecosystems					
Wet Coniferous Forest	Organic, Morainal (Till)	Terric Fibrisol; Terric Mesisol; extending to Typic Fibrisols and Typic Mesisols	Treed wetlands predominantly along valley bottom associated with poorly drained, wetted depressions often, underlain by peat and/or coarse textured morainal parent materials.	2.5 / 7.2	5.7 / 4.5
Shrub / Graminoid Fen Shrub Bog	Organic, Morainal (Till)	Terric Fibrisol; Terric Mesisol; extending to Typic Fibrisols and Typic Mesisols.	Level areas and depressions with poor to very poor drainage with thick organic materials underlain by peat and/or coarse textured morainal parent materials.	4.6 / 13.3	11.2 / 8.8
Sparsely Vegetated, Naturally Non-Vegetated and Anthropogenically Altered / Disturbed Ecosystems					
Exposed Sand / Gravel Shoreline	Lacustrine, Fluvial	Regosols	Sparsely vegetated and/or un-vegetated shoreline with landforms generated by waves and currents. Mapped along Red Indian Lake and Victoria Lake Reservoir, where the artificial basins are created by the impoundment of water behind a man-made structure (i.e., a dam, berm, dyke) exposing sandy or gravelly shoreline.	-	0.6 / 0.5
Open Water	n/a	n/a	Waterbodies (lakes, ponds, rivers and streams)	1.3 / 3.7	21.8 / 17.2
Anthropogenic	Anthropogenic	n/a	Areas currently or historically subject to intense levels of human disturbance and use (does not include areas regenerating from forest management)	1.9 / 5.4	2.5 / 1.9
Total				**34.7 / 100.0**	**127.0 / 100.0**

Notes:
[A] Numbers rounded to one decimal place. Areas and percentages may not add up to total amounts due to rounding
Values pertain to the portion of the Project Area and LAA with ELC data

In the LAA and the Project Area, medium-textured, morainal (till) surface materials were the most commonly mapped parent material. Lesser commonly mapped material types included organic (bog and fen), colluvium, lacustrine and fluvial deposits. Bedrock was mapped intermittently throughout the LAA and was primarily associated with hummocks and upper elevation ridge areas. A summary of parent material types is presented below. Soil drainage classes throughout this chapter follow those described in ECSS 1982.

Morainal Deposits (Till)

Morainal deposits, or till, is the most commonly mapped parent material covering approximately 70% of the LAA and approximately 67% of the Project Area. Till is also found underlaying organic and fluvial deposits along valley bottoms. Till is associated with the dominant ecotypes: along the mid-slopes, BF Ecotype located on level to gently sloping terrain, and lower slope seepage zones in the BS Ecotype.

Throughout the LAA and Project Area, till has a variable thickness, ranging from a few centimetres near crests and hummocks, to greater than 1 m along lower slopes. The rolling to undulating topography is characterized by shallow veneers (less than 1 m thick); the level to slightly undulating topography is primarily comprised of thick till blankets (greater than 1 m thick). Thick, uniform deposits are mapped along the central portion of the Project Area, roughly aligned southwest-northeast under the proposed pits and overburden stockpiles. The till is dominated by sandy loam to loam textures and well to imperfect drainage. Deposits are generally well drained along crest and upper slopes areas (KH Ecotypes), becoming moderately well drained from ridges to gently sloping areas (KB Ecotype). Imperfectly drained deposits are most common along undulating topography with greater than 1.0 m depths (MW, RF and AT Ecotypes).

Organic Deposits

Organic deposits were mapped as the dominant parent material for 13% of the LAA and 20% of the Project Area. Within the Project Area, organic deposits are concentrated in the northwestern and southwestern portions of the landscape. Organic accumulations are generally found in topographic depressions, along the margins of watercourses, and within areas where shallow seepage is forced to the surface due to near-surface bedrock and other shallow unconsolidated material (i.e., till). Organic materials are found in poor to very poorly drained sites (i.e., associated with high water tables) within the WC and OW Ecotypes. The two types of open wetlands identified with the Project Area and LAA are bogs and fens (Section 9.2.2.1). Bogs are poorly to very poorly drained peatlands, commonly associated with stagnant water in depressional areas, that can appear raised (due to thickness of peat) relative to the surrounding landscape and are typically isolated from underlaying mineral soils. The depth of organics over the underlying mineral contact varies considerably from 0.4 m to over 2 m. Fens are peatlands with slightly to moderately decomposed organic material that has originated from mineral soils and are typically associated with overland or subsurface flow. Drainage is also poor to very poor and has slow internal drainage via seepage processes.

Colluvial Deposits

Colluvial deposits represent the downslope movement of material due to gravitational processes and were infrequently mapped across the LAA and Project Area. Colluvium was typically complexed with till and exposed bedrock in association with steep valley sides (BSA.7, Attachment 7-D). Colluvium was mapped as a secondary parent material type within forested ecosystem units. Moderate slopes and hummocks were the most frequently mapped surface expressions (BSA.7, Attachment 7-D). Due to steeper slopes and typically slightly coarser material texture, drainage is typically rapid to well drained. In addition, slow mass movement was noted as the most common geomorphological process associated with colluvial deposits (BSA.7, Attachment 7-D).

Fluvial Deposits

Fluvial materials are associated with deposition of sediments along modern stream floodplains, fluvial fans and terraces, and in some cases derived from glaciofluvial sands and silts. Fluvial deposits are not common in the LAA and Project Area and are primarily found adjacent to Victoria River; along tributaries to, and small islands within, the river system in the Project Area; and along other medium to large river systems in the LAA. Fluvial deposits are one of the dominant parent materials (complexed with lacustrine) associated with the RT Ecotype, covering approximately 0.4% or 0.15 km^2 of the Project Area, and 0.49% or 0.63 km^2 of the LAA. Fluvial materials were mapped as a secondary parent material in the AT Ecotype, along sparsely vegetated sites associated with watercourses and shorelines and less commonly in RF and KB Ecotypes. Specifically, Fluvial / Glaciofluvial parent materials were identified at inspection site MARSBe142921 during the 2014 soil survey identified in the ELC report (BSA.7, Attachment 7-D), located along a Victoria River tributary in the northeastern portion of the Project Area. Fluvial materials typically contain variations of stratified silt, sand and gravel with finer textured sediments associated with flood events. The soils derived from fluvial parent materials generally have a loam texture (varying percent of sand, silt and clay) and imperfect to poor drainage, with less than 5% coarse fragments.

Glaciofluvial Deposits

Glaciofluvial materials deposited by glacial meltwater are also uncommon within the LAA and Project Area. As noted in the ELC, glaciofluvial materials are located primarily within the riparian ecotypes along slopes ranging from 0.5% to 30%, with surface expressions ranging from undulating to hummocky to ridged (BSA.7, Attachment 7-D). Glaciofluvial materials are generally moderate to well drained (BSA.7, Attachment 7-D). Glaciofluvial veneers (typically less than 1 m in depth) were also identified by regional mapping (Natural Resources Canada 2019). These areas were mapped along the Victoria River in the northeastern portion of the Project Area. Two small glaciofluvial ridge features (i.e., potential eskers) were identified in the regional mapping, and are located just south of the existing exploration camp along the Victoria Lake Reservoir shoreline. These features are just outside of and adjacent to the Project Area.

As noted in the ELC report, gullying and meltwater channels were the most common geomorphological processes associated with glaciofluvial deposits, and eskers were not common (BSA.7, Attachment 7-D). These processes and landform were not identified in the ELC datasets and not provided in regional mapping.

Lacustrine Deposits

Lacustrine deposits are found primarily along a narrow band of riparian vegetation surrounding Red Indian Lake and Victoria Lake Reservoir within the RT Ecotype (BSA.7, Attachment 7-D). Lacustrine, and the associated fluvial deposits within the RT Ecotype, cover approximately 0.5% of both the LAA and Project Area. These parent material types are also common within the Exposed Sand / Gravel Shoreline Ecosystem Units, covering approximately 0.6 km^2 or 0.47% of the LAA. Lacustrine deposits are generally fine textured materials and associated with moderately well to imperfectly drained soils and are composed of fine textured, thick sediments.

Weathered Bedrock

Weathered bedrock (in situ bedrock modification by mechanical and chemical weathering) was not commonly mapped in the LAA or Project Area and is assumed to be primarily associated with the KH Ecotype associated with crest and ridge areas. Weathered bedrock is noted in the ELC (BSA.7, Attachment 7-D) as a very thin, discontinuous veneer (typically less than 0.3 m thick) along gently sloping to undulating bedrock outcrops and hummocky terrain (BSA.7, Attachment 7-D). Weathered bedrock is generally associated with angular coarse fragments with varying amounts of interstitial silty sand (dependent on bedrock type). It is non-cohesive and rapidly to very rapidly drained.

Bedrock

Bedrock, complexed with till and colluvium, was common at mid to high elevations within the ELC (BSA.7, Attachment 7-D) mapped areas of the LAA and Project Area. Exposed outcrops and bedrock covered by a thin mantle (up to 0.1 m thick) of unconsolidated or upland organic materials were observed throughout the ELC mapped area of the LAA and Project Area. Based on regional surficial geology mapping, a small bedrock ridge is present in the southeastern portion of the Project Area, between the shoreline and the proposed accommodations camp.

Anthropogenic

As defined in the ELC (BSA.7, Attachment 7-D), anthropogenic materials are modified by human activities or geomorphological processes so that their original physical properties (e.g., structure, cohesion, consolidation) have been drastically altered. The Anthropogenic Ecotype ecosystem unit occupies 5.4% (1.9 km^2) of the Project Area and 1.9% (2.5 km^2) of the LAA. Mapped AN Ecotype units include areas with historical mining (e.g., access roads used for exploration drilling, borrow pits) and forest management activities, as well as sites with more recent disturbances such as slumping, mass wasting and flooding (BSA.7, Attachment 7-D).

9.2.2.6 Terrain Stability

While there is limited site specific information on the subsurface conditions for all planned infrastructure, based on a review of the site topography and geological conditions (overburden and bedrock) for the Project Area the potential for issues related to terrain stability is low. Further details regarding issues related to terrain stability are presented in Section 21.5.2 and summarized below.

For ecotypes consisting of colluvial materials (forested ecosystems), slow mass movement (i.e., soil creep) was noted as the most common geomorphological process; however, areas with this process were not identified in spatial data (BSA.7, Attachment 7-D). Also noted in the ELC report, although not identified in spatial data, gully erosion was the most common geomorphological process for ecotypes with morainal and glaciofluvial materials (forested and riparian). Gullying can sometimes lead to unstable slopes depending on slope gradient, volume of material available for transport, and gully configuration.

In reference to landslides and rockfalls, there are no recorded cases of landslides in the Project Area (NLDNR 2020), and there is no evidence of landslide deposits in the Project Area based on spatial and field data (Stantec 2015). In addition, the landscape within the Project Area is gently sloping with rolling hills, with no exposed high relief bedrock ridges. Therefore, the combination of site topography with geological characteristics limits the potential for landslides and rockfalls within the Project Area.

Subsidence related terrain stability concerns are also considered low for the project area. This conclusion is based on the low seismic hazard risk for the area, the absence of subsidence prone overburden soil types, and the absence of geological rock types such as limestone that would give rise to subsidence concerns.

9.2.2.7 Soils

A description of soils for the Project Area and LAA, and an overview of rehabilitation suitability of soils in the Project Area, are provided below.

Soil Description

Soil descriptions have been summarized from information provided in the ELC report (BSA.7, Attachment 7-D), with detailed soils information for each ecotype provided in the ELC report. Upland or mineral soils, and organic / wetland soils are common through the LAA and Project Area, representing the varied topography of the underlying bedrock, depth of surficial materials and drainage conditions. An overview of ecotypes and soil associations subtypes is provided in Table 9.6 in Section 9.2.2.5.

Upland Soils

Upland soils are located within the forested and riparian ecosystem units. Soil associations within these units include Red Indian, Silver Mountain and Topsails (BSA.7, Attachment 7-D). The LAA and Project Area are dominated by the Red Indian soils association primarily mapped along lower to middle elevation slopes. The most common subtype of the Red Indian soils association are variants of Orthic Humo-Ferric Podzols, which have developed on moderately coarse textured, morainal (till) along 10% to 15% slope gradients. Soils are typically up to 1 m in depth with low to moderate coarse fragment content and loam to clay loam topsoil textures. Colluvium derived soils are most commonly mapped along upper elevations and steeper gradients where the soils are shallower, well drained, and have an increased coarse fragment content.

The Silver Mountain soil association is primarily mapped in the southern portion of the Project Area. Subsoils include Gleyed Humo-Ferric Podzols typically occurring on till veneer (less than 1 m depth) overlying hummocky to rolling bedrock found in upland positions on slopes of 16% to 30%. Bedrock outcrops are common throughout this soil association.

Gleyed variants of the Red Indian soils association and Gleysols associated with the Silver Mountain soils are less extensive, representing imperfect to poorly drained transitional sites between organic and upland soils (till and colluvium). Gleyed Humo-Ferric Podzols typically occupy mid to lower slopes with restricted vertical drainage, with Orthic and Rego Gleysols common in depressional areas (e.g., MW Ecotype). These soil types generally have a steady supply of water associated with high water tables and nearby organic / wetland soils. The soils typically have distinctive mottling (coloured spots interspersed within the dominant matrix colour), generally red or yellow when oxidized, and within Gleysols, typically blue, green and gray when oxygen is reduced (i.e., due to high water tables) beyond 50 cm depth, which represent oxidizing conditions. Drainage ranges from moderately well to imperfectly drained depending on slope position and gradient, depth to bedrock, and the occurrence of vertical drainage restrictions (BSA.7, Attachment 7-D). Topsoils are dominated by loam to clay loam, with areas of shallow weathered bedrock having coarser sandy loam textures. Coarse fragment content is low to moderate.

Additional subsoils of these associations are mapped in seepage zones, along valley bottoms and tributaries subject to flooding and sedimentation (i.e., AT and RT Ecotype units). Dominant soil subtypes are Orthic, Gleyed, or Cumulic Regosols and Gleysols. In depression areas, soils can also have surface O-horizons (BSA.7, Attachment 7-D). Mineral soil texture ranges from the more common sand-sandy loam silt loam (fluvial / glacifluvial dominant) to silt loam (till / fluvial / glaciofluvial) depending on parent material type and/or deposition event. Drainage is generally moderately well to imperfectly drained. Soil variants with sand and gravel textures located further from current shorelines and active river channels are typically well to rapidly drained. Potential rooting depth is variable yet tends to be less than 50 cm due to high water levels and potential root restricting layers (i.e., fragipans).

Variants of the Red Indian and Silver Mountain soil associations are mapped along middle to upper elevations and sites with bedrock outcrops (e.g., KB and KH Ecotypes). These areas consist of shallow till derived soils, fragmental colluvial deposits and weathered bedrock. Soils range from rapidly drained upland organic Folisols to moderately well drained Orthic Humo-Ferric and Ferro-Humic Podzols (BSA.7, Attachment 7-D). Soils within these ecotypes have moderate to high coarse fragment content, increasing at crests and upper slope positions. Topsoils are dominated by textures dominated by sandy loams.

Subsoils of the Topsails soil association were less commonly mapped, primarily located in the north central portion of the Project Area. These soils are characterized by Gleyed Ortstein Ferro-Humic Podzol (lithic phase). These soils developed from washed, partially sorted, coarse textured morainal till, as well as fluvial and glaciofluvial deposits. They occur on undulating (slopes 2% to 5%) to hummocky moraine (slopes 6% to 9%). Drainage is imperfect and the soils are exceedingly stony and slightly rocky (BSA.7, Attachment 7-D).

Organic Soils / Wetlands

Soils developed on organic parent materials include the Deadwolf Pond and Ebbegunbaeg Soil Associations. Deadwolf Pond soil associations generally occur as sloping and domed bogs. Subtypes are mainly Terric Fibrisols with fibric peat material derived mostly from sphagnum moss, which is underlain by till or less commonly fluvial material or bedrock. These soils can develop into domed bogs. Domed bogs are patterned landforms that are a result of circular pools of standing water radiating outward from a buildup, or ‘bulge’, of sphagnum mosses. Soils mapped within the SB Ecotype have poor to very poor drainage with water at or near the surface. Depth to bedrock is generally 40 cm to 160 cm, with sphagnum moss associated with domed bogs commonly reaching 3 m to 10 m in thickness. These were not identified in the ELC.

The Ebbegunbaeg Soil Association is characterized by organic soils that have developed in fens associated with depressions and slopes less than 2% (BSA.7, Attachment 7-D). These soils are generally associated with the SF Ecotype and occur in areas of very poorly drained, low-lying depressions between mineral soils, knobs or hummocks (BSA.7, Attachment 7-D). Common soil types associated with gently sloping and shallow deposits are Terric Fibrisols and Mesisols (i.e., unconsolidated mineral layer at least 30 cm thick beneath the surface organic tier). They consist of moderately decomposed sphagnum peat underlain by compact and coarse textured till deposits. Typic Fibrisols and Mesisols are common in areas of depressions where organic materials are generally greater than 110 cm thick (definition of Typic soils as per the Canadian System of Soil Classification [Agriculture and Agri-Food Canada 1998]).

Soil Suitability for Rehabilitation

Changes to soil characteristics (i.e., soil quality and quantity) can affect rehabilitation success and the ability to meet end land use capability objectives. An overview of these characteristics is provided below. As required, further details will be provided when the Rehabilitation and Closure Plan and associated management plans are developed.

Soil Quality

Sixteen geotechnical borehole overburden samples collected between 0.4 m to 3.7 m depths were reviewed (BSA.3, Attachment 3-D). Particle size analyses across test pits indicate medium textured loam to silt loam subsoils and parent materials, with some clay loam textures found in deeper horizons where thick till deposits were mapped. Results from overburden samples collected from geotechnical boreholes (19-TP-8, 19-TP-10 and 19-TP-17) showed soil samples are neutral pH (3.9 to 6.5) to basic pH (6.5 to 8.6).

Admixing, Compaction and Rutting

In general, moderately well to poorly drained soils with fine textures (i.e., elevated clay content) are typically more susceptible to compaction and rutting than well drained coarser textured (i.e., elevated sand content) soils. Topsoils and subsoils within the Project Area are primarily derived from till and have loam to silt loam to clay loam textures, with well to moderately well drainage (excluding wetlands). These soils are not anticipated to have admixing, compaction or rutting concerns.

Soils with elevated clay content (i.e., where soil textures are classified as clay to heavy clay, or in some silt textured soils) may be more susceptible to admixing, rutting and compaction. Based on GEMTEC test pits, areas around geotechnical test pits 19-TP-8, 19-TP-10 and 19-TP-17 may also have elevated clay content. These areas are in the northeastern and southeastern portions of the Project Area. In addition, shoreline areas where lacustrine materials are present may also have elevated clay content in soils. Topography (i.e., slope gradients) can also affect rutting, where slopes redirect water down preferential pathways, and compaction, with level terrain allowing for ponding.

Soil Chemistry

Detailed soil chemistry for topsoil (i.e. total organic content, pH, nutrients and total metals) is unknown. Based on available parent material / soils information and known disturbed areas, baseline soil nutrient levels are potentially low (i.e., RF and AN Ecotypes). Based on limited test pit sampling (BSA.3, Attachment 3-D), metal concentrations in the top 50 cm are generally low (CCME 1999).

Soil Quantity

Soil quantity is measured by the total area and volume of soil. Improper or insufficient soil handling, stockpiling and/or placement following disturbance can cause a loss of a non-renewable resource of growth media for revegetation. Changes in soil quantity and potential soil loss for the Project Area are measured by surface soil erosion potential and availability of salvageable material (soil salvage balanced with soil cover loss), or the soil salvage depths.

Erosion Potential

Erosion potential is the likelihood of soil loss through movement by factors of wind or water. Erosion potential assumes bare ground conditions and is more likely to occur during construction, following removal of vegetation, during rehabilitation, and in areas where soil replacement has occurred on slopes.

Moderate to high erosion potential ratings are typically associated with sites having:

- Thick till or colluvial deposits with high clay content
- Slope gradients greater than 40%
- Areas with potentially unstable slopes
- Organic deposits and clay dominated fluvial deposits (and other soils derived from poorly sorted parent materials with low coarse fragment content) on slopes generally greater than 5%

Within the Project area, these sites generally correlate with upland forested ecotype map units on valley side slopes, WC Ecotypes (thick parent materials and development of organic soils), and RT and AT Ecotypes where fluvial and organic soils are greater than 5% gradients.

Soil Cover Loss

Assessment of soil cover is linked to soil loss. The creation of permanent water features post-closure (e.g., open pits) results in loss of area where soil forming processes can occur. The magnitude of soil cover loss is assessed quantitatively in hectares and percentages within the Project Area using spatial overlays of soil map units and rehabilitation suitability ratings with permanent mine features (i.e., existing post closure).

Overall Soil Suitability for Rehabilitation

Soils in the Project Area have developed primarily on till (typically finer textured with low to moderate coarse fragment content), with scattered organic deposits and lesser sites developed on colluvium and fluvial deposits (typically coarser textured and higher coarse fragment content).

In general, the majority of the Project Area consists of upland forested ecosystem soils with variable ratings from Poor to Fair rehabilitation soil suitability ratings (i.e., shallow soils associated with bedrock), to Fair to Good for thick soils located along valley bottoms with minimal coarse fragments, medium textures and productive soil chemistry conditions.

Soils derived from till are generally characterized by loamy textures with typically lower coarse fragment content, with generally Good to Fair rehabilitation suitability ratings. Soils developed on parent material deposits greater than 1 m will depend on variability of coarse fragment content and drainage, resulting in Fair rehabilitation suitability ratings. Deep organic material in the Project Area could provide a source of valuable rehabilitation material, provided nutrient and metal concentrations are adequate. Soils developed on coarse textured, sand dominated parent material (i.e., colluvial dominate upland soils, Alder and Riparian Thicket, and exposed shorelines) may contain higher proportions of gravels and cobbles (coarse fragments), rendering them unsuitable as capping material for rehabilitation.

Based on existing CLI mapping, forestry land capability ratings for soils in the Project Area are primarily Class 7 with less than 40% of the Project Area mapped as Class 5 (CanSIS 2018). Class 7 are lands having severe limitations that can impede growth of commercial forests; Class 5 are lands having moderate limitations (CanSIS 2018). Forestry land capability subclasses (i.e., limitation characteristics) associated with these Class descriptions are:

- Stoniness as it affects forest density or growth (P)
- Soil moisture excess (W)
- Restriction of rooting zone by bedrock (R)
- Topographic limitations (i.e., excessively steep slopes) (T)

A Soil and Rock Management Plan providing soil handling considerations, including considerations for compaction, rutting and admixing, will be developed as part of the Environmental Protection Plan.

9.3 ASSESSMENT CRITERIA AND METHODS

This section describes the criteria and methods used to assess environmental effects on vegetation, wetlands, terrain and soils. Residual environmental effects (Section 9.5) are assessed and characterized using criteria defined in Section 9.3.1, including direction, magnitude, geographic extent, timing, frequency, duration, reversibility, and ecological or socio-economic context. The assessment also evaluates the significance of residual effects using threshold criteria or standards beyond which a residual environmental effect is considered significant. The definition of a significant effect for the Vegetation, Wetlands, Terrain and Soils VC is provided in Section 9.3.2. Section 9.3.3 identifies the environmental effects to be assessed for vegetation, wetlands, terrain and soils, including effect pathways and measurable parameters. This is followed by the identification of potential Project interactions with this VC

(Section 9.3.4). Analytical assessment techniques used for the assessment of vegetation, wetlands, terrain and soils are provided in Section 9.3.5.

9.3.1 Residual Effects Characterization

Table 9.7 presents definitions for the characterization of residual environmental effects on vegetation, wetlands, terrain and soils. The criteria are used to describe the potential residual effects that remain after mitigation measures have been implemented. Quantitative measures have been developed, where possible, to characterize residual effects. Qualitative considerations are used where quantitative measurement is not possible.

Table 9.7 Characterization of Residual Effects on Vegetation, Wetlands, Terrain and Soils

Characterization	Description	Quantitative Measure or Definition of Qualitative Categories
Direction	The long-term trend of the residual effect	**Neutral –** no net change in measurable parameters for the vegetation, wetlands, terrain and soils relative to baseline **Positive –** a residual effect that moves measurable parameters in a direction beneficial to vegetation, wetlands, terrain and soils relative to baseline **Adverse –** a residual effect that moves measurable parameters in a direction detrimental to vegetation, wetlands, terrain and soils relative to baseline
Magnitude	The amount of change in measurable parameters or the VC relative to existing conditions	**Negligible –** no measurable change from baseline conditions. **Low –** a measurable change of less than 5% of • habitat for SAR or SOCC in the ELC study area (ELCA) • the total area of wetland in the ELCA • soil quality / quantity with respect to end land-use capability • terrain (unique landform features) and terrain stability **Moderate –** measurable change greater than 5% but not exceeding 25% of • habitat for SAR or SOCC in the ELCA • the total area of wetland in the ELCA • soil quality / quantity with respect to end land-use capability • terrain (unique landform features) and terrain stability **High –** measurable change of greater than 25% of • habitat for SAR or SOCC in the ELCA • the total area of wetland in the ELCA • soil quality / quantity with respect to end land-use capability even without mitigation • terrain (unique landform features) and terrain stability

Table 9.7 Characterization of Residual Effects on Vegetation, Wetlands, Terrain and Soils

Characterization	Description	Quantitative Measure or Definition of Qualitative Categories
Geographic Extent	The geographic area in which a residual effect occurs	**Project Area –** residual effects are restricted to the Project Area **LAA –** residual effects extend into the LAA **RAA –** residual effects interact with those of other projects in the RAA
Frequency	Identifies how often the residual effect occurs and how often during the Project or in a specific phase	**Single event** **Multiple irregular event –** occurs at no set schedule **Multiple regular event –** occurs at regular intervals **Continuous –** occurs continuously
Duration	The period of time required until the measurable parameter or the VC returns to its existing (baseline) condition, or the residual effect can no longer be measured or otherwise perceived	**Short term** – residual effect restricted to construction or decommissioning, rehabilitation and closure phases **Medium term** – residual effect extends through the operation phase (12 years) **Long term** – residual effect extends beyond the operation phase (>12 years) **Permanent –** recovery to baseline conditions unlikely
Reversibility	Describes whether a measurable parameter or the VC can return to its existing condition after the project activity ceases	**Reversible –** the residual effect is likely to be reversed after activity completion and rehabilitation **Irreversible –** the residual effect is unlikely to be reversed
Ecological and Socio-economic Context	Existing condition and trends in the area where residual effects occur	**Undisturbed –** area is relatively undisturbed or not adversely affected by human activity **Disturbed –** area has been substantially previously disturbed by human development or human development is still present

9.3.2 Significance Definition

A significant adverse residual effect on vegetation and wetlands is defined as one that:

- Threatens the long-term persistence or viability of a vegetation species in the RAA, including effects that are contrary to or inconsistent with the goals, objectives, or activities of provincial or federal recovery strategies, action plans and management plans (i.e., change from a non-listed species to a species of management concern)
- Threatens the long-term persistence or viability of a vegetation community in the RAA, including effects that are contrary to or inconsistent with the goals, objectives or activities of provincial or federal recovery strategies, action plans and management plans
- Results in a non-conformance with section 5.1 of the NL *Policy for Development in Wetlands* or a loss of more than 10% of wetland area within the RAA

A significant adverse residual effect on terrain and soils is defined as one that:

- Alters soil quality or quantity such that successful rehabilitation to self-sustaining ecosystems with an average capability relative to that present at existing conditions are prevented
- The function of ecologically or culturally important landforms is substantially altered
- Unstable terrain is affected such that successful slope stability mitigation measures do not prevent and/or protect as per regulatory guidelines such as the NL *Mining Act* and the NL EPA

9.3.3 Potential Effects, Pathways and Measurable Parameters

Table 9.8 lists the potential Project effects on vegetation, wetlands, terrain and soils and provides a summary of the Project effect pathways and measurable parameters and units of measurement to assess potential effects. Potential environmental effects and measurable parameters were selected based on review of recent environmental assessments for mining projects in NL and other parts of Canada, comments provided during engagement, and professional judgment.

Table 9.8 Potential Effects, Effect Pathways and Measurable Parameters for Vegetation, Wetlands, Terrain and Soils

Potential Environmental Effect	Effect Pathway	Measurable Parameter(s) and Units of Measurement
Change in species diversity	• Direct disturbance (loss), change in habitat	• Occurrences and population attributes of traditional use plant resources important to Indigenous groups • Occurrences and population attributes of provincially or federally listed plant SAR • Occurrences and population attributes of non-native invasive plant species • Occurrences and population attributes of rare plants
Change in community diversity	• Direct disturbance (loss), change in abiotic factors	• Areal extent (hectares [ha]) of ecological communities or vegetation types
Change in wetland function	• Direct disturbance (loss), change in hydrology	• Areal extent (ha) of loss or disturbance to wetland ecosystems (by class and vegetation structure) • Indicators of wetland functions as evidenced by change in areal extent of wetlands or change in wetland type resulting from a change in hydrology
Change in soil quality	Potential decreases in soil quality resulting from: • Admixing, compaction, or decreased fertility • Compaction from heavy machinery traffic during post-closure and operation • Contamination of soils due to particulate deposition (Project air emissions, fugitive dustfall) and chemical spills • Change in soil chemistry, including acidification	• Soil baseline characteristics (i.e., physical and chemical parameters) • Admixing or loss of structure • Compaction and rutting risk • Soil chemistry changes (i.e., nutrient and metal levels) from trace metal uptake, dust accumulation, soil acidification • Rehabilitation suitability ratings

Table 9.8 Potential Effects, Effect Pathways and Measurable Parameters for Vegetation, Wetlands, Terrain and Soils

Potential Environmental Effect	Effect Pathway	Measurable Parameter(s) and Units of Measurement
Change in soil quantity	Potential soil volume losses (availability and volume of stored soils) from: • Soils handling and transport • Loss of suitable sites for soil development as a result of pit wall creation or new permanent water features • Erosion following removal of vegetation and disturbance during construction • Burial under spoil sites (i.e., waste rock, tailings) • Creation of permanent pit features	• Erosion potential ratings (wind and water) • Soil stripping volume and replacement depth • Burial and areas of no soil stripping and flooding (e.g., sedimentation ponds if not stripped)
Change in terrain (landforms) and terrain stability	• Loss of unique landform features (e.g. eskers, fragile / sensitive landscapes associated with ecosystems and wildlife habitat areas)	• Presence and extent of unique landform features identified from existing conditions
	Increase in terrain instability including: • Potential effects on the stability of terrain in Project facilities and infrastructure due to mass movement processes • Potential changes to occurrence, frequency and distribution of terrain (slope stability) mass movement processes	• Identification of potential terrain hazards (mass movement processes)

9.3.4 Project Interactions with Vegetation, Wetlands, Terrain and Soils

Table 9.9 identifies the physical activities that might interact with the VC and result in the identified environmental effect. These interactions are indicated by checkmark and are discussed in detail in Section 9.5, in the context of effect pathways, standard and Project-specific mitigation / enhancement, and residual effects. Following the table, justification is provided for where no interaction (and therefore no resulting effect) is predicted.

Table 9.9 Project-Environment Interactions with Vegetation, Wetlands, Terrain and Soils

Physical Activities	Environmental Effects to be Assessed						
	Change in Species Diversity	Change in Community Diversity	Change in Wetland Function	Change in Soil Quality	Change in Soil Quantity	Loss of Unique Landform	Changes in Terrain Stability
CONSTRUCTION							
Access Road Upgrade / Realignment: Where required, road widening and replacement / upgrades of roads and culverts.	✓	✓	✓	✓	✓	✓	✓
Construction related Transportation along Access Road	✓	✓	✓	✓	✓	–	–
Mine Site Preparation and Earthworks: Clearing and cutting of vegetation and removal of organic materials, development of roads and excavation and preparation of excavation bases within the mine site, grading for infrastructure construction. For the open pits, earthworks include stripping, stockpiling of organic and overburden materials, and development of in-pit quarries to supply site development rock for infrastructure such as structural fill and road gravels. Also includes temporary surface water and groundwater management, and the presence of people and equipment on site.	✓	✓	✓	✓	✓	✓	✓
Construction / Installation of Infrastructure and Equipment: Placement of concrete foundations, and construction of buildings and infrastructure as required for the Project. Also includes: • Installation of water control structures (including earthworks) • Installation and commissioning of utilities on-site • Presence of people and equipment on-site	–	–	✓	✓	✓	✓	✓

Table 9.9 Project-Environment Interactions with Vegetation, Wetlands, Terrain and Soils

Physical Activities	Environmental Effects to be Assessed						
	Change in Species Diversity	Change in Community Diversity	Change in Wetland Function	Change in Soil Quality	Change in Soil Quantity	Loss of Unique Landform	Changes in Terrain Stability
Emissions, Discharges and Wastes[A]: Noise, air emissions / GHGs, water discharge, and hazardous and non-hazardous wastes.	✓	✓	✓	✓	✓	✓	✓
Employment and Expenditures[B]	–	–	–	–	–	–	–
OPERATION							
Operation-related Transportation Along Access Road	✓	✓	✓	✓	✓	–	–
Open Pit Mining: Blasting, excavation and haulage of rock from the open pits using conventional mining equipment.	–	–	–	✓	✓	✓	✓
Topsoil, Overburden and Rock Management: Five types of piles: • Topsoil • Overburden • Waste rock • Low-grade ore • High-grade ore Rock excavated from the open pits that will not be processed for gold will be used as engineered fill for site development, maintenance and rehabilitation, or will be deposited in waste rock piles.	✓	✓	✓	✓	✓	✓	✓
Ore Milling and Processing: Ore extracted from the open pits will be moved to the processing area where it will either be stockpiled for future processing or crushed and milled, then processed for gold extraction via gravity, flotation and leach processes.	–	–	–	✓	✓	–	–

Table 9.9 Project-Environment Interactions with Vegetation, Wetlands, Terrain and Soils

Physical Activities	Environmental Effects to be Assessed						
	Change in Species Diversity	Change in Community Diversity	Change in Wetland Function	Change in Soil Quality	Change in Soil Quantity	Loss of Unique Landform	Changes in Terrain Stability
Tailings Management Facility: Following treating tails via cyanide destruction, tailings will be thickened and pumped to an engineered TMF in years 1 to 9, then pumped to the exhausted Leprechaun open pit in years 10 through 12.	–	–	–	✓	✓	✓	✓
Water Management (Intake, Use, Collection and Release): Recirculated process water and TMF decant water will serve as main process water supply, and raw water (for purposes requiring clean water) will be obtained from Victoria Lake Reservoir. Site contact water and process effluent will be managed on site and treated prior to discharge to the environment. Where possible, non-contact water will be diverted away from mine features and infrastructure, and site contact and process water will be recycled to the extent possible for use on site.	–	–	–	✓	✓	✓	✓
Utilities, Infrastructure and Other Facilities • Accommodations camp and site buildings operation, including vehicle maintenance facilities • Explosives storage and mixing • Site road maintenance and site snow clearing • Access road maintenance and snow clearing • Power and telecom supply • Fuel supply	–	–	–	✓	✓	✓	✓
Emissions, Discharges and Wastes[A]: Noise, air emissions / GHGs, water discharge, and hazardous and non-hazardous wastes.	✓	✓	✓	✓	✓	✓	✓
Employment and Expenditure[B]	–	–	–	–	–	–	–

Table 9.9 Project-Environment Interactions with Vegetation, Wetlands, Terrain and Soils

Physical Activities	Environmental Effects to be Assessed						
	Change in Species Diversity	Change in Community Diversity	Change in Wetland Function	Change in Soil Quality	Change in Soil Quantity	Loss of Unique Landform	Changes in Terrain Stability
DECOMMISSIONING, REHABILITATION, AND CLOSURE							
Decommissioning of Mine Features and Infrastructure	–	–	–	✓	✓	✓	✓
Decommissioning, Rehabilitation and Closure-related Transportation Along Access Road	✓	✓	✓	✓	✓	✓	✓
Progressive Rehabilitation: Rehabilitating infrastructure or areas not required for ongoing operations (e.g., buildings, roads, laydown areas); covering and revegetating completed tailings areas, where practicable, including commencing closure of TMF beginning in Year 9 (when tailings deposition moves to Leprechaun open pit); erosion stabilization and re-vegetation of completed overburden and/or waste rock piles; infilling or flooding of exhausted mining areas; and completing revegetation studies and trials.	✓	✓	✓	✓	✓	✓	✓
Closure Rehabilitation: Active rehabilitation based on successes of progressive rehabilitation activities. Includes: demolishing infrastructure (e.g., buildings, equipment, facilities, roads, laydown areas); grading and revegetating cleared areas, where practicable; breaching and regrading ponds to reestablish drainage patterns; completing closure of TMF (covering with overburden and revegetating); erosion stabilization and revegetation of completed overburden and/or waste rock piles; and infilling or flooding of open pits.	✓	✓	✓	✓	✓	✓	✓

Table 9.9 Project-Environment Interactions with Vegetation, Wetlands, Terrain and Soils

Physical Activities	Environmental Effects to be Assessed						
	Change in Species Diversity	Change in Community Diversity	Change in Wetland Function	Change in Soil Quality	Change in Soil Quantity	Loss of Unique Landform	Changes in Terrain Stability
Post-Closure: Long-term monitoring	–	–	–	✓	✓	–	–
Emissions, Discharges and Wastes[A]	✓	✓	✓	✓	✓	–	–
Employment and Expenditure[B]	–	–	–	–	–	–	–

Notes:
✓ = Potential interaction
– = No interaction
[A] Emissions, Discharges, and Wastes (e.g., air, waste, noise, light, liquid and solid effluents) are generated by many Project activities. Rather than acknowledging this by placing a checkmark against each of these activities, “Wastes and Emissions” is an additional component under each Project phase
[B] Project employment and expenditures are generated by most Project activities and components and are the main drivers of many socio-economic effects. Rather than acknowledging this by placing a checkmark against each of these activities, “Employment and Expenditures” is an additional component under each Project phase

During the construction phase, interactions between Project activities and the identified effects will occur during Mine Site Preparation and Earthworks, Access Road Upgrade / Realignment, Construction related Transportation along Access Road, and through Emissions, Discharges and Wastes. Employment and Expenditure are not anticipated to interact with vegetation, wetlands, terrain and soils during construction or any other Project phase. The Construction / Installation of Infrastructure and Equipment will occur in areas that have previously been subject to clearing; therefore, no interaction with species diversity or changes in community diversity are anticipated. The construction and installation of infrastructure, however, has the potential to interact with changes to wetland function (as this activity includes installation of water control structures), soil quality and quantity, and terrain and terrain stability.

Except for Employment and Expenditures, all Project activities throughout each phase are expected to interact with soil quality and quantity through direct (i.e., ground disturbance) or indirect (i.e., fugitive dust) interactions. Open Pit Mining, Ore Milling and Processing, Tailings Management Facility, and Utilities, Infrastructure, and Other Facilities will occur in areas that have been cleared during construction; therefore, no interactions with species diversity, community diversity or wetland function are predicted to occur following construction activities. Ore Milling and Processing is not expected to interact with terrain and terrain stability, as the processing infrastructure will be in areas of stable terrain with surface erosion management procedures in place. During operation, activities associated with Utilities, Infrastructure and Other Facilities (including access road maintenance), Topsoil, Overburden and Rock Management, and

Emissions, Discharges and Wastes may interact with species diversity, community diversity and wetland functions. Access road maintenance, including periodic road surface repair, snow clearing and dust control activities, has the potential to interact with wetland function; however, it is not anticipated to interact with terrain and terrain stability given maintenance will be conducted to maintain slope stability and mitigate surface erosion.

Decommissioning of Mine Features and Infrastructure will occur in areas where species diversity, community diversity and wetland function may have previously been affected during mine site preparation and earthworks, and no further interactions are predicted. Decommissioning, rehabilitation and closure includes long-term monitoring. Long-term monitoring activities are not expected to interact with species diversity, community diversity, wetland function, terrain or terrain stability.

9.3.5 Analytical Assessment Techniques

9.3.5.1 Assumptions and the Conservative Approach

A conservative approach was used to address uncertainty in the environmental effects assessment, allowing for increased confidence in the final determination of significance. Specifically, the following assumptions were made:

- All habitat within the Project Area will be disturbed, altered or lost, resulting in a direct loss of vegetation and resulting effects on species diversity and community diversity; in practice, not all vegetation will be cleared within the Project Area
- All wetlands within the Project Area will be disturbed, altered or lost, resulting in a direct loss of wetland function; in practice, not all wetlands within the Project Area will be altered or disturbed
- The magnitude of change in community diversity was assessed in relation to the ELCA (1,830.6 km^2), which constitutes 20.5% of the RAA (8,916.8 km^2); as the proportion of habitat affected by the Project within the RAA would be substantially less than in the ELCA (as the RAA is considerably larger than the ELCA), the estimated magnitude of Project-related change in community diversity is conservative

The assessment of vegetation, wetlands, terrain and soils also relied on the results of air emission modelling conducted as part of the assessment of Project effects on the Atmospheric Environment VC (Chapter 5) and the various water models completed as part of the assessment of Project effects on the Groundwater Resources VC (Chapter 6) and Surface Water Resources VC (Chapter 7). The conservative assumptions outlined in Sections 5.3.5, 6.3.5 and 7.3.5 therefore also contribute to the conservative nature of the effects predictions for this VC.

9.3.5.2 Assessment of Effects on Vegetation and Wetlands

An assessment of potential environmental effects on vegetation and wetlands was conducted using a combination of field data and digital information, including remote sensing. Vegetation surveys were conducted within the Project Area (BSA.7, Attachments 7-F and 7-I) and an ELC study (BSA.7, Attachment 7-D) using remote sensing and validated via field surveys. Project activities may not occur throughout the Project Area, however, for the purposes of this assessment, it is assumed that vegetation and wetlands throughout the Project Area could be affected by Project activities. The magnitude of residual effects has been characterized in relationship to the ELCA (i.e., the percentage of the ELCA in which a loss or change could occur). For this assessment, the ELCA has been used as a surrogate for the RAA, as it is an appropriately large enough area to provide regional context and is the area for which comparable ecological land classification data is available.

9.3.5.3 Assessment of Effects on Terrain and Soils

An assessment of potential environmental effects on terrain (topography, surficial geology) and unique landforms, terrain stability and soils was conducted by reviewing and interpreting existing information. The assessment considered protection of unique landforms, identification and management of potential unstable slopes, and rehabilitation objectives. Existing Project Area reports and data and an ELC study (BSA.7, Attachment 7-D) were reviewed and interpreted with base mapping (i.e., elevation and slope data, imagery) and regional surficial geology and soils mapping data (NLDNR 2019) via desktop ESRI ® ArcMap.

9.4 MITIGATION AND MANAGEMENT MEASURES

A series of environmental management plans will be developed by Marathon to mitigate the effects of Project development on the environment. A full list of mitigation measures to be applied throughout Project construction, operation and decommissioning, rehabilitation and closure is provided in Section 2.7.4. Project planning and design and the application of proven mitigation measures will be used to reduce or avoid adverse effects of the Project on vegetation, wetlands, terrain and soils, as outlined in Table 9.10.

Table 9.10 Mitigation Measures: Vegetation, Wetlands, Terrain and Soils

Category	Mitigation	C	O	D
Site Clearing, Site Preparation and Erosion and Sediment Control	• Project footprint and disturbed areas will be limited to the extent practicable.	✓	-	-
	• The boundaries of areas to be cleared will be well marked prior to the start of clearing activities.	✓	-	-
	• Sensitive areas (e.g., wetlands, hibernacula, mineral licks, roosts, caribou migration corridors) will be identified prior to construction and appropriate buffers will be flagged and maintained around these areas, where feasible.	✓	-	-
	• Existing riparian vegetation will be maintained to the extent practicable.	✓	-	-
	• Vegetation will be maintained around high activity areas to the extent practicable, to act as a buffer to reduce sensory (light and noise) disturbance.	✓	-	-
	• Clearing for road construction will be limited to the width required for road embankment, drainage requirements, and safe line of sight requirements. Trees will be cut close to ground level, and only large tree stumps will be removed, where practicable. Low ground shrubs will be left in place for soil stability and erosion protection purposes.	✓	-	-

Table 9.10 Mitigation Measures: Vegetation, Wetlands, Terrain and Soils

Category	Mitigation	C	O	D
Site Clearing, Site Preparation and Erosion and Sediment Control	• Vegetation will be removed from development areas in accordance with cutting permits.	✓	-	-
	• Standard construction practices will be used, such as erosion and sediment control measures, placement and stabilization of excavated material, and seepage cutoff collars (pipes and culverts).	✓	-	-
	• Construction areas will be routinely monitored to identify areas of potential erosion and to apply appropriate mitigation. Progressive erosion and sediment control measures will be implemented, as required.	✓	-	-
	• Where crossing of wetlands beyond the area to be cleared is unavoidable, protective layers such as matting or biodegradable geotextile and clay ramps or other approved materials will be used between wetland root / seed bed and construction equipment if ground conditions are encountered that create potential for rutting, admixing or compaction.	✓	-	-
	• To reduce the risk of introducing or spreading exotic and/or invasive vascular plant species, equipment will arrive at the Project site clean and free of soil and vegetative debris. Equipment will be inspected by Marathon personnel or designate and, if deemed to be in appropriate condition, will be approved for use. Equipment that does not arrive at the Project site in appropriate condition will not be allowed on the construction footprint until it has been cleaned, re-inspected and deemed suitable for use.	✓	-	-
	• Quarried, crushed material will be used for road building in and near wetlands, to reduce the risk of introducing or spreading exotic and/or invasive vascular plant species.	✓	-	-
	• Merchantable timber will be salvaged and used, or it will be made available to local communities for fuelwood.	✓	-	-
	• Construction materials (soils and rock) will not be sourced from locations known to contain invasive plant species.	✓	-	-
	• Environmental personnel responsible for site monitoring during construction will receive training to recognize species of conservation concern (SOCC) that may be present in Project Area.	✓	-	-
	• Known occurrences of plant SOCC will be avoided. If avoidance of plant SOCC is not possible, seed collection or transplant of the plant will be considered in consultation with the applicable regulators.	✓	-	-
	• Grading will be directed away from wetlands, where possible, and will be reduced within wetland boundaries unless required for site specific purposes.	✓	-	-
	• Ground level cutting / mowing / mulching of wetland vegetation will be conducted instead of grubbing, where practicable.	✓	-	-

Table 9.10 Mitigation Measures: Vegetation, Wetlands, Terrain and Soils

Category	Mitigation	C	O	D
Site Clearing, Site Preparation and Erosion and Sediment Control	• Slope stability will be considered with respect to the development of Project infrastructure, and if required a slope stability assessment will be conducted for areas where risks may exist. Where possible, construction in areas with potentially unstable terrain will be avoided. Where avoidance is not possible, best management practices will be implemented which may include: – Reduction of slope gradient with grading or terracing – Slope stabilization methods: retaining wall, drainage management, etc. – Geotextiles, wire mesh, shotcrete to manage erosion and rockfall potential – Revegetating soil slopes as soon as possible	✓	-	-
	• Cross drainage will be maintained to allow water to move freely from one side of the road to the other in areas of permanent or temporary access roads.	✓	✓	-
	• Movement of equipment / vehicles will be restricted to defined work areas and roads, and specified corridors between work areas.	✓	✓	✓
	• Native seed mix (free of non-native, invasive, and weed species) and native species (where available) will be used as erosion control on exposed soils and overburden stockpiles and during site rehabilitation.	✓	✓	✓
	• The requirement for broad-spraying of herbicide is not anticipated; spot-spraying may be required on occasion. If broad-spraying of herbicides is required, it will not be conducted within 30 m of plant SOCC, wetlands or waterbodies.	✓	✓	-
Soil Management	• During excavation, organic and mineral topsoil will be separated from cleared trees and brush and stored for future use during rehabilitation.	✓	-	-
	• Care will be taken to reduce topsoil and subsoil mixing during excavation.	✓	-	-
	• Soil salvage will occur during appropriate weather conditions (avoiding high winds and dry conditions) as practicable. Appropriate machinery will be used for salvage to avoid compaction.	✓	-	-
	• Organic and mineral topsoil will be stored and kept separate from subsoil or rock material used for construction.	✓	✓	-
	• Soil stockpiles will be easily accessible, on well-drained ground, and away from bodies of water (minimum of 30 metres) and standing timber. A working space of at least 5 metres will be maintained around soil stockpiles.	✓	✓	-
	• Topsoil and organics will be stored in stable piles to decrease compaction effects.	✓	✓	-
	• Soil stockpiles will be constructed and maintained in lifts to achieve flatter slopes and permit terracing to reduce erosion and maintain moisture within the topsoil.	✓	✓	-
	• Longer term stockpiles will be seeded to reduce erosion due to wind and precipitation.	✓	✓	-

Table 9.10 Mitigation Measures: Vegetation, Wetlands, Terrain and Soils

Category	Mitigation	C	O	D
Soil Management	• Marathon will develop and implement a Soil and Rock Management Plan as part of the Environmental Protection Plan, which will outline management practices for handling of overburden / soils and associated stockpiles. Soil management will also be conducted in accordance with the Rehabilitation and Closure Plan.	✓	✓	✓
	• Sediment control fences will be installed in areas where topsoil is exposed to erosion and siltation, such as slopes and embankments and approaches to stream crossings or water bodies. Sediment control fences will be inspected and maintained over the course of the construction phase until the disturbed area has stabilized and natural revegetation has occurred. Non-biodegradable materials used for Sediment control fences will be removed following revegetation.	✓	✓	✓
Air Emissions	• An Air Quality Management Plan will be developed and implemented as part of the EPP. The Plan will specify the mitigation measures for the management and reduction of air emissions during Project construction and operation.	✓	✓	✓
	• Surfaces of topsoil and overburden stockpiles will be stabilized during extended periods between usage by means of vegetating or covering the exposed surfaces.	✓	✓	-
Vehicles / Equipment / Roads	• 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.	✓	✓	✓
	• Vehicles will use existing roads / trails while operating at the mine site. All-terrain vehicles used by Marathon personnel will also be restricted to existing roads, trails and corridors to the extent possible.	✓	✓	✓
Site Water Management	• Marathon will implement a Water Management Plan (Appendix 2A) for the site which will incorporate standard management practices, including drainage control, excavation and open pit dewatering which collectively comprise the water management infrastructure currently designed as part of the Project scope (Section 2.3.5). The Water Management Plan provides detail on runoff and seepage collection strategies and systems (e.g., local seepage collection ponds, berms, drainage ditches, pumps) to collect and contain surface water runoff and groundwater discharge from major Project components (open pit, waste rock piles, TMF, ore stockpile and overburden storage areas, process plant) during climate normal and extreme weather conditions.	✓	✓	✓
	• Existing drainage patterns will be maintained to the extent feasible with the use of culverts and bridges.	✓	✓	-
	• Site ditching will be designed to reduce erosion and sedimentation through use of rock check dams, silt fences, plunge pools, and grading as appropriate.	✓	✓	✓
	• Culverts will be inspected periodically to remove accumulated material and debris upstream and downstream of the culverts.	✓	✓	✓
	• A maintenance schedule will be developed and implemented to provide for regular maintenance and inspection of site water management infrastructure, including culverts.	✓	✓	✓

Table 9.10 Mitigation Measures: Vegetation, Wetlands, Terrain and Soils

Category	Mitigation	C	O	D
Materials Handling and Waste Management	• Waste will be transported from site to be recycled, reused or disposed of in licensed / approved facilities. Non-reusable and non-recyclable wastes will be sent to the provincial waste management facility in Norris Arm, and reuse / recycling materials will be sent to the nearest management facility for each material type.	✓	✓	✓
	• Fuels and lubricants will be stored according to regulated containment methods in designated areas. Refueling, servicing, and equipment and waste storage will not take place within 30 m of watercourses to reduce the likelihood that deleterious substances will enter watercourses. Spill kits will be maintained at locations on-site during all Project phases.	✓	✓	✓
Rehabilitation and Closure	• Marathon will develop a Rehabilitation and Closure Plan that meets the requirements of the Department of Industry, Energy and Technology, Department of Environment, Climate Change, and Municipalities, and Department of Fisheries, Forestry and Agriculture. The plan will be reviewed and updated regularly until implemented.	✓	✓	✓
	• The volume of soils required for rehabilitation activities will be assessed, and a materials (soils) balance will be developed for the overall Project to ensure that sufficient soils are available for rehabilitation.	✓	✓	✓
	• Native seed mix (free of non-native, invasive, and weed species) and native species (where available) will be used as erosion control on exposed soils and overburden stockpiles and during site rehabilitation.	✓	✓	✓
	• 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.	-	✓	✓
	• Pre-mining site drainage patterns will be re-established to the extent practicable.	-	-	✓
	• Disturbed areas will be graded and/or scarified, covered with overburden and organic materials, where required, and seeded with native seed mix to promote natural plant colonization and succession.	-	-	✓

Notes:
C – Construction Activities
O – Operation Activities
D – Decommissioning, Rehabilitation and Closure Activities

9.5 ASSESSMENT OF ENVIRONMENTAL EFFECTS ON VEGETATION, WETLANDS, TERRAIN AND SOILS

For each potential effect identified in Section 9.3.3, specific Project activities that may interact with the VC and result in an environmental effect (i.e., a measurable change that may affect the VC) are identified and described. The following sections first describe the pathways by which a potential Project effect could result from Project activities in the absence of mitigation during each Project phase (i.e., construction, operation and decommissioning, rehabilitation and closure). Mitigation and management measures (Section 9.4) are applied to avoid or reduce these potential pathways and resulting environmental effects.

Residual effects are those remaining following implementation of mitigation, which are then characterized using the criteria defined in Section 9.3.1. A summary of predicted residual effects is provided in Section 9.5.6.

9.5.1 Change in Species Diversity

9.5.1.1 Project Pathways

Construction

The construction of the Project has the potential to result in a change in plant species diversity through direct disturbance or change in habitat. A change in species diversity may occur through loss or change in:

- Occurrences or population attributes of traditional use plant resources important to Indigenous groups
- Occurrences and population attributes of provincially or federally listed plant SAR and/or vascular plant SOCC
- Occurrences and population attributes of non-native invasive plant species

These interactions will occur primarily through the mine site preparation and earthworks activities; however, interactions will also occur through access road upgrades and minor realignments where vegetation clearing is necessary. Site preparation includes clearing and cutting of vegetation, removal of organic materials and overburden, and construction of ditches and sedimentation ponds as part of water and erosion control, as well as construction of site roads and haul roads. These activities will result in the direct loss of vascular plant species within the Project Area, including SAR or SOCC that may be present. Clearing will remove trees, shrubs and understory vegetation. Removal of soils and excavation activities will remove remaining vegetation and will likely remove the associated seedbank, and compact remaining soil layers, changing habitat quality for plants that may later regenerate within the area.

The removal of vegetation during site preparation activities can have indirect interactions on adjacent areas through edge effects. Edge effects include abiotic changes such as an increase in available light and associated increased temperatures. Some plant species are more susceptible to edge effects than others, as plant species have ideal ranges of abiotic conditions which they can tolerate. Some can tolerate a wide range of conditions, while others have narrow and specific needs. Edge effects can also result in direct mortality of plants through increased access for herbivores. It is expected that edge effects will occur in areas adjacent to the mine site and in areas adjacent to upgrades or realignment of the access road.

The increase in Project-related transportation along the access road throughout the life of the Project has potential to affect species diversity by introducing or aiding in the spread of invasive or exotic species. Invasive species can outcompete and displace native species, particularly rare species which can be slow growing or have very narrow habitat requirements. Although there is no comprehensive list of invasive species on the Island of Newfoundland, some exotic species that are known to be invasive in other jurisdictions are present within NL; several of these species were observed during field studies conducted in support of the Project (Section 9.2.2.3).

Transportation can also result in dust deposition onto vegetation, which can cover leaves and block stomata, reducing photosynthesis and causing other physiological effects (Farmer 1993), as well as altering soil chemistry (Brown 2009). Components of dust can also be absorbed by plants through the soil, and can lead to a host of reactions, including reduction of plant productivity or overall fitness, and can ultimately lead to the loss of more sensitive plant species (Hosker and Lindberg 1982).

To date, no surveys have been conducted along the access road, so it is unknown if the road upgrades or transportation will affect vascular plant SAR or SOCC. The upgrades to the road are currently expected to be relatively minor widening where required, and limited realignment of sharp turns and bridge approaches for safety. Further surveys will be conducted as part of the follow-up program for the Project once further detailed engineering confirms the locations and extent of road upgrades required.

Emissions, discharges and wastes from the Project will include stormwater and run-off from construction areas. Water that is diverted from one location to another can alter the hydrology of areas outside of the Project Area. In wetland areas, these changes may be extensive enough to affect plant species that cannot tolerate the changed hydrologic conditions.

Operation

Many of the changes to species diversity, particularly within the Project Area, are expected to occur during construction activities, and thus limited additional changes to species diversity are expected during operation activities. As described above for construction, Project-related transportation during operation could introduce or aid in the spread of invasive or exotic species, and is expected to spread dust onto species adjacent to the access road, although the rate of traffic is expected to be lower than during construction. The use of excavated rock for engineered backfill may result in a change in soil characteristics, such as texture and chemistry, thereby influencing which plants may recolonize disturbed areas adjacent to the access road.

Decommissioning, Rehabilitation and Closure

During the decommissioning, rehabilitation and closure phase, transportation will continue to potentially aid in the spread of invasive or exotic species, although the rate of traffic will be lower than during the construction and operation phases.

Progressive and closure rehabilitation will interact with species diversity as plants recolonize rehabilitated portions of the Project Area. Progressive rehabilitation activities will overlap with the operation phase of the Project and will include covering exposed tailings with overburden and revegetating the area (after Year 9), and erosion stabilization and seeding of overburden areas. The waste rock piles will also be progressively rehabilitated via placement of overburden / organic materials on completed benches and slopes and subsequent revegetation. Generally, natural revegetation will be encouraged throughout the Project Area, and revegetation studies and trials will occur. Closure will commence following completion of the operation phase and will include the dismantling and removal of equipment and buildings, drainage of sedimentation and stormwater ponds, and the re-establishment of pre-Project drainage patterns. Natural revegetation will be promoted within disturbed areas through grading and scarification.

Progressive and closure rehabilitation are expected to allow vegetation to recolonize most of the Project Area such that, over time, succession to natural plant communities will occur.

9.5.1.2 Residual Effects

Construction activities, such as mine site preparation and earthworks activities, are expected to result in the loss or change of up to 32.0 km^2 (i.e., the area of the mine site) of vegetated areas and associated species within the mine site (Table 9.4). Approximately 2.8 km^2 of additional vegetated areas and associated species will be changed or lost within the access road upgrades footprint (the exact area will be dependent on detailed design plans when they become available). In addition, plants within wetland vegetation communities outside of the mine site are expected to experience hydrological changes (discussed further in Section 9.5.3) through groundwater drawdown and hydrological discharges during construction and operation. The extent of change in species diversity resulting from emissions, discharges and wastes from the Project will depend on the level of hydrological change, however, the extent is expected to be restricted to watersheds directly affected by the Project Area. It is estimated that this could include vegetation species that occupy up to 6.3 km^2 of wetland vegetation communities outside of the Project Area; however, the actual amount of hydrological change will likely not be great enough to result in vegetation changes in wetlands throughout the entire extent of these watersheds. Altogether, construction activities could result in changes to plants within an area of 41.0 km^2, which represents approximately 2.2% of the ELCA.

Project-related transportation along access roads during construction, operation and decommissioning, rehabilitation and closure phases could lead to an introduction or further spread of invasive species. With mitigation, the likelihood of introduction and spread of invasive and exotic species will be reduced. Dust deposition onto plants adjacent to the road could also occur. Although many factors influence the distance to which road dust penetrates adjacent vegetation (e.g., climate, vehicle speed, vehicle weight, gravel properties, density and structure of adjacent vegetation), most dust deposition and resultant effects on vegetation occur within 125 m of unpaved roads (Walker and Everett 1987). Although the distance which edge effects and dust deposition may affect vegetation cannot be known without a study conducted in this region, conservatively it is assumed that edge effects could occur within 200 m of the road. This could result in changes to species within approximately 24.7 km^2 of habitats adjacent to the access road footprint (approximately 1.3% of the ELCA), in addition to direct disturbance related to access road upgrades.

In total, it is expected that plants within approximately 65.6 km^2 of vegetated habitat could be affected by the Project. This represents approximately 3.6% of the 1,830.6 km^2 of vegetated habitat within the ELCA.

Although many vegetation species will be affected by the Project, nearly all observed plant species are common and no changes to population attributes of common species are predicted. This includes the plant species observed during field surveys conducted in support of the Project that have been identified as traditional use plant resources important to Indigenous groups, all of which are common in the area (Section 9.2.2.4 and Section 17.2).

Of the three vascular plant SOCC observed during field work conducted in support of the Project, one individual of one species, nodding water nymph (S2), is within the footprint of the Marathon open pit and will be lost as a result of the Project. Both observations of perennial bentgrass (S2) are within the Project Area, yet are outside of site infrastructure development area and are expected to be unaffected. Short-scale sedge (S2) was observed in two locations outside of the Project Area. One of these locations is west of the mine site and the other is outside of the LAA. Neither are expected to be affected by the Project. Although the single observation of nodding water nymph will be affected by the Project, this species' provincial status rank of S2 indicates there are other known populations in the province. This species is ranked S5 in other Atlantic provinces, and because of its habitat, may be underreported on the Island of Newfoundland. The loss of a single individual of nodding water nymph is not expected to lead to a change in the population attributes of the species.

With mitigation, the Project will result in an adverse residual effect on a change in species diversity through a decline in the number of occurrences of vascular plant SOCC and some common traditional use plant resources in the LAA that are important to Indigenous groups, and a potential for increase in the occurrences of invasive plant species. The magnitude of this effect will be low because the measurable change in habitat for SOCC and traditionally used plants will be less than 5% of the habitat within the ELCA. This change in species diversity will occur once during the construction phase, however, the effect will continue throughout the life of the Project. The duration of the effect will be long-term, as the loss of habitat will extend beyond the life of the Project. While residual effects to a change in species diversity is reversible, the loss of some habitats for SOCC within the mine site will be permanent.

9.5.2 Change in Community Diversity

9.5.2.1 Project Pathways

Construction

The construction of the Project has the potential to result in a change in community diversity through direct disturbance or change in abiotic factors, resulting in a change in the areal extent of ecological communities or vegetation types. As with a change in species diversity, these interactions are expected to occur primarily through the mine site preparation and earthworks activities, where vegetation communities will be lost or changed through vegetation clearing and disturbances to soils, such as removal of organic materials and overburden. Access road upgrades and realignments where vegetation clearing is necessary will also result in changes to vegetation community diversity. Clearing will remove trees and shrubs and damage understory vegetation. Removal of soils and excavation will completely remove any remaining vegetation and will likely remove the associated seedbank and compact remaining soil layers, thereby influencing the plant communities that may later regenerate within the area.

Edge effects that will occur in areas adjacent to cleared areas will have some effects on community composition, although are unlikely to result in major changes to community diversity. An exception can be the introduction of an extremely invasive plant species, which could occur through edge effects and through Project-related transportation along access roads. Invasive species can outcompete and displace native species, which could lead to a change in community diversity by altering plant community types. Although there is no comprehensive list of invasive species on the Island of Newfoundland, some exotic species that are known to be invasive in other jurisdictions are present within NL; several of these species were observed during field studies conducted in support of the Project (Section 9.2.2.3).

As described in Section 9.5.1, Project-related transportation throughout the life of the Project can lead to dust deposition on plants adjacent to the access road. This could alter plant community composition.

Emissions, discharges and wastes from the Project will include stormwater and run-off from construction areas. Water that is diverted from one location to another can alter the hydrology of areas outside of the Project Area, potentially affecting plant species that cannot tolerate the changed hydrologic conditions. This could lead to a change in plant community structure, as raising or lowering water table levels can lead to a change from upland to wetland or vice versa, resulting in a change to the overall area of wetland or to wetland class or type. These potential changes, which are also expected to occur during operation, are discussed further in Section 9.5.3.

Operation

Most of the change in community diversity resulting from the Project is expected to occur during construction, with few operation activities expected to result in changes to community diversity. As stated above, Project-related transportation during operation can introduce and spread invasive species to the Project Area and can lead to dust deposition on plants adjacent to the access road. The use of excavated rock for engineered backfill may result in a change in soil characteristics, such as texture and chemistry, thereby influencing which plants and plant communities may recolonize those areas.

Decommissioning, Rehabilitation and Closure

During the decommissioning, rehabilitation and closure phase, Project-related transportation will continue to potentially aid in the spread of invasive or exotic species and to spread dust to vegetation communities adjacent to the access road, which can alter vegetation communities and affect community diversity. The rate of traffic is expected to be lower than during the construction and operation phases.

Progressive and closure rehabilitation activities will affect community diversity as plants recolonize rehabilitated portions of the Project Area and form regenerating communities. Progressive rehabilitation will overlap with the operation phase of the Project and will include covering of the exposed tailings with overburden and revegetating the area (after Year 9), and erosion stabilization and seeding of overburden areas. The waste rock piles will also be progressively rehabilitated via placement of overburden / organic materials on benches and slopes and subsequent revegetation. Generally, natural revegetation will be encouraged throughout the Project Area, and revegetation studies and trials will occur. Closure rehabilitation will commence following the operation phase and will include the dismantling and removal of equipment and buildings, drainage of sedimentation and stormwater ponds, and the re-establishment of pre-Project drainage patterns, where practicable. Natural revegetation will be promoted within disturbed areas through grading and scarification. Progressive and closure rehabilitation activities are expected to allow vegetation to recolonize most of the Project Area such that over time, natural succession will occur.

9.5.2.2 Residual Effects

As indicated in Section 9.5.1.2, construction activities such as mine site preparation and earthworks activities are expected to result in the loss or change of up to 32.0 km^2 of vegetation communities within the mine site (Table 9.4). Approximately 2.8 km^2 of additional vegetation communities will be changed or lost within the footprint of the access road upgrades (the exact area will be dependent on detailed design plans when they become available). These direct disturbances represent approximately 1.9% of the ELCA. In addition, up to 6.3 km^2 wetland vegetation communities outside of the mine site area (representing 0.3% of the ELCA) are expected to experience hydrological changes (Section 9.5.3) through groundwater drawdown and hydrological discharges during construction and operation, which could alter these communities. As described in Section 9.5.1.2, it is assumed that edge effects and dust deposition could occur within 200 m of the road, which has the potential to change approximately 24.7 km^2 of vegetation communities (approximately 1.3% of the ELCA) adjacent to the access road footprint, in addition to the direct disturbance related to access road upgrades.

In total, it is predicted that approximately 65.6 km^2 of vegetation communities could be altered by the Project. This represents approximately 3.6% of the 1,830.6 km^2 of vegetation communities within the ELCA.

With mitigation, the Project is predicted to have an adverse residual effect on community diversity through a decline in the areal extent of ecological communities or vegetation types in the LAA. The magnitude of this effect will be low because the measurable change in the area of ecological communities will be less than 5% of the total area of ecological communities in the ELCA. This change in community diversity will occur continuously through the construction, operation, and decommissioning, rehabilitation and closure phases. The duration of the effect will be long-term, as the change in communities will extend beyond the life of the Project. Based on past evidence, this environmental effect will be irreversible as some ecological communities (e.g., some wetland classes) require development periods much longer than those considered in this assessment.

9.5.3 Change in Wetland Function

9.5.3.1 Project Pathways

Construction

Construction of the Project could result in a change in wetland function through direct disturbance or through changes in hydrology. Such changes could result in a loss of, or disturbance to, the areal extent of wetland ecosystems or a change in wetland functions. These interactions are expected to occur primarily through mine site preparation and earthworks activities where wetlands will be lost or changed by vegetation clearing and disturbances to soils, such as removal of organic materials and overburden, and infilling. Clearing will remove trees and shrubs and damage understory vegetation, changing wetland types and area. Removal of soils and excavation will remove remaining vegetation and will likely remove the associated seedbank and compact remaining soil layers, thereby influencing what plant communities may later regenerate within the area. Infilling will remove some wetland areas.

Changes to wetland function will result from loss of wetland area or conversion of wetland class and type through vegetation removal and disturbance. Loss of wetlands will result in a decrease in available habitat within the Project Area for plants and wildlife that use wetland habitats, including waterfowl (Section 10.2), large mammals such as moose and bear (Section 12.2), and small mammals such as beaver, muskrat and marten (Section 12.2). Loss of wetland habitats will reduce the carbon sequestration function of the Project Area. Organic carbon sequestration is an important wetland function (Government of Canada 1991), particularly in *Sphagnum*-dominated peatlands (Glenn et al. 2006), which are common in and near the Project Area. Hydrologic and water quality functions, such as stream flow support, water cooling and functions related to water chemistry may also be lost. Conversion of wetland habitat (i.e., a change from one type of wetland to another) will result in a change in the extent to which individual wetland functions are performed, as some wetland classes, forms and types perform different functions to varying degrees. For example, if a forested wetland is cleared of trees while the wetland area remains unchanged, the wetland may have a reduced carbon sequestration function or altered wildlife habitat functions.

During the construction phase, water management and erosion control structures (e.g., ditches and sedimentation ponds) will be constructed or installed, which, in addition to clearing and infilling portions of the Project Area, may also alter hydrological outputs to wetlands outside the Project Area in the LAA. Changes to hydrological outputs, such as the amount or timing of water released to wetlands outside the Project Area could result in raising or lowering of the water table, which could result in a change in wetland area or wetland class or type, and a change in or reduction to associated wetland function.

Access road upgrades and realignments where vegetation clearing is necessary may also result in loss of wetland area and related changes to wetland function, as is described above for mine site preparation, yet on a smaller scale.

Edge effects, as a result of site preparation and other clearing, can affect wetlands by changing abiotic conditions for plants and increasing susceptibility of wetlands to invasive species. Invasive species may also be spread to wetlands through Project-related transportation along the access road throughout the life of the Project. Wetlands are more susceptible than upland habitats to colonization and spread of invasive species, a result of characteristics of both wetland habitats and the species invading them (Zedler and Kercher 2004).

Emissions, discharges and wastes from the Project will include stormwater and run-off from construction areas. Water that is diverted from one location to another can alter the hydrology of wetlands outside of the Project Area, affecting their extent and structure as plant species composition changes in response to changed water levels.

Operation

Although most of the changes to wetlands, particularly within the Project Area, are expected to occur during the construction phase, some additional changes are expected when the Project enters the operation phase. Access road maintenance will include dust control activities, which can increase sedimentation and siltation into wetlands adjacent to the access road. Sand applied for road maintenance during winter months can enter the surrounding environment, resulting in siltation and changes to soil fertility and soil structure, and direct damage to plants, particularly in wetlands. The use of excavated rock for engineered backfill may result in a change in soil characteristics, such as texture and chemistry, reducing the likelihood that wetlands may reform in areas during or following the operation phase. Drawdown of groundwater levels may also affect the hydrology of wetlands outside of the Project Area.

As described above for construction, Project-related transportation during operation could introduce or aid in the spread of invasive or exotic species to wetlands and can spread dust in areas adjacent to the access road, although the rate of traffic is expected to be lower than during construction. Emissions, discharges and wastes during operation are predicted to interact with wetland function through several water discharge points, which will affect the hydrology of wetlands within and adjacent to the Project Area.

Decommissioning, Rehabilitation and Closure

Progressive and closure rehabilitation activities will interact with wetland function as plants recolonize rehabilitated portions of the Project Area. Progressive rehabilitation will overlap with the operation phase of the Project and will include covering of the exposed tailings with overburden and revegetating the area (after Year 9), and erosion stabilization and seeding of overburden areas. The waste rock piles will also be progressively rehabilitated via placement of overburden / organic materials on benches and slopes and subsequent revegetation. The chemical and physical properties of the tailings, waste rock and other soils affected by Project components, as well as the nature of grading and revegetation will determine the extent to which wetlands will reform in these rehabilitated areas. Closure rehabilitation will commence following the operation phase and will include the dismantling and removal of equipment and buildings, drainage of sedimentation and stormwater ponds and the re-establishment of pre-Project drainage patterns, where practicable. This may facilitate the re-establishment and development of wetlands within and adjacent to the Project Area.

9.5.3.2 Residual Effects

A summary of the ELC Ecosystem Units that are within the various study areas related to the Project is presented in Table 9.4. Of the 12 Ecosystem Units, five are primarily or almost entirely composed of wetland habitat. These habitats and their areas and percentages within the site features, Project Area, LAA, and ELCA are presented in Table 9.11.

Table 9.11 Wetland Ecosystem Units and Ecotypes within the Study Areas

Ecosystem Units	Ecotypes	Description	Area (km^2) within Footprint of Site Features (Percentage of Site Features)	Area (km^2) in Project Area (Percentage of Project Area)	Area (km^2) in LAA (Percentage of LAA)	Area (km^2) in ELCA (Percentage of ELCA)
Alder Thicket	Alder Thicket	Alder-dominated communities on moist seepage slopes and riparian areas	0.2 (3.2)	2.2 (6.5)	11.9 (9.3)	97.4 (5.3)
Black Spruce Forest	Black Spruce Forest	Dry to moist and sometimes wet conifer-dominated forests	1.3 (17.4)	4.3 (12.5)	17.6 (13.9)	233.1 (12.7)
Open Wetlands	Shrub / Graminoid Fen	Very moist to wet shrub / herb dominated peatlands	1.4 (18.8)	4.6 (13.3)	11.2 (8.8)	280.3 (15.3)
	Shrub Bog					
Riparian Thicket	Riparian Thicket	Shrub thickets located in transitional areas and subject to periodic flooding	0.02 (0.3)	0.2 (0.4)	0.6 (0.5)	15.1 (0.8)
Wet Coniferous Forest	Wet Coniferous Forest	Very moist to wet conifer forests	0.5 (7.0)	2.5 (7.2)	5.7 (4.5)	130.7 (7.1)
Total			**3.5 (46.8)**	**13.8 (39.9)**	**47.0 (37.0)**	**756.6 (41.2)**

Notes:
Ecotype descriptions from BSA.7, Attachment 7-D
Numbers are rounded to one decimal place. Areas and percentages may not add up to total amounts due to rounding

Direct loss of approximately 3.4 km^2 of wetlands will occur within the footprint of site features and an additional 9.7 km^2 of wetlands within the Project Area and outside the site features footprint may be directly and/or indirectly affected by the Project. While not within the footprint of site features, it is possible these wetlands will be subject to vegetation clearing, removal of organic materials and overburden, and infilling, or could experience hydrological changes from adjacent disturbance. As such, they could experience reduction in area, change in wetland class, form, or type, alteration of hydrology, or edge effects, which would result in a change in wetland function.

The extent and location of direct disturbance to wetlands associated with access road upgrades is assumed to be approximately 0.7 km^2. However, as described in Section 9.5.1.2, edge effects, including introduction or spread of invasive species and dust deposition could occur within 200 m of the road, which has the potential to alter wetland species composition. Although this distance is conservative, edge effects could result in changes to wetland function within an additional 10.2 km^2 of wetland vegetation communities beyond the access road footprint. Of the four invasive vascular plant species observed during field surveys (Section 9.2.2.3), all can be found in wetlands and one (broad-leaved cattail) grows exclusively in wetlands.

Disturbance to wetlands within the Project Area during construction and operation, changes to hydrological outputs during both construction and operation, and potential groundwater drawdown during operation could result in changes to the function of wetlands outside of the Project Area. It is assumed that the extent of change will be limited to wetlands within the watersheds that are directly affected by Project activities and infrastructure. Conservatively, it is assumed that all wetlands within those watersheds may be affected, resulting in an additional 6.3 km^2 of potentially affected wetland. In total, up to 30.3 km^2 of wetland habitat, or 4.0% of wetland habitat within the ELCA, may be directly or indirectly affected by the Project during construction and operation. Areal amounts and percentages of individual wetland ELC Ecosystem Units that may be directly or indirectly affected by the Project are provided in Table 9.12.

Table 9.12 Wetland Ecosystem Units and Ecotypes Affected by the Project

Ecosystem Unit	Ecotype	Description	Area (km^2)				% of ELCA
			Project Area	Watersheds outside Project Area	Within 200 m of Access Road	ELCA	
Alder Thicket	Alder Thicket	Alder-dominated communities on moist seepage slopes and riparian areas	2.2	0.8	4.0	97.4	7.2
Black Spruce Forest	Black Spruce Forest	Dry to moist and sometimes wet conifer-dominated forests	4.3	1.2	4.7	233.1	4.4
Open Wetlands	Shrub / Graminoid Fen	Very moist to wet shrub / herb dominated peatlands	4.6	2.7	0.9	280.3	2.9
	Shrub Bog						
Riparian Thicket	Riparian Thicket	Shrub thickets located in transitional areas and subject to periodic flooding	0.2	0.2	0.02	15.1	2.8
Wet Coniferous Forest	Wet Coniferous Forest	Very moist to wet conifer forests	2.5	1.3	0.6	130.7	3.4
Total			**13.8**	**6.2**	**10.2**	**756.6**	**4.0**

Notes:
Ecotype descriptions from BSA.7, Attachment 7-D
Numbers are rounded to one decimal place. Areas and percentages may not add up to total amounts due to rounding

Several of the subwatersheds within the Valentine Lake watershed, located at the northeastern end of Valentine Lake and the northern end of the mine site, contain portions of a large wetland complex (Figure 9-5). This wetland complex is comprised largely of open wetlands (shrub / graminoid fen and shrub bog) interspersed with open water. Among other functions, this wetland likely provides habitat for waterfowl as waterfowl have been observed within this wetland during surveys conducted in support of the Project (BSA.7, 7-E). A large portion of the wetland (approximately 56% based on the CANVEC 1:50,000 Wetland data) falls within the Project Area and within overlapping watersheds. However, only a relatively small portion of this wetland will be directly affected by Project infrastructure.

The portion of the wetland complex within the Project Area contains open wetland interspersed with Black Spruce Forest and Wet Coniferous Forest, whereas outside of the Project Area, the wetland contains more continuous open wetland. Project mitigation will include limiting clearing within the Project Area north of the waste rock pile. Although this wetland complex will be affected by the Project, remaining wetlands in watersheds that do not overlap with the Project Area are expected to continue to provide habitat for waterfowl. Drawdown effects will be limited in bog portions of the wetland because bogs typically have low water flow, receiving nearly all their water through precipitation (National Wetlands Working Group 1997). Landry and Rochefort (2012) found that in peat bogs, the distance that drawdown effects could be detected varied between bogs ranging from 30 to 200 m from the drainage ditch. In most instances, drawdown effects could be detected at less than 60 m. This would limit the area of drawdown effects in individual bogs or in watersheds partially affected by construction and operation of site features. Overall, a relatively small amount of this wetland habitat type (3.0%) will be affected within the ELCA.

Removal of wetlands and reduction in flows into the Victoria River are predicted following the construction of and during the operation of the TMF (Section 7.5.2.2 and Figure 7-22). A reduction in wetland area and function near the TMF, as well as the diversion of water from that area to Victoria Lake, will result in a reduction in flow into the Victoria River; however, the mean annual flow of the Victoria River at the boundary of the Surface Water Resources LAA is expected to decrease by only 1% (Section 7.5.2.2). Changes to wildlife habitat within wetlands of concern that are part of the Victoria Steadies Sensitive Wildlife Area are not expected, as the habitat that is of primary focus for protection is located further downstream on the Victoria River than the Surface Water Resources LAA boundary (B. Adams pers. comm. 2020).

With mitigation, the Project is predicted to have an adverse residual effect on wetland function through a decline in the areal extent of wetland ecosystems and a decline in wetland functions (evidenced by an expected change in hydrology) resulting in a change in wetland type within the LAA. The magnitude of this effect will be low because the measurable change in wetland area will be less than 5% of the total area of wetlands in the ELCA. Although the potential change in alder thickets may be up to 7.3% of the area of this wetland type in the ELCA, this wetland type regenerates quickly and it is not expected to result in a change in wetland function at the ELCA (RAA) level. This change in wetland function will occur during the construction phase and will continue throughout the Project. The duration of the effect will be long-term, as the loss of wetland area will extend beyond the life of the Project. Based on past evidence, although the magnitude of the effect is low, it will be irreversible. Although some wetlands will reform in the Project Area following decommissioning, rehabilitation and closure, most wetland classes, particularly those with mature trees and/or thick layers of peat, require development periods much longer than those considered in this assessment.

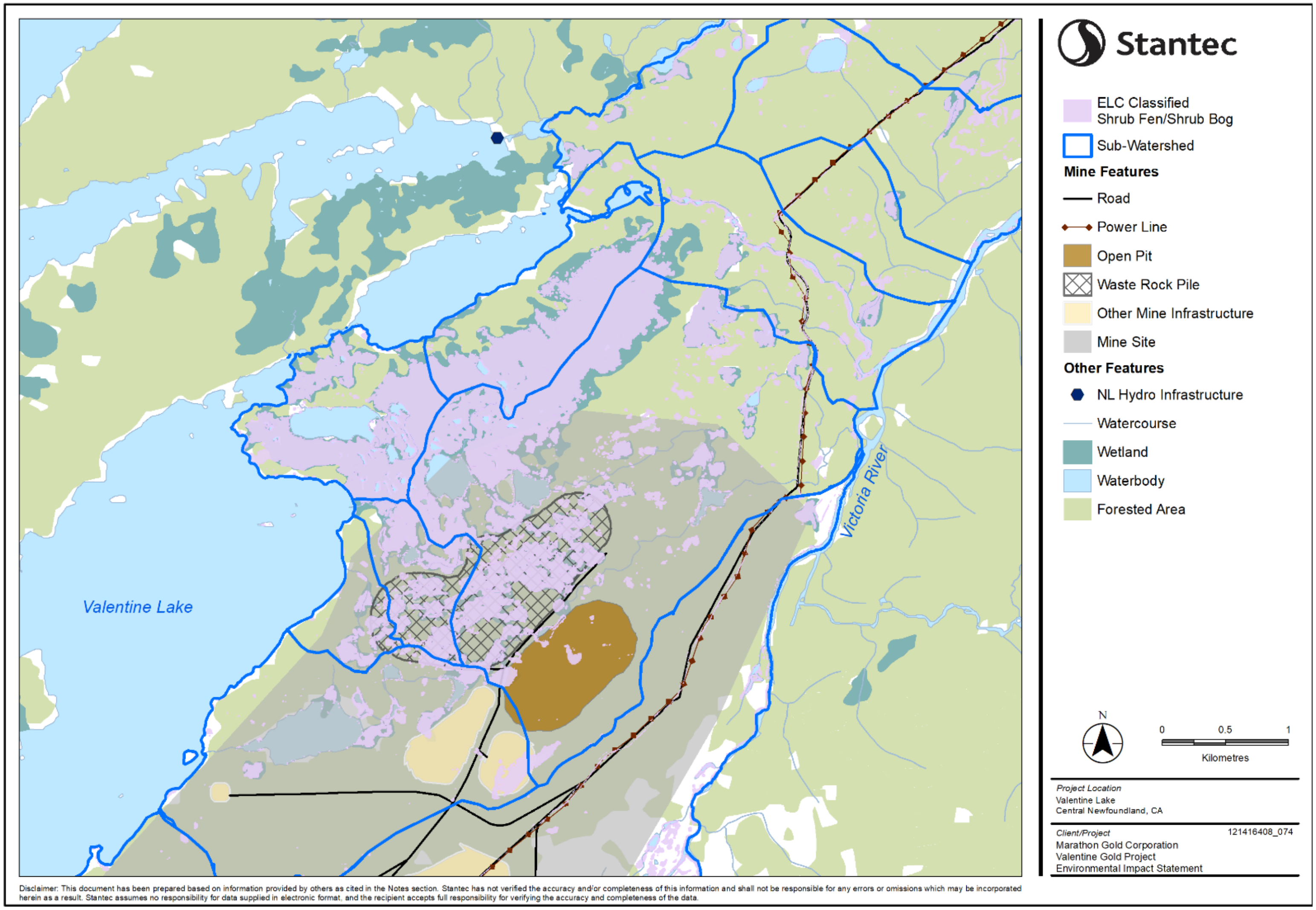

Figure 9-5 Large Wetland Complex Near Valentine Lake

9.5.4 Change in Terrain and Terrain Stability

9.5.4.1 Project Pathways

Construction

Construction activities, such as vegetation clearing, development of the TMF waste rock piles, and stockpiles, general soil salvage, road construction, blasting, grading, engineered embankment construction, and construction of water management infrastructure may result in changes to terrain and terrain stability. Changes primarily occur due to destabilizing surficial materials along slopes, changes to drainage / slope hydrology and creating steep, unstable terrain conditions. Effects of these changes may result in exposed soils and loss of consolidation, increased bank erosion / channel incision along watercourses and steep terrain (berm, waste rock piles). Ground and water pathway disturbance, and creation of steep unstable terrain, may increase the potential for mass movement processes to occur (e.g., landslide, slumping), which is a direct pathway. An example of an indirect effect is a landslide reaching a watercourse that may cause temporary flow blockage or flooding.

Operation

Operation activities, such as tailings management, waste rock management, overburden storage, road use and maintenance, and open pit mining have the potential to affect slope gradient, soil and parent material internal strength, and hydrological changes that may initiate or increase the frequency of mass movement processes and soil erosion.

Decommissioning, Rehabilitation and Closure

Decommissioning and rehabilitation activities that may result in changes to terrain stability include decommissioning of roads, bridges and water management features, and re-distribution of salvaged soils and recontouring. In general, distribution of large volumes of unconsolidated soils may result in changes to the natural or constructed landscape and change or increase the potential for mass movement events to occur or increase in frequency.

9.5.4.2 Residual Effects

Changes in terrain may occur though changes to landforms that may interact with unique features identified beyond the mine site, including wetlands, watercourses and eskers. Two small glaciofluvial ridge features (i.e., potential eskers) were identified in the regional mapping and are located south of the existing exploration camp along the Victoria Lake Reservoir shoreline. These features are just outside of and adjacent to the Project Area and the Project is not anticipated to affect them. The potential effects of the Project on wetlands are assessed in Section 9.5.3 and are not repeated here. The potential effects of the Project on watercourses are fully assessed in Chapter 7 (Surface Water Resources).

Changes in terrain stability may affect the potential for mass movement processes that may affect Project facilities and infrastructure, terrain (unique landforms), fluvial processes and soil erosion. Changes to terrain stability have the potential to directly and indirectly affect ecosystem components such as vegetation and aquatic habitats. Increased erosion or the loss of topsoil due to mass movement processes can also lead to sediment loading in watercourses and waterbodies, and can affect growth and vigor of vegetation. Terrain stability issues and accelerated erosion can occur during all phases of the Project; however, the implementation of mitigation will reduce adverse residual effects. Naturally occurring mass movement processes can be triggered by periods of intense precipitation or snowmelt, which may result in oversaturation and soil structure weakening, as well as slope undercutting (i.e., toe support) with increased erosion. The rate of these naturally occurring processes can be intensified by Project-related activities.

Geotechnical investigations for all site infrastructure, open pits, waste rock piles and stockpiles will be conducted prior to construction to further assess site specific conditions and associated risk of geophysical or geological hazards. Where possible, construction areas deemed to be directly or indirectly connected to unique features, or unstable or potentially unstable, will be avoided. Best management practices and mitigation measures outlined in environmental management and protection plans will be followed, and if required, slope stabilization techniques will be applied.

With the implementation of mitigation measures, it is anticipated that adverse residual effects related to terrain and terrain stability will have low magnitude and will be associated with single or irregular events throughout the life of the Project. Effects from terrain stability are considered reversible with mitigation and monitoring (e.g., landslide rehabilitation, stream sedimentation monitoring).

9.5.5 Change in Soil Quality and Quantity

9.5.5.1 Project Pathways

Construction and Operation

Project-related effects for both soil quality and quantity will occur throughout the mine life and post-closure; however, the potential for adverse effects on soils will be greatest during the construction and operation phases of the Project.

Project construction activities have the potential to result in a direct loss or alteration of soil quality and quantity due to ground disturbance and vegetation clearing. Vegetation clearing, overburden removal (e.g., site preparation, pit construction, construction of water management features), soil stockpiling, dust liftoff and upgrading / realigning of the access road during construction has the potential to affect 34.8 km^2 of land area and vegetation communities (i.e., the spatial extent of the Project Area). This includes the removal or alteration of soils from the productive land base (soil quality) and loss of soils to burial and erosion (soil quantity). The indirect effects of dust on soil quality is considered a secondary effect pathway. Potential effects due to changes to soil conditions during construction and operation include: loss of existing vegetated and/or forested land; stockpiling and soil storage resulting in loss or change of soil quality; admixing, compaction and rutting of surface soils; and effects from dust and particulate matter deposition.

Removal of soil from its native context during site clearing and stockpiling activities has the potential to disrupt the natural chemical and biological processes that are fundamental to ecosystem functioning (i.e., nutrient cycling and habitat for micro and mesofauna). Soils placed in a stockpile tend to have altered horizon distribution (i.e., mixed topsoil and subsoil), as well as changed bulk density and porosity as compared to undisturbed soils. This may affect aeration and moisture levels and may differ compared to those found within undisturbed soil profiles under native vegetation. Soil also acts as habitat for micro and mesofauna that have adapted to the physical and chemical conditions of the undisturbed soil profile under the influence of a particular vegetation community. Stockpiling soils results in soil habitat alteration.

Physical soil quality influences hydrologic (water retention and transmission) and aeration processes (porosity and gaseous diffusion) within soils. Construction activities have the potential to compact, admix and cause rutting of surface soils, which causes adverse effects on soil physical conditions.

As noted, Project-related transportation can also result in dust deposition altering soil chemistry and vegetation (Brown 2009). Dust and particulate matter deposition (i.e., deposits for other metals, diesel emissions) during transportation and/or equipment operation may alter soil chemistry. The air quality assessment (Chapter 5) addresses air emissions, including total suspended particulates (TSP) predictions for the Project Area.

Decommissioning, Rehabilitation and Closure

Closure rehabilitation will include dismantling and removal of equipment and buildings, drainage of sedimentation and stormwater ponds, and the re-establishment of pre-Project drainage patterns, where practicable. Decommissioning and closure activities, including progressive rehabilitation (overlapping with the operation phase), that can affect soils are general ground disturbance such as regrading, re-sloping, stabilizing and soil replacement. During rehabilitation, stockpiled soils will be replaced on disturbed areas to support revegetation. During the decommissioning, rehabilitation and closure phase, Project-related transportation will continue to spread dust to soils throughout the Project Area and areas adjacent to the access road.

9.5.5.2 Residual Effects

Potential direct Project effects on soil quality and quantity include soil disturbance, soil contamination, dust deposition and accelerated erosion. Dust deposition is considered both a direct and indirect effect as dust deposition can also result in the introduction of trace elements (i.e., heavy metals) to the soil.

Residual effects are predicted for both soil quality and quantity. The residual effect characterizations are summarized below, and determinations of significance are presented in Section 9.6. Where conservative assumptions have been considered in the assessment, these are discussed as they pertain to analytical techniques and residual effects predictions. Conservative assumptions are also relevant to the discussion of prediction confidence in Section 9.7.

As noted earlier, residual effects on soils are not necessarily inherently adverse; the implications of these residual effects are meaningful primarily as they relate to effects on post-closure ecosystems and the capacity of disturbed areas within the Project Area to eventually sustain site productive capability, wildlife habitat, and land and resource uses.

In most cases, implementation of mitigation strategies described above can effectively reduce and manage residual effects on soil resources. A description of the residual Project effects is provided below.

Changes to Soil Quality

Construction, operation and decommissioning may result in changes to soil quality with respect to admixing, compaction and rutting, rehabilitation suitability and soil chemistry.

Admixing of soils can occur during salvage and storage of rehabilitation (soils) materials. Prescribed mitigation, such as salvaging only good or fair quality soil and suitable overburden to the prescribed salvage depths, are expected to mitigate the effects of admixing on soil quality. Subsequently, adverse residual effects anticipated for soil quality due to admixing are negligible to low in magnitude.

Compaction and rutting of soils can result from the presence of heavy machinery and traffic during all Project phases. Prescribed mitigation measures such as ripping up compacted soils on cleared areas and practicing appropriate surface scarification / loosening before soil replacement, will mitigate the effects of compaction on soil quality. Wet conditions will be avoided to the extent practicable during soil salvage operations. In addition, traffic will be controlled during the salvage process to limit soil compaction, admixing and rutting. Project-related traffic and equipment will also be confined to established access routes and operating areas, thereby avoiding unnecessary compaction of soil in undisturbed areas. With the implementation of these mitigation measures, the adverse Project residual effects on soil quality due to compaction are predicted to be negligible to low in magnitude.

Soil chemistry can be altered through the deposition of dust and particulate matter during transportation and/or equipment operation. As noted in Section 9.5.5.1, dust and particulate matter deposition effects on soils chemistry and TSP predictions have been addressed in the air quality assessment. For vegetation, it is assumed edge effects and dust deposition could occur within 200 m buffer of the access road, which has the potential to affect approximately 24.7 km^2 of vegetation communities and soils (Section 9.5.1.2). Although dust deposition is anticipated, the overall residual effects (with mitigation measures in place) are predicted to be negligible in magnitude and long-term in duration as the effects extend over the life of the Project. In addition, a negligible to low adverse residual effect on soil quality as the result of trace element contamination of soils by the Project is anticipated.

Stockpiling can result in soil fertility loss over time; however, mitigation measures such as fertilization, use of legumes in seeding mixes and inoculation of planting stock with mycorrhizae, can mitigate this potential effect. Therefore, adverse residual effects on soil quality due to changes in soil fertility are predicted to be negligible to low.

With mitigation, the Project is predicted to result in a low adverse residual effect on soil quality. Soil handling plans will address appropriate storage and replacement of topsoil and subsoil through the construction, operation and subsequent rehabilitation phase of the Project. Stockpiled soils will be used for progressive rehabilitation during the life of the Project, and therefore soil storage time will be limited to the extent practicable. In addition, direct placement techniques and prompt progressive rehabilitation will occur wherever practicable to limit changes to chemical and biological soil properties. Soil processes may take some time to gain a state of equilibrium within the newly reclaimed landscape, however, soil recovery is anticipated to occur over time with stockpiled soils having been successfully used as a growth medium to rehabilitate disturbed sites. The duration of the effect will be long-term, as the change in soil quality will extend beyond the life of the Project. The residual effect will be reversible as adverse effects on soils will be mitigated through best practices during construction and operation and through implementation of the Rehabilitation and Closure Plan. Natural recovery will be encouraged throughout the Project Area through soil and revegetation monitoring, and adaptive management techniques. These monitoring and management techniques will support post-closure ecosystems and wildlife habitat end land use objectives.

Changes to Soil Quantity

A variety of Project pathways can result in a reduction of soil quantity in the Project Area, including burial and erosion. Management strategies and rehabilitation planning will provide a means to mitigate most potential Project-related residual effects on soil quantity. Even where some loss of in situ soils occurs through burial under waste rock or through erosion, excavated soils will be placed over most of the post-mine area through rehabilitation, and soil recovery will take place over time. Vegetation will be re-established, and lead to organic matter deposition, nutrient cycling and soil biota processes. Soils that have reduced quality as a result of handling and stockpiling will recover through rehabilitation activities.

There is a potential adverse residual effect on soil quantity due to erosion in the Project Area. Where soil erosion risk is moderate to high, these areas will have site-specific erosion control measures applied to limit soil loss. With implementation of erosion control measures, the residual effect will not result in substantial changes to soil quantity and is predicted to be low in magnitude.

Potential changes to soil quantity are focused within the Project Area with the potential to occur over the life of the Project (i.e., long-term). During all phases of the Project, effects are anticipated to be single and / or irregular events that can be managed through mitigation. As described above, where loss of in situ soils occurs through burial under waste rock, this effect would be reversible as soils will be placed over most of the disturbed areas through rehabilitation, and soil recovery will take place over time. It is assumed, however, that soil loss will likely occur during soil handling, and this would be irreversible. Therefore, this residual effect for soil quantity in areas of ground disturbance is predicted to be irreversible. The characterizations of residual effects are based on the assumed implementation of mitigation, and soil salvage and rehabilitation.

9.5.6 Summary of Project Residual Environmental Effects

A summary of the residual environmental effects on species diversity, community diversity, wetland function, soil quality, soil quantity and terrain (unique landforms) during Project construction, operation and decommissioning, rehabilitation and closure is provided in Table 9.13. The significance of residual adverse effects is considered in Section 9.6.

Table 9.13 Project Residual Effects on Vegetation, Wetlands, Terrain and Soils

Residual Effect	Residual Effects Characterization							
	Project Phase	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological and Socio-economic Context
Change in Species Diversity	C	A	L	LAA	LT	C	R/I	D
	O	A	L	LAA	LT	C	I	D
	D	N	L	LAA	MT	C	R	D
Change in Community Diversity	C	A	L	LAA	LT	C	I	D
	O	A	L	LAA	LT	C	I	D
	D	N	L	LAA	MT	C	R	D
Change in Wetland Function	C	A	L	LAA	LT	C	I	D
	O	A	L	LAA	LT	C	I	D
	D	N	L	LAA	MT	C	I	D
Changes in Soil Quality	C	A	L	LAA	LT	C	R	D
	O	A	L	LAA	LT	C	R	D
	D	N	L	LAA	LT	C	R	D
Changes in Soil Quantity	C	A	L	PA	ST	S/IR	R/I	D
	O	A	L	PA	MT	S/IR	R/I	D
	D	N	L	LAA	LT	S/IR	R/I	D
Changes in Terrain (unique landforms)	C	A	L	LAA	LT	C	I	D
	O	A	L	LAA	LT	C	I	D
	D	N	L	LAA	LT	C	I	D
Changes in Terrain Stability	C	A	L	LAA	LT	IR	R	D
	O	A	L	LAA	LT	IR	R	D
	D	N	L	LAA	LT	IR	R	D

Table 9.13 Project Residual Effects on Vegetation, Wetlands, Terrain and Soils

Residual Effect	Residual Effects Characterization							
	Project Phase	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological and Socio-economic Context

KEY
See Table 9.7 for detailed definitions

Project Phase
C: Construction
O: Operation
D: Decommissioning

Direction:
P: Positive
A: Adverse
N: Neutral

Magnitude:
N: Negligible
L: Low
M: Moderate
H: High

Geographic Extent:
PA: Project Area
LAA: Local Assessment Area
RAA: Regional Assessment Area

Duration:
ST: Short term
MT: Medium term
LT: Long term

N/A: Not applicable

Frequency:
S: Single event
IR: Irregular event
R: Regular event
C: Continuous

Reversibility:
R: Reversible
I: Irreversible

Ecological / Socio-Economic Context:
D: Disturbed
U: Undisturbed

9.6 DETERMINATION OF SIGNIFICANCE

A significant adverse residual effect on vegetation and wetlands is defined as one that:

- Threatens the long-term persistence or viability of a vegetation species in the RAA, including effects that are contrary to or inconsistent with the goals, objectives, or activities of provincial or federal recovery strategies, action plans and management plans (i.e., change from a non-listed species to a species of management concern)
- Threatens the long-term persistence or viability of a vegetation community in the RAA, including effects that are contrary to or inconsistent with the goals, objectives or activities of provincial or federal recovery strategies, action plans and management plans
- Results in a non-compliance with section 5.1 of the NL *Policy for Development in Wetlands* or a loss of more than 10% of wetland area within the RAA

Although individuals of vegetation species will be lost as a result of the Project, the long-term persistence of vegetation species are not predicted to be threatened by the Project. No vegetation species are expected to experience a change in conservation status as a result of the Project. The Project will result in the potential loss of, or change to, up to 65.6 km^2 of vegetation communities, which represents 3.6% of the vegetation communities in the ELCA, and less than 1% of the RAA. The Project is not expected to result in a loss within the RAA of any vegetation community type. The Project is expected to result in potential direct loss or change of wetland function of up to approximately 30.8 km^2 of wetland area within the RAA. The Project is not expected to result in a non-compliance with section 5.1 of the NL Policy for Development in Wetlands. The potential total loss of, or change to, wetland area is predicted to be up to approximately 4.1% of the wetland area within the ELCA, which is well below 1% of the wetland area within the RAA.

A significant adverse residual effect on terrain, terrain stability and soils is defined as one that:

- Alters soil quality or quantity such that successful rehabilitation to self-sustaining ecosystems with an average capability relative to that present at existing conditions is prevented
- The function of ecologically or culturally important landforms is substantially altered
- Unstable terrain is affected such that successful slope stability mitigation measures do not prevent and/or protect as per regulatory guidelines such as the NL *Mining Act* and the NL EPA

With respect to unique landforms and slope stability, a significant adverse residual effect is one that would occur within the geographic extent of a landscape and would be expected to last continuously into the future. Such an effect may also be distinguishable at the ecosystem level. As potentially affected ecosystems are expected to display limited sensitivity to Project activities, the function of ecologically or culturally important landforms is not anticipated to be substantially altered. Soil quality or quantity, and terrain and terrain stability are not expected to be altered such that rehabilitation to self-sustaining ecosystems with an average capability equivalent to that present at existing conditions is prevented.

With proposed mitigation and environmental protection measures, Project-related residual adverse environmental effects on vegetation, wetlands, terrain and soils are predicted to be not significant.

9.7 PREDICTION CONFIDENCE

Prediction confidence in the assessment of residual effects on species diversity is moderate because surveys have not been completed within the footprint of proposed access road upgrades (which have not been finalized). Prediction confidence in the assessment of residual effects on community diversity is high because of the calculated accuracy and quality of the ELC data, created through remote sensing and verified through field data collection. For wetland function, prediction confidence in the assessment of residual effects is moderate because the functions of wetlands that will be affected by the Project were not specifically evaluated, and are instead inferred from wetland class, form and type. Mitigation measures proposed for vegetation and wetlands identified in Section 9.4 are well-established and proven environmental protection measures. As residual effects are predicted assuming application of mitigation measures, this adds to the confidence in predicted residual effects for vegetation and wetlands.

In general, the prediction confidence in the assessment of residual effects for change in soil quality is moderate, as the precise locations and extent of admixing and compaction changes is uncertain. However, the effects on soil quality from ground disturbance are well understood, and mitigation strategies to reduce the effects of construction and mining activities on soil quality have been demonstrated to be effective.

The overall prediction confidence in the assessment of residual effects for change in soil quantity is moderate. There is some uncertainty regarding the predictions for soil volume loss, since there are several potential Project pathways that can lead to soil loss, and some are not quantifiable. For example, soil loss from machine handling or timing of weather events during soil handling can lead to soil loss that cannot be predicted or quantified. However, confidence in the predictions of residual effects for soil erosion are generally high, as is the confidence in the soil quality data. In addition, mitigation measures to manage the effects of construction and mining activities on soil quantity are generally well established and proven to be effective.

As indicated in Section 9.1, terrain refers to landforms associated with the general physiography of the natural landscape such as topography, surficial geology and unique landforms (e.g., wetlands and eskers). As wetlands are the unique landform that occurs most frequently in the Project Area, the prediction confidence in the assessment of residual effects for change in terrain is based on the confidence prediction for wetlands. As is stated above, the prediction confidence in the assessment of residual effects for change in wetland function is moderate.

With regards to terrain stability, it is assumed that Project design will be modified to accommodate potential terrain instabilities identified in the detailed geotechnical assessment for the Project Area. The mine site will be managed to prevent the development of unstable terrain, which will include the implementation of well-established mitigation measures. Based on these assumptions, the prediction confidence in the assessment of residual effects for terrain stability is moderate to high.

9.8 PREDICTED FUTURE CONDITION OF THE ENVIRONMENT IF THE UNDERTAKING DOES NOT PROCEED

The predicted future condition of the environment for vegetation and wetlands if the Project does not proceed is not expected to differ markedly from the current condition. No SAR were observed within the Project Area, and there is no indicated that the status of the SOCC that were observed will change in the future. Community diversity and wetland function may change with other potential developments and resource use, such as forest management, that is currently and will likely continue to occur in the area, or by natural processes such as disease, insect pests, severe weather events or fires. Climate change has the potential to result in changes to vegetation species, communities and wetland function over time. As weather events become more extreme (e.g., greater amounts of precipitation, when it is received) and erratic (e.g., longer dry spells in between precipitation events), hydrological systems (including wetlands) will receive precipitation over shorter durations (Bush and Lemmen 2019; NRDC 2020). Coupled with predicted faster snowmelt, most systems are expected to experience more frequent flooding events (Bush and Lemmen 2019). As average annual temperatures rise, boreal species may become less common and vegetation patterns may shift (Bush and Lemmen 2019). The general uncertainty of climate change models and predictions makes it difficult to predict if or when, and to what extent, such changes may be expected to occur, though the greatest changes are expected to occur in more northern regions (Bush and Lemmen 2019).

The predicted future condition of the environment for soils, terrain (unique landforms) and terrain stability if the Project does not proceed is not expected to differ markedly from the current condition. Soil, terrain and terrain stability conditions for the Project are primarily attributable to disturbance, which include natural processes such as flooding or landslides, or natural events such as wildfires. For example, wildfire events can affect soil erosion potential by creating hydrophobic soils (i.e., extreme heat may result in waxy build up on soil particles causing soils to repel water rather than absorb water), which can lead to increased runoff rates and oversaturated conditions in unstable slope areas. Climate change is a factor associated with the future conditions of the environment. As noted above, the general uncertainty of climate change models and predictions makes it difficult to predict if or when, and to what extent such changes may be expected to occur. In general, increased precipitation and frequency of storm events may lead to faster snowmelt, increased ground saturation and watercourse flow volumes, flooding events, which may lead to increased erosion events. Changing temperatures may also affect soil nutrient cycling patterns and micro – meso fauna habitats, which may affect soil quality.

9.9 FOLLOW-UP AND MONITORING

Pre-construction vegetation surveys will be conducted within the footprint of the access road upgrades. Compliance monitoring will be conducted to confirm environmental mitigation measures for vegetation and wetlands are implemented and properly maintained.

Follow-up work for this assessment of environmental effects on soil quality and quantity will include development of the Rehabilitation and Closure Plan and Environmental Protection Plan, with the latter including measures for soil management and handling, and erosion and sediment control. Compliance monitoring will be conducted to confirm environmental mitigation measures are implemented and properly maintained. This includes stockpile monitoring for soil quality, and soil management measures to reduce site soil loss. In addition, ongoing soil contamination assessments will be implemented where and when warranted. Follow-up and monitoring will focus on soil stockpiles, the TMF, water management infrastructure, waste rock piles and open pit slopes. The water quality of tailings effluents and discharges from sedimentation ponds will be monitored for pH, metals, sulfates, and other applicable analytes, and integrated into soil monitoring and follow up plans where required. The potential for soil erosion and sedimentation of watercourses and waterbodies will be routinely assessed and mitigated.

Follow-up work for this assessment of environmental effects on terrain and terrain stability may include follow-up surveys conducted over the mine life to allow for better prediction of potential areas of instability, with closure planning taking into account management of known residual instability. Unique landforms, including wetlands and eskers (if identified) will be addressed though monitoring for compliance with identified mitigation measures.

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10.0 AVIFAUNA

10.1 SCOPE OF ASSESSMENT

Avifauna was selected as a valued component (VC) because of the potential for interactions between Project activities and avifauna species and their habitat and protected areas. Avifauna are of importance to the public, Indigenous groups and resource managers, and are regulated under the federal *Migratory Birds Convention Act* (MBCA) and the Newfoundland and Labrador (NL) *Wild Life Act*. Avifauna species provide recreational, domestic (food supply) and economic benefits for residents in central Newfoundland.

In this assessment, the term "avifauna" encompasses bird species, including species at risk (SAR) and species of conservation concern (SOCC).

SAR are those species:

- Designated under Schedule 1 of the federal *Species at Risk Act* (SARA)
- Listed as Extirpated, Endangered, Threatened, or Vulnerable under the NL *Endangered Species Act* (NL ESA)
- Listed as Extirpated, Endangered, Threatened, Vulnerable, or Special Concern by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC)

SOCC are those species identified as provincially rare in NL (ranked as S1 or S2) by the Atlantic Canada Conservation Data Center (AC CDC). For this avifauna survey program, SOCC include those bird species:

- recommended for listing by the Species Status Advisory Committee (SSAC) as Endangered, Threatened, Vulnerable, or Special Concern, however not yet listed under NL ESA or SARA
- considered provincially rare, i.e., those species with provincial status ranks (S-ranks), of S1 (Critically Imperiled), S2 (Imperiled)[2], or combinations thereof (e.g., S1S2) upon review by the AC CDC (AC CDC 2020a)

A summary of the ranking systems defined by SARA, COSEWIC, NL ESA and AC CDC is provided in Appendix 10A.

Numerous avifauna species inhabit the region given the widespread availability of habitat types, including wetlands, rivers, lakes and forests. It is not feasible to assess all species with potential to occur in the region; therefore, the assessment of avifauna is focused on representative species from each bird group in the area (e.g., landbirds, waterfowl) which are known to occupy the Regional Assessment Area (RAA) and have the most potential to be affected by the Project. The habitat requirements of these species are

[2] While *S3* species may be of concern from a provincial biodiversity perspective, they are often not included, as their populations are considered less sensitive. This determination is typically at the discretion of the Newfoundland and Labrador Department of Fisheries, Forestry and Agriculture (NLDFFA) – Wildlife Division.

also discussed. Avifauna habitats are defined as areas where avifauna species live, selected by individual species to meet their nutritional, reproductive and shelter requirements.

The assessment of avifauna is linked to and/or informed by the conclusions of the effect assessments for the following VCs:

- Vegetation, Wetlands, Terrain and Soils (Chapter 9) with respect to potential changes in habitats used by avifauna
- Land and Resource Use (Chapter 16) with respect to potential effects on hunting should the Project alter the distribution and abundance of avifauna species
- Indigenous Groups (Chapter 17) with respect to potential changes in the hunting areas used by Indigenous groups should the Project alter the distribution and abundance of avifauna species of cultural importance

10.1.1 Regulatory and Policy 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 assessment on avifauna.

10.1.1.1 Federal Guidance

The assessment of potential Project-related environmental effects on avifauna includes consideration of the requirements of the Federal Environmental Impact Statement (EIS) Guidelines (Appendix 1A) and the following federal legislation:

- The SARA provides protection for SAR in Canada. The legislation provides a framework to facilitate recovery of species listed as Threatened, Endangered or Extirpated and to prevent species listed as Special Concern from becoming Threatened or Endangered. SAR and their habitats are protected under SARA which prohibits: 1) the killing, harming, or harassing of Endangered or Threatened SAR (sections 32 and 36); and 2) the destruction of critical habitat of Endangered or Threatened SAR (sections 58, 60 and 61).
- The MBCA provides protection for migratory birds, nests and eggs. This act affords protection to most native bird species expected to occur in the RAA, except some non-migratory groups, and some species, such as raptors, kingfishers and cormorants. Those species not protected under the MBCA are afforded protection under provincial legislation described below.

10.1.1.2 Provincial Guidance

The assessment of potential Project-related environmental effects on avifauna includes consideration of the Provincial EIS Guidelines (Appendix 1B) and the following provincial legislation:

- The NL ESA provides protection for terrestrial vegetation and animal species considered to be Endangered, Threatened or Vulnerable in NL. The Wildlife Division, within the NL Department of

Fisheries, Forestry and Agriculture (NLDFFA) coordinates the assessment and listing of SAR and develops recovery and management plans, monitoring programs and research projects to promote conservation of species under the Act.
- The NL *Wild Life Act* affords protection of wildlife (including avifauna species) and prohibits the hunting, taking or killing of wildlife or classes of wildlife, whether in particular places or at particular times or by particular methods, except under license or permit. The Act, in combination with other provincial regulations and Acts including the *Wilderness and Ecological Reserves Act* and the NL ESA, protects the biodiversity and wildlife resources of NL from being compromised.

10.1.2 The Influence of Engagement on the Assessment

As part of ongoing engagement and consultation activities, Marathon has documented interests and concerns about the Project received from communities, governments, Indigenous groups and stakeholders. An overview of Marathon's engagement activities is provided in Chapter 3. Documented interests and concerns have influenced the design and operational plans for the Project and the development of the EIS, including the scope of assessment on the VCs. Interests and concerns noted that specifically relate to avifauna or routine Project activities that could affect avifauna are provided below. Issues and concerns related to potential accidents or malfunctions are described in the assessment of accidental events (Chapter 21).

Questions and concerns raised by Qalipu through Marathon's engagement efforts include:

- Whether Project infrastructure can be relocated to reduce the Project footprint
- Terrestrial environment, including the disturbance of caribou migration routes and the potential for the introduction of invasive plant and wildlife species
- Limitation of access to lands and resources for traditional use
- Interest in involvement in the environmental monitoring for the Project

Questions and concerns raised by Miawpukek through Marathon's engagement efforts include:

- The size of the Project footprint
- Acknowledgement that interests of Miawpukek extend beyond caribou and include plants and waterfowl
- Need to consider buffers as a potential mitigation measure for Species at Risk
- Potential impact on Miawpukek land and resource use
- Interest in involvement in environmental monitoring for the Project.

Questions and concerns raised by fish and wildlife and civil society organizations through Marathon's engagement efforts include:

- Project description, including the size of the Project footprint, pit stability, the source of power for the Project, use of cyanide, the process that will replace the heap leach process, how tailings will be transported, and tailings management (and consideration of alternatives)

10.1.3 Boundaries

The scope of the assessment is defined by spatial boundaries (i.e., geographic extent of potential effects) and temporal boundaries (i.e., timing of potential effects). Spatial boundaries for the Avifauna VC were selected in consideration of the geographic extent over which Project activities and their effects, are likely to occur on the VC. Temporal boundaries are based on the timing and duration of Project activities and the nature of the interactions with the VC. The spatial and temporal boundaries associated with the effects assessment for the Avifauna VC are described in the following sections.

10.1.3.1 Spatial Boundaries

The following spatial boundaries were used to assess Project effects, including residual environmental effects, on avifauna in areas surrounding the mine site and access road (Figures 10-1 and 10-2):

Project Area: The Project Area encompasses the immediate area in which Project activities and components occur and is comprised of two distinct areas: the mine site and the access road. The mine site includes the area within which Project infrastructure will be located, and the access road is the existing road to the site, plus a 20-metre (m) wide buffer on either side. The Project Area is the anticipated area of direct physical disturbance associated with the construction, operation and decommissioning, rehabilitation and closure of the Project.

Local Assessment Area (LAA): The LAA includes the Project Area, plus a 1-km buffer around the mine site (Figure 10-1), and a 500-m buffer around the portion of the existing access road to be upgraded and maintained by Marathon.

Regional Assessment Area (RAA): The RAA includes the Project Area, LAA and a 35-km buffer around the Project Area (Figure 10-2) encompassing Victoria River and Red Indian Lake, as well as the communities of Millertown, Buchans and Buchans Junction. The RAA has been used to inform the assessment of cumulative effects (Chapter 20), and the effects of accidental events on avifauna (Chapter 21) are also assessed within the RAA.

This assessment also refers to the Ecological Land Classification Area (ELCA), which is the area within which detailed habitat data have been collected (Appendix 7: Avifauna, Other Wildlife and Their Habitats [BSA.7], Attachment 7-D). While the extent of the ELC data does not fully cover the Project Area, LAA or RAA (Figure 10-1), the ELCA is used to assess quantitative effects on avifauna habitat. In particular, the magnitude of residual effects has been characterized in relationship to the ELCA (i.e., the percentage of the ELCA in which a loss or change will occur). In this context, the ELCA has been used as a surrogate for the RAA, as it is an area sufficiently large enough to provide regional context and is the area for which comparable ecological land classification data is available.

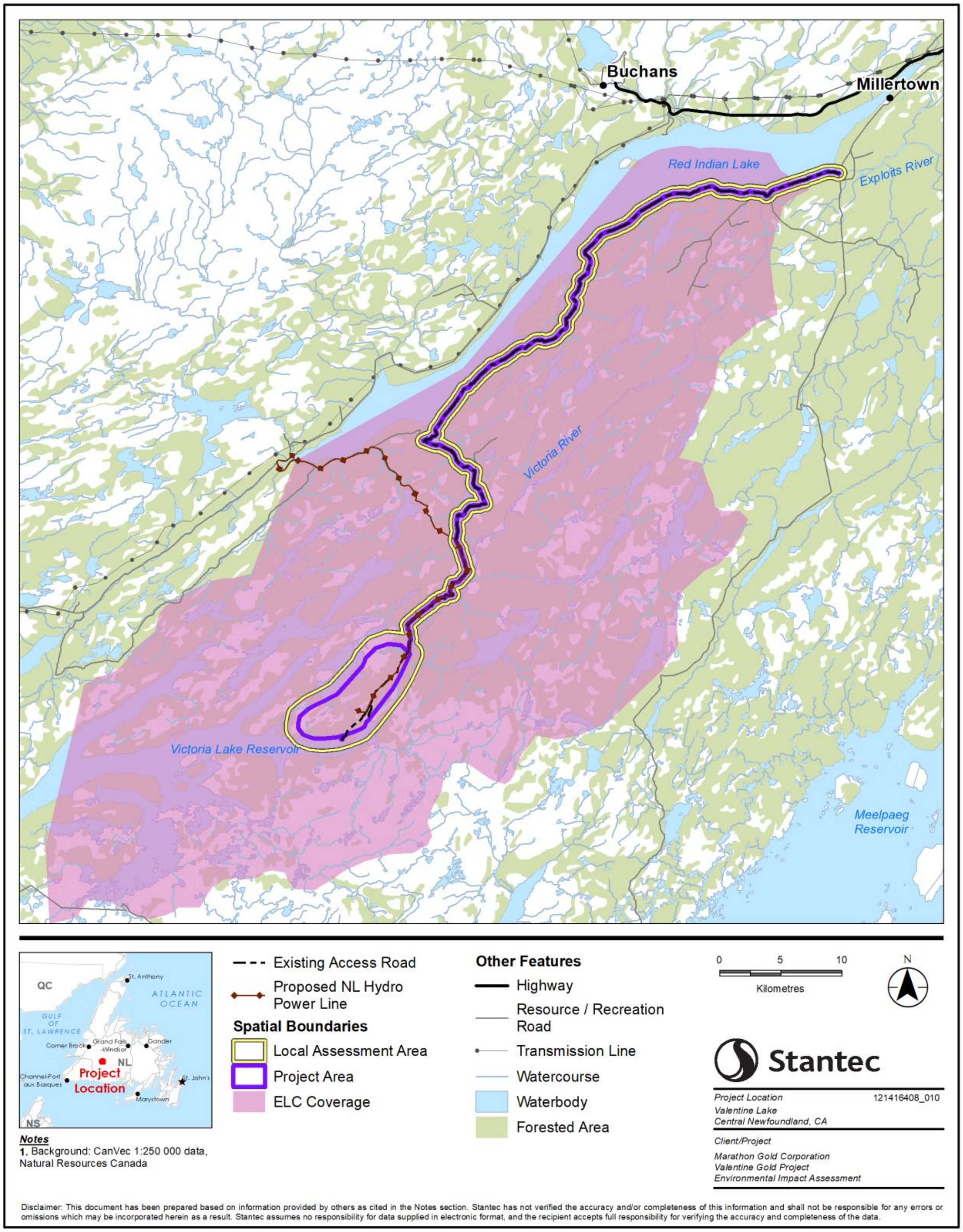

Figure 10-1 Avifauna Local Assessment Area and ELCA

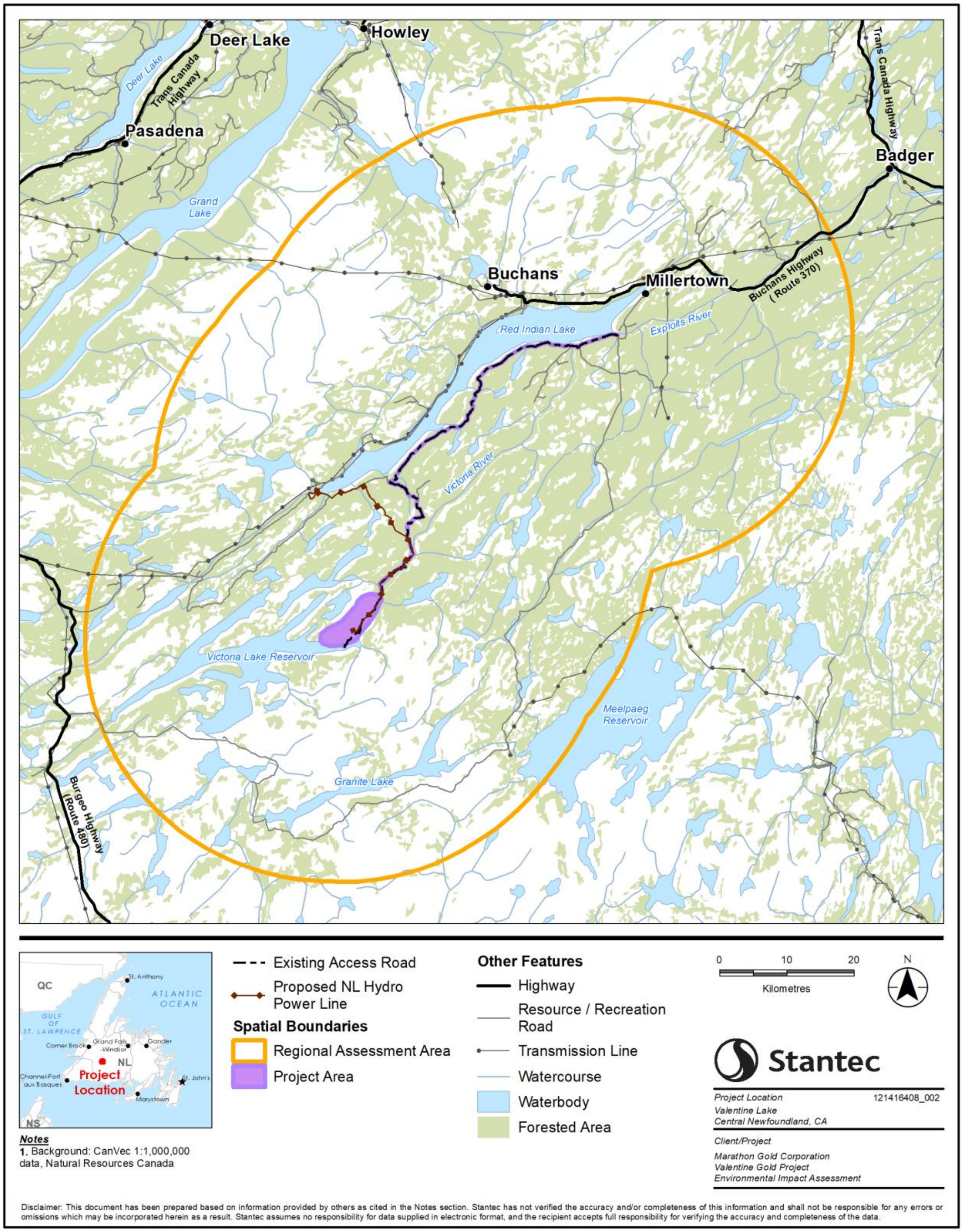

Figure 10-2 Avifauna Regional Assessment Area

10.1.3.2 Temporal Boundaries

The temporal boundaries for the assessment of potential effects on the Avifauna VC include:

- Construction Phase – 16 to 20 months, beginning in Q4 2021, with 90% of activities occurring in 2022
- Operation Phase – Estimated 12-year operation life, with commissioning / start-up and mine / mill operation slated to start Q2 2023
- Decommissioning, Rehabilitation and Closure Phase – Closure rehabilitation to occur once it is no longer economical to mine or resources are exhausted

10.2 EXISTING CONDITIONS FOR AVIFAUNA

A characterization of the existing conditions within the spatial boundaries defined in Section 10.1.3 is provided in the following sections. This includes a discussion of the influences of past and present physical activities on the VC, leading to the current conditions. An understanding of the existing conditions for the VC within the spatial area being assessed is a key requirement in the prediction of potential Project effects provided in Section 10.5.

The Avifauna VC considers the avifauna species in the Project Area and the LAA. It includes SAR and SOCC, as well as birds that are of socio-economic value and species that are characteristic of the various habitat types present in the Project Area and LAA.

10.2.1 Methods

10.2.1.1 Avifauna Surveys and Data

Existing conditions for avifauna and avifauna habitat within the LAA were compiled from sources including relevant publicly available primary and secondary literature, field studies conducted in the Project Area (Appendix 10B) and portions of the LAA, and federal and provincial databases.

The following key public resources were used to assist in establishing the existing conditions for avifauna and avifauna habitat:

- COSEWIC Assessment and Status Update Reports
- AC CDC – observation data on SAR / SOCC in Atlantic Canada
- Labrador-Island Transmission Link Environmental Impact Statement (EIS) (Nalcor Energy 2012)
- Ecological Land Classification (ELC) and Wildlife Species Habitat Analysis, Alderon Iron Ore Corp (Alderon 2012)
- North American Breeding Bird Survey (BBS)
- Christmas Bird Counts (CBC)
- Project-specific field surveys

Atlantic Canada Conservation Data Centre

The AC CDC is a registered charity that was established in 1997, and has the following mission statement: "To assemble and provide objective and understandable data and expertise about species and ecological communities of conservation concern, including those at risk, and to undertake field biological inventories in support of decision-making, research, and education in Atlantic Canada" (AC CDC 2020a). AC CDC data, including rare avifauna species, was requested for the LAA and is included in the consideration of species presence in the Project Area and LAA (AC CDC 2020b).

The AC CDC data included records of two rare species occurring within the LAA. These included common nighthawk (*Chordeiles minor*) (a record generated by an observation made by Stantec Consulting Ltd. [Stantec]), and bank swallow (*Riparia riparia*). A list of species identified as present within or near the LAA, including those identified by the AC CDC, is presented in Appendix 10C.

North American Breeding Bird Survey

The North American Breeding Bird Survey (BBS) began in 1966 and is now one of the longest-running breeding bird surveys in North America. The BBS database is extensive and can be used to determine long-term population trends of breeding bird species in Canada. A search of the BBS database was conducted to obtain records of bird species observed near the Project Area (Environment and Climate Change Canada [ECCC] 2019).

The route nearest to the Project Area (NL 5704) lies to the east of the Project Area in Buchans. This route was surveyed annually from 2011 through 2018. A total of 68 species have been observed on this route, varying between 32 and 42 species per year in the most recent survey years. The most numerous species in recent years were white-throated sparrow (*Zonotrichia albicollis*), American robin (*Turdus migratorius*) and yellow-rumped warbler (*Setophaga coronata*) (United States Geological Survey, Patuxent Wildlife Research Center 2020). A list of species identified as occurring within or near the LAA is presented in Appendix 10C.

Christmas Bird Count

The nearest Christmas Bird Count (CBC) (CBC n.d.) was conducted in Buchans. This count was conducted annually between 2000 and 2003, and in 2007. Typically, surveys are done in mid to late December, or early January. A total of 27 species have been observed on this count since 2000 (Audubon 2020). The species observed every year of the count include hairy woodpecker (*Dryobates villosus*), Canada jay (*Perisoreus canadensis*), blue jay (*Cyanocitta cristata*), American crow (*Corvus brachyrhynchos*), common raven (*Corvus corax*), boreal chickadee (*Poecile hudsonicus*), European starling (*Sturnus vulgaris*) (an exotic species), pine grosbeak (*Pinicola enucleator*), common redpoll (*Acanthis flammea*), evening grosbeak (*Coccothraustes vespertinus*) (SAR) and house sparrow (*Passer domesticus*) (an exotic species).

Project-specific Field Surveys

Four directed avifauna surveys were conducted by Stantec in the Project Area and surrounding areas of the LAA to better understand the occurrence, distribution and habitat associations of avifauna. Incidental observations of avifauna species were also recorded during other field studies. Table 10.1 provides an overview of the field studies conducted between 2011 and 2019 that include relevant information on avifauna and avifauna habitat in the Project Area and parts of the LAA. These reports are presented in BSA.7.

Table 10.1 Avifauna Field Surveys Conducted During Baseline Field Programs

Study	Date	Summary
2011 Baseline Waterfowl and Waterfowl Habitat Study (BSA.7, Attachment 7-C)	May 16 and July 7, 2011	Aerial waterfowl breeding pair and brood surveys, and wetland habitat characterization. Includes incidental observations of other avifauna.
2011 Forest Songbird Surveys (BSA.7, Attachment 7-B)	June 14 – 18, 2011	Point count surveys and transects targeting forest breeding songbirds in the Project Area and LAA.
Waterfowl Baseline Study: Aerial Waterfowl Spring Breeding and Fall Staging Surveys (BSA.7, Attachment 7-E)	June 6 and September 7, 2017	Aerial waterfowl surveys conducted in spring and fall to increase understanding of waterfowl species richness and habitat use in the Project Area and LAA.
2019 Avifauna Baseline Study: Results of the 2019 Songbird and Common Nighthawk Surveys (BSA.7, Attachment 7-H)	June 26 – 28, 2019	Point count surveys targeting breeding songbirds, and crepuscular surveys (common nighthawk [*Chordeiles minor*]) in the Project Area.
Winter Wildlife Survey (BSA.7, Attachment 7-A)	February 28 – March 29, 2013	Included aerial track survey, ground-based track survey and incidental observations of avifauna.
Ecosystem Classification and Mapping (BSA.7, Attachment 7-D)	2013 – 2014	Ecosystem classification using remote sensing and field-based habitat descriptions including documentation of incidental avifauna observations.

The species recorded in the studies outlined above are presented in the sections below. Appendix 10B lists the avifauna species observed during forest breeding bird surveys conducted in 2011 and 2019.

10.2.1.2 Avifauna Habitat Assessment

The types of habitat present in the Project Area and the LAA were determined using an ELC (BSA.7, Attachment 7-D).

Discussion of habitat type availability in this chapter refers to the ELCA. The ELCA covers more than 99% of the Project Area and 97% of the LAA (Figure 10-1). The area of the Project Area and LAA outside the ELCA is restricted to a small portion of the site access road at its northern-most reach (i.e., furthest from the mine site) and is considered negligible in the context of assessing potential Project effects on the VC. An analysis of the remaining portion of the LAA was completed, although could not be combined with the

ELCA as the methods are not comparable. A detailed explanation of this analysis is provided in Section 9.2.1.1.

Given the number of avifauna species that occur on the Island of Newfoundland, it is not practical to assess habitat use for each in detail. Therefore, representative species from each of the main groups of birds have been selected and considered further with respect to habitat use within the Project Area. In terms of spatial overlap with the Project Area, habitat use by avifauna during breeding is a key focus. Representative species were selected from the following bird groups: passerines, waterfowl (swimming gamebirds, such as duck and goose species), raptors, upland gamebirds and SAR. The selected species are:

- Passerines
  - Lincoln’s sparrow (*Melospiza lincolnii*)
  - Yellow-bellied Flycatcher (*Empidonax flaviventris*)
- Waterfowl
  - Canada goose (*Branta canadensis*)
  - American black duck (*Anas rubripes*)
- Raptors
  - Northern harrier (*Circus hudsonius*)
  - Osprey (Pandion haliaetus)
- Upland Gamebirds
  - Spruce grouse (Falcipennis canadensis)
  - Ruffed grouse (*Bonasa umbellus*)
- SAR
  - Olive-sided flycatcher (*Contopus cooperi*)
  - Rusty blackbird (*Euphagus carolinus*)

The habitat requirements for the representative species were evaluated based on literature reviews, available information and discussion with experts. Each habitat type present in the Project Area and LAA was evaluated for features such as the presence of structural and compositional elements and other factors such as forage availability.

Three ranks of habitat value were assigned to the habitat types within the Project Area and LAA: high, moderate and low. High value habitat provides forage, protection, and nesting and resting habitat; moderate value habitat provides an abundance of one or more (or marginal amounts of all) of the critical elements (i.e., foraging, protection, nesting and resting); and low value habitat provides marginal foraging, protection, nesting or resting opportunities, or may be used only during transit or migratory periods. The evaluation of habitat suitability for the representative avifauna species in this chapter provides an overview of the potential for portions of the Project Area and LAA to support these species and species with similar habitat preferences.

10.2.2 Overview

The Project lies within the Red Indian Lake Subregion of the Central Newfoundland Forest Ecoregion, which covers most of the central and north-eastern portions of the Island of Newfoundland (Protected Areas Association 2008). This area has a continental climate and experiences colder winters and warmer summers than coastal areas. It is characterized by a mainly coniferous boreal forest, domed bogs and a rolling landscape, with elevations in the Project Area ranging from 160 m above sea level (masl) to 437 masl. Upland vegetation is mostly balsam fir and black spruce forest with some hardwood and mixedwood stands, and heath areas. Lowlands include wetlands and areas of wet coniferous forest (BSA.7, Attachment 7-D).

The region includes a variety of avifauna species commonly found in boreal forests on the Island of Newfoundland. Broadly, the avifauna groups present in this area include passerines, waterfowl, upland gamebirds and raptors. Passerine species (known as “perching birds”) are the most abundant and widespread group of birds, and many species can be indicators of the ‘health’ of ecosystems. Some waterfowl and upland game bird species are ecologically important, however also have economic, cultural and traditional value to the public. Raptors, including owls, represent top avifauna predators, and use both terrestrial and freshwater habitats. Some raptor species also have important cultural and traditional value to the public.

A Sensitive Wildlife Area along the Victoria River was identified by the NLDFFA and the Newfoundland and Labrador Eastern Habitat Joint Venture (NL-EHJV) as containing important waterfowl habitat (NL-EHJV 2008) (Figure 10-3). This area, the Victoria Steadies Sensitive Wildlife Area, was established for the protection of wetland habitat used as breeding, brood rearing and staging grounds for waterfowl. While this area overlaps with the Project Area and LAA (Figure 10-3), NLDFFA has indicated that the waterfowl habitat that was likely the focus of this designation are “steadies” on the Victoria River system located well to the north of the mine site, before the river drains into Red Indian Lake (B. Adams, pers. comm., 2020). A larger area was likely designated to highlight the need for continued drainage of the Victoria River watershed from Victoria Lake Reservoir to Red Indian Lake, to maintain wetland habitat for waterfowl species. A number of ponds / wetlands drain into the Victoria River, and following the establishment of two dams in the 1960s, these appear to be the central aspects of waterflow to the special management areas / steadies, which flow into Red Indian Lake (B. Adams, pers. comm, 2020). Therefore, maintaining wetland / watershed integrity and drainage patterns on the key ponds and wetlands was identified as a central conservation goal relating to this Sensitive Wildlife Area.

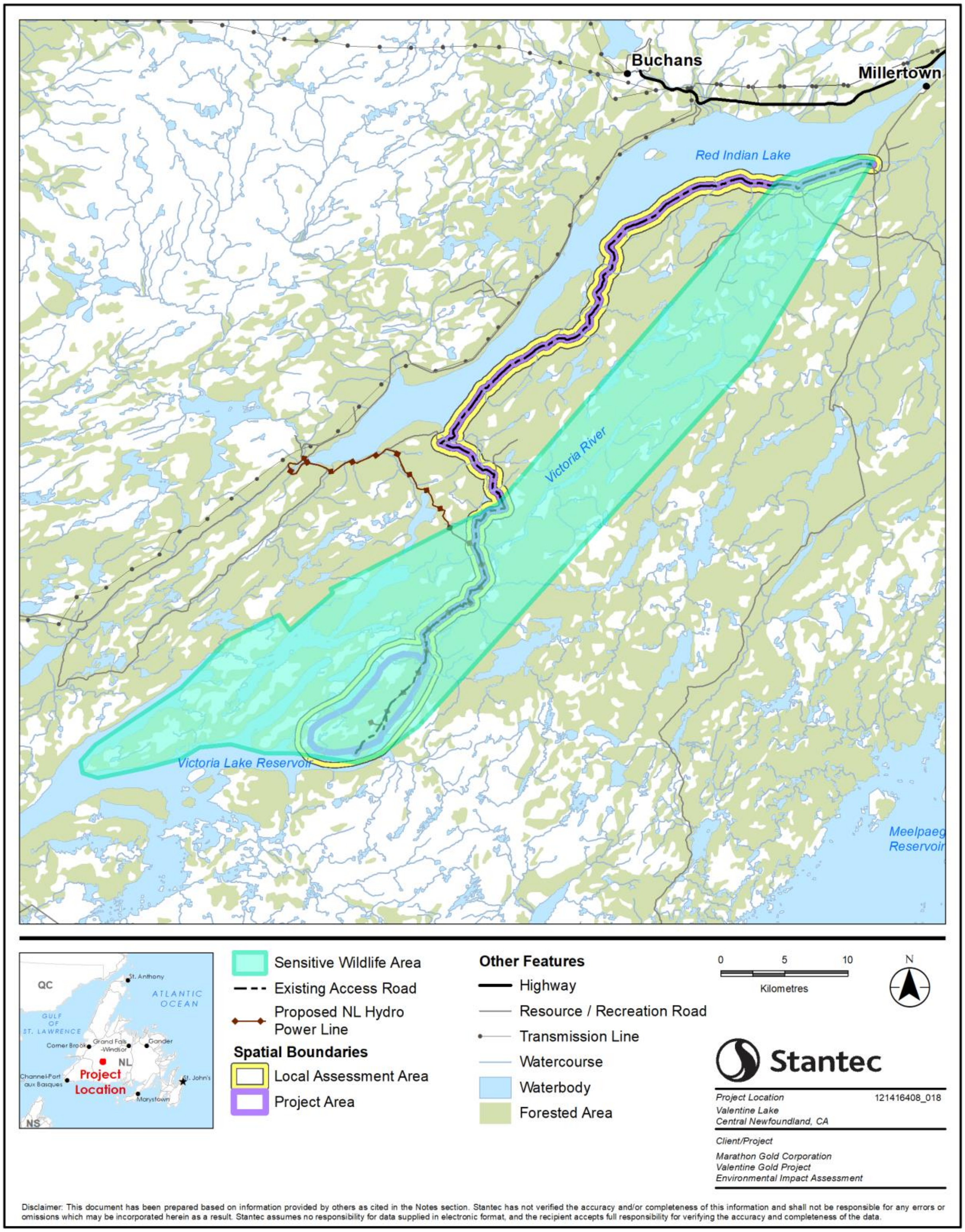

Figure 10-3 Sensitive Wildlife Area along the Victoria River

10.2.3 Avifauna Species

Migratory birds are protected under the federal MBCA and associated regulations. Avifauna species, including those which are not listed under the MBCA, are afforded protection under the NL *Wild Life Act*. A total of 98 species of birds were identified as having the potential to occur in or near the LAA by the various data sources, including the AC CDC, BBS and field surveys (Table 10C.1, Appendix 10C). The identified species fell within the main groups of birds that have been selected and considered further with respect to habitat use within the Project Area (passerines, waterfowl, raptors, upland gamebirds and SAR).

10.2.3.1 Forest Breeding Bird Survey Results: Passerines, Raptors and SAR

Most migratory passerines are protected by the MBCA and are an important component in ecosystems. Passerines in inland areas of the Island of Newfoundland are relatively abundant and breed in a variety of habitats, including forests and wetlands.

Forest breeding songbird surveys were conducted in June 2011 and June 2019 within the Project Area and LAA to determine species biodiversity, distribution and relative abundance of passerines (including SAR). Through incidental or opportunistic observation, a general understanding of the diversity of raptor and upland gamebird species within the Project Area and LAA was also noted. Species recorded during these surveys, including incidental observations, are presented in Appendix 10B.

During the 2011 forest breeding songbird survey program, 45 forest passerine species were detected during point count surveys conducted in the Project Area and LAA. The most commonly recorded species included white-throated sparrow, ruby-crowned kinglet (*Regulus satrapa*), Swainson's thrush (*Catharus ustulatus*), boreal and black-capped chickadees (*Poecile atricapillus*), Canada jay, black-and-white warbler (*Niotilta varia*), yellow-bellied flycatcher (*Empidonax flaviventris*) and common loon (*Gavia immer*) (BSA.7, Attachment 7-B). The raptors observed in the vicinity of the Project Area were boreal forest-dwelling species that rely on the habitat for nesting, hunting and breeding. These raptor species included bald eagle (*Haliaeetus leucocephalus*), northern harrier and osprey. One upland gamebird species, spruce grouse, was observed incidentally. Two SAR, rusty blackbird and common nighthawk (observed incidentally), and one SOCC, Nashville warbler (*Leiothlypis ruficapilla*) were detected during this study.

During the 2019 forest breeding songbird survey program, 49 species (including two species observed only incidentally (common tern [*Sterna hirundo*] and tree swallow [*Tachycineta bicolor*]) were identified within the Project Area during the point counts. Of these, 45 were passerines and one was a waterfowl species. The remaining two were wading birds. Excluding incidental observations, the most abundant species observed across the point counts were white-throated sparrow, yellow-bellied flycatcher and ruby-crowned kinglet. No raptors or upland gamebird species were observed. One SAR, olive-sided flycatcher, and two SOCC, bay-breasted warbler (*Setophaga castanea*) and Nashville warbler, were observed in the Project Area during this study. Additionally, rusty blackbird, a SAR, was observed incidentally, outside of the Project Area.

10.2.3.2 Waterfowl Study Results

Waterfowl use wetland habitats in both inland and coastal areas during breeding, staging and molting in NL (NL-EHJV 2008). Wetlands are abundant on the Island of Newfoundland; however, most are not highly productive waterfowl habitat, therefore a wide distribution of waterfowl at low densities results (NL-EHJV 2008). The Newfoundland Boreal Ecozone is rated as moderately important for breeding waterfowl relative to other ecozones in Canada (Fast et al. 2011). Breeding surveys conducted annually since 1990 by the Black Duck Joint Venture show stable population trends for American black duck, common goldeneye (*Bucephala clangula*), ring-necked duck (*Aythya collaris*) and green-winged teal (*Anas crecca*), and an increasing population trend for Canada goose (*Branta canadensis*) (NL-EHJV 2008).

Aerial surveys were conducted in spring (2011 and 2017), summer (2011) and fall (2017) to describe wetland productivity in the vicinity of the Project and to assess waterfowl use of wetland habitat during spring breeding, brood rearing and fall staging. The detailed results of these surveys are available under separate cover (BSA.7, Attachment 7-E).

In general, waterfowl were relatively common in wetland and open water habitats in the vicinity of the Project Area and LAA during spring breeding and fall staging periods. Canada goose, American black duck and ring-necked duck were common in the wetlands. Common loon occasionally occurred on the lakes. Avifauna species observed over the course of these two survey programs, including those observed incidentally, are presented in Table 10.2.

Table 10.2 Waterfowl Species Observed during Waterfowl Studies - 2011 and 2017

Common Name	Latin Name	AC CDC[A] Rank	Years Observed
American black duck	*Anas rubripes*	S4	Spring and Summer 2011, Spring and Fall 2017
Canada goose	*Branta canadensis*	S4	Spring and Summer 2011, Spring 2017
Common goldeneye	*Bucephala clangula*	S4	Spring and Summer 2011, Spring and Fall 2017
Common loon	*Gavia immer*	S5B, S4N	Spring and Summer 2011, Spring and Fall 2017, Forest Breeding Songbird 2019 (Incidental)
Common merganser	*Mergus merganser*	S4	Spring and Summer 2011
Green-winged teal	*Anas crecca*	S4B, SUM	Summer 2011, Spring and Fall 2017
Mallard	*Anas platyrhynchos*	S3B, SUM	2017 Fall
Red-breasted merganser	*Mergus serrator*	S4B, S4M	Spring 2011
Ring-necked duck	*Aythya collaris*	S5B, S5M	Spring and Summer 2011, Spring and Fall 2017

Note:
[A] These species are not listed under SARA, COSEWIC or NL ESA

Spring aerial surveys conducted in 2011 recorded seven species of waterfowl (Figure 10-4) and nine species of other birds. Records were scattered relatively evenly throughout the Project Area and LAA, mainly in wetlands and open water habitats. Twenty-four observations of waterfowl species were located within the LAA; nine of these were within the Project Area. Observations of common loon, Canada goose and five duck species occurred on waterbodies and wetlands in the Project Area. Other species identified in Table 10.2, including red-breasted merganser, were observed within the LAA.

Summer aerial surveys in 2011 identified seven waterfowl species and provided evidence of successful breeding and adult moulting activity (Figure 10-5). Eleven observations of waterfowl species were made in the LAA, and of these, seven were located within the Project Area. Species observed in the Project Area and LAA included common loon, ring-necked duck and American black duck. Other species, including green-winged teal, common merganser (*Mergus merganser*) and Canada goose, were observed in the RAA. No avifauna SAR were observed during these surveys.

Spring aerial surveys conducted in 2017 identified six waterfowl species (Figure 10-6). As with spring surveys conducted in 2011, waterfowl species observations were scattered relatively evenly through the Project Area and LAA, mainly in wetlands and along the perimeter of Valentine Lake Reservoir. Twenty records of waterfowl were located within the LAA; 10 of these were also within the Project Area. Species observed in the Project Area and LAA included Canada goose, ring-necked duck, American black duck, green-winged teal, common goldeneye and common loon. One SAR (rusty blackbird) was observed on two occasions during these surveys.

Aerial surveys conducted in fall 2017 (Figure 10-7) identified six waterfowl species. Eleven records of waterfowl species were located within the LAA; four of these were also located within the Project Area. Species observed in the Project Area and LAA included American black duck, ring-necked duck, common loon, green-winged teal, common goldeneye and mallard (*Anas platyrhynchos*). No SAR were observed during these surveys.

Combined data for the 2017 spring waterfowl and 2017 fall waterfowl surveys suggest that the waterfowl species with the highest abundance in the Project Area and LAA were Canada goose, American black duck, green-winged teal and ring-necked duck (BSA.7, Attachment 7-E).

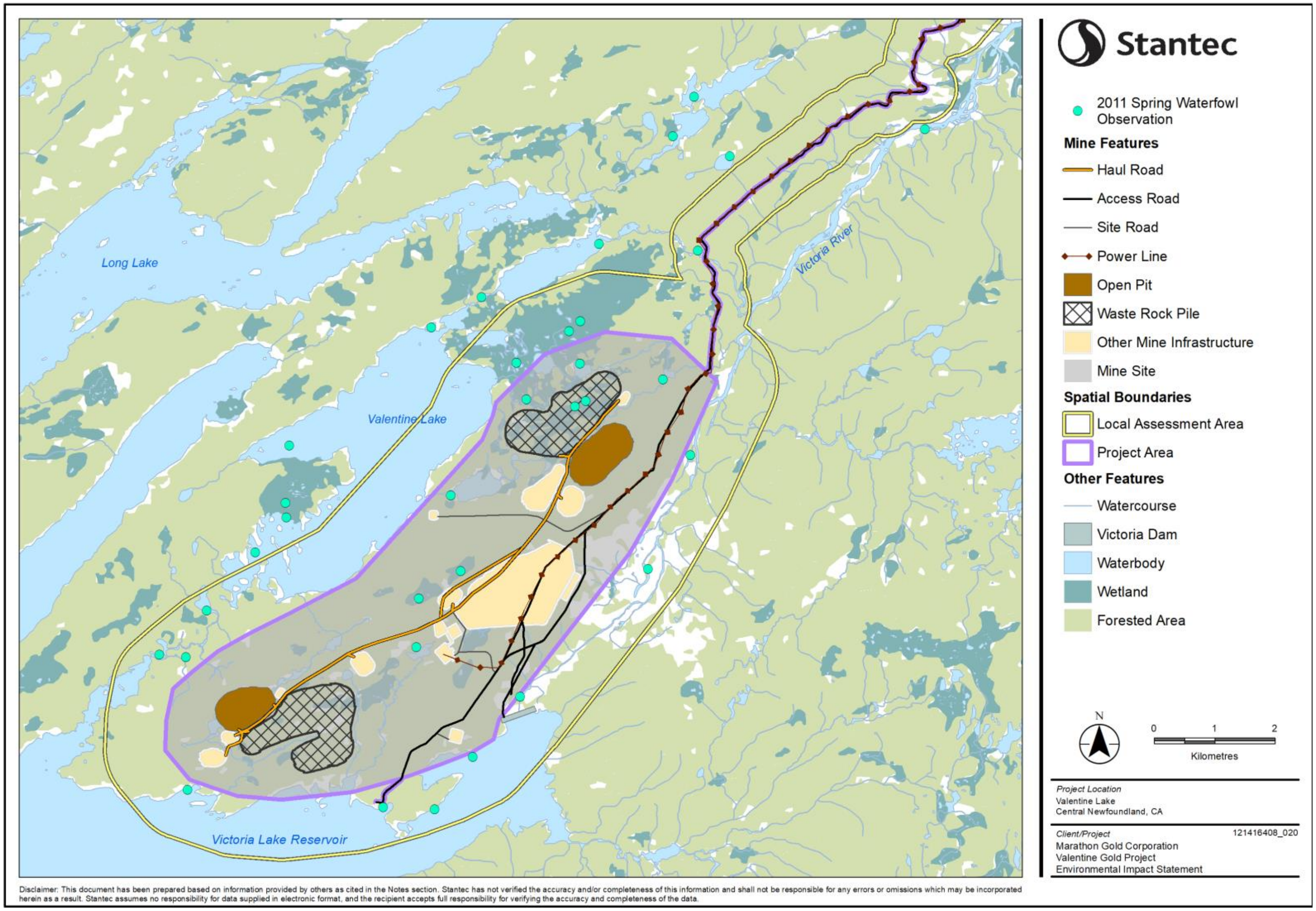

Figure 10-4 Locations of Waterfowl Species Detected during Spring 2011 Aerial Surveys

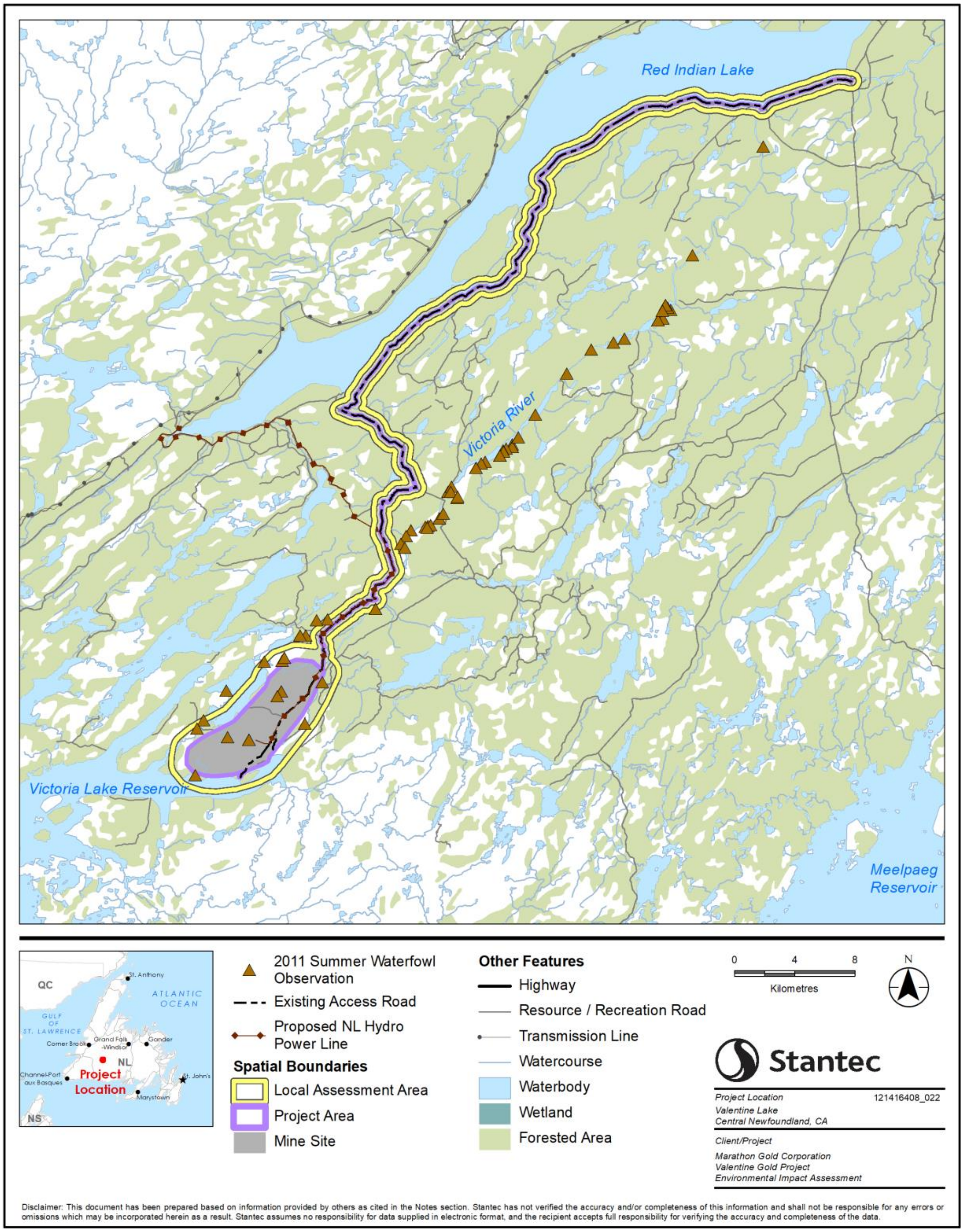

Figure 10-5 Locations of Waterfowl Species Detected during Summer 2011 Aerial Surveys

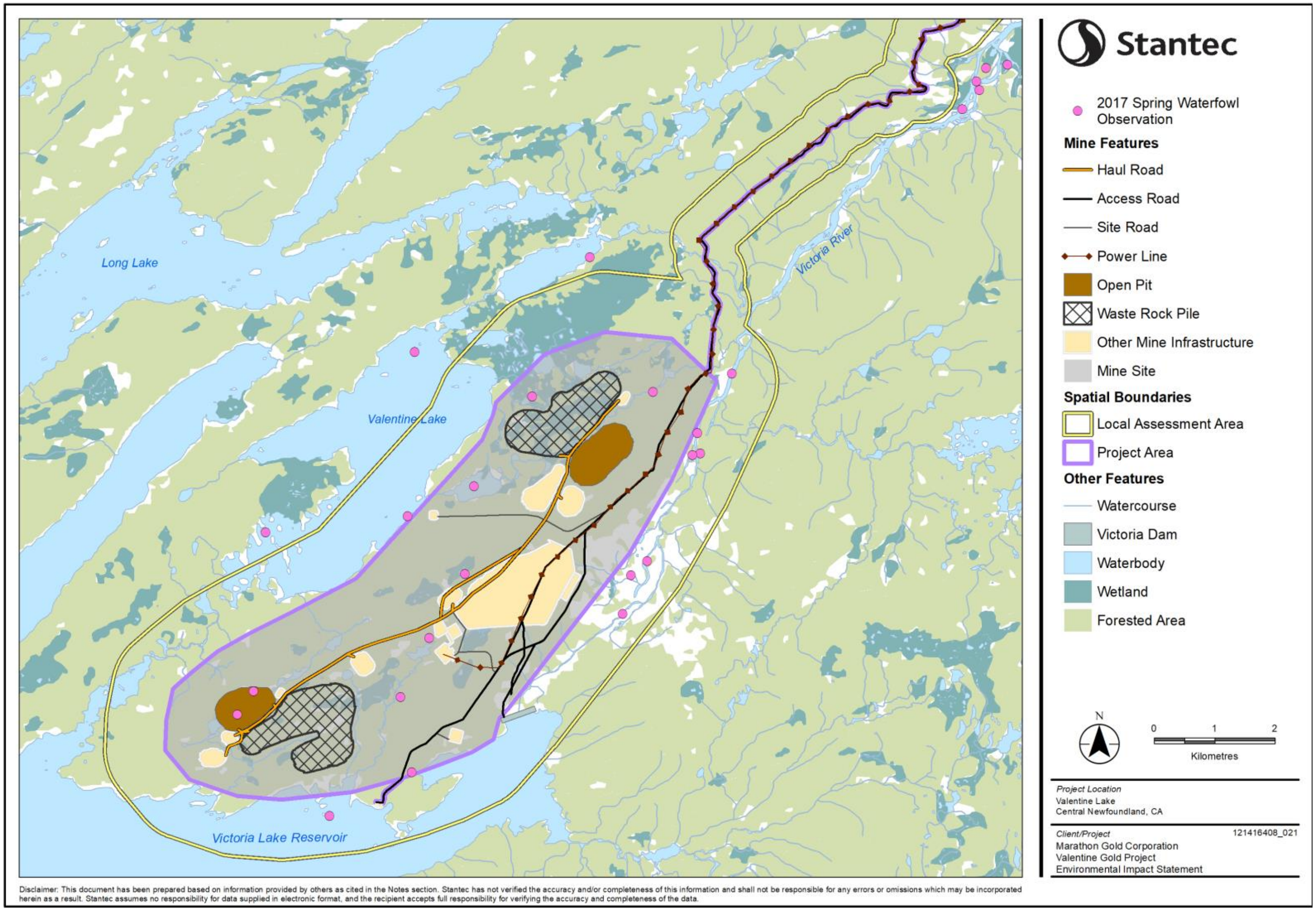

Figure 10-6 Locations of Waterfowl Species Detected during Spring 2017 Aerial Surveys

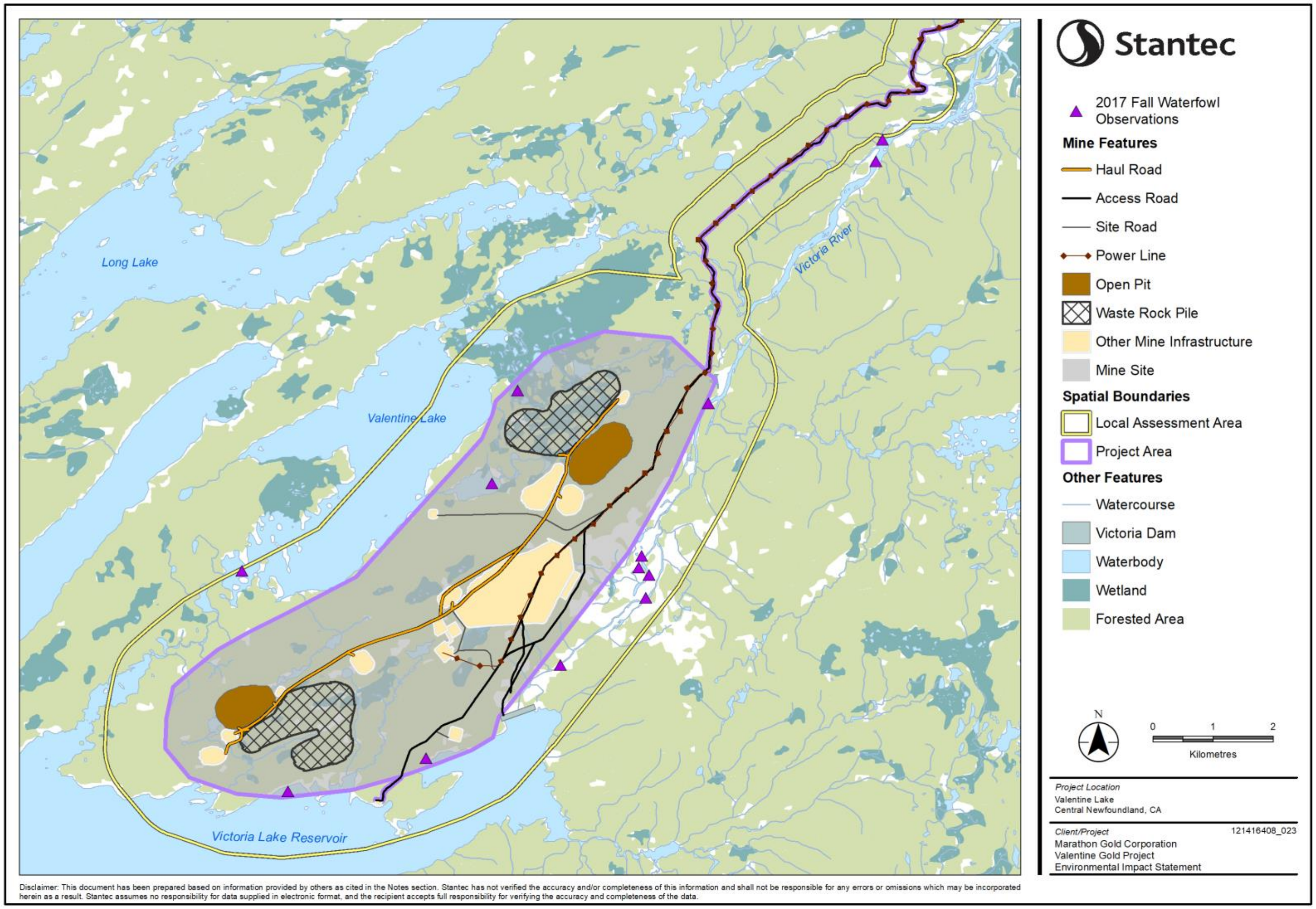

Figure 10-7 Locations of Waterfowl Species Detected during Fall 2017 Aerial Surveys

10.2.3.3 Overwintering Species

Winter wildlife surveys were conducted within the Project Area by Stantec in late February 2013 (BSA.7, Attachment 7-A). Although mammal species were the focus of these surveys, records of upland gamebird tracks were recorded, and other bird observations were made incidentally throughout the survey. Both aerial and ground-based transects were surveyed. The surveys revealed the presence of seven species of overwintering birds, including three upland gamebird species (ruffed grouse, spruce grouse and willow ptarmigan [*Lagopus lagopus*]), which were recorded primarily through tracks. Table 10.3 presents the bird species observed over the course of the surveys, including those observed incidentally.

Table 10.3 Overwintering Bird Species Observed in the Project Area during Winter Wildlife Surveys Conducted in 2013

Common Name	Latin Name	Observation Type
Boreal chickadee	*Poecile hudsonicus*	Incidental
Canada jay	*Perisoreus canadensis*	Incidental
Common raven	*Corvus corax*	Incidental
Red-breasted nuthatch	*Sitta canadensis*	Incidental
Ruffed grouse	*Bonasa umbellus*	Tracks
Spruce grouse	*Falcipennis canadensis*	Tracks
Willow ptarmigan	*Lagopus lagopus*	Tracks

The species detected during this study were species that were anticipated within the Project Area. No avifauna SAR or SOCC species were observed.

10.2.3.4 Species at Risk

A species is defined as rare when it has relatively few individuals, it is uncommon or scarce, or it occurs within a limited geographical range. The rarity of a species may also be a matter of scale, meaning that a species may not be rare in Canada, though may be considered "regionally rare" in a given province or territory. The rarest species are those with small geographic ranges, few occurrences and few individuals in each occurrence.

Although an understanding of rare or sensitive bird species and their protection is important for a variety of reasons, the protection of the rarest or most sensitive species is also a legal requirement for species listed under Schedule 1 of SARA and the NL ESA. There are a variety of bird species designated or listed under federal and provincial legislation in NL.

In the context of the Project, a rare or sensitive bird species is generally defined as a native species that, because of its biological characteristics, or because it occurs at the periphery of its range, or for some other reason, exists in low numbers or in restricted areas, in Canada and/or NL. A SAR is defined as a bird species listed as Extirpated, Endangered, Threatened, Vulnerable or Special Concern under the NL ESA and/or SARA.

Three avifauna SAR were identified during field surveys in the vicinity of the Project Area including olive-sided flycatcher, common nighthawk and rusty blackbird. Additionally, four SAR were identified as potentially occurring near the LAA by other data sources. A record of bank swallow was identified by the AC CDC as being potentially within the LAA, and records of grey-cheeked thrush (*Catharus minimus minimus*) and red crossbill (*Loxia curvirostra*) were noted within the BBS data recorded along the NL 5704 route in Buchans. The Buchans CBC count identified evening grosbeak in 2007. The locations of SAR and SOCC recorded during field surveys in the Project Area and LAA are shown in Figure 10-8.

Olive-sided Flycatcher

Olive-sided flycatcher is ranked as Threatened under Schedule 1 of SARA and as Special Concern by COSEWIC. The NL ESA ranks this species as Threatened and the AC CDC lists the olive-sided flycatcher as S3B, SUM, which indicates that the breeding population of this species is considered Vulnerable and the migrating population is considered unrankable on the Island of Newfoundland (Appendix 10A). The olive-sided flycatcher is a stout, medium-sized passerine that breeds in scattered locations throughout most of forested Canada (COSEWIC 2018a). The population of this species is in decline in Canada, and the main factors thought to be associated with its decline include habitat loss and alteration (COSEWIC 2018a). Declining insect populations on breeding and wintering grounds may also be a contributing factor.

Olive-sided flycatchers are most often associated with open areas, where they perch in tall live trees or snags and forage for flying insects (COSEWIC 2018a). Suitable habitat for this species is found within the Project Area. Olive-sided flycatchers were typically found in areas where there was an interspersion of small to medium sized coniferous forest stands and bogs or fens of similar size. These areas provide a combination of suitable nesting sites (islands of coniferous forest), open foraging areas (small to medium sized bogs and fens) and perch sites (tall trees and snags).

Olive-sided flycatcher was observed within the Project Area during breeding bird surveys in 2011 and 2019, and up to six olive-sided flycatchers were recorded in the Project Area in 2019 (Figure 10-8).

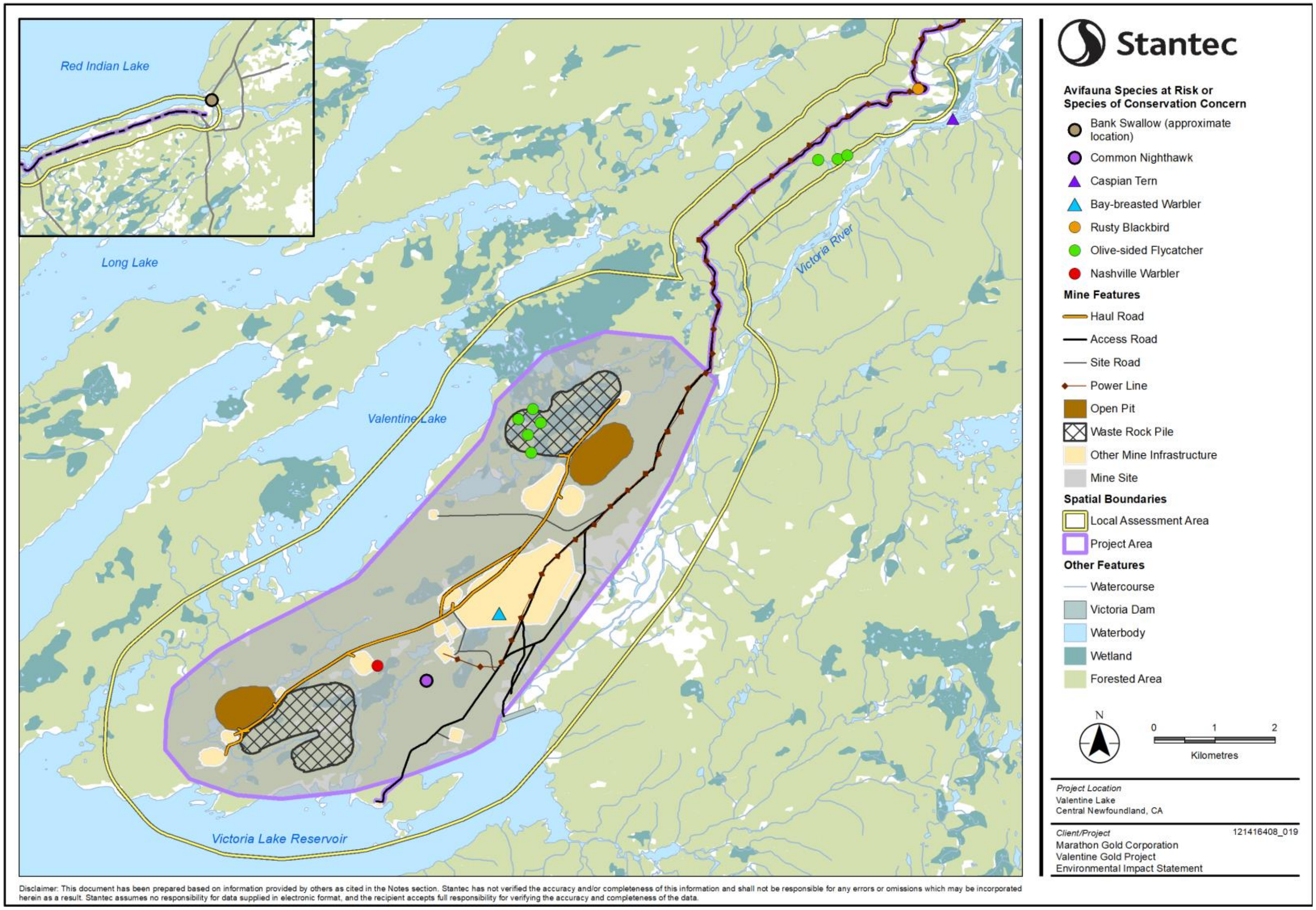

Figure 10-8 Locations of Avifauna SAR and SOCC Recorded in the Project Area and LAA during Field Surveys

Common Nighthawk

Common nighthawk is ranked as Threatened under Schedule 1 of SARA and as Special Concern by COSEWIC. The NL ESA ranks this species as Threatened, and the AC CDC lists common nighthawk as SNA, indicating a conservation status rank is not applicable because the species is not a suitable target for conservation activities in NL. This species is the most frequently seen member of the nightjar family. It is a well camouflaged bird and is most often seen in flight, where it pursues and catches flying insects (COSEWIC 2018b). The populations of this species in Canada have been in decline, with the declining abundance of aerial insects due to the effects of agricultural and other pesticides, changes in precipitation and hydrological regimes, and changes in temperature regimes thought to be the main threats and limiting factors (COSEWIC 2018b).

In NL, this species breeds on bare ground, such as sand dunes, beaches, forest clearings, burned areas and barrens. Although they can be found throughout the province, common nighthawks are known to breed only in the southern part of Labrador and are considered an uncommon visitor on the Island of Newfoundland (Government of NL 2020a). A single common nighthawk was observed incidentally during field surveys conducted in the LAA in 2011.

Rusty Blackbird

Rusty blackbird is ranked as Special Concern under Schedule 1 of SARA and as Special Concern by COSEWIC. The NL ESA ranks this species as Vulnerable and the AC CDC lists the rusty blackbird as S2S3B, SUM indicating that the breeding population of this species is ranked between Imperiled and Vulnerable and the migrating population is considered unrankable on the Island of Newfoundland.

This species is not regularly found throughout the Island; however, an established population is found in central Newfoundland. This species is associated with forested wetlands, particularly those with waterbodies such as slow-moving streams and beaver ponds. It is also found in peat bogs, sedge meadows and scrub edges (Government of NL 2020a; COSEWIC 2006).

Rusty blackbird was observed incidentally within a tall shrub swamp along the access road portion of the Project Area (Figure 10-8), approximately one km northeast of the northern end of the wider section of the Project Area. The observation was of a lone, singing male. Additionally, two rusty blackbirds were observed incidentally during aerial waterfowl surveys. A single individual was observed incidentally on two occasions during the surveys, and on both occasions the observation took place outside of the Project Area and LAA, though within the RAA.

Bank Swallow

Bank Swallow is ranked as Threatened under Schedule 1 of SARA and as Threatened by COSEWIC. The AC CDC lists the bank swallow as S1S2B, SUM, indicating that the breeding population of this species is ranked between Critically Imperiled and Imperiled and the migrating population is considered unrankable on the Island of Newfoundland.

Bank swallow is a widespread, insectivorous passerine species with an extensive distribution (COSEWIC 2013). In Canada, it breeds in all provinces and territories except perhaps Nunavut. This species is migratory and winters primarily in South America.

Bank swallows breed colonially and a wide variety of sites may be used for constructing nest burrows including natural and artificial sites with vertical banks. These include riverbanks, lake and ocean bluffs, aggregate pits, road cuts and stockpiles of soil. The preferred substrate for nest burrows appears to be a sand-silt mixture. Burrows are often situated near open terrestrial habitat, which is used for aerial foraging, including grasslands, meadows, pastures and croplands. Large wetlands may be used as communal nocturnal roost sites during the non-breeding periods.

In NL, breeding has been reported in low-lying sand pits, in sand banks on shorelines, sand-clay banks and sandy dunes, turf atop sea cliffs and in gravel pits (SSAC 2009).

In 2009, the SSAC recommended a status of Not at Risk be applied to this species. Despite populations of bank swallow experiencing declines in neighboring jurisdictions, there is insufficient evidence to establish that the species is presently at risk in NL (SSAC 2009). A record of bank swallow was reported on the edge of the LAA, near Buchans. The accuracy associated with this data point was approximately one km, indicating the record may or may not lie within the LAA. No bank swallows were recorded during field surveys conducted in the Project Area or LAA.

Grey-cheeked Thrush

Grey-cheeked thrush is ranked as Threatened by the NL ESA. The AC CDC lists the grey-cheeked thrush as S2B, SUM, indicating that the breeding population of this species is considered Imperiled and the migrating population is considered unrankable on the Island of Newfoundland.

In NL, the grey-cheeked thrush is a subspecies, which is slightly larger than other *Catharus* thrushes, with greyish face and upperparts. This long-distance migrant is known to breed in coniferous and mixedwood boreal forests across North America. In the province, preferred breeding grounds for grey-cheeked thrush include dense low coniferous woods, including young regenerating forest, open-canopy old growth forests having a dense understory, and dense, stunted spruce stands (SSAC 2005). This species has been reported as being most common on the Great Northern Peninsula, the northeast coast and the Avalon Peninsula. It is less common on the west coast and in the interior (Government of NL 2020a).

Grey-cheeked thrushes were observed along the BBS NL 5704 route in Buchans. The most recent observation of a single individual was reported in 2002; however, none has been recorded in the survey years since. No grey-cheeked thrush was noted during field surveys conducted in the Project Area and LAA.

Evening Grosbeak

Evening grosbeak is ranked as Special Concern under Schedule 1 of SARA and by COSEWIC. It currently has no rank under the NL ESA. The AC CDC lists this species as S4, indicating that the populations of this species are considered Apparently Secure in NL.

The evening grosbeak is a stocky, boldly colored songbird with a large, distinctive bill. The species distribution includes all Canadian provinces and territories except for Nunavut (COSEWIC 2016). Distribution of evening grosbeak ranges widely in winter, and its distribution is dependent upon the quantity of seeds produced in the boreal forest. Optimal breeding habitat for this species includes open mature mixedwood forests, where fir or white spruce are dominant and spruce budworm is abundant (COSEWIC 2016).

Evening grosbeak has been recorded in winter during the CBC in Buchans, just northwest of the LAA. The most recent record of this species was from 2007. No specific location data is available.

Red Crossbill

Red crossbill is ranked as Threatened under Schedule 1 of SARA and as Threatened by the COSEWIC. The species is ranked as Endangered by the NL ESA, and the AC CDC lists red crossbill as S1S2 indicating that the population of this species is ranked between Critically Imperiled and Imperiled on the Island of Newfoundland.

The red crossbill is a medium-sized finch that specializes in feeding on conifer cones. On the Island of Newfoundland, red crossbills belong to the *percna* subspecies, which is unique to the island and appears to have become rare in recent years (Government of NL 2020a). Sporadic reports of this species occur in other Atlantic Provinces, however, it is likely that it is mainly restricted to the Island of Newfoundland. Preferred habitat for red crossbill includes conifer habitats, with the highest abundance likely occurring in older, mature forests in western Newfoundland (Government of NL 2020a). AC CDC data suggests that the habitat within the LAA is potentially suitable for this species (AC CDC 2020b), as large stands of coniferous forest types are present that may provide foraging opportunities.

One record of red crossbill was identified along the NL 5704 route in Buchans. The observation, made in 1984, was of a single individual, with none recorded along this route in the survey years since. No red crossbills were observed during field surveys conducted in the Project Area and LAA.

10.2.3.5 Species of Conservation Concern

For the purposes of this VC, SOCC includes bird species that are:

- Recommended for listing by the SSAC as Endangered, Threatened, Vulnerable or Special Concern, however not yet listed under the NL ESA or SARA
- Considered provincially rare, i.e., those species with provincial status ranks (S-ranks), of S1 (Critically Imperiled), S2 (Imperile*d*)[3], or combinations thereof (e.g., S1S2) upon review by the AC CDC (AC CDC 2020a

Unlike some SAR, SOCC are not protected by federal or provincial legislation. Rather, they are included as a precautionary measure, reflecting observations and trends in their provincial population status. SOCC

[3] While *S3* species may be of concern from a provincial biodiversity perspective, they are often not included, as their populations are considered less sensitive. This determination is typically at the discretion of the NL FLR – Wildlife Division.

may be important indicators of ecosystem health and regional biodiversity. Thus, their presence in an area may warrant mitigation, given their rarity or importance. They are also often indicators of the presence of unusual and / or sensitive habitat, and their protection as umbrella species could possibly result in protection of their associated unusual habitats and co-existing species.

Three avifauna SOCC, Caspian tern (*Hydroprogne caspia*), Nashville warbler and bay-breasted warbler were detected in the Project Area during field surveys. These three species are listed as S2B by the AC CDC, indicating that their breeding populations are Imperiled on the Island of Newfoundland. The locations of SOCC recorded during field surveys in the Project Area and LAA are shown in Figure 10-8.

Caspian terns typically breed in colonies located on islands in large lakes or on offshore islands. During the 2011 waterfowl study, a single Caspian tern was observed incidentally. Given that the individual was alone and far from known colony sites in the marine environment, it is unlikely that this represents a breeding attempt within the Project Area.

For both warbler species, the low numbers of individuals present in the Newfoundland population may be attributable to the fact that NL represents the northern most distribution of their breeding ranges. Global populations of Nashville warbler and bay-breasted warbler are relatively stable.

Nashville warblers typically inhabit open coniferous woodlands and brushy habitats. During the songbird survey, Nashville warblers were recorded in point count sites situated in coniferous forest at two locations in the Project Area (Figure 10-8). The first observed Nashville warbler was found in a relatively open balsam fir stand and the second was found in a mature forest stand dominated by black spruce and tamarack.

Bay-breasted warblers typically nest in mature forest stands dominated by spruce and fir. One bay-breasted warbler was recorded during the breeding bird surveys (Figure 10-8).

10.2.4 Avifauna Habitat Assessment

Twelve habitat types were identified within the Project Area and LAA (Table 10.4). Approximately 75% of the Project Area consists of upland, 20% consists of lowland and 4% is open water. Within the LAA, approximately 69% consists of upland, 14% is lowland and 22% is open water. Upland areas are dominated by softwood forests (i.e., the Balsam Fir Forest and Black Spruce Forest) and Mixedwood Forest. Lowland sites consist predominantly of open peatlands (i.e., Shrub / Graminoid Fen and Shrub Bog), alder thickets and treed wetlands (i.e., Wet Coniferous Forest).

Table 10.4 Ecosystem Units within the Project Area, LAA and ELCA

Ecosystem Units	Description	Area in Project Area[A] (km^2 / %)	Area in LAA[A] (km^2 / %)	Area in ELCA[A] (km^2 / %)
Alder Thicket	Alder-dominated communities on moist seepage slopes and riparian areas	2.2 / 6.5	11.9 / 9.3	97.4 / 5.3
Anthropogenic	Areas currently or historically subject to intense levels of human disturbance and use (does not include areas regenerating from forest management)	1.9 / 5.4	2.5 / 1.9	8.2 / 0.5
Balsam Fir Forest	Dry to moist and sometimes wet conifer-dominated forests	6.2 / 18.0	15.1 / 11.9	126.9 / 6.9
Black Spruce Forest	Dry to moist and sometimes wet conifer-dominated forests	4.3 / 12.5	17.6 / 13.9	233.1 / 12.7
Exposed Sand / Gravel Shoreline	Sparsely vegetated and/or un-vegetated shorelines	-	0.6 / 0.5	2.8 / 0.2
Kalmia-Black Spruce Woodland	Dry to moist and sometimes wet stunted tree and shrub / heath dominated communities	3.6 / 10.3	8.6 / 6.8	208.8 / 11.4
Mixedwood Forest	Mesic to moist forests with high deciduous component	6.0 / 17.3	18.9 / 14.9	179.3 / 9.8
Open Wetlands	Very moist to wet shrub / herb dominated peatlands	4.6 / 13.3	11.2 / 8.8	280.3 / 15.3
Open Water	Waterbodies (lakes, ponds, rivers and streams)	1.3 / 3.7	21.8 / 17.2	408.5 / 22.3
Regenerating Forest	Forests regenerating as a result of influences such as harvesting, fire and windthrow	2.0 / 5.6	12.5 / 9.9	139.5 / 7.6
Riparian Thicket	Shrub thickets located in transitional areas and subject to periodic flooding	0.2 / 0.4	0.6 / 0.5	15.1 / 0.8
Wet Coniferous Forest	Very moist to wet conifer forests	2.5 / 7.2	5.7 / 4.5	130.7 / 7.1
	Total	**34.7 / 100**	**127.0 / 100**	**1,830.6 / 100**

Note:
[A] Numbers are rounded to one decimal place. Areas and percentages may not add up to the total due to rounding. Values pertain to the portion of the Project Area and LAA within the ELCA. Ecosystem unit descriptions from BSA.7, Attachment 7-D

10.2.4.1 Passerines

Passerine birds are species in the order Passeriformes and are commonly known as the perching birds. This order is the largest and most dominant group of birds, and most species observed within the Project Area fall within this classification. As a group, passerines occupy many habitat types. Lincoln's sparrow and yellow-bellied flycatcher were selected as representative passerine species due to their specific habitat needs and ubiquity, respectively.

Lincoln's Sparrow

Life History and Distribution

The Lincoln's sparrow has a boreal distribution, with the northern boundaries stretching from west-central Alaska east to Labrador and the Island of Newfoundland. In Canada, its breeding range encompasses most provinces in Canada, including NL. This species migrates and overwinters from extreme southern parts of Canada south through Mexico, south-central Guatemala, northern El Salvador and southwestern Honduras (Cornell Lab 2020).

Moisture, tree density, ground vegetation and habitat area are critical factors that define habitat suitability for Lincoln's sparrow and other wetland sparrows (Ammon 1995; Mowbray 1997; Arcese et al. 2002). This species has an affinity for subalpine and subarctic ecosystems, and is a distinct microsite specialist, preferring boggy willow, sedge and moss-dominated habitats, particularly where shrub cover is dense (Cornell Lab 2020). On the Island of Newfoundland, nests are constructed in boggy areas and wet meadows (Ammon 1995).

Lincoln's sparrows have been observed in the Project Area and LAA during songbird field surveys conducted in 2011 and 2019. Individuals were observed in Wet Coniferous habitats and in Open Wetlands.

Habitat Occurrence in the Project Area

As the riparian marsh habitat preferred by Lincoln's sparrow in NL is difficult to discern at the scale of the ELC data, Wet Coniferous Forest, Riparian Thicket and Alder Thicket habitats were selected to represent high value wet habitat for this species (Table 10.5). The combined area of selected high value habitats for Lincoln's sparrow occupies 6.9 km^2 (20.0%) of the Project Area, 30.7 km^2 (24.2%) of the LAA and 328.7 km^2 (20.9%) of the ELCA (Table 10.6). The actual area of primary habitat would likely be smaller than this and there appears to be approximately equal proportions of high value habitat in the Project Area, the LAA and the ELCA.

Kalmia-Black Spruce Woodland and Open Wetlands were ranked as moderate value for Lincoln's sparrow (Table 10.5). Kalmia-Black Spruce Woodland may provide some foraging opportunities (primarily invertebrates) (Cornell Lab 2020), however the understory lacks the density and cover vegetation preferred by this species given that it tends to be well drained. Open wetlands may provide some foraging opportunities and contain some of the ground cover vegetation noted in higher value habitat types, though lacks the higher structural components and provides fewer shelter or protection opportunities for this species.

Other habitat types were ranked as low value as they provide limited protection, resting, or foraging opportunities.

Table 10.5 Habitat Value Ranking for Passerines

Habitat Type	Habitat Value Ranking	
	Lincoln's Sparrow	Yellow-bellied Flycatcher
Balsam Fir Forest	Low	Moderate
Black Spruce Forest	Low	High
Kalmia-Black Spruce Woodland[A]	Moderate	Low
Mixedwood Forest	Low	Moderate
Regenerating Forest	High	Moderate
Alder Thicket	High	High
Riparian Thicket	High	Low
Wet Coniferous Forest	High	High
Open Wetlands[B]	Moderate	Low
Open Water	Low	Low
Exposed Sand / Gravel Shoreline	Low	Low
Anthropogenic	Low	Low
Sources	Cornell Lab 2020; Ammon 1995; Mowbray 1997; Arcese et al. 2002	Cornell Lab 2020

Notes:
[A] – Includes Kalmia-Black Spruce Forest and Kalmia Health Ecotypes
[B] – Includes Shrub / Graminoid Fen and Shrub Bog Ecotypes

Table 10.6 Amount of Habitat Type by Habitat Value Ranking for Passerines in Assessment Areas

Habitat Value Ranking	Lincoln's Sparrow Habitat			Yellow-bellied Flycatcher Habitat		
	Area in Project Area[A] (km^2 / %)	Area in LAA[A] (km^2 / %)	Area in ELCA[A] (km^2 / %)	Area in Project Area[A] (km^2 / %)	Area in LAA[A] (km^2 / %)	Area in ELCA[A] (km^2 / %)
High	6.9 / 19.9	30.7 / 24.2	328.7 / 20.9	9.0 / 25.9	35.2 / 27.7	461.2 / 25.2
Moderate	8.2 / 23.6	21.8 / 17.2	489.1 / 26.7	14.2 / 40.9	46.5 / 36.6	445.6 / 24.3
Low	19.7 / 56.8	76.5 / 60.2	958.8 / 52.4	11.6 / 33.4	45.3 / 35.7	923.7 / 50.5
Total	34.8 / 100.0	127.0 / 100.0	1,830.6 / 100.0	34.8 / 100.0	127.0 / 100.0	1,830.6 / 100.0

Notes:
[A] Numbers rounded to one decimal place. Areas and percentages may not add up to total amounts due to rounding
Values pertain to the portion of the Project Area and LAA with ELC data

Limiting Factors

Limiting factors for Lincoln's sparrow include habitat loss, flooding, severe weather, parasites, competition for food and territory, predation by domestic pets and birds of prey and nest predation by rodent species (Mowbray 1997; Arcese et al. 2002).

Yellow-bellied Flycatcher

Life History and Distribution

This small Empidonax flycatcher breeds across most of Canada from western Yukon through most of the Canadian provinces, east to NL. This species is migratory and overwinters from northeast Mexico south to Central America.

Yellow-bellied flycatchers are a characteristic breeding bird of Canadian boreal conifer forests and peatlands, and typically nest in cool, moist conifer or mixed forests, bogs, swamps and muskegs, and other landscapes that are flat or poorly drained (Cornell Lab 2020). Dominant trees in the preferred habitat normally include spruce or balsam fir, as well as occasionally hemlock, pine, or larch. Stands can be mixed with as much as one-half deciduous species (Cornell Lab 2020). These habitats provide cover and abundant opportunities for foraging on insects and other arthropods.

Yellow-bellied flycatchers have been observed in the Project Area and LAA during field surveys conducted in 2011 and 2019. In 2019, this species was recorded on 45 occasions. Habitat types where yellow-bellied flycatchers were observed in the Project Area included Wet Coniferous Forest, Alder Thicket, Black Spruce Forest and edges of Open Wetland Habitats.

Habitat Occurrence in the Project Area

Black Spruce Forest, Alder Thicket and Wet Coniferous Forest were ranked as high value for yellow-bellied flycatcher (Table 10.5). Each of these habitats within the Project Area provides the preferred dense understory with moss, lichen and/or herbaceous ground cover components that appear to be preferred by yellow-bellied flycatchers (Cornell Lab 2020). The combined area of selected high-value habitats for yellow-bellied flycatcher occupies 9.0 km^2 (25.9%) of the Project Area, 35.2 km^2 (27.7%) in the LAA and 461.2 km^2 (25.2%) in the ELCA (Table 10.6). Proportionally, the LAA contains slightly more high-quality habitat than the Project Area and the ELCA.

Mixedwood Forest, Balsam Fir Forest and Regenerating Forest were selected as moderate value habitats for yellow-bellied flycatcher. These habitats provide foraging opportunities and the presence of conifer cover that is preferred by this species; however, the understory may be either too open (Mixedwood Forest) or the canopy may be too low (Regenerating Forest). In addition, this species appears to prefer a more poorly drained habitat than these habitats generally provide within the Project Area and LAA.

Other habitat types were ranked as low value as they provide limited protection, resting, or foraging opportunities for this species.

Limiting Factors

Although the yellow-bellied flycatcher is relatively common and secure in the Canadian portion of its range, this species is threatened by habitat fragmentation. The association of this species with moss suggests that forest fragmentation that leads to desiccation of ground cover may be detrimental (Cornell Lab 2020). Additional limiting factors include loss and alteration of habitat through climate change, forest harvesting and wetland removal, parasites, competition for food and predation (Cornell Lab 2020).

10.2.4.2 Waterfowl

Waterfowl (swimming gamebirds, such as duck and goose species) have economic, cultural and traditional value to the public, and depend upon sensitive wet environments, usually with open water habitat to complete their life cycle.

Canada Goose

Life History and Distribution

Canada goose is the most widely distributed goose species in North America. This species' breeding range extends from eastern Labrador to western Alaska, and as far south as the 49th parallel. Most Canada geese undertake an annual migration, although some remain year-round, particularly in coastal areas (Mowbray et al. 2002).

The Canada geese breeding on the Island of Newfoundland belong to the North Atlantic population, subspecies *Branta canadensis canadensis* (Cotter 2009). Canada geese form long term pair bonds and demonstrate fidelity to both breeding and wintering areas. Adults return to breeding areas early in the spring and are among the first waterfowl to reproduce.

Canada geese are attracted to deltaic areas with shallow water for foraging and rely upon open, fast-flowing water when they arrive in early spring. For nesting, this species prefers peatlands and fluvial sites in boreal regions (Mowbray et al. 2002). Molting and autumn-staging geese demonstrate more restricted habitat preferences, favouring marshes and other extensive shallow areas with abundant emergent vegetation and semi-aquatic plants.

Food sources in spring and summer consist mainly of grasses, sedges, aquatic vegetation and roots, while berries and seeds are preferred on the winter habitat (Cornell Lab 2020).

Breeding pairs of Canada geese were observed in the Project Area and LAA during the waterfowl surveys conducted in support of the Project in 2011 and 2017. Habitat use was generally as expected for this species, which is a generalist and known to nest in treeless and forested areas near open water habitats.

Habitat Occurrence in the Project Area

Open wetland and open water habitats were ranked as having high value for Canada geese (Table 10.7). These habitats provide feeding, shelter, resting and nesting (at the fringes in the case of open water) opportunities. Open water habitats, particularly shallow open water offers feeding opportunities for adults and their young and protection from terrestrial predators. Open wetland habitats with pockets of open water can provide similar opportunities and also offer protected spaces for nesting.

Exposed sand/gravel shoreline was ranked as having moderate value for Canada goose. This habitat type may provide some resting and potentially foraging opportunities.

Other habitat types were ranked as low value as they provide limited protection, resting, or foraging opportunities.

Table 10.8 summarizes high, moderate and low value breeding habitat for Canada goose. High-value habitat for this species occupies 5.9 km^2 (17.0 %) of the Project Area, 33.0 km^2 (26.0%) of the LAA and 689.9 km^2 (37.6%) of the ELCA (Table 10.8). The actual amount of primary habitat is predicted to be lower, as Canada geese prefer specific wetland types, such as string bogs that provide island nesting sites for breeding (Minaskuat Limited Partnership 2005). Proportionally, the LAA contains approximately 9% more high value habitat for Canada goose than the Project Area, and the ELCA provides approximately 11.5% more high value habitat, proportionally, than does the LAA for Canada goose.

Table 10.7 Habitat Value Ranking for Waterfowl

Habitat Type	Habitat Value Ranking	
	Canada Goose	**American Black Duck**
Balsam Fir Forest	Low	Low
Black Spruce Forest	Low	Low
Kalmia-Black Spruce Woodland[A]	Low	Low
Mixedwood Forest	Low	Low
Regenerating Forest	Low	Low
Alder Thicket	Low	Low
Riparian Thicket	Low	Low
Wet Coniferous Forest	Low	Low
Open Wetlands[B]	High	High
Open Water	High	High
Exposed Sand / Gravel Shoreline	Moderate	Moderate
Anthropogenic	Low	Low
Sources	Mowbray et al 2002; Cotter 2009; Minaskuat Limited Partnership 2005; Cornell Lab 2020	ECCC 2020; Cornell Lab 2020; Ducks Unlimited 2020; Longcore et al. 2000; Minaskuat Limited Partnership 2005; Sandilands 2005

Notes:
[A] Includes Kalmia-Black Spruce Forest and Kalmia Health Ecotypes
[B] Includes Shrub / Graminoid Fen and Shrub Bog Ecotypes

Table 10.8 Amount of Habitat Type by Habitat Value Ranking for Waterfowl in Assessment Areas

Habitat Value Ranking	Canada Goose Habitat			American Black Duck Habitat		
	Area in Project Area[A] (km^2 / %)	Area in LAA[A] (km^2 / %)	Area in ELCA[A] (km^2 / %)	Area in Project Area[A] (km^2 / %)	Area in LAA[A] (km^2 / %)	Area in ELCA[A] (km^2 / %)
High	5.9 / 17.0	33.0 / /26.0	688.9 / 37.6	5.9 / 17.0	33.0 / 26.0	688.9 / 37.6
Moderate	0 / 0	0.6 / 0.5	2.75 / 0.2	0 / 0	0.6 / 0.5	2.75 / 0.2
Low	28.9 / 83.3	93.4 / 73.5	1,139.0 / 62.2	28.9 / 83.3	93.4 / 73.5	1,139.0 / 62.2
Total	34.8 / 100.0	127.0 / 100.0	1,830.6 / 100.0	34.8 / 100.0	127.0 / 100.0	1,830.6 / 100.0

Notes:
[A] Numbers rounded to one decimal place. Areas and percentages may not add up to total amounts due to rounding
Values pertain to the portion of the Project Area and LAA with ELC data

Limiting Factors

Harvesting pressure is a limiting factor for Canada goose throughout its winter range and subsistence hunting also occurs in northern breeding areas (Mowbray et al. 2002). Changes in harvest rates have been linked to adult survival (Rexstad 1992). Productivity in northern areas can be affected by delayed snow melt, which results in late starts to nest initiation and smaller than average clutch size (Raveling 1978). Predators of geese include fox (*Vulpes spp*.), Canada lynx (*Lynx canadensis*), golden eagle (*Aquila chrysaetos*), bald eagle, common raven, black bear (*Ursus americanus*) and American crow (Mowbray et al. 2002).

American Black Duck

Life History and Distribution

The American black duck breeds from the upper Mississippi River across to the northeastern United States, north through northern Saskatchewan, Manitoba and across Ontario and the eastern Canadian provinces. The highest breeding densities are found in Maine and Nova Scotia (Ducks Unlimited 2020). Most individuals undergo an annual migration, with wintering habitat mainly consisting of saltwater wetlands, and to a lesser extent beaver ponds, agricultural fields and riverine habitats in the southern parts of their range in Canada and into the United States (ECCC 2020).

Adults pair in early winter and most arrive paired at their breeding sites. Nests are constructed on the ground, usually in a clump of grass or sedges, under a shrub or tree, or in a low hole or fork of a tree.

American black ducks occupy a number of habitats near water and breed predominantly in freshwater wetlands, including in habitats such as alkaline marshes, acidic bogs, beaver ponds, shallow lakes with reeds and sedges, and wooded swamps (Cornell Lab 2020). Adults and young forage for a variety of food sources, including aquatic invertebrates, tadpoles, seeds, tubers and roots of a variety of aquatic plants.

This species was confirmed as breeding near the Project Area during the spring and summer waterfowl surveys in 2011.

Habitat Occurrence in the Project Area

Open wetland and open water habitats were ranked as having high value for American black duck. These habitats provide feeding, shelter, resting and nesting opportunities. Open water habitats, particularly shallow open water, offers feeding opportunities for adult ducks and their young and protection from terrestrial predators. Open wetland habitats with pockets of water can provide similar opportunities, as well as protected spaces for nesting.

Exposed Sand / Gravel Shoreline was ranked as having moderate value for American black duck. This habitat type may provide some resting and potentially foraging opportunities, however in general, due to its more open and barren nature, provides fewer opportunities than the high value habitats.

Other habitat types were ranked as low value as they provide limited protection, resting, or foraging opportunities.

Table 10.7 summarizes high, moderate, and low value breeding habitat for American black duck. High-value habitat for this species occupies 5.9 km^2 (17.0%) of the Project Area and 33.0 km^2 (26.0%) of the LAA (Table 10.8). Proportionally, the LAA contains approximately 9% more high value habitat for American black duck than the Project Area. Proportionally, the ELCA contains approximately 11% more high value habitat for American black duck than does the LAA, and the LAA contains approximately 9% more high value habitat for American black duck than does the Project Area.

Limiting Factors

Harvesting pressure is a limiting factor for American black duck throughout its winter range. Subsistence hunting, which occurs in the northern breeding areas can also be a limiting factor (Cornell Lab 2020). Habitat alteration and other anthropogenic disturbances affect this species more intensively than other waterfowl (Longcore et al. 2000).

Timing of availability and stratification in the water column of invertebrate prey is a limiting factor for American black ducks, particularly when hatchlings are newly emerged. Insects and other invertebrates comprise up to 95% of the diet of ducklings, and very young ducklings can only feed at and near the surface of the water (Sandilands 2005). Acidification of freshwater habitats and application of pesticides reduce invertebrate biomass and result in lowered brood success.

American black ducks are susceptible to lead poisoning, particularly along the Atlantic Flyway, the major north-south flyway for migratory birds that follows the Atlantic coast of Canada, where incidence of elevated lead levels is highest. Sub-lethal effects include reduced growth rates and decreased productivity (Cornell Lab 2020).

Competition and hybridization with mallard may be the most substantial limiting factor for the American black duck (Sandilands 2005). Hybridization is frequent and hybrids are fertile. Due to its smaller gene pool and because the male American black duck plumage is not as distinct as that of the male mallard, this species is more disadvantaged when hybridization occurs (Cornell Lab 2020).

10.2.4.3 Raptors

Raptors are birds of prey that include species which primarily hunt and feed on other vertebrates (including mammals, fish and other birds). The presence of raptors, as primary predators in an ecosystem, can serve as an indicator of the health of that ecosystem. Because of their position at the top of the trophic chain, these birds are susceptible to changes in the environment, such as habitat loss or change and use of deleterious substances.

Northern Harrier

Life History and Distribution

The northern harrier is widely but locally distributed in North America, breeding from northern Alaska east to the Maritimes and southern Newfoundland. Migration of this species is partial, although often long-distance. Most individuals migrate alone during the day and generally at low altitudes (primarily 500 to 900 m). The winter range of the northern harrier is primarily from southern Canada south through the conterminous United States, Central America and Caribbean islands (Cornell Lab 2020).

Northern harriers nest on the ground in open (treeless) vegetated habitats, including wetlands dominated by rushes, sedges and grasses, or large fields (including agricultural fields), shrubby deciduous growth, and tamarack and spruce bogs. Less commonly, cattail marshes, open swamps, grassy meadows, pastures and hay fields have been used (Sandilands 2005). A single northern harrier was observed incidentally within the RAA during aerial waterfowl surveys conducted in 2017. No northern harriers were reported within the Project Area or LAA in field data collected in support of the Project, or by desktop data sources such as the BBS.

Habitat Occurrence in the Project Area

Riparian Thickets and Open Wetlands were ranked as having high value for northern harrier (Table 10.9). These habitats provide hunting, nesting and resting opportunities. Open Wetlands may provide the highest-value habitats within the Project Area. These habitats provide high value habitat for the northern harriers’ primary food source (meadow vole [*Microtus pennsylvanicus*]), as well as other food sources, including birds, amphibians and insects, which can be an important food source for fledglings that are still inexperienced hunters (Sandilands 2005). Northern harriers primarily hunt on the wing, coursing low over the ground, such that open habitat types are strongly preferred (Cornell Lab 2020).

Regenerating Forest was ranked as having moderate value for northern harriers. Regenerating stands in the early phases of regrowth would provide a moderately open habitat for hunting. This habitat type would be of lesser value as regeneration progresses.

Other habitat types were ranked as low value as they provide limited protection, resting, and particularly foraging opportunities.

Table 10.10 summarizes high, moderate and low value breeding habitat for northern harrier. High value habitat for this species occupies 4.8 km^2 (13.8%) of the Project Area, 11.8 km^2 (9.3%) of the LAA and 295.4 km^2 (16.1%) of the ELCA. Proportionally, there is approximately 5% more high value habitat available for northern harrier within the Project Area than in the LAA. Proportionally, the ELCA contains approximately 2% more high value habitat for northern harrier than the Project Area.

Table 10.9 Habitat Value Ranking for Raptors

Habitat Type	Habitat Value Ranking	
	Northern Harrier	Osprey
Balsam Fir Forest	Low	Moderate
Black Spruce Forest	Low	Moderate
Kalmia-Black Spruce Woodland[A]	Low	Low
Mixedwood Forest	Low	Moderate
Regenerating Forest	Moderate	Low
Alder Thicket	Low	Low
Riparian Thicket	High	Low
Wet Coniferous Forest	Low	Low
Open Wetlands[B]	High	Low
Open Water	Low	High
Exposed Sand / Gravel Shoreline	Low	Low
Anthropogenic	Low	Moderate
Sources	Cornell Lab 2020; Sandilands 2005	Cornell Lab 2020; Sandilands 2005; Poole et al. 2002; Minaskuat Inc. 2008; Wetmore and Gillespie 1976

Notes:
[A] Includes Kalmia-Black Spruce Forest and Kalmia Health Ecotypes
[B] Includes Shrub / Graminoid Fen and Shrub Bog Ecotypes

Table 10.10 Amount of Habitat Type by Habitat Value Ranking for Raptors in Assessment Areas

Habitat Value Ranking	Northern Harrier Habitat			Osprey Habitat		
	Area in Project Area[A] (km^2 / %)	Area in LAA[A] (km^2 / %)	Area in ELCA[A] (km^2 / %)	Area in Project Area[A] (km^2 / %)	Area in LAA[A] (km^2 / %)	Area in ELCA[A] (km^2 / %)
High	4.8 / 13.8	11.8 / 9.3	295.4 / 16.1	1.3 / 3.7	21.8 / 17.2	408.5 / 22.3
Moderate	2.0 / 5.8	12.5 / 9.8	139.5 / 7.6	18.4 / 53.0	54.1 / 42.6	547.5 / 29.9
Low	28.0 / 80.7	102.7 / 80.9	1,395.6 / 76.2	15.1 / 43.5	51.1 / 40.2	874.5 / 47.8
Total	34.8 / 100.0	127.0 / 100.0	1,830.6 / 100.0	34.8 / 100.0	127.0 / 100.0	1,830.6 / 100.0

Notes:
[A] Numbers rounded to one decimal place. Areas and percentages may not add up to total amounts due to rounding
Values pertain to the portion of the Project Area and LAA with ELC data

Limiting Factors

Habitat loss and alteration of wetlands and grasslands, principally to agriculture and urban development, is likely the biggest limiting factor for northern harriers. Meadow voles are the most important food source for northern harriers and as such, the availability of meadow voles is one of the most important factors controlling harrier populations (Sandilands 2005). Additional limiting factors include the application of fire to control vegetation in grassland areas and the use of pesticides.

Osprey

Life History and Distribution

Osprey breed across North America from Alaska to the Island of Newfoundland in the east, and extending into parts of the United States, particularly along the east and west coasts (Poole et al. 2002). Most individuals are migratory (with the exception of individuals of populations in the most southern part of the range such as Florida and Cuba) and winter along rain-forest rivers and seacoasts and lakes in Central and South America (Poole et al. 2002). This species generally nests in trees throughout its range and has been known to construct nests on large rocks within suitable waterbodies (Poole et al. 2002; Minaskuat Limited Partnership 2008). Many species of trees can be used for nesting, however those selected are generally higher than surrounding vegetation, allowing for clear sight of nearby surroundings. Mixed spruce forests are particularly favoured, especially when adjacent to waterbodies (Gillespie and Wetmore 1974).

On the Island of Newfoundland, osprey tend to nest on the coast, where shallow bays provide abundant, easily spotted groundfish. Adult osprey nests have been associated with young second growth and uncut old-growth balsam fir habitats near large waterbodies in western Newfoundland (Montevecchi 1993). Three records of osprey were noted in field data collected in support of the Project. Two individuals were incidentally observed on separate occasions during waterfowl surveys conducted in 2011, and a single individual was observed incidentally during surveys conducted in support of the ELC.

Habitat Occurrence in the Project Area

Open Water habitat was ranked as high value for osprey (Table 10.9). Osprey depend on fish-bearing, shallow, open water sources for hunting. These habitats must be generally within an energetically adequate commuting distance (10 to 20 km) of a suitable nest site (Cornell Lab 2020).

Balsam Fir Forest, Black Spruce Forest, Mixedwood Forest and Anthropogenic were ranked as having moderate value for osprey. Each of these habitat types may provide nesting and resting opportunities although must be within 10 to 20 km of the high value Open Water habitat type to be of importance. Anthropogenic sites, in particular the poles and towers along power lines, can provide attractive nesting locations for this species.

Other habitat types were ranked as low value as they provide limited protection, resting and particularly foraging opportunities.

Table 10.10 summarizes high, moderate and low value breeding habitat for osprey. High value habitat for this species occupies 1.3 km^2 (3.7%) of the Project Area, 21.8 km^2 (17.2%) of the LAA and 408.5 km^2 (22.3%) of the ELCA. This indicates that proportionally, there is more (approximately 14%) high value habitat for osprey available in the LAA than in the Project Area, and approximately 5% more high value habitat for osprey available in the ELCA than in the LAA. At the scale of available ELC data and habitat classifications, important micro-habitat features such as the presence of a suitable nest site and access to open water with available fish are not distinguishable. Therefore, the true amount of high value habitat would likely be less abundant in all areas than indicated by the modelling exercise.

Limiting Factors

Osprey populations throughout North America experienced severe declines in the 1970s due to the widespread use of pesticides, such as dichlorodiphenyltrichloroethane (DDT). Bioaccumulation of these substances in the food chain affected eggshell formation, greatly reducing the reproductive success of adults. Alternative pest control practices in the past three decades have allowed for recovery of the species throughout its range.

Hunting pressure (Ewins and Houston 1992), and fish abundance and availability are critical factors in reproductive success. Inclement weather can also affect productivity and influence population dynamics (Chubbs and Trimper 1998).

10.2.4.4 Upland Gamebirds

Upland gamebirds are non-waterfowl species which are hunted for subsistence or sport, and the group includes species such as grouse and ptarmigan. In NL, the main species that are hunted include ruffed grouse, spruce grouse, willow ptarmigan and rock ptarmigan (Government of NL 2020b). Both species of grouse were introduced to the Island of Newfoundland in the 1960s and 1970s (Warkentin and Newton 2009).

Spruce Grouse

Life History and Distribution

The spruce grouse is resident across much of northern North America, including NL. Migrations may occur, although they appear to be relatively local in nature, and the species does not undergo long-distance movements out of their northern forest habitats (Cornell Lab 2020).

Spruce grouse were first introduced in Central Newfoundland and have expanded their range to include the Northern Peninsula (Warkentin and Newton 2009). This species is largely herbivorous and relies heavily on needles of pine, spruce, or other conifers as its main or sole (in winter) food source (Cornell Lab 2020). This species prefers coniferous and mixedwood forests and bogs including stands of jack pine (*Pinus banksiana*), white spruce (*Picea glauca*), black spruce (*Picea mariana*), and tamarack (*Larix laricina*), forest edges and openings, as well as blueberry barrens and later stage burnt areas (Government of NL 2020c). Spruce grouse have been observed in the Project Area during field surveys conducted in the winter of 2013 during the ELC and incidentally during songbird surveys conducted in 2011.

Habitat Occurrence in the Project Area

Balsam Fir Forest, Black Spruce Forest, Kalmia Black Spruce Woodland, Mixedwood Forest, Regenerating Forest and Wet Coniferous Forest were ranked as being of high value for spruce grouse (Table 10.11). Each of these habitats provide cover and nesting opportunities and importantly, winter forage sources in the form of conifer needles.

Alder Thicket and Anthropogenic habitats were ranked as being of moderate value to spruce grouse. Alder Thicket habitat provides for some foraging, resting and cover opportunities, however it would be of little value during winter due to a lack of conifer species. Anthropogenic habitats are of little value in regard to cover and nesting opportunities, however habitats such as roadsides may provide some summer foraging opportunities and importantly, a source of grit for spruce grouse.

Other habitat types were ranked as low value as they provide limited protection, resting and particularly foraging opportunities.

Table 10.12 summarizes high, moderate and low value breeding habitat for spruce grouse. High valuehabitat for this species occupies 24.6 km^2 (70.9%) of the Project Area, 78.4 km^2 (61.7%) of the LAA and 1018.2 km^2 (55.6%) of the ELCA. Proportionally, there is approximately 9% more high value habitat for spruce grouse available within the Project Area than in the LAA, and approximately 15% more high value habitat for spruce grouse available in the Project Area than in the ELCA.

Table 10.11 Habitat Value Ranking for Upland Gamebirds

Habitat Type	Habitat Value Ranking	
	Spruce Grouse	Ruffed Grouse
Balsam Fir Forest	High	Low
Black Spruce Forest	High	Low
Kalmia-Black Spruce Woodland[A]	High	Low
Mixedwood Forest	High	High
Regenerating Forest	High	High
Alder Thicket	Moderate	High
Riparian Thicket	Low	Low
Wet Coniferous Forest	High	Moderate
Open Wetlands[B]	Low	Low
Open Water	Low	Low
Exposed Sand / Gravel Shoreline	Low	Low
Anthropogenic	Moderate	High
Sources	Warkentin and Newton 2009; Cornell Lab 2020; NLDFFA 2020; Sandilands 2005	Cornell Lab 2020; Sandilands 2005; Warkentin and Newton 2009; Nalcor Energy 2012; Rusch et al. 2000
Notes: [A] Includes Kalmia-Black Spruce Forest and Kalmia Health Ecotypes [B] Includes Shrub / Graminoid Fen and Shrub Bog Ecotypes		

Table 10.12 Amount of Habitat Type by Habitat Value Ranking for Upland Gamebirds in Assessment Areas

Habitat Value Ranking	Spruce Grouse Habitat			Ruffed Grouse Habitat		
	Area in Project Area[A] (km^2 / %)	Area in LAA[A] (km^2 / %)	Area in ELCA[A] (km^2 / %)	Area in Project Area[A] (km^2 / %)	Area in LAA[A] (km^2 / %)	Area in ELCA[A] (km^2 / %)
High	24.6 / 70.9	78.4 / 61.7	1,018.2 / 55.6	12.1 / 34.9	45.8 / 36.1	424.4 / 23.2
Moderate	4.1 / 11.8	14.4 / 11.3	105.6 / 5.8	2.5 / 7.2	5.7 / 4.5	130.7 / 7.1
Low	6.1 / 17.6	34.2 / 26.9	706.7 / 38.6	20.2 / 58.2	75.5 / 59.4	1,275.5 / 69.7
Total	34.8 / 100.0	127.0 / 100.0	1,830.6 / 100.0	34.8 / 100.0	127.0 / 100.0	1,830.6 / 100.0

Notes:
[A] Numbers rounded to one decimal place. Areas and percentages may not add up to total amounts due to rounding
Values pertain to the portion of the Project Area and LAA with ELC data

Limiting Factors

Predation and harvesting are likely the greatest sources of mortality for adult spruce grouse (Cornell Lab 2020). Limiting factors to populations of spruce grouse include forest loss and fragmentation resulting from human habitation and forest harvesting practices, and widespread use of pesticides, which reduce the abundance of invertebrates upon which spruce grouse chicks depend for food (Sandilands 2005).

Ruffed Grouse

Life History and Distribution

Ruffed grouse is resident throughout most of Canada, including in forests of southern Labrador and in western Newfoundland. This species is a permanent resident throughout its range, however, shows some seasonal differences in movements, home range and habitat use.

Generally, ruffed grouse use the same habitat types year-round. The species is closely associated with aspen (*Populus spp*), although in boreal regions, it is found employing mixed deciduous-conifer forests in early stages of succession, and other early successional areas including old fields with regenerating aspen, pin cherry, or alder; forest edges; shrubby ravines; and forest openings dominated by raspberries (Cornell Lab 2020). Where aspen is absent, it may occur in much lower densities, and in these cases, it may inhabit maple-beech-yellow birch, balsam fir and tamarack forests, alder fens and black spruce bogs (Sandilands 2005). Mixedwood forests are also inhabited, however abundant conifers may be detrimental as they provide cover for predators and do not serve as a food source. On the Island of Newfoundland, preferred habitat is identified as second-growth deciduous and mixed forests, particularly with abundant birch or aspen (Warkentin and Newton 2009). Two records of ruffed grouse presence have been gathered incidentally during field surveys conducted in the Project Area and LAA. One individual bird was observed during surveys conducted in support of the ELC. Additionally, tracks belonging to ruffed grouse were recorded during winter wildlife surveys conducted in 2013.

Habitat Occurrence in the Project Area

Mixedwood Forest, Regenerating Forest, Alder Thicket and Anthropogenic habitats were identified as high value habitat for ruffed grouse (Table 10.11). Mixedwood Forest, Regenerating Forest and Alder Thicket habitats provide the preferred deciduous tree species, which are used as a primary food source. Cover and nesting opportunities are also provided by these habitat types. Anthropogenic habitats, particularly roadsides, provide a rich source of vegetation for feeding and an important source of grit for ruffed grouse.

Wet Coniferous Forest was ranked as moderate value to ruffed grouse. While this habitat type provides few deciduous trees to act as a food source for ruffed grouse, it provides cover, some ground vegetation food sources and possible nesting opportunities.

Other habitat types were ranked as low value as they provide limited protection, resting and/or foraging opportunities.

Table 10.12 summarizes high, moderate and low value breeding habitat for ruffed grouse. High-value habitat for this species occupies 12.1 km^2 (34.9%) of the Project Area, 45.8 km^2 (36.1%) of the LAA and 424.4 km^2 (23.2%) in the ELCA. Proportionally, there is little difference in the availability of high value habitat available in the LAA and in the Project Area, and approximately 10% less high value habitat available for ruffed grouse in the ELCA than in the Project Area or LAA.

Limiting Factors

Habitat requirements and limited mobility throughout all life stages result in limited distribution of ruffed grouse in NL (Nalcor Energy 2012). Shooting and trapping, habitat degradation, predation (primarily by birds of prey), and pesticides and other contaminants have been identified as limiting factors (Rusch et al. 2000). In addition, increased hunting pressure due to increased road access can reduce population numbers by five to 29% annually. Suppression of wildfires, elimination of clear-cutting and implementation of forest management practices that reduce the abundance of deciduous tree species, and increase the abundance of conifers can reduce the availability of early successional habitat required by ruffed grouse (Rusch et al. 2000).

10.2.4.5 Species at Risk

SAR include those bird species listed as Extirpated, Endangered, Threatened, Vulnerable, or Special Concern under the NL ESA, SARA, or by COSEWIC. These species are protected under SARA and/or the NL ESA, as described in Section 10.1.1. There are a variety of bird species designated or listed under the federal and provincial legislation in NL and some have been found within the Project Area and LAA.

Olive-sided Flycatcher

Life History and Distribution

Olive-sided flycatcher is listed as Threatened under SARA (Schedule 1) and under the NL ESA. This species is most often associated with open areas of the boreal forest which contain tall live trees or snags for perching, such as wetlands, forest clearings, forest edges near natural openings (such as rivers or swamps) or human made openings such as in logged and burned areas (Government of NL 2020a; COSEWIC 2018a). Preferred habitat types are most often characterized by mature trees and large numbers of dead trees. Coniferous or mixedwood stands may be used, and in the boreal forest, suitable habitat is more likely to be in or near wetland areas (COSEWIC 2018a). This species breeds throughout the forests of Canada, including on the Island of Newfoundland. They winter in Central America and the Andes Mountains of South America (Government of NL 2020a).

Olive-sided flycatcher was observed within the Project Area during breeding bird surveys in 2011 and 2019, with up to six olive-sided flycatchers recorded in the Project Area in 2019.

Habitat Occurrence in the Project Area

Wet Coniferous Forest and Open Wetlands were identified as being of high value to olive-sided flycatcher (Table 10.13). These habitats provide the preferred tall living or dead trees for perching, overlooking openings where the bird can hunt and catch aerial insect prey. In the Project Area, olive-sided flycatchers were most often encountered in areas where these two habitat types occurred adjacent to each other.

Black Spruce Forest was identified as being of moderate value to olive-sided flycatcher. This habitat type provides tall trees for perching and cover, although possess fewer open or wet areas that are suitable for foraging for aerial insect prey.

Other habitat types were ranked as low value as they provide limited protection, resting and/or foraging opportunities.

Table 10.14 summarizes high, moderate and low value breeding habitat for olive-sided flycatcher. High-value habitat for this species occupies 7.1 km^2 (20.4%) of the Project Area, 16.9 km^2 (13.3%) of the LAA and 411.0 km^2 (22.5%) of the ELCA. Proportionally, there is a greater percentage (7%) of high value habitat for olive-sided flycatcher available in the Project Area than in the LAA. Proportionally, the ELCA contains approximately 2% more high value habitat for olive-sided flycatcher than the Project Area.

Table 10.13 Habitat Value Ranking for SAR

Habitat Type	Habitat Value Ranking	
	Olive-sided Flycatcher	Rusty Blackbird
Balsam Fir Forest	Low	Low
Black Spruce Forest	Moderate	Low
Kalmia-Black Spruce Woodland[A]	Low	Low
Mixedwood Forest	Low	Low

Table 10.13 Habitat Value Ranking for SAR

Habitat Type	Habitat Value Ranking	
	Olive-sided Flycatcher	Rusty Blackbird
Regenerating Forest	Low	Moderate
Alder Thicket	Low	Moderate
Riparian Thicket	Low	Moderate
Wet Coniferous Forest	High	High
Open Wetlands	High	Moderate
Open Water	Low	Low
Exposed Sand / Gravel Shoreline	Low	Low
Anthropogenic	Low	Low
Sources	Government of NL 2020aCOSEWIC 2018a; Nalcor Energy 2012	Government of NL 2020a; COSEWIC 2006; Cornell Lab 2020; Avery 1995; Edmonds et al. 2010

Notes:
[A] Includes Kalmia-Black Spruce Forest and Kalmia Health Ecotypes
[B] Includes Shrub / Graminoid Fen and Shrub Bog Ecotypes

Table 10.14 Amount of Habitat Type by Habitat Value Ranking for SAR in Assessment Areas

Habitat Value Ranking	Olive-sided Flycatcher Habitat			Rusty Blackbird Habitat		
	Area in Project Area[A] (km^2 / %)	Area in LAA[A] (km^2 / %)	Area in ELCA[A] (km^2 / %)	Area in Project Area[A] (km^2 / %)	Area in LAA[A] (km^2 / %)	Area in ELCA[A] (km^2 / %)
High	7.1 / 20.5	16.9 / 13.3	411.0 / 22.5	2.5 / 7.2	5.7 / 4.5	130.7 / 7.1
Moderate	4.3 / 12.4	17.6 / 13.9	233.1 / 12.7	9.0 / 25.9	36.2 / 28.5	532.3 / 29.1
Low	23.4 / 67.4	92.5 / 72.8	1,186.4 / 64.8	23.3 / 67.1	85.1 / 67.0	1,167.6 / 63.8
Total	34.8 / 100.0	127.0 / 100.0	1,830.6 / 100.0	34.8 / 100.0	127 / 100.0	1,830.6 / 100.0

Notes:
[A] Numbers rounded to one decimal place. Areas and percentages may not add up to total amounts due to rounding
Values pertain to the portion of the Project Area and LAA with ELC data

Limiting Factors

Key limiting factors for olive-sided flycatcher include a decline in insect populations, predation (particularly eggs or young), habitat loss / modification (including reforestation), collision with motor vehicles, loss of nesting sites and climate change (COSEWIC 2018a). A reduction in suitable habitat and the use of pesticides are thought to be the primary limiting factors in the wintering habitat of this species (Nalcor Energy 2012).

Rusty Blackbird

Life History and Distribution

Rusty blackbirds are found breeding throughout most of Canada from northern Yukon, east to NL. This species is migratory and winters primarily in the southern part of central and eastern United States (Cornell Lab 2020).

Rusty blackbird is listed as a species of Special Concern under SARA (Schedule 1) and as Vulnerable under the NL ESA. This species is not regularly found throughout NL; however, an established population can be found in central Newfoundland. This species is associated with forested wetlands, particularly those associated with waterbodies such as slow-moving streams and beaver ponds. They are also found in peat bogs, sedge meadows and scrub edges (Government of NL 2020a; COSEWIC 2006).

Rusty blackbird was observed incidentally within a tall shrub swamp along the access road portion of the Project Area approximately one km northeast of the northern end of the wider section of the Project Area. The observation was of a lone, singing male.

Habitat Occurrence in the Project Area

Wet Coniferous Forest was identified as being of high value to rusty blackbird (Table 10.13). This habitat type provides nesting, foraging and cover opportunities, and the openings and required moisture regime preferred by this species

Regenerating Forest, Alder thicket, Riparian Thicket and Open Wetland were identified as being of moderate value to rusty blackbird. Though this species may be found in Regenerating Forest, Alder Thicket and Riparian Thicket, these habitat types may contain few openings which provide foraging opportunities for rusty blackbird. Open Wetland habitat types provide little cover or nesting opportunities for this species, though they may be used for foraging activities

Other habitat types were ranked as low value as they provide limited protection, resting and particularly foraging opportunities.

Table 10.14 summarizes high, moderate and low value breeding habitat for rusty blackbird. High-value habitat for this species occupies 2.5 km^2 (7.2%) of the Project Area, 5.7 km^2 (4.5%) of the LAA and 130.7 km^2 (7.1%) of the ELCA. Proportionally, there is a slightly higher availability (approximately 3%) of high value habitat for rusty blackbird within the Project Area than in the LAA. Proportionally the Project Area and the ELCA contain the same amount of high value habitat for rusty blackbird.

Limiting Factors

Limiting factors for rusty blackbird include: the destruction of habitat through conversion of wetlands into other land uses (e.g., farm land or other anthropogenic types); creation of hydroelectric reservoirs; bird control programs designed to control populations of birds that damage crops (e.g., red-winged blackbirds) (COSEWIC 2006); predation by raptors and other birds of prey; and food shortages during severe weather in winter and late spring (Avery 1995). Destruction of primary wintering habitat in the forests of the Mississippi Valley have also played a role in the decline of this species (COSEWIC 2006). Mercury has also been determined to be a key threat to rusty blackbirds (Edmonds et al. 2010).

10.3 ASSESSMENT CRITERIA AND METHODS

This section describes the criteria and methods used to assess environmental effects on avifauna. Residual environmental effects (Section 10.5) are assessed and characterized using criteria defined in Section 10.3.1, including direction, magnitude, geographic extent, timing, frequency, duration, reversibility and ecological or socio-economic context. The assessment also evaluates the significance of residual effects using threshold criteria or standards beyond which a residual environmental effect is considered significant. The definition of a significant effect for the Avifauna VC is provided in Section 10.3.2. Section 10.3.3 identifies the environmental effects to be assessed for avifauna, including effect pathways and measurable parameters. This is followed by the identification of potential Project interactions with this VC (Section 10.3.4). Analytical assessment techniques used for the assessment of avifauna are provided in Section 10.3.5.

10.3.1 Residual Effects Characterization

Table 10.15 presents definitions for the characterization of residual environmental effects on avifauna. The criteria are used to describe the potential residual effects that remain after mitigation measures have been implemented. Quantitative measures have been developed, where possible, to characterize residual effects. Qualitative considerations are used where quantitative measurement is not possible.

Table 10.15 Characterization of Residual Effects on Avifauna

Characterization	Description	Quantitative Measure or Definition of Qualitative Categories
Direction	The long-term trend of the residual effect	**Neutral –** no net change in measurable parameters for avifauna relative to existing conditions **Positive –** a residual effect that moves measurable parameters in a direction beneficial to avifauna relative to existing conditions **Adverse –** a residual effect that moves measurable parameters in a direction detrimental to avifauna relative to existing conditions
Magnitude	The amount of change in avifauna habitat	***Change in Habitat*** **Negligible –** no measurable change in habitat for avifauna, including SAR **Low –** Project changes less than 10% of high and moderate value habitat in the ELCA for representative avifauna species, or less than 5% of high and moderate value habitat in the ELCA for representative avifauna SAR **Moderate –** Project changes 10-20% of high and moderate value habitat in the ELCA for representative avifauna species, or 5-10% of high and moderate value habitat in the ELCA for representative avifauna SAR

Table 10.15 Characterization of Residual Effects on Avifauna

Characterization	Description	Quantitative Measure or Definition of Qualitative Categories
		High – Project changes more than 20% of high and moderate value habitat in the ELCA for representative avifauna species, or more than 10% of high and moderate value habitat in the ELCA for representative avifauna SAR ***Change in Mortality Risk*** **Low –** a substantial change in the abundance of avifauna in the LAA is not anticipated, although temporary local shifts in distribution in the LAA could occur **Moderate –** a substantial change in the abundance and/or distribution of avifauna in the LAA might occur, although a measurable change in the abundance of avifauna in the RAA is not anticipated **High –** a substantial change in the abundance and/or distribution of avifauna in the RAA could occur
Geographic Extent	The geographic area in which a residual effect occurs	**Project Area –** residual effects are restricted to the Project Area **LAA –** residual effects extend into the LAA **RAA –** residual effects extend into the RAA
Frequency	Identifies how often the residual effect occurs and how often during the Project or in a specific phase	**Single event –** occurs once **Multiple irregular event –** occurs at no set schedule **Multiple regular event –** occurs at regular intervals **Continuous –** occurs continuously
Duration	The period of time required until the measurable parameter or the VC returns to its existing (baseline) condition, or the residual effect can no longer be measured or otherwise perceived	**Short-term –** residual effect restricted to construction or decommissioning, rehabilitation and closure phases **Medium-term –** residual effect extends through the operation phase (12 years) **Long-term –** residual effect extends beyond the operation phase (>12 years) **Permanent –** recovery to baseline conditions unlikely
Reversibility	Describes whether a measurable parameter or the VC can return to its existing condition after the project activity ceases	**Reversible –** the residual effect is likely to be reversed after activity completion and rehabilitation **Irreversible –** the residual effect is unlikely to be reversed
Ecological and Socio-economic Context	Existing conditions and trends in the area where residual effects occur	**Undisturbed –** area is relatively undisturbed or not adversely affected by human activity **Disturbed –** area has been substantially previously disturbed by human development or human development is still present

10.3.2 Significance Definition

A significant adverse residual effect on avifauna is defined as one that threatens the long term persistence, viability or recovery of an avifauna species population in the RAA, including effects that are contrary to or inconsistent with the goals, objectives or activities of recovery strategies, action plans and management plans.

10.3.3 Potential Effects, Pathways and Measurable Parameters

Table 10.16 lists the potential Project effects on avifauna and provides a summary of the Project effect pathways and measurable parameters and units of measurement to assess potential effects. Potential environmental effects and measurable parameters were selected based on review of recent environmental assessments (EAs) for mining projects in NL and other parts of Canada, comments provided during engagement and professional judgment.

Table 10.16 Potential Effects, Effect Pathways and Measurable Parameters for Avifauna

Potential Environmental Effect	Effect Pathway	Measurable Parameter(s) and Units of Measurement
Change in habitat	• Direct and/or indirect loss or alteration of habitat due to vegetation clearing, sensory disturbance and/or edge effects	• Amount (ha) of avifauna habitat directly or indirectly (qualitative) lost or altered for representative species, including SAR with the most potential to be affected by the Project.
Change in mortality risk	• Direct change in mortality risk due to vegetation clearing activities, vehicular collisions, and indirect change in mortality risk due to predation and harvest pressure	• Estimated change in mortality risk is assessed qualitatively through: - Change in traffic volumes during the life of the Project - Interactions with Project infrastructure, vehicles and equipment - Increase in predation, hunting and/or poaching because of improved access or other habitat changes

10.3.4 Project Interactions with Avifauna

Table 10.17 identifies the physical activities that might interact with the VC and result in the identified environmental effect. These interactions are indicated by checkmark and are discussed in detail in Section 10.5, in the context of effect pathways, standard and Project-specific mitigation / enhancement and residual effects. Justification where no interaction and, therefore, no resulting effect is predicted is provided following the table.

Table 10.17 Project-Environment Interactions with Avifauna

Physical Activities	Environmental Effects to be Assessed	
	Change in Habitat	Change in Mortality Risk
CONSTRUCTION		
Access Road Upgrade / Realignment: Where required, road widening and replacement / upgrades of roads and culverts.	✓	✓
Construction-related Transportation along Access Road	–	✓
Mine Site Preparation and Earthworks: Clearing and cutting of vegetation and removal of organic materials, development of roads and excavation and preparation of excavation bases within the mine site, grading for infrastructure construction. For the open pits, earthworks include stripping, stockpiling of organic and overburden materials, and development of in-pit quarries to supply site development rock for infrastructure such as structural fill and road gravels. Also includes temporary surface water and groundwater management, and the presence of people and equipment on site.	✓	✓
Construction / Installation of Infrastructure and Equipment: Placement of concrete foundations, and construction of buildings and infrastructure as required for the Project. Also includes: • Installation of water control structures (including earthworks) • Installation and commissioning of utilities on-site • Presence of people and equipment on-site	✓	✓
Emissions, Discharges and Wastes[A]: Noise, air emissions / greenhouse gases (GHGs), water discharge, and hazardous and non-hazardous wastes.	✓	–
Employment and Expenditures[B]	–	✓
OPERATION		
Operation-related Transportation Along Access Road	–	✓
Open Pit Mining: Blasting, excavation and haulage of rock from the open pits using conventional mining equipment.	–	✓
Topsoil, Overburden and Rock Management: Five types of piles: • Topsoil • Overburden • Waste rock • Low-grade ore • High-grade ore • Rock excavated from the open pits that will not be processed for gold will be used as engineered fill for site development, maintenance and rehabilitation, or will be deposited in waste rock piles.	–	✓
Ore Milling and Processing: Ore extracted from the open pits will be moved to the processing area where it will either be stockpiled for future processing or crushed and milled, then processed for gold extraction via gravity, flotation and leach processes.	–	✓

Table 10.17 Project-Environment Interactions with Avifauna

Physical Activities	Environmental Effects to be Assessed	
	Change in Habitat	Change in Mortality Risk
Tailings Management Facility: Following treating tails via cyanide destruction, tailings will be thickened and pumped to an engineered TMF in years 1 to 9, then pumped to the exhausted Leprechaun open pit in years 10 through 12.	–	✓
Water Management (Intake, Use, Collection and Release): Recirculated process water and TMF decant water will serve as main process water supply, and raw water (for purposes requiring clean water) will be obtained from Victoria Lake Reservoir. Site contact water and process effluent will be managed on site and treated prior to discharge to the environment. Where possible, non-contact water will be diverted away from mine features and infrastructure, and site contact and process water will be recycled to the extent possible for use on site.	✓	✓
Utilities, Infrastructure and Other Facilities • Accommodations camp and site buildings operation, including vehicle maintenance facilities • Explosives storage and mixing • Site road maintenance and site snow clearing • Access road maintenance and snow clearing • Power and telecom supply • Fuel supply	–	✓
Emissions, Discharges and Wastes[A]: Noise, air emissions/GHGs, water discharge, and hazardous and non-hazardous wastes.	✓	✓
Employment and Expenditure[B]	–	✓
DECOMMISSIONING, REHABILITATION AND CLOSURE		
Decommissioning of Mine Features and Infrastructure	✓	✓
Decommissioning, Rehabilitation and Closure-related Transportation Along Access Road	–	✓
Progressive Rehabilitation: Rehabilitating infrastructure or areas not required for ongoing operation (e.g., buildings, roads, laydown areas); covering and revegetating completed tailings areas, where practicable, including commencing closure of TMF beginning in Year 9 (when tailings deposition moves to Leprechaun open pit); erosion stabilization and re-vegetation of completed overburden and/or waste rock piles; infilling or flooding of exhausted mining areas; and completing revegetation studies and trials.	✓	✓
Closure Rehabilitation: Active rehabilitation based on successes of progressive rehabilitation activities. Includes: demolishing infrastructure (e.g., buildings, equipment, facilities, roads, laydown areas); grading and revegetating cleared areas, where practicable; breaching and regrading ponds to reestablish drainage patterns; completing closure of TMF (covering with overburden and revegetating); erosion stabilization and revegetation of completed overburden and/or waste rock piles; and infilling or flooding of open pits.	✓	✓

Table 10.17 Project-Environment Interactions with Avifauna

Physical Activities	Environmental Effects to be Assessed	
	Change in Habitat	Change in Mortality Risk
Post-Closure: Long term monitoring	✓	–
Emissions, Discharges and Wastes[A]	✓	✓
Employment and Expenditure[B]	–	✓

Notes:
✓ = Potential interaction
– = No interaction
[A] Emissions, Discharges, and Wastes (e.g., air, waste, noise, light, liquid and solid effluents) are generated by many Project activities. Rather than acknowledging this by placing a checkmark against each of these activities, "Wastes and Emissions" is an additional component under each Project phase
[B] Project employment and expenditures are generated by most Project activities and components and are the main drivers of many socio-economic effects. Rather than acknowledging this by placing a checkmark against each of these activities, "Employment and Expenditures" is an additional component under each Project phase

Employment and Expenditure activities are not expected to interact with habitat for the lifetime of the Project, as there is no pathway for these activities to affect avifauna. A change in mortality risk could occur if the presence of Project workers increases harvesting pressure on waterfowl and gamebirds. Transportation along the Access Road throughout the life of the Project is also not expected to interact with a change in habitat, as noise and dust emissions from this activity are considered under Emissions, Discharges and Wastes. Transportation could result in a change in mortality risk, through collisions with vehicles.

Construction-related Emissions, Discharges and Wastes are not expected to result in a change in mortality risk, as these are not anticipated to have serious or lethal effects on avifauna. However, Emissions, Discharges and Wastes throughout the life of the Project have the potential to result in sensory disturbance from noise and human presence causing an indirect change in habitat. Emissions, Discharges and Wastes during operation and decommissioning, rehabilitation and closure may contain parameters of potential concern (POPC) and could interact with mortality risk.

Mine Site Preparation and Earthworks will interact with habitat and mortality risk through the direct and indirect loss of avifauna habitat and the potential for equipment and vehicles to crush or collide with avifauna individuals, respectively. Construction / Installation of Infrastructure and Equipment could also interact with habitat as this activity includes earthworks associated with the installation of water management infrastructure.

Areas where operation activities will occur will have been cleared during construction activities and most avifauna will typically avoid noisy areas with lots of activity. Therefore, in the assessment of change in habitat, no interaction has been identified for physical activities that avifauna are expected to avoid, including:

- Open Pit Mining
- Topsoil, Overburden and Rock Management

- Ore Milling and Processing
- Operation-related Transportation along the Access Road
- Utilities, Infrastructure and Other Facilities

The noise and dust associated with the above activities, which could result in an indirect change in habitat, are included under Emissions, Discharges and Wastes. During operation, some avifauna species are known to nest on anthropogenic structures, including overburden stockpiles. Therefore, activities that may result in a small change in mortality risk include Open Pit Mining, Ore Milling and Processing, Topsoil, Overburden and Rock Management, and Utilities, Infrastructure and Other Facilities, given these activities have the potential to cause mortality to avifauna species through loss of nests, eggs or individual avifauna.

During operation, activities associated with the Tailings Management Facility (TMF) and Water Management have the potential to increase mortality risk through attraction of avifauna to the TMF and sedimentation ponds as a source of drinking water or foraging. Water Management could also result in the alteration of off-site waterbodies and wetlands, creating a change in habitat for some avifauna species.

Progressive Rehabilitation and Closure Rehabilitation are anticipated to interact with both change in habitat and change in mortality risk. Avifauna habitat will be restored throughout much of the mine site, but as with earthworks during construction, there will be a potential for equipment to crush or collide with avifauna individuals or result in mortality of avifauna that have nested in buildings or infrastructure to be dismantled.

10.3.5 Analytical Assessment Techniques

10.3.5.1 Assumptions and the Conservative Approach

A conservative approach was used to address uncertainty in the environmental effects assessment, allowing for increased confidence in the final determination of significance. Specifically, the following assumptions were made:

- All habitat within the Project Area will be lost, resulting in a direct loss of habitat; in practice, not all vegetation will be cleared within the Project Area
- While the effects assessment focused on the representative species identified for each bird group (as described in Section 10.2), the effects of the Project on other species are inferred based on similar or less specific habitat requirements and environmental sensitivities
- The distance from which indirect changes in habitat extend from the source were always assumed to occur at the maximum identified distances; in reality, the indirect effects will vary greatly depending on site activity
- With respect to sound, it was assumed there was no vegetation between the source of the noise and the receptor; in reality, some vegetation will attenuate sound pressure
- Change in habitat was assessed within the ELCA (1,830.6 km^2), which constitutes 20.5% of the RAA (8916.8 km^2); as the proportion of habitat affected by the Project within the RAA will be less than in

the ELCA (as the RAA is larger than the ELCA), the estimated proportion of Project-related change in habitat is conservative

10.3.5.2 Change in Habitat

Effects on avifauna and their habitat were assessed quantitatively using geographic information system (GIS) and qualitatively through a literature review of predicted effects.

Direct changes in habitat were calculated by determining the area of suitable habitat lost for the representative species. For each representative species, all habitat types were ranked as low, moderate or high quality. Habitats ranking as high or moderate were classified as suitable habitat. It was assumed that all habitat in the Project Area will be lost and the amount of suitable habitat lost for each representative species was calculated using GIS.

Indirect effects on habitat were measured based on estimated areas of potential sensory disturbance, primarily from noise and light. The sensory disturbance zone defines the area over which the effects of a disturbance are assumed to reduce the effectiveness of the adjacent avifauna habitat due to avoidance or underutilization. For this assessment, two sensory disturbance zones were applied around the Project Area:

- Mine site portion of the Project Area: 200 m, based on guidance provided for buffers applied to similar Projects in similar habitat contexts (Ontario Ministry of Natural Resources 2000)
- Access road portion of the Project Area: 100 m, to account for the occasional and less intense nature of the sensory disturbance predicted to take place within this section of the Project Area

The sensory disturbance zones were calculated as discrete areas located outside of the Project Area and do not overlap with areas where habitat is directly lost. This was necessary to not double count both direct and indirect habitat loss.

10.3.5.3 Change in Mortality Risk

Change in mortality risk was assessed qualitatively through changes in direct sources of mortality (e.g., vehicle collisions, human-wildlife conflict). The qualitative assessment included a combination of literature review and professional judgment to predict the mortality risks to avifauna. The assessment of change in mortality risk focused on the construction and operation phases as the change in mortality risk during decommissioning, rehabilitation and closure activities is expected to be low relative to construction or operation.

10.4 MITIGATION AND MANAGEMENT MEASURES

A series of environmental management plans will be developed by Marathon to mitigate the effects of Project development on the environment. A full list of mitigation measures to be applied throughout Project construction, operation and decommissioning, rehabilitation and closure is provided in Section 2.7.4. Project planning and design and the application of proven mitigation measures will be used to reduce adverse effects to habitat and mortality risk for avifauna. Mitigation measures identified for other

VCs will also reduce the potential effects on avifauna (Chapter 5 – Atmospheric Environment, Chapter 7 – Surface Water Resources and Chapter 9 – Vegetation, Wetlands, Terrain and Soils). Key measures to mitigate the potential effects of the Project on avifauna are listed in Table 10.18.

Table 10.18 Mitigation Measures: Avifauna

Category	Mitigation	C	O	D
Site Clearing, Site Preparation and Erosion and Sediment Control	• Project footprint and disturbed areas will be limited to the extent practicable.	✓	-	-
	• Sensitive areas (e.g., wetlands, hibernacula, mineral licks, roosts, caribou migration corridors) will be identified prior to construction and appropriate buffers will be flagged and maintained around these areas, where feasible.	✓	-	-
	• Existing riparian vegetation will be maintained to the extent practicable.	✓	-	-
	• Environmental personnel responsible for site monitoring during construction will receive training to recognize species of conservation concern (SOCC) that may be present in Project Area.	✓	-	-
Air Emissions	• An Air Quality Management Plan (AQMP) will be developed and implemented as part of the EPP. The Plan will specify the mitigation measures for the management and reduction of air emissions during Project construction and operation.	✓	✓	✓
Vehicles / Equipment / Roads	• Vehicles and heavy equipment will be maintained in good working order and will be equipped with appropriate mufflers to reduce noise.	✓	✓	✓
	• Vehicles will use existing roads / trails while operating at the mine site. All-terrain vehicles used by Marathon personnel will also be restricted to existing roads, trails and corridors to the extent possible.	✓	✓	✓
	• Project vehicles will be required to comply with posted speed limits on the access road, site roads and haul roads to limit fugitive dust from vehicle travel on unpaved roads. Speed limits will be set in accordance with provincial regulations and industry standards (e.g., for haul roads). Additional speed restrictions will be implemented during caribou migration periods.	✓	✓	✓
	• Marathon will develop and implement a Traffic Management Plan to manage transportation of workers and materials to site, product leaving site, the number of vehicles accessing the site, and to reduce traffic delays.	✓	✓	✓
	• Marathon will implement traffic control measures to restrict public access to the mine site, which may include gating approaches, placing large boulders and/or gated fencing.	✓	✓	✓
Light Emissions	• Project lighting will be limited to that which is necessary for safe and efficient Project activities. Lighting design guidelines will be followed, such as the Commission Internationale de L'Éclairage, International Dark Sky Association, Illuminating Engineering Society, and the lighting requirements for workspaces, as applicable.	✓	✓	✓
	• Mobile and permanent lighting will be located such that unavoidable light spill off the working area is not directed toward receptors outside of the Project Area, to the extent practicable.	✓	✓	✓
Noise Emissions	• Project facilities and infrastructure will be designed to limit noise emissions.	-	✓	-

Table 10.18 Mitigation Measures: Avifauna

Category	Mitigation	C	O	D
Tailings Management	• Cyanide detoxification within the mill using the sulphur dioxide / air oxidation process will result in the degradation of cyanide and precipitation of metals prior to discharge to the TMF.	-	✓	-
Wildlife / Avifauna Management	• An Avifauna Management Plan will be developed and implemented for the Project and will include such measures as conducting pre-clearing surveys for active migratory bird nests during the breeding bird season and buffer / set-back distances from active nests. Where practicable, clearing and grubbing during the breeding season will be avoided.	✓	✓	✓
	• Trees that provide actual or potential habitat will be retained where safe to do so and technically feasible. Removal activities, where required, will be scheduled to the extent practicable, outside the migratory bird breeding season. If tree clearing is required during the migratory bird breeding season, experienced environmental monitors will inspect the trees to assess occupancy before tree removal.	✓	-	-
	• The discovery of nests by staff will be reported to the Marathon environmental manager at site and appropriate action or follow-up will be guided by the Avifauna Management Plan.	✓	✓	✓
	• As waterfowl species are particularly sensitive to disturbance during critical breeding and brood-raising periods (from May to mid-July), personnel will be made aware of the importance of the surrounding wetlands to waterfowl and efforts will be made to reduce impacts on them during Project activities.	✓	✓	✓
	• Embankments of the TMF and of sedimentation ponds will be maintained free of vegetation. This will also limit the attraction of waterfowl and/or wildlife to these ponds for foraging or breeding.	✓	✓	-
	• Avifauna use of the TMF ponds, open aquatic areas and other key Project locations will be monitored (primarily targeting waterfowl but also other wildlife species). If problematic avifauna use occurs, adaptive management measures (e.g., deterrents and/or exclusionary measures) will be implemented.	✓	✓	-
Rehabilitation and Closure	• Marathon will develop a Rehabilitation and Closure Plan that meets the requirements of the Department of Industry, Energy and Technology, Department of Environment, Climate Change, and Municipalities, and Department of Fisheries, Forestry and Agriculture. The plan will be reviewed and updated regularly until implemented.	✓	✓	✓
	• Prior to demolishing existing building and infrastructure, surveys for breeding birds and for bats will be conducted as per the Avifauna Management Plan. Where practicable, existing buildings and infrastructure will be demolished outside of the migratory breeding bird season.	-	-	✓

Notes:
C – Construction Activities
O – Operation Activities
D – Decommissioning, Rehabilitation and Closure Activities

10.5 ASSESSMENT OF ENVIRONMENTAL EFFECTS ON AVIFAUNA

For each potential effect identified in Section 10.3.3, specific Project activities that may interact with the VC and result in an environmental effect (i.e., a measurable change that may affect the VC) are identified and described. The following sections first describe the pathways by which a potential Project effect could result from Project activities (i.e., the Project-effect pathway) during each Project phase (i.e., construction, operation and decommissioning, rehabilitation and closure). Mitigation and management measures (Section 10.4) are applied to avoid or reduce these potential pathways and resulting environmental effects. Residual effects are those remaining following implementation of mitigation, which are then characterized using the criteria defined in Section 10.3.1. A summary of predicted residual effects is provided in Section 10.5.3.

10.5.1 Change in Habitat

10.5.1.1 Project Pathways

Construction

Most of the direct changes to avifauna habitat (i.e., habitat loss and/or alteration) will occur during Project construction, through vegetation removal during site preparation and subsequent conversion of land cover type. This direct change in habitat will be evident through the life of the Project and beyond the decommissioning, rehabilitation and closure phase.

Vegetation clearing also results in the creation of habitat edges and subsequently can create edge effects. Edge effects can include changes in microclimate, vegetation structure, changes to avifauna presence and/or abundance and behavioral responses of avifauna (Harper et al. 2005; Murcia 1995). Clearing of upland forest areas can result in changes to habitat that was previously forest interior with respect to abiotic factors. These factors include noise, light availability, humidity, wind and temperature (i.e., microclimate), which can change which plants are able to grow and thrive in an area (Murcia 1995). The magnitude of edge effects varies depending on the distance to the edge and is typically greater closer to the edge (Fuentes-Montemayor et al. 2009). Avifauna habitat may also experience a change in structure (Harper et al. 2005), community structure (Schmiegelow et al. 1997; Bayne et al. 2008) and behavioral responses of avifauna (Machtans 2006).

Construction can also result in indirect effects on habitat through sensory disturbance (e.g., noise, light pollution, dust and vibrations). Sensory disturbance from noise of blasting and heavy equipment use, site lighting, increased traffic volumes and dust deposition may cause avifauna to avoid or abandon habitat and may cause stress or other physiological effects. The magnitude of indirect effects on habitat is directly associated with the level of nearby Project activity. Chronic noise exposure can affect the ability of avifauna to perceive acoustic signals, causing changes in foraging and anti-predator behavior, reproductive success, density and community structure (Barber et al. 2010). This sensory disturbance could result in a change of habitat use around the mine site and/or access road (e.g., habitat avoidance [Bayne et al. 2008; Benitez-Lopez et al. 2010, Shannon et al. 2016]). Noise may also affect the ability of land bird species to detect and find mates or prey (Barber et al. 2010). These effects are generally considered greatest if disturbance occurs during critical periods (e.g., breeding season). These effects can be expected to occur in the LAA within 200 m of the Project Area, however, may extend farther (Ontario Ministry of Natural Resources 2000). These indirect habitat effects will occur during the construction phase and will continue throughout the life of the Project until closure.

Site lighting may also result in sensory disturbance to avifauna species. Light pollution resulting from Project sources can cause adverse effects for local and migrating avifauna; the zone of influence varies with factors such as weather, intensity and position (height) of the light source, and ambient light conditions (Poot et al. 2008; Jones and Francis 2003; Montevecchi 2006).

Operation

Most of the vegetation clearing (and subsequent creation of new edges and edge effects) will occur during construction activities. For the purposes of this assessment, it has been assumed that avifauna habitat will generally not be restored during operation due to ongoing activity within the Project Area, including open pit mining, ore processing, waste and water management and road use. However, there may be some localized areas within the Project Area where some avifauna habitat value is retained because vegetation removal will not be complete during construction (e.g., along a right-of-way). For this reason, there will be fewer direct effects on avifauna habitat during operation.

Indirect effects on wildlife habitat will occur throughout the operation phase. The main noise generating sources associated with Project operation include blasting, processing equipment, such as rock breakers and feeders and mobile sources, such as trucks and heavy equipment. Additional sources of sensory disturbance for avifauna may include stationary lighting sources associated with buildings and infrastructure, as well as mobile sources. As with construction, light pollution resulting from these sources can cause adverse effects for local and migrating avifauna; however, the zone of influence varies with factors such as weather, intensity and position (height) of the light source, and ambient light conditions (Poot et al. 2008; Jones and Francis 2003; Montevecchi 2006).

The extent of Project-related sensory disturbance experienced by avifauna during operation will vary by the type, intensity and timing of disturbance. More pronounced effects may be experienced if disturbance occurs during key life cycle periods, such as early in the breeding season.

Water management activities may also result in fluctuating water levels in adjacent waterbodies causing direct change in habitat. As the pits are excavated, the water balance in nearby lakes, rivers and wetlands may be affected, which can directly affect the habitat available for certain avifauna species, particularly those that nest over water (e.g., rusty blackbirds), along lake margins (e.g., waterbirds) or in riparian areas.

Decommissioning, Rehabilitation and Closure

The pathways that result in a direct change in habitat will vary over time as operational mining activities transition to site restoration and succession during progressive rehabilitation, decommissioning and closure activities.

In comparison to the operation phase, the rehabilitation and revegetation of the Project Area may result in an increase in habitat availability. Some avifauna species may be able to move back into areas that had been abandoned during construction and operation. Following closure, the habitat in the Project Area will change over time as vegetation becomes established in the disturbed areas. Shortly after closure, the site will likely become covered in low vegetation and will remain quite open. Mature forest habitat will take much longer to re-establish. Because of the open pits, restoration of the mine site footprint upon decommissioning, rehabilitation and closure is unlikely to result in the complete reversal of some of the effects associated with the Project. Some previously vegetated communities within the Project footprint are not expected to return to existing conditions.

If avifauna used built features of the Project Area during Project operation, this habitat will be lost upon decommissioning. The removal of mine infrastructure could affect species such as barn swallow (*Hirudo rustica*) that are known to nest on infrastructure (COSEWIC 2011; Brown and Brown 1999).

Activities that cause an indirect change in habitat use (e.g., sensory disturbance, edge effects) will cease upon closure, with reduced traffic levels and the cessation of Project activities.

10.5.1.2 Residual Effects

Vegetation clearing during the construction phase will result in the direct loss of habitat for avifauna. Mitigation measures presented in Section 10.4 (e.g., design considerations to reduce the extent of direct disturbance of habitat where practicable) will reduce the total amount of habitat lost during construction and operation. The scale and magnitude of habitat loss will vary by species, depending on a species' habitat requirements. The specific amounts of suitable habitat lost for the representative species identified in the Existing Environment (Section 10.2) are presented and discussed in the sections below.

Approximately 34.8 km^2 of potential avifauna habitat will be lost within the Project Area, based on the conservative assumptions identified in Section 10.3.5.1 (i.e., all habitat within the Project Area will be lost due to a combination of site clearing, habitat fragmentation and sensory disturbance). Seventy-eight percent of this habitat is forest and treed wetland (27 km^2 of 34.8 km^2), which is important habitat for numerous avifauna species (Section 10.2.4). Disturbance-related construction effects are anticipated to be long term, as removal of vegetation habitat from some areas of the Project Area (e.g., open pits) will be permanent and may not completely re-establish to pre-existing conditions upon closure. Other areas (e.g., haul roads) that will be rehabilitated will experience medium term effects. However, avifauna species within the LAA are generally not limited by habitat within their breeding range, that is, habitats are not at maximum capacity and therefore loss of high and moderate value habitat is likely to cause displacement of avifauna using these areas. Additional habitat of varying quality will be made available as a result of Project rehabilitation activities.

Sensory disturbance is largely caused by activities resulting in noise and light. This effect will primarily occur during the construction and operation phases, as a result of activities such as blasting, heavy equipment use and traffic. Sensory disturbance may cause avifauna to abandon important habitat features. Indirect change of habitat for avifauna as a result of sensory disturbance from Project noise levels will vary across location as activities change in position and intensity. Chronic noise exposure can affect the ability of avifauna to perceive acoustic signals, causing changes in foraging and anti-predator behavior, reproductive success, density and community structure (Barber et al. 2010). This sensory disturbance could result in a change of habitat use around the mine site or access road (e.g., habitat avoidance [Bayne et al. 2008; Benitez-Lopez et al. 2010, Shannon et al. 2016]).

It is conservatively assumed that approximately 51 km² of avifauna habitat is predicted to be altered due to sensory effects. Sound pressure levels related to construction are predicted to be below 35 dBA (background levels) approximately 5 km from the mine site, and at 25 dBA approximately 8 km from the mine site (Chapter 5). Sound pressure levels related to the access road are predicted to be 25 dBA approximately 1 km from the access road during rotation changes. During operation, sound pressure levels related to operation are predicted to be below 35 dBA approximately 5 km from the mine, and 25 dBA approximately 10 km from the mine. Sound pressure levels related to the access road are predicted to be 25 dBA approximately 1 km from the access road during rotation changes. Within the mine site, predicted sound pressure levels could reach approximately 80 dBA (e.g., rock breaker: 80 dBA at 100 m distance; processing plant: 67 dBA at 100 m; edge of Marathon Pit: 52 dBA at 100 m; edge of Leprechaun Pit: 55-60 dBA at 100 m). Acoustic modelling for this assessment assumed no vegetation between the source of the noise and the receptor, adding conservatism to the estimates. However, the effects described above are localized to the area around the mine site, as the access road is not expected to result in noise over 40 dBA in the LAA.

Physiological responses to noise exposure in birds, such as hearing loss, elevated stress hormone levels and hypertension have been observed at exposure levels of 55 to 60 dBA (Barber et al. 2010), while other studies report levels greater than 40 dBA have resulted in avoidance behavior (Shannon et al. 2016). This indicates there will likely be some noise-related effects on avifauna from Project activities at the mine site, and these effects could expand beyond the LAA.

Light pollution from equipment, vehicles, buildings and infrastructure during construction, operation and decommissioning, rehabilitation and closure can also cause adverse effects for local and migrating avifauna. The zone of influence varies with factors such as weather, intensity and position (height) of the light source, and ambient light conditions (Poot et al. 2008; Jones and Francis 2003; Montevecchi 2006). Typically, birds are more attracted to intense light (Jones and Francis 2003), and white and red light (rather than blue and green) (Poot et al. 2008), while lights shielded from above and strobe lighting are less attractive (Jones and Francis 2003). Down-lighting, a technique of directing night lighting downward to reduce light effects on avifauna adjacent to the mine site, as well as noise and light abatement measures for machinery and buildings, will be used to reduce sensory disturbance to avifauna within the LAA. With the application of mitigation measures, residual adverse effects are anticipated to be low in magnitude and localized to the LAA.

Operation activities, including water management, may result in fluctuating water levels in adjacent waterbodies causing direct change in habitat. Alteration of the natural flow regime could result from changes to surface vegetation cover, imperviousness, topography and drainage divides, slopes, open pit dewatering, seepage from stockpiles and management of surface water runoff. Changes to the water balance in nearby lakes, rivers and wetlands may be therefore be affected, which can directly affect the habitat available for certain avifauna species, particularly those that nest over water (e.g., rusty blackbird), along lake margins (e.g., waterbirds) or in riparian areas. As discussed in Chapter 7 (Surface Water Resources), while it is predicted that the Project is likely to cause reduction in surface water quantity at several watercourses downstream of the mine, the magnitude of effects is predicted to be low and considered to be within the range of natural variability. Adverse effects to habitat available to avifauna beyond the Project Area are, therefore, predicted to be low in magnitude.

Indirect changes in habitat use (e.g., sensory disturbance, edge effects) will be reduced upon decommissioning, rehabilitation and closure, with reduced traffic levels and the cessation of Project activities. Residual adverse effects are anticipated to be low in magnitude. Revegetation and infilling or flooding of mining areas in the mine site during decommissioning, rehabilitation and closure will also restore habitat value for some avifauna species within the mine site.

The direct and indirect residual environmental effects of the Project on change in habitat for the representative species identified in Section 10.2.4 is provided in Table 10.19 and characterized below. For each representative species, it is conservatively assumed that up to 34.8 km^2 of high and moderately ranked habitat could be directly lost in the Project Area (i.e., through a combination of vegetation clearing, habitat fragmentation and sensory disturbance). In addition, 50.9 km^2 of habitat could be lost due to indirect effects, including edge effects and sensory disturbance resulting from noise and light pollution.

Some individual species may experience higher relative loss of high and moderate value habitat, such as yellow-bellied flycatcher (6.8%), spruce grouse (6.3%) and ruffed grouse (8.5%). While rusty blackbird may experience a lower relative loss of high and moderate value habitat within the Project Area (5.2%) compared to other species, this change may be of greater magnitude given its SAR status. For SAR, loss of high and moderate value habitat may represent greater adverse environmental effects in the absence of mitigation.

Upon decommissioning, rehabilitation and closure, habitat will progressively increase in value as vegetation reestablishes.

Table 10.19 Residual Project-Related Change in Avifauna Habitat in the ELCA

Guild	Representative Species	Existing Conditions in the ELCA[A] (km²)			Direct Loss[A, B] (km²)			Indirect Loss[A, B] (km²)			Percent of High and Moderate Value Habitat Loss in ELCA[A] (Direct and Indirect Loss Combined) (%)
		Habitat Value Ranking									
		High	Moderate	Total	High	Moderate	Total	High	Moderate	Total	
Landbirds	Lincoln's sparrow	382.7	489.1	871.8	6.9	8.2	15.1	17.6	7.1	24.7	4.6
	Yellow-bellied flycatcher	461.2	445.6	906.8	9.0	14.2	23.2	21.97	16.7	38.7	6.8
Waterfowl	Canada goose	688.9	2.8	691.7	5.9	0.0	5.9	8.3	0.1	8.4	1.9
	American black duck	688.9	2.8	691.7	5.9	0.0	5.9	8.3	0.1	8.4	1.9
Raptors	Northern harrier	295.4	139.5	434.9	4.8	2.0	6.8	5.8	3.7	9.4	3.7
	Osprey	408.5	547.5	956.0	1.3	18.4	19.7	2.8	23.5	26.3	4.8
Upland Gamebirds	Spruce grouse	1018.2	105.6	1123.8	24.6	4.1	28.7	29.3	13.1	42.4	6.3
	Ruffed grouse	424.4	130.7	555.1	12.1	2.5	14.6	29.8	2.7	32.5	8.5
SAR	Olive-sided flycatcher	411	233.1	644.1	7.1	4.3	11.4	8.2	8.3	16.5	4.3
	Rusty blackbird	130.7	532.3	663.0	2.5	9.0	11.5	2.7	20.4	23.1	5.2

Notes:

[A] Numbers rounded to one decimal place. Areas may not add up to total amounts due to rounding.
[B] Values based on Project Area.
[C] Values based on 200 m buffer around Project Area plus 100m buffer around access road.

Values pertain to the portion of the Project Area and LAA with ELC data.

Landbirds

Yellow-bellied flycatcher is associated with boreal conifer forests and peatlands, in particular the Balsam Fir Forest, Mixedwood Forest and Regenerating Forest ELC habitat types. These habitat types are not well represented in the greater landscape, accounting for 24.3% of the ELCA and 40.0% of the Project Area (Section 10.2.4.1). Yellow-bellied flycatcher is anticipated to lose up to 23.2 km^2 of high and moderate value habitat due to direct loss and alteration of up to 38.7 km^2 of high and moderate value habitat through indirect effects (Table 10.19).

Lincoln's sparrow is associated with Wet Coniferous Forest, Riparian Thicket and Alder Thicket habitats, which occupy 6.9 km^2 (20.0%) of the Project Area, 30.7 km^2 (24.2%) of the LAA and 328.7 km^2 (20.9%) of the ELCA. Lincoln's sparrow is anticipated to lose up to 15.1 km^2 of high and moderate value habitat due to direct loss and alteration of up to 24.7 km^2 of high and moderate value habitat through indirect effects (Table 10.19).

As a result of Project-related direct and indirect effects, it is estimated that a loss of 4.6% of high and moderate value habitat may occur for the Lincoln's sparrow and 6.8% of high and moderate value habitat for yellow-bellied flycatcher in the ELCA. The RAA consists of the Central Newfoundland Ecoregion, the Maritime Barrens Ecoregions and the Long Range Barrens Ecoregion, which include habitats similar to those described for the LAA in Section 10.2.4, with upland areas dominated by Balsam Fir, Black Spruce and Mixed-wood Forests and lowland areas dominated by open peatlands, shrub heaths, alder thickets, and treed wetlands (Government of NL 2019). Therefore, habitat that can support these and other landbirds is common in the RAA and the effect of the Project on other landbird species can be inferred from the estimated loss of habitat for the representative species.

Waterfowl

High-value habitat for Canada goose occupies 5.9 km^2 (17.0 %) of the Project Area, 33.0 km^2 (26.0%) of the LAA and 689.9 km^2 (37.6%) of the ELCA. Proportionally, the LAA contains approximately 9% more high value habitat for Canada goose than the Project Area and the ELCA provides proportionally approximately 11.5% more high value habitat than the LAA for Canada goose (Section 10.2.4.2). Canada goose is anticipated to lose up to 5.9 km^2 of high and moderate value habitat due to direct loss and alteration of up to 5.9 km^2 of high and moderate value habitat through indirect effects (Table 10.19).

High-value habitat for American black duck occupies 5.9 km^2 (17.0%) of the Project Area, 33.0 km^2 (26.0%) of the LAA and 689.9 km^2 (37.6%) of the ELCA. Proportionally, the ELCA contains approximately 11% more high value habitat for American black duck than the LAA and the LAA contains approximately 9% more high value habitat for American black duck than the Project Area. American black duck is anticipated to lose up to 5.9 km^2 of high and moderate value habitat due to direct loss and alteration of up to 5.9 km^2 of high and moderate value habitat through indirect effects (Table 10.19).

Project-related direct and indirect effects combined will result in an estimated loss of 1.9% of high and moderate value habitat for Canada goose and American black duck in the ELCA. Habitat which can support these species and other waterfowl are relatively common in the RAA (Government of NL 2019)

(Section 10.2.4.2) and the effect of the Project on other waterfowl species can be inferred from the estimated loss of habitat for the representative waterfowl species.

Raptors

High value habitat for Northern harrier occupies 4.8 km^2 (13.8%) of the Project Area, 11.8 km^2 (9.3%) of the LAA and 295.4 km^2 (16.1%) of the ELCA. Proportionally, there is approximately 5% more high value habitat available for northern harrier within the Project Area than in the LAA. Proportionally, the ELCA contains approximately 2% more high value habitat for northern harrier than the Project Area (Section 10.2.4.3). Northern harrier is anticipated to lose up to 6.8 km^2 of high and moderate value habitat due to direct loss and alteration of up to 9.4 km^2 of high and moderate value habitat through indirect effects (Table 10.19).

High value habitat for osprey occupies 1.3 km^2 (3.7%) of the Project Area, 21.8 km^2 (17.2%) of the LAA and 408.5 km^2 (22.3%) of the ELCA. This indicates that proportionally, there is more high value habitat for osprey (approximately 14% more) available in the LAA than in the Project Area and approximately 5% more high value habitat for osprey available in the ELCA than in the LAA (Section 10.2.4.3). Osprey is anticipated to lose up to 19.7 km^2 of high and moderate value habitat due to direct loss and alteration of up to 26.3 km^2 of high and moderate value habitat through indirect effects (Table 10.19).

Project-related direct and indirect effects combined will result in an estimated loss of 3.7% of high and moderate value habitat for northern harrier and 4.8% of high and moderate value habitat for osprey in the ELCA. Habitat which can support these species and other raptors is common in the RAA (Government of NL 2019) and the effect of the Project on other raptor species can be inferred from the estimated loss of habitat for the representative raptor species.

Upland Gamebirds

Spruce grouse is associated with softwood forest types, represented by the Balsam Fir Forest, Black Spruce Forest, Kalmia-Black Spruce Woodland, Mixedwood Forest and Regenerating Forest ELC habitat types. These high value habitat types represent a higher relative area within the Project Area (70.9%) than that in the ELCA (55.6%). Habitat types of moderate value to spruce grouse, including Alder Thicket and Anthropogenic types, are also more abundant within the Project Area (11.8%) than in the greater ELCA (5.8%). Habitat types of moderate value to spruce grouse are more evenly represented in the LAA (11.3%) compared to the Project Area. Spruce grouse is anticipated to lose up to 28.7 km^2 of high and moderate value habitat due to direct loss and alteration of 42.4 km^2 of high and moderate value habitat through indirect effects (Table 10.19).

Ruffed grouse are closely associated with mixed deciduous-conifer forests in early stages of succession, represented by Mixedwood Forest, Regenerating Forest, Alder Thicket and Anthropogenic ELC habitat types. These high value habitat types represent a higher relative area within the Project Area (34.9%) than within the ELCA (23.2%). Habitat types of moderate value to ruffed grouse are relatively evenly represented within the Project Area (7.2%) and ELCA (7.1%). Ruffed grouse is anticipated to lose up to 14.6 km^2 of high and moderate value habitat due to direct loss and alteration of up to 32.5 km^2 of high and moderate value habitat through indirect effects (Table 10.19).

Project-related direct and indirect effects combined will result in an estimated loss of 6.3% of high and moderate value habitat for spruce grouse, and 8.5% of high and moderate value habitat for ruffed grouse in the ELCA. Habitat which can support these species and other upland gamebirds are common in the RAA (Government of NL 2019) (Section 10.2.4.4) and the effect of the Project on other upland gamebird species can be inferred from the estimated loss of habitat for the representative upland gamebird species.

Species at Risk

Three avifauna SAR were identified during field surveys in the vicinity of the Project Area: olive-sided flycatcher, common nighthawk and rusty blackbird. Four other SAR (bank swallow, grey-cheeked thrush, red crossbill, and evening grosbeak) were identified as potentially occurring near the LAA by other data sources (Section 10.2.3.4). Common nighthawk is considered an uncommon visitor on the Island of Newfoundland (Government of NL 2020a) and only a single common nighthawk was observed incidentally during field surveys conducted in the LAA in 2011. The other SAR described in Section 10.2.3.4 were single observations, in most cases from many years ago, and no observations were made during Project-related field surveys. Therefore, the assessment of potential effects on SAR is focused on olive-sided flycatcher and rusty blackbird.

Olive-sided flycatchers are associated with Wet Coniferous Forest and Open Wetlands. These habitat types were identified as being of high value to olive-sided flycatcher. Proportionally, there is a greater percentage (7%) of high value habitat for olive-sided flycatcher available in the Project Area than in the LAA. Proportionally, the ELCA contains approximately 2% more high value habitat for olive-sided flycatcher than does the Project Area (Section 10.2.4.5).

Rusty blackbirds are associated with forested wetlands, particularly those with open water features such as slow-moving streams or beaver ponds. A single ELC habitat type, Wet Coniferous Forest, represents high value habitat for rusty blackbird within the ELCA. High value habitat for this species is represented relatively equally within the Project Area (7.2%) and the ELCA (7.1%) (Section 10.2.4.5).

The Project may result in the direct loss of up to 11.4 km^2 of high and moderate value habitat for olive-sided flycatcher and up to 11.5 km^2 of high and moderate value habitat for rusty blackbird (Table 10.19). An additional 16.5 km^2 of high and moderate value habitat for olive-sided flycatcher and up to 23.1 km^2 of high and moderate value habitat for rusty blackbird is conservatively predicted to be lost through indirect effects. Project-related direct and indirect effects combined will result in an estimated loss of 4.3% of high and moderate value habitat for olive-sided flycatcher and 5.2% of high and moderate value habitat for rusty blackbird in the ELCA.

Critical habitat, as defined by SARA, has not been designated for any of the avifauna SAR observed within the Project Area, nor noted as potentially being within the LAA and therefore the Project does not result in the loss of critical habitat for those SARA listed avifauna species. Suitable breeding habitat for rusty blackbird and olive-sided flycatcher is relatively common within the RAA. Avifauna potentially displaced by development of the Project are likely to find breeding habitat elsewhere within the LAA or RAA. The SAR located in the vicinity of the Project Area are not more susceptible to the effects of the Project than are the other assessed species.

10.5.1.3 Summary

Project activities associated with Project construction will result in change in habitat for avifauna either through direct loss of habitat, or indirect loss through sensory disturbance. These effects are predicted to be long term, extending beyond the life of the Project as habitats re-establish across most of the site. Project activities associated with construction, operation and decommissioning, rehabilitation and closure will also result in a change in habitat for avifauna through indirect disturbance effects associated with noise and lighting.

The residual effects on habitat from the Project will be adverse in direction. For the representative avifauna species, the changes in habitat for non-SAR species are anticipated to be low in magnitude. The amount of high and moderate value habitat lost for the majority of species is estimated to be less than 5% of the ELCA. Change in habitat for representative avifauna SAR is predicted to be moderate in magnitude; as described in Section 10.3.1, Project changes to 5-10% of high and moderate value habitat in the ELCA for representative avifauna SAR are defined as moderate. Project-related direct and indirect effects combined will result in an estimated loss of 4.3% of high and moderate value habitat for olive-sided flycatcher and 5.2% of high and moderate value habitat for rusty blackbird in the ELCA. The assessment of direct habitat loss assumed that all habitat in the Project Area would be lost. However, as there will be some localized areas within the Project Area where vegetated areas will be retained and mitigation measures will be applied to reduce areas of Project disturbance to the extent practicable and to reduce Project emissions, the amounts of Project-related habitat loss are conservative. Habitat loss will be further reduced with the initiation of progressive rehabilitation during operation and completion of closure rehabilitation during the decommissioning, rehabilitation and closure phase. The effects of change in habitat are expected to occur at the geographic extent of the LAA, to be long term in duration and to occur continuously. The Project Area has been previously disturbed from the ongoing mineral exploration and forestry in the area.

Habitat loss from some construction activities will be irreversible, as some vegetation communities are not expected to return to existing conditions following decommissioning, rehabilitation and closure and some Project features (e.g., flooded open pits) will be permanent features on the landscape. As well, following decommissioning, rehabilitation and closure, the site is expected to gradually progress from open habitats to forested habitat, reversing some habitat loss for other wildlife species.

10.5.2 Change in Mortality Risk

10.5.2.1 Project Pathways

Construction

Site preparation activities related to the Project have the greatest potential to result in adverse effects resulting in change in mortality risk to avifauna. During the construction phase, clearing activities (vegetation removal) will be the primary pathway to Project-related change in mortality risk. In the absence of mitigation, this may result in the direct mortality of eggs or flightless young birds, primarily if these activities are conducted during the nesting period of avifauna species. Additionally, Project-related traffic during construction could result in equipment and vehicles crushing or colliding with avifauna individuals and / or avifauna colliding with Project-related infrastructure or equipment. In the absence of mitigation, the presence of Project workers could also result in an increase in harvesting of waterfowl and gamebirds.

Operation

Although most Project activities with potential to result in change in mortality risk will occur during the construction phase, activities during operation of the Project may also result in increased adverse encounters with avifauna. The primary effect pathway is collisions with Project vehicles and infrastructure. The increase in traffic due to ore hauling within the mine site and transportation of site personnel and materials and supplies to the mine site along the access road will result in an increase in mortality risk for avifauna near the Project Area.

Although noise and activity associated with operation activities will likely deter avifauna from the Project Area, some migratory birds (e.g., ducks, geese) may interact with the tailings and/or polishing pond when transiting through the area. A change in mortality risk may result from the ingestion and/or absorption of water with potential exceedances in POPC as outlined under the *Metal and Diamond Mining Effluent Regulations* (MDMER), specifically for total cyanide, unionized ammonia(product of cyanide decomposition) and Copper (added as catalysis during cyanide destruction or leached from the ore) in the tailings and/or polishing pond. Wildlife, including avifauna, have been reported drinking from ponds associated with TMFs (Eisler and Wiemeyer 2004; Donato et al. 2007) and could also be exposed to POPC by ingesting aquatic flora and fauna within these site water features.

The existence of access routes and the creation of edge habitats as a result of vegetation clearing can indirectly result in avifauna mortality through increasing access to avifauna by predators, nest parasites and hunters. Nest predators can occur more frequently closer to forest edges (Lloyd et al. 2005; Rich et al. 1994) and predators such as *Canis* (including coyotes) and humans use linear features (e.g., trails, cutlines) to increase hunting efficiency and gain access to prey species (Tigas et al. 2002; Dickie et al. 2016). There could be increased access by predators along edge habitat within the mine site, as well. Generalist predators, such as American crow, common raven, red fox and coyote, could hunt along edges of the mine site throughout the life of the Project. Similar to construction and in the absence of mitigation, the presence of Project workers could also result in an increase in harvesting of waterfowl and gamebirds.

There is also potential for a change of mortality risk for avifauna species that nest on or in anthropogenic structures. Some avifauna species, such as the barn swallow, will construct their nests under the eaves of buildings or inside of buildings in which apertures are kept open. Bank swallows and belted kingfishers will sometimes construct nesting burrows in soil stockpiles that have steep faces and light soils that are amenable for burrowing. American robins and common grackles will occasionally construct their nests on unused equipment or on buildings.

Decommissioning, Rehabilitation and Closure

While site traffic and equipment activity in the Project Area during decommissioning, rehabilitation and closure are expected to be similar to, or less than, during construction, a change in mortality risk would still occur as equipment and vehicles could crush or collide with avifauna individuals and / or avifauna. Similar to earlier phases and in the absence of mitigation, the presence of Project workers could also result in an increase in harvesting of waterfowl and gamebirds.

Removal of infrastructure could result in direct mortality for some avifauna species (e.g., barn swallow) that nest on anthropogenic structures, if the activity is carried out during the nesting period of avifauna (COSEWIC 2011; Brown and Brown 1999). This effect pathway is limited in both timing and with regards to the number of species that may be affected.

The closure phase and post-closure activities could have longer-lasting effects, primarily as it relates to the indirect mortality of avifauna resulting from increased access. Predators such as coyotes and humans use linear features for hunting (Tigas et al. 2002; Dickie et al. 2016) and with the cessation of Project activities and removal of security, the existence of roads and edge habitats within the mine site could indirectly result in avifauna mortality through increased access for predators and hunters. As indicated above, the main linear feature associated with the Project is an existing access road and a net change in access along this feature is not anticipated.

10.5.2.2 Residual Effects

Interactions that could result in a change in mortality risk for avifauna within the Project Area include clearing and cutting of vegetation during site preparation and access road upgrade / realignment, interactions with traffic and infrastructure, increased human activity, interactions with the TMF and sedimentation ponds and removal of infrastructure during decommissioning. A number of standard mitigation measures will be implemented to reduce or avoid these potential effects as outlined in Section 10.4, including timing of Project activities (e.g., site clearing) to avoid sensitive breeding periods for migratory species.

There is a change in mortality risk associated with change in habitat; however, because habitats are not at maximum capacity, loss of high and moderate value habitat is likely to result in mortality of few birds using these areas. These effects are not anticipated to be substantial. Further, additional habitat of varying quality will be made available as a result of Project activities and rehabilitation.

Change in mortality risk associated with each Project phase is further assessed in the following sections.

Construction

A direct increase to mortality risk is anticipated from clearing and cutting of vegetation during mine site preparation and access road upgrade / realignment. This effect will be low for adult avifauna due to their ability to move away from construction activities, however the change in mortality risk will be greatest during sensitive time periods (e.g., during the breeding period) and for eggs or unfledged birds. Risk will be reduced through the application of timing windows for activities that involve removal of vegetation. If vegetation removal is required within the primary nesting period, pre-construction avian use and nest search surveys will be completed to mitigate the risk to avifauna by identifying and avoiding active nests (Section 10.4).

Construction-related traffic could also result in a direct increase to mortality risk for avifauna from collisions with Project traffic and/or Project-related equipment. Incidents of avifauna-vehicle collisions along the access road are difficult to predict; however, an increase in truck traffic over existing conditions could result in a direct increase in mortality risk for avifauna. The average Project-related traffic on the access road over the 16 to 20-month construction period is anticipated to be six vehicles per day, with a peak of 18 vehicles per day on rotation change days. The application of mitigation, including speed limits, vegetation maintenance along road shoulders and reduction of overall traffic volumes by transporting multiple employees for each shift via bus, will reduce the overall likelihood of bird mortalities related to vehicle collisions.

The construction and / or upgrading of roads can increase access to the Project Area and LAA for both people and wildlife. Increasing access for people can increase hunting pressure. To reduce this pressure, hunting / harvesting will be strictly prohibited on the mine site. Workers will not be permitted to hunt / harvest while staying at the accommodations camp and will not be permitted to bring firearms to site. Marathon will also implement traffic control measures, which may include gating approaches and placing large boulders and/or gated fencing to restrict public access to the mine site. Although the existing road will be upgraded and used for site access, the Project is contributing few new roads to the area.

Operation

Some accidental avifauna fatalities may occur through avifauna-vehicle collisions; however, such incidents are expected to be infrequent. During operation, Project-related traffic will consist of five vehicles per day, with a peak of ten vehicles per day on crew rotation days (once a week). Most Project-related travel on the access road will be during daytime. Mitigation measures will be implemented to reduce overall traffic volumes. For example, multiple employees will be transported to site together on a bus during coordinated rotation changes. Project vehicles will be required to comply with posted speed limits on the access road, haul roads and site roads. Speed limits will be set in accordance with provincial regulations and industry standards (e.g., for haul roads). In general, avifauna are anticipated to avoid the mine site during operation activities due to loss of habitat and sensory disturbance; therefore, the incidence of avifauna-vehicle collisions is expected to be low within the mine site. Progressive rehabilitation and natural revegetation in cleared areas and along roadsides may, however, progressively increase attraction to birds near the mine site, which could increase collision risk over the life of the Project. Overall, the application of mitigation measures is predicted to reduce the likelihood of avifauna-vehicle collisions.

A change in mortality risk may result from possible ingestion and/or absorption of water in the tailings and/or polishing ponds, with potential exceedances in POPC as outlined under the MDMER, specifically for total cyanide, unionized ammonia (product of cyanide decomposition) and Copper (added as catalysis during cyanide destruction or leached from the ore. Wildlife, including avifauna, have been reported drinking from ponds associated with TMFs (Eisler and Wiemeyer 2004; Donato et al. 2007) and could also be exposed by ingesting aquatic flora and fauna within the TMF. The embankments of the TMF and the sedimentation ponds will be maintained free of vegetation; vegetation that naturally regenerates around sedimentation ponds and the TMF will be removed. While this is done for safety reasons, it will also reduce attraction to these areas by waterfowl for foraging or breeding. In addition, avifauna use of these Project features will be monitored and adaptive management measures (e.g., deterrents and/or exclusionary measures) will be implemented, as required. Cyanide concentrations in effluent discharged to the environment will comply with the appropriate guidelines. The greatest risk of mortality due to exposure to toxic substances or wastes would result from an accidental event, which are addressed in Chapter 21.

As discussed for construction, the existence of access routes and the creation of edge habitats as a result of vegetation clearing can indirectly result in avifauna mortality through increasing access to avifauna by predators, nest parasites and hunters. However, the Project will not be creating new linear features (the existing access road will be upgraded and maintained for the purposes of mine site access), therefore there will be no net change in the amount of edge habitat or access along the road. While there will be new roads developed within the mine site, there will not be public access to these roads and hunting / harvesting of wildlife will be strictly prohibited at the mine site until post-closure. In addition, avifauna are generally anticipated to avoid the mine site during operation due to loss of habitat and sensory disturbance within this area.

There is also potential for a change of mortality risk for avifauna species that nest on anthropogenic structures. A number of avifauna species, including bank swallows, barn swallows, American robin, belted kingfisher and common grackle are known to make use of anthropogenic areas for nesting and feeding. Most species avoid close contact with humans and stay away from these structures, although some species readily adapt to the presence of humans. In the absence of mitigation, operation activities have the potential to disturb these species if they are using the area / infrastructure as habitat.

The number of birds nesting on anthropogenic structures during the operational phase of the Project is expected to be low; however, some of these species (barn swallow and bank swallow) are listed under SARA. Bird species that nest on anthropogenic structures during Project operation can be expected to be tolerant of anthropogenic activities, so long as nests are not destroyed and buffers are established around active nests. Most migratory birds are protected under the MBCA. Native species not listed under the MBCA are typically protected under the provincial *Wild Life Act*. As such, the presence of the bird nests on or near anthropogenic structures could result in the requirement for nest protection measures.

The discovery of nests by workers will be reported to the Marathon on-site environment team and appropriate action or follow-up will be guided by the Avifauna Management Plan. Preventative measures such as contouring of stockpiles to make them less attractive to birds that construct nest burrows, the closing of doors to keep birds out of buildings, and design features and bird nesting deterrents to make buildings less attractive to nesting birds will be used where practicable to reduce the likelihood of birds nesting on anthropogenic structures and being adversely affected by mine site activities. The mortality risk of birds nesting on or near anthropogenic structures prior to implementation of mitigation would be low, as most birds will avoid these areas during Project operation and the species that do use the structures are tolerant of anthropogenic activities. With the implementation of mitigation measures and adherence to applicable regulations, the magnitude of the effects on nesting birds is expected to be low.

Decommissioning, Rehabilitation and Closure

Decommissioning, rehabilitation and closure activities are expected to have similar residual adverse effects as those described above for the construction phase. Removal of site infrastructure has the potential to result in mortality for avifauna species using these structures for nesting (e.g., barn swallow) (COSEWIC 2011; Brown and Brown 1999). Given the limited number of buildings associated with the Project and the mitigation measures described above to deter nesting, this is not anticipated to affect many individuals, if any. The application of proven mitigation measures and timing windows will reduce the potential for interactions between infrastructure removal activities and avifauna. Prior to demolishing existing buildings and infrastructure, surveys for breeding birds will be conducted as per the Avifauna Management Plan. Where practicable, existing buildings and infrastructure will be demolished outside of the migratory breeding bird season. Decommissioning and rehabilitation-related traffic could also present a mortality risk for avifauna from collisions; however, with the application of mitigation measures discussed above in Section 10.4, the overall likelihood of vehicle collision related mortality for birds will be low.

The cessation of Project activities and removal of security from the Project Area could result in an increased mortality risk to avifauna, resulting from increased access of predators and hunters. However, as the main linear feature associated with the Project is an existing access road, access along this feature for predators and hunters will remain similar to baseline conditions throughout the Project. There will be some increased access to edge habitat as hunters are allowed access to the mine site following closure, however based on current levels of land and resource use in the mine site (Chapter 16 – Land and Resource Use), this is unlikely to become a preferred harvesting location.

10.5.2.3 Summary

Successful application of the mitigation measures described in Section 10.4 is key to reducing the magnitude and duration of potential Project effects on mortality risk. With the application of these mitigation measures, the number of direct mortalities resulting from the Project is expected to be small relative to existing sources of mortality within the RAA, including from the existing access road. The magnitude of change in mortality risk is anticipated to be low for all phases of the Project. Effects are anticipated to be limited to the geographic extent of the LAA and are expected to be short term (for risks associated with construction activities and decommissioning, rehabilitation and closer) or medium term (for risks during operation activities) in duration. Mortality events are expected to occur at an irregular frequency. The access road already exists and, as such, may already cause some avifauna mortality through vehicle-avifauna collisions. Like other avifauna species, the magnitude of these effects is also anticipated to be low for SAR. The change in mortality risk will be reversible following completion of the Project. The Project Area has been previously disturbed from the ongoing mineral exploration and forestry in the area.

10.5.3 Summary of Project Residual Environmental Effects

A summary of residual environmental effects that are likely to occur as a result of the Project are summarized in Table 10.20. The significance of residual adverse effects is considered Section 10.6.

Table 10.20 Project Residual Effects on Avifauna

Residual Effect	Residual Effects Characterization							
	Project Phase	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological and Socio-economic Context
Change in Habitat	C	A	L-M	LAA	LT	C	I	D
	O	A	L-M	LAA	MT	C	R	D
	D	P/A	L-M	LAA	MT	C	R	D
Change in Mortality Risk	C	A	L	LAA	ST	IR	R	D
	O	A	L	LAA	MT	IR	R	D
	D	A	L	LAA	MT	IR	R	D

KEY
See Table 10.15 for detailed definitions

Project Phase
C: Construction
O: Operation
D: Decommissioning, Rehabilitation, and Closure

Direction:
P: Positive
A: Adverse
N: Neutral

Magnitude:
N: Negligible
L: Low
M: Moderate
H: High

Geographic Extent:
PA: Project Area
LAA: Local Assessment Area
RAA: Regional Assessment Area

Duration:
ST: Short-term
MT: Medium-term
LT: Long-term
P: Permanent

N/A: Not applicable

Frequency:
S: Single event
IR: Irregular event
R: Regular event
C: Continuous

Reversibility:
R: Reversible
I: Irreversible

Ecological/Socio-Economic Context:
D: Disturbed
U: Undisturbed

10.6 DETERMINATION OF SIGNIFICANCE

The residual environmental effects from the Project on avifauna do not threaten the long term persistence, viability or recovery of an avifauna species (including SAR and SOCC) in the RAA. Nor is the Project predicted to result in residual effects to avifauna that are contrary to or inconsistent with the goals, objectives or activities of recovery strategies, action plans or management plans within the RAA. Project-related activities and emissions may result in some localized, short to long-term effects to avifauna in parts of the Project Area and LAA, primarily as a result of clearing and cutting of vegetation, avifauna collisions with Project traffic, equipment or infrastructure and sensory disturbance. Overall, however, the

Project is not predicted to result in a substantial decline in avifauna abundance or a substantial loss of habitat within this area. Loss in habitat is predicted to be low in magnitude for non-SAR species and moderate in magnitude for SAR species. This is a conservative prediction as it assumes all habitat within the Project Area will be lost and the predicted habitat loss for SAR only just meets the lower threshold for a moderate effect. No identified critical habitat is present in the Project Area, LAA or RAA. The Project is therefore not predicted to jeopardize the overall abundance, distribution or health of SAR. With the implementation of mitigation and environmental protection measures, the residual adverse environmental effects on avifauna are predicted to be not significant

10.7 PREDICTION CONFIDENCE

Confidence in the residual adverse environmental effects and significance predictions for avifauna is high. Factors contributing to high confidence in prediction are:

- The potential environmental effects and effects mechanisms for this Project are common to mining operation and other large construction projects and are generally well understood
- The mitigation measures are well understood and align with standard management practices
- The understanding of existing conditions for avifauna is supported by literature review and field data collected for the Project
- The Project effects on habitat are quantified using GIS and Project Area-specific habitat data
- The assessment employed a conservative approach and methodology to increase the level of confidence, specifically:
  - a conservative-case scenario is used for the predictions of direct and indirect habitat loss (Section 10.3.5)
  - indirect effects are determined as though they were static over time and not influenced by factors such as season, vegetation cover, age and topography

10.8 PREDICTED FUTURE CONDITION OF THE ENVIRONMENT

The Project is in an area with past mining activity, and past and ongoing mineral exploration and forestry activity. Should mineral reserves associated with the Project remain undeveloped, the predicted future condition of avifauna would be relatively unchanged from what is discussed in the existing environment portion of this assessment (Section 10.2). Avifauna populations vary over time because of natural processes including fire, disease, population and community dynamics, and major weather events. Major changes in avifauna populations, communities and distribution could occur over time as a result climate change.

Three avifauna SAR were identified during field surveys in the vicinity of the Project Area including olive-sided flycatcher, common nighthawk and rusty blackbird. Additionally, four SAR, including bank swallow, grey-cheeked thrush, red crossbill and evening grosbeak were identified as potentially occurring near the LAA by other data sources (Section 10.2.3.4). A discussion of population status and threats to these species is provided in Section 10.2.3.4. If the Project were to not proceed, habitat for these species may not be disturbed.

10.9 FOLLOW-UP AND MONITORING

Follow-up and monitoring are intended to verify the accuracy of the environmental effects assessment, assess the implementation and effectiveness of mitigation and the nature of the residual effects and to manage adaptively, if required. Compliance monitoring will be conducted to confirm that mitigation measures are properly implemented.

Specific monitoring programs for avifauna will be developed in consultation with regulators and could include:

- Regular inspection of facilities to determine if birds are nesting on or near anthropogenic structures during Project operation; this will assist in compliance with the MBCA and SARA, and help develop onsite bird control features to deter nesting on or near mine infrastructure
- Follow-up surveys to determine accuracy of effects predictions for SARA-listed species (e.g., olive-sided flycatcher and rusty blackbird) found adjacent to the mine site
- Breeding bird surveys conducted at varying distances from the mine infrastructure to determine accuracy of effects predictions on avifauna

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11.0 CARIBOU

11.1 SCOPE OF ASSESSMENT

Caribou is a valued component (VC) because the species provides ecological, cultural, aesthetic, recreational and economic value to stakeholders including the public, Indigenous groups, local businesses, and government agencies. As caribou is valued by resource users, it is important to maintain a stable or increasing caribou population such that harvesting and traditional activities can continue. The Caribou VC considers the species and its habitat; the latter includes daily, seasonal and annual life requisites necessary for feeding, movement, reproduction, calving, and refuge.

Caribou have the potential to be affected by the Project and caribou is often considered an ‘indicator species’ (ECCC 2018) of the health of the environment. Caribou have the potential to be affected by Project-related changes to vegetation and wetlands (Chapter 9), and to air and water quality (Chapters 5 to 7), through effects such as land clearing or release of chemicals or dust / sediment into the air and water. As such, residual effects related to vegetation and wetlands, atmospheric environment, and surface water VCs were used to inform the assessment of potential Project effects on caribou and their habitat.

The Caribou VC is also linked to:

- Community Health (Chapter 14) – changes in caribou habitat, movement, or mortality risk can affect the availability of caribou for consumption as a country food, which can indirectly affect the health of community members
- Land and Resource Use (Chapter 16) – changes in caribou habitat, movement, or mortality risk have the potential to affect land and resource use associated with hunting and outfitting
- Indigenous Groups (Chapter 17) – changes in caribou habitat, movement, or mortality risk have the potential to affect the current use of land for traditional purposes by Indigenous groups (i.e., for hunting)

11.1.1 Regulatory and Policy Setting

In addition to the *Canadian Environmental Assessment Act, 2012* (CEAA 2012) and the Newfoundland and Labrador *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 which influence the scope of the assessment on caribou. Note that some of the strategies, management plans and areas listed below are not directly related to caribou, yet have been included because management decisions related to habitat and other wildlife species could have indirect effects or implications on caribou (e.g., predation rates).

11.1.1.1 Federal Guidance

The assessment of potential Project-related environmental effects on caribou and their habitat includes consideration of Federal Environmental Impact Statement (EIS) Guidelines and guidance from the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). COSEWIC is an independent body of experts that assesses wildlife according to a broad range of scientific data. The committee reviews status reports on species suspected of being at risk and provides assessments to government and the public. Following review and engagement with affected stakeholders and other groups, the federal Cabinet decides whether those species should receive legal protection under the federal *Species at Risk Act* (SARA). Caribou on the Island of Newfoundland were assessed by COSEWIC in 2014 and designated as Special Concern (COSEWIC 2014), although this population is not currently listed under SARA.

The Regional Assessment Area (RAA) overlaps with Gros Morne National Park, therefore other federal legislation pertaining to the protection of wildlife and their habitat in the RAA include:

- *Canada National Parks Act*
- *National Parks General Regulations*

11.1.1.2 Provincial Guidance

The assessment of potential Project-related environmental effects on caribou and their habitat includes consideration of the Provincial EIS Guidelines and following provincial legislation:

- The NL *Wild Life Act*, RSNL 1990, c W-8, and *Wild Life Regulations*, NLR 1156/1996 and associated orders afford protection of wildlife (including caribou) and prohibits the hunting, taking or killing of wildlife or classes of wildlife, whether in particular places or at particular times or by particular methods, except under license or permit. *The Wild Life Act* allows for the management and the regulation of activities relating to the taking and trading of wildlife, primarily game animals and furbearer species.

Woodland caribou on the Island of Newfoundland are not listed under the Newfoundland and Labrador (NL) *Endangered Species Act* (ESA).

Other provincial legislation, regulations, strategies, and management plans pertaining to the protection of wildlife and their habitat in the RAA include:

- *Wilderness Reserve Regulations*
- *Wilderness and Ecological Reserves Act*
- *Botanical Ecological Reserve Regulations*
- *Provincial Parks Regulations*
- *Forestry Act*
- Provincial Sustainable Forest Management Strategy 2014-2024
- *Glover Island Public Reserve Regulations*
- *King George IV Ecological Reserve Order*
- King George IV Ecological Reserve Management Plan

- *Little Grand Lake Provisional Ecological Reserve Regulations*
- *Little Grand Lake Wild Life Reserve Regulations*
- *Main River Special Management Area Regulations*
- *West Brook Ecological Reserve Order*

The RAA also overlaps with the following provincial management areas:

- Black Bear Management Areas (BBMAs) 3, 4, 7-8,10-13, 15-21, 25, 37 and 41
- Moose Management Areas (MMAs) 3, 4, 7-8,10-13, 15-21, 25, 37 and 41
- Caribou Management Areas (CMAs) 61-64, 66, 67, 69 and 79
- Fur Zones 4, and 7-11
- Lynx Zone A
- Forestry Management Divisions 6, 7, 9-16 and 50
- Main River Waterway Provincial Park

11.1.2 The Influence of Consultation and Engagement on the Assessment

As part of ongoing engagement and consultation activities, Marathon has documented interests and concerns about the Project received from communities, governments, Indigenous groups and stakeholders. An overview of Marathon's engagement activities is provided in Chapter 3. Documented interests and concerns have influenced the design and operational plans for the Project, and the development of the EIS, including the scope of assessment on the VCs. Interests and concerns noted that specifically relate to caribou or routine Project activities that could affect caribou are provided below. Issues and concerns related to potential accidents or malfunctions are described in the assessment of accidental events (Chapter 21).

Questions and concerns raised by Qalipu through Marathon's engagement efforts include:

- Whether Project infrastructure can be relocated to reduce the Project footprint
- Decommissioning, rehabilitation and closure of the Project, including disposition of camp infrastructure at end of mine life and ensuring remediation of the Project Area takes place
- Terrestrial environment including the disturbance of caribou migration routes and the potential for the introduction of invasive plant and wildlife species
- Limitation of access to lands and resources for traditional use.
- Interest in involvement in the environmental monitoring for the Project.

Questions and concerns raised by Miawpukek through Marathon's engagement efforts include:

- The size of the Project footprint
- Tailings, including questions about treatment, accidental events, and rehabilitation and closure
- Acknowledgement that interests of Miawpukek extend beyond caribou and include plants and waterfowl
- Potential impacts on pine marten and caribou migration as a result of increased industrial activity in the Central Region, and potential impacts of the Project on moose and salmon

- Potential impact on Miawpukek land and resource use
- Interest in involvement in environmental monitoring for the Project

Questions and concerns raised by communities and other stakeholders through Marathon's engagement efforts include:

- Potential long-term effects of the Project on fish and wildlife and downstream effects on tourism, and concerns related to the allotment of Project profits being set aside for harm prevention and remediation of the area
- Impacts of the Project to caribou and on moose hunting in the area

Questions and concerns raised by fish and wildlife and civil society organizations through Marathon's engagement efforts include:

- Caribou including understanding the information provided by the Province of NL, the collection of caribou data by Marathon, and the potential impact of noise and waste rock and interference with caribou migration

11.1.3 Boundaries

The scope of the assessment is defined by spatial boundaries (i.e., geographic extent of potential effects) and temporal boundaries (i.e., timing of potential effects). Spatial boundaries for caribou were selected in consideration of the geographic extent over which Project activities, and their effects, are likely to occur on the VC. Temporal boundaries are based on the timing and duration of Project activities and the nature of the interactions with the VC. The spatial and temporal boundaries associated with the effects assessment for caribou are described in the following sections.

11.1.3.1 Spatial Boundaries

The following spatial boundaries were used to assess Project effects, including residual environmental effects, on caribou in areas surrounding the mine site and access road (Figures 11-1 and 11-2):

Project Area: The Project Area encompasses the immediate area in which Project activities and components occur and is comprised of two distinct areas: the mine site and the access road. The mine site includes the area within which Project infrastructure will be located, and the access road is the existing road to the site, plus a 20 metre (m) wide buffer on either side. The Project Area is the anticipated area of direct physical disturbance associated with the construction, operation and decommissioning, rehabilitation and closure of the Project.

Local Assessment Area (LAA): includes a 1 km buffer surrounding the mine site and a 500 m buffer surrounding the access road (Figure 11-1). The LAA was established to reflect the area within which caribou-specific Project effects are most likely to occur, including indirect habitat loss due to sensory disturbance (i.e., displacement or avoidance) (e.g., Benítez-López et al. 2010).

Regional Assessment Area: includes the combined population ranges (28,809 km^2) of the Buchans, Gaff Topsails, Grey River and La Poile Herds (Figure 11-2) as determined by caribou telemetry data obtained from the Newfoundland and Labrador (NL) Department of Fisheries, Forestry and Agriculture – Wildlife Division (NLDFFA-Wildlife Division). The method used to determine the RAA from the telemetry data (Section 11.2.1.3) resulted in a number of small, spatially discrete areas of use (e.g., base of the Northern Peninsula, north of Grand Falls-Windsor), in addition to the comparatively larger 'core' area of use.

11.1.3.2 Temporal Boundaries

The temporal boundaries for the assessment of potential effects on the Caribou VC include:

- Construction Phase – 16 to 20 months, beginning in Q4 2021, with 90% of activities occurring in 2022
- Operation Phase – Estimated 12-year operation life, with commissioning / start-up and mine / mill operation slated to start Q2 2023
- Decommissioning, Rehabilitation and Closure Phase – Closure rehabilitation to occur once it is no longer economical to mine or resources are exhausted

The seasonal distribution of caribou is also an important temporal consideration for the assessment of Project effects on caribou as the movement patterns and seasonal ranges of the assessed herds influence the nature and extent of interactions with the Project.

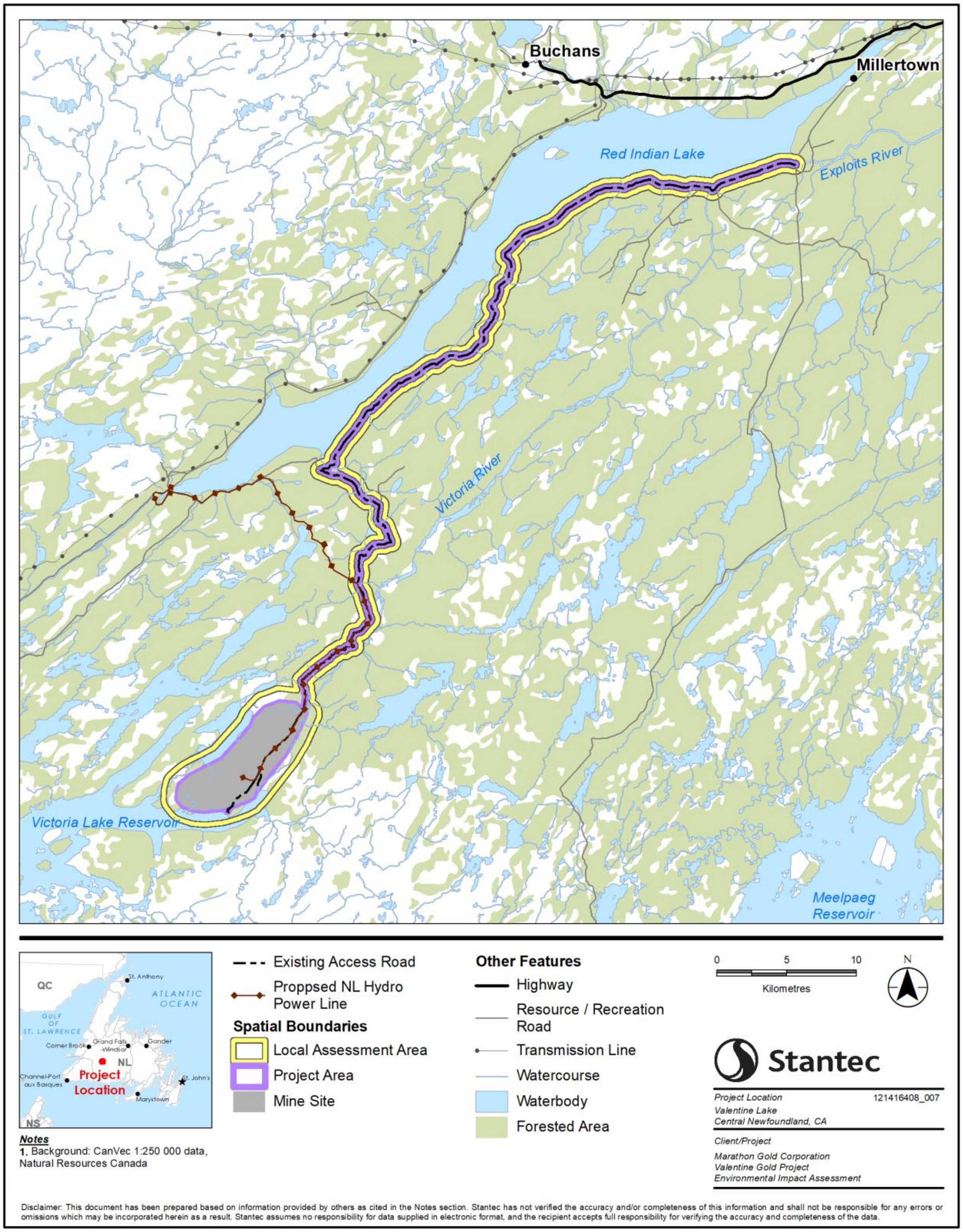

Figure 11-1 Local Assessment Area

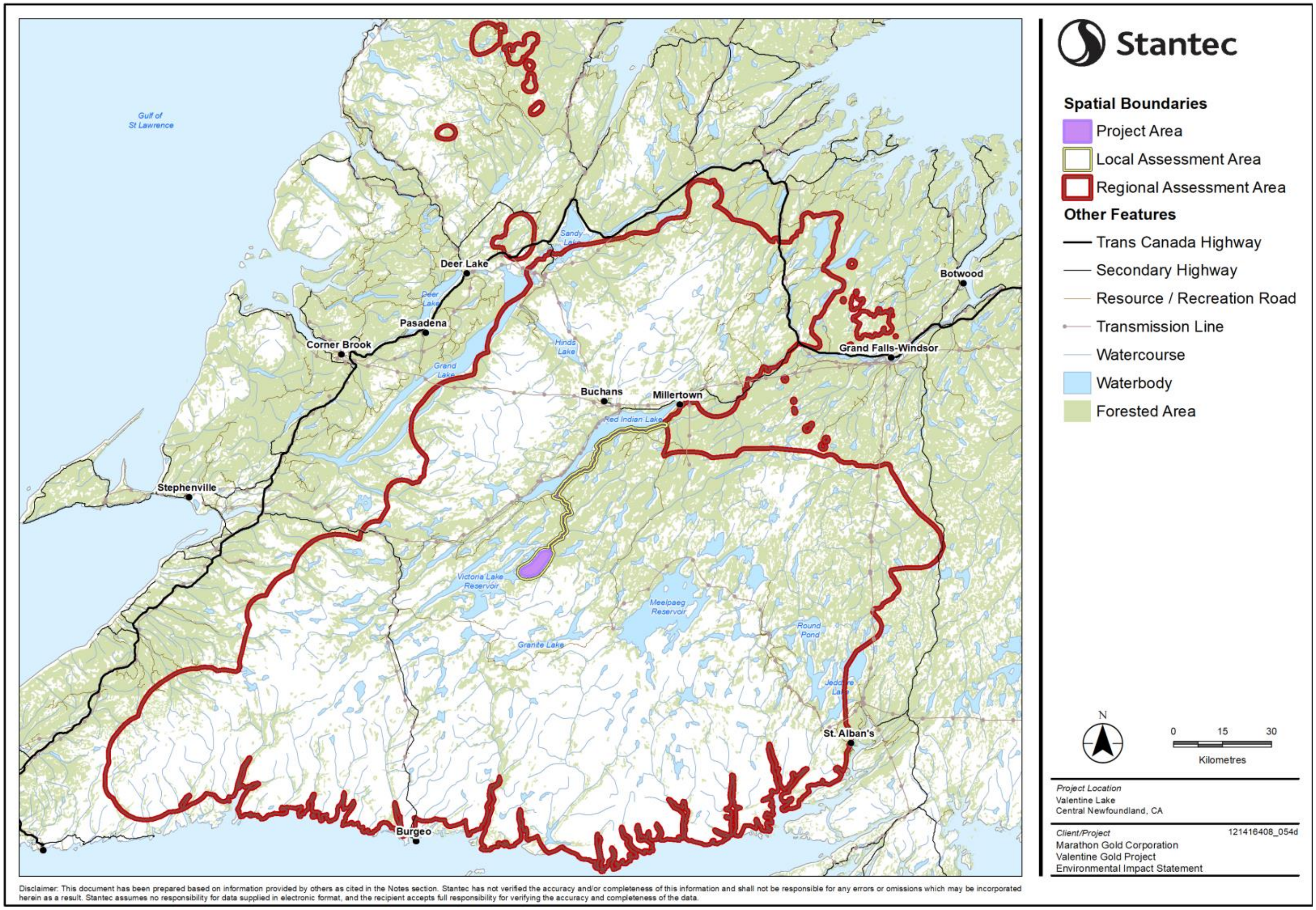

Figure 11-2 Regional Assessment Area

11.2 EXISTING CONDITIONS FOR CARIBOU

A characterization of the existing conditions within the spatial boundaries defined in Section 11.1.3 is provided in the following sections. This includes a discussion of the influences of past and present physical activities on the VC, leading to the current conditions. An understanding of the existing conditions for the VC within the spatial area being assessed is a key requirement in the prediction of potential Project effects provided in Section 11.5.

In consideration of Provincial and Federal EIS Guidelines and discussions with NLDFFA-Wildlife Division, this chapter focuses on the seasonal and annual distribution of the Buchans, Gaff Topsails, Grey River and La Poile herds that potentially interact with the Project Area, LAA and RAA. Note that these four herds are collectively referred to as the assessed herds.

11.2.1 Methods

Existing conditions for caribou and their habitat within the Project Area were compiled from various sources, including a review of available information from literature and provincial databases, communication with NLDFFA-Wildlife Division, Project-specific field studies, an analysis of caribou telemetry data, and a caribou habitat assessment.

11.2.1.1 Literature Review

The following key public resources were used during background reviews to assist in describing existing conditions for caribou:

- Provincial Report on The Newfoundland Caribou (Government of NL 2015)
- Provincial 2020-2021 Hunting and Trapping Guide (Government of NL 2020a)
- Committee on the Status of Endangered Wildlife in Canada (COSEWIC) Assessment and Status Update Report (COSEWIC 2014)
- Labrador-Island Transmission Link Environmental Impact Statement (Nalcor 2012)
- Labrador-Island Transmission Link Caribou and Their Predators (Labrador and Newfoundland) Component Study (Stantec 2012)
- Ecological Land Classification (ELC) and Wildlife Species Habitat Analysis, Alderon Iron Ore Corp (Alderon 2012)

11.2.1.2 Project-Specific Field Studies

Stantec completed several Project-specific field studies on wildlife in the Project Area, LAA and RAA between 2011 and 2020. The results of surveys undertaken for caribou are included in the Baseline Study Appendix (BSA) 2: Woodland Caribou (BSA.2) and include a fall 2019 remote camera caribou survey (BSA.2, Attachment 2-A), a spring 2020 remote camera caribou survey (BSA.2, Attachment 2-B) and a 2020 aerial post-calving survey (BSA.2, Attachment 2-C). In addition, caribou were detected during several other terrestrial field programs. A summary of these studies is provided in Table 11.1 and additional detail is provided in BSA.2 and BSA.7.

Table 11.1 Caribou Field Studies for the Valentine Gold Project

Study	Date	Summary
Caribou Field Studies (BSA.2)		
Fall 2019 Caribou Survey – Remote Cameras (BSA.2, Attachment 2-A)	October 5, 2019 – February 11, 2020	Results from 12 remote cameras on caribou fall migration movement pathways within the Project Area.
Spring 2020 Caribou Survey – Remote Cameras (BSA.2, Attachment 2-B)	March 26 – June 18, 2020	Results from 11 remote cameras on caribou spring migration pathways within the Project Area.
Post-Calving Aerial Survey 2020 (BSA.2, Attachment 2-C)	June 9 – 13, 2020	Aerial survey of post-calving areas to classify resident caribou and Buchans caribou, and provide a population estimate of the Buchans herd on the calving grounds.
Other Wildlife Field Studies (BSA.7) where Caribou were Detected		
Winter Wildlife Survey (BSA.7, Attachment 7-A)	February 28 – March 29, 2013	Aerial track survey, ground-based track survey and deployment of three marten hair snag traps and DNA analysis.
2011 Forest Songbird Surveys at the Valentine Lake Prospect (BSA.7, Attachment 7-B)	June 14 – 18, 2011	Forty-five 10-minute point count surveys were completed. Incidental wildlife observations were also recorded.
2011 Baseline Waterfowl and Waterfowl Habitat Study, Valentine Lake Project (BSA.7, Attachment 7-C)	Breeding waterfowl survey: May 16, 2011 Brood survey: July 7, 2011	Aerial surveys to assess waterfowl utilization, and nesting, breeding and brood rearing habitat preferences. Incidental wildlife observations were also recorded.
Ecosystem Classification and Mapping of the Marathon Gold Corporation Valentine Lake Project, Central Newfoundland (BSA.7, Attachment 7-D)	2013 – 2014	Ecosystem classification based on interpretation of remotely sensed data. Field component included terrain, soil and vegetation surveys, and documentation of incidental wildlife observations.

11.2.1.3 Analysis of Caribou Telemetry Data

Stantec obtained caribou telemetry data from NLDFFA-Wildlife Division for the assessed herds. The data included telemetry locations from Very High Frequency (VHF), ARGOS and Global Positioning System (GPS) collars spanning the period of 1994-2018 (Table 11.2). Collars were deployed by NLDFFA-Wildlife Division, mainly on females.

Table 11.2 Summary of Collars on Assessed Caribou Herds

Herd	Collar Type[A]	Years	Number of Collars			
			Total	Females	Males	Unknown
Buchans	VHF	1994 – 1998	65	45	20	
	ARGOS	2005 – 2011	22	22		
	GPS	2006 – 2018	43	41	2	
Gaff Topsails	ARGOS	2005 – 2011	16	16		
	GPS	2006 – 2013	31	27	4	
Grey River	VHF	1979 – 1986	281	147	132	2
	ARGOS	2004 – 2011	25	25		
	GPS	2006 – 2013	17	17		
La Poile	VHF	1985 – 1990	263	161	100	2
	ARGOS	2004 – 2011	21	21		
	GPS	2006 – 2013	18	18		
		Total	**802**	**540**	**258**	**4**

Notes:
[A] VHF – Very High Frequency radio tracking
ARGOS – tracking using the ARGOS satellite system; collar make – Telonics
GPS – Global Positioning System tracking; collar make – Lotek

Seasonal Analysis

Kernel or range density estimates were used to describe the location, area and seasonal range use of collared caribou. The seasons and dates used for this analysis (Table 11.3) are specific to caribou on the Island of Newfoundland (Emera Newfoundland and Labrador 2013).

Table 11.3 General Seasons for Island Caribou in NL

Season	Seasonal Dates
Winter	December 16 – March 31
Spring Migration / Pre-calving	April 1 – May 19
Calving	May 20 – June 10
Post-Calving Migration / Dispersal	June 11 – June 30
Post-Calving Rearing	July 1 – August 31
Fall Rut	September 1 – October 31
Fall Migration / Dispersal	November 1 – December 15

Source: Emera Newfoundland and Labrador (2013)

Seasonal analysis included ARGOS and GPS locations only. VHF locations were not included as they were not available for all herds, they accounted for less than 2% of locations in each season, and had an irregular fix-rate (i.e., elapsed time between locations). ARGOS and GPS data were available for all herds and had a fix-rate of one hour (ARGOS) and two hours (GPS). The data were quality reviewed to remove locations that were either low quality or faulty (e.g., Fix Status ≥ 2). Caribou distribution was analyzed by season (Table 11.3), and ranges (or kernels) were estimated from telemetry data using a geographic information system (GIS). The seasonal range calculations included only collared animals with at least 50 locations in the season of interest based on recommendations for wildlife kernel analyses (Seaman et al. 1999; Barg et al. 2005; Tri et al. 2014).

Caribou seasonal utilization distributions were determined using the kernel density estimation method in ArcGIS™ v.10.7.1 (ESRI 2017) using Kernel Density in the Spatial Analyst Tools in ArcGIS™. Two contour intervals (isopleths) were calculated for each seasonal range. A 50% contour area was calculated to represent the area where there is a 50% probability of a collared caribou occurring (i.e., areas with higher densities of locations). Additionally, a larger 95% contour area was calculated to represent the area where there is a 95% probability that a collared caribou occurs. The 50% contour area is a representation of the "core area" where caribou live, and the 95% contour area is a representation of the estimated seasonal home range boundary. Smoothed cross-validation was used as the smoothing parameter for the calculation. Figures were created for each season illustrating the collared caribou seasonal range in relation to the Project Area and LAA (Section 11.2.2).

Migration Path Analysis

Data Preparation

Prior to the migration analysis, the telemetry data for the Gaff Topsails and Buchans herds were analyzed to investigate movement between the seasonal ranges. Specifically, the winter ranges (i.e., December 16 to March 31) were compared to the summer ranges (i.e., May 20 to August 31). Although there was a shift in distribution between the summer and winter ranges for the Gaff Topsails herd, the summer and winter ranges maintained a high degree of overlap. Additionally, both the summer and winter ranges occurred north of the Project and did not overlap with the Project Area. As the intent of the analysis was to describe the migration patterns with respect to the Project Area and the Gaff Topsails did not undergo a migration between two distinct ranges, the migration of the Gaff Topsails herd was not analyzed further.

Although the data for the Buchans herd was collected using a variety of collar types (including VHF, ARGOS and GPS), the migration analysis was limited to GPS collars as the collars record locations at the interval necessary to identify fine-scale movements relative to the Project (i.e., every 1 to 2 hours). Migration paths were identified using dates for seasonal migration periods determined by NLDFFA-Wildlife Division (Emera Newfoundland and Labrador 2013), which included April 1 to May 19 (spring migration / pre-calving) and November 1 to December 15 (fall migration / dispersal) (Table 11.3).

For the Buchans herd, GPS-collared caribou were excluded from the migration analysis if one of the following applied:

- GPS-collared caribou did not migrate (i.e., summer and winter ranges overlapped [n = 1])
- GPS-collared caribou locations did not include the entire migration period (i.e., 49-day spring migration or 45-day fall migration [n = 6])
- GPS-collared caribou did not interact with the mine site (i.e., migration path or home range did not overlap the Project LAA) [n = 3])

Except for two caribou that were collared in 2015 and programmed to record locations every hour, the remaining GPS-collars were programmed to record locations every two hours. Spring migration paths were identified using 29,578 GPS locations collected from 14 GPS-collared caribou between 2007 and 2012, and 13,379 GPS locations from 16 GPS-collared caribou during 2016 and 2017. Fall migration paths were identified using 30,691 GPS locations collected from 14 GPS-collared caribou between 2006 and 2012, and 19,963 GPS locations from 16 GPS-collared caribou between 2015 and 2017. A total of 74 spring and 93 fall migration paths from 30 GPS-collared caribou were used in the migration analysis described below.

Migration Analysis

Dynamic Brownian bridge movement models (dBBMM) (Kranstauber et al. 2012) were used to estimate utilization distributions (UD) for individual GPS-collared caribou during the spring and fall migration periods. Brownian bridge movement models (BBMM) estimate the missing movement path between two sequential locations (Horne et al. 2007). Similar to the BBMM, the dBBMM provides a probabilistic estimate of animal occurrence at each grid cell within the migration path by considering the distance and time between successive locations as well as location error and uncertainty of the movement path between locations (Horne et al. 2007; Kranstauber et al. 2012). The dBBMM represents an improvement over the BBMM because the Brownian motion variance (σ^2_m), which measures how irregular the movement path is, varies along the path of the animal resulting in more accurate estimates of the UD and changes in behaviour along a movement route (Kranstauber et al. 2012; Byrne et al. 2014). The dBBMM determines whether there is a behavioral change in movement (speed) by comparing model fit using estimates of σ^2_m within a sliding window of locations. A window size of 31 locations and margin of 11 locations were used in the analysis based on Kranstauber et al. (2012).

The fix success rate, as well as the 3D fix success rate, was high (>99%) for both spring and fall migration periods. As such, a 20 m location error was used in the analysis because 3D fixes typically have an estimated error that is less than 20 m (Di Orio et al. 2003). A 100 x 100-m grid cell was used to generate the dBBMM, which provided a reasonable level of spatial resolution and computer processing time. For each pixel within the migration path a UD was calculated, which represented the probability that an individual GPS-collared caribou was located within that grid cell during their spring or fall migration periods relative to other grid cells within the migration path. Because most caribou had more than one spring or fall migration recorded, probability cell values were summed and then rescaled to sum to 1 to represent one UD for each collared caribou within each season (Sawyer et al. 2009). A dBBMM was fit to each individual GPS-collared caribou for each season using the 'move' package (Kranstauber et al. 2020) in program R (R Core Team 2019).

For the purpose of this assessment, 'migration corridor' refers to an area used for migration at the population-level. The migration corridor may contain various smaller 'migration paths', which are used by individual caribou. A path may be used by a single individual or several caribou. Although the GPS telemetry data included individuals from two different sampling periods (2006 to 2012 and 2015 to 2017), the UD from each collared caribou were combined to identify a population-level migration corridor for each season because there was relatively strong fidelity to migration paths across years. A population-level migration corridor was estimated by summing the UD for each collared caribou and rescaling cell values to sum to 1 (Sawyer et al. 2009). The UD values for each population-level spring and fall migration corridor was classified into quartiles where the upper 25% quartile of the UD for each seasonal migration period was considered to be areas of high use and assumed to represent 'migratory stopovers' (e.g., resting, foraging) similar to Sawyer et al. (2009) and Sawyer and Kauffman (2011). The remaining quartiles (25-50% and 50-75%) were considered connecting movement pathways between stopover sites, and the last quartile (75-99%) represented relatively low use areas. This collection of migration paths identified by the dBBMM is referred to as a migration corridor.

As a migration corridor was defined for the Buchans herd only, the possibility of GPS-collared caribou in the Buchans herd using priority or preferred travel paths during spring and fall migration was explored. The number of individual migration paths that occurred in each 100 x 100-m grid cell was calculated as a proportion of the total number of GPS-collared caribou (n=30) following Sawyer et al. (2009). A preferred path was defined as one used by > 15% of the GPS-collared caribou. For the portion of a preferred path that overlapped the Project Area, the proportion of caribou using the path was determined.

The length of the migration corridor was defined using the results of the analysis. Based on the distribution of the areas of use identified by the dBBMM, boundaries were delineated between the seasonal ranges at both ends of the distinct population-level migration corridor. In the north, the migration corridor was separated from the calving range by the boundary between the elevated Buchans Plateau and the lower, forested area. In the south, the migration corridor was separated from the winter range by the Grey River. The dates of spring and fall migration through the Project Area were determined from the telemetry data.

11.2.1.4 Caribou Habitat Assessment

Habitat types in the LAA were determined from the ELC (BSA.7, Attachment 7-D), which included a desktop analysis of satellite imagery supported by soils and vegetation field surveys. Eleven satellite images (RapidEye, 5 m resolution, multispectral) of the ELC Area (ELCA) (1,830.6 km^2) (Figure 11-3) were processed and adjusted with ortho-corrected aerial images. Ecotypes were classified based on various characteristics including terrain, soils, moisture and nutrient regime, and plant species richness.

Discussion of habitat type availability in this chapter refers to the ELCA. The ELCA covers more than 99% of the Project Area and 97% of the LAA (Figure 11-3). The area of the Project Area and LAA outside the ELCA is restricted to a small portion of the site access road at its northern-most extent (i.e., furthest from the mine site) and is negligible in the context of assessing potential Project effects on the VC. An analysis of the remaining portion of the LAA was completed, however it could not be combined with the ELCA as the methods are not comparable. A detailed explanation of this analysis is provided in Chapter 9, Section 9.2.1.1.

Habitat suitability was assessed for caribou based on identified habitat requirements from the literature review, field studies, telemetry locations during migration (Buchans herd only) and discussions with experts. The identification of caribou-habitat associations from the literature were based on a range of approaches used within those studies, including Chi-square analysis and Bonferroni z-statistics (Chubbs et al. 1993), mechanistic modelling (Bastille-Rousseau et al. 2015; Bastille-Rousseau 2018), and resource selection function [RSF] models (Rettie and Messier 2000; Mahoney and Virgl 2003; Fortin et al. 2008; Stewart 2016). Based on this information, each ELC habitat type present in the Project Area and LAA was evaluated in consideration of its ability to provide structural and compositional elements, and forage availability, for caribou life requisites. Seasonal habitat requirements such as foraging, breeding, calving or migration were also considered. Habitat suitability was ranked based on the availability of three critical elements: forage, refuge and habitat used during migration.

ELC habitat types were assigned one of three value ratings: high, moderate or low. High value habitat types provide an abundance of all three critical elements (forage, refuge and habitat used during migration); moderate habitat types provide an abundance of one or two of the critical elements; and low value habitat types provide marginal forage or refuge, or are rarely used during migration. The evaluation of habitat suitability provides an overview of the potential for portions of the Project Area and LAA to support caribou.

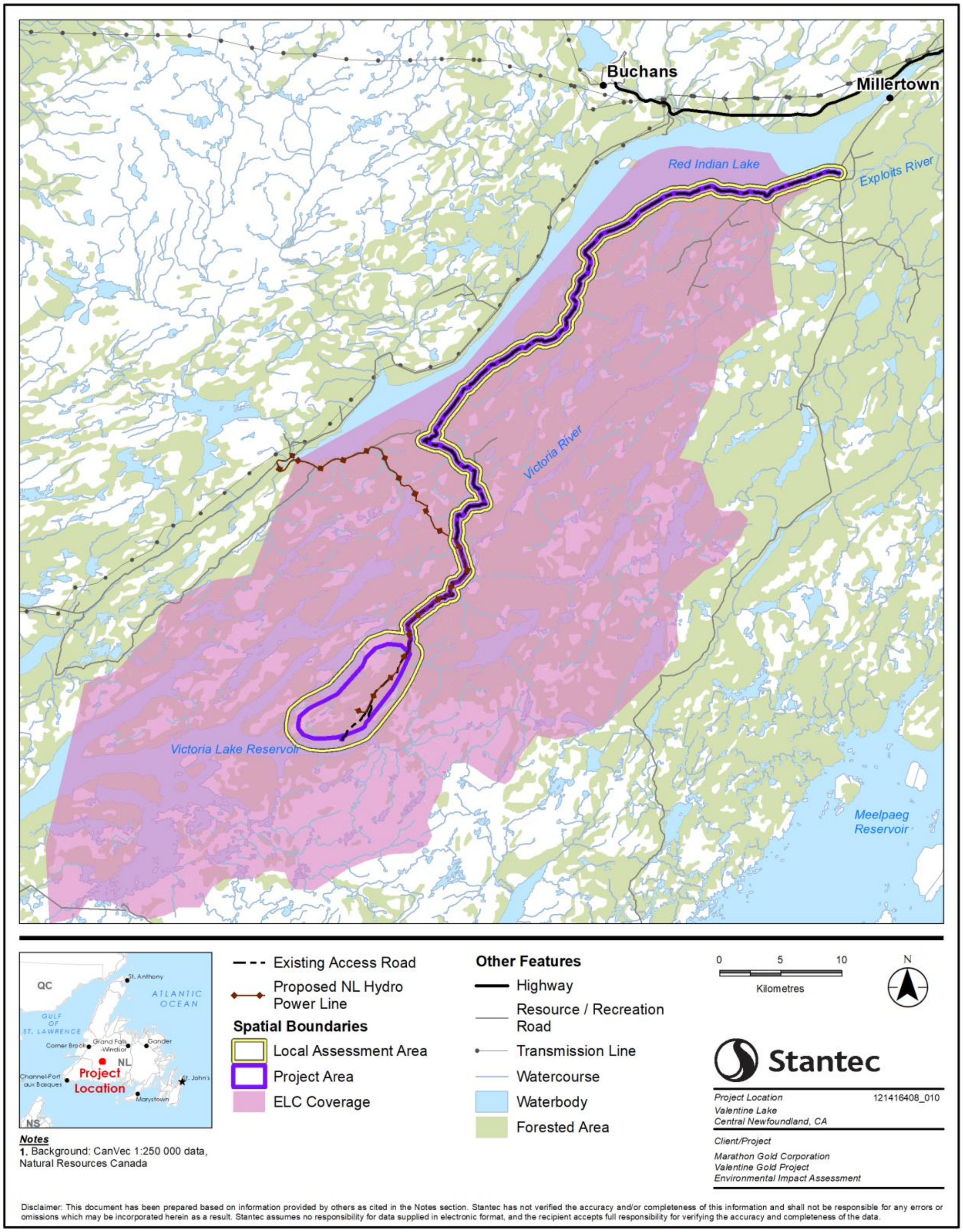

Figure 11-3 Coverage of ELC Data and Overlap with Project Area and LAA

11.2.2 Overview

The Project is in rural central Newfoundland in the Red Indian Lake Subregion of the Central Newfoundland Forest Ecoregion, which covers most of the central and northeastern portions of the Island of Newfoundland. This region is characterized by boreal forest comprised primarily of coniferous trees and is influenced by a continental climate with colder winters and warmer summers compared to coastal areas. The area is characterized as a rolling landscape with domed bogs and dense forest. Elevation within the LAA (calculated in ArcGIS™ v.10.7.1 [ESRI 2017]) ranges from approximately 160 to 440 m above sea level (masl).

The distribution of assessed caribou herds also occurs within the Maritime Barrens Ecoregion and the Long Range Barrens Ecoregion. Within the Maritime Barrens Ecoregion, caribou occur in the South Coast and Central Barrens Subregions, which have extensive barrens. While both subregions experience fog, strong winds and low temperatures in the summer, the South Coast Subregion has much milder winters than the interior Central Barrens Subregion, although both receive considerable snowfall which persists through the winter (PAA 2008a, 2008b). Vegetation in both subregions consists primarily of stunted balsam fir and dwarf shrub heaths. Within the Long Range Mountains Ecoregion, caribou occur in the Southern Long Range and Buchans Plateau / Topsails Subregions. Elevation in both subregions ranges from approximately 200 to 650 masl, and string bogs and string fens are common (PAA 2008c, 2008d).

Twelve ecosystem units were identified within the LAA, with eleven occurring in the Project Area (Table 11.4). Upland areas are dominated by coniferous forests (i.e., Balsam Fir Forest and Black Spruce Forest), Alder Thicket and Mixedwood Forest. Lowland sites consist of open peatlands (i.e., Shrub / Graminoid Fen and Shrub Bog) and treed wetlands (i.e., Wet Coniferous Forest).

Table 11.4 Ecosystem Units within the Project Area, LAA and ELCA

Ecosystem Units	Description	Area in Project Area[A] (km^2 / %)	Area in LAA[A] (km^2 / %)	Area in ELCA[A] (km^2 / %)
Alder Thicket	Alder-dominated communities on moist seepage slopes and riparian areas	2.2 / 6.5	11.9 / 9.3	97.4 / 5.3
Anthropogenic	Areas currently or historically subject to intense levels of human disturbance and use (does not include areas regenerating from forest management)	1.9 / 5.4	2.5 / 1.9	8.2 / 0.5
Balsam Fir Forest	Dry to moist and sometimes wet conifer-dominated forests	6.2 / 18.0	15.1 / 11.9	126.9 / 6.9
Black Spruce Forest	Dry to moist and sometimes wet conifer-dominated forests	4.3 / 12.5	17.6 / 13.9	233.1 / 12.7
Exposed Sand / Gravel Shoreline	Sparsely vegetated and/or un-vegetated shorelines	-	0.6 / 0.5	2.8 / 0.2

Table 11.4 Ecosystem Units within the Project Area, LAA and ELCA

Ecosystem Units	Description	Area in Project Area[A] (km² / %)	Area in LAA[A] (km² / %)	Area in ELCA[A] (km² / %)
Kalmia-Black Spruce Woodland	Dry to moist and sometimes wet stunted tree and shrub / heath dominated communities	3.6 / 10.3	8.6 / 6.8	208.8 / 11.4
Mixedwood Forest	Mesic to moist forests with high deciduous component	6.0 / 17.3	18.9 / 14.9	179.3 / 9.8
Open Wetlands	Very moist to wet shrub / herb dominated peatlands	4.6 / 13.3	11.2 / 8.8	280.3 / 15.3
Open Water	Waterbodies (lakes, ponds, rivers and streams)	1.3 / 3.7	21.8 / 17.2	408.5 / 22.3
Regenerating Forest	Forests regenerating as a result of influences such as harvesting, fire and windthrow	2.0 / 5.6	12.5 / 9.9	139.5 / 7.6
Riparian Thicket	Shrub thickets located in transitional areas and subject to periodic flooding	0.2 / 0.4	0.6 / 0.5	15.1 / 0.8
Wet Coniferous Forest	Very moist to wet conifer forests	2.5 / 7.2	5.7 / 4.5	130.7 / 7.1
	Total	**34.7 / 100**	**127.0 / 100**	**1,830.6 / 100**

Notes:
[A] Numbers are rounded to one decimal place. Areas and percentages may not add up to the total due to rounding
Values pertain to the portion of the Project Area and LAA within the ELCA
Ecosystem unit descriptions from BSA.7, Attachment 7-D

11.2.2.1 Life History and Distribution

Woodland caribou are distributed across northern North America from Alaska to the Island of Newfoundland and are generally associated with mature, lichen-rich, boreal forest, barrens, bogs and fens. Under the federal *Species at Risk Act* (SARA), woodland caribou on the Island of Newfoundland are recognized as a distinct population (Newfoundland Population) (COSEWIC 2014). While considered sedentary (Government of NL 2009), some herds undergo seasonal migrations (Government of NL 2015). Caribou are distributed over much of the Island of Newfoundland, occurring on the Northern Peninsula, Central and Eastern Newfoundland and on the Avalon Peninsula (Government of NL 2015). The caribou population on the Island of Newfoundland has decreased by approximately 60% since the late 1990s (COSEWIC 2014; Government of NL 2015). While woodland caribou on the Island of Newfoundland are not listed under the federal SARA or the provincial *Endangered Species Act* (ESA), they are considered of Special Concern by COSEWIC (COSEWIC 2014).

On the Island of Newfoundland, the caribou population includes several sub-populations that are differentiated based on annual movement patterns, spatial affiliations and genetic structure (Wilkerson

2010; Government of NL 2015). The Project, situated in west-central Newfoundland, is within the South Coast sub-population range (Wilkerson 2010; Schaefer and Mahoney 2013; Government of NL 2019a). The South Coast sub-population is comprised of several herds which share winter ranges near the south coast between Burgeo and the Connaigre Peninsula (Weir et al. 2014), yet have separate calving and summer ranges. The RAA is based on the ranges of the following South Coast sub-population herds: Buchans, Grey River, Gaff Topsails and La Poile (Government of NL 2019a, 2020a). Collectively, these herds represent approximately 36% of the caribou population on the Island of Newfoundland (Government of NL 2019a).

Caribou were considered abundant on the Island of Newfoundland during the early 1900s. However, populations declined rapidly between 1915 and 1920 (Government of NL 2015), possibly as a result of the introduction of a parasite associated with reindeer (Ball et al. 2001). Following this decline, caribou herds remained in relatively low numbers until the 1980s (Government of NL 2015). By the mid-1990s, the population had returned to historical levels, peaking in the year 2000 at 94,000 caribou (Government of NL 2015) with a density of approximately 150 caribou/100 km^2 (Thomas and Gray 2002). Since that time, numbers have declined to approximately 30,000 caribou (NLDFLR in Randell 2019), which has led to hunting closures in some Caribou Management Areas (CMAs) (e.g., Avalon Peninsula in 2002 [Government of NL 2002], Grey River in 2008 [Government of NL 2008], and Northern Peninsula in 2019 [Government of NL 2019b]). The Project Area overlaps with the Grey River CMA. Recent population estimates indicate that the Grey River, Gaff Topsails and La Poile herds have decreased by 60-80% compared to population peaks recorded from the late 1980s (Table 11.5). Recent surveys indicate that population trends for the assessed caribou herds may be stabilizing (Table 11.5) (Government of NL 2019a).

Table 11.5 Population Estimates for Assessed Caribou Herds

Herd	Buchans	Gaff Topsails	Grey River	La Poile
Period of Population Increase				
1960[A]	450+		1,200	500
1962[A]	1,000		1,300	650
1963[A]	643		1,800	692
1964[A]	1,341		1,772	
1965[A]	892		2,400	800
Period of Peak Population				
1986[B]				8,569 (8,105-9 089)[C]
1987[B]			9,973 (8,089-13,001)[C]	
1988[B]				11,176 (10,478-12,001)[C]
1989[B]		4,664 (3,984-5,813)[C]		

Table 11.5 Population Estimates for Assessed Caribou Herds

Herd	Buchans	Gaff Topsails	Grey River	La Poile
1992[B]				8,861 (7,817-10,342)[C]
1997[D]				10,565 (±1,908)[E]
Period of Population Decrease				
2007[F]	4,474 (±992)[G]	2,183 (±444)[G]	1,223 (±219)[G]	5,612 (±867)[G]
2011[F]	4,651 (±743)[G]	1,890 (±244)[G]	2,133 (±165)[G]	4,197 (±642)[G]
2016[H]	4,149	1,688	1,945	3,304
2019[H]	4,112	1,824	2,022	3,154
Percent of Caribou Population on Island of Newfoundland (%)[I, J]	13.7%	6.1%	6.7%	10.5%
Year of Peak Population		1996[K]	1991[K]	1988[K]

Notes:
Empty cells = no information available
[A] Bergerud 1971 – strip transects survey from fixed wing
[B] Mahoney et al. 1998 – mark-resight survey from helicopter; Petersen Population estimator
[C] 95% Confidence Interval
[D] Mahoney et al. 2011
[E] 90% Confidence Interval
[F] Government of NL 2020c – spring survey, strip transect survey
[G] Confidence Interval
[H] Government of NL 2020c – winter survey, mark-resight survey
[I] Percentages are based on estimate of 30,000 caribou on Island of Newfoundland in 2019 (NLDFLR in Randell 2019)
[J] Numbers rounded to one decimal place.
[K] Bastille-Rousseau et al. 2016

Woodland caribou require large interconnected, lichen-rich, mature coniferous forests interspersed with barrens and wetlands (Environment Canada 2012; Weir et al. 2014; Government of NL 2020b). Lichens are the most important vegetation for woodland caribou (Government of NL 2020b) and are consumed as forage in all seasons (Boertje 1984; Thomas et al. 1994; Thompson et al. 2015). Caribou also consume mosses and shrubs, as well as some herbs and grasses (Government of NL 2015), and their diet varies seasonally as follows:

- Winter: primarily terrestrial lichens with some use of arboreal lichens, shrubs (e.g., sheep-laurel [*Kalmia angustifolia*], leatherleaf [*Chamaedaphne calyculata*], Labrador tea [*Rhododendron groenlandicum*]), graminoids, forbs and bryophytes (Bergerud and Russell 1964; Bergerud 1972; Boertje 1984; Thomas et al. 1994; Thompson et al. 2015; Shaefer et al. 2016).
- Spring: primarily leafy-green vegetation such as shrubs (e.g., alder species [*Alnus sp*.], Rhodora [*Rhododendron canadense*], lowbush blueberry [*Vaccinium angustifolium*], sweet gale [*Myrica gale*], birch species [*Betula sp.*], leatherleaf, sheep-laurel, bog laurel [*Kalmia polifolia*], Labrador tea), and also includes forbs (e.g., cloudberry [*Rubus chamaemorus*], bunchberry [*Cornus canadensis*]),

graminoids, lichens and bryophytes (Bergerud and Russell 1964; Bergerud 1972; Boertje 1984; Thomas et al. 1994; Thompson et al. 2015; Schaefer et al. 2016).

- Summer: mostly shrubs (e.g., Rhodora, blueberry, sweet gale, chuckley pear [*Amelanchier bartramiana*], birch species, Labrador tea, sheep-laurel, bog laurel, leatherleaf) and forbs (e.g., bunchberry, bottlebrush [*Sanguisorba canadensis*]), and some graminoids and lichens (Bergerud and Russell 1964; Bergerud 1972; Boertje 1984; Thomas et al. 1994; Thompson et al. 2015; Schaefer et al. 2016).
- Fall: primarily lichens and also shrubs (e.g., Labrador tea, sheep-laurel, bog laurel, leatherleaf, blueberry), forbs, graminoids, mosses, and occasionally fungi (Bergerud and Russell 1964; Bergerud 1972; Boertje 1984; Thomas et al. 1994; Thompson et al. 2015; Schaefer et al. 2016).

Research on the Island of Newfoundland found that when caribou populations were declining in the 2000s, caribou diets showed an increase in the proportion of mosses consumed, and a decrease in the proportion of shrubs, graminoids and lichens consumed (Schaefer et al. 2016). The shift in diet to low-quality forage indicates that the availability of preferred forage was limited by high caribou density (Schaefer et al. 2016).

Caribou are polygynous, with males corralling females into harems during the mating season (COSEWIC 2014). Females can begin reproducing at two or three years old (Bergerud 1971; COSEWIC 2014), and males can breed at 1.5 years old (Government of NL 2020b), although they generally do not have the maturity and dominance to breed successfully until approximately four years old (Bergerud 1974). Mating occurs in early to late October during the rut. Gestation lasts approximately seven months, with calves being born in June. Although females continue to nurse through fall or early winter, calves are generally reliant on natural forage within 45 days (Shefferly 2000). Caribou live approximately 12 to 15 years, with a maximum documented life span of 17 years (Neville, J., NLDEC in COSEWIC 2014; Canadian Geographic n.d.).The assessed caribou herds undergo seasonal movements between ranges and intermix on winter ranges with other herds. The Buchans herd moves between ranges and migrates from central Newfoundland during spring to wintering areas on the south coast. The Buchans herd has an overall range of approximately 15,650 km^2 between Sandy Lake to the north and the south coast of the Island of Newfoundland, and between Highways 480 and 360 (Figure 11-4). The calving and post-calving ranges occur primarily north of the Project Area, while the other seasons include range near the south coast (Figure 11-5). The sizes of the seasonal ranges are provided in Table 11.6. The range of the Gaff Topsails herd (approximately 5,685 km^2) also occurs between Sandy Lake and the Twin Lakes in the north and Star Lake in the south (Figure 11-6). Based on available telemetry data, the Gaff Topsails herd may have smaller seasonal movements within the range and did not migrate south through the Project Area (Figure 11-7).

Table 11.6 Areas† of Seasonal Use by Collared Caribou from the Assessed Caribou Herds

Season	Buchans[A]		Gaff Topsails[B]		Grey River[C]		La Poile[D]	
	Area[E] in km² (n = no. of collared caribou)							
	50% kernel	95% kernel	50% kernel	95% kernel	50% kernel	95% kernel	50% kernel	95% kernel
Winter	2,589 (n=47)	9,493 (n=47)	1,087 (n=32)	3,403 (n=32)	1,958 (n=23)	7,138 (n=23)	1,480 (n=29)	5,018 (n=29)
Spring Migration / Pre-Calving	4,481 (n=36)	14,382 (n=36)	953 (n=28)	3,443 (n=28)	1,857 (n=16)	10,389 (n=16)	3,566 (n=18)	9,218 (n=18)
Calving	270 (n=35)	1,351 (n=35)	424 (n=28)	1,887 (n=28)	777 (n=16)	4,579 (n=16)	530 (n=18)	2,363 (n=18)
Post-Calving Migration / Dispersal	399 (n=33)	1,128 (n=33)	481 (n=28)	1,858 (n=28)	605 (n=16)	3,611 (n=16)	513 (n=18)	2,243 (n=18)
Post-Calving Rearing	1,517 (n=37)	4,834 (n=37)	890 (n=28)	3,261 (n=28)	454 (n=16)	2,990 (n=16)	1,003 (n=18)	2,900 (n=18)
Fall Rut	617 (n=39)	2,526 (n=39)	461 (n=27)	2,030 (n=27)	271 (n=16)	2,238 (n=16)	575 (n=18)	2,873 (n=18)
Fall Migration / Dispersal	2,730 (n=41)	7,640 (n=41)	614 (n=27)	2,117 (n=27)	950 (n=16)	4,823 (n=16)	1,718 (n=18)	5,682 (n=18)

Notes:
† Area calculated using only collars with more than 50 locations in the season
A Telemetry data from 2005 – 2018
B Telemetry data from 2006 – 2013. Gaff Topsails data from 2005 was not included in the calculation because the collars had less than 50 locations per season.
C Telemetry data from 2006 – 2013. Grey River data from 2005 was not included in the calculation because the collars had less than 50 locations per season.
D Telemetry data from 2006 – 2013. La Poile data from 2005 was not included in the calculation because the collars had less than 50 locations per season.
E Areas rounded to integers.

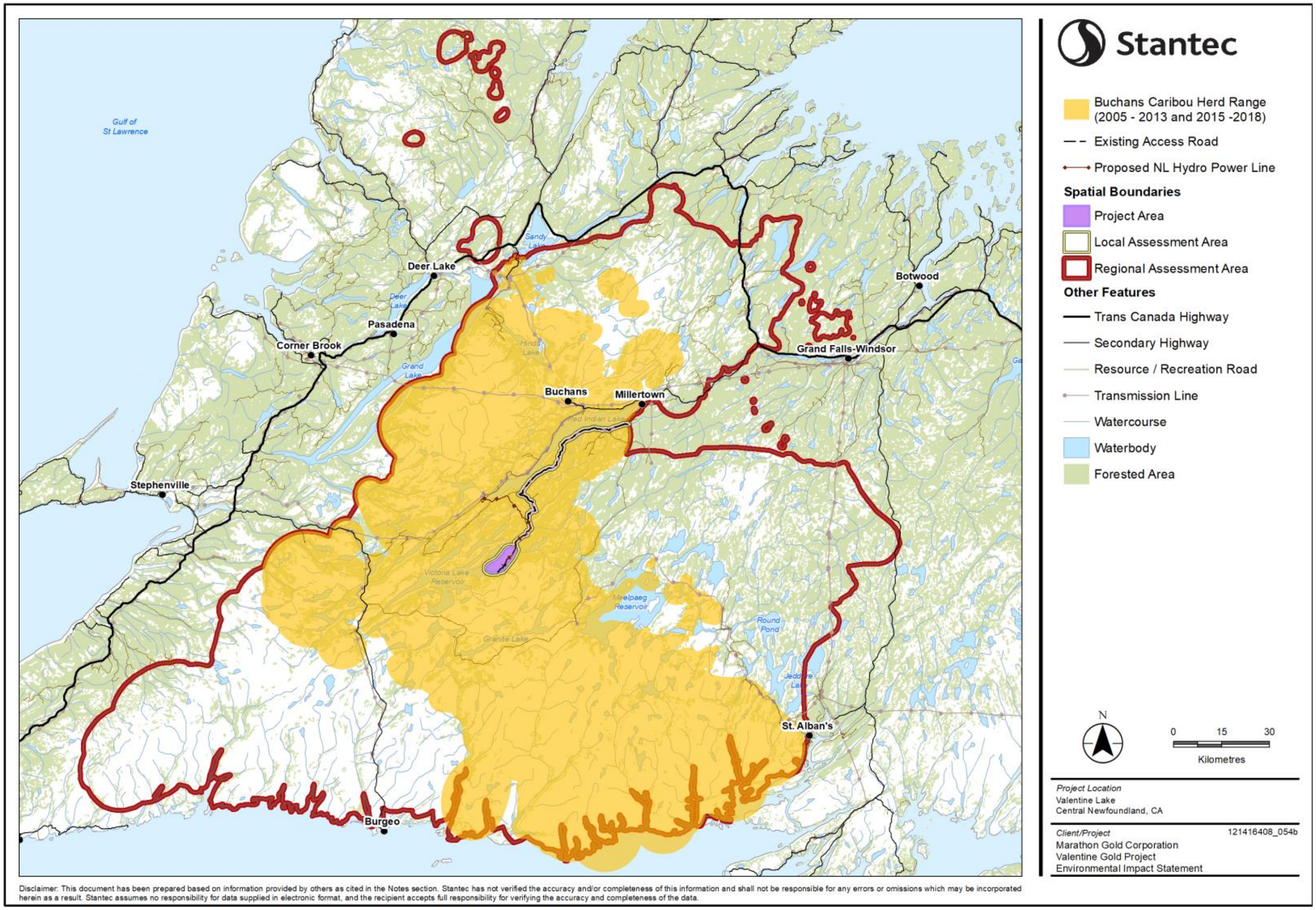

Figure 11-4 Distribution of the Buchans Caribou Herd

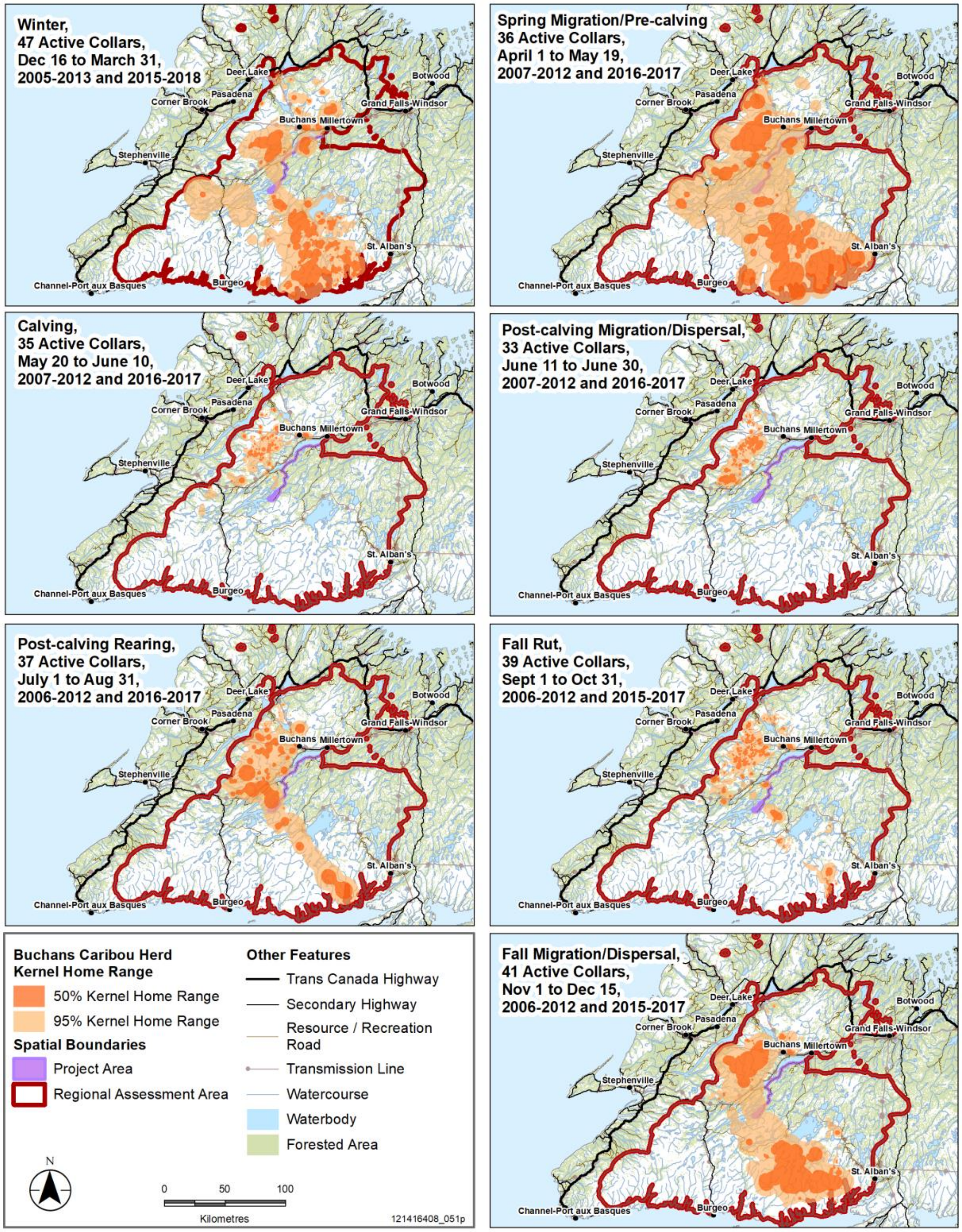

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Figure 11-5 Seasonal Ranges for the Buchans Caribou Herd

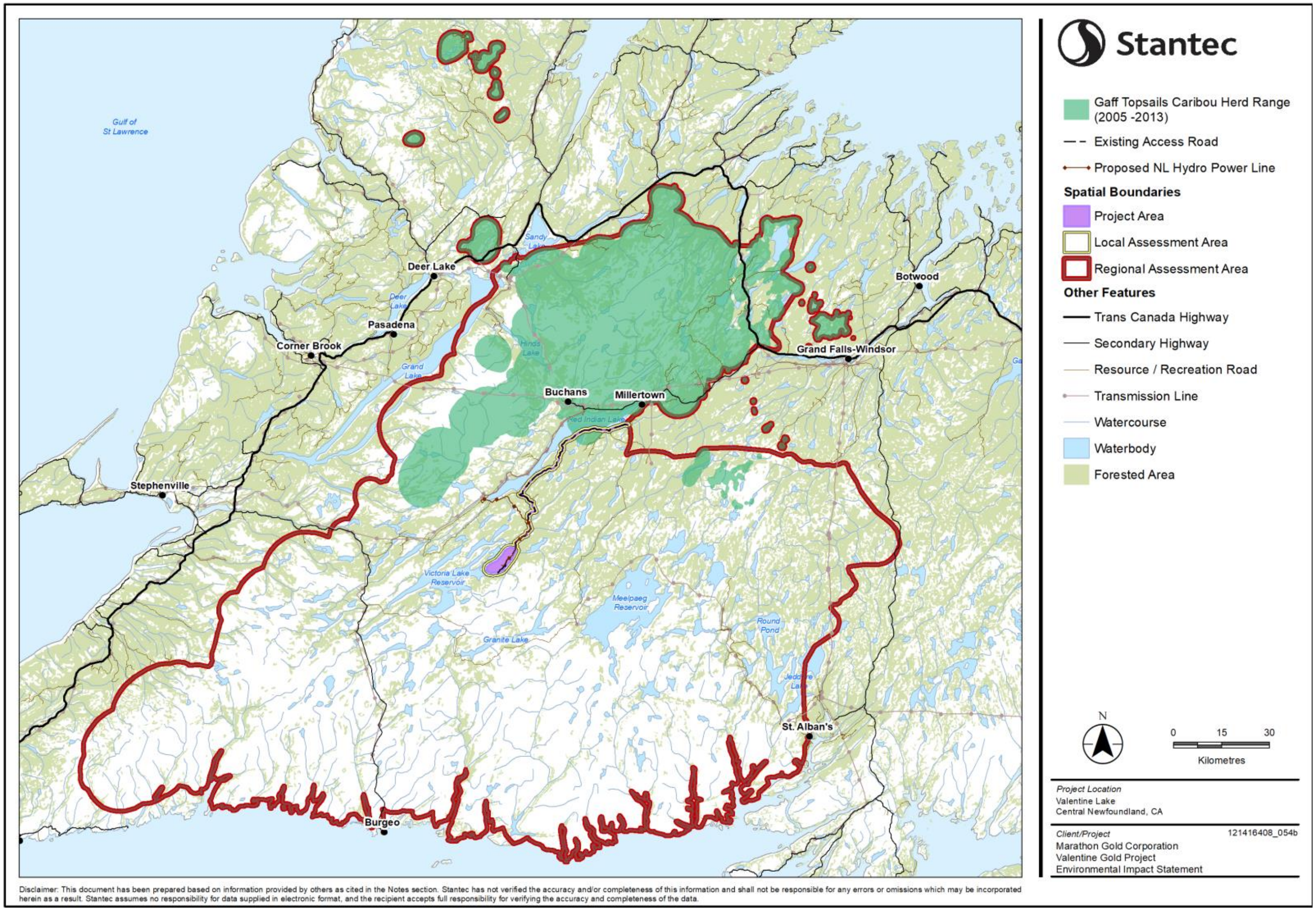

Figure 11-6 Distribution of the Gaff Topsails Caribou Herd

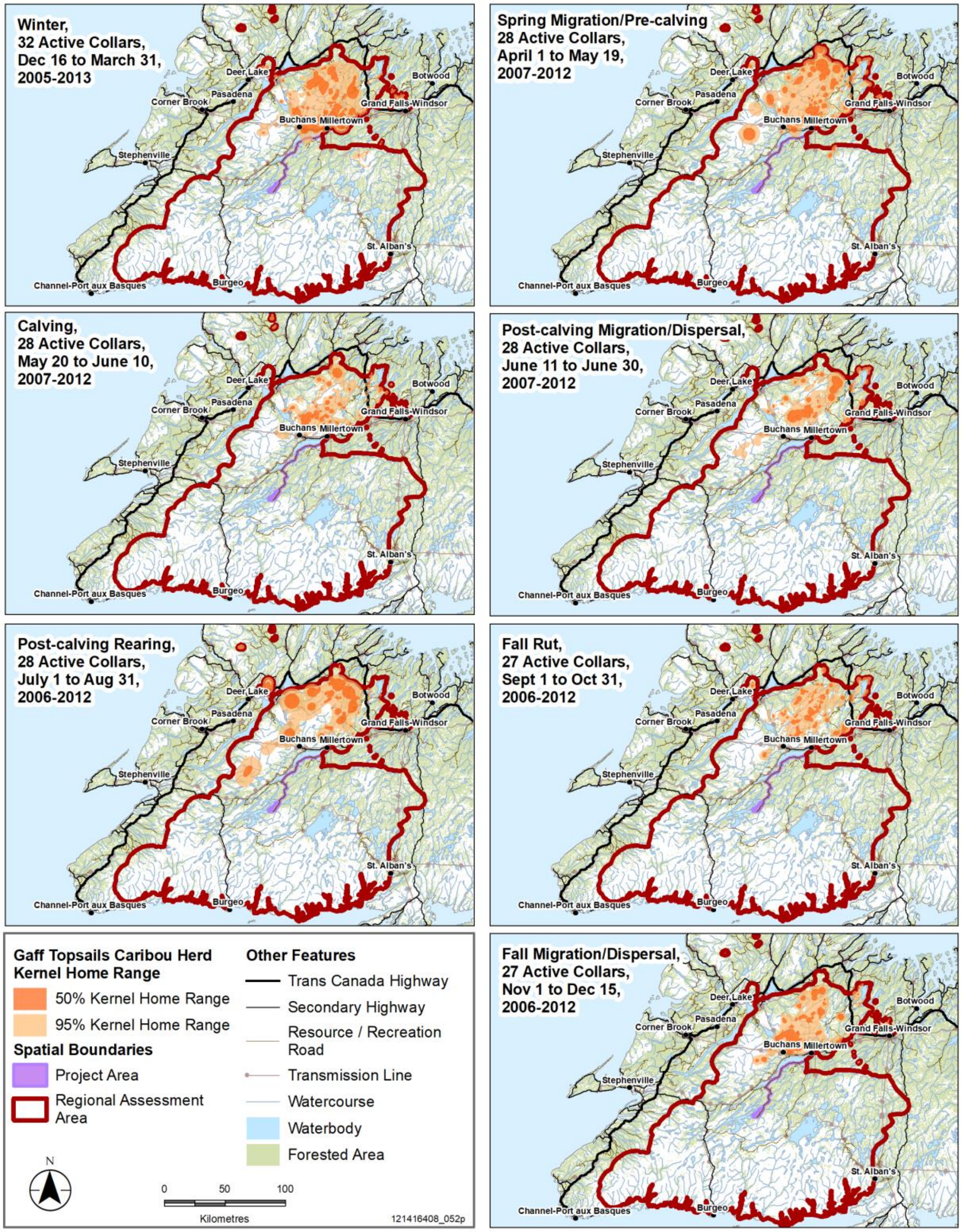

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Figure 11-7 Seasonal Ranges for the Gaff Topsails Caribou Herd

The Grey River and La Poile herds move between calving and summer ranges in south-west Newfoundland and winter range on the south coast. The range of the Grey River herd is approximately 15,500 km^2 and is generally located between Meelpaeg Lake in the north and the coast in the south, and between Highway 360 in the east and the area near Channel-Port Aux Basques in the west (Figure 11-8). The fall and winter ranges occur southeast of the Project Area towards St. Alban's, while the spring and summer ranges occur further west (Figure 11-9). The overall range of the La Poile herd (approximately 11,200 km^2) occurs between Channel-Port Aux Basques and St. Alban's in the east and extends no further north than Victoria Lake Reservoir (Figure 11-10). To the south of the Project Area, the La Poile herd is furthest east in fall and winter, and moves toward Channel-Port Aux Basques for calving in spring (Figure 11-11).

Caribou display site fidelity (the tendency to return to a previously used area) in their seasonal ranges, with highest site fidelity occurring during the spring, calving and post-calving seasons (Ferguson and Elkie 2004). In the 2000s during peak population, the La Poile herd showed reduced site fidelity and the Buchans and Grey River herds showed increased site fidelity, compared to the 1990s (Schaefer and Mahoney 2013). In the Buchans herd, differences in calving season fidelity may be influenced by the amount of snowfall in early spring (Mahoney and Schaefer 2002). Additionally, the Buchans herd spent six more weeks on the calving and summer ranges in the 2000s than in the 1990s (Schaefer and Mahoney 2013).

While seasonal ranges are important for caribou, migration corridors are also essential to maintain connectivity between seasonal ranges. The assessed herds move between seasonal ranges, with the Buchans herd undertaking the largest movements. Previous research has indicated some variability in the timing of migration on the Island of Newfoundland; between 1995 and 2000, the median dates of migration of the Buchans herd varied by almost a month (spring: April 17 to May 23; fall: October 8 to November 7) (Mahoney and Schaefer 2002). The migration corridors may be used for short periods of time and produce relatively few telemetry locations compared to the rest of the season; therefore, these important migration corridors may not be captured by the kernel analysis used to delineate seasonal ranges.

Following discussion with the NLDFFA-Wildlife Division, the spring and fall migration movement patterns of the Buchans and Gaff Topsails herds were analyzed. Based on available telemetry data for 2006 – 2013, no movements between distinct summer and winter ranges were identified for the Gaff Topsails herd (Section 11.2.1.3) and a migration corridor through the Project Area was not identified. While there was movement northeast towards Sandy Lake during the spring migration and south-east towards Star Lake during the fall, the summer and winter ranges are not spatially discrete (Figure 11-7). Similar seasonal range use has been reported for the Gaff Topsails herd in the 1980s when the herd range occurred primarily between Sheffield Lake and Hinds Lake (Mahoney 2000). Although there were differences in seasonal distribution, the calving and winter ranges were not spatially discrete (Mahoney 2000). As a migration corridor through the Project Area was not identified, the migration corridor for the Gaff Topsails herd was not analyzed further for this assessment.

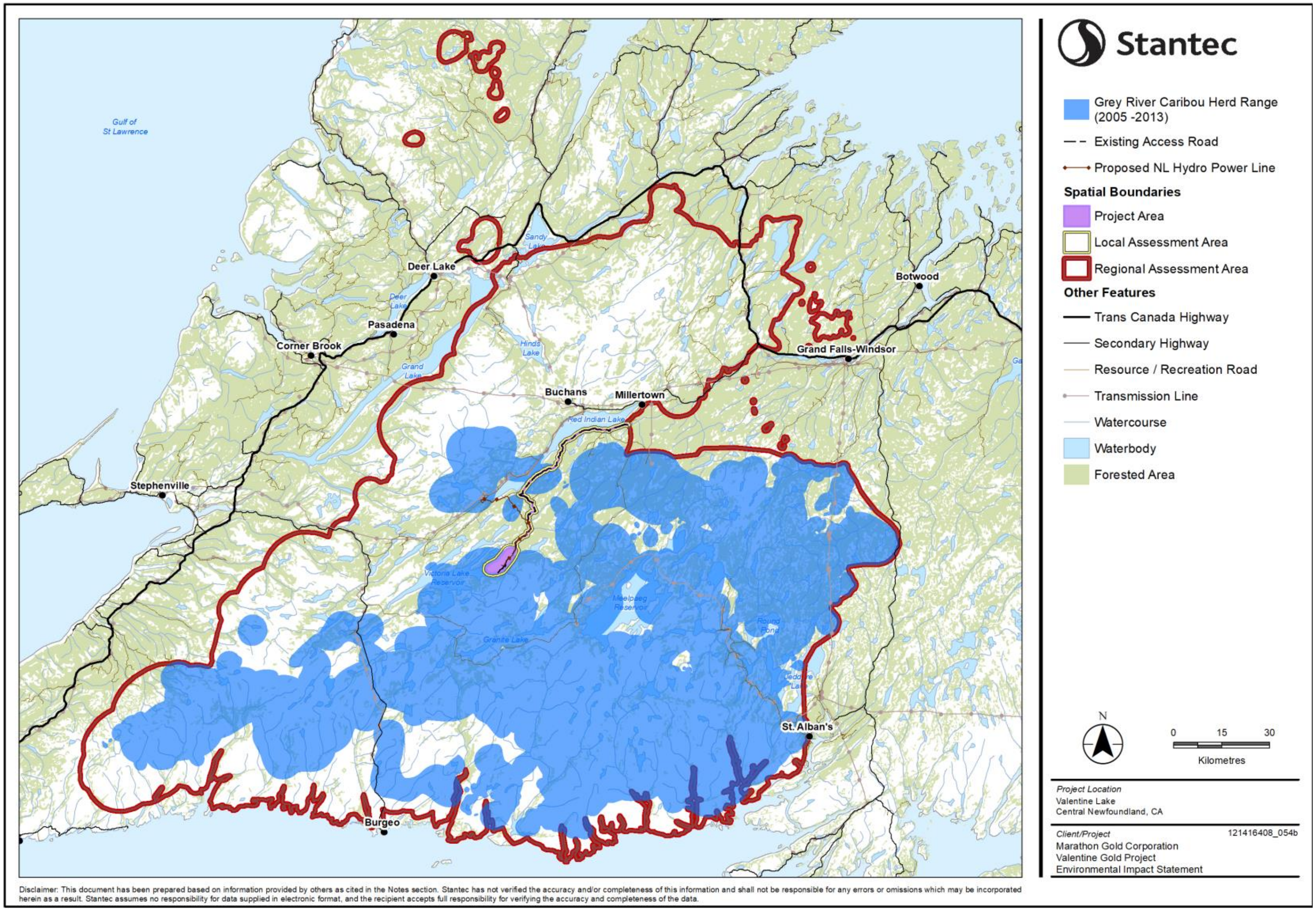

Figure 11-8 Distribution of the Grey River Caribou Herd

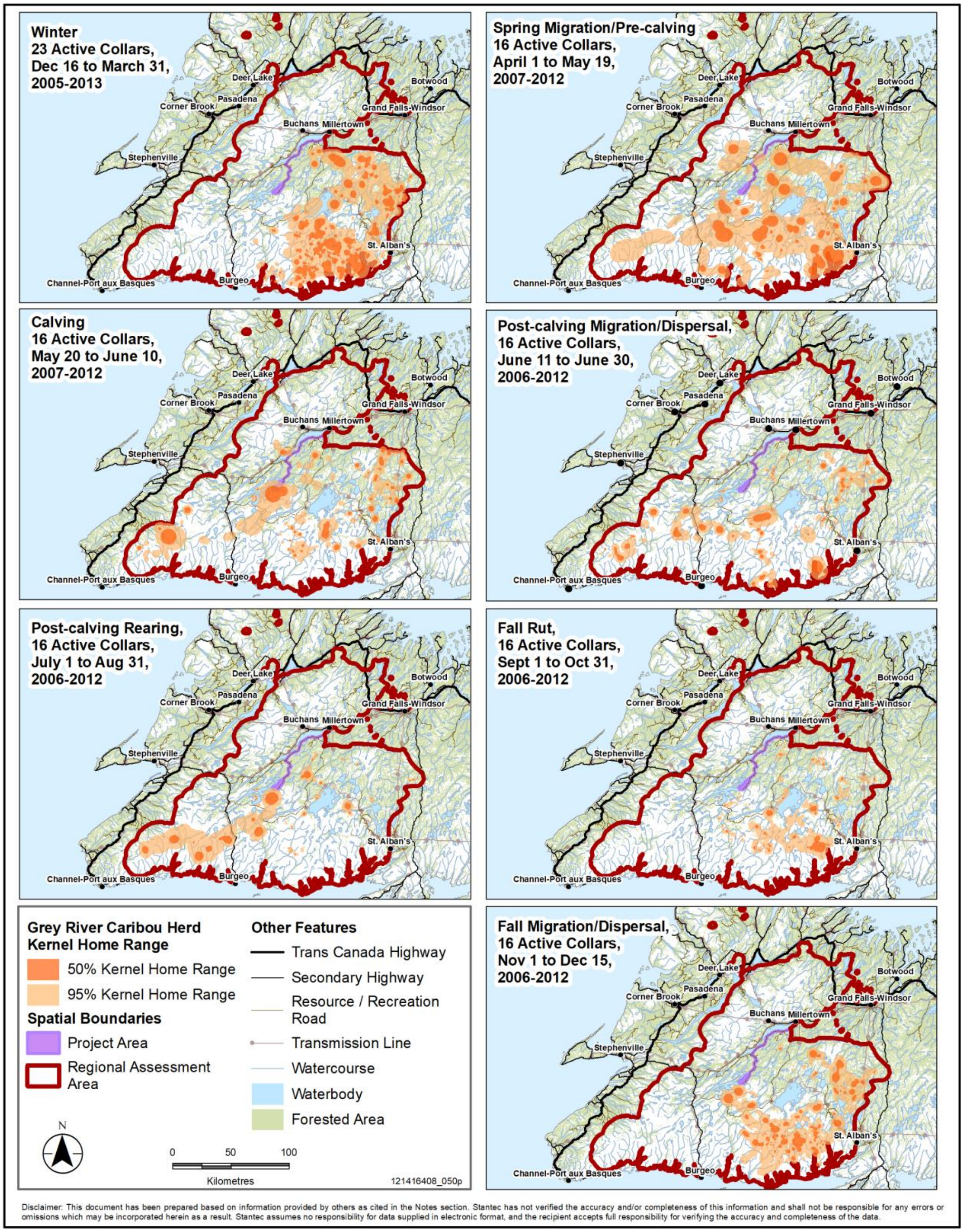

Figure 11-9 Seasonal Ranges for the Grey River Caribou Herd

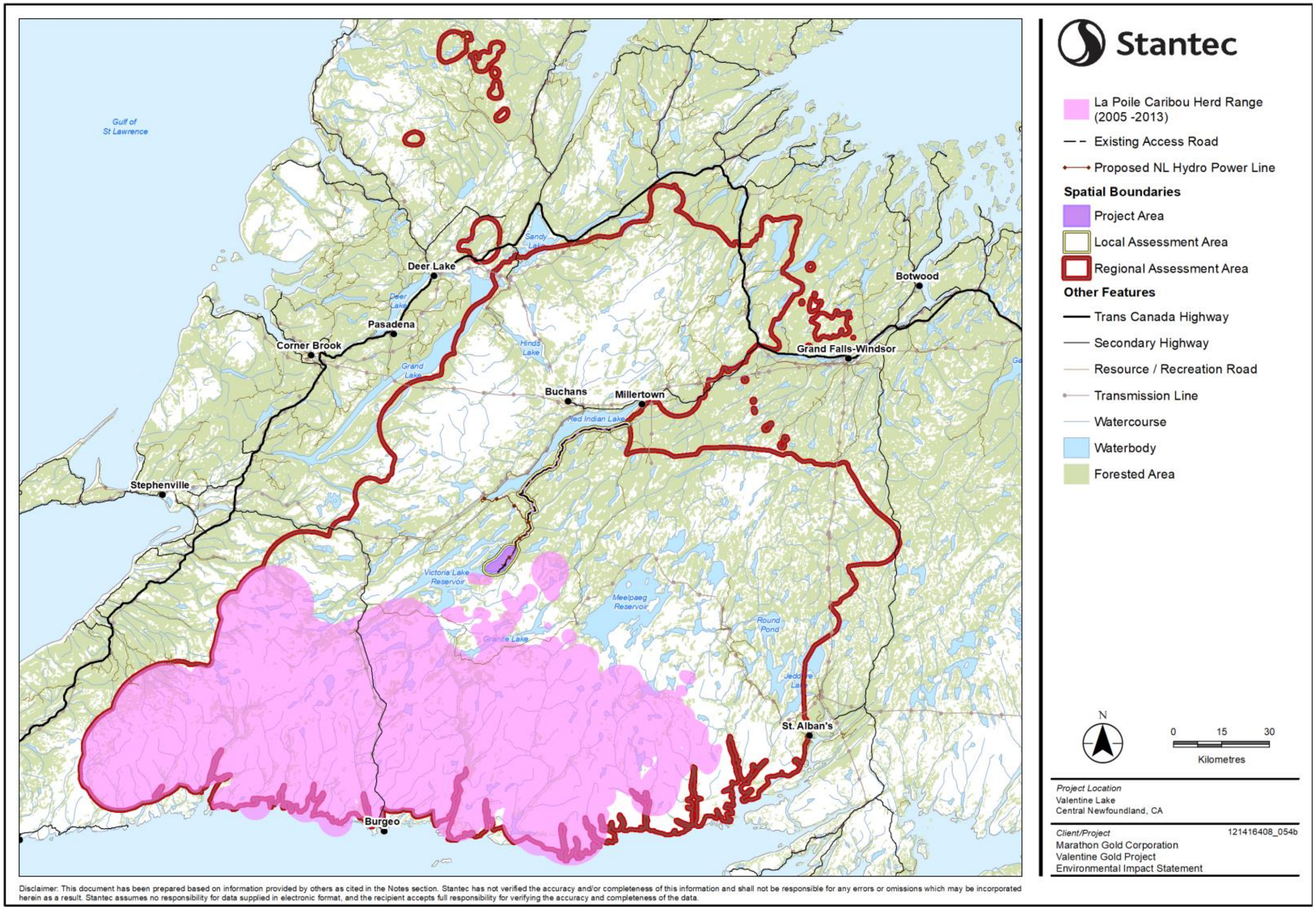

Figure 11-10 Distribution of the La Poile Caribou Herd

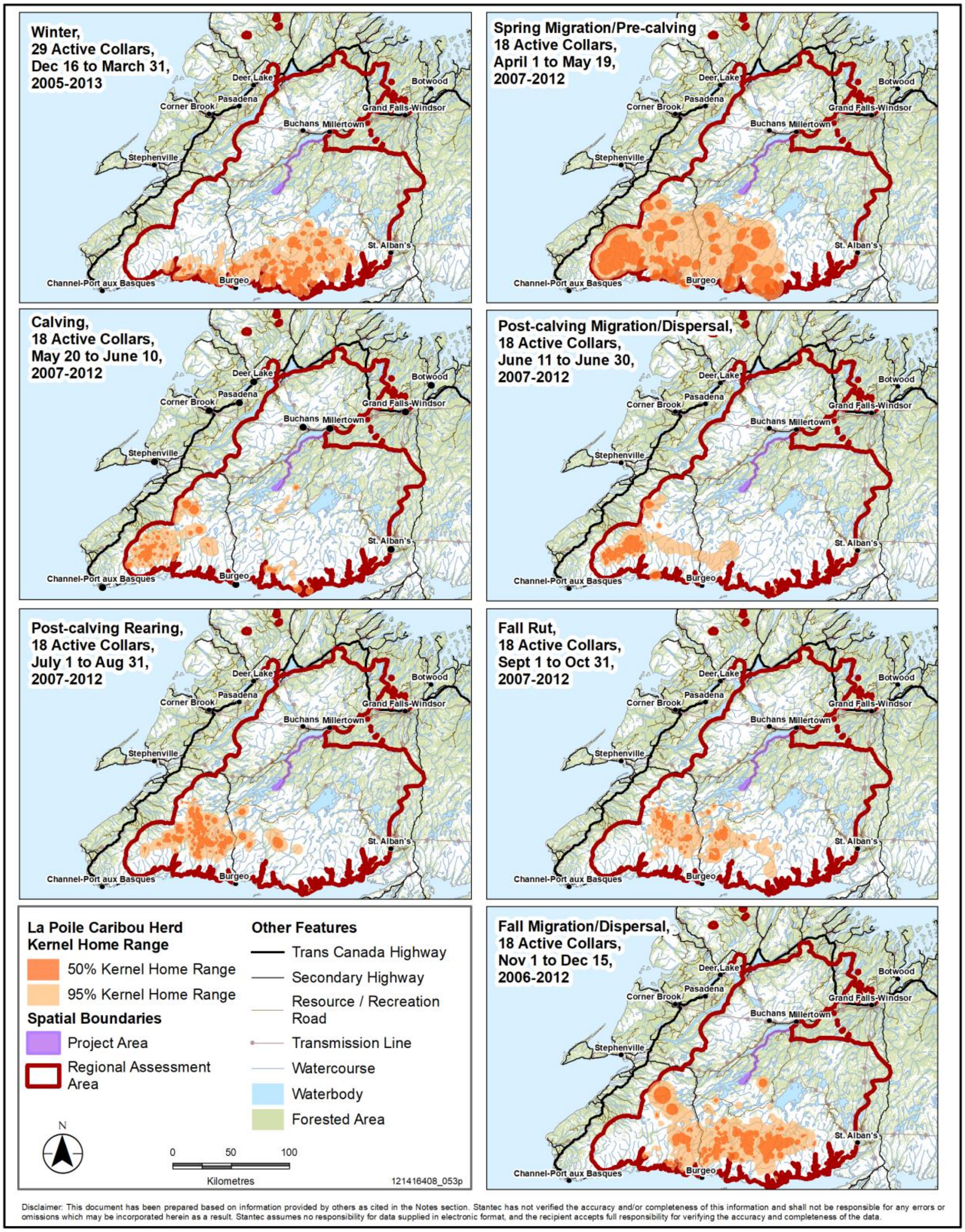

Figure 11-11 Seasonal Ranges for the La Poile Caribou Herd

For the Buchans herd, the dBBMM models identified areas where individual GPS-collared caribou occurred during seasonal migration periods, which included a network of travel paths that extended approximately 30 to 86 km wide. However, there was only one distinct population-level path identified that included high use areas (stopover sites) connected by a migration corridor during both spring (Figure 11-12) and fall migration periods (Figure 11-13). The proposed mine site intersected the spring migration corridor for approximately 5.5 km where caribou moved through a relatively narrow area (< 3 km wide) as they headed north from their winter range. The spring migration corridor crossed the northern section of Victoria Lake Reservoir and Long Lake and included one stopover (high use) area located on the south side of Star Lake, west of the hydroelectric development (Figure 11-12). Two other stopover areas were located east of Victoria Lake Reservoir, one of which overlapped with the Project Area (Figure 11-12). Another two stopovers were located just south of Granite Lake. There were some low use paths in spring migration that crossed Red Indian Lake; these paths overlapped the existing access road.

The fall migration corridor had four stopover sites, which included the same high use area used during spring migration (south of Star Lake) and a new stopover area near the south arm of Granite Lake (Figure 11-13). There were two smaller stopover area near Victoria Lake Reservoir: one south of the Project Area, and one that overlapped the Project Area (Figure 11-13). Although the dBBMM identified one population-level migration corridor during both spring and fall migration periods, the fall migration included a narrower network of low use travel paths compared to spring when some individuals travelled west of Victoria Lake Reservoir and across Red Indian Lake (Figure 11-13).

Because the dBBMM model identified a single population-level migration path during both spring and fall migration, the preferred path analysis did not identify other paths based on a proportion of the sampled population. Up to 55.1% of the collared caribou used the dominant migration path during spring, and up to 58.4% used it in fall. While this result is based on collared caribou, the assumption is that the movement patters are representative of the herd generally. This implies that over half of the Buchans herd migrates through the higher use area of the migration path.

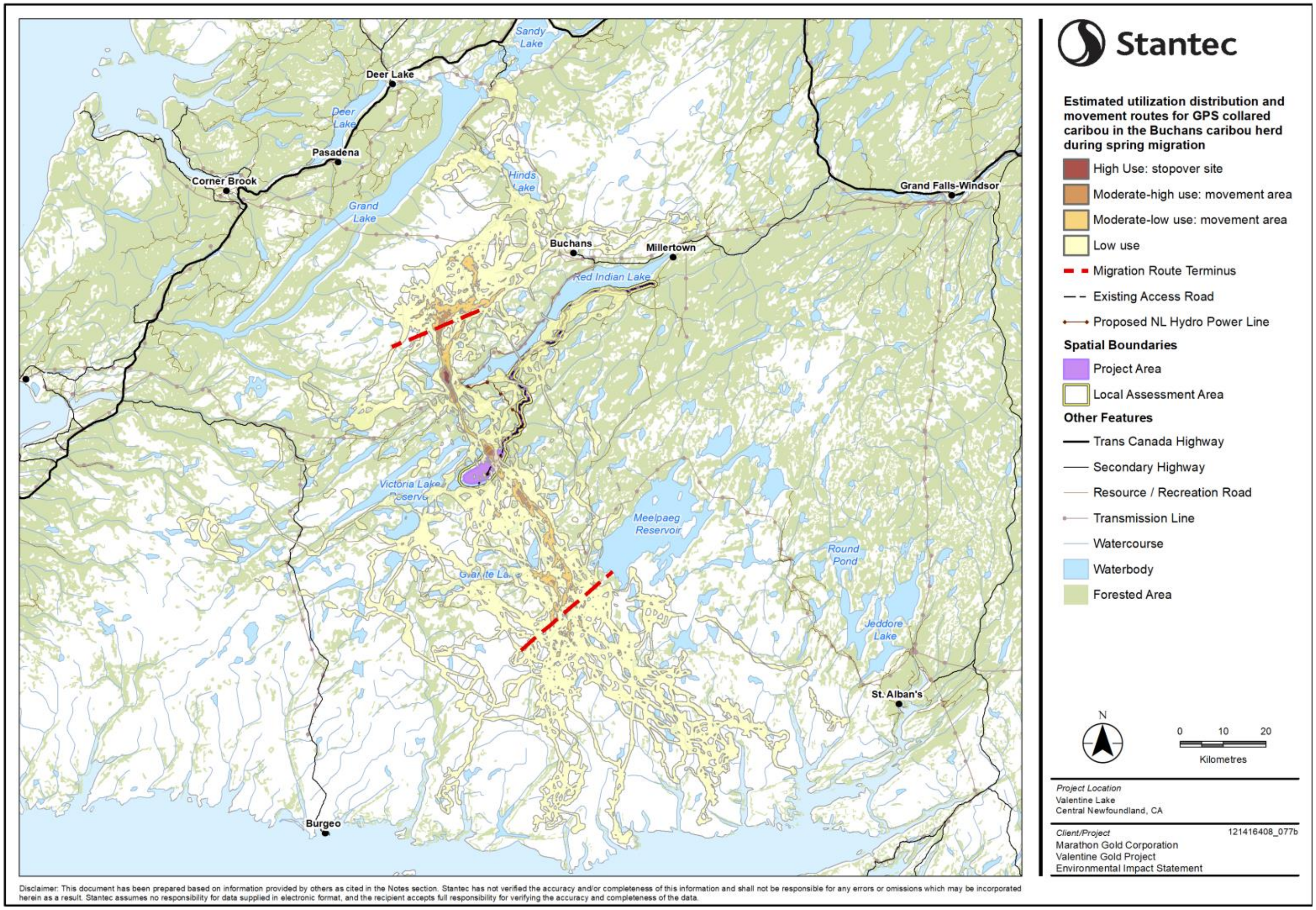

Figure 11-12 Estimated Utilization Distribution and Migration Corridors for GPS Collared Caribou In Buchans Herd During Spring Migration

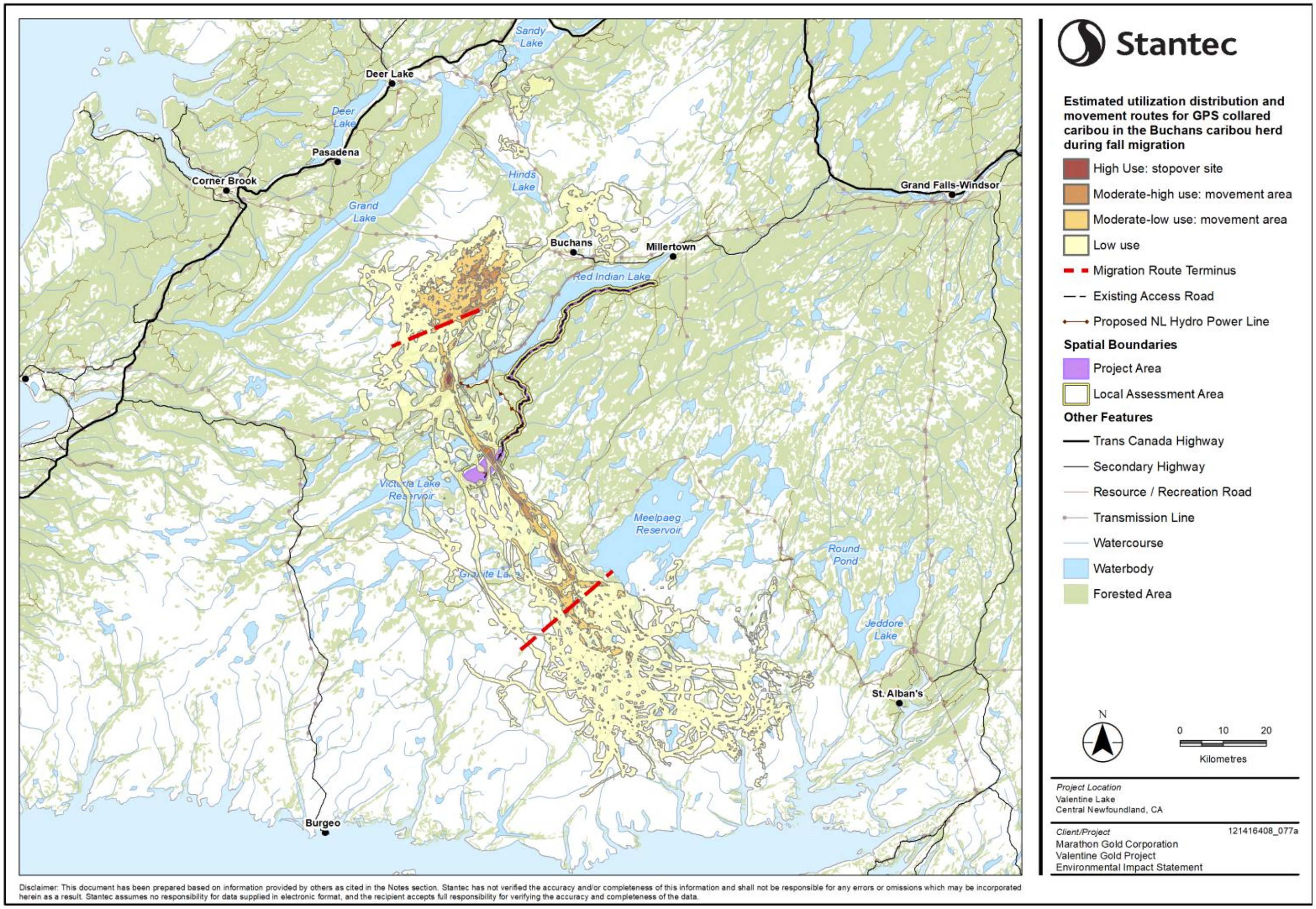

Figure 11-13 Estimated Utilization Distribution and Migration Corridors for GPS Collared Caribou in the Buchans Herd During Fall Migration

The length of the migration corridor between the Buchans Plateau and Grey River is 145 km. Within the migration corridor, the area used for migration was wider and more dispersed in spring (3,639 km^2) than in fall (3,005 km^2). The timing of migration for the Buchans herd has been shown to vary. Between 1995 to 2000, Buchans caribou crossed the north shore of Red Indian Lake between April 17 and May 25 during spring migration, and between October 8 to November 7 during fall migration (Mahoney and Schaefer 2002). Based on the telemetry data (2005 to 2013 and 2015 to 2017), dates of movement through the Project Area in the spring ranged from April 22 to May 6; however, these dates varied between years. Telemetry locations from collared caribou occurred within the Project Area between April 18 to April 22 in 2016, and between April 29 and May 10 in 2017. Results from remote cameras deployed for the Spring 2020 Caribou Survey indicated peak female caribou movement through the Project Area was between April 25 to May 7, 2020 and peak of movement for males was between May 15 and May 27, 2020 (BSA.2, Attachment 2-B). Remote cameras deployed in the Project Area during fall 2019 detected caribou moving north through the Project Area from November 9 to November 12 (BSA.2, Attachment 2-A). The dates of telemetry locations within the Project Area during fall indicated variability in the timing of fall migration as well. Overlap with the Project Area during fall occurred between November 17 to 20 in 2015, November 28 to 30 in 2016, and December 6 to 12 in 2017.

Although recent surveys indicate that population estimates of some herds in the south coast sub-population may be stabilizing (Government of NL 2019a), research also indicates that caribou populations on the Island of Newfoundland continue to be limited by poor calf survival (Government of NL 2015) and, subsequently, poor recruitment rates. The calf survival rate (i.e., proportion of calves surviving to six months) between 1979 and 1997 was approximately 66%, however it decreased to less than 8% in 2003 (Mahoney et al. 2015). The calf survival rate appears to be increasing gradually (Government of NL 2015) and reached nearly 50% in 2012 (Mahoney et al. 2015). In the assessed caribou herds, the proportion of calves (i.e., percent calves out of total caribou classified) is near 10% (Table 11.7). Although calf mortality rates have increased (i.e., higher in the early 2000s compared to 1979 –1997), adult survival is high and is comparable to earlier estimates (i.e., rates from 2004 – 2011 are similar to 1979 – 1997) (Government of NL 2015). Analyses completed in the late 2010s indicated that the average age of the caribou population on the Island of Newfoundland had increased overall (Government of NL 2015), and an improvement in calf survivorship is necessary to increase population size (Randell et al. 2012; Weir et al. 2014). The sex ratio for the Island of Newfoundland caribou population is generally more females to males, with a decreasing trend in males observed between the 1970s to 2006 (Weir et al. 2014). The previously observed decline in sex ratio may have slowed, as a higher number of males has been observed since 2006 (Weir et al. 2014).

Table 11.7 Classification Results for the Assessed Caribou Herds

Year	Buchans		Gaff Topsails		Grey River		La Poile	
	% Calves	% Bulls	% Calves	% Bulls	% Calves	% Bulls	% Calves	% Bulls
2007[A]	11.3	16.2	10.8	15.8	5.7	23.6	7.1	23.3
2011[A]	15.8	19.2	10.3	22.8	6.6	13.9	8.7	17.1
2016[B]	9.4	21.6	14.5	24.3	15.3	29.0	11.3	23.8
2018[C]	10.5	26.1	11.4	21.2	5.6	26.7	9.9	32.9
2019[B]	8.3	28.2	10.7	25.4	11.9	37.3	5.9	22.5
2020[D]	30.6	10.5			11.3[E]	31.6[E]		

Notes:
Numbers rounded to one decimal place.
[A] Government of NL 2020c – spring survey, strip transect survey
[B] Government of NL 2020c – winter survey, mark-resight survey
[C] Government of NL 2020d
[D] BSA.2, Attachment 2-C – June survey, strip transect survey from helicopter
[E] Based on the 2020 post-calving survey area only. Does not include the Grey River calving range

There is a regulated annual hunt for caribou on the Island of Newfoundland from September 12 to December 6 (Government of NL 2020e). Licenses are available to both residents and non-residents. The 2020 – 2021 total caribou quota for the Island of Newfoundland was 359 licenses, down from 366 licenses issued in 2018 with a hunter success rate over 75% (Government NL 2020e). The Project Area overlaps with CMAs 62 and 63 (Figure 11-14); however, CMA 63 (Grey River Zone) has been closed to hunting since 2008 (Government of NL 2008). The caribou quota in CMA 62 for 2020/21 consists of 38 resident licenses and 37 non-resident licenses (Government of NL 2020e).

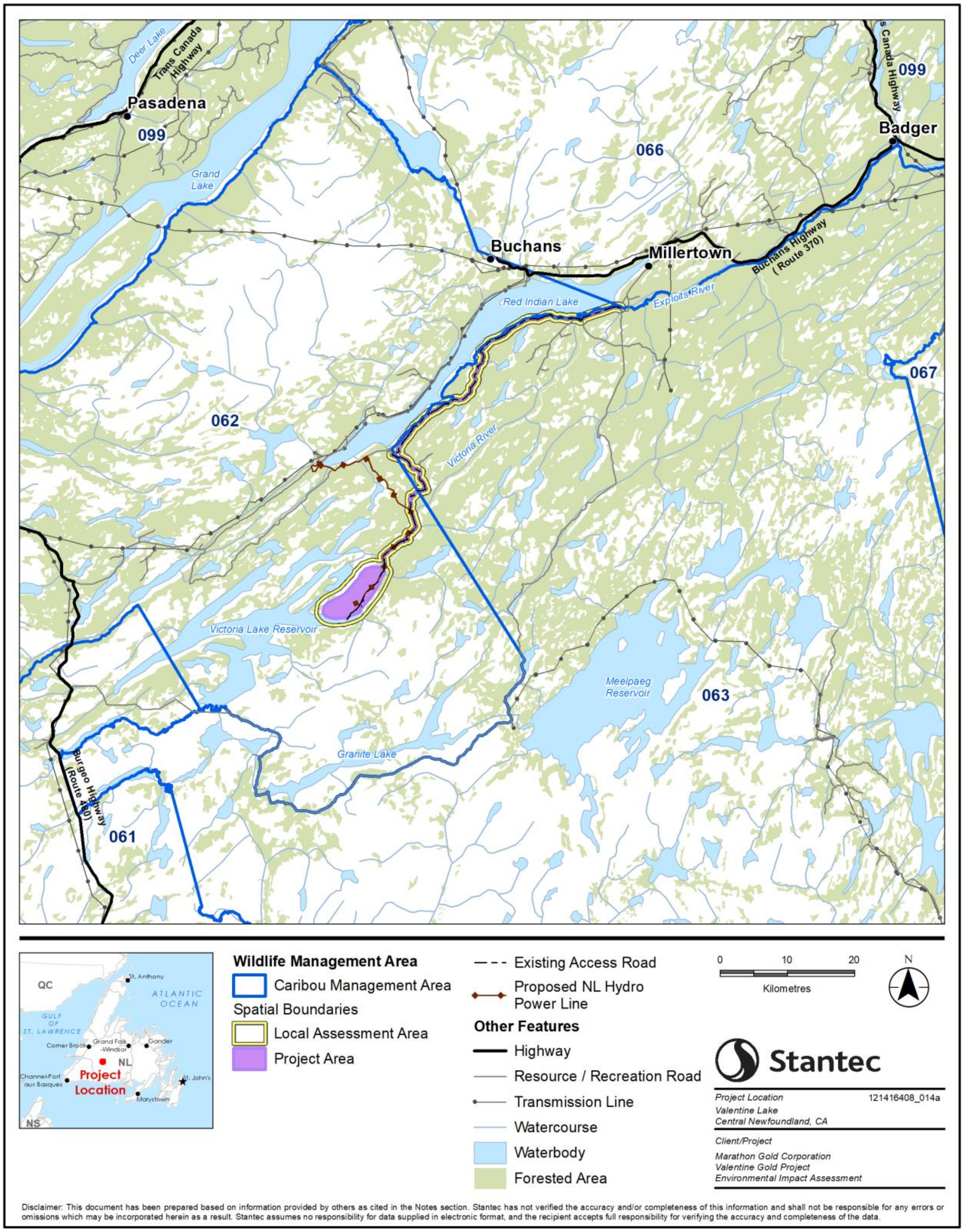

Figure 11-14 Overlap of Project Area with Caribou Management Areas

11.2.2.2 Habitat Occurrence in the Project Area

Caribou select their habitat based on multiple factors, including reduction of predation risk, access to preferred forage and preferred snow depth. They are generally associated with mature, lichen-rich boreal forest, barrens and bogs and fens.

Habitat types ranked as high value for caribou are Balsam Fir Forest, Black Spruce Forest, Kalmia-Black Spruce Woodland and Open Wetlands (Table 11.8). Caribou select open habitats such as barrens and wetlands (Rettie and Messier 2000; Mahoney and Virgl 2003; Bastille-Rousseau et al. 2015; Schaefer et al. 2016), and forested areas (Chubbs et al. 1993; Rettie and Messier 2000; Mahoney and Virgl 2003; Courtois et al. 2004) as these provide the greatest amount of lichen and other vegetation for forage while also reducing predation risk. Moderate-ranked habitats include Open Water, Wet Coniferous and Mixedwood Forest (Table 11.8). Open Water is ranked as moderate habitat (Rettie and Messier 2000; Ferguson and Elkie 2005) (Table 11.8) as lakes provide aquatic forage (Bergerud 1972), can be used as escape from predators, and shorelines have been selected as calving sites (Metsaranta and Mallory 2007). Additionally, caribou travel across frozen lakes (Leblond et al. 2016) and may select habitat with frozen lakes to provide escape from predators (Ferguson and Elkie 2005). While mixedwood is selected by caribou infrequently (Fortin et al. 2008), it was ranked as moderate habitat for this Project as the caribou migration corridor within the LAA overlaps Mixedwood Forest. Alder Thicket, Riparian Thicket, Regenerating Forest, Exposed Sand / Gravel and Anthropogenic are ranked as low value habitats (Table 11.8).

Based on these relative habitat value rankings, the summary of habitat availability for caribou within the Project Area, LAA and ELCA is presented in Table 11.9. High and moderate ranked habitat for caribou is relatively abundant in the LAA, accounting for 98.9 km^2 or 77.9% of the LAA. Low-ranked habitat covers 6.2 km^2 or 18% of the LAA.

Table 11.8 Habitat Value Ranking for Caribou

Habitat Type	Habitat Value Rank
Alder Thicket	Low
Anthropogenic	Low
Balsam Fir Forest	High
Black Spruce Forest	High
Exposed Sand / Gravel Shoreline	Low
Kalmia-Black Spruce Woodland[A]	High
Mixedwood Forest	Moderate
Open Wetlands[B]	High
Open Water	Moderate

Table 11.8 Habitat Value Ranking for Caribou

Habitat Type	Habitat Value Rank
Regenerating Forest	Low
Riparian Thicket	Low
Wet Coniferous Forest	Moderate

Notes:
[A] Includes Kalmia-Black Spruce Forest and Kalmia Heath Ecotypes
[B] Includes Shrub / Graminoid Fen and Shrub Bog Ecotypes
Sources: Schaefer and Pruitt 1991; Chubbs et al. 1993; Rettie and Messier 2000; Mahoney and Virgl 2003; Courtois et al. 2004; Ferguson and Elkie 2005; Brown et al. 2007; Fortin et al. 2008; LeBlond et al. 2011; Alderon 2012; Nalcor 2012; MacNearney 2013; Bastille-Rousseau et al. 2015; Stewart 2016; Bastille-Rousseau et al. 2018; BSA.7, Attachment 7-D

Table 11.9 Amount of Habitat by Ranking for Caribou in the Project Area, LAA and ELCA

Habitat Value Ranking	Area in Project Area[A] (km^2 / %)	Area in LAA[A] (km^2 / %)	Area in ELCA[A] (km^2 / %)
High	18.7 / 53.9	52.5 / 41.3	849.1 / 46.4
Moderate	9.8 / 28.1	46.5 / 36.6	718.5 / 39.2
Low	6.2 / 18.0	28.0 / 22.1	263.0 / 14.4
Total	34.7 / 100.0	127.0 / 100.0	1,830.6 / 100.0

Notes:
[A] Numbers rounded to one decimal place. Areas and percentages may not add up to total amounts due to rounding
Values pertain to the portion of the Project Area and LAA with ELC data

The relative amounts of high, moderate and low habitat value rankings are similar in the Project Area and ELCA. This suggests that the quantity and quality of the caribou habitat in the Project Area are similar to those of the ELCA.

11.2.2.3 Limiting Factors

The primary predators of caribou on the Island of Newfoundland are black bear (*Ursus americanus*) and coyote (*Canis latrans*). Adult caribou are preyed upon less frequently compared to calves (Ballard 1994; Lewis and Mahoney 2014; Mahoney and Weir 2009). Predation is the primary cause of caribou calf mortality on the Island of Newfoundland with approximately 90% of calf deaths attributed to predation (Lewis and Mahoney 2014). During the Island-wide population increase between 1979 and 1997, the predation rate on calves was approximately 60%, increasing to 83% between 2003 and 2007 (Mahoney and Weir 2009). While black bear and coyote are the primary predators of caribou calves on the Island of Newfoundland (Mumma et al. 2016, 2019; Bastille-Rousseau et al. 2016), calves are also preyed upon by other predators such as bald eagle (*Haliaeetus leucocephalus*), golden eagle (*Aquila chrysaetos*) and Canada lynx (*Lynx canadensis)* (Lewis et al. 2017). The current adult caribou mortality rate is thought to be similar to historical rates, and the decrease in calf survival since the mid-1990s is due to an increase in predation rate (Government of NL 2015).

Coyote is a relatively recent predator of caribou on the Island of Newfoundland, as it was not established on the Island of Newfoundland until the 1990s (Blake 2006). Coyote on the Island of Newfoundland consume mostly moose (*Alces alces*), as well as caribou and snowshoe hare (*Lepus americanus*) (Bridger 2006; Mumma et al. 2016). Coyote do contribute to caribou calf mortality (approximately 28% of collared calves) (Lewis and Mahoney 2014); however, data have suggested that calf mortality and resultant poor recruitment is also affected by other predators, including black bear (Mumma et al. 2016; Mahoney and Weir 2009) and Canada lynx (Mahoney and Virgil 2003; Snow and Mahoney 1995; Mahoney et al. 1990). Based on Lewis and Mahoney (2014), black bear accounted for 34% of collared caribou calf mortality, approximately 14% of calves were killed by an unidentified predator, 15% died of non-predation causes (e.g., accident, starvation), and the cause of 14% of mortalities could not be determined.

Gray wolf (*Canis lupus*) is not a major predator of caribou on the Island of Newfoundland, unlike for other caribou populations in parts of Canada. The wolf became extirpated on the Island of Newfoundland in the 1930s; however, wolf and wolf-coyote hybrids have been documented here since 2009 (Government of NL 2012). The natural recolonization of gray wolf on the Island of Newfoundland could increase predation rates on caribou.

Hunting can be an important tool for managing wildlife populations; however, harvest rates need to be carefully adjusted to sustain populations. The caribou population on the Island of Newfoundland has decreased by approximately 60% since the 1990s (Government of NL 2015). Previously, hunter success was 80 to 85% in the 1980s prior to the peak, decreasing to approximately 60% in the 2000s (Weir et al. 2014). In response to the population decline, caribou quotas have been reduced accordingly. Hunter success in 2018 in the Buchans CMA (CMU 62) was approximately 64% (Government of NL 2020e).

Habitat loss or alteration is an important factor affecting caribou populations across North America (Vors and Boyce 2009). Caribou require mature, lichen-rich boreal forest, barrens and bogs and fens. They rely on a mixture of open areas with abundant lichen and older forest habitat, which together provide forage and cover to evade predators. Caribou habitat can be directly affected through loss or alteration, as is the case with disturbances such as agriculture, forestry, forest fires and industrial and residential development. While habitat may remain intact, it may be affected indirectly through mechanisms such as sensory disturbance, which would reduce its suitability for caribou.

Parasites in caribou have been linked to reduced health (Hughes et al. 2009) and changes in behaviour (Government of NL 2010). First introduced to the Island of Newfoundland through imported reindeer in 1907 and 1908 (Government of NL 2010), brain worm (*Elaphostrongylus rangiferi*) in caribou now occurs across the Island of Newfoundland (Ball et al. 2001). Brain worm can cause a debilitating neurologic disease seen primarily in young animals in late winter (Nalcor 2012). Tapeworms (*Taenia hydatigena* and *Taenia krabbei*) and oestrid flies (*Hypoderma tarandii* and *Cephenemyia trompe*) also affect caribou on the Island of Newfoundland. Harassment and infestation by oestrids can affect habitat selection (Skarin et al. 2004) and overall caribou health (Weladji et al. 2003).

Climate change (i.e., global warming) has the potential to affect global caribou populations, including those on the Island of Newfoundland. Warmer temperatures will affect landscape-level plant composition and plant and insect phenology (timing of recurring biological events). As the assemblage of plant species in boreal regions change (Boulanger et al. 2017), the habitats selected by caribou may become less suitable as the abundance and distribution of preferred plants change. Warmer temperatures resulting from climate change may cause plants to undergo spring green-up earlier. However, so far earlier warm temperatures appear not to have affected the timing of calving (Post and Forchhammer 2008). If decoupling does occur, this could lead to misalignment of forage biomass availability and seasonal energetic needs of caribou. For example, as the length of time between green-up and calving increases, there has been an observed increase in calf mortality and a decrease in calf production (Post and Forchhammer 2008).

A warming climate could also alter the timing of insect emergence, as well as winter survival and development rates (Robinet and Roques 2010), which has the potential to increase the amount of insect harassment. Caribou harassed by insects spend less time foraging than those without harassment, which could lead to decreased body condition (Vors and Boyce 2009). Changes in the abundance or diversity of parasites resulting from climate change could also have negative effects on caribou populations (Mallory and Boyce 2018).

In addition to warmer temperatures, climate change is predicted to change the frequency, intensity, duration and timing of weather and climate extremes (Seneviratne et al. 2012), including increased risk and magnitude of forest fires and winter icing events. An increase in the magnitude or spatial extent of forest fires can reduce the amount of old forest available to caribou and alter forest and plant communities (Racey 2005). An icing event is the formation of an ice layer caused by rain on snow or freeze-thaw cycles, which limits or prevents access to underlying forage. An increase in the frequency of icing events can limit the amount of forage available to caribou during the winter period (Mallory and Boyce 2018). Recent research in Labrador found a decrease in caribou survival with a reduction in snowfall and an increase in freezing rain in the fall (Schmelzer et al. 2020).

Caribou can also be affected by existing and future development within their range. There is an existing road system within the range of the assessed herds, which has likely contributed to direct and indirect habitat loss (e.g., habitat fragmentation). Disturbed areas and linear features are avoided by caribou, which can affect mortality risk. Future developments (e.g., mining, hydroelectric development) may cause habitat lost and sensory disturbance, and affect mortality rate. For example, Buchans caribou showed avoidance of Star Lake hydroelectric facility and a delay in the timing of migration following construction of the facility in 1997 to 1998 (Mahoney and Schaefer 2002). Cumulative effects are discussed in detail in Section 20.8.

11.3 ASSESSMENT CRITERIA AND METHODS

This section describes the criteria and methods used to assess environmental effects on caribou. Residual environmental effects (Section 11.5) are assessed and characterized using criteria defined in Section 11.3.1, including direction, magnitude, geographic extent, timing, frequency, duration, reversibility and ecological or socio-economic context. The assessment also evaluates the significance of residual effects using threshold criteria or standards beyond which a residual environmental effect is considered significant. The definition of a significant effect for caribou is provided in Section 11.3.2 and considers the goals, objectives and activities of recovery strategies, action plans and management plans. Section

11.3.3 identifies the environmental effects to be assessed for caribou, including effect pathways and measurable parameters. This is followed by the identification of potential Project interactions with this VC (Section 11.3.4). Analytical assessment techniques used for the assessment of caribou are provided in Section 11.3.5.

11.3.1 Residual Effects Characterization

Table 11.10 presents definitions for the characterization of residual environmental effects on caribou. The criteria are used to describe the potential residual effects that remain after mitigation measures have been implemented. Quantitative measures have been developed, where feasible, to characterize residual effects. Qualitative considerations are used where quantitative measurement is not possible. The magnitude of the effect on change in caribou habitat, which has been assessed relative to the ELCA, is further described in Section 11.5.1.

Table 11.10 Characterization of Residual Effects on Caribou

Characterization	Description	Quantitative Measure or Definition of Qualitative Categories
Direction	The long-term trend of the residual effect	**Neutral –** no net change in measurable parameters for caribou relative to baseline **Positive –** a residual effect that moves measurable parameters in a direction beneficial to caribou relative to baseline **Adverse –** a residual effect that moves measurable parameters in a direction detrimental to caribou relative to baseline
Magnitude	Change in caribou habitat	**Negligible –** no measurable change in caribou habitat in the ELCA **Low –** Project changes less than 10% of caribou habitat in the ELCA **Moderate –** Project changes 10-20% of caribou habitat in the ELCA **High –** Project changes more than 20% of other caribou in the ELCA
	Change in caribou movement	**Negligible –** no measurable change to the proportion of caribou use in the migration corridor **Low –** Project changes less than 25% of the proportion of caribou use in the migration corridor **Moderate –** Project changes 25-50% of the proportion of caribou use in the migration corridor **High –** Project changes more than 50% of the proportion of caribou use in the migration corridor

Table 11.10 Characterization of Residual Effects on Caribou

Characterization	Description	Quantitative Measure or Definition of Qualitative Categories
Magnitude	Change in caribou mortality risk	**Negligible –** no measurable change in caribou mortality risk in the LAA **Low –** a measurable change in caribou mortality risk in the LAA is not anticipated, although individuals may be affected **Moderate –** a measurable change in caribou mortality risk in the LAA might occur; however, a measurable change in the caribou mortality risk in the RAA is not anticipated **High –** a measurable change in the caribou mortality risk in the RAA may occur
Geographic Extent	The geographic area in which a residual project effect occurs	**Project Area –** residual effects are restricted to the Project Area **LAA –** residual effects extend into the LAA **RAA –** residual effects extend into the RAA
Frequency	Identifies how often the residual project effect occurs and how often during the Project or in a specific phase	**Single event** **Multiple irregular event –** occurs at no set schedule **Multiple regular event –** occurs at regular intervals **Continuous –** occurs continuously
Duration	The period of time required until the measurable parameter or the VC returns to its existing (baseline) condition, or the residual effect can no longer be measured or otherwise perceived	**Short term** – residual effect restricted to construction or decommissioning, rehabilitation and closure phases **Medium term** – residual effect extends through the operation phase (12 years) **Long term** – residual effect extends beyond the operation phase (>12 years) **Permanent** – recovery to baseline conditions unlikely
Reversibility	Describes whether a measurable parameter or the VC can return to its existing condition after the project activity ceases	**Reversible –** the residual effect is likely to be reversed after activity completion and rehabilitation **Irreversible –** the residual effect is unlikely to be reversed
Ecological and Socio-economic Context	Existing condition and trends in the area where residual effects occur	**Undisturbed –** area is relatively undisturbed or not adversely affected by human activity **Disturbed –** area has been substantially previously disturbed by human development or human development is still present

11.3.2 Significance Definition

A significant adverse residual Project effect on caribou and their habitat is defined as one that threatens the long-term persistence or viability of one or more of the four assessed caribou herds (Buchans, Gaff Topsails, Grey River, La Poile herds) within the RAA, including effects that are contrary to or inconsistent with the goals, objectives and activities of recovery strategies, action plans and management plans.

The Newfoundland Population of woodland caribou is not currently listed under SARA or NL ESA. However, an assessment and status report (COSEWIC 2014), a precursor to potential listing on SARA, does identify the status of Newfoundland caribou as Special Concern due to declining populations and identified threats. Further, the Government of Newfoundland and Labrador has developed a 'Caribou Strategy' to address caribou population declines (Government of NL 2020f).

11.3.3 Potential Effects, Pathways and Measurable Parameters

Table 11.11 lists potential Project effects on caribou and their habitat and provides a summary of the Project effect pathways and measurable parameters, and units of measurement used to assess potential effects. Potential environmental effects and measurable parameters were selected based on review of recent environmental assessments (EAs) for mining projects in NL and other parts of Canada, comments provided during engagement, and professional judgment.

Project-related environmental effects can affect caribou directly or indirectly, and positively or adversely. A direct effect is characterized as an interaction resulting from the Project with no intermediate effects (e.g., habitat loss, mortality from vehicle collision), while an indirect effect is characterized as an interaction resulting from the Project that has intermediary steps. Indirect effects may occur at the same time and space as the direct effect (e.g., sensory disturbances associated with vegetation clearing) or at a later time and space (e.g., altered predator-prey dynamics following clearing).

Table 11.11 Potential Effects, Effect Pathways and Measurable Parameters for Caribou

Potential Environmental Effect	Effect Pathway	Measurable Parameter(s) and Units of Measurement
Change in habitat	• Direct and/or indirect loss or alteration of habitat arising from vegetation clearing and mine construction, and/or sensory disturbance (e.g., avoidance)	• Amount of high and moderate -ranked caribou habitat (km^2) directly or indirectly lost or altered relative to its availability in the ELCA
Change in movement	• Change in movement paths or patterns arising from habitat loss and/or sensory disturbance (e.g., avoidance)	• Amount of high and moderate -high existing caribou paths (km^2) directly lost or altered relative to availability in the migration corridor • Proportion of relative amount of use of the preferred migration path within the Project Area
Change in mortality risk	• Direct change in mortality risk due to vegetation clearing and site preparation activities, vehicular collisions, and indirect change in mortality risk (e.g., increased predation)	• Changes in traffic volumes during the life of the Project • Likelihood of interactions with Project infrastructure, vehicles and equipment

11.3.4 Project Interactions with Caribou

Table 11.12 identifies the physical activities that might interact with the VC and result in the identified environmental effect. These interactions are indicated by checkmark and are discussed in detail in Sections 11.3 to 11.5, in the context of effect pathways, standard and Project-specific mitigation /

enhancement, and residual effects. Following the table, justification is provided for where no interaction (and therefore no resulting effect) is predicted.

Table 11.12 Project-Environment Interactions with Caribou

Physical Activities	Environmental Effects to be Assessed		
	Change in Habitat	Change in Movement	Change in Mortality Risk
CONSTRUCTION			
Access Road Upgrade / Realignment: Where required, road widening and replacement / upgrades of roads and culverts.	✓	✓	✓
Construction related Transportation along Access Road	✓	✓	✓
Mine Site Preparation and Earthworks: Clearing and cutting of vegetation and removal of organic materials, development of roads and excavation and preparation of excavation bases within the mine site, grading for infrastructure construction. For the open pits, earthworks include stripping, stockpiling of organic and overburden materials, and development of in-pit quarries to supply site development rock for infrastructure such as structural fill and road gravels. Also includes temporary surface water and groundwater management, and the presence of people and equipment on site.	✓	✓	✓
Construction / Installation of Infrastructure and Equipment: Placement of concrete foundations, and construction of buildings and infrastructure as required for the Project. Also includes: • Installation of water control structures (including earthworks) • Installation and commissioning of utilities on-site • Presence of people and equipment on-site	✓	✓	✓
Emissions, Discharges and Wastes[A]: Noise, air emissions / GHGs, water discharge, and hazardous and non-hazardous wastes.	✓	✓	–
Employment and Expenditures[B]	✓	✓	✓
OPERATION			
Operation-related Transportation Along Access Road	✓	✓	✓
Open Pit Mining: Blasting, excavation and haulage of rock from the open pits using conventional mining equipment.	–	✓	✓
Topsoil, Overburden and Rock Management: Five types of piles: • Topsoil • Overburden • Waste rock • Low-grade ore • High-grade ore • Rock excavated from the open pits that will not be processed for gold will be used as engineered fill for site development, maintenance and rehabilitation, or will be deposited in waste rock piles.	–	✓	–

Table 11.12 Project-Environment Interactions with Caribou

Physical Activities	Environmental Effects to be Assessed		
	Change in Habitat	Change in Movement	Change in Mortality Risk
Ore Milling and Processing: Ore extracted from the open pits will be moved to the processing area where it will either be stockpiled for future processing or crushed and milled, then processed for gold extraction via gravity, flotation and leach processes.	–	✓	✓
Tailings Management Facility: Following treating tails via cyanide destruction, tailings will be thickened and pumped to an engineered TMF in years 1 to 9, then pumped to the exhausted Leprechaun open pit in years 10 through 12.	–	✓	–
Water Management (Intake, Use, Collection and Release): Recirculated process water and TMF decant water will serve as main process water supply, and raw water (for purposes requiring clean water) will be obtained from Victoria Lake Reservoir. Site contact water and process effluent will be managed on site and treated prior to discharge to the environment. Where feasible, non-contact water will be diverted away from mine features and infrastructure, and site contact and process water will be recycled to the extent practicable for use on site.	–	✓	–
Utilities, Infrastructure and Other Facilities • Accommodations camp and site buildings operation, including vehicle maintenance facilities • Explosives storage and mixing • Site road maintenance and site snow clearing • Access road maintenance and snow clearing • Power and telecom supply • Fuel supply	✓	✓	✓
Emissions, Discharges and Wastes[A]: Noise, air emissions / GHGs, water discharge, and hazardous and non-hazardous wastes.	✓	✓	–
Employment and Expenditure[B]	✓	–	✓
DECOMMISSIONING, REHABILITATION, AND CLOSURE			
Decommissioning of Mine Features and Infrastructure	✓	✓	✓
Decommissioning, Rehabilitation and Closure-Related Transportation Along Access Road	✓	✓	✓
Progressive Rehabilitation: Rehabilitating infrastructure or areas not required for ongoing operation (e.g., buildings, roads, laydown areas); covering and revegetating completed tailings areas, where practicable, including commencing closure of TMF beginning in Year 9 (when tailings deposition moves to Leprechaun open pit); erosion stabilization and re-vegetation of completed overburden and/or waste rock piles; infilling or flooding of exhausted mining areas; and completing revegetation studies and trials.	✓	✓	✓

Table 11.12 Project-Environment Interactions with Caribou

Physical Activities	Environmental Effects to be Assessed: Change in Habitat	Change in Movement	Change in Mortality Risk
Closure Rehabilitation: Active rehabilitation based on successes of progressive rehabilitation activities. Includes: demolishing infrastructure (e.g., buildings, equipment, facilities, roads, laydown areas); grading and revegetating cleared areas, where practicable; breaching and regrading ponds to reestablish drainage patterns; completing closure of TMF (covering with overburden and revegetating); erosion stabilization and revegetation of completed overburden and/or waste rock piles; and infilling or flooding of open pits.	✓	✓	✓
Post-Closure: long term monitoring	–	–	–
Emissions, Discharges and Wastes[A]	✓	✓	–
Employment and Expenditures[B]	✓	–	✓

Notes:
✓ = Potential interaction
– = No interaction
[A] Emissions, Discharges, and Wastes (e.g., air, waste, sound, light, liquid and solid effluents) are generated by many Project activities. Rather than acknowledging this by placing a checkmark against each of these activities, “Wastes and Emissions” is an additional component under each Project phase
[B] Project employment and expenditures are generated by most Project activities and components and are the main drivers of many socio-economic effects. Rather than acknowledging this by placing a checkmark against each of these activities, “Employment and Expenditures” is an additional component under each Project phase

During construction, no interaction was identified between caribou mortality risk and Emissions, Discharges and Waste. There is no apparent pathway as discharges will be treated to meet regulatory thresholds, which are designed to prevent adverse health effects to fauna, including caribou, prior to their release to the environment.

During operation, acoustic emissions and lighting associated with various mining activities are accounted for under Emissions, Discharges and Wastes; therefore, no further pathway exists between change in habitat and the following activities:

- Open Pit Mining
- Overburden and Rock Management
- Ore Milling and Processing
- Tailings Management Facility
- Water Management Intake

The above activities are also not anticipated to interact with change in mortality risk, except for Open Pit Mining, where there is the potential for collisions between vehicles on the site roads and haul roads and caribou, and the potential for individual caribou to be injured or trapped in an open pit. The above activities have been identified to interact with change in movement, as the physical presence of these mine features on the landscape may interrupt caribou movements.

During decommissioning, rehabilitation and closure, no interactions are anticipated between Post-Closure Monitoring and caribou habitat, movement or mortality risk, as there is no apparent pathway. There is also no predicted pathway between Emissions, Discharge and Waste and caribou mortality risk. In addition, no interaction was identified between Employment and Expenditures and caribou habitat and movement, as there is no apparent pathway for potential Project effects.

11.3.5 Analytical Assessment Techniques

The general approach to assessing potential environmental effects on caribou and their habitat follows the sequence and methods outlined in Chapter 4. Analytical assessment techniques specific to each potential environmental effect are described below.

11.3.5.1 Assumptions and the Conservative Approach

A conservative approach is used to address uncertainty in the environmental effects assessment, which increases confidence in the final determination of significance. Specifically, the following conservative assumptions were made:

- All habitat within the Project Area will be lost, resulting in a direct loss of habitat; in practice, not all vegetation will be cleared within the Project Area
- Both high and moderate -ranked habitat were included in the calculation of change in caribou habitat (rather than just high-ranked habitat) as a conservative measure
- Change in habitat was assessed within the ELCA (1,830.6 km^2), which constitutes 6.4% of the RAA (28,809 km^2); as the proportion of habitat affected by the Project within the RAA will be less than in the ELCA (as the RAA is considerably larger than the ELCA), the estimated proportion of Project-related change in habitat is conservative
- The distance from which indirect changes in habitat extend from the source were always assumed to occur at the maximum identified distances; in reality, the indirect effects will vary greatly depending on site activity
- With respect to sound, it was assumed there was no vegetation between the source of the noise and the receptor; in reality, some vegetation will attenuate sound pressure
- Direct mortality risk due to site preparation and mine activities was assessed using a conservative approach; caribou usually have the ability to move out of the way of danger and will typically avoid areas where work is being conducted, because of the presence of human activity and noise

The assumptions used to address uncertainty are identified as part of the description of analytical assessment techniques for each of the respective environmental effects (Sections 11.5.1-11.5.3). The prediction confidence of the assessment for caribou and their habitat (Section 11.7) incorporates these assumptions.

11.3.5.2 Change in Habitat

Change in caribou habitat was assessed for those Project activities identified with a checkmark in Table 11.12. The assessment of change in caribou habitat used a GIS to overlay the Project Area with spatial data generated from the ELC to determine the amount of high and moderate -ranked caribou habitat that may be directly affected by the Project. Additionally, the amount of caribou habitat indirectly affected by the Project (i.e., through sensory disturbance) was determined by calculating the amount of high and moderate -ranked caribou habitat that occurs within a 500 m sensory disturbance zone around the Project Area. While it is understood that caribou will preferentially use high-ranked habitat, the change in moderate-ranked habitat has also been included in the calculation for change in habitat as a conservative measure.

Direct change in caribou habitat (i.e., loss of physical habitat) was calculated as the loss of suitable habitat from clearing and development of the Project Area. Habitat types were ranked as low, moderate or high quality, and those ranked as high or moderate were categorized as suitable habitat. The assessment of direct change assumes that habitat in the Project Area will be of no or limited value for caribou during the construction and operation phases, and during active rehabilitation in the decommissioning, rehabilitation and closure phase.

Indirect changes in habitat result primarily from avoidance of anthropogenic disturbance. Indirect effects on habitat were measured based on the estimated area of potential sensory disturbance, primarily from sound and light emissions. The sensory disturbance zone defines the area over which the effects of a disturbance are assumed to reduce the effectiveness of the adjacent caribou habitat due to avoidance or underutilization. For this assessment, a sensory disturbance zone of 500 m was applied around the outer extent of the Project Area where vegetation will not be removed. The use of a 500 m buffer for caribou is aligned with the federal Scientific Assessment to Inform the Identification of Critical Habitat for Woodland Caribou (*Rangifer tarandus caribou*), Boreal Population, in Canada (Environment Canada 2011), which applies a 500 m zone to anthropogenic disturbances to determine overall disturbed caribou habitat. Direct and indirect effects were considered in the context of habitat availability within the ELCA. As sensory disturbance within the 500 m buffer will be more substantial than outside of the 500 m buffer (given the proximity to Project activities), habitat within the buffer is considered to have reduced value for caribou during the construction and operation phase, and during active rehabilitation in the decommissioning, rehabilitation and closure phase.

The assessment of Project-related habitat loss conservatively includes both direct habitat loss within the Project Area and indirect habitat loss within the 500 m buffer, to include the area of greatest sensory disturbance. Calculations for the amount of direct habitat loss are based on the footprint of the Project Area. Indirect habitat loss in the sensory disturbance zone include the 500 m buffer only and do not include the footprint of the Project Area (to avoid counting the Project Area twice).

11.3.5.3 Change in Movement

Change in caribou movement was assessed for those Project activities identified with a checkmark in Table 11.12. For the purposes of this assessment, 'migration corridor' refers to a broader area used for migration at the population-level. The migration corridor is composed of various smaller 'migration paths', which are used by individual caribou. A migration path may be used by a single individual or several caribou. The Project may affect caribou movement by altering existing migration corridors. Existing migration corridors directly overlap with Project infrastructure, which could disrupt movement patterns. Caribou movement may also be indirectly affected by Project-related sensory disturbance, which could cause avoidance of the dominant migration paths beyond the Project Area.

The assessment of change in movement used a GIS to overlay the Project Area with spatial data generated from the analysis of migration (Section 11.2.1.3) to determine the length and area of the migration corridor, and the portion that overlaps the Project Area. Additionally, the percentages of high and moderate -high use areas within the migration corridor that overlap the Project Area were calculated. The location of the migration corridors in relation to the Project Area was assessed qualitatively. An analysis of migration corridor selection and migration path use was completed, and that analysis identified one dominant migration path for both spring and fall migration, as described in Section 11.2.2.1.

11.3.5.4 Change in Mortality Risk

Change in caribou mortality risk was assessed for those Project activities identified with a checkmark in Table 11.12. Change in mortality risk was assessed qualitatively through a review of the literature and professional judgment. Changes in direct and indirect sources of mortality were considered. Both the construction and the operation phases are the focus of the assessment of mortality risk. During decommissioning, rehabilitation and closure activities, adverse Project effects on mortality risk are expected to be less pronounced relative to the construction and operation phases due to the reduced level of Project activities. The effects of the Project on mortality risk are expected to decline over the duration of closure, with a return to baseline conditions at the end of active closure. A conservative approach has been used to characterize the effects of decommissioning, rehabilitation and closure by using the same effects as described for construction.

Direct sources of mortality risk are estimated through predictions of increases in construction activity and equipment, vehicular traffic and hunting activity by Project workers. Direct sources of mortality risk, mainly associated with construction and operation phases of the Project, are also assessed through predictions of wildlife interactions with Project infrastructure. Indirect sources of mortality are assessed qualitatively and include predictions of changes in predator-prey interactions and harvest pressure. Indirect sources of mortality are associated with all phases of the Project.

11.4 MITIGATION AND MANAGEMENT MEASURES

A series of environmental management plans will be developed by Marathon to mitigate the effects of Project development on the environment. Project planning and design and the application of proven mitigation measures will be used to reduce adverse effects to caribou. Mitigation measures to reduce potential adverse effects on caribou and their habitat are provided in Table 11.13. Environmental management plans will also be developed by Marathon to mitigate the effects of Project development on the environment. Project planning and design, and the application of proven mitigation measures, will be used to reduce adverse effects on habitat, movement and mortality risk for caribou. Mitigation measures identified in other VCs are also expected to reduce potential adverse effects on caribou (Chapter 5 –

Atmospheric Environment, Chapter 7 – Surface Water Resources, Chapter 9 – Vegetation, Wetlands, Terrain and Soil, Chapter 10 – Avifauna and Chapter 12 – Other Wildlife).

Marathon has already completed some early mitigation with respect to potential effects of the Project on caribou. Early in the EA process, and based on consultation with regulators, Indigenous groups, stakeholders, NL Hydro and in particular with respect to caribou, with the NLDFFA-Wildlife Division, Marathon completed a review and update of the Project design and layout to address concerns raised, including those specifically regarding caribou. The following changes in the Project design and layout were implemented to, at least in part, reduce potential effects on caribou:

- The TMF location study considered the caribou migration corridor and paths in the evaluation of location options
- Victory pit was removed from the Project design, eliminating additional Project activities and infrastructure that could further affect migration
- The process plant was moved to the west of the new TMF location, reducing potential sensory disturbance along the migration paths
- The Marathon waste rock pile was relocated and reconfigured, reducing the footprint perpendicular to the migration path
- Based on consultation with NL Hydro, the proposed power line route was relocated to align with the existing access road, and will follow existing access roads along its entire route to the Star Lake generating station, thereby eliminating development of a new linear feature in the area

Table 11.13 Mitigation Measures: Caribou

Category	Mitigation	C	O	D
Site Clearing, Site Preparation and Erosion and Sediment Control	• Project footprint and disturbed areas will be limited to the extent practicable.	✓	-	-
	• Vegetation will be maintained around high activity areas to the extent practicable, to act as a buffer to reduce sensory (light and noise) disturbance.	✓	-	-
Vehicles / Equipment / Roads	• Vehicles and heavy equipment will be maintained in good working order and will be equipped with appropriate mufflers to reduce noise.	✓	✓	✓
	• Vehicles will use existing roads / trails while operating at the mine site. All-terrain vehicles used by Marathon personnel will also be restricted to existing roads, trails and corridors to the extent possible.	✓	✓	✓
	• Project vehicles will be required to comply with posted speed limits on the access road, site roads and haul roads to limit fugitive dust from vehicle travel on unpaved roads. Speed limits will be set in accordance with provincial regulations and industry standards (e.g., for haul roads). Additional speed restrictions will be implemented during caribou migration periods.	✓	✓	✓

Table 11.13 Mitigation Measures: Caribou

Category	Mitigation	C	O	D
Vehicles / Equipment / Roads	• Caribou crossing on roads / features will be facilitated where they occur (e.g., crossing point across ditch) within the caribou migration corridor. The access road, site roads and haul roads will be designed for provision of low areas in the plowed snowbanks, where practicable, to facilitate wildlife movements: – Breaks in snowbanks will be created at approximately 200 m intervals, to the extent practicable, to provide wildlife crossing opportunities – Snow berms will typically be less than 1 m tall to facilitate caribou crossing – Where feasible, breaks in snowbanks will be aligned on opposing sides and with existing wildlife trails, where they occur, to facilitate caribou crossing	✓	✓	✓
	• Project-related air traffic (helicopter, airplane) will maintain a minimum ferrying altitude of 500 m to the extent feasible.	✓	✓	✓
	• Marathon will develop and implement a Traffic Management Plan to manage transportation of workers and materials to site, product leaving site, the number of vehicles accessing the site, and to reduce traffic delays.	✓	✓	✓
	• Marathon will implement traffic control measures to restrict public access to the mine site, which may include gating approaches, placing large boulders and/or gated fencing.	✓	✓	✓
Light Emissions	• Project lighting will be limited to that which is necessary for safe and efficient Project activities. Lighting design guidelines will be followed, such as the Commission Internationale de L'Éclairage, International Dark Sky Association, Illuminating Engineering Society, and the lighting requirements for workspaces, as applicable.	✓	✓	✓
	• Mobile and permanent lighting will be located such that unavoidable light spill off the working area is not directed toward receptors outside of the Project Area, to the extent practicable.	✓	✓	✓
Noise Emissions	• Project facilities and infrastructure will be designed to limit noise emissions.	-	✓	-
Site Water Management	• Water management ditches will be designed to allow wildlife crossing opportunities, aligned with wildlife trails where practicable.	✓	✓	✓
Tailings Management	• Cyanide detoxification within the mill using the sulphur dioxide / air oxidation process will result in the degradation of cyanide and precipitation of metals prior to discharge to the TMF.	-	✓	-
Materials Handling and Waste Management	• Through proper handling and storage of industrial materials and debris, the mine site will be maintained in a manner that reduces the risk that caribou and other wildlife will encounter potential hazards.	✓	✓	✓

Table 11.13 Mitigation Measures: Caribou

Category	Mitigation	C	O	D
Wildlife / Avifauna Management	• The potential for on-site activity to be limited / restricted during caribou migration to reduce sensory disturbance will be reviewed with regulators.	✓	✓	✓
	• Activities in the Marathon pit area that may result in sensory disturbance to migrating caribou (e.g., blasting, loading, hauling) will be reduced or ceased while caribou are migrating through the corridor and within a set distance from the site (e.g., 10 km north or south). The extent of the activity reduction, and the conditions regarding caribou migration proximity will be determined in consultation with NLFFA-Wildlife Division and potentially developed under an adaptive management approach as described in Section 11.9.	✓	✓	✓
	• Wildlife-vehicle collisions, near misses or observations of wildlife (caribou, moose) road mortality on site roads and/or involving Project vehicles on the access road will be reported to the on-site environmental team and the NLDFFA - Wildlife Division. Adaptive management measures will be implemented should locations of high frequency wildlife-vehicle interactions be identified.	✓	✓	✓
	• The on-site environment team will be notified if caribou are observed within 500 m of Project activities such as vegetation clearing, construction, heavy equipment use, and the environmental manager will determine if the activity will be reduced or delayed (in consultation with NLDFFA-Wildlife Division, as applicable).	✓	✓	✓
	• The TMF will be monitored daily during caribou migration for hazards to caribou and caribou activity. Observations or signs of caribou within 500 m of the TMF will be reported to the on-site environmental manager. If observed repeatedly, Marathon will employ mitigation measures, such as fencing at the TMF, to discourage caribou from accessing the area.	✓	✓	-
	• If caribou are observed near the open pits during migratory periods, fencing may be installed as needed around the crest of the pits to reduce the risk of caribou becoming entrapped or injured. Note that a barrier (usually large rock) is required to be installed adjacent to the pit crest for closure and is usually completed as part of progressive rehabilitation activities – this barrier could be erected to achieve both purposes. Marathon will consult with NLFFA-WD on this issue.	✓	✓	✓
	• Caribou activities during the migratory periods will be monitored in the vicinity of the Project through visual observation, aerial surveys, and/or telemetry data from GPS (global positioning system) collars.	✓	✓	✓
	• To reduce the risk of caribou-vehicle collisions, caribou will have right-of-way except where deemed unsafe to site personnel. If wildlife is on a road, speed will be reduced and vehicle stopped if necessary, to allow wildlife to leave road.	✓	✓	✓
	• If a caribou mortality is observed or discovered on site or are reported by Project personnel, Marathon will report this event to NLDFFA-Wildlife Division as soon as possible.	✓	✓	✓
	• To reduce sensory disturbance, a visual survey for caribou will be conducted prior to blasting. If caribou are observed within a 500 m blasting radius buffer activity will be delayed until animals have left the buffer.	✓	✓	-

Table 11.13 Mitigation Measures: Caribou

Category	Mitigation	C	O	D
Wildlife / Avifauna Management	• Pets will be prohibited on site.	✓	✓	✓
Employment and Expenditures	• Hunting / fishing / harvesting of wildlife will be strictly prohibited on the mine site. Workers will not be permitted to hunt / fish / harvest while staying at the accommodations camp and will not be permitted to bring firearms or angling gear to site.	✓	✓	✓
	• Workers will be bussed from nearby designated communities to the mine site for rotations.	✓	✓	✓
Rehabilitation and Closure	• Marathon will develop a Rehabilitation and Closure Plan that meets the requirements of the Department of Industry, Energy and Technology, Department of Environment, Climate Change, and Municipalities, and Department of Fisheries, Forestry and Agriculture. The plan will be reviewed and updated regularly until implemented.	✓	✓	✓
	• Linear features on the mine site (i.e., roads and power line corridors) not required for long-term monitoring will be decommissioned and rehabilitated to limit future hunting pressures on wildlife and restore habitat to pre-mine conditions where possible.	-	-	✓

Notes:
C – Construction Activities
O – Operation Activities
D – Decommissioning, Rehabilitation and Closure Activities

11.5 ASSESSMENT OF ENVIRONMENTAL EFFECTS ON CARIBOU

For each potential effect identified in Section 11.3.3, specific Project activities that may interact with the VC and result in an environmental effect (i.e., a measurable change that may affect the VC) are identified and described. The following sections first describe the pathways by which a potential Project effect could result from Project activities in the absence of mitigation during each Project phase (i.e., construction, operation and decommissioning, rehabilitation and closure). Mitigation and management measures (Section 11.4) are applied to avoid or reduce these potential pathways and resulting environmental effects. Residual effects are those remaining following implementation of mitigation, which are then characterized using the criteria defined in Section 11.3.1. A summary of predicted residual effects is provided in Section 11.5.4.

11.5.1 Change in Habitat

11.5.1.1 Project Pathways

Construction

The primary pathway for change in caribou habitat associated with construction activities is habitat loss through direct vegetation removal. Site preparation activities will include clearing and cutting of vegetation, removal of organic materials and overburden, construction of ditches and sedimentation ponds, and upgrade and realignment of the access road, as well as construction of site roads and haul roads. These activities will result in the direct loss of trees, shrubs and understory vegetation, including lichens. Earthworks, such as removal of soils and excavation activities (e.g., open pit preparation), will remove remaining vegetation and will likely alter the remaining soil layers, changing habitat quality for plants that may later regenerate within the area.

In addition to direct habitat loss, sensory disturbance (e.g., sound and light emissions) associated with site preparation, earthworks and mine construction activities and equipment, including construction-related transportation on the access road, has the potential to indirectly affect caribou habitat by causing avoidance of the site. Road upgrade and realignment activities may also affect caribou habitat adjacent to the road through other indirect mechanisms, such as dust deposition, which may reduce caribou habitat suitability by altering vegetation communities and functionally reducing caribou forage (i.e., potential avoidance of consuming dust-covered plants).

Loss of habitat directly due to vegetation removal, or habitat avoided due to sensory disturbance, could adversely affect caribou (e.g., lower forage availability, greater predation risk). Additionally, caribou may be displaced to habitats that are less secure or have lower forage value or require higher energetic costs for movement. Use of less ideal habitat could lead to reduced survival and reproductive success. Direct habitat loss will persist through the life of the Project until the completion of rehabilitation activities. Sensory disturbance from construction activities will vary in duration, magnitude and location, depending on the activity. For example, there will be less sensory disturbance created by vehicles on the access road than from earth-moving activities. The effect of sensory disturbance on caribou may be greater during key life cycle periods (e.g., calving).

Operation

The majority of habitat loss for caribou will occur during the construction phase. For this assessment, it has been assumed that caribou habitat will generally not be restored during operation due to ongoing activity within the Project Area such as mining activities, overburden and rock management, ore milling and processing, water management and road maintenance and use. There will be few direct effects on caribou habitat during operation, as the removal of caribou habitat during the operation phase will be limited.

Operation activities will contribute to change in habitat for caribou indirectly through sensory disturbance. This will persist throughout the operation phase due to ongoing mine activity. Noise and vibration disturbance generated through equipment and activities such as rock breakers, blasting and heavy equipment operations have the potential to indirectly affect caribou habitat adjacent to the Project Area and may cause reduced use or avoidance by caribou. Maintenance activities on the access road may also indirectly affect caribou habitat adjacent to the access road through dust deposition, which could reduce habitat suitability as caribou may avoid dust-covered forage.

The extent of habitat loss for caribou through sensory disturbance resulting from operation activities will vary with the type and intensity of disturbance, season and spatial scale, and may have a greater effect during sensitive life cycle periods (e.g., calving).

Decommissioning, Rehabilitation and Closure

Pathways that affect caribou habitat will change over time as mine operation transitions towards habitat restoration during decommissioning, rehabilitation and closure, which will include removing infrastructure, revegetating tailings, overburden and waste rock piles, and infilling or flooding mining areas. These activities may reverse some of the adverse effects on caribou habitat.

Decommissioning, rehabilitation and closure activities include the removal of infrastructure and revegetation of disturbed areas. While regenerating habitat is generally considered low-quality for caribou, the revegetated areas would mature during post-closure and become more suitable for caribou over time. Not all changes to caribou habitat resulting from the Project will be able to be reversed through rehabilitation. Certain components of the Project, such as the open pits that will be flooded, will not return to baseline condition following rehabilitation. Additionally, some vegetated communities within the Project Area are not expected to return to baseline conditions.

Sensory disturbance from decommissioning, rehabilitation and closure -related activities such as demolishing infrastructure and transportation along the access road could affect caribou habitat indirectly, as caribou may continue to avoid the area while physical activities are occurring. However, the level of sensory disturbance is expected to be less than during operation and to gradually return to baseline conditions following closure.

11.5.1.2 Residual Effects

Project-related change in habitat was identified as an environmental effect with the potential for interaction with caribou. The avoidance of anthropogenic disturbance and its effects are well documented for caribou (e.g., Vors et al. 2007). Caribou react to both the presence of physical structures in their habitat and to sensory disturbances caused by human activity. The mechanisms for change in caribou habitat considered in this assessment are direct habitat loss through Project-related vegetation clearing and mine construction, and indirect habitat loss through sensory disturbance from construction, operation and decommissioning activities.

Vegetation Clearing and Mine Construction

Caribou habitat will be most affected by site preparation activities during construction, such as vegetation clearing and earthworks. Although the Project effect on change in habitat assumes that all suitable caribou habitat within the Project Area will be adversely affected, mitigation will include measures to reduce the footprint of cleared areas and to avoid unnecessary habitat disturbance within the Project Area (Table 11.13).

Caribou require large interconnected, lichen-rich, mature coniferous forests interspersed with barrens and wetlands (Environment Canada 2012; Weir et al. 2014; Government of NL 2020b). Lichens are the most important forage (Government of NL 2020b) and are consumed by caribou in all seasons (Boertje 1984; Thomas et al. 1994; Thompson et al. 2015). Habitat types that are selected by caribou and that provide the greatest amounts of lichen and other preferred forage were ranked as high-value habitat. On the Island of Newfoundland, this included Balsam Fir Forest, Black Spruce Forest, Kalmia-Black Spruce

Woodland and Open Wetlands (Table 11.8), as these habitat types are most frequently selected by caribou (Chubbs et al. 1993; Rettie and Messier 2000; Mahoney and Virgl 2003; Courtois et al. 2004; Bastille-Rousseau et al. 2015; Schaefer et al. 2016).

Most of the direct habitat loss for caribou will be caused by vegetation clearing and earthworks. Research has shown that caribou avoid anthropogenic activity and infrastructure including mines (Weir et al. 2007; Plante et al. 2018), roads (Dyer et al. 2002; Plante et al. 2018) and power lines (Vistnes and Nellemann 2001; Plante et al. 2018) (Table 11.14). Table 11.14 includes examples of spatial areas of avoidance surrounding activities and structures. In addition to mining activity, the Project will also include linear features (i.e., roads and power lines). Caribou show avoidance of roads even when inactive, indicating avoidance of the feature in the absence of human activity (Oberg 2001).

Some research has shown increased caribou home range size in disturbed areas, probably in response to avoiding disturbed habitat (Courtois et al. 2007). However, caribou survival decreased with increasing levels of disturbance within the home range (Courtois et al. 2007). Caribou also shift their individual home ranges to avoid overlap with disturbed areas, which may result in less use of previously used ranges (MacNearey et al. 2016). Caribou select habitat based on its ability to provide an optimal balance of features, such as forage opportunities and reduced predation risk. A shift in caribou distribution following disturbance from a previously used range could result in the use of habitat that was not selected previously (i.e., less preferred or less suitable) (Sawyer et al 2006).

Table 11.14 Avoidance of Anthropogenic Structures by Caribou

Type of Activity or Structure	Amount of Avoidance	Source
Mines		
Not specified	Up to 5 km	Leblond et al. 2014
	2 km in winter 0.25 km during summer	Polfus et al. 2011
Gold Mine (Hope Brook Gold Mine – Open Pit and Underground)	Up to 4 km year-round Up to 6 km during calving	Weir et al. 2007
Diamond Mine (Ekati and Diavik Diamond Mines – Open Pit)	11-14 km in winter	Boulanger et al. 2012
Nickle and Copper Mine (Raglan Mine – Underground)	Up to 19-23 km (only summer was analyzed)	Plante et al. 2018
Quartzite (Sydvaranger Mine – Surface Mining)	1.5 km	Eftestøl et al. 2019
Coal Mine (Wolverine and Trend Mines – Open Pit)	3 km	Johnson et al. 2015

Table 11.14 Avoidance of Anthropogenic Structures by Caribou

Type of Activity or Structure	Amount of Avoidance	Source
Oil and Gas Development		
Wells, Pipelines	1 km during mosquito harassment 2 km during post-calving season 5 km during calving season (well pads, pipelines, processing stations and associated roads)	Johnson et al. 2020
	4.25 km during summer (mountainous habitat) 2-12.5 km during summer (boreal habitat) (oil and gas wells and facilities)	Johnson et al. 2015
Seismic Lines	100-200 m	Dyer et al. 2001
	2-2.5 km	Johnson et al. 2015
Wells	250 m-1 km	Dyer et al. 2001
Hydroelectic Dam	3 km	Mahoney and Schaefer 2002
Linear Features		
Roads	Up to 5 km (forest road and paved road)	Leblond et al. 2014
	Up to 8 km (gravel road)	Plante et al. 2018
	4 km for calving females	Cameron et al. 2005
	250 m (gravel roads)	Dyer et al. 2001
	1.75 km	Johnson et al. 2015
Power lines	2.5 km	Nellemann et al. 2001
	4 km	Vistnes and Nellemann 2001
	4 km	Nellemann et al. 2003
Forestry Activity		
Recent Cut Blocks	10 km (females from new cut block) 4 km (males from new cut block) 2 km (males from 1-year old cut block)	Chubbs et al. 1993
	5.5 km	Johnson et al. 2015
	1.2 km (recently fragmented areas)	Smith et al. 2000
	9.2 km (females, active cut blocks)	Schaefer and Mahoney 2007

RSFs are often used to explain caribou selection for (or avoidance of) habitat features. RSFs are models used in spatial ecology to assess the habitat characteristics selected by wildlife. The models require wildlife locational data (e.g., telemetry data) and habitat data that describe the habitat characteristics, including the availability of habitat types. Research has shown that the outputs of RSFs depend on the scale of selection on which it is modelled (i.e., first order: selection of population home range; second-order: individual home range; and third order: individual locations within the home range), meaning it may not be possible to apply RSF results (i.e., selection or avoidance of a feature) to other scales (DeCesare et al. 2010). Therefore, the scale at which an RSF is modelled should be considered when assessing implications of habitat selection and potential project effects.

As the research frequently does not separate the effects of habitat loss from the effects of sensory disturbance arising from human activity (e.g., Vors et al. 2007; Plante et al. 2018), recent clear-cuts and forest fires are discussed in this section as examples of habitat loss with lesser amounts of sensory disturbance. Caribou have been shown to avoid recently cut forestry blocks in both summer (Chubbs et al. 1993; Schaefer and Mahoney 2007) and winter (Smith et al. 2000). Caribou home-range size has been found to initially increase with increasing disturbance. However, when the amount of disturbance increases beyond a certain level, home ranges contract (Beauchesne et al. 2014). Areas recently burned by forest fire may be avoided by caribou, particularly in winter, as caribou may select other, undisturbed habitat types with higher amounts of lichen (Schaefer and Pruitt 1991). However, while caribou may prefer unburned areas, caribou may also select burned areas with residual unburned patches, as these may provide both food availability and increased predator detection due to openness (Skatter et al. 2017).

Fragmentation is defined as the process by which large, contiguous habitats are subdivided into smaller, isolated habitat patches and results in habitat loss. Some fragmentation will occur because of the Project, particularly in the mine site, through installation of mining infrastructure and linear features (i.e., the access and haul roads, power lines). As caribou require large, interconnected tracts of lichen-rich forest (Environment Canada 2012), changes in habitat that affect the interconnectivity between optimal habitat patches can affect caribou, as can the loss of habitat. Caribou avoid assemblages of different habitats types and the boundaries between them (Stuart-Smith et al. 1997; Smith et al. 2000). While some research has demonstrated avoidance of power lines by caribou (Nellemann et al. 2001; Vistnes et al. 2001), other research has found that reindeer in Finland avoid power lines during construction, yet show no avoidance following construction (Eftestøl et al. 2016). While caribou avoid crossing roads (Dyer et al. 2002), migrating caribou have also been shown to cross fences (Miller et al. 1972). Other mine infrastructure, such as open pits and piles of ore, waste rock and overburden, may also result in some habitat fragmentation. However, the largest linear feature associated with the Project (i.e., the access road) already exists, and while widening the access road will result in minor habitat loss, it will not increase fragmentation.

The amount of direct habitat loss from vegetation clearing was calculated for the Project Area (Table 11.15). While the Project Area may retain some areas where vegetation will not be removed, the calculation of direct habitat loss for this assessment conservatively assumes that all habitat in the Project Area will be lost. Within the ELCA, 28.5 km^2 of high and moderate-ranked caribou habitat will be directly lost through site preparation (e.g., vegetation removal, earthworks) in the Project Area (Table 11.15) equal to approximately 2% of the total ELCA. Project-related change in habitat will have the greatest effect on caribou whose home-ranges overlap the Project Area. Analysis of the assessed caribou herds showed that the winter, calving and spring migration / pre-calving ranges of the Grey River herd overlapped the Project Area (Figure 11-9). However, the percentage of overlap was less than 2% of the Grey River herd seasonal range (Table 11.16). The Buchans herd also overlaps with the Project Area (Figure 11-5). While the ranges for winter, spring migration / pre-calving, post-calving / rearing, fall migration / dispersal and fall rut overlapped the Project Area, the percentage of overlap was approximately 1% of the Buchans herd seasonal range (Table 11.16). The La Poile herd had no seasonal range overlap with the Project Area (Table 11.16). There is no overlap between the Gaff Topsails herd and the mine site, and a small amount of overlap with the existing access road during the winter (Table 11.16). The Project-related habitat loss due to vegetation clearing and mine construction will affect a small amount of seasonal range for the Buchans and Grey River herd. The effects of direct habitat loss will not affect the Gaff Topsails and La Poile herds as their seasonal ranges have little to no overlap with the Project Area.

Table 11.15 Residual Project-Related Change in Caribou Habitat in the ELCA

Habitat Value Ranking	Existing Conditions in the ELCA[A] (km^2)	Direct Loss[A,B] (km^2)	Indirect Loss[A,C] (km^2)	Total Habitat Loss (Direct and Indirect Loss Combined)[A] (km^2)	Percent of High and Moderate Value Habitat Loss in ELCA[A] (Direct and Indirect Loss Combined) (%)
High	849.1	18.7	29.3	48.1	5.7
Moderate	718.5	9.8	28.0	37.8	5.3
Total (High and Moderate)	1,567.6	28.5	57.3	85.8	5.5

Notes:
[A] Numbers rounded to one decimal place. Areas may not add up to total amounts due to rounding.
[B] Values based on Project Area.
[C] Values based on 500 m buffer around Project Area.
Values pertain to the portion of the Project Area and LAA with ELC data.

Table 11.16 Overlap Between Areas of Seasonal Use by Collared Caribou from the Assessed Caribou Herds and the Project Area

Season	Total Overlap with Project Area[E] in km^2 (Overlap with Mine Site + Overlap with Access Road)							
	Buchans[A]		Gaff Topsails[B]		Grey River[C]		La Poile[D]	
	50% kernel	95% kernel	50% kernel	95% kernel	50% kernel	95% kernel	50% kernel	95% kernel
Winter	0.3 (0 + 0.3)	15.1 (13.4 + 1.7)	0	0.4 (0 + 0.4)	0	0	0	0
Spring Migration / Pre-Calving	0.8 (0 + 0.8)	35.0 (32.0 + 3.0)	0	0	0	0.7 (0.7 + 0)	0	0
Calving	0	0	0	0	11.8 (11.8 + 0)	27.3 (27.3 + 0)	0	0
Post-Calving Migration / Dispersal	0	0	0	0	0	0	0	0
Post-Calving Rearing	16.0 (16.0 + 0)	32.5 (32.0 + 0.6)	0	0	0	1.3 (1.3 + 0)	0	0
Fall Rut	0	0.3 (0 + 0.3)	0	0	0	0	0	0

Table 11.16 Overlap Between Areas of Seasonal Use by Collared Caribou from the Assessed Caribou Herds and the Project Area

Season	Total Overlap with Project Area[E] in km² (Overlap with Mine Site + Overlap with Access Road)							
	Buchans[A]		Gaff Topsails[B]		Grey River[C]		La Poile[D]	
	50% kernel	95% kernel	50% kernel	95% kernel	50% kernel	95% kernel	50% kernel	95% kernel
Fall Migration / Dispersal	0	32.3 (32.0 + 0.3)	0	0	0	0	0	0

Notes:
† Amounts calculated using only collars with more than 50 locations in the season
A Telemetry data from 2005 – 2018
B Telemetry data from 2006 – 2013. Gaff Topsails data from 2005 was not included in the calculation because the collars had less than 50 locations per season
C Telemetry data from 2006 – 2013. Grey River data from 2005 was not included in the calculation because the collars had less than 50 locations per season
D Telemetry data from 2006 – 2013. La Poile data from 2005 was not included in the calculation because the collars had less than 50 locations per season
E Numbers rounded to one decimal place. Areas and percentages may not add up to total amounts due to rounding.

Although the Project effect on change in habitat conservatively assumes that all habitat within the Project Area will be lost, the actual extent of vegetation clearing within the Project Area will be less. This will be done, to the extent practical, by limiting the area to be cleared, avoiding disturbance of natural habitats, and aligning or combining Project features (e.g., roads, power lines) with existing disturbances.

Sensory Disturbance

Caribou show decreased use of habitat near anthropogenic structures (Table 11.14). In addition to direct habitat loss resulting from vegetation clearing and mine construction, caribou habitat will also be indirectly affected by sensory disturbance arising from Project-related activities.

Caribou have been documented to reduce use of habitat within 2 km to 11 km of mines (e.g., Weir et al. 2007; Polfus et al. 2011; Boulanger et al. 2012; Johnson et al. 2015) (Table 11.14). Caribou avoidance of disturbance may be affected by the type and intensity of the disturbance. Features of disturbance, such as habitat, infrastructure type and location, could affect the perceived risk of the disturbance due to differences in visibility and sound (Benítez-López et al. 2010). Avoidance by caribou of the Raglan Mine of up to 23 km has been observed, although not all caribou included in that study exhibited this degree of an avoidance distance (Plante et al. 2018). Plante et al. (2018) suggested that the open tundra surrounding the mine could have affected the perceived zone of influence (ZOI) for caribou on that project.

While caribou have been shown to avoid inactive roads (Oberg 2001) and roads with little traffic (Dyer et al. 2001), caribou showed the greatest avoidance of roads during the highest traffic period (Dyer et al. 2001). Caribou have also been shown to have increased avoidance of roads with higher disturbance intensity (i.e., highway compared to smaller roads) (Leblond et al. 2013). Other ungulates (i.e., red deer) may avoid crossing roads during periods of increased traffic (Kušta et al. 2017). This variability in response to disturbance indicates that the extent of sensory disturbance for caribou may vary due to several factors including season, habitat, intensity or type of disturbance.

Sound and light emissions are the primary mechanisms for sensory disturbance. These mechanisms will occur primarily during the construction and operation phases during blasting, heavy equipment and traffic operation and other mine site activities. Sound pressure levels related to construction are predicted to be below 35 dBA (background levels) approximately 5 km from the mine site, and at 25 dBA approximately 8 km from the mine site (Chapter 5). Sound pressure levels related to the access road are predicted to be 25 dBA approximately 1 km from the access road during rotation changes. During operation, sound pressure levels related to operation are predicted to be below 35 dBA approximately 5 km from the mine, and 25 dBA approximately 10 km from the mine. Sound pressure levels related to the access road are predicted to be 25 dBA approximately 1 km during rotation changes. Within the mine site, predicted sound pressure levels could reach approximately 80 dBA (e.g., rock breaker: 80 dBA at 100 m distance; processing plant: 67 dBA at 100 m; edge of Marathon Pit: 52 dBA at 100m; edge of Leprechaun Pit: 55-60 dBA at 100 m). Acoustic modelling for this assessment assumes no vegetation between the source of the noise and the receptor, adding conservatism to the estimates. Studies have shown that effects of acoustic emissions on wildlife have the potential to occur above 40 dBA (Shannon et al. 2016).

A ZOI is defined as the distance at which caribou change their behaviour, habitat selection and distribution relative to disturbance (Boulanger et al. 2012). A ZOI describes how far the effects of a disturbance extend from the source. The ZOI for the Project considers the following:

- The area of habitat indirectly lost from sensory disturbance (i.e., the 500 m buffer around the Project Area [Environment Canada 2011]) where the highest level of sensory disturbance is anticipated due to proximity to Project activities
- Results from acoustic emission modelling for the Project, which predict a return to baseline sound pressure levels 5 km from the mine site
- ZOIs presented in the literature that show caribou avoidance of mines between 2 and 11 km (Table 11.15)

The ZOI for the Project will depend on several factors including the intensity and duration of the disturbance, topography, habitat type and the timing of the disturbance (e.g., calving, migration). The 2020 aerial post-calving survey included a 17-km buffer around the mine site and a 4-km buffer along the south side of the access road (BSA.2, Attachment 2-C). This buffer size was selected for the survey to gather existing data on caribou distribution prior to construction such that it may be considered in discussions about changes in caribou distribution over time if such effects are evident.

Indirect habitat loss attributed to sensory disturbance from the Project (based on 500 m buffer) will be 57.3 km^2 of high and moderate -ranked habitat (Table 11.15). When combined with direct habitat change in the Project Area, 85.8 km^2 (representing 5.5% of the ELCA) of habitat will be altered (Table 11.15). Of the assessed caribou herds, the effects of Project-related sensory disturbance will be greatest for the Buchans and Grey River herds (Table 11.16). The Gaff Topsail and La Poile herds have little to no overlap with the Project Area (Table 11.16), and the effects of sensory disturbance on these herds are predicted to be negligible.

A variety of mitigation measures have been proposed to reduce the effects of sensory disturbance on wildlife. For example, vehicles and heavy equipment on site will be equipped with appropriate mufflers to reduce noise. Project-related air travel (i.e., helicopters) will maintain a minimum ferrying altitude of 500 m, where feasible, to reduce noise disturbance. Project lighting will be limited to that required to ensure safe and feasible Project activities, and directional lighting will be used to the extent practicable (Table 11.13). These mitigation measures will help reduce sensory disturbance effects on wildlife, including on caribou, during construction, operation and decommissioning.

11.5.1.3 Summary

With mitigation, the Project is anticipated to result in adverse effects to caribou habitat that are low in magnitude, occur continuously, and are long-term in duration. As caribou are known to avoid disturbance by more than 1 km, the geographic extent of the effect will extend into the RAA. Caribou may show various degrees of avoidance beyond the 500-m buffer, as the level of sensory disturbance may vary in this extended area depending on the season, location and nature of Project activities. Project-related changes in habitat will occur during all Project phases and are generally adverse in direction, although some neutral changes in habitat may occur during decommissioning. The existing conditions in the ELCA are disturbed from mineral exploration, mining, forestry, and hydroelectric development, and from the existence of roads, including the access road. While effects on change in habitat will be greatest for the Grey River and Buchans herds, the residual effect is anticipated to be low in magnitude for all assessed herds. The Project will result in the loss or alteration of 85.8 km^2 of high and moderated -ranked caribou habitat in the ELCA (i.e., the Project Area, plus the 500-m sensory disturbance buffer), a decrease of less than 6% from existing conditions within the ELCA.

11.5.2 Change in Movement

11.5.2.1 Project Pathways

Construction

Construction activities have the potential to directly affect caribou movement through mine site preparation activities. The physical placement of mine structures, including the pits, waste rock piles, stockpiles and TMF, may overlap migration paths and act as a barrier, thereby altering existing movement patterns. Other Project features, such as ditches, roads and power lines, also have the potential to alter wildlife movement in the absence of mitigation. Caribou may be reluctant to cross if these features present obstacles that are too high or wide.

Sensory disturbance, primarily from sound, light and human presence, has the potential to affect caribou movement indirectly by causing avoidance of the Project Area. Sensory disturbance may also cause caribou to avoid migration paths.

Operation

The primary mechanism for change in movement during operation is the continued presence of the TMF, open pits, waste rock piles and associated infrastructure that could act as a barrier to caribou movement.

These mine features (TMF, open pits, waste rock piles and associated infrastructure) will expand in footprint during the first few years of operation, until reaching their planned size. Other Project features, such as ditches, roads and power line corridors, also have the potential to affect caribou movement. In the absence of mitigation, caribou may avoid these features because of human activity, sensory disturbance, or because the features impede movement.

Sensory disturbance arising from the use of Project features, such as access roads or open pits, has the potential to indirectly affect caribou movement by causing avoidance of the Project Area. Sound, light, or human presence arising from operation activities may cause caribou to avoid migration paths.

Decommissioning, Rehabilitation and Closure

Pathways that directly affect caribou movement will change over time as mine activities transition from operation to closure activities. The physical interruption to the migration corridor will persist as the open pits will be flooded and become pit lakes, rather than backfilled. As the vegetation composition of revegetated areas of the site may differ from baseline conditions, there may be continued avoidance of the Project Area if the habitat is not suitable for caribou migration.

Indirect changes to caribou migration will also change over time from decommissioning to closure activities. During decommissioning, the level of sensory disturbance will be reduced in comparison to operation and will continue to be reduced through rehabilitation and closure. Indirect effects will abate when the mine closes, with reduced traffic levels and the cessation of Project activities.

11.5.2.2 Residual Effects

Change in movement was identified as an environmental effect with the potential for interaction with caribou. Caribou react to both the presence of physical structures in their habitat and to sensory disturbances caused by human-activity, which can alter traditional movement patterns. Habitat change is the mechanism for change in caribou movement considered in this assessment, which includes both direct and indirect effects. Caribou habitat will also be directly changed by the construction of Project infrastructure (e.g., open pits, stockpiles) that will act as physical barriers to movement.

Habitat Loss (Direct and Indirect)

The effects of disturbance on caribou movement are well documented (e.g., Plante et al. 2018). Caribou have been shown to increase activity near disturbances and delay crossing or fail to cross linear structures (Wolfe et al. 2000). However, much of the research has considered linear features. While there are existing linear features associated with the Project, the larger risk to caribou movement is the construction of the Marathon pit and associated waste rock pile as these will overlap the migration corridor. Maintaining connectivity between seasonal ranges is vital to sustaining viable populations of migratory ungulates (Monteith et al. 2018).

Caribou select migration paths that provide adequate forage and resting habitat (Saher 2005), are less energetically demanding (e.g., less rugged, open terrain) (Saher and Schmigelow 2005), and have relatively low predation risk compared to other potential migration paths (Bergerud et al. 1990; Ferguson and Elkie 2004). Anthropogenic disturbance can act as an impediment to migratory movement, and avoidance of disturbance by caribou during migration has the potential to affect these aspects of migration corridor selection. Beyer et al. (2016) differentiate between different types of impediments to caribou movement based on whether the feature can be crossed or circumnavigated. Linear features are considered as barriers as they can be crossed, but not navigated around (Beyer et al. 2016). Semi-permeable barriers are those which can be crossed, yet affect aspects of migration (e.g., migration paths, stopover sites) (Sawyer et al. 2012). Disturbances that must be circumnavigated and cannot be crossed can be classified as 'obstacles' (Beyer et al. 2016). Using this definition, the Project would be classified as an obstacle to caribou movement as it is anticipated that caribou will demonstrate avoidance of the Project and will not migrate through the site.

Caribou have a reduced tendency to cross linear features, such as power lines and roads (Dyer et al. 2002; Vistnes et al. 2004), although seismic lines are crossed (Dyer et al. 2002). Other research has indicated that elevated pipelines create a barrier for migrating caribou (Smith and Cameron 1985) and that caribou generally avoid roads while migrating (Baltenspergber and Joly 2019). Caribou may delay or fail to cross linear features (Curatolo and Murphy 1986; Wolfe et al. 2000). Caribou have also been shown to demonstrate avoidance of a hydroelectric development in central Newfoundland (Star Lake) and alter the timing of migration following construction (Mahoney and Schaefer 2002). Other ungulates (i.e. mule deer) show high annual fidelity to stopover sites and may select to optimize forage availability during migration (Sawyer and Kauffman 2011). The locations of stopovers and migration paths for mule deer show avoidance of anthropogenic disturbance (Monteith et al. 2018).

Another potential Project effect on caribou movement is the energetic costs of using a less ideal migration path (Fullman et al. 2017; Wyckoff et al. 2018). Caribou movement has been found to increase during migration when linear features are encountered (Murphy and Curatolo 1987). Additionally, linear features may delay crossings and increase the movement rate following crossing (Wilson et al. 2016), and daily movement rates increase with increasing anthropogenic disturbance within the range (MacNearney et al. 2016).

Effects of change in movement could result in increased energetic demands, particularly during migration, which could translate to a decrease in pregnancy rates. Project-related changes to movement pattern, such as increased movement or movement through difficult terrain (e.g., deep snow, degree of ruggedness), could have increased energetic requirements. As caribou select migration paths that are energetically efficient (Saher and Schmiegelow 2005), Project-related changes to movement that result in increased energy consumption could result in a decrease in body condition. Research that modelled the effects of sudden sound disturbance on caribou indicated that energetic costs associated with repeated disturbance (e.g., movement, flight response) could result in a substantial loss in body mass (Bradshaw et al. 1998). Caribou exposed to petroleum development have lower body weights (Cameron et al. 2005). Pregnancy rates during the fall are linked to caribou body condition (Gerhart et al. 1997; Russell et al. 1998). Body weight is also correlated with parturition (Cameron et al. 1993), therefore diversions or delays from existing migration patterns could contribute to reduced calving rates. Caribou in areas with higher levels of disturbance have been shown to have decreased parturition rates (Cameron et al. 2005). McCarthy et al. (2011) found that calving rates decreased with increasing disturbance in caribou herds in central Newfoundland. Increased energetic requirements associated with Project-related changes to movement have the potential to affect caribou recruitment through reduced pregnancy rates. Additionally, migrating caribou that move into less than ideal habitat by a disturbance may encounter reduced availability of suitable forage, or higher predation risk.

The effect of the Project on the migration of the Grey River, Gaff Topsails and La Poile herds is expected to be negligible, as these herds have little overlap with the Project Area and do not migrate through the site.

Analysis of the migration patterns for the Buchans herd identified areas used by GPS-collared caribou in the spring and fall migration periods. For this assessment, ‘migration corridor’ refers to an area used for migration at the population-level. The corridor may contain various 'migration paths', which are used by individual caribou. A migration path may be used by a single individual or several caribou. While the analysis identified a network of migration paths between the seasonal ranges, only one population-level migration corridor was identified. The migration corridor is used differently by caribou during spring and fall migration. In spring, caribou use a wider portion of the migration corridor and are more dispersed than during fall migration; however, in both seasons, the caribou follow similar paths between the Buchans Plateau (calving range) and Grey River (winter range), and both paths overlap the Project Area (Figures 11-12 to 11-13). The amounts of the spring and fall migration corridor and amounts of high and moderate use areas within the migration corridor predicted to be directly affected by the Project are provided in Table 11.16.

The Project Area overlaps with 5.5 km of the length of the migration corridor, equal to approximately 3.8% of its total length (Table 11.16). The Project Area overlaps approximately 1.3% of the total area of the spring migration paths, and approximately 1.7% in fall. During spring migration, approximately 1.0 km^2 of the high and moderate-high areas of use within the corridor will be lost in the Project Area, equal to approximately 4.7% of the area of the corridor (Table 11.16). The Project Area overlaps 2.2 km^2 of the areas of use within the corridor during fall migration, equal to approximately 6.8% (Table 11.16).

The telemetry data did not identify a migration corridor for the Gaff Topsails herd through the Project Area The NLDFFA-Wildlife Division has observed migration of the Gaff Topsails herd, and while some caribou from the Gaff Topsail population have used the same corridor as the Buchans caribou on migration, others use different pathways and, as these are not well understood, may or may not be affected by the mine (I. Schmelzer, pers. comm. 2020).

Mitigation measures such as limiting or restricting mining activities during migration periods (to be determined in consultation with NLDFFA-Wildlife Division), delaying blasting activity if caribou are in the vicinity, facilitating caribou crossings across snowbanks or ditches, and aligning crossing points with existing migration paths are expected to reduce the amount of sensory disturbance on caribou. However, these mitigation measures will not reduce the physical disruption of the existing migration path that overlaps the Project Area.

11.5.2.3 Summary

The Project effects on the movement patterns of the Gaff Topsails and La Poile herds are predicted to be negligible in magnitude because of the limited overlap between those herd ranges and the Project Area.

The Grey River herd has some overlap with the Project Area during the summer season, and as a result the Project effects on change in movement are predicted to be low in magnitude. Project effects on change in movement of the Buchans herd are predicted to be high in magnitude due to the overlap of the Project Area with a well-defined and well-used migration corridor. Based on the assessment of available data, Project effects potentially affect an estimated 5.5 km of the preferred migration path, which has been used by up to 55.1% of collared caribou in the spring and 58.4% of collared caribou in the fall. The geographic extent of the effect on movement for the Buchans herd could extend into the RAA as the presence of the Project may alter caribou movements before they reach the Project Area, potentially affecting their ability to reach their seasonal grounds. Duration will be long term and effects will be irreversible, as the open pits will not be returned to their former land state (i.e., will be refilled to become a pit lake). Mitigation measures to reduce effects on movement will reduce sensory disturbance within the Project Area (e.g., limiting or restricting mining activities during migration periods, delaying blasting activity if caribou are in the vicinity, facilitating caribou crossings across snowbanks or ditches, aligning crossing points with existing migration paths). These measures, however, will not mitigate the physical alteration of the migration paths in the mine site.

Changes in movement due to human activities have been studied on the Island of Newfoundland and in other jurisdictions. However, there is uncertainty as to how the residual effects of the Project will affect the movement of the Buchans herd, and in terms of what the long-term effects on the herd might be (e.g., reduced calving rates, increased predation). A Project-related change in movement could result in changes to timing of movement or movement rate, which may ultimately cause a change in recruitment or survival.

11.5.3 Change in Mortality Risk

11.5.3.1 Project Pathways

Construction

The pathways for change in caribou mortality risk include direct effects (e.g., vehicle collisions) and indirect effects (e.g., increased predation risk). Site preparation, including vegetation clearing, earthworks, construction of infrastructure and construction-related transportation, are expected to be the primary pathways through which construction-related changes in caribou mortality risk may occur. Project-related transportation and heavy equipment have the potential to result in vehicle-caribou collisions. The greatest risk of a mortality event is from vehicle-collision during winter when caribou may occur between snowbanks along roads and when egress is impeded.

Changes to vegetation communities resulting from clearing activities may temporarily increase moose presence. While there will be some localized areas within the Project Area where vegetated areas will be retained, it is assumed that there will be limited use of the mine site due to the level of sensory disturbance. However, vegetation clearing will also create edge habitat, which is often associated with moose as it can provide high value browse (Ardea Biological Consulting 2004). Selection of this edge habitat by moose could increase their abundance in affected areas. This may result in an increase in predator populations (e.g., black bear, coyote), which in turn may also increase mortality risk for caribou.

The Project will not create access for hunters to previously inaccessible areas as the access road exists presently and the public will not have access to the new roads within the mine site. Employment and expenditures are unlikely to result in an increased caribou mortality risk. The NLDFFA-Wildlife Division determines the number of caribou licenses based on the size and health of the herd. Project-related employment and expenditures could result in an increase in the number of people requesting a license; however, the Project would not change the amount of legal hunting. Additionally, employees will not be permitted to hunt while on site or to bring firearms to site. As the Project will not create new access into caribou habitat and employees will be prohibited from hunting while on site, the Project is not anticipated to result in an increase in hunting pressure.

Operation

Vehicle and equipment traffic are the most likely sources of a potential increase in direct mortality risk to caribou during operation. Operation-related transportation on the access road and haul roads presents the greatest risk for collision due to the frequency of vehicle and equipment operation.

Interactions with the open pits or TMF could also result in direct caribou injury or mortality. While unlikely, it is possible that caribou moving through the mine site could enter an open pit or the TMF, resulting in injury or mortality.

The Project may increase adult and calf mortality risk indirectly through increased predation. Project effects may also lead to decreased body condition, which could result in increased mortality. Migrating caribou that may be displaced by the Project into less ideal habitat may encounter reduced availability of suitable forage. Fragmentation of the range by the Project could also limit access to preferred forage. Additionally, movement along a less suitable path may require higher energy expenditure. These factors (use of sub-optimal forage and increased energy requirement) could result in a decrease in body condition, which could lead to decreased survival over time (Crête et al. 1996). The potential effects of the Project on energetics, forage availability and body condition are also discussed in Section 11.5.2.2.

Emissions, discharges and wastes, including contaminants from vehicles and equipment, have the potential to affect caribou mortality risk. However, the release of emissions, discharges and wastes will be managed in a manner consistent with environmental regulations and guidelines. There is no predicted pathway between emissions, discharges and wastes and caribou mortality risk and are therefore not considered further as a potential effect on the Caribou VC.

As described above for construction, employment and expenditures are unlikely to result in an increase caribou mortality risk. The Project will not affect the amount of caribou hunting. Employees will be bussed to site and will not be permitted to hunt while on site or bring firearms to site. An increase in hunting pressure is not anticipated as the Project will not create new access to caribou habitat, and hunting will be prohibited on site.

Decommissioning, Rehabilitation and Closure

A change in caribou mortality risk during decommissioning, rehabilitation and closure activities is expected to be low relative to construction or operation. While there will continue to be a risk of vehicle collisions, that risk will be reduced due to reduced traffic volumes and equipment activity. Decommissioning, rehabilitation and closure activities are not expected to further affect caribou mortality risk through increased predation or hunting. Linear features on the mine site (e.g., roads and power line corridors) not required for long-term monitoring will be decommissioned and rehabilitated to limit future hunting pressures on wildlife and restore habitat to pre-mine conditions where practicable.

11.5.3.2 Residual Effects

Direct Mortality

There is low risk of caribou mortality through vegetation clearing and site preparation. There will be considerable sensory disturbance associated with the majority of vegetation clearing and site preparation activities; in most instances, caribou are expected to avoid these activities and therefore be at low risk of directly mortality from equipment and construction activities. The amount of vegetation clearing during Project construction will be reduced by aligning or combining infrastructure (e.g., roads or power lines) with existing disturbances.

The amount of overlap between the assessed herds and the Project Area is less than 2% for the Grey River herd and less than 1% for the Buchans herd (Table 11.16). The seasonal ranges of the Gaff Topsails and La Poile herds have little to no overlap with the Project Area (Table 11.16). The risk of direct mortality resulting from vegetation clearing and site preparation is considered negligible to low for all assessed caribou herds because of the limited exposure of caribou to machinery and equipment within their seasonal ranges.

Mitigation measures will be applied to reduce the risk of caribou mortality resulting from the Project. Creation of breaks in snow berms should facilitate efficient caribou movement across roads. The installation of temporary fencing, as needed, around the open pits is anticipated to reduce the risk of caribou becoming trapped or injured in the pits. As development of the open pits progresses and clean waste rock becomes available, a rock berm will be developed around the open pits as part of progressive rehabilitation. The design of the rock berm will consider caribou, including discouraging animals from accessing the pit or approaching the pit crest. In addition, the TMF will be monitored daily during caribou migration for hazards to caribou and caribou activity. Observations or signs of caribou within 500 m of the TMF will be reported to the on-site environment team.

These mitigation measures, and resolutions to potential adverse interactions between caribou and the TMF, will be proactively managed through the development and implementation of adaptive management framework. The adaptive management framework will allow for the early identification of issues that might affect mortality risk, proactive implementation of remedial measures, and opportunities to learn from and adjust management of effects based on the effectiveness of these mitigation measures. Follow-up and monitoring initiatives completed during construction and early operation are expected to provide information on Project-related caribou mortality risk and the effectiveness of proposed mitigation measures. With the proposed mitigation measures and the implementation of an adaptive management framework to address mortality risk, the effect of vegetation clearing, site preparation, and operation on mortality risk is predicted to be low.

Vehicular Collisions

The highest risk of Project-related caribou mortality will occur from collisions with vehicles; however, wildlife-vehicle collisions are expected to occur infrequently. In a study of caribou on the Island of Newfoundland between 2005 and 2011, approximately 4% of adult caribou mortality (where the cause of mortality was known) was due to vehicle collision (Lewis and Mahoney 2014). Many factors influence rates of wildlife-vehicle collisions, including vehicle speed, traffic volume, animal speed, seasonality and time of day (Litvaitus and Tash 2008).

During the construction period, Project-related traffic volumes on the access road is estimated at an average of approximately six vehicles per day, with a peak of 18 vehicles per day on rotation change days. During operation, Project-related traffic is estimated at an average of approximately five vehicles per day, with a peak of 10 vehicles per day on rotation change days (once a week). Project-related traffic volumes on the access road will be incremental to existing traffic volumes. Traffic on the haul roads within the mine site will be substantial, with a high number of daily trips between site features as part of open pit mining activities. At peak operation, the volume of haul traffic between the open pits, waste rock piles, stockpiles and processing facility is estimated at approximately 4,000 one-way trips every 24 hours (approximately 2,180 of these one-way trips would be associated with mining activities at the Marathon pit).

The area of overlap between the assessed herds and the Project Area is small (less than 2% of Grey River herd range; less than 1% of the Buchans herd range) (Table 11.16). Given this limited overlap, the Project-related risk of direct mortality resulting from vehicular collision on the access road and the site roads is considered negligible for the Gaff Topsails and La Poile herds, which have little to no overlap with the Project, and is considered low for the Buchans and Grey River herds, which that have a greater degree of overlap with the Project.

Mitigation measures including adhering to posted speed limits, yielding the right-of-way to caribou where safe to do so, and facilitating caribou crossings on roads (e.g., including low areas in plowed snowbanks and crossing points across ditches) are likely to reduce the risk of vehicle collisions. Additionally, vehicle traffic will be reduced by transporting employees to the site by bus and through implementation of a Traffic Management Plan. As described in Table 11.13, Marathon will review with the applicable regulators the possibility of limiting sensory disturbance by limiting or restricting some aspects of on-site Project activity during caribou migration. This mitigation would also serve to reduce the potential for mortality from vehicle collisions on the haul roads during caribou migration. The application of mitigation measures is predicted to reduce the likelihood of wildlife-vehicle collisions.

Indirect Mortality Risk

In addition to a change in direct mortality risk (e.g., vehicle collision), caribou mortality risk could be affected indirectly through Project-related changes that may affect predation risk or increase energy expenditure.

Although some research on predation has been completed on the Island of Newfoundland, little literature considers areas where black bears and coyotes (not wolves) are the main predators of caribou. The mechanisms described below may be different on the Island of Newfoundland than in other regions due to the small wolf population (i.e., no evidence of a breeding population [Government of NL 2012]). While there is uncertainty surrounding the effects of development on the mortality risk of caribou in an ecosystem with moose, black bear and coyote and a small to absent wolf population, there are likely parallels from ecosystems with wolves. Additionally, much of the research on the effects of disturbance on caribou predation rates pertains to linear features (e.g., DeMars and Boutin 2017; Dickie et al. 2017; Newton et al. 2017; Mumma et al. 2019). As the Project does not include the creation of new linear features outside of the mine site, the change in mortality risk related to linear features will be negligible. Regardless, the following discussion is included for context to describe the range of disturbance-related effects on caribou mortality risk.

Predation rates on caribou are higher near linear features (Mumma et al. 2017). Development and disturbance can alter existing habitat, causing a shift to an alternate habitat type (e.g., forest harvesting changes mature forest to regenerating forest). This can result in an increase in habitat types that are selected by moose (Peters 2010; Peek 2007 in Michaud et al. 2014), leading to range expansion or increases in moose density within caribou range. Compared to caribou populations that are spatially separate from moose, caribou populations that overlap with moose distribution have higher wolf predation rates (James et al. 2004; Mumma et al. 2018). Research on grizzly bear (*Ursus arctos*) indicates that predation rates on caribou and moose as a function of grizzly bear density are independent of moose density (Boertje et al. 1987). While this is not directly comparable to the Island of Newfoundland because grizzly bear is absent, there may be similarities to the dynamic between black bears and caribou and moose. Coyotes have also been shown to select for disturbed habitats, due to their selection by and subsequent availability of moose as a prey or as carcasses (Boisjoly et al. 2010). In Quebec, an increase in moose abundance in disturbed areas was correlated with coyote abundance, and coyote abundance negatively influenced caribou calf recruitment (Frenette et al. 2020).

Like wolves, black bears have been shown to select for linear features such as seismic lines (Tigner et al. 2014) and roads (Hinton et al. 2015; Tomchuk 2019) which could increase the amount of predation on caribou. Black bear has also been found to select disturbed habitat, as regenerating vegetation may provide increased availability of forage (Mosnier et al. 2008). Coyotes also show selection for linear features such as roads (Latham et al. 2013; Hinton et al. 2015), although avoidance of linear features has also been observed (Ellington 2015). This selection by predators could increase predation of caribou by black bears through higher encounter rates due to ease of movement, or increased access to caribou range (DeMars and Boutin 2017). Additionally, selecting habitat that has reduced predation by wolves may increase the risk of predation by black bears (Dussault et al 2012).

In addition to the increase in wolves that may follow an increase in moose, the density of wolves in a disturbed area could increase irrespective of increases in moose abundance. Wolves select for linear disturbances (Newton et al. 2017), which improve landscape coverage and hunting efficiency that can lead to an increase in predation on caribou (McKenzie et al. 2012; Dickie et al. 2017; Mumma et al. 2018). Although caribou select for habitats with lower risk of predation by wolves (Dussault et al. 2012) and avoid linear features, Mumma et al. (2018) suggested that the avoidance of linear disturbance by caribou is not sufficient to negate the level of wolf predation associated with linear features. However, unlike many other caribou populations, wolf is not a major predator of caribou on the Island of

Newfoundland as there is no evidence of a breeding population (Government of NL 2012). While the Project will not create a new linear feature outside of the mine site, this discussion has been included as an example of the effects of anthropogenic disturbance on predation rates of caribou. As there is uncertainty surrounding the effects of development on the mortality risk of caribou in an ecosystem with moose, black bear and coyote and a small to absent wolf population, there are likely parallels from ecosystems with wolves.

Mortality risk may also be affected by habitat fragmentation. Fragmented habitat may restrict the ability for caribou to move freely between habitat patches. This could result in an increase in caribou density in the remaining habitat patches, which may increase the risk of predation (Seip 1991; Wittmer et al. 2005). The issue of predator efficiency along linear features is compounded by increased reproductive potential of predators which leads to increased predator density and increased predation rates. This process has been shown to be detrimental to caribou populations where primary prey, such as moose, remain abundant to support high predator densities, and caribou are disproportionately preyed upon even if only secondarily to primary prey (McCutchen 2007; Kittle et al. 2017; Newton et al. 2017) .

Research has found that caribou may show selection for some anthropogenically disturbed habitat (Faille et al. 2010; Dussault et al. 2012; St-Laurent and Dussault 2012) and caribou density can increase near human disturbance (Fortin et al. 2013). These findings seemingly contradict research that shows avoidance of disturbance by caribou (COSEWIC 2014). However, as caribou exhibit a high degree of site fidelity, especially during calving (Schaefer et al. 2000), this can result in some individuals returning to disturbed locations despite the potential for increased predation risk or sub-optimal forage (Faille et al. 2010; Dussault et al. 2012; Lesmerises et al. 2013). This maladaptive behavior could cause a decrease in recruitment rates, and a population decline if recruitment rates remained low.

While direct habitat change will be limited to the Project Area, a Project-related increase in predator abundance could extend into the RAA. The primary predators of caribou on the Island of Newfoundland are coyote and black bear (Lewis et al. 2014; Mahoney and Weir 2009). Home range size for coyotes that overlap the Middle Ridge and La Poile herd ranges varies between 140 to 330 km^2 (Blake 2006; Fifield et al. 2013). Black bear home range size has been estimated at 50-200 km^2 for females and 150-870 km^2 for males in the ranges of the La Poile and Middle Ridge caribou herds (Fifield et al. 2013; Rayl et al. 2018). It is feasible that caribou near the Project Area may be affected even if their range does not overlap with the Project Area. However, the most pronounced effect is expected to occur near the Project Area, as much of the effect of increased predation is associated with linear features (i.e., selection of linear features by black bears and moose) and habitat changes (i.e., selection of regenerating habitat).

While predation is the primary cause of mortality for neonate calves on the Island of Newfoundland, the risk of predation decreases substantially as calves age (Lewis and Mahoney 2014). Between 2003 and 2011, the survival rate of 6-month old caribou calves was between 79% and 100% (Lewis and Mahoney 2014). A Project-related increase in predator abundance or hunting efficiency is anticipated to have the greatest effect on caribou calves less than six months of age (e.g., resident caribou with calving range overlapping the Project) and a lesser effect on older calves.

The Buchans and Grey River herds will be most affected by a potential increase in predators as they have the greatest degree of overlap with the Project. However, at the low densities of predators reported for the Island of Newfoundland, a potential Project-related increase in predator density, and subsequently an increase in predation rate, is predicted to be low.

Hunting pressure, and therefore mortality risk, can increase with increased access to caribou range. While access to caribou herds via winter roads can contribute to an increase in hunting efficiency (Boulanger et al. 2011), the largest road associated with the Project (i.e., the access road) exists already and new roads created by the Project will be within the mine site and restricted to public access. The Project will therefore not create new roads that could facilitate hunter access into previously inaccessible areas and affect mortality risk through hunting.

Project-related changes to movement patterns that may shift caribou into less than ideal habitat may also contribute to an increase in mortality risk. As caribou prefer habitat that has reduced predation risk (Rettie and Messier 2000; Viejou et al. 2017), use of habitat that was not selected previously may increase the risk of predation.

Mitigation measures that will reduce the risk of caribou mortality from indirect sources such as hunting pressure include prohibiting employees from hunting caribou on the mine site or while staying at the accommodations camp, restricting employees from bringing personal firearms to site, and restricting public access to the mine site.

11.5.3.3 Summary

With the implementation of mitigation measures, a change in mortality risk for caribou resulting from the Project is expected to be adverse. The magnitude of change in mortality risk is anticipated to be low in the construction and operation phases, and negligible to low during decommissioning, for all assessed caribou herds. Effects of change in mortality risk will be greatest for the Buchans and Grey River herds as their ranges overlap the Project Area. However, all assessed caribou herds could experience an increase in mortality risk due to an increase in predation rates. The geographic extent is expected to extend to the RAA based on home range sizes and movement patterns of predators and because of the previously discussed effects of the Project on caribou habitat and movement. The direct risk of mortality from vegetation clearing, site preparations, operation and vehicular collisions is predicted to be limited to the Project Area. Mortality events are expected to occur at an irregular frequency and the change in mortality risk will be medium term in duration. The effect is anticipated to be reversible following closure.

11.5.4 Summary of Project Residual Environmental Effects

Residual environmental effects that are likely to occur as a result of the Project are summarized in Table 11.17. The significance of residual adverse effects is considered in Section 11.6.

Residual effects on caribou and their habitat are predicted to be adverse. The residual effects of change in habitat and mortality risk are predicted to be low in magnitude for all four herds. The magnitude for change in movement for the Gaff Topsails, Grey River and La Poile herds is also predicted to be low. However, the residual effect for change in movement for one herd, the Buchans herd, is predicted to be high due to the amount of overlap of the Project with an existing migration corridor, and the proportion of collared caribou that use the path overlapping the Project. The effects of the Project on caribou habitat, movement and mortality risk extend to the RAA. However, most of the effect associated with change in habitat and change in mortality risk is predicted to occur in the LAA. The duration of Project effects on habitat and movement are predicted to be long term. Effects associated with a change in mortality risk are predicted to be medium term during construction and operation, and short-term during decommissioning. Changes to caribou habitat and movement are considered irreversible, as existing conditions will not be restored following closure.

Table 11.17 Project Residual Effects on Caribou

Residual Effect	Residual Effects Characterization							
	Project Phase	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological and Socio-economic Context
Change in Habitat	C	A	L	RAA	LT	C	I	D
	O	A	L	RAA	LT	C	I	D
	D	A/N	L	RAA	LT	C	I	D
Change in Movement	C	A	H	RAA	LT	C	I	D
	O	A	H	RAA	LT	C	I	D
	D	A	H	RAA	LT	C	I	D
Change in Mortality Risk	C	A	L	RAA	MT	IR	R	D
	O	A	L	RAA	MT	IR	R	D
	D	A	L	RAA	ST	IR	R	D

KEY
See Table 11.10 for detailed definitions

Project Phase
C: Construction
O: Operation
D: Decommissioning

Direction:
P: Positive
A: Adverse
N: Neutral

Magnitude:
N: Negligible
L: Low
M: Moderate
H: High

Geographic Extent:
PA: Project Area
LAA: Local Assessment Area
RAA: Regional Assessment Area

Duration:
ST: Short term
MT: Medium term
LT: Long term
P: Permanent

N/A: Not applicable

Frequency:
S: Single event
IR: Irregular event
R: Regular event
C: Continuous

Reversibility:
R: Reversible
I: Irreversible

Ecological/Socio-Economic Context:
D: Disturbed
U: Undisturbed

11.6 DETERMINATION OF SIGNIFICANCE

The adverse residual effects of the Project on the Gaff Topsails, Grey River and La Poile herds are anticipated to be low in magnitude. While it is understood that caribou will preferentially use high-ranked habitat, the change in moderate-ranked habitat has been included in the calculation for change in habitat as a conservative measure. While change in habitat, movement and mortality risk may affect individual caribou in these herds, incremental Project-related change is predicted to be low for these caribou herds given the existing conditions.

For the Buchans herd, the adverse residual effects of change in habitat and mortality risk are anticipated to be low in magnitude compared to existing conditions. However, the adverse residual effect on change in caribou movement for this herd is anticipated to be high in magnitude.

A robust statistical analysis of the migration corridor was completed to understand the movement patterns of the assessed caribou herds. The analysis shows there is a high likelihood that Project-related effects will alter caribou movement compared to existing conditions (i.e., caribou may increase their use of less-used migration paths, or select previously unused paths) due to the overlap between the Project and the migration path used by more than half of the Buchans herd. Changes in movement have been studied on the Island of Newfoundland and in other jurisdictions. However, there is uncertainty as to how the movement of the Buchans herd will be affected by the Project and the resulting effect on the herd. A Project-related change in movement could result in changes to timing of movement or speed of migration, and ultimately changes in recruitment or survival.

Mitigation measures will be applied to reduce the Project effects on caribou movement; however, the majority of mitigation measures will target the reduction of sensory disturbance and not the overlap of the Project with the migration paths that are intersected. While sensory disturbance may exacerbate Project-related effects to caribou movement, the Project Area will permanently overlap the existing migration paths. The primary concern for the Buchans herd is with regards to the interruption of the existing migratory corridor and creation of a physical obstacle to movement. While caribou may be able to circumnavigate the Project features in the migration path, and possibly the Project entirely, it is unclear what effects this deviation from a migratory corridor will have on the Buchans herd. These potential effects may not be realized for several years when considering predation rates and calf survival and the effect of those demographic parameters on the population.

A significant adverse residual Project effect on caribou and their habitat is defined as one that threatens the long-term persistence or viability of one or more of the four assessed caribou herds (i.e., Buchans, Gaff Topsails, Grey River and La Poile herds) within the RAA, including effects that are contrary to or inconsistent with the goals, objectives and activities of recovery strategies, action plans and management plans.

The predicted residual environmental effects from the Project do not threaten the long-term persistence or viability of the Grey River, La Poile and Gaff Topsails herds, and are not contrary or inconsistent with the goals, objectives and activities of recovery strategies, action plans and management plans. Due to the overlap between the Project and the migration path used by over 50% of the Buchans herd, the residual effect on change in movement for the Buchans herd is predicted to be high in magnitude and is considered likely to occur. With implementation of mitigation measures, and given the uncertainties described above, the residual adverse effect of change in movement for the Buchans herd is conservatively predicted to be significant. Therefore, the residual adverse effect of the Project on caribou is predicted to be significant.

11.7 PREDICTION CONFIDENCE

The overall level of confidence in the predictions for Project-related residual effects on caribou and their habitat is moderate. While the prediction confidence regarding change in habitat and change in caribou mortality are high, the determination regarding change in movement is moderate to low.

For change in habitat, the overall calculation of the amount of habitat lost is conservative and based on standard practices and recommendations. Habitat requirement for caribou and the effects of habitat loss are well understood, and habitat occurrence and loss were mapped using available satellite imagery, which allowed for a detailed quantitative analysis. Standard mitigation measures for reducing habitat loss will be applied (e.g., limiting the size of Project footprint and disturbed areas, maintaining vegetation around high activity areas to buffer sensory disturbance), which contributes to the high confidence in the determination for change in habitat.

The prediction confidence for change in caribou movement is moderate to low. As described in Section 11.6, due to the overlap between the Project and the migration corridor, there is a high likelihood that Project-related effects will alter caribou movement compared to existing conditions. However, there is uncertainty in how the movement of the Buchans herd will be affected by the Project and what the effect will be on the herd. This uncertainty has contributed to the conservative prediction of a significant residual effect on caribou.

For change in mortality risk, the prediction confidence is high. The effects of development and disturbance on caribou mortality are well understood and standard mitigation measures to limit the effects of the Project on mortality will be implemented.

11.8 PREDICTED FUTURE CONDITION OF THE ENVIRONMENT IF THE UNDERTAKING DOES NOT PROCEED

The Project is in an area with a long history of mining and mineral exploration, and it is likely that other mining projects would occur in this area if this Project were not to proceed. Future projects are anticipated to have similar effects on caribou. Should mineral reserves associated with the Project remain undeveloped, the predicted future condition of caribou would be relatively unchanged from what is discussed in the existing environment portion of this assessment (Section 11.2). The caribou population on the Island of Newfoundland has recently undergone a decline, most likely due to a combination of food limitation with predation by coyotes; however, the population now may be increasing (Government of NL 2015). Other factors that could contribute to changes in caribou populations in the absence of further development include natural processes such as fire, disease, population and community dynamics, and major weather events.

Changes in the abundance and distribution of the assessed caribou herds may also be affected by climate change. Climate change has the potential to result in indirect changes to caribou habitat over time due to changes in temperature and precipitation, which could affect the assemblage and quantity of forage species and the timing of spring green-up (Forchhammer et al. 2005), and the abundance of insects and timing of emergence (Robinet and Roques 2010). Climate change could also affect the frequency and intensity of weather and exacerbate natural events, such as forest fires and icing events. However, the general uncertainty of climate change models and predictions makes it difficult to predict if or when and to what extent such changes may occur.

11.9 FOLLOW-UP AND MONITORING

Marathon understands and acknowledges the importance of the caribou migration and population with respect to the general environment and to outfitters, Indigenous groups, the public and the province. Given that the determination of a potentially significant effect is in part a result of the uncertainty of how the Project activities may affect the migratory movement of the Buchans herd and the uncertainty of success of the proposed mitigation measures, Marathon is committed to working with regulators, Indigenous groups and stakeholders to employ robust monitoring programs respecting migration patterns and populations of the Buchans and Grey River herds. Marathon is currently engaging with the NLDFFA-Wildlife Division with respect to ongoing baseline monitoring programs, and it is anticipated that these monitoring programs will continue and adapt as required over the life of the Project (including closure and post-closure monitoring).

Follow-up and monitoring activities are likely to include the following, to be confirmed via continued consultation with NLDFFA-Wildlife Division:

- Deployment of telemetry collars on Buchans caribou and resident (Grey River) caribou in the ZOI
- Assessment of the effects of the Project on migration to identify changes in patterns of migration (e.g., timing, duration, location, stop-overs)
- Monitoring of effects on resident caribou within the ZOI during construction and operation
- Aerial post-calving surveys of the Buchans herd and resident caribou within the ZOI
- Continuation of remote camera deployment and analysis of migration in spring and fall

Marathon is proposing an adaptive management approach to address the potential adverse effects of the Project on caribou migration and populations in the Project Area. While the construction activities related to site development will result in full footprint development in some areas of the site, the largest Project components (e.g., the pits, waste rock piles, overburden and ore stockpiles, TMF), will only be partially developed during construction and will not be fully developed until several years into Project operation. Follow-up and monitoring activities completed during the construction and early development period should provide valuable information on the change in caribou movement with respect to the Project and the effectiveness of initial mitigation measures. This information can then be used to determine if different mitigation measures should be applied. With the proposed mitigation measures and the implementation of an adaptive management framework to address the effects of vegetation clearing, site preparation and operation, the risk of direct mortality is predicted to be low.

The adaptive management approach is used in many environmental protection and conservation projects and applies a cycle of planning, implementation, monitoring and analysis / learning to systematically find the optimum approach or solution to an issue and to continually adapt to changing circumstances and knowledge. Marathon is committed to working with regulators, Indigenous groups and stakeholders to implement initial mitigation measures (Table 11.13), conduct follow-up and monitoring activities, and adapt mitigation measures as required to reduce Project-related effects on caribou.

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12.0 OTHER WILDLIFE

12.1 SCOPE OF ASSESSMENT

Other wildlife is a valued component (VC) because it provides ecological, cultural, recreational, aesthetic, and economic value to stakeholders including the public, Indigenous groups, local businesses and government agencies. The Other Wildlife VC considers large mammals, furbearers and small mammals, including species at risk (SAR) and species of conservation concern (SOCC). It also includes their habitats, defined as areas where wildlife live, and as selected by species to meet their nutritional and shelter needs. Access to other wildlife is important to resource users that continue to practice harvesting and recreational activities, such as hunting and trapping, throughout the region. Note that fish are discussed in Chapter 8 (Fish and Fish Habitat), birds are discussed in Chapter 10 (Avifauna) and caribou are assessed in Chapter 11 (Caribou).

Other wildlife and their habitat have the potential to be affected by Project-related changes to vegetation and wetlands (Chapter 9), or air and water quality (Chapters 5 to 7) through effects such as land clearing, or release of chemicals or dust / sediment into the air and water. Therefore, residual effects predicted for vegetation and wetlands, atmospheric environment, and surface water resources were used to inform potential Project effects on other wildlife and their habitat.

The Other Wildlife VC is also linked to:

- Community Health (Chapter 14) – atmospheric emissions and water discharges from Project activities can add concentrations of parameters of potential concern to ambient air, soil, surface water and sediment, which in turn may affect the health of wildlife
- Land and Resource Use (Chapter 16) – changes in other wildlife and their habitat have the potential to affect land and resource use associated with hunting, trapping and outfitting
- Indigenous Groups (Chapter 17) – changes in other wildlife and their habitat have the potential to affect hunting and trapping activities by Indigenous groups

The network of boreal forest, wetlands, rivers and lakes within the Regional Assessment Area (RAA) (Table 12.1) provides habitat for numerous wildlife species. As it is not feasible to assess all species that could occur in the region, the assessment of other wildlife focused on a select group of species and species assemblages that are representative of the wildlife species occurring within the RAA.

Table 12.1 Species Assemblages and Focal Species for the Evaluation of Other Wildlife

Species Assemblages	Focal Species for the Evaluation of Other Wildlife
Large Mammals	Moose (*Alces alces*) and black bear (*Ursus americanus*) were assessed as these species provide ecological, cultural, subsistence, and/or economic value to resource users and Indigenous groups. Note: Caribou (*Rangifer tarandus*) is assessed in Chapter 11.
Furbearers and Small Mammals	Furbearers: Beaver (*Castor canadensis*), muskrat (*Ondatra zibethicus*) and Canada lynx (*Lynx canadensis*) were assessed as they provide ecological, cultural, subsistence, and/or economic value to resource users and Indigenous groups. Beaver and muskrat are representative of aquatic mammals and Canada lynx is representative of a forest-dwelling species. Small Mammals: Meadow Vole (*Microtus pennsylvanicus*) and southern red-backed vole (*Myodes rutilus*) were assessed as they are ecologically important as prey species for other wildlife species.
SAR / SOCC	Little brown bat (*Myotis lucifugus*) and American marten (Newfoundland population) (*Martes americana atrata*) were assessed as SAR / SOCC that either occupy the Local Assessment Area (LAA) (i.e., marten) or are likely to occur in the LAA based on the distribution of suitable habitat (i.e., bat).

12.1.1 Regulatory and Policy Setting

In addition to the *Canadian Environmental Assessment Act, 2012* (CEAA 2012) and the Newfoundland and Labrador (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 assessment on other wildlife.

12.1.1.1 Federal Guidance

The assessment of potential Project-related environmental effects on the Other Wildlife VC includes consideration of the Federal EIS Guidelines (Appendix 1A) and the following federal legislation:

- The *Species at Risk Act* (SARA) provides protection for SAR in Canada. The legislation provides a framework to facilitate recovery of species listed as Threatened, Endangered, or Extirpated and to prevent species listed as Special Concern from becoming Threatened or Endangered. SAR and their habitats are protected under SARA and prohibits: 1) the killing, harming, or harassing of Endangered or Threatened SAR (sections 32 and 36); and 2) the destruction of critical habitat of and Endangered or Threatened SAR (sections 58, 60 and 61).
- Recovery Strategy for the American Marten (*Martes americana atrata*), Newfoundland population, in Canada

12.1.1.2 Provincial Guidance

The assessment of potential Project-related environmental effects on other wildlife and their habitat includes consideration of the Provincial EIS Guidelines (Appendix 1B) and the following provincial legislation:

- The NL *Endangered Species Act* (NL ESA) provides protection to Endangered, Threatened or Vulnerable plant and animal species in NL. The Act facilitates the development of management plans and recovery strategies for Vulnerable, Threatened, Endangered, and Extirpated or Extinct species to prevent further declines and promote recovery. Species listed under the Act are “part of [the provincial] landscape, and their loss would forever diminish our natural heritage” (Government of NL 2020a).
- *The* NL *Wild Life Act*, RSNL 1990, c W-8, *Wild Life Regulations*, NLR 1156/1996 and associated orders afford protection of wildlife (including caribou) and prohibits the hunting, taking or killing of wildlife or classes of wildlife, whether in particular places or at particular times or by particular methods, except under license or permit. It allows for the management and the regulation of activities relating to the taking and trading of wildlife, primarily game animals and furbearer species.

Other provincial Acts, strategies, and management plans pertaining to the protection of wildlife and their habitat in the RAA include:

- *Little Grand Lake Provisional Ecological Reserve Regulations*
- *Little Grand Lake Wild Life Reserve Regulations*
- *Forestry Act*
- 2015-2020 *Newfoundland and Labrador Moose Management Plan* (Government of Newfoundland and Labrador [NL] 2015)
- *Recovery Plan for the Threatened Newfoundland population of American marten (Martes americana atrata*) (The Newfoundland Marten Recovery Team 2010)
- *Provincial Sustainable Forest Management Strategy* 2014-2024 (Government of Newfoundland and Labrador [NL] 2014)
- *Sustainable Forest Management Planning Regulations*, NLR 61/13

The RAA also overlaps with the following provincial management areas:

- Black Bear Management Areas (BMAs) 17 and 18
- Moose Management Areas (MMAs) 17 and 18
- Caribou Management Areas (CMAs) 62 and 63
- Lynx Zone A
- Several trap lines (14, 83, 221 and 239)
- Forestry Management Divisions 12 and 13

12.1.2 The Influence of Engagement on the Assessment

As part of ongoing engagement and consultation activities, Marathon has documented interests and concerns about the Project received from communities, governments, Indigenous groups and stakeholders. An overview of Marathon’s engagement activities is provided in Chapter 3. Documented interests and concerns have influenced the design and operational plans for the Project, and the development of the EIS, including the scope of assessment on the VCs. Interests and concerns noted that specifically relate to other wildlife or routine Project activities that could affect other wildlife are provided below. Issues and concerns related to potential accidents or malfunctions are described in the assessment of accidental events (Chapter 21).

Questions and concerns raised by Qalipu through Marathon's engagement efforts include:

- Whether Project infrastructure can be relocated to reduce the Project footprint
- Decommissioning, rehabilitation and closure of the Project, including disposition of camp infrastructure at end of mine life and ensuring remediation of the Project Area takes place
- Terrestrial environment including the disturbance of caribou migration routes and the potential for the introduction of invasive plant and wildlife species
- Limitation of access to lands and resources for traditional use
- Interest in involvement in the environmental monitoring for the Project

Questions and concerns raised by Miawpukek through Marathon's engagement efforts include:

- The size of the Project footprint
- Acknowledgement that interests of Miawpukek extend beyond caribou and include plants and waterfowl
- Potential impacts on pine marten and caribou migration as a result of increased industrial activity in the Central Region, and potential impacts of the Project on moose and salmon.
- Need to consider buffers as a potential mitigation measure for Species at Risk
- Potential impact on Miawpukek land and resource use
- Interest in involvement in environmental monitoring for the Project

Questions and concerns raised by communities and other stakeholders through Marathon's engagement efforts include:

- Project components and infrastructure including: if pits will be mined simultaneously; how many ponds there will be; if the mine will be open pit only or include underground; how ore will be transported to the mill and how and where it will be processed; use of cyanide; what will replace the heap leach process; whether other metals, like silver, are present; whether product will be tested at an on-site lab or externally; and what will happen to waste rock and overburden
- Potential long-term effects of the Project on fish and wildlife and downstream effects on tourism, and concerns related to the allotment of Project profits being set aside for harm prevention and remediation of the area
- Impacts of the Project to caribou and on moose hunting in the area

12.1.3 Boundaries

The scope of the assessment is defined by spatial boundaries (i.e., geographic extent of potential effects) and temporal boundaries (i.e., timing of potential effects). Spatial boundaries for the Other Wildlife VC were selected in consideration of the geographic extent over which Project activities, and their effects, are likely to occur on the VC. Temporal boundaries are based on the timing and duration of Project activities and the nature of the interactions with the VC. The spatial and temporal boundaries associated with the effects assessment for the Other Wildlife VC are described in the following sections.

12.1.3.1 Spatial Boundaries

The following spatial boundaries were used to assess Project effects, including residual environmental effects, on other wildlife and their habitat in areas surrounding the mine site and access road (Figure 12-1).

Project Area: The Project Area encompasses the immediate area in which Project activities and components occur and is comprised of two distinct areas: the mine site and the access road. The mine site includes the area within which Project infrastructure will be located, and the access road is the existing road to the site, plus a 20-metre (m) wide buffer on either side. The Project Area is the anticipated area of direct physical disturbance associated with the construction, operation and decommissioning, rehabilitation and closure of the Project.

Local Assessment Area (LAA): The LAA includes a 1 kilometre (km) buffer surrounding the mine site, and a 500 m buffer around the access road (Figure 12-1). The LAA was established to reflect the area within which wildlife-specific Project effects are most likely to occur including indirect habitat loss due to sensory disturbance (i.e., displacement or avoidance) (e.g., Laurian et al. 2008a; Benitez-Lopez et al. 2010; Eldegard et al. 2012).

Regional Assessment Area (RAA): The RAA includes the Project Area, LAA and a 35 km buffer around the Project Area (Figure 12-2) encompassing Victoria River and Red Indian Lake, as well as the communities of Millertown, Buchans and Buchans Junction. The RAA informed the assessment of cumulative effects (Chapter 20) and is also the area in which accidental events are assessed (Chapter 21).

This assessment also refers to the Ecological Land Classification Area (ELCA) (Section 12.2.1.3), which is the area within which detailed habitat data have been collected (Baseline Study Appendix 7 [BSA.7], Attachment 7-D). While the extent of the ELC data does not fully cover the Project Area, LAA or RAA, the ELCA is used to assess quantitative effects on habitat. In particular, the magnitude of residual effects has been characterized in relationship to the ELCA (i.e., the percentage of the ELCA in which a loss or change will occur). In this context, the ELCA has been used as a surrogate for the RAA, as it is an area of sufficient size to provide regional context and is the area for which comparable ecological land classification data is available.

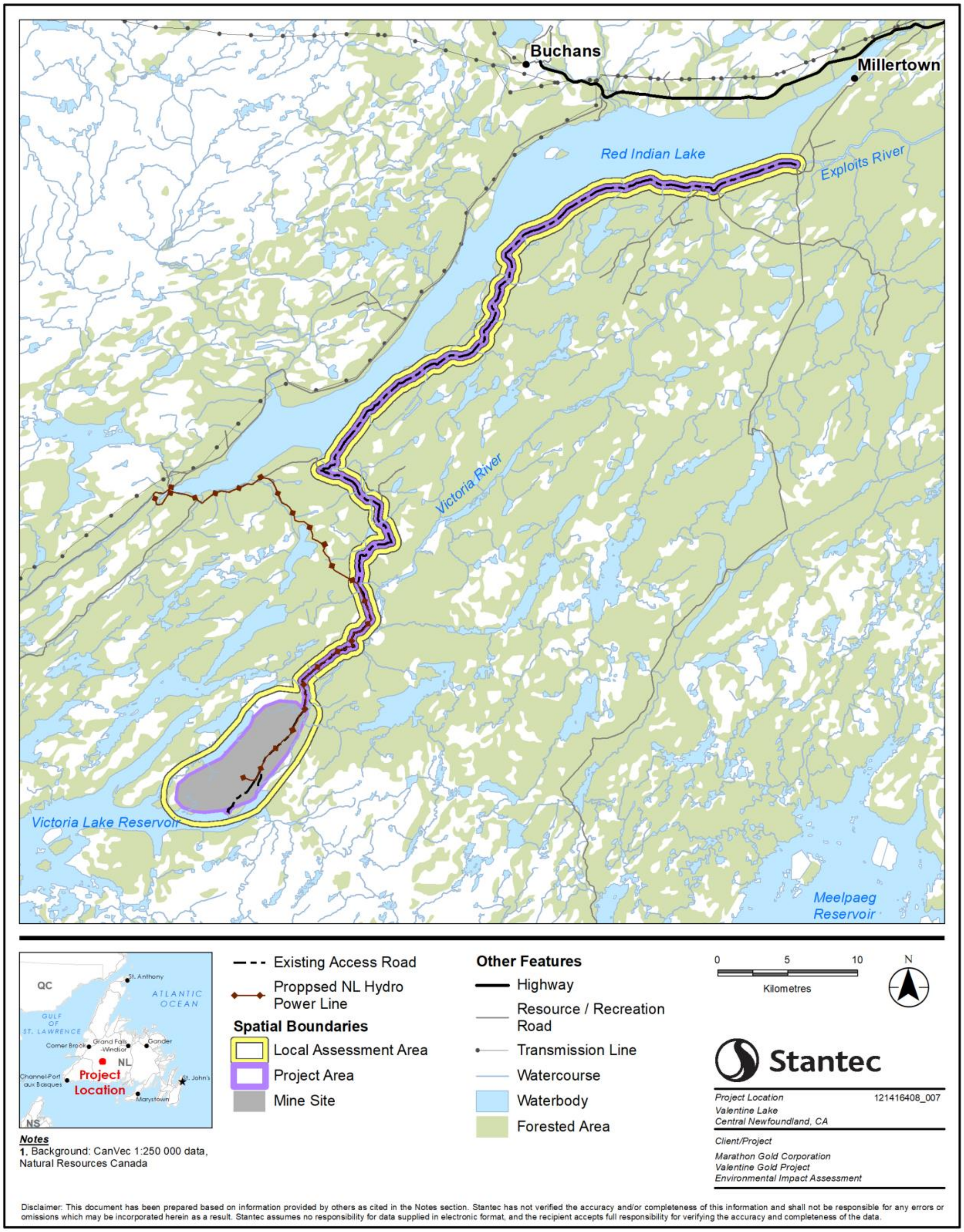

Figure 12-1 Local Assessment Area for Other Wildlife

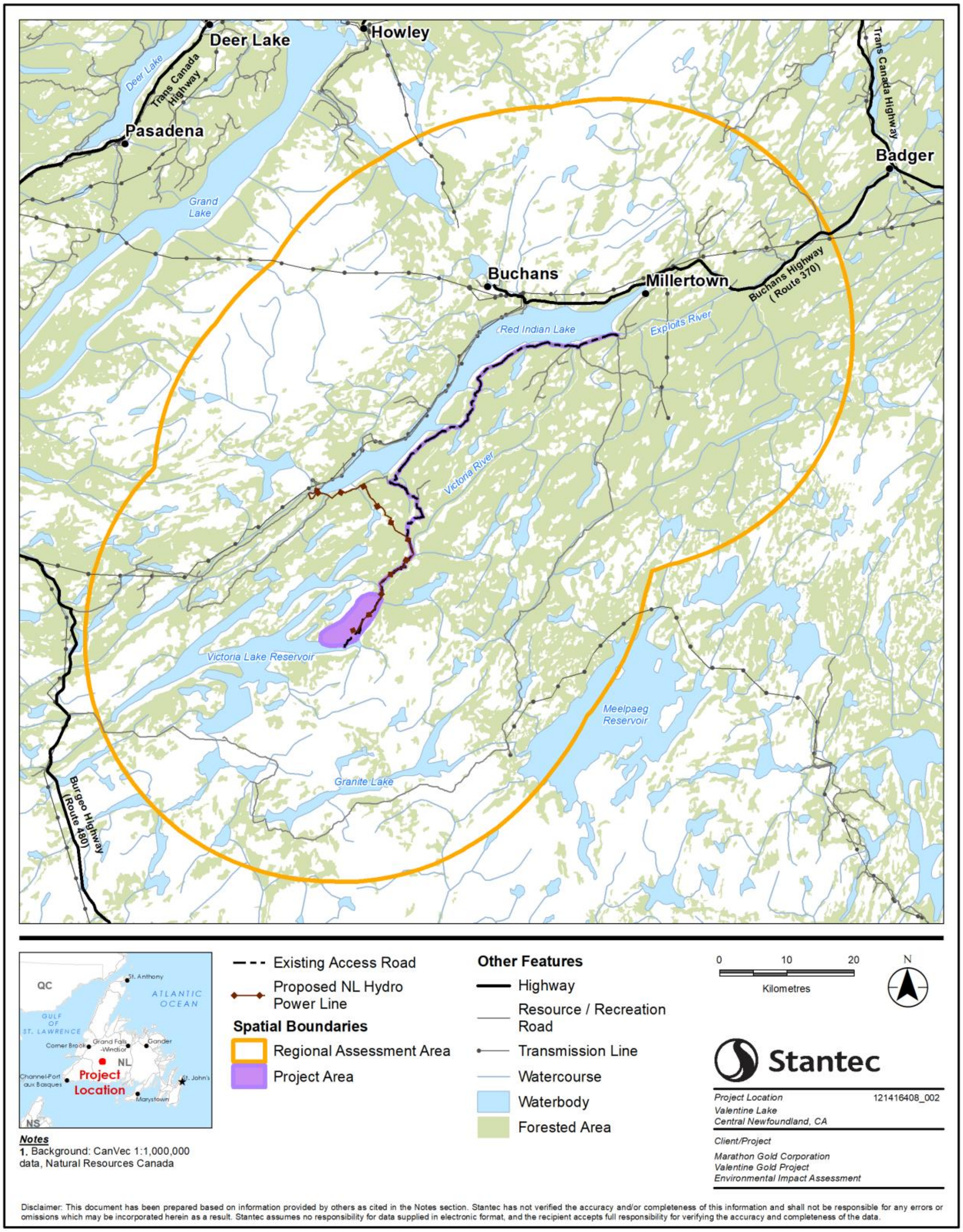

Figure 12-2 Regional Assessment Area for Other Wildlife

12.1.3.2 Temporal Boundaries

The temporal boundaries for the assessment of potential effects on the Other Wildlife VC include:

- Construction Phase – 16 to 20 months, beginning in Q4 2021, with 90% of activities occurring in 2022
- Operation Phase – Estimated 12-year operation life, with commissioning / start-up and mine / mill operation slated to start Q2 2023
- Decommissioning, Rehabilitation and Closure Phase – Closure rehabilitation to occur once it is no longer economical to mine or resources are exhausted

12.2 EXISTING CONDITIONS FOR OTHER WILDLIFE

A characterization of the existing conditions within the spatial boundaries defined in Section 12.1.3.1 is provided in the following sections. This includes a discussion of the influences of past and present physical activities on the VC, leading to the current conditions. An understanding of the existing conditions for the VC within the spatial area being assessed is a key requirement in the prediction of potential Project effects provided in Section 12.5.

The species included in this chapter are outlined in Table 12.1. The large mammals included are moose (*Alces alces*) and black bear (*Ursus americanus*). For furbearers and small mammals, representative species were identified to focus the description of existing conditions relative to the Project Area. The following representative species were selected based on their affinities for a particular habitat type, and / or representation of a particular group (e.g., terrestrial or semi-aquatic species):

- Furbearers
  - Beaver (*Castor canadensis*)
  - Canada Lynx (*Lynx canadensis*)
  - Muskrat (*Ondatra zibethicus*)
- Small Mammals
  - Meadow vole (*Microtus pennsylvanicus*)
  - Southern red-backed vole (*Myodes gapperi*)

This chapter also includes a description of existing conditions for SAR and SOCC relative to the LAA. American marten (*Martes americana atrata*) (Newfoundland population) (referred to as marten) is known to occur within the Project Area. Northern long-eared bat (*Myotis septentrionalis)* and little brown bat (*Myotis lucifugus*) have the potential to occur in the Project Area based on the occurrence of mature mixedwood forest in the region.

12.2.1 Methods

The existing conditions for other wildlife and their habitats within the Project Area were compiled from various sources, including a literature review, Project-specific field studies, and a wildlife habitat assessment.

12.2.1.1 Literature Review

The information on existing conditions was compiled from several sources including peer-reviewed published literature, field studies within the Project Area, federal and provincial databases, publications and data sources from not-for-profit organizations, and communications with the Newfoundland and Labrador (NL) Department of Fisheries, Forestry and Agriculture – Wildlife Division (NLDFFA-Wildlife Division). The following key public resources were used during background reviews to assist in establishing the existing conditions for other wildlife and their habitats:

- Provincial Moose Management Plan (Government of Newfoundland and Labrador [NL] 2015)
- Provincial 2019-20 Hunting and Trapping Guide (Government of NL 2019a)
- Provincial Recovery Plans for SAR (The Newfoundland Marten Recovery Team 2010)
- Committee on the Status of Endangered Wildlife in Canada (COSEWIC) Assessment and Status Update Reports (COSEWIC 2007, 2013)
- SARA Public Registry – Residence Descriptions (Government of Canada 2007)
- SARA Recovery Strategy Series: Recovery Strategy for Little Brown Myotis *(Myotis lucifugus*), Northern Myotis (*Myotis septentrionalis*), and Tri-colored Bat (*Perimyotis subflavus*) in Canada (Environment Canada [now Environment and Climate Change Canada (ECCC)] 2015)
- Atlantic Canada Conservation Data Centre (AC CDC) – observation data on SAR / SOCC in Atlantic Canada
- Labrador-Island Transmission Link Environmental Impact Statement (Nalcor 2012)
- Labrador-Island Transmission Link Furbearer and Small Mammal Component Study (Stantec 2012)
- Ecological Land Classification (ELC) and Wildlife Species Habitat Analysis, Alderon Iron Ore Corp (Alderon 2012)

12.2.1.2 Field Studies

Stantec completed several field studies on wildlife in the Project Area and surrounding areas between 2011 and 2018, including a winter wildlife survey (BSA.7, Attachment 7-A), marten hair snagging surveys (BSA.7, Attachments 7-A, 7-G), and an ELC (BSA.7, Attachment 7-D) (Table 12.2). Further detail on these studies is available in the Baseline Study Appendix 7: Avifauna, Other Wildlife and Their Habitats (BSA.7).

Table 12.2 Wildlife Field Studies for the Project

Study	Date	Summary
Winter Wildlife Survey (BSA.7, Attachment 7-A)	February 28 – March 29, 2013	Aerial track survey, ground based track survey, and deployment of three marten hair snag traps and deoxyribonucleic acid (DNA) analysis.
Ecosystem Classification and Mapping of the Marathon Gold Corporation Valentine Lake Project, Central Newfoundland (BSA.7, Attachment 7-D)	2013 – 2014	Ecosystem classification based on: classification of remotely sensed data; accompanying field program including terrain and soil surveys, and vegetation surveys; and documentation of wildlife observations.

Table 12.2 Wildlife Field Studies for the Project

Study	Date	Summary
Valentine Lake Project: Newfoundland Marten Baseline Study (BSA.7, Attachment 7-G)	February 26 – March 27, 2018	Deployment of three marten hair snag traps and DNA analysis of captured hair.
2011 Forest Songbird Surveys at the Valentine Lake Prospect (BSA.7, Attachment 7-B)	June 14 and 18, 2011	Forty-five 10-minute point count surveys were completed. Incidental wildlife observations recorded.
2011 Baseline Waterfowl and Waterfowl Habitat Study, Valentine Lake Project (BSA.7, Attachment 7-C)	Breeding waterfowl survey: May 16, 2011 Brood survey: July 7, 2011	Aerial surveys to assess waterfowl utilization, and nesting, breeding, and brood rearing habitat preferences. Incidental wildlife observations recorded.
Valentine Lake Project: Waterfowl Baselines Study (BSA.7, Attachment 7-E)	Spring Breeding: June 6, 2017 Fall Staging: September 27, 2017	Aerial transect surveys overflown, waterfowl species identified and counted, and densities determined.
Valentine Gold Project: 2019 Avifauna Baseline Study (BSA.7, Attachment 7-H)	June 26 – 28, 2019	Fifty-two 10-minute point count surveys were completed, in addition to eight passive point surveys for common night-hawk. Incidental wildlife observations recorded.

12.2.1.3 Other Wildlife Habitat Assessment

The habitat types surrounding the Project Area were determined by an ELC (BSA.7, Attachment 7-D). The ELC included the desktop analysis of satellite imagery, supported by field surveys for soils and vegetation. Eleven separate satellite images of the ELCA were processed and adjusted with ortho-corrected aerial images. Ecotypes were classified based on various characteristics including terrain, soils, moisture and nutrient regime, and plant species richness.

Discussion of habitat type availability in this chapter refers to the ELCA. The ELCA covers more than 99% of the Project Area and 97% of the LAA (Figure 12-3). The area of the Project Area and LAA outside the ELCA is restricted to a small portion of the access road at its northern-most extent (i.e., furthest from the mine site) and is negligible in the context of assessing potential Project effects on the VC. An analysis of the remaining portion of the LAA was completed, however this could not be combined with the ELCA, as the methods are not comparable. A detailed explanation of this analysis is provided in Section 9.2.1.1.

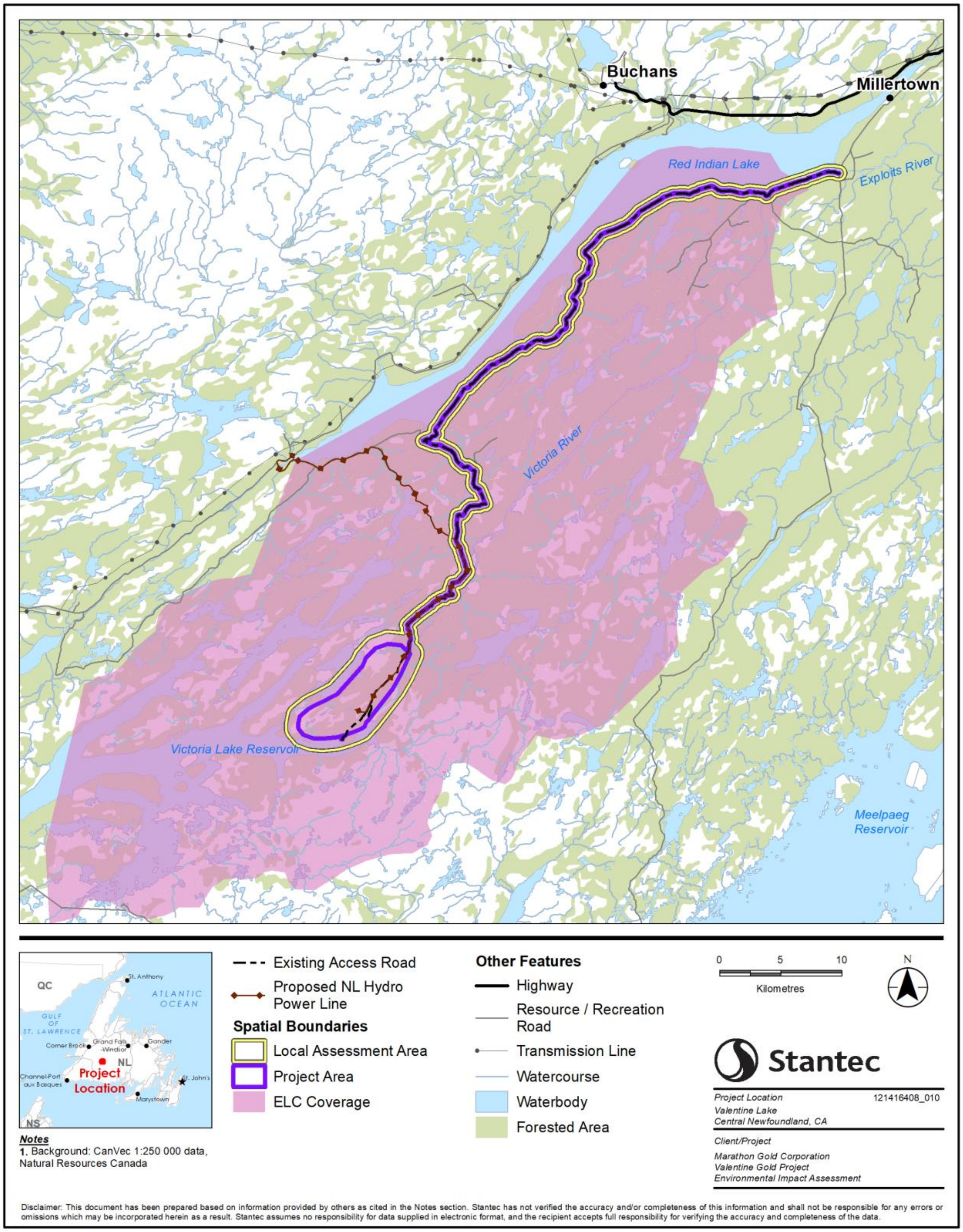

Figure 12-3 Coverage of ELC Data and Overlap with Project Area and LAA

Habitat quality was assessed for the representative wildlife species identified for this VC. The habitat requirements for the representative species were determined, and each habitat type evaluated based on literature reviews, available information and discussion with experts. Each habitat type present in the Project Area and LAA was evaluated and considered features such as the presence of structural and compositional elements, and prey or forage availability. Year-round habitat requirements were considered to account for seasonal habitat requirements such as breeding, denning, and hunting or foraging.

Three ranks of habitat value were assigned to the habitat types within the Project Area and LAA: high, moderate and low. High value habitat provides forage, protection, and nesting and resting habitat; moderate habitat provides an abundance of one or more (or marginal amounts of all) of the critical elements (e.g., foraging, protection and resting); and low value habitat provides marginal foraging, protection, or resting opportunities, or may be used only during transit. The evaluation of habitat suitability for the representative other wildlife species in this chapter provides an overview of the potential for portions of the Project Area and LAA to support these species.

12.2.2 Overview

The Project is in the Red Indian Lake Subregion of the Central Newfoundland Forest Ecoregion, which covers most of the central and northeastern portions of the Island. This area has a continental climate and experiences colder winters and warmer summers than coastal areas. It is characterized by a mainly coniferous boreal forest, domed bogs, and a rolling landscape, with elevations within the Project Area ranging from approximately 160 to 430 m above sea level.

Upland vegetation is mostly balsam fir and black spruce forest with some hardwood and mixedwood stands, and heath areas. Lowlands include wetlands and areas of wet coniferous forest (BSA.7, Attachment 7-D). Twelve habitat types have been identified within the Project Area and LAA (Table 12.3). Upland areas are dominated by softwood forests (i.e., Balsam Fir Forest and Black Spruce Forest), Alder Thicket and Mixedwood Forest. Lowland sites consist of open peatlands (i.e., Shrub / Graminoid Fen and Shrub Bog) and treed wetlands (i.e., Wet Coniferous Forest).

Table 12.3 Ecosystem Units within the Project Area, LAA and ELCA

Ecosystem Units	Description	Area in Project Area[A] (km^2 / %)	Area in LAA[A] (km^2 / %)	Area in ELCA[A] (km^2 / %)
Alder Thicket	Alder-dominated communities on moist seepage slopes and riparian areas	2.2 / 6.5	11.9 / 9.3	97.4 / 5.3
Anthropogenic	Areas currently or historically subject to intense levels of human disturbance and use (does not include areas regenerating from forest management)	1.9 / 5.4	2.5 / 1.9	8.2 / 0.5
Balsam Fir Forest	Dry to moist and sometimes wet conifer-dominated forests	6.2 / 18.0	15.1 / 11.9	126.9 / 6.9

Table 12.3 Ecosystem Units within the Project Area, LAA and ELCA

Ecosystem Units	Description	Area in Project Area[A] (km^2 / %)	Area in LAA[A] (km^2 / %)	Area in ELCA[A] (km^2 / %)
Black Spruce Forest	Dry to moist and sometimes wet conifer-dominated forests	4.3 / 12.5	17.6 / 13.9	233.1 / 12.7
Exposed Sand / Gravel Shoreline	Sparsely vegetated and/or un-vegetated shorelines	-	0.6 / 0.5	2.8 / 0.2
Kalmia-Black Spruce Woodland	Dry to moist and sometimes wet stunted tree and shrub / heath dominated communities	3.6 / 10.3	8.6 / 6.8	208.8 / 11.4
Mixedwood Forest	Mesic to moist forests with high deciduous component	6.0 / 17.3	18.9 / 14.9	179.3 / 9.8
Open Wetlands	Very moist to wet shrub / herb dominated peatlands	4.6 / 13.3	11.2 / 8.8	280.3 / 15.3
Open Water	Waterbodies (lakes, ponds, rivers and streams)	1.3 / 3.7	21.8 / 17.2	408.5 / 22.3
Regenerating Forest	Forests regenerating as a result of influences such as harvesting, fire and windthrow	2.0 / 5.6	12.5 / 9.9	139.5 / 7.6
Riparian Thicket	Shrub thickets located in transitional areas and subject to periodic flooding	0.2 / 0.4	0.6 / 0.5	15.1 / 0.8
Wet Coniferous Forest	Very moist to wet conifer forests	2.5 / 7.2	5.7 / 4.5	130.7 / 7.1
	Total	**34.7 / 100**	**127.0 / 100**	**1,830.6 / 100**

Note:
[A] Numbers are rounded to one decimal place. Areas and percentages may not add up to the total due to rounding. Values pertain to the portion of the Project Area and LAA within the ELCA. Ecosystem unit descriptions from BSA.7, Attachment 7-D

The region includes a variety of wildlife species commonly found in boreal forest on the Island of Newfoundland. Species confirmed in the Project Area include caribou, moose, black bear, Canada lynx, coyote (*Canis latrans*), red fox (*Vulpes vulpes*), marten, muskrat, river otter (*Lutra canadensis*), southern red-backed vole, meadow vole, snowshoe hare (*Lepus americanus*), and American red squirrel (*Tamiasciurus hudsonicus*) (BSA.7, Attachments 7-A, 7-D, 7-G). While not detected in field studies, mink (*Neovison vison*), ermine (*Mustela erminea*), northern long-eared bat, and little brown bat are expected to occur in the vicinity of the Project.

12.2.2.1 Large Mammals

The only large mammal species occurring on the Island of Newfoundland are moose, black bear and caribou, all of which are present in the Project Area and LAA. Most of the wildlife species on the Island are small to mid -sized birds and mammals. Caribou are discussed separately in Chapter 11 due to their cultural and ecological importance.

Moose

Life History, Distribution, and Density

Moose are the largest ungulate in North America (Timmermann and McNicol 1988) and are common throughout the Island of Newfoundland (Mahoney, NLDFLR in Joyce and Mahoney 2001). They were introduced to the Island in the late 1800s (Government of NL 2019b). Due to low predation and a large amount of uncolonized suitable habitat (McLaren et al. 2004), their population rapidly increased and dispersed to the rest of the island (Government of NL 2015), and was estimated at over 112,000[4] in 2014 (Government of NL 2015). Moose are distributed across the Island in varying densities, ranging from 0.5 moose/km^2 in non-forested areas to 2 moose/km^2 or greater in forested areas (McLaren et al. 2009). The densities in some areas of the Island are known to exceed the provincial management target of 2 moose/km^2 (Government of NL 2015), reaching as high as 12 moose/km^2 in MMA 17 (Mercer and McLaren 2002). High density moose populations have experienced issues including reduced body weight and growth, lower reproductive rates, and lower recruitment (Ferguson et al. 2000).

Moose are generally associated with mixedwood and boreal forests (Timmermann and Rodgers 2005), although habitat preferences shift seasonally (Peek et al. 1976). Summer diet for moose often consists of leaves from deciduous trees and shrubs (e.g., ash, aspen, maple, and birch), as well as grasses and forbs, sedges, and aquatic plants. Winter diet is primarily twigs from balsam fir, and other coniferous and deciduous shrubs (Dodds 1960).

Moose have developed a flexible reproduction strategy with variable pregnancy rates, age at sexual maturity, and twinning rates (Ferguson et al. 2000), making them highly adaptable to differing habitat conditions and predation rates. Male moose (or bulls) have large antlers that can weigh approximately 22 kilograms (kg) (Gasaway 1974) and span more than 125 centimetres (cm) wide (Schmidt et al. 2007). The antlers are used during the fall rut to attract females (or cows) and fight with other males over a female. The antlers are shed over the winter and begin to regrow in early spring. Unlike many mammals, female moose reach reproductive maturity based on size and weight, rather than age (Malmsten et al. 2014), and typically have 1 to 2 calves in spring. Twinning rates vary with moose density, and ranges of 2 to 28% have been reported on the Island of Newfoundland (Pimlott 1959). The most recent population estimates for moose MMAs 17 and 18 are 2,151 (+/- 259) and 2,639 (+/- 286), respectively (Government of Newfoundland 2020b).

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[4] Excluding the National Parks (Government NL 2015)

Regulated hunting of moose began in 1935 and management areas were established by the Province in 1954 (Government of NL 2015). The Project Area overlaps with MMA 17 and 18 (Figure 12-4), where a fall hunting season is permitted, and licenses are available to residents and non-residents. The 2019 to 2020 moose quota for the Island of Newfoundland was over 15,000 licenses, with a success rate of approximately 59% (Government of NL 2019a). Within MMA 17 and 18, the moose quotas were 184 and 160 licenses, respectively (Government of NL 2015). Additionally, the Government of NL created two Moose Reduction Zones in 2015, to reduce moose-vehicle collisions along major roadways. The Moose Reduction Zones, positioned along the highway, have an additional quota allocation of 800 licenses (Government of NL 2019a).

Moose have been confirmed in the LAA and Project Area through both sightings and observation of sign (e.g., trails, droppings, beddings) (BSA.7, Attachments 7-A, 7-B, 7-C, 7-D, 7-E, 7-H, unpublished data) (Figure 12-5). Moose tracks were observed during the winter wildlife survey (BSA.7, Attachment 7-A) and during summer field studies (BSA.7, Attachment 7-B, 7-D). Individuals have also been observed during field studies in 2011 (eight sightings, including two females with yearlings) (BSA.7, Attachment 7-C), 2014 (one sighting) (BSA.7, Attachment 7-D), and 2017 (two sightings, including and female and calf) (BSA.7, Attachment 7-E). Most recently, remote wildlife cameras in the Project Area have captured 140 moose observations (males=37; females=73; calves=6; yearlings = 1; unknown=23) (BSA.2, Attachments 2-A and 2-B).

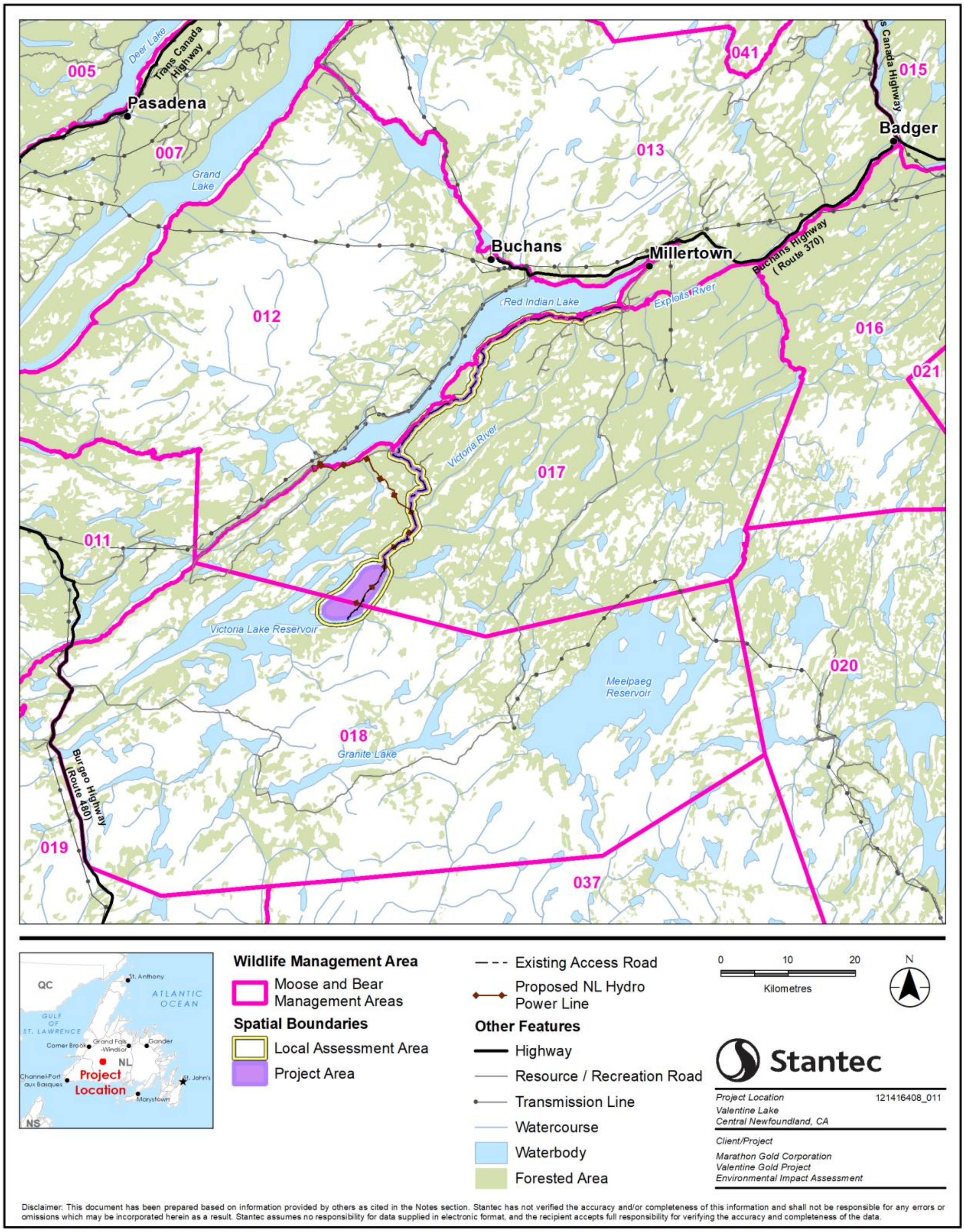

Figure 12-4 Overlap of Project Area with Moose and Bear Management Areas

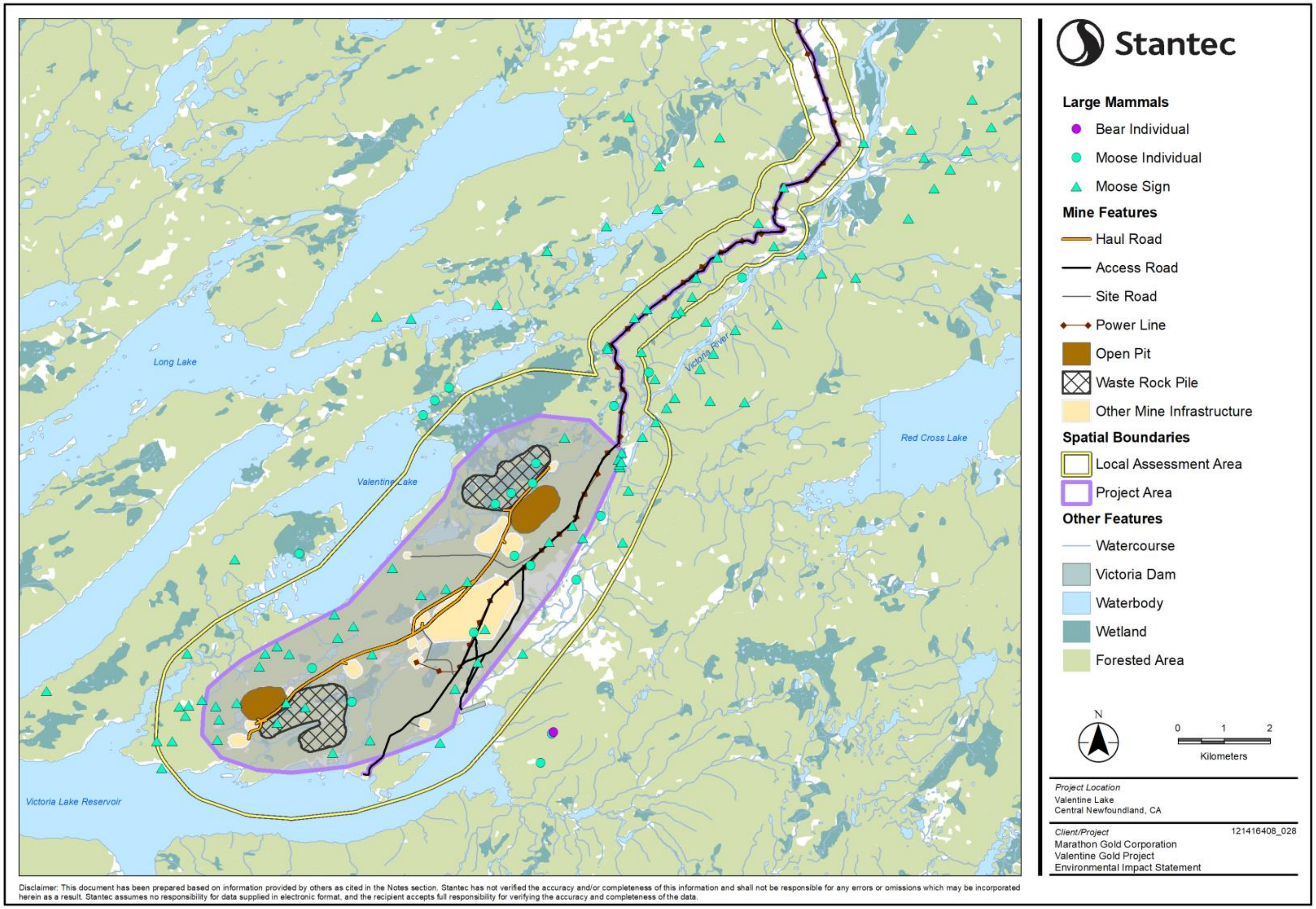

Figure 12-5 Large Mammal Observations from Field Studies in the Project Area, 2011-2019

Habitat Occurrence in the Project Area

Moose select their habitat based on multiple factors including distribution of forage species, nutritional requirements, predation risk, and snow depth. Moose are generally associated with mixedwood or coniferous forests habitats, and disturbed or regenerating habitats.

Habitat types ranked as high value for moose are Mixedwood Forest, Alder Thicket, Riparian Thicket, and Wet Coniferous Forest (Table 12.4). Mixedwood Forests are important as they provide suitable forage including balsam fir and deciduous trees as well as a shrub understory, and adequate cover that offers protection from predation and shelter (BSA.7, Attachment 7-D; Crête and Courtois 1997; Alderon 2012; Nalcor 2012; McGraw 2019). Alder and Riparian Thicket are ranked as high value because they provide a dense shrub layer that includes both coniferous and deciduous species (BSA.7, Attachment 7-D; Crête and Courtois 1997; Poole and Stuart-Smith 2005). Additionally, Riparian Thicket provides aquatic vegetation in the spring and summer. Finally, Wet Coniferous Forest is ranked as high value to moose because it contains a mixture of trees to provide cover, as well as a dense herbaceous layer for forage (Herfindal et al. 2009; BSA.7, Attachment 7-D). The amount of high value moose habitat in the Project Area is 10.9 km^2 (or 31.3% of the total area) (Table 12.5). There are 37.2 km^2 (29.3%) of high value moose habitat within the LAA and 422.5 km^2 (23.1%) within the ELCA (Table 12.5).

Table 12.4 Habitat Value Ranking for Large Mammals

Habitat Type	Habitat Value Ranking	
	Moose	**Black Bear**
Alder Thicket	High	High
Anthropogenic	Moderate	Moderate
Balsam Fir Forest	Moderate	High
Black Spruce Forest	Moderate	High
Exposed Sand / Gravel Shoreline	Low	Low
Kalmia-Black Spruce Woodland[A]	Moderate	High
Mixedwood Forest	High	High
Open Wetlands[B]	Moderate	Moderate
Open Water	Moderate	Moderate
Regenerating Forest	Moderate	High
Riparian Thicket	High	High
Wet Coniferous Forest	High	High
Sources	Timmermann and McNicol 1988; Crête and Courtois 1997; Poole and Stuart-Smith 2005; Herfindal et al. 2009; Jung et al. 2009; Olsson et al. 2011; Alderon 2012; Nalcor 2012; McGraw 2019; BSA.7, Attachment 7-D	Brodeur et al. 2008; Lyons et al. 2003; Jung et al. 2009; Carter et al. 2010; Obbard et al. 2010; Latham et al. 2011; Sadeghpour and Ginnett 2011; Nalcor 2012; BSA.7, Attachment 7-D

Notes:
[A] Includes Kalmia-Black Spruce Forest and Kalmia Health Ecotypes
[B] Includes Shrub / Graminoid Fen and Shrub Bog Ecotypes

Table 12.5 Amount of Habitat by Habitat Value Ranking for Large Mammals in the Assessment Areas

Habitat Value Ranking	Moose Habitat			Black Bear Habitat		
	Area in Project Area[A] (km^2 / %)	Area in LAA[A] (km^2 / %)	Area in ELCA[A] (km^2 / %)	Area in Project Area[A] (km^2 / %)	Area in LAA[A] (km^2 / %)	Area in ELCA[A] (km^2 / %)
High	10.9 / 31.3	37.2 / 29.3	422.5 / 23.1	27.0 / 77.6	91.0 / 71.6	1,130.7 / 61.8
Moderate	23.9 / 68.7	89.2 / 70.3	1,405.3 . 76.8	7.8 / 22.4	35.4 / 27.9	697.1 / 38.1
Low	0	0.6 / 0.5	2.8 / 0.2	0	0.6 / 0.5	2.8 / 0.2
Total	34.7 / 100.0	127.0 / 100.0	1,830.6 / 100.0	34.7 / 100.0	127.0 / 100.0	1,830.6 / 100.0

Notes:
[A] Numbers rounded to one decimal place. Areas and percentages may not add up to total amounts due to rounding
Values pertain to the portion of the Project Area and LAA with ELC data

Balsam Fir and Black Spruce Forests, Kalmia-Black Spruce Woodland, Regenerating Forest, Open Wetlands, Open Water, and Anthropogenic habitats are ranked as having a moderate importance to moose (Table 12.4). Coniferous forests (e.g., Balsam Fir and Black Spruce Forests) are important winter habitat as they provide forage and cover (Crête and Courtois 1997; Olsson et al. 2011; Nalcor 2012; BSA.7, Attachment 7-D). Kalmia-Black Spruce Woodland provides year-round forage (e.g., Kalmia, ericaceous shrubs, herbs), and may be used in the winter if snow conditions are suitable (BSA.7, Attachment 7-D; Herfindal et al. 2009; Nalcor 2012; McGraw 2019). Regenerating Forest is also of some importance as young balsam fir and birch can be a food source (Olsson et al. 2011; Alderon 2012; BSA.7, Attachment 7-D). Open Wetlands can provide aquatic forage in addition to shrubs and herbs (Jung et al. 2009; Olsson et al. 2011; Alderon 2012; BSA.7, Attachment 7-D). Open water may provide aquatic forage (Timmermann and McNicol 1988) and this habitat type can be particularly important if the conditions of the open water are optimal for aquatic vegetation (e.g., shallow and clear water). Finally, some types of anthropogenic disturbance, such as roadways, are selected by moose as they may provide mineral or salt deposits (Laurian et al. 2008b), or abundant vegetation regrowth (Rea et al. 2010). There are 23.9 km^2 of moderate value moose habitat in the Project Area (68.7%), 89.2 km^2 in the LAA (70.3%), and 1,405.3 km^2 (76.8%) in the ELCA (Table 12.5).

Other habitat types are considered low quality (Table 12.4), based on limited protection, resting or foraging opportunities. Low quality habitat equals 0 km^2 in the Project Area, 0.6 km^2 in the LAA (0.5%) and 2.8 km^2 (0.2%) in the ELCA (Table 12.5).

The proportions of high, moderate and low -quality habitat are similar in both the Project Area and LAA (Table 12.5). The proportion of high-quality moose habitat is somewhat lower in the ELCA than in the Project Area or LAA.

Limiting Factors

Moose populations can be limited by several factors including food availability, predation, hunting pressure, weather conditions (e.g., snow depth) and parasite load. Food availability limits moose populations by affecting reproductive rates, especially at high moose densities (Ferguson et al. 2000; Dussault et al 2005; Joly et al. 2017). Therefore, habitat loss or alteration from development or disturbance could limit the amount of suitable moose habitat. Snow depth can also limit populations by reducing food availability and increasing energy expenditure (Newbury et al. 2007; Dussault et al. 2005). The predation rate from wolves and bears can limit moose populations (Ballenberghe and Ballard 1994; Zager and Beecham 2006). On the Island of Newfoundland, which does not have a breeding wolf population, coyote and black bear are the primary moose predators. Predation rates may increase with increasing snow depth as escape is more difficult (Huggard 1993).

Black Bear

Life History, Distribution, and Density

Black bears are found throughout much of Canada, the Northwest Territories, the Yukon, and Alaska. South of Canada, they occur in a number of isolated pockets within parts of the United States (US) and Mexico. Black bears are distributed across the Island of Newfoundland and occur in the Project Area, as confirmed by remote wildlife cameras (BSA.2, Attachments 2-A and 2-B) (Figure 12-5).

Black bears become sexually mature between three and five years. Usually solitary animals, mating occurs in June to August. Black bears have delayed implantation whereby mating in the summer, implantation typically does not occur until October or November (Banfield 1987). Black bears hibernate over the winter, creating dens by excavating holes into soil or under tree roots, creating shelter from fallen trees, or using existing rock crevices. One to six cubs are born in January or February. The young remain with the female for 16 to 17 months and will den with her the following winter during hibernation.

There is a legal black bear hunt in NL for both residents and non-residents within the BMAs (Figure 12-4), the boundaries for which mirror those of the MMAs. The Project Area overlaps BMAs 17 and 18. The hunting quota is two black bears (either sex) in management areas open to hunting (Government of NL 2019a). Hunting on the Island is permitted in either of the designated fall or spring seasons. Black bears on the Island of Newfoundland are considerably heavier than those on the mainland (Mahoney et al. 2001) and this has contributed to the success of bear hunting guiding operations on the Island. Black bear on the Island of Newfoundland also have larger home ranges than in other parts of North America. In the La Poile area, females were found to have ranges of 145 km^2 while males had ranges greater than 850 km^2 (Fifield et al. 2013).

An opportunistic omnivore, black bears primarily forage for plants and insects (Graber and White 1980; Bull et al. 2001; Greenleaf et al. 2009; Bastille-Rousseau et al. 2011), however will hunt or scavenge when possible (Allen et al. 2014). Black bears rely heavily on fruits (e.g., blueberry, cherry), graminoids and forbs (Greenleaf et al. 2009). They are also known to be important predators of neonate / young ungulates (Zager and Beecham 2006; Mumma et al. 2016) and are also known to consume hare on the Island of Newfoundland (Mumma et al. 2016). On the Island, over 30% of predated caribou calves are killed by black bears (Lewis and Mahoney 2014; Lewis et al. 2017). However, black bears may hunt moose and caribou young opportunistically as research indicates they may select habitats rich in vegetation rather than selecting habitat with a higher likelihood of encountering moose and caribou young (Bastille-Rousseau et al. 2011). While black bears have no predators, they can experience infanticide and cannibalism from other bears (LeCount 1987; Schwartz and Franzmann 1991).

Habitat Occurrence in the Project Area

Vegetation-rich areas are important to black bear (Bastille-Rousseau et al. 2011), as they contain a wide variety of forage species. Areas with forest cover are also important to black bear for security, protection and bedding sites. Balsam Fir / Black Spruce Forests, Kalmia-Black Spruce Woodland, Mixedwood Forest, Regenerating Forest, Alder and Riparian Thickets, and Wet Coniferous Forests are ranked as high importance (Table 12.4) as these habitat types include diverse forage as well as sufficient cover for black bear (Lyons et al. 2003; Brodeur et al. 2008; Carter et al. 2010; Obbard et al. 2010). These habitat types include plentiful herbaceous plants (e.g., bunchberry (*Cornus canadensis*), cloudberry (*Rubus chamaemorus*), dewberry (*Rubus pubescens*), shrubs (blueberry (*Vaccinium* spp.), fire cherry (*Prunus pensylvanicum*), raspberry (*Rubus idaeus*), currant (*Ribes* spp.), crowberry (Empetrum spp.), partridgeberry (*Vaccinium vitis-idaeus*), forbs, graminoids, and horsetails (*Equisetum* spp.), which are consumed by black bears (Graber and White 1980; Bull et al. 2001; Greenleaf et al. 2009; Bastille-Rousseau et al. 2011). The trees and understory in these habitat types also provide adequate cover for black bear. There are 27.0 km^2 of high value black bear habitat in the Project Area (or 77.6% of the total area), 91.0 km^2 (71.6%) in the LAA, and 1,130.7 km^2 (61.8%) in the ELCA (Table 12.5).

Habitat types of moderate importance to black bear are Open Wetlands, Open Water and Anthropogenic habitats (Table 12.4) (Carter et al. 2010; Latham et al. 2011). While these habitats may provide some of the preferred forage species, they occur in lower quantities and lack the trees used as cover by black bear. Some anthropogenic habitats may provide plentiful forage (e.g., cleared areas adjacent to roadways) or easy access to human food (e.g., garbage cans and dump sites); however, these habitats can present higher risks due to their proximity to humans and traffic. There are 7.8 km^2 (22.4%) of moderate habitat in the Project Area, 35.4 km^2 (27.9%) in the LAA, and 697.1 km^2 (38.1%) in the ELCA (Table 12.5).

Exposed Sand/Gravel is ranked as low importance to black bear (Table 12.4); this equals 0 km^2 in the Project Area, 0.6 km^2 (0.5%) in the LAA, and 2.8 km^2 (0.2%) in the ELCA (Table 12.5).

The proportions of high, moderate and low-quality habitat are similar in both the Project Area and LAA (Table 12.5). The proportion of high-quality black bear habitat is somewhat lower in the ELCA than in the Project Area or LAA.

Limiting Factors

Black bears have few natural predators, although infanticide and cannibalism have been reported (LeCount 1987; Schwartz and Franzmann 1991). Low reproductive rates, delays in sexual maturity / reproduction, and high juvenile mortality rates are also limiting factors. In most areas however, hunting pressure and vehicle collisions are the greatest source of black bear mortality (Schwartz and Franzmann

1991; Tri et al. 2017). Several parasites have been reported from black bear in North America (e.g., ticks, lice, protozoa, nematodes and tapeworms) (Rogers and Rogers 1974; Rogers 1975), however there is little research on the effects of parasites on the populations.

12.2.2.2 Furbearers and Small Mammals

Furbearers

While the term 'furbearers' traditionally refers to species that are managed for harvesting, for the purpose of this report, the definition includes species managed as such by the province, as well as other medium-sized furbearing mammals, such as hare. Small mammals include mice, voles, shrews, bats, and rats.

Life History, Distribution, and Density

Thirteen species of furbearers occur on the Island of Newfoundland (Table 12.6). Of these, four were introduced by European settlers. A fifth non-native species, coyote, was established on the Island of Newfoundland through range expansion. Coyotes arrived on the Island in the 1980s on pack ice from the Gulf of St. Lawrence, likely travelling from Cape Breton (Government of NL n.d.a).

Table 12.6 Furbearer Species Occurring on the Island of Newfoundland

Scientific Name	Common Name	Origin
Lepus americanus	Snowshoe Hare	Introduced
Lepus arcticus bangsii	Arctic Hare	Native
Tamias striatus	Eastern Chipmunk	Introduced
Tamiasciurus hudsonicus	Red Squirrel	Introduced
Castor canadensis	American Beaver	Native
Ondatra zibethicus	Muskrat	Native
Canis latrans	Eastern Coyote	Naturally introduced through range expansion
Canis lupus	Gray Wolf	Extirpated in 1930s; genetic testing has confirmed presence of wolf and wolf-coyote hybrids on the Island of Newfoundland (Government of NL 2012), though no evidence of breeding population
Vulpes vulpes	Red Fox	Native
Martes americana atrata	American Marten	Native
Mustela erminea	Ermine (Weasel)	Native
Neovison vison	Mink	Introduced
Lontra canadensis	Northern River Otter	Native
Lynx canadensis	Canada Lynx	Native

The Newfoundland population of American marten is listed as Threatened under SARA and is discussed in Section 12.2.2.3.

Most of the species listed in Table 12.6 are managed for hunting or trapping in NL, with snowshoe hare managed as “small game”. Arctic hare (*Lepus arcticus bangsii*) is not hunted on the Island of Newfoundland, although it is in Labrador. The other species, with the exceptions of American marten and eastern chipmunk (*Tamias striatus*), are managed as furbearers. For the purpose of harvesting, the Island is divided into 11 Fur Zones, each of which is split into traplines. The Project Area is located in Newfoundland Beaver Fur Zone 7 and intersects with four traplines (Figure 12-6); the mine site is fully encompassed in trapline 83, and the access road transects traplines 239, 221, and 14. The LAA also intersects trapline 134, which is located at the eastern end of the access road.

Four of the furbearer species occurring on the Island of Newfoundland are mustelids: marten, ermine, mink, and river otter. Mustelids are a diverse family in the order Carnivora. They typically have elongated bodies and short legs, with round ears and thick fur. Mink were introduced to the Island as escapees from fur farms, after fur farming began in the 1930s (Northcott et al. 1974). Since this time, their range has expanded, and they are now likely distributed throughout the province where suitable habitat occurs. Mink are typically found near water and watercourses, including streams, lakeshores, or in marshy areas. They also occur on marine coastlines and coastal islands (Northcott et al. 1974). The mink diet is made up of small mammals, fish, birds, frogs, crayfish and other vertebrates associated with aquatic environments. When present, muskrat appear to be a favoured prey species of mink (Northcott et al. 1974; NatureServe 2019). On the Island of Newfoundland, meadow vole and muskrat constitute the mammal portion of mink diet. This has resulted in the suppression of the muskrat population (Northcott et al. 1974), and substantially reduced muskrat from parts of the Island of Newfoundland. However, in recent years it appears that muskrat may be recovering in certain areas (Government of NL n.d.b.).

The river otter is a semi-aquatic mustelid found throughout the Island of Newfoundland in lakes, rivers, marshes, and bays. Their diet consists primarily of fish; however, they will also eat frogs, tadpoles, aquatic invertebrates, and small mammals, including muskrat, beaver and vole (Government of NL n.d.b). Ermine, also known as short-tailed weasel, is the smallest of the mustelids found on the Island. This species can be found in a wide variety of habitats, although prefers wooded areas with thick understory (NatureServe 2019), forming dens in hollow logs, under stumps, roots, brush piles, or rocks. The ermine diet consists of small mammals, other small vertebrates and insects (NatureServe 2019).

Rodent furbearers occurring on the Island of Newfoundland include eastern chipmunk, red squirrel, beaver, and muskrat. Eastern chipmunk and red squirrel were introduced to the Island of Newfoundland in the 1960s and both species are now found throughout the Island of Newfoundland. Red squirrels are typically found in mixedwood and coniferous forests; eastern chipmunks are found in deciduous or mixedwood areas. Both species are granivores, meaning that they feed primarily on seeds and nuts (NatureServe 2019; Spicer 2017). The introduction of red squirrel in NL has had effects on conifer cone crops, particularly for balsam fir. The squirrels harvest cones, which can prevent balsam from reproducing at previously normal rates (Spicer 2017; Gosse et al. 2011).

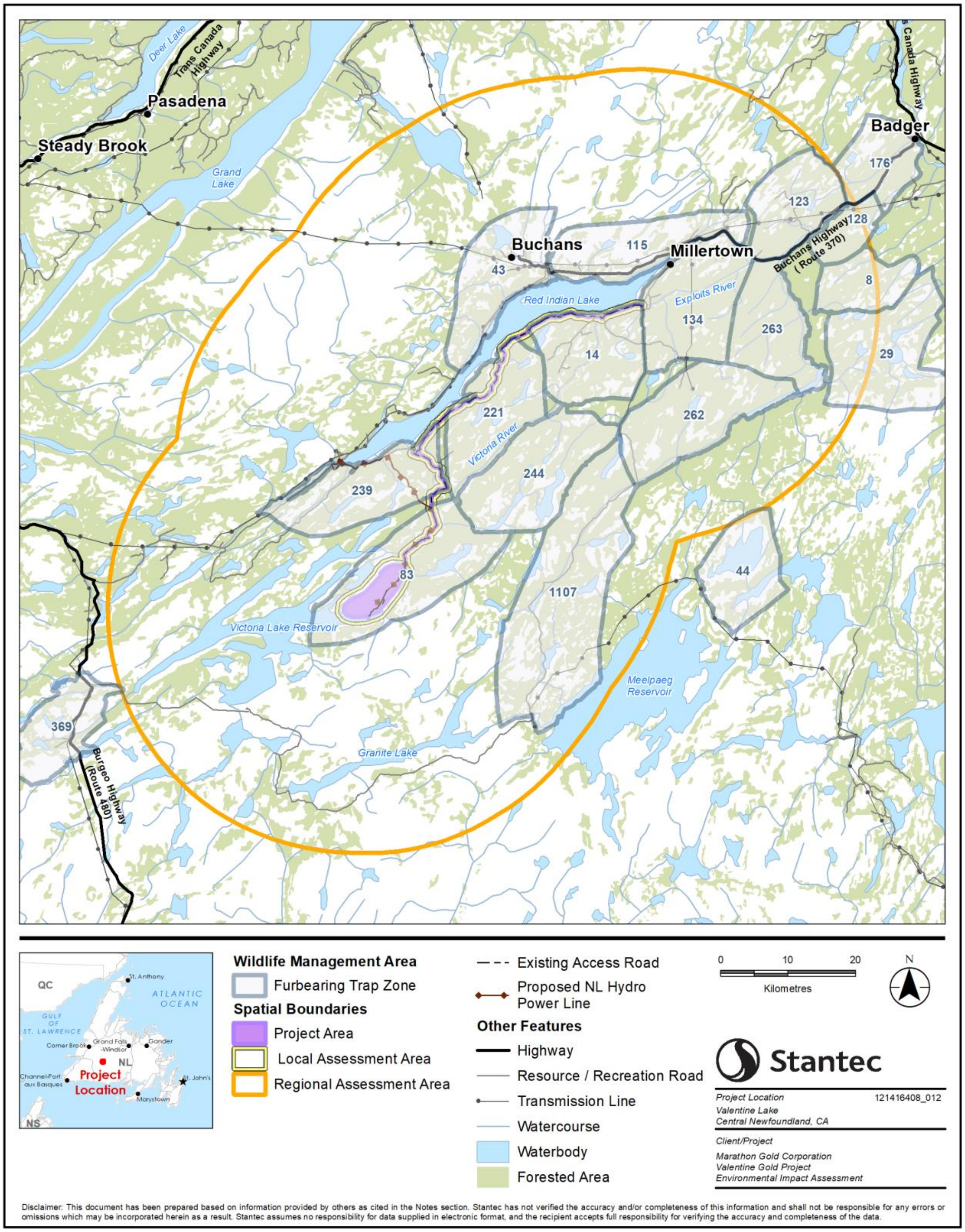

Figure 12-6 Overlap of Project Area with Furbearing Trap Zones

Beaver and muskrat are larger rodents found in aquatic environments. The muskrat population has been suppressed by the introduction of mink to NL. Muskrats are omnivores and feed mainly on aquatic vegetation; however, they also eat mussels, frogs, crayfish, small turtles, and fish. Beaver are nocturnal and feed primarily on the bark, twigs and leaves of deciduous trees, as well as on aquatic vegetation.

Two species of canines regularly occur on the Island of Newfoundland: red fox and coyote. Both species are fairly generalist predators that are found in a wide variety of habitat types. Since naturally expanding their range onto the Island of Newfoundland in the 1980s, coyotes have become distributed throughout the Island. Historically, a Newfoundland subspecies of gray wolf (*Canis lupus*) also occurred, though was thought to be extinct on the Island of Newfoundland in the early twentieth century (Government of NL n.d.b). However, genetic testing of harvested animals in 2009 and 2012 confirmed the presence of wolf and wolf-coyote hybrids on the Island of Newfoundland (Government of NL 2012). Research continues on wolves and wolf-coyote hybrids, however, currently there is no evidence of an established breeding population of wolves on the Island of Newfoundland (Government of NL 2012). It is likely that coyotes are occupying the ecological niche left by the gray wolf. Both red fox and coyote are opportunistic omnivores, feeding on small mammals including snowshoe hare, as well as birds, eggs, insects, and vegetation. Coyote also rely heavily on carrion for food (NatureServe 2019). Coyote and Canada lynx are predators of red fox.

The Canada lynx (hereafter, lynx) is the only member of the *Felidae* family that occurs in NL. Limited trapping is permitted for lynx on the Island of Newfoundland. The lynx is a medium-sized cat that ranges between 5 and 16 kg (NatureServe 2019). Most of its diet consists of snowshoe hare, particularly in the winter. As such, lynx population fluctuations follow those of the snowshoe hare. Lynx were rare on the Island of Newfoundland prior to the introduction of snowshoe hare and have increased since (Government of NL n.d.b). They are typically found in areas occupied by snowshoe hare.

Two species of hare occur on the Island of Newfoundland: arctic hare and snowshoe hare. Arctic hare are restricted to high elevation locations on the Island, including the alpine barrens in the highlands in the western half of the Island (Nalcor 2012). Snowshoe hare was introduced to NL around 1860 and is now found throughout the Island. It prefers dense stands or young conifers or brushy deciduous growth, and feeds on deciduous trees and shrubs, as well as some conifers, grasses, and forbs (NatureServe 2019). Snowshoe hare is an important prey source for lynx and red fox.

Winter wildlife surveys were conducted in 2013 in the LAA and surrounding area. These surveys involved both aerial and ground surveys, where wildlife observations, including tracks and scat, were recorded. During these surveys, furbearer species identified included lynx, coyote, red fox, river otter, snowshoe hare, ermine, red squirrel, and marten. Of these species, snowshoe hare had the highest density of tracks recorded in both aerial and ground surveys (BSA.7, Attachment 7-A). For the ground surveys, the density of snowshoe hare tracks were 125 tracks/km per day. The species recorded at the next highest density was ermine (20 tracks/km per day), followed by coyote (nine tracks/km per day) (BSA.7, Attachment 7-A).

Incidental records of furbearers were recorded during breeding bird surveys conducted in the summer of 2019. Four furbearer species were recorded in the Project Area: coyote, red squirrel, snowshoe hare, and marten (BSA.7, Attachment 7-H). The locations of furbearers observed during the field studies are provided in Figure 12-7.

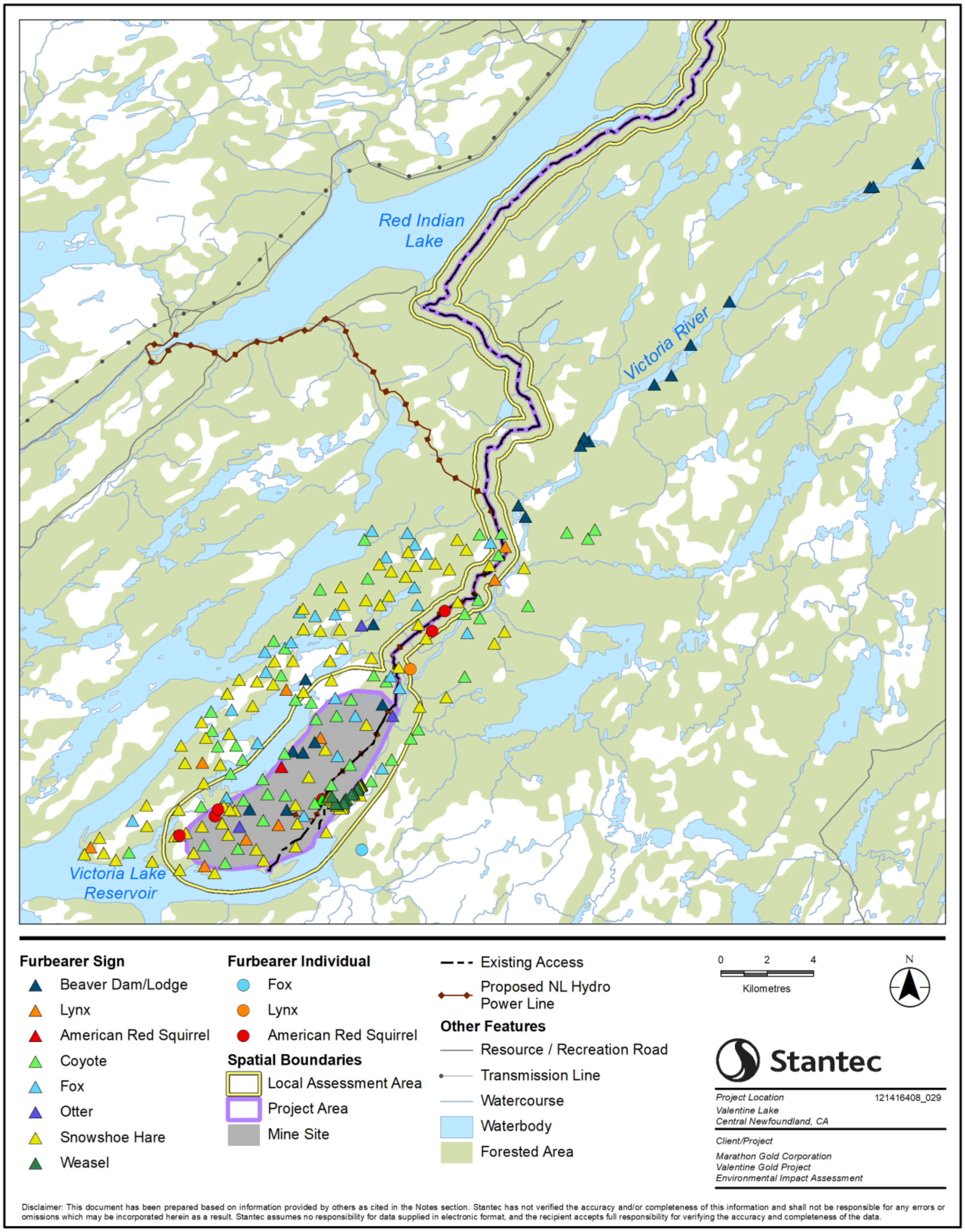

Figure 12-7 Furbearer Observations from Field Studies in Project Area, 2011-2019

Habitat Occurrence in the Project Area

Three species of furbearer were chosen for the habitat evaluation: lynx, beaver and muskrat. These species represent semi-aquatic and terrestrial species with wide-ranging distributions and limited habitat preferences. Red fox and coyote were not chosen for habitat evaluation because their habitat preferences are general and widespread. Marten is also included in the habitat evaluation (Section 12.2.2.3).

Lynx prefer older regenerating forest stands older than about 20 years of age. Stand level preferences by lynx follow closely those of its main prey, the snowshoe hare. During the winter, lynx select complex multistory mature coniferous stands providing prey (i.e., snowshoe hare) and cover. Summer and denning habitat also includes some younger forests with complex multistory (Moen et al. 2008; Squires et al. 2010; Simons-Legaard et al. 2013). Dens are typically located in hollow trees, under stumps, or in thick brush (NatureServe 2019).

Beaver are highly associated with water. They are typically found in ponds and lakes that provide escape cover and den sites such as lodges or bank burrows (Allen 1983). Beavers select habitat with availability of preferred forage, which consists of aquatic vegetation and ericaceous shrubs in summer, and alder and birch, aspen, and other hardwoods in winter (Northcott 1971). Beavers are well known for their behavior of dam building. The purpose of these dams is to create deep ponds that do not freeze to the bottom in the winter. Beavers store their winter food caches in these ponds. They also build their lodges in these ponds, which are accessible by underwater entries as well as tunnels. A family colony will live in this lodge, and this is where denning occurs (CWS and CWF 2017).

Muskrats are semi-aquatic, similar to beaver. They typically live in freshwater marshes, slow moving streams and rivers, and marshy areas of lakes. Suitable habitats require water that is deep enough that it does not freeze to the bottom in the winter, yet shallow enough to produce aquatic vegetation (CWS and CFS 1986; Nadeau at al. 1995). Depending on the resources available, muskrats may build lodges with bulrushes and cattails, or dig burrows in river or stream banks (CWS and CFS 1986). Muskrats are relatively inactive in the winter and remain in their lodges or burrows.

Habitat ranks for lynx, beaver and muskrat are provided in Table 12.7. For lynx, five habitat types are ranked as high: Balsam Fir Forest, Black Spruce Forest, Regenerating Forest, Alder Thicket and Riparian Habitat. These habitats represent the mature coniferous forest requirements for winter habitat, and younger habitats with a complex multistory and/or thick brush for summer habitat and denning. Mixedwood Forests, Kalmia-Black Spruce Woodland and Wet Coniferous forests are ranked as moderate. Open Wetland, Open Water, Exposed Sand/Gravel Shorelines and Anthropogenic Habitats are ranked as low.

Table 12.7 Habitat Value Ranking for Furbearers

Habitat Type	Habitat Value Ranking		
	Lynx	**Beaver**	**Muskrat**
Alder Thicket	High	High	Low
Anthropogenic	Low	Low	Low
Balsam Fir Forest	High	Low	Low
Black Spruce Forest	High	Low	Low
Exposed Sand / Gravel Shoreline	Low	Moderate	Moderate
Kalmia-Black Spruce Woodland[A]	Moderate	Low	Low
Mixedwood Forest	Moderate	Moderate	Low
Open Wetlands[B]	Low	Low	Moderate
Open Water	Low	High	High
Regenerating Forest	High	Moderate	Low
Riparian Thicket	High	High	Moderate
Wet Coniferous Forest	Moderate	Moderate	Low
Sources	Parker et al 1983; Mowat & Slough 2011; Mowat et al. 2000; Mowat and Slough 2003; Stantec 2012	Northcott 1971; Thompson 1988; Northland Associates 1980; Novak 1987; Van Gelder 1982; Stantec 2012	Nadeau et al. 1995; Cotner and Schooley 2011; NatureServe 2019; Stantec 2012

Notes:
[A] Includes Kalmia-Black Spruce Forest and Kalmia Health Ecotypes
[B] Includes Shrub / Graminoid Fen and Shrub Bog Ecotypes

For beaver, high-ranked habitats included Alder Thickets, Riparian Thickets and Open Water, which provide denning and important foraging sites required by this species. Mixedwood Forest and Regenerating Forest are ranked as moderate because they provide hardwood trees and shrubs for foraging; however, these habitat types will only be used if they are located near water. Wet Coniferous Forests and Exposed Sand/Gravel Shorelines are also ranked as moderate because of their associations with water, although these have limited ability to provide forage. Balsam Fir Forest, Black Spruce Forest, Kalmia-Black Spruce Woodland, and Anthropogenic Habitats are ranked as low.

For muskrat, the only habitat ranked as high is Open Water. Habitats ranked as moderate included Riparian Thicket, Open Wetlands and Exposed Sand/Gravel Shoreline, as these habitats are associated with aquatic habitats.

Based on these rankings, summaries of habitat availability for lynx, beaver and muskrat are presented in Table 12.8.

Table 12.8 Amount of Habitat by Habitat Value Ranking for Furbearers in the Assessment Areas

Habitat Value Ranking	Lynx Habitat			Beaver Habitat			Muskrat Habitat		
	Area in Project Area[A] (km^2 / %)	Area in LAA[A] (km^2 / %)	Area in ELCA[A] (km^2 / %)	Area in Project Area[A] (km^2 / %)	Area in LAA[A] (km^2 / %)	Area in ELCA[A] (km^2 / %)	Area in Project Area[A] (km^2 / %)	Area in LAA[A] (km^2 / %)	Area in ELCA[A] (km^2 / %)
High	14.9 / 42.9	57.7 / 45.4	612.0 / 33.4	3.7 / 10.6	34.3 / 27.0	521.1 / 28.5	1.3 / 3.7	21.8 / 17.2	408.5 / 22.3
Moderate	12.1 / 34.7	33.3 / 26.2	518.7 / 28.3	10.5 / 30.1	37.8 / 29.8	452.2 / 24.7	4.8 / 13.7	12.4 / 9.8	298.2 / 16.3
Low	7.8 / 22.4	36.0 / 28.4	699.9 / 38.2	20.6 / 59.3	54.9 / 43.3	857.3 / 46.8	28.7 / 82.6	92.8 / 73.1	1,123.8 / 61.4
Total	34.7 / 100.0	127.0 / 100.0	1,830.6 / 100.0	34.7 / 100.0	127.0 / 100.0	1,830.6 / 100.0	34.7 / 100.0	127.0 / 100.0	1,830.6 / 100.0

Notes:
[A] Numbers rounded to one decimal place. Areas and percentages may not add up to total amounts due to rounding
Values pertain to the portion of the Project Area and LAA with ELC data

High-ranked habitat for lynx is relatively common in the Project Area, LAA and ELCA. In the LAA, it accounts for 57.7 km^2, or 45.4% of habitat. Moderate and low ranked habitat appear at almost equal percentages, accounting for 26.2% and 28.4% of the LAA, respectively. When combined, high and moderate -ranked habitats account for 71.6% of the LAA. The relative portions of high, moderate, and low habitat value rankings are relatively even in the Project Area, the LAA and the ELCA. For example, high and low -ranked habitats account for 42.9% and 22.4% of the Project Area, 45.4% and 28.4% of the LAA, and 33.4% and 38.2% of the ELCA, respectively. This suggests that the quality of the lynx habitat in the Project Area is similar to that of the LAA and ELCA.

Results for beaver indicate that high-ranked habitat is not common in the Project Area, LAA or ELCA. High-quality habitat occurs at a lower percentage in the Project Area than in the LAA or ELCA. This indicates that, in comparison to the surrounding area, the Project Area contains relatively low-quality habitat for beaver, with only 3.7 km^2 (10.6%) of high-quality habitat in the Project Area. Low-quality habitat accounts for the majority of the Project Area, covering 20.6 km^2 (59%). In the LAA, high-quality habitat accounts for 27.0% of the total area, with low-quality habitat accounting for 43.3%. In the ELCA, high-quality habitat accounts for 28.5% of the total area, with low-quality habitat accounting for 46.8%.

The Project Area, LAA and ELCA have limited habitat suitable for muskrat. High-quality habitat accounts for 1.3 km^2 (3.7%), 21.8 km^2 (17.2%), and 408.5 km^2 (22.3%) of habitat in the Project Area, LAA and ELCA, respectively. Low-quality habitat makes up the largest portion of the Project Area, LAA and ELCA, accounting for 82.6%, 73.1% and 61.4% of habitat, respectively. High and moderate quality habitat in the Project Area is more limited than in the surrounding area.

Limiting Factors

The largest pressure on furbearers comes from humans, particularly from hunting and trapping (Nalcor 2009; Stantec 2012; Government of NL n.d.b). Beaver is a particularly important species for trapping on the Island of Newfoundland. Human pressures on furbearers also come from habitat loss and increased disturbance. Lynx are sensitive to human disturbance and increasing road density may cause range contractions (Bayne et al. 2008). Deforestation poses a large threat to forest-dependent furbearers.

Predation pressure is also a limiting factor for furbearers, including muskrat and beaver. Predators of beaver and muskrat include lynx, coyote, bears, owls and river otter (Payne 1985; Stantec 2012; Government of NL n.d.b). For muskrat, predators also include red fox and mink (CWS and CWF 1986). The muskrat population on the Island of Newfoundland is threatened by the introduction of mink, and muskrats have been eliminated from some areas. Coyotes may be predators of lynx (Government of NL n.d.b).

Payne (1985) suggested that winter starvation might be a more common source of natural mortality for beaver in NL than previously suspected. This may relate to the sparse supply of deciduous trees for winter food.

Small Mammals

Life History, Distribution, and Density

Four native small mammal species occur on the Island of Newfoundland: meadow vole and three bat species. Six species of small mammals were introduced to the Island of Newfoundland (Table 12.9).

Table 12.9 Small Mammal Species Occurring on the Island of Newfoundland

Species	Common Name	Origin
Rattus norvegicus	Norway rat	Introduced
Microtus pennsylvanicus	Meadow vole	Native
Mus musculus	House mouse	Introduced
Peromyscus maniculatus	Deer mouse	Introduced
Myodes gapperi	Southern red-backed vole	Introduced
Myodes glareolus	Northern bank vole	Introduced
Sorex cinereus	Masked shrew	Introduced
Myotis lucifugus	Little brown bat	Native
Myotis septentrionalis	Northern long-eared bat	Native
Aeorestes cinereus	Hoary bat	Native (uncommon)

Bats that have been recorded on the Island of Newfoundland include the little brown bat, northern long-eared bat and hoary bat. The hoary bat is a migratory, tree-roosting species that does not commonly occur in the province. It is thought to only pass through occasionally while migrating (Maunder 1988). Both species of *Myotis* found in NL are federally listed as Endangered and are discussed in Section 12.2.2.3.

The meadow vole occurs throughout NL and has historically been an important prey species for marten, other weasels and owls (Folinsbee et al. 1973). This species is typically about 16 cm long and weighs approximately 36.5 grams (Government of NL n.d.a.). The lifespan of a meadow vole is up to 12 months, and females may have up to four litters, typically born between May and September. The diet of the meadow vole is typically made up of grasses, sedges, herbs, berries, insects, and snails. The meadow vole is found in every province and territory in Canada, and throughout most of the central and northern US. Within NL, this species is widely distributed and is found wherever suitable habitat occurs; however, abundance is low (Rodrigues 2009). The home range for meadow vole is typically less than 0.01 hectare (ha) (Banfield 1987). A broad range population estimate of meadow vole on the Island of Newfoundland is 10,000 to 100,000 individuals (Government of NL 2005).

A second species of vole, the southern red-backed vole (hereafter, red-backed vole), is native to Labrador and was introduced to the Island of Newfoundland in the late 1900s. The first detection of the red-backed vole on the Island was at Little Grand Lake in 1999 (Hearn et al. 2006). Since that time, the range of the red-backed vole has expanded throughout most of the Island of Newfoundland; however, it is not known to occur on the Avalon Peninsula or on parts of the Northern Peninsula (Stantec 2012). Red-backed vole have become an important prey species for marten, as well as other predators such as red fox and owls. Red-backed voles have a typical weight of 42 grams and length of 16 cm (NatureServe 2019). They breed from mid-January to late November and have from one to four litters per year, producing one to nine young (NatureServe 2019). The lifespan of a red-backed vole ranges from 10 to 20 months. Their diets vary seasonally, with plant parts consumed in spring, with berries added in summer, followed by seeds in fall (Nature Works 2010). In winter, their diet is based on stored foods, as well as opportunistically located foods such as fungi, insects and roots (Nature Works 2010). This species is most active at night.

Other small mammals that have been introduced to the Island of Newfoundland include the northern bank vole (*Clethrionomys glareolus*), masked shrew (*Sorex cinerius*), deer mouse (*Peromyscus maniculatus*), house mouse (*Mus musculus*), and Norway rat (*Rattus norvegicus*). These species may function as important prey species for predators in NL, including marten and other weasels, fox, coyote, lynx, and raptors.

Habitat Occurrence in the Project Area

Two species of small mammals were chosen for habitat evaluation: meadow vole and red-backed vole. These species were chosen as representative small mammals in part because they occupy specific niches and reflect natural disturbances and habitat changes. The meadow vole has historically been an important prey source for marten on the Island of Newfoundland (Folinsbee et al. 1973). In more recent years, the red-backed vole has increased in importance as its distribution expands across the Island (following its relatively recent introduction), and it now represents an important prey species for marten (Hearn et al. 2006).

Meadow Vole

Meadow voles are typically associated with wet meadows and grassland habitat; however, they also occur in coniferous forests, barrens, wooded swamps and bogs (Folinsbee et al. 1973; Thompson and Curran 1995; Sturtevant and Bissonette 1996; NatureServe 2019). They require grass cover for food, predator protection and nesting material. Abundant woody debris in areas of blowdown and in some regenerating cutovers also provide suitable cover and subnivean protection (Adair and Bissonette 1997). Summer diets generally consist of herbaceous vegetation; however, meadow voles will also feed year-round on plants characteristic of forests, indicating their forage selection has adjusted to existence in such habitats (Riewe 1973). In a study conducted in Labrador in 2008, meadow voles were most commonly associated with deciduous-dominant mixed forests; however, were also detected in spruce and fir-spruce coniferous forests (Minaskuat Inc. 2008). Meadow vole habitat preference ranks are provided in Table 12.10.

Table 12.10 Habitat Value Ranking for Small Mammals

Habitat Type	Habitat Value Ranking	
	Meadow Vole	**Red-backed Vole**
Alder Thicket	High	Moderate
Anthropogenic	Moderate	Low
Balsam Fir Forest	Moderate	High
Black Spruce Forest	Moderate	High
Exposed Sand / Gravel Shoreline	Low	Low
Kalmia-Black Spruce Woodland[A]	Moderate	Moderate
Mixedwood Forest	Moderate	High
Open Water	Low	Low
Open Wetlands[B]	High	High
Regenerating Forest	Moderate	Moderate
Riparian Thicket	High	Moderate
Wet Coniferous Forest	Moderate	High
Sources	Folinsbee et al 1973; Simon et al. 1998; Stantec 2012	Folinsbee et al. 1973; Vanderwel et al. 2010; Rodrigues 2009; Stantec 2012

Notes:
[A] Includes Kalmia-Black Spruce Forest and Kalmia Health Ecotypes
[B] Includes Shrub / Graminoid Fen and Shrub Bog Ecotypes

Habitats ranked as high include Open Wetlands, Alder Thickets and Riparian Habitats, due to the meadow vole's preference for moist habitats, and for the high likelihood of grass cover in these habitat types. Exposed Sand / Gravel Shoreline habitat is ranked as low due to the lack of cover. Open Water is also ranked as low. The remaining habitat types are categorized as moderate, as they may provide some foraging, nesting or other habitat for meadow vole; however, these are not preferred habitat types. Based on these rankings, a summary of habitat availability for meadow vole is presented in Table 12.11.

Table 12.11 Amount of Habitat by Habitat Value Ranking for Small Mammals in the Assessment Areas

Habitat Value Ranking	Meadow Vole Habitat			Red-backed Vole Habitat		
	Area in Project Area[A] (km^2 / %)	Area in LAA[A] (km^2 / %)	Area in ELCA[A] (km^2 / %)	Area in Project Area[A] (km^2 / %)	Area in LAA[A] (km^2 / %)	Area in ELCA[A] (km^2 / %)
High	7.0 / 20.1	23.7 / 18.6	392.8 / 21.5	23.7 / 68.1	68.5 / 54.0	950.3 / 51.9
Moderate	26.5 / 76.3	80.9 / 63.7	1,026.4 / 56.1	7.9 / 22.8	33.6 / 26.5	460.8 / 25.2
Low	1.3 / 3.7	22.4 / 17.6	411.3 / 22.5	3.2 / 9.1	24.8 / 19.6	419.5 / 22.9
Total	34.7 / 100.0	127.0 / 100.0	1,830.6 / 100.0	34.7 / 100.0	127.0 / 100.0	1,830.6 / 100.0

Notes:
[A] Numbers rounded to one decimal place. Areas and percentages may not add up to total amounts due to rounding
Values pertain to the portion of the Project Area and LAA with ELC data

The majority of the Project Area, the LAA and the ELCA are composed of habitat ranked as moderate for the meadow vole. This habitat rank accounts for 80.9 km^2, or 63.7% of the LAA, and 1,026.4 km^2 (56.1%) of the ELCA. High and low -quality habitats occur at nearly equal percentages (18.6% and 17.6% of the LAA, respectively). This suggests that the quantity and quality habitat for meadow vole in the Project Area are similar to those of the ELCA. High-quality habitat occurs at relatively the same proportion in the Project Area, the LAA and the ELCA. Moderate habitat occurs at a slightly higher proportion in the LAA, and low-quality habitat is a higher proportion of the Project Area. Overall, habitat suitability is relatively similar in the Project Area and in the overall environment.

Red-backed Vole

Red-backed vole is associated with mature, moist coniferous and mixedwood forests, as well as bogs (Simon et al. 1998; Nature Works 2010). Ground cover is required, and coarse woody debris is particularly important for travel, nesting, foraging and navigation (Simon et al. 1998). Nesting typically occurs under logs, stumps, or roots (NatureServe 2019). A scientific research project that involved trapping of small mammals along the lower Churchill River valley in 2006 (Minaskuat Inc. 2008) found that red-backed voles were typically captured in habitat types with a coniferous component, with highest capture rates in wet-spruce habitats. This species also occurs in clear-cuts (Simon et al. 2002). Red-backed vole habitat preference ranks are provided in Table 12.10.

Five habitat types are ranked as high quality: Balsam Fir Forest, Black Spruce Forest, Mixedwood Forest, Wet Coniferous Forest (as a result of the propensity for this species to occupy coniferous habitat), and Open Wetlands. Three habitat types are ranked low quality, including Open Water, Exposed Sand / Gravel and Anthropogenic. The remaining habitat types are ranked as moderate quality.

Habitats ranked as high for the red-backed vole account for the majority of habitat within the Project Area, the LAA and the ELCA. In the LAA, 68.5 km^2 (54% of habitat) ranks as high (Table 12.11). In the ELCA, 950.3 km^2 (51.9%) ranks as high (Table 12.11). Moderate habitat quality makes up the next largest portion of the LAA and ELCA, accounting for 26.5% and 25.2, respectively, of the areas. In total, red-backed vole may occur in over 80% of the LAA and in 77% of the ELCA (Table 12.11). This is indicative of the species' propensity to occupy a wide variety of habitat types. The Project Area provides relatively good habitat for red-backed vole, in comparison to the surrounding environment. In comparison to the LAA and ELCA, the Project Area has a higher percentage of habitat ranked as high quality, and a lower percentage of habitat ranked as low quality.

Limiting Factors

Habitat loss through natural disturbances (e.g., fire), or anthropogenic causes (e.g., clearcutting), pose threats to small mammals. The loss of coarse woody debris on site may result in habitat loss for small mammals that depend on low cover. Small mammals in NL are under pressure from predators, including marten and other weasel, red fox, coyote, and raptors. Meadow vole is also facing interspecific competition with the introduced red-backed vole. Prior to the introduction of the red-backed vole, the meadow vole was the only small mammal prey species for some predators on the Island (Sturtevant and Bissonette 1996). The results of the 2008 Small Mammal Monitoring Network report (Rodrigues 2009) provided early indication that the red-backed vole was out-competing the native meadow vole on the island.

12.2.2.3 SAR / SOCC

SAR and/or SOCC may occur in or near the Project Area. SAR includes species listed under Schedule 1 of SARA or listed in the Endangered Species List Regulations under the NL ESA. SOCC include species that are:

- Recommended for listing by the provincial Species Status Advisory Committee (SSAC) as Endangered, Threatened, Vulnerable, or Special Concern however not yet listed under NL ESA or SARA
- Considered provincially Rare, i.e., those species with provincial status ranks (S-ranks), of S1 (critically imperiled), S2 (imperiled)[5], or combinations thereof (e.g., S1S2) upon review by the Atlantic Canada Conservation Data Centre (AC CDC 2020)

Wildlife SAR with potential to occur near the Project Area include the American marten and two bat species. The Newfoundland population of marten is listed as Threatened and is protected by SARA (COSEWIC 2007) and the NL ESA, while the bat species northern long-eared bat and little brown bat are designated as Endangered under SARA (COSEWIC 2013).

[5] While S3 species may be of concern from a provincial biodiversity perspective, they are often not included, as their populations are considered less sensitive. This determination is typically at the discretion of the NLDFFA-Wildlife Division.

Bats

Life History, Distribution and Density

Two species of bats, the little brown bat and northern long-eared bat, have historically been abundant on the Island of Newfoundland. However, in 2014 both of these species were emergency listed as Endangered under SARA, due to sudden population declines as a result of white-nose syndrome. A recovery strategy for these species was released in 2015 (ECCC 2015). Neither species of bat is currently listed under the NL ESA.

The little brown and northern long-eared bats are both in the genus *Myotis* (mouse-eared bats) in the family *Vespertilionidae*, which is made up of relatively small, insectivorous bats. Little brown and northern long-eared bats are similar in appearance, with brown fur, and black ears and wings. The weight of an adult bat generally ranges from five to nine grams (van Zyll de Jong 1985; ECCC 2015). The two species are most easily distinguished from each other by the shape of the tragus (a pointed portion of the external ear, located in front of the ear canal), which is longer and pointier for the northern long-eared bat. Both species are long-lived, and records exist of little brown bats living for over 30 years (Davis and Hitchcock 1995). Little brown and northern long-eared bats are year-round residents on the Island of Newfoundland.

Both species of bats are nocturnal and use echolocation to hunt. Their diets are made up of a variety of insects, including moths, beetles and spiders (Moosman et al. 2012, Clare et al. 2014). Foraging habits vary by species. Little brown bats typically forage in open areas and are aerial hawkers, meaning that they catch their prey during flight. Feeding over open water is common, and as such their diet commonly includes aquatic insects such as mayflies and caddisflies. Little brown bats will also glean prey from foliage in forested areas (i.e., swoop in and pluck it off the foliage). Northern long-eared bats primarily feed on terrestrial insects. They typically glean prey in forested areas, although they can also catch prey in flight (Ratcliffe and Dawson 2003). They have also been observed foraging along forest-covered creeks and forested road corridors (Owen et al. 2003; Henderson and Broders 2008).

Little brown and northern long-eared bats mate in the fall during an activity called swarming. During swarming, bats congregate at the entrances to underground sites. Swarming may be used both for breeding purposes and to stopover during migration, to assess sites for hibernation (called hibernacula) or to engage in information transfer or other social purposes (ECCC 2015). Many swarming sites are also used as hibernacula; however, it is not known what percentage of bats swarming at a location will also hibernate there (Johnson et al. 2015). After swarming is complete, bats enter into hibernation in the fall, where they remain until spring. Females store sperm during this time, and do not become pregnant until they have emerged in the spring, which typically occurs in April (Government of NL n.d.b). After emergence, females roost together in maternity colonies, whereas males tend to roost alone or in small groups. Habitat preferences for each species during this time are discussed below in detail. Gestation is approximately 50 to 60 days, after which females give birth to a single pup.

The little brown bat is the most widely distributed and common bat species in Canada. The range of the northern long-eared bat is slightly more restricted, although it still has a wide distribution in Canada. Both species are found in every province and territory in Canada, except Nunavut. Both species have patchy distribution across the Island of Newfoundland (Park and Broders 2012). While it was previously thought that northern long-eared bats were only found in the southwestern portion of the Island of Newfoundland, a 2012 study recorded this species further north and east on the Island than previously observed (Park and Broders 2012). Northern long-eared bats were found as far north as River of Ponds on the Northern Peninsula, and as far east as Port Rexton (Park and Broders 2012).

Habitat Occurrence in the Project Area

The habitat needs for little brown and northern long-eared bats vary by season. These species spend their winters hibernating at underground sites, including caves and abandoned mines. Appropriate hibernacula require a specific microclimate, which typically includes a temperature ranging between 2 degrees Celsius (ºC) and 10ºC, and humidity levels over 80% (Fenton 1970; Anderson and Robert 1971; ECCC 2015). Little brown and northern long-eared bats hibernate together at the same sites. Hibernacula are used for overwintering, as well as for swarming in the fall. Little is known regarding the location of hibernacula and swarming sites on the Island of Newfoundland. There is one known hibernaculum in the RAA, located approximately 12.2 km from the Project Area. Hibernation counts have occurred at this site over the past 11 years, with a maximum count of 38 individuals. This site has tested positive for white-nose syndrome (Government of NL 2020b). On the Island of Newfoundland, it is thought that bats may use unconventional hibernation sites, including sinkholes and fissures. Although there are no known sinkholes in the Project Area, it is possible that small, unknown hibernation sites may occur.

During the spring and summer, habitat requirements vary somewhat between the two species. Northern long-eared bats are generally more forest dependent, forming maternity colonies in trees, where females give birth to and raise their young. Colony size can vary from several to tens of individuals. In one study, the results of emergence counts from maternity colonies ranged from 1 to 28 individuals, with mean group sizes of nine for lactating females, and 7.6 for non-lactating females (Park and Broders 2012). Northern long-eared bat maternity colonies are typically found in trees that are larger than average in the surrounding habitat (Park and Broders 2012). Both living trees and dead trees (snags) may be used as roosts, and bats roost in cavities or under loose bark. In NL, tree species used for roosting by northern long-eared bats include balsam fir and white birch and, to a lesser extent, black spruce. Approximately one-third of roost trees observed were in an advanced stage of decay (Park and Broders 2012). Roosts are selected for specific microclimatic conditions, which may vary based upon reproductive status (Garroway and Broders 2008). Bats may switch roost sites frequently. Male northern long-eared bats tend to roost alone or in small groups, and likely use the same species of trees as those used for maternity colonies. However, they are less restricted in roost choice than are maternity colonies.

Little brown bats typically form maternity colonies in human structures such as barns, attics, or sheds. These maternity roosts may house hundreds of female bats and their pups. Less commonly, little brown bats may also form maternity colonies in live or decaying trees, or snags that are typically found in mature forest stands (Grindal 1999). In addition to microscale characteristics, such as microclimate and the presence of suitable crevices and cavities, roosts are likely chosen based on landscape scale characteristics, such as proximity to water and foraging sites, canopy cover, and degree of forest fragmentation (Henderson and Broders 2008; Fabianek et al. 2011). As with northern long-eared bats, male little brown bats typically roost alone or in small groups and may roost in human structures or in trees.

Habitat value rankings and mapping were conducted for the northern long-eared bat. This species was chosen based on its heavy reliance on forest habitats, in comparison to the more generalist little brown bat. Habitat value rankings are based on spring and summer habitat and are provided in Table 12.12. Not enough is known about the presence of hibernation sites in NL to include these in the habitat analysis.

Table 12.12 Habitat Value Ranking for SAR / SOCC

Habitat Type	Habitat Value Ranking	
	Northern Long-eared Bat	**Marten**
Alder Thicket	Low	Low
Anthropogenic	Low	Low
Balsam Fir Forest	High	High
Black Spruce Forest	High	High
Exposed Sand / Gravel Shoreline	Low	Low
Kalmia-Black Spruce Woodland[A]	Moderate	Moderate
Mixedwood Forest	High	Moderate
Open Wetlands[B]	Low	Low
Open Water	Moderate	Low
Regenerating Forest	Low	Low
Riparian Thicket	Low	Low
Wet Coniferous Forest	Moderate	High
Sources	Park and Broders 2012; Henderson and Broders 2008; Sasse and Perkins 1996	Thompson and Curran 1995; Bowman and Robitaille 1997; Forsey and Baggs 2001; Potvin et al 2002; Smith and Schaefer 2002; Gosse et al. 2005; Alderon 2012; Nalcor 2012

Notes:
[A] Includes Kalmia-Black Spruce Forest and Kalmia Health Ecotypes
[B] Includes Shrub / Graminoid Fen and Shrub Bog Ecotypes

Three habitat types are ranked as high for the northern long-eared bat, including Balsam Fir Forest, Black Spruce Forest and Mixedwood Forest (Table 12.12). The northern long-eared bat is a forest dependent species that depends on mature forest stands. Kalmia-Black Spruce Woodland and Wet Coniferous Forest are ranked as moderate because these forest types tend to have smaller trees, which may be less suitable as roost sites. Open Water is also ranked as moderate, as northern-long eared bat may use watercourses for foraging or for travel corridors. The remaining habitat types are ranked as low-quality habitat. Based on these rankings, an analysis of habitat availability in the Project Area, LAA and ELCA was conducted. These results are shown in Table 12.13.

Table 12.13 Amount of Habitat by Habitat Value Ranking for SAR / SOCC in the Assessment Areas

Habitat Value Ranking	Northern Long-Eared Bat Habitat			Marten Habitat		
	Area in Project Area[A] (km^2 / %)	Area in LAA[A] (km^2 / %)	Area in ELCA[A] (km^2 / %)	Area in Project Area[A] (km^2 / %)	Area in LAA[A] (km^2 / %)	Area in ELCA[A] (km^2 / %)
High	16.6 / 47.7	51.6 / 40.7	539.3 / 29.5	13.0 / 37.5	38.4 / 30.3	490.7 / 26.8
Moderate	7.3 / 21.1	36.1 / 28.5	748.0 / 40.9	9.6 / 27.6	Area in Project Area[A] (km^2 / %)	Area in LAA[A] (km^2 / %)
Low	10.8 / 31.2	39.2 / 30.9	543.3 / 29.7	12.1 / 34.9	61.0 / 48.0	951.9 / 52.0
Total	34.7 / 100.0	127.0 / 100.0	1,830.6 / 100.0	34.7 / 100.0	127.0 / 100.0	1,830.6 / 100.0

Notes:
[A] Numbers rounded to one decimal place. Areas and percentages may not add up to total amounts due to rounding
Values pertain to the portion of the Project Area and LAA with ELC data

Large amounts of high-quality habitat exist for the northern long-eared bat in the Project Area and the LAA. The ELCA is composed mostly of moderate quality habitat. There are 51.6 km^2 of high-quality habitat (40.7%) in the LAA and 539.3 km^2 (29.5%) in the ELCA. Moderate habitat accounts for 36.1 km^2, or 28.5% of habitat in the LAA and 748.0 km^2 (40.9%) in the ELCA. In total, this indicates that the northern long-eared bat could occur throughout the majority (69% and 70%, respectively) of the LAA and the ELCA. This species is likely not limited by summer roosting habitat in this area. High, moderate and low-quality habitat is present in the Project Area at similar proportions as in the LAA. However, the proportion of habitat in the ELCA that is classed as high quality is lower than in either the Project Area or LAA. This indicates that overall habitat suitability in the Project Area and LAA is somewhat higher than in the surrounding environment (ELCA).

Limiting Factors

The largest threat to both little brown and northern long-eared bats in North America is white-nose syndrome, a fungal pathogen that was first detected in the state of New York in 2006. White-nose syndrome is caused by the dermatophyte fungus *Pseudogymnoascus destructans*, which grows on the skin of bats during hibernation. This fungus grows in the same microclimate as occurs in hibernation sites used by little brown and northern-long eared bats. Other hibernating species are also affected, where they occur. *P. destructans* results in physiological changes, including chronic respiratory acidosis and hyperkalemia (Verant et al. 2014), as well as skin lesions, and appears to be associated with increased evaporative water loss (and subsequent dehydration), and more frequent arousals during hibernation (Verant et al. 2014; Cryan et al. 2010; ECCC 2015). Ultimately, the combination of an increased metabolic rate and more frequent arousal from torpor results in a depletion of fat reserves, and death by starvation and/or dehydration (Verant et al. 2014; Frank et al. 2014; Cryan et al. 2010).

Since its discovery in 2006, white-nose syndrome has spread southwest throughout the US, and north into Canada. The first Canadian confirmations of the pathogen occurred in 2010 in Ontario and Quebec, and it has since spread to all provinces except Saskatchewan, Alberta and British Columbia. White-nose syndrome was confirmed on the Island of Newfoundland in the winter of 2016/2017 (US Fish and Wildlife Service 2019). In areas affected by white-nose syndrome, mortality rates are typically high. Populations of little brown and northern long-eared bats at known hibernacula in eastern Canada have declined by 94% since the arrival of white-nose syndrome (COSEWIC 2013).

Marten

Life History, Distribution and Density

The American marten is a mustelid species native to the Island of Newfoundland. Associated primarily with mature forests, marten is distributed through much of Canada (including Nunavut, the Northwest Territories and Yukon) and Alaska. While technically classified as carnivores (Order Carnivora), marten are omnivorous and have a varied diet. They hunt small prey and consume berries, bird eggs, insects and carrion (Cumberland et al. 2001; Wilk and Raphael 2017), and will also consume vegetation (Thompson and Colgan 1990; Wilk and Raphael 2017). In NL, the marten diet includes meadow and red-backed vole, shrew, hare and red squirrel as well as insects, berries, carrion and eggs when available (Gosse and Hearn 2005; Government of NL 2019c).

On the Island of Newfoundland, marten are considered Threatened under SARA (COSEWIC 2007) and the NL ESA (AC CDC 2020), and the AC CDC ranks marten as S3 (or Vulnerable) (AC CDC 2020).

The mainland population of marten is genetically similar across its range, yet genetically distinct from the Island population (Kyle and Strobeck 2003). Historically, marten were distributed throughout much of the central portion of the Island of Newfoundland in the most productive forests (Bergerud 1969). Currently, there are three main areas on the Island where breeding populations of marten remain: Main River, Terra Nova National Park and west-central Newfoundland (The Newfoundland Marten Recovery Team 2010). The west-central Newfoundland population includes three separate core areas: Little Grand Lake / Red Indian Lake, Sandy Lake and Crabbes River (Nalcor 2012). Of these, the Little Grand Lake / Red Indian Lake core area, including critical habitat, overlaps the Project Area. The marten population in the Little Grand Lake / Red Indian Lake core area is estimated to be between 237 and 481 individuals (Schmelzer 2008 in Nalcor 2012).

As part of the NL ESA, critical habitat for endangered species must be defined and protected. The Recovery Plan for marten on the Island of Newfoundland identified an area of critical habitat of approximately 6,200 km^2, based on marten occurrences and habitat suitability (The Newfoundland Marten Recovery Team 2010), of which a portion overlaps the Project Area (Figure 12-8). There is 6.3 km^2 of provincially proposed critical habitat that overlaps the Project Area, and 41.8 km^2 in the LAA. This critical habitat was identified in the provincial recovery plan, although has not been formally protected (The Newfoundland Marten Recovery Team 2010). In support of marten conservation efforts, the provincial government established the Pine Marten Study Area in 1973 (Snyder and Bisonette 1987). The study area (2,078 km^2 [Hearn et al. 2006]) is overlapped by a system of provincial reserves (Glover Island Public Reserve, Little Grand Lake Provisional Ecological Reserve and the Little Grand Like Wild Life Reserve) that have varying levels of restrictions on forestry harvest and development, and snaring (Government of NL 2019a; The Newfoundland Marten Recovery Team 2010).

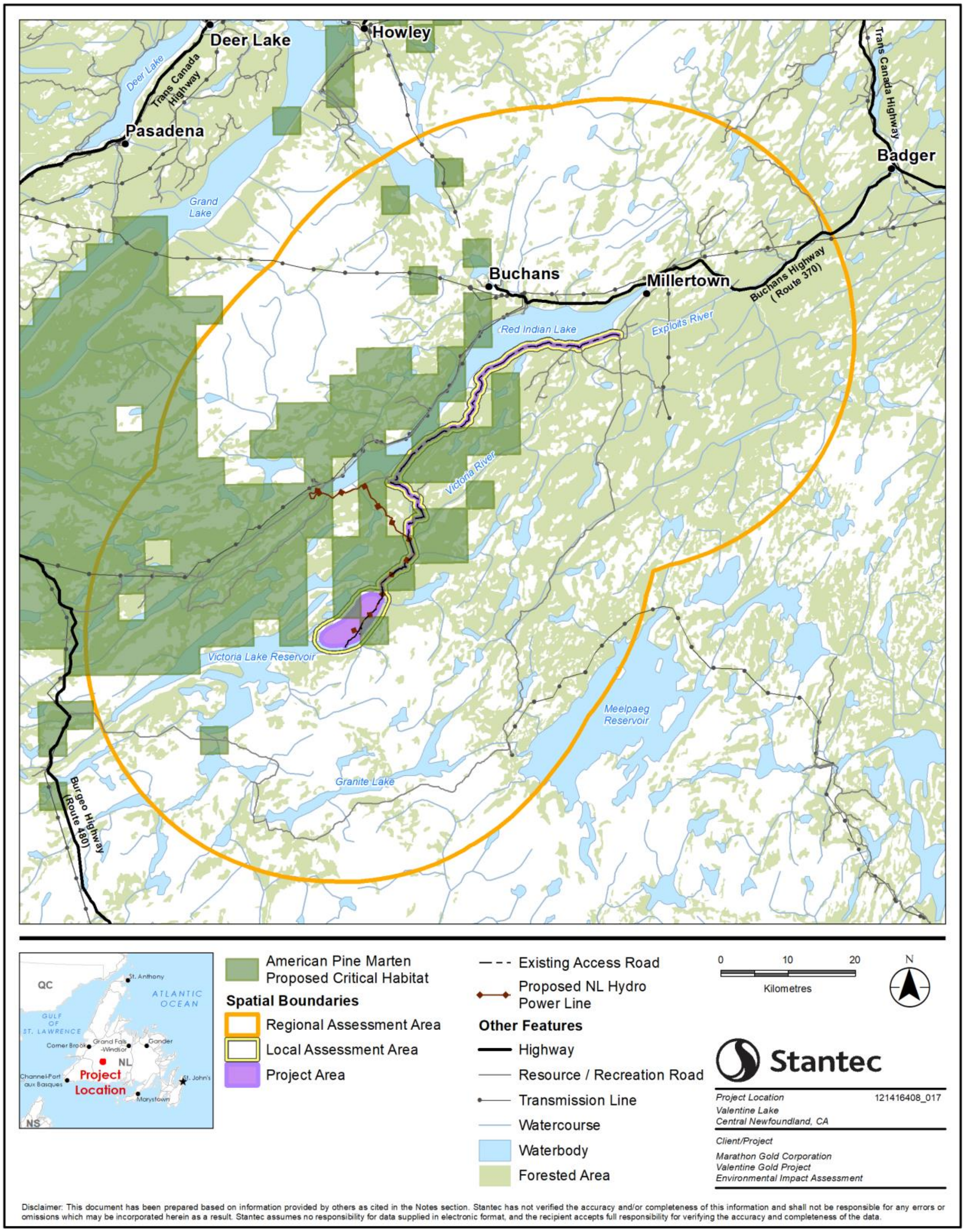

Figure 12-8 Proposed Critical Habitat for Marten in the Project Area and LAA

Marten are usually solitary. Although marten may reach sexual maturity between one to two years of age, the first litter is generally not born until about three years (Banfield 1987). Though mating occurs in July, marten have delayed implantation and the young are born the following spring. Females establish dens in holes in trees (e.g., hollow trees, woodpecker holes), or on the ground in rock piles, squirrel middens or openings at the bases of trees (Government of Canada 2007). Females use two types of dens: a natal den where the kits are born, and a series of up to ten maternal dens where the young are reared (Ruggiero et al. 1998).

Trapping of marten has been prohibited on the Island of Newfoundland since 1934; however, trapping of other furbearer species is permitted. Therefore, Best Management Practices have been developed by the provincial government to reduce the non-targeted marten mortality that occurs during legal trapping (Government of NL 2019a). Several areas have been established that have restrictions on the types of trapping techniques that can be employed. The Project Area is within the boundaries of the Red Indian Lake Modified Snare and Trapping Area, a Category 2 trapping area (Government of NL 2019a). Trapping for other furbearers is permitted in this area, only using legal snare wire (i.e., 22-gauge brass wire or 6-strand picture cord) as it is more effective at releasing accidentally snared marten (Fisher and Twitchell 2004 in Government of NL 2019a). Land-based traps are prohibited in this area (Government of NL 2019a).

Marten have been confirmed in the LAA through observation (BSA.7, Attachment 7-H) and hair snag traps (BSA.7, Attachments 7-A, 7-G) (Figure 12-9) and have also have been observed within the Project Area (BSA.2, Attachments 2-A and 2-B; BSA.7, Attachment 7-H, unpublished data). Five individual marten confirmed in the LAA through deoxyribonucleic acid (DNA) analysis of hair collected from the snagging traps in 2018 (BSA.7, Attachment 7-G) had not been previously identified in the provincial database of individual marten genomic markers, and were subsequently added (BSA.7, Attachment 7-G).

The AC CDC provided information on marten sightings within 5 km of the LAA (Figure 12-10). Between 1973 and 2013, 308 marten sightings were recorded in the area, although the number of individuals cannot be determined from this data set. Most observations were recorded along the south side of Red Indian Lake. Within the LAA, most of the sightings occurred along the access road portion, with one sighting recorded from within the mine site.

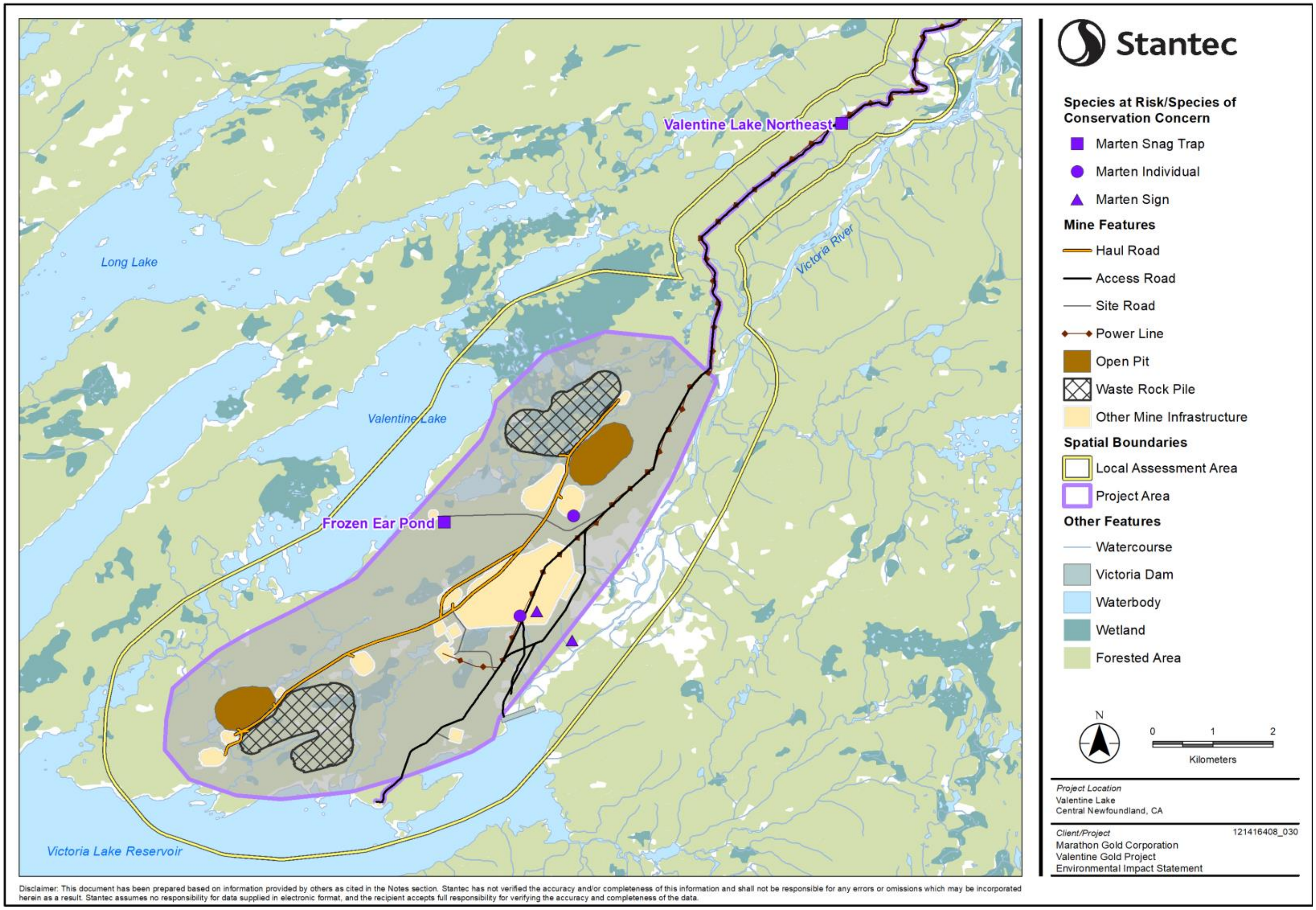

Figure 12-9 Marten Observations from Field Studies in Project Area, 2011-2019

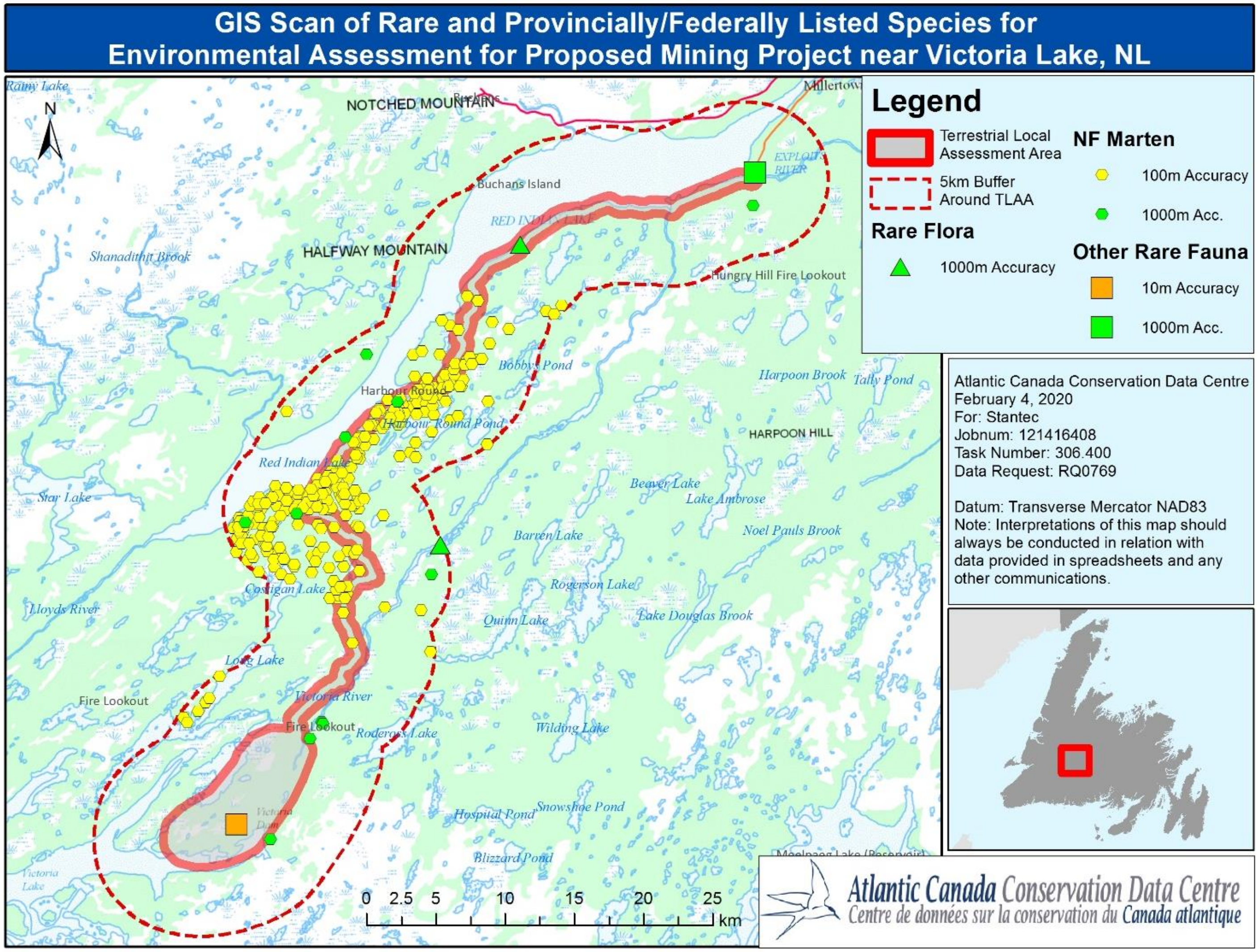

Figure 12-10 Marten Sightings within 5 km of LAA (Source AC CDC)

Habitat Occurrence in the Project Area

Marten generally select mature, dense canopy forest patches within a matrix of bogs and scrub (Smith and Schaefer 2002; Payer and Harrison 2003; Poole et al. 2004; Gosse et al. 2005; Hearn et al. 2010). Their habitat selection may be driven by the structural features of old-growth forest, such as multi-layered overstory, large-diameter trees, standing and fallen deadwood, coarse woody debris, and a dense understory. These attributes are important to marten as they offer increased prey availability and foraging efficiency (Andruskiw et al. 2008; Godbout and Ouellet 2010), warmer winter resting sites (Zalewski 1997), and protection from predators (Storch et al. 1990; Drew 1995; Godbout and Ouellet 2010). Defoliation, such as that caused by spruce bud worm, can increase coarse woody debris creating habitat selected by marten (Drew 1995).

Balsam Fir and Black Spruce Forests, and Wet Coniferous Forest are ranked as high value habitat types for marten in the Project Area and LAA (Table 12.12). The mixture of large-diameter mature trees, somewhat open shrub layer, and plentiful coarse woody debris are important to marten as they provide cover and protection, as well as prey availability (Thompson and Curran 1995; Godbout and Ouellet 2010; Hearn et al. 2010; Caryl et al. 2012). The amount of high value marten habitat in the Project Area, the LAA and the ELCA is 13.0 km^2 (37.5%), 38.4 km^2 (30.3%) and 490.7 km^2 (26.8%), respectively (Table 12.13).

Moderate ranked habitat types for marten include Kalmia-Black Spruce Woodland and Mixedwood Forest (Table 12.12). These habitats do not provide the complex structural features important to marten (Government of Canada 2007). Marten select habitats with a high percentage of tall spruce or fir trees, canopy closure, and woody debris (Bowman and Robitaille 1997), features which are not prevalent in Kalmia-Black Spruce Woodland or Mixedwood Forest Habitats. There are 9.6 km^2 (27.6%) of moderate ranked marten habitat in the Project Area, 27.6 km^2 (21.7%) within the LAA, and 388.0 km^2 (21.2%) within the ELCA (Table 12.13).

Regenerating Forest, Alder and Riparian Thickets, Open Wetlands, Open Water, Exposed Sand/Gravel Shoreline, and Anthropogenic habitats are ranked as low value for marten based on the amounts of foraging, protection and resting opportunities they offer (Table 12.12). Marten avoid regenerating forests (Potvin et al. 2002; Fuller and Harrison 2005; Hearn et al. 2010), riparian areas (Forsey and Baggs 2001), and open areas such as scrub forests, bogs and fens (Smith and Schaefer 2002; Gosse et al. 2005; Hearn et al. 2010). The area of low-ranked habitat was 12.1 km^2 (34.9%) in the Project Area, 61 km^2 (48%) within in the LAA, and 951.9 km^2 (52.0%) within the ELCA (Table 12.13).

The Project Area has a higher proportion of high and moderate -ranked habitat than the LAA and the ELCA (Table 12.13).

Limiting Factors

There are many factors that can limit marten populations. Sources of mortality for marten include predation by lynx, great horned owls, hawk owls and fox (Government of NL 2019d), and other marten

(Bull and Heater 2001). On the Island of Newfoundland, disease in marten (encephalitis) has caused considerable mortality in a population south of Corner Brook (Fredrickson 1990).

Habitat loss or alteration, and mortality from trapping and snaring may be the most important factors affecting marten populations (The Newfoundland Marten Recovery Team 2010). Habitat could be altered or made less suitable to marten through human activities including forest harvesting, agricultural development, mining operation, hydroelectric projects, and the construction of roads and power lines, or from natural disturbance (e.g., forest fire, insect infestation). Altered habitat may reduce availability of resting or denning sites, breeding habitat, or prey availability (Fuller and Harrison 2005; Godbout and Ouellet 2010), which could affect marten survival (Snyder and Bissonette 1987). Commercial forestry is the primary cause of habitat loss and fragmentation in marten habitat on the Island of Newfoundland (The Newfoundland Marten Recovery Team 2010).

Trapping and snaring are the other important sources of mortality for marten. Research in the Little Grand Lake / Red Indian Lake area reported that trapping and snaring accounted for nearly 50% of marten mortalities (Hearn 2007).

12.3 ASSESSMENT CRITERIA AND METHODS

This section describes the criteria and methods used to assess environmental effects on other wildlife. Residual environmental effects (Section 12.5) are assessed and characterized using criteria defined in Section 12.3.1, including direction, magnitude, geographic extent, timing, frequency, duration, reversibility, and ecological or socio-economic context. The assessment also evaluates the significance of these effects using threshold criteria or standards beyond which a residual environmental effect is considered significant. The definition of a significant effect for the Other Wildlife VC is provided in Section 12.3.2. Section 12.3.3 identifies the environmental effects to be assessed for other wildlife, including effect pathway and measurable parameters. This is followed by the identification of potential Project interactions with this VC (Section 12.3.4). Analytical assessment techniques used for the assessment of other wildlife are provided in Section 12.3.5.

12.3.1 Residual Effects Characterization

Table 12.14 presents definitions for the characterization of residual environmental effects on other wildlife. The criteria are used to describe the potential residual effects that remain after mitigation measures have been implemented. Quantitative measures have been developed, where possible, to characterize residual effects. Qualitative considerations are used where quantitative measurement is not possible.

Table 12.14 Characterization of Residual Effects on Other Wildlife

Characterization	Description	Quantitative Measure or Definition of Qualitative Categories
Direction	The long-term trend of the residual effect	**Neutral –** no net change in measurable parameters for the other wildlife relative to existing conditions **Positive –** a residual effect that moves measurable parameters in a direction beneficial to other wildlife relative to existing conditions **Adverse –** a residual effect that moves measurable parameters in a direction detrimental to other wildlife relative to existing conditions
Magnitude	Change in habitat	**Negligible –** no measurable change in high or moderate ranked habitat for other wildlife, including SAR and SOCC **Low –** Project changes less than 10% of other wildlife habitat in the ELCA, or less than 5% of habitat for other wildlife SAR and SOCC in the ELCA **Moderate –** Project changes 10-20% of other wildlife habitat in the ELCA, or 5-10% of habitat for other wildlife SAR and SOCC in the ELCA **High –** Project changes more than 20% of other wildlife habitat in the ELCA, or more than 10% of habitat for other wildlife SAR and SOCC in the ELCA
	Change in mortality risk	**Negligible –** no measurable change in mortality risk of other wildlife in the LAA **Low –** a measurable change in mortality risk of other wildlife in the LAA is not anticipated, although individuals may be affected **Moderate –** a measurable change in mortality risk of other wildlife in the LAA might occur, however a measurable change in mortality risk in the RAA is not anticipated **High –** a measurable change in mortality risk of other wildlife in the RAA may occur
Geographic Extent	The geographic area in which a residual effect occurs	**Project Area –** residual effects are restricted to the Project Area **LAA –** residual effects extend into the LAA **RAA –** residual effects interact with those of other projects in the RAA
Frequency	Identifies how often the residual effect occurs and how often during the Project or in a specific phase	**Single event** – occurs once **Multiple irregular event –** occurs at no set schedule **Multiple regular event –** occurs at regular intervals **Continuous –** occurs continuously
Duration	The period of time required until the measurable parameter or the VC returns to its existing (baseline) condition, or the residual effect can no longer be measured or otherwise perceived	**Short term** – residual effect restricted to construction or decommissioning, rehabilitation and closure phases **Medium term** – residual effect extends through the operation phase (12 years) **Long term** – residual effect extends beyond the operation phase (>12 years) **Permanent** – recovery to baseline conditions unlikely

Table 12.14 Characterization of Residual Effects on Other Wildlife

Characterization	Description	Quantitative Measure or Definition of Qualitative Categories
Reversibility	Describes whether a measurable parameter or the VC can return to its existing condition after the project activity ceases	**Reversible –** the residual effect is likely to be reversed after activity completion and rehabilitation **Irreversible –** the residual effect is unlikely to be reversed
Ecological and Socio-economic Context	Existing condition and trends in the area where residual effects occur	**Undisturbed –** area is relatively undisturbed or not adversely affected by human activity **Disturbed –** area has been substantially previously disturbed by human development or human development is still present

12.3.2 Significance Definition

A significant adverse residual effect on other wildlife and their habitat is defined as one that threatens the long-term persistence, viability, or recovery of a wildlife species population in the RAA, including effects that are contrary or inconsistent with the goals, objectives or activities of the federal recovery strategy for bats (ECCC 2015), provincial recovery plan for marten (the Newfoundland Marten Recovery Team 2010), or other action plans and management plans.

12.3.3 Potential Effects, Pathways and Measurable Parameters

Table 12.15 lists the potential Project effects on other wildlife and provides a summary of the Project effect pathways and measurable parameters and units of measurement to assess potential effects. Potential environmental effects and measurable parameters were selected based on review of recent environmental assessments for mining projects in NL and other parts of Canada, comments provided during engagement, and professional judgment.

Table 12.15 Potential Effects, Effect Pathways and Measurable Parameters for Other Wildlife

Potential Environmental Effect	Effect Pathways	Measurable Parameter(s) and Units of Measurement
Change in Habitat	• Direct and/or indirect loss or alteration of habitat due to: – vegetation clearing – sensory disturbance (e.g., avoidance) – edge effects	• Amount (km^2) of wildlife habitat directly lost for focal species (Table 12.1), including for SAR that may be present in the RAA: – little brown bat – marten • Quantitatively and qualitatively, amount of wildlife habitat indirectly lost for focal species (Table 12.1)

Table 12.15 Potential Effects, Effect Pathways and Measurable Parameters for Other Wildlife

Potential Environmental Effect	Effect Pathways	Measurable Parameter(s) and Units of Measurement
Change in Mortality Risk	• Direct and/or indirect change in mortality risk due to: – vegetation clearing activities – vehicular collisions – human-wildlife conflicts – predation and harvest pressure	• Change in mortality risk is assessed qualitatively through: – Change in traffic volumes during the life of the Project – Likelihood of interactions with Project infrastructure, vehicles, and equipment – Change in predator-prey dynamics and harvest pressure

12.3.4 Project Interactions with Other Wildlife

Table 12.16 identifies the physical activities that might interact with the VC and result in the identified environmental effect. These interactions are indicated by checkmark and are discussed in detail in Section 12.5, in the context of effect pathways, standard and Project-specific mitigation/enhancement, and residual effects. Following the table, justification is provided for where no interaction (and therefore no resulting effect) is predicted.

Table 12.16 Project-Environment Interactions with Other Wildlife

Physical Activities	Environmental Effects to be Assessed	
	Change in Habitat	Change in Mortality Risk
CONSTRUCTION		
Access Road Upgrade / Realignment: Where required, road widening and replacement / upgrades of roads and culverts.	✓	✓
Construction related Transportation along Access Road	✓	✓
Mine Site Preparation and Earthworks: Clearing and cutting of vegetation and removal of organic materials, development of roads and excavation and preparation of excavation bases within the mine site, grading for infrastructure construction. For the open pits, earthworks include stripping, stockpiling of organic and overburden materials, and development of in-pit quarries to supply site development rock for infrastructure such as structural fill and road gravels. Also includes temporary surface water and groundwater management, and the presence of people and equipment on site.	✓	✓

Table 12.16 Project-Environment Interactions with Other Wildlife

Physical Activities	Environmental Effects to be Assessed	
	Change in Habitat	Change in Mortality Risk
Construction / Installation of Infrastructure and Equipment: Placement of concrete foundations, and construction of buildings and infrastructure as required for the Project. Also includes: • Installation of water control structures (including earthworks) • Installation and commissioning of utilities on-site • Presence of people and equipment on-site	✓	✓
Emissions, Discharges and Wastes[A]: Noise, air emissions / GHGs, water discharge, and hazardous and non-hazardous wastes.	✓	✓
Employment and Expenditures[B]	–	✓
OPERATION		
Operation-related Transportation Along Access Road	✓	✓
Open Pit Mining: Blasting, excavation and haulage of rock from the open pits using conventional mining equipment.	✓	✓
Topsoil, Overburden and Rock Management: Five types of piles: • Topsoil • Overburden • Waste rock • Low-grade ore • High-grade ore • Rock excavated from the open pits that will not be processed for gold will be used as engineered fill for site development, maintenance and rehabilitation, or will be deposited in waste rock piles.	✓	✓
Ore Milling and Processing: Ore extracted from the open pits will be moved to the processing area where it will either be stockpiled for future processing or crushed and milled, then processed for gold extraction via gravity, flotation and leach processes.	✓	–
Tailings Management Facility: Following treating tails via cyanide destruction, tailings will be thickened and pumped to an engineered TMF in years 1 to 9, then pumped to the exhausted Leprechaun open pit in years 10 through 12.	–	✓
Water Management (Intake, Use, Collection and Release): Recirculated process water and TMF decant water will serve as main process water supply, and raw water (for purposes requiring clean water) will be obtained from Victoria Lake Reservoir. Site contact water and process effluent will be managed on site and treated prior to discharge to the environment. Where practicable, non-contact water will be diverted away from mine features and infrastructure, and site contact and process water will be recycled to the extent feasible for use on site.	✓	–

Table 12.16 Project-Environment Interactions with Other Wildlife

Physical Activities	Environmental Effects to be Assessed	
	Change in Habitat	Change in Mortality Risk
Utilities, Infrastructure and Other Facilities • Accommodations camp and site buildings operation, including vehicle maintenance facilities • Explosives storage and mixing • Site road maintenance and site snow clearing • Access road maintenance and snow clearing • Power and telecom supply • Fuel supply	✓	✓
Emissions, Discharges and Wastes[A]: Noise, air emissions/GHGs, water discharge, and hazardous and non-hazardous wastes.	✓	✓
Employment and Expenditure[B]	–	✓
DECOMMISSIONING, REHABILITATION AND CLOSURE		
Decommissioning of Mine Features and Infrastructure	✓	✓
Decommissioning, Rehabilitation and Closure-related Transportation Along Access Road	✓	✓
Progressive Rehabilitation: Rehabilitating infrastructure or areas not required for ongoing operation (e.g., buildings, roads, laydown areas); covering and revegetating completed tailings areas, where practicable, including commencing closure of TMF beginning in Year 9 (when tailings deposition moves to Leprechaun open pit); erosion stabilization and re-vegetation of completed overburden and/or waste rock piles; infilling or flooding of exhausted mining areas; and completing revegetation studies and trials.	✓	✓
Closure Rehabilitation: Active rehabilitation based on successes of progressive rehabilitation activities. Includes: demolishing infrastructure (e.g., buildings, equipment, facilities, roads, laydown areas); grading and revegetating cleared areas, where practicable; breaching and regrading ponds to reestablish drainage patterns; completing closure of TMF (covering with overburden and revegetating); erosion stabilization and revegetation of completed overburden and/or waste rock piles; and infilling or flooding of open pits.	✓	✓
Post-Closure: Long-term monitoring	–	–

Table 12.16 Project-Environment Interactions with Other Wildlife

Physical Activities	Environmental Effects to be Assessed	
	Change in Habitat	Change in Mortality Risk
Emissions, Discharges and Wastes[A]	✓	✓
Employment and Expenditure[B]	–	–

Notes:
✓ = Potential interaction
– = No interaction
[A] Emissions, Discharges and Wastes (e.g., air, waste, noise, light, liquid and solid effluents) are generated by many Project activities. Rather than acknowledging this by placing a checkmark against each of these activities, "Wastes and Emissions" is an additional component under each Project phase
[B] Project employment and expenditures are generated by most Project activities and components and are the main drivers of many socio-economic effects. Rather than acknowledging this by placing a checkmark against each of these activities, "Employment and Expenditures" is an additional component under each Project phase

Project-related environmental effects can influence other wildlife directly or indirectly, and positively or adversely. A direct effect is characterized as an interaction resulting from the Project with no intermediate effects (e.g., habitat loss, mortality from vehicle collision), while an indirect effect is characterized as an interaction resulting from the Project that has intermediary steps. Indirect effects may occur at the same time and space as the direct effect (e.g., sensory disturbances associated with vegetation clearing) or at a later time and space (e.g., altered predator-prey dynamics following clearing).

Project activities during the construction phase (Table 12.16) are expected to affect habitat and mortality risk for wildlife, with one exception. No interaction is expected to occur between Employment and Expenditures and change in habitat, as employees on site are anticipated to be present in areas where habitat loss has already been addressed through another interaction (e.g., Construction / Installation of Infrastructure and Equipment).

During operation, sound emissions and lighting (i.e., sensory disturbance) associated with various mining activities (Table 12.16) are accounted for under Emissions, Discharges and Wastes; therefore, no further pathway exists between change in habitat and the Tailings Management Facility.

Wildlife will typically avoid noisy areas with lots of activity. Therefore, in the assessment of change in mortality risk, no interaction has been identified for physical activities that wildlife are expected to avoid, such as:

- Ore Milling and Processing
- Water Management
- Utilities, Infrastructure and Other Facilities

During decommissioning, no interactions are anticipated between Post-closure Monitoring and other wildlife habitat or mortality risk, as there is no apparent pathway. In addition, no interaction was identified between Employment and Expenditures and change in habitat, as there is no apparent pathway for potential Project effects.

12.3.5 Analytical Assessment Techniques

12.3.5.1 Assumptions and the Conservative Approach

A conservative approach was used to address uncertainty in the environmental effects assessment, allowing for increased confidence in the final determination of significance. Specifically, the following assumptions were made:

- All habitat within the Project Area will be lost, resulting in a direct loss of habitat. In practice, not all vegetation will be cleared within the Project Area
- For each focal species, the amount of high and moderate -ranked habitat was identified using a conservative approach. Relatively broad habitat classes were used for rankings, which may result in an overestimation of suitable habitat. In practice, species may only use a portion of habitats identified. Habitat requirements may also vary by season, which is similarly not reflected in the habitat value rankings (i.e., may result in an overestimation of suitable habitat depending on the season).
- Change in habitat was assessed within the ELCA (1,830.6 km^2), which constitutes 20.5% of the RAA (8916.8 km^2); as the proportion of habitat affected by the Project within the RAA will be less than in the ELCA (as the RAA is larger than the ELCA), the estimated proportion of Project-related change in habitat is conservative
- The distance from which indirect changes in habitat extend from the source were assumed to occur at the maximum identified distances at all times, whereas the indirect effects will actually vary greatly depending on site activity.
- Mortality risk was also assessed using a conservative approach. Wildlife typically have the ability to move out of the way of danger and will typically avoid areas where work is being conducted, because of the presence of human activity and noise

12.3.5.2 Change in Habitat

The general approach to assessing potential environmental effects on wildlife followed the sequence and methods outlined below.

While the assessment for other wildlife and their habitat is focused on the species identified in Table 12.1, the effects of the Project on habitat for other wildlife species and species groups can be inferred based on the habitat associations identified in Table 12.17 and, where relevant, the effects on other VCs (e.g., vegetation or wetland communities [Chapter 9]).

Table 12.17 Measurable Parameters and Additional Wildlife Associations

Measurable Parameter	General Habitat Association	Additional Wildlife Associations
• Moose primary habitat • Black bear primary habitat • Lynx primary habitat • Marten primary habitat • Northern long-eared bat primary habitat • Red-backed vole primary habitat	woodland (coniferous, deciduous and mixed forests) and treed wetland	• marten and black bear denning sites • snowshoe hare • lynx • red fox • small mammals
• Beaver primary habitat • Muskrat primary habitat	open water and habitats associated with aquatic habitats (Riparian Thicket, Open Wetlands and Exposed Sand/Gravel Shoreline)	• aquatic furbearers (e.g., beaver, mink, otter)
• Meadow vole primary habitat	non-treed wetlands (marsh, bog and fens)	• marten hunting area

Effects on other wildlife and their habitat were assessed quantitatively using geographic information system (GIS) and qualitatively through a literature review of predicted effects.

Direct changes in habitat were calculated by determining the area of suitable habitat lost for nine focal species. For each focal species, all habitat types were ranked as low, moderate or high quality. Habitats ranking as high or moderate were classified as suitable habitat. It was assumed that all habitat in the Project Area will be lost, and the amount of suitable habitat lost for each focal species was calculated using GIS.

Indirect effects on habitat were measured based on estimated areas of potential sensory disturbance, primarily from noise and light. The sensory disturbance zone defines the area over which the effects of a disturbance are assumed to reduce the effectiveness of the adjacent wildlife habitat due to avoidance or underutilization. For this assessment, two sensory disturbance zones were applied around the Project Area:

- Mine site portion of the Project Area: 200 m, based on guidance provided for buffers applied to similar Projects in similar habitat contexts (MNR 2000)
- Access road portion of the Project Area: 100 m, to account for the occasional and less intense nature of the sensory disturbance predicted to take place within this section of the Project Area

The sensory disturbance zones were calculated as discrete areas located outside of the Project Area, and do not overlap with areas where habitat is directly lost. This was necessary to not double count both direct and indirect habitat loss.

12.3.5.3 Change in Risk of Mortality

Change in mortality risk was assessed qualitatively through changes in direct sources of mortality (e.g., vehicle collisions, human-wildlife conflict). The qualitative assessment included a combination of literature review and professional judgment to predict the mortality risks to wildlife. The assessment of change in mortality risk is focused on the construction and operation phases, as the change in mortality risk during decommissioning, rehabilitation and closure activities is expected to be low relative to construction or operation.

12.4 MITIGATION AND MANAGEMENT MEASURES

A series of environmental management plans will be developed by Marathon to mitigate the effects of Project development on the environment. A full list of mitigation measures to be applied throughout Project construction, operation and decommissioning, rehabilitation and closure is provided in Section 2.7.4. Project planning and design and the application of proven mitigation measures will be used to reduce adverse effects to other wildlife. Mitigation and management measures to reduce potential adverse effects on other wildlife is provided in Table 12.18. Mitigation measures identified for other VCs will also address potential adverse effects on the Other Wildlife VC, including Chapter 5 – Atmospheric Environment; Chapter 8 – Fish and Fish Habitat; Chapter 9 – Vegetation, Wetlands, Terrain and Soils; Chapter 10 – Avifauna; Chapter 11 – Caribou, Chapter 16 – Land and Resource Use.

Table 12.18 Mitigation Measures: Other Wildlife

Category	Mitigation	C	O	D
Site Clearing, Site Preparation and Erosion and Sediment Control	• Project footprint and disturbed areas will be limited to the extent practicable.	✓	-	-
	• Sensitive areas (e.g., wetlands, hibernacula, mineral licks, roosts, caribou migration corridors) will be identified prior to construction and appropriate buffers will be flagged and maintained around these areas, where feasible.	✓	-	-
	• Existing riparian vegetation will be maintained to the extent practicable.	✓	-	-
	• Vegetation will be maintained around high activity areas to the extent practicable, to act as a buffer to reduce sensory (light and noise) disturbance.	✓	-	-
	• Environmental personnel responsible for site monitoring during construction will receive training to recognize species of conservation concern (SOCC) that may be present in Project Area.	✓	-	-
Vehicles / Equipment / Roads	• Vehicles and heavy equipment will be maintained in good working order and will be equipped with appropriate mufflers to reduce noise.	✓	✓	✓
	• Project vehicles will be required to comply with posted speed limits on the access road, site roads and haul roads to limit fugitive dust from vehicle travel on unpaved roads. Speed limits will be set in accordance with provincial regulations and industry standards (e.g., for haul roads). Additional speed restrictions will be implemented during caribou migration periods.	✓	✓	✓

Table 12.18 Mitigation Measures: Other Wildlife

Category	Mitigation	C	O	D
Vehicles / Equipment / Roads	• Caribou crossing on roads / features will be facilitated where they occur (e.g., crossing point across ditch) within the caribou migration corridor. The access road, site roads and haul roads will be designed for provision of low areas in the plowed snowbanks, where practicable, to facilitate wildlife movements: – Breaks in snowbanks will be created at approximately 200 m intervals, to the extent practicable, to provide wildlife crossing opportunities – Snow berms will typically be less than 1 m tall to facilitate caribou crossing – Where feasible, breaks in snowbanks will be aligned on opposing sides and with existing wildlife trails, where they occur, to facilitate caribou crossing	✓	✓	✓
	• Project-related air traffic (helicopter, airplane) will maintain a minimum ferrying altitude of 500 m to the extent feasible.	✓	✓	✓
	• Marathon will implement traffic control measures to restrict public access to the mine site, which may include gating approaches, placing large boulders and/or gated fencing.	✓	✓	✓
Light Emissions	• Project lighting will be limited to that which is necessary for safe and efficient Project activities. Lighting design guidelines will be followed, such as the Commission Internationale de L'Éclairage, International Dark Sky Association, Illuminating Engineering Society, and the lighting requirements for workspaces, as applicable.	✓	✓	✓
	• Mobile and permanent lighting will be located such that unavoidable light spill off the working area is not directed toward receptors outside of the Project Area, to the extent practicable.	✓	✓	✓
Noise Emissions	• Project facilities and infrastructure will be designed to limit noise emissions.	-	✓	-
	• Where practicable in accessible areas (e.g., along cleared rights-of-ways), trees and other vegetation will be left in place or encouraged to grow to obstruct the view of Project facilities, reducing the change in viewshed and muffling nuisance noise.	✓	✓	-
Site Water Management	• Water management ditches will be designed to allow wildlife crossing opportunities, aligned with wildlife trails where practicable.	✓	✓	✓
Tailings Management	• Cyanide detoxification within the mill using the sulphur dioxide / air oxidation process will result in the degradation of cyanide and precipitation of metals prior to discharge to the TMF.	-	✓	-
Materials Handling and Waste Management	• A Project-specific Waste Management Plan will be developed to address the collection, storage and transportation of hazardous and non-hazardous wastes generated from the Project. The Waste Management Plan will set out procedures for reducing Project-related waste and limiting demands on the regional landfill.	✓	✓	✓

Table 12.18 Mitigation Measures: Other Wildlife

Category	Mitigation	C	O	D
Wildlife / Avifauna Management	• Wildlife-vehicle collisions, near misses or observations of wildlife (caribou, moose) road mortality on site roads and/or involving Project vehicles on the access road will be reported to the on-site environmental team and the NLDFFA - Wildlife Division. Adaptive management measures will be implemented should locations of high frequency wildlife-vehicle interactions be identified.	✓	✓	✓
	• Observations of bat colonies, potential hibernacula sites, sick or dead bats will be reported to the provincial Wildlife Division at 709-637-2025. Bat sightings can also be reported to the toll-free bat hotline: 1-833-434-2287 (BATS).	✓	✓	✓
	• During the construction of buildings or other structures, bats will be discouraged from establishing roost sites by sealing openings of 15 mm in diameter or larger. Chutes and ducts will be sealed at the outside / top, so as to prevent entry by bats. Structures will be assessed to identify potential entry points before they become a problem.	✓	-	-
	• If a bat colony is found to exist within a Project structure, bats can remain there when it is safe for people and where there is no chance of contact with people. If it is not safe for bats to remain, Wildlife Division will be contacted to develop an approved removal plan.	✓	✓	✓
	• Open buckets, garbage bins, tubs or containers will be kept covered where practicable. Bats may fly into these open containers and may be attracted to standing water within them. Bats cannot climb slippery surfaces and are unable to fly straight up into the air, so can easily become trapped in such containers.	✓	✓	✓
	• Use of sticky traps for problem rodents will be avoided, as bats are often attracted to these.	✓	✓	✓
	• Large-diameter trees will be maintained to the extent possible; especially those that are old, dead or dying. These types of trees typically have the peeling bark, crevices and cavities that provide important natural roosting habitats for bats.	✓	-	-
	• Vegetation clearing will be avoided during the bird breeding season, if feasible, which will also protect other breeding wildlife species, by preventing the destruction of small mammal nests and bat maternity roosts. If avoidance is not practicable, pre-clearing surveys will be conducted for bat maternity roosts. Buffers / set back distances will be established if maternity roosts are identified.	✓	-	-
Employment and Expenditures	• Hunting / fishing / harvesting of wildlife will be strictly prohibited on the mine site. Workers will not be permitted to hunt / fish / harvest while staying at the accommodations camp and will not be permitted to bring firearms or angling gear to site.	✓	✓	✓

Table 12.18 Mitigation Measures: Other Wildlife

Category	Mitigation	C	O	D
Rehabilitation and Closure	• Marathon will develop a Rehabilitation and Closure Plan that meets the requirements of the Department of Industry, Energy and Technology, Department of Environment, Climate Change, and Municipalities, and Department of Fisheries, Forestry and Agriculture. The plan will be reviewed and updated regularly until implemented.	✓	✓	✓
	• Linear features on the mine site (i.e., roads and power line corridors) not required for long-term monitoring will be decommissioned and rehabilitated to limit future hunting pressures on wildlife and restore habitat to pre-mine conditions where possible.	-	-	✓
Notes: C – Construction Activities O – Operation Activities D – Decommissioning, Rehabilitation and Closure Activities				

12.5 ASSESSMENT OF ENVIRONMENTAL EFFECTS ON OTHER WILDLIFE

For each potential effect identified in Section 12.3.3, specific Project activities that may interact with the VC and result in an environmental effect (i.e., a measurable change that may affect the VC) are identified and described. The following sections first describe the pathways by which a potential Project effect could result from Project activities in the absence of mitigation during each Project phase (i.e., construction, operation and decommissioning, rehabilitation and closure). Mitigation and management measures (Section 12.4) are applied to avoid or reduce these potential pathways and resulting environmental effects. Residual effects are those remaining following implementation of mitigation, which are then characterized using the criteria defined in Section 12.3.1. A summary of predicted residual effects is provided in Section 12.5.3.

12.5.1 Change in Habitat

12.5.1.1 Project Pathways

Construction

Most of the direct changes to wildlife habitat (i.e., habitat loss and/or alteration) will occur during Project construction, through vegetation removal during site preparation and subsequent conversion of land cover type. If present in the Project Area, there is potential for important habit features, including denning sites or hibernacula, to be altered or destroyed during this phase. Some bat species, for example, use mature trees and/or snags as maternity roosts during the breeding season. Northern long-eared bats typically use trees that are larger than average, and often in advanced stages of decay for their maternity roosts (Park and Broders 2012). This direct change in habitat will be evident through the life of the Project and beyond the decommissioning, rehabilitation and closure phase.

Vegetation clearing can result in habitat fragmentation, which can have particularly detrimental effects on species with large ranges, and those that require large patches of interior forest or other types of homogenous habitat. For example, marten prefer mature forest and require forest habitats with horizontal and vertical structure (COSWEIC 2007). In one study that involved radiotracking marten, it was found that patch size was a good predictor of marten occurrence, where larger patches were used more frequently than small patches (Chapin et al. 1998). This suggests that forest fragmentation could have adverse effects on marten if the remaining habitat patches are not large enough. Similarly, a study on northern-long eared bats and habitat fragmentation on Prince Edward Island found a positive relationship between forest cover and bat presence (Henderson et al. 2008). Fragmentation can also result in a reduction in animal movement, potentially resulting in a reduction of gene flow (Frankham 2006).

Vegetation clearing also results in the creation of habitat edges, and subsequently can create edge effects. Edge effects can include changes in microclimate, vegetation structure, changes to wildlife presence and/or abundance, and behavioral responses of wildlife (Harper et al. 2005; Murcia 1995). The magnitude of edge effects varies depending on the distance to the edge and is typically greater closer to the edge (Fuentes-Montemayor et al. 2009). Edge effects vary greatly by species. Species that are dependent on interior and mature forests as core habitat, including marten and lynx, may be the most adversely affected by edges, as they may avoid edge habitats. Other species preferentially choose edge habitats for foraging or travelling. Moose commonly use edge habitat for foraging year-round as these habitats provide high value browse (Ardea Biological Consulting 2004). Black bears also forage in open and edge habitats, and mother bears with cubs may prefer edge habitats because of the protection that the nearby forest provides (Lindzey and Meslow 1977).

Construction can also result in indirect effects on habitat through sensory disturbance (e.g., noise, light pollution, dust and vibrations). As sensory disturbance is avoided by wildlife, Project-related effects of construction could affect habitat selection by wildlife due to avoidance of the site. Sensory disturbance primarily occurs at habitat edges. The magnitude of indirect effects on habitat are directly associated with the level of nearby Project activity. For example, sensory disturbance will be relatively low along the access road and could be relatively high during blasting activities at the mine site. Noise caused by construction and operation may cause some wildlife to avoid the area or to alter their behaviour and may cause stress or other physiological effects (Shannon et al. 2016; Naguib 2013; Barber at al. 2010). Noise can also affect the ability of wildlife to communicate, which can interfere with finding mates (Naguib 2013). These effects are generally considered greatest if disturbance occurs during critical life stages, such as courtship or breeding.

Site lighting may also result in sensory disturbance to wildlife species. Some species may avoid lit areas, while other may be attracted to artificial light. Some small mammals, including mice (Bird et al. 2004; Bliss-Ketchum et al. 2016), have been shown to avoid artificially lit areas. This behaviour could be attributed to mice trying to avoid predation (Bliss-Ketchum et al. 2016). Conversely, some species of bats, including little brown bats, have been shown to be attracted by artificial lights, which concentrate flying insects (ECCC 2015). This could increase foraging efficiency for bats and could attract them to the Project Area, where overall threats may be higher.

Operation

Most of the vegetation clearing (and subsequent creation of new edges and edge effects) will occur during the construction phase. For the purposes of this assessment, it has been assumed that wildlife habitat will generally not be restored during operation due to ongoing activity within the Project Area, including open pit mining, ore processing, waste and water management, and road use. However, there may be some localized areas within the Project Area where some wildlife habitat value is retained because vegetation removal will not be complete during construction (e.g., along some rights-of-way). For this reason, there will be few direct effects on wildlife habitat during operation.

Indirect effects on wildlife habitat will occur throughout the operation phase and could be long-lasting. Noise will be generated by equipment and processes associated with facility operation. Noise generating activities include blasting, processing equipment such as rock breakers and feeders, and mobile sources such as trucks and heavy equipment. Light emissions discussed above will continue during operation.

Should bat hibernacula occur within the LAA, blasting and other loud noise may result in disturbance to hibernating bats. Blasting can also result in underground vibrations, which may disturb hibernating bats if they are close enough to the blasting to experience vibrations. Noise or vibrations could wake bats from hibernation, thereby causing them to expend undue energy and burn limited fat reserves (West Virginia Department of Environmental Protection 2006). Underground vibrations could also result in damage to underground hibernacula sites, including collapses, which could affect the ability of bats to access sites. Changes to underground structures, such as caves, could also result in a change to airflow, and subsequently the site microclimate.

The extent of sensory disturbance experienced by wildlife from Project operation will vary with the type of disturbance, the intensity of human use, season and spatial scale. Sensory disturbance may be most pronounced if experienced during key life cycle periods, such as during the breeding season, when offspring are young and most vulnerable, during seasons when resources are limited, and during hibernation.

Decommissioning, Rehabilitation and Closure

Decommissioning, rehabilitation and closure will include the removal of mine infrastructure, and the revegetation and infilling of mining areas. This project phase can have both positive and adverse effects on wildlife habitat.

In comparison to the operation phase, the rehabilitation and revegetation of the Project Area may result in an increase of habitat availability. Some animals may be able to move back into areas that they had abandoned during construction and operation. The rehabilitation of the site will take time, and the habitat in the Project Area will change over time after closure as vegetation becomes established in the disturbed areas. Shortly after closure, the site will likely become covered in low vegetation and will remain quite open. This may provide suitable habitat for animals that use open habitats, including moose and meadow voles. Mature forest habitat will take much longer to re-establish. Because of the open pits, restoration of the mine site footprint upon decommissioning, rehabilitation and closure is unlikely to result in the complete reversal of some of the effects associated with the Project. Some previously vegetated communities within the Project footprint are not expected to return to existing conditions.

If wildlife used built features of the Project Area during Project operation, this habitat will be lost upon decommissioning. Little brown bats frequently roost in human structures and could establish day roosts or maternity colonies in Project buildings. Once these buildings are removed, these sites would be destroyed.

Effects which cause an indirect change in habitat (e.g., noise and light disturbance) will abate upon closure, with reduced traffic levels and the cessation of Project activities.

12.5.1.2 Residual Effects

Change in habitat is one of the two environmental effects identified in the Project-environment interactions table (Table 12.16). The Project will result in a variety of changes to habitat, which will have both direct and indirect effects on wildlife. Direct effects occur when habitat is lost through vegetation clearing. For example, when a section of forest is cleared to create a road, this results in a direct loss of habitat for species that inhabited the forest. Indirect effects of changes in habitat are associated with the sensory disturbance that result from construction, operation or decommissioning activities. The three primary pathways for changes in habitat are vegetation clearing, sensory disturbance and edge effects.

Vegetation Clearing and Edge Effects

Vegetation clearing during the construction phase will result in the direct loss of habitat for wildlife. Both of the SAR species discussed in this chapter (marten and the northern long-eared bat) will experience habitat loss. Mitigation measures presented in Section 12.4 (e.g., design considerations to reduce the extent of direct disturbance of habitat where practicable) will reduce the total amount of habitat lost during construction and operation. The scale and magnitude of habitat loss will vary by species, depending on their particular habitat requirements. The specific amounts of suitable habitat lost for the nine focal species identified in the Existing Environment (Section 12.2) are presented and discussed in Section 12.5.1.

Project activities will result in some forest fragmentation, particularly within the mine site. Linear features (i.e., the access, mine site and haul roads) can fragment habitat for species that are unable or unwilling to cross them. Other mine infrastructure, including the pits and waste rock piles, may also result in some habitat fragmentation. However, the largest linear feature associated with the Project, the access road, already exists. Although widening the road will result in some habitat loss, it is not expected to result in an increase in habitat fragmentation.

Fragmentation can also result in a reduction in animal movement and subsequent reduction in gene flow (e.g., Frankham 2006; Méndez et al. 2011; Wan et al. 2018; Sawaya et al. 2019). However, this is not expected to occur as a result of this Project, due to the relatively short overall life span of the construction and operation phases (16 to 20 months, and 12 years, respectively), and the relatively small portion of habitat in the Project Area, in relation to the overall region.

Vegetation clearing can result in the removal of important habitat features including dens, small mammal nests or maternity roosts. Bats, for example, use mature trees and/or snags as maternity roosts during the breeding season, and vegetation clearing could remove these features from the landscape. Suitable roosting habitat for bats is abundant in the RAA. Alternative roosts are therefore widely available in the surrounding areas, and bats can readily move to these sites. The same logic is true for other large mammals, furbearers, small mammals and marten, who all have widely available suitable habitat in the RAA. The potential for injury or mortality resulting from the removal of these habitat features while they are occupied is discussed in Section12.5.2. Mitigation measures will be in place to reduce these effects. Mitigation specifies that environmentally sensitive areas (e.g., seeps and springs, mineral licks, dens, roosts, stick nests, hibernacula, wildlife trails) will be flagged prior to clearing and construction and evaluated for additional mitigation measures (e.g., setbacks / buffers, seasonal timing of clearing activities) (Table 2.18).

Overall, adverse edge effects on wildlife from the Project are anticipated to be minor. Some edge effects will likely occur in the mine site area. However, many wildlife species are tolerant of edges and some prefer this habitat. The Project Area is surrounded by relatively undisturbed forest, which indicates that alternative interior habitat is available. The Project component with the greatest linear edge is the access road, which already exists, thus limiting new edge effects.

Sensory Disturbance

Sensory disturbance is largely caused by activities resulting in noise and light. This effect will primarily occur during the construction and operation phases, where there will be noise as a result of blasting, heavy equipment use, traffic and other site activities. Sensory disturbance may cause wildlife to abandon important habitat features, including denning sites or hibernacula. The sensory disturbance may also result in stress or other physiological effects, resulting in behavioral changes. Noise may also affect the ability of wildlife species to detect and find prey or mates.

Sound pressure levels related to Project construction activities were predicted to be generally below 35 decibel (dBA) (background levels) at about 5 km from the mine, and 25 dBA about 1 km from the access road during rotation changes (Chapter 5). Studies have shown that noise related effects on wildlife have the potential to occur beyond 40 dBA (Shannon et al. 2016). This indicates there will likely be some noise related effects on wildlife from Project activities at the mine site, and these effects could expand beyond the LAA. Sound pressure levels related to construction are predicted to be below 35 dBA (background levels) approximately 5 km from the mine site, and at 25 dBA approximately 8 km from the mine site (Chapter 5). Sound pressure levels related to the access road are predicted to be 25 dBA approximately 1 km from the access road during crew rotation change. During operation, sound pressure levels related to operation are predicted to be below 35 dBA approximately 5 km from the mine, and 25 dBA approximately 10 km from the mine. Sound pressure levels related to the access road are predicted to be 25 dBA approximately 1 km during crew rotation change. Within the mine site, predicted sound pressure levels could reach approximately 80 dBA (e.g., rock breaker: 80 dBA at 100 m distance; processing plant: 67 dBA at 100 m; edge of Marathon Pit: 52 dBA at 100 m; edge of Leprechaun Pit: 55-60 dBA at 100 m). Acoustic modelling for this assessment assumes no vegetation between the source of the noise and the receptor, adding conservatism to the estimates. However, the effects described above are localized to the area around the mine site, as the access road is not expected to result in noise over 40 dBA in the LAA.

Should bat hibernacula occur within the LAA, blasting and other loud noises may result in disturbance to hibernating bats. Blasting can result in noise as well as underground vibrations, which can result in the alteration or collapse of underground hibernacula. Underground vibrations could also disturb bats during hibernation by waking them, thus causing bats to use their limited fat reserves. This effect could also occur for hibernating bears. Vibrations could also cause stress on other species, particularly during sensitive hibernation and breeding periods. However, no known bat hibernacula or sink holes occur in the Project Area. The only known hibernation site in the area is over 12 km away from the Project Area.

A variety of mitigation measures have been proposed to reduce the effects of sensory disturbance on wildlife. For example, vehicles and heavy equipment on site will be equipped with appropriate mufflers to reduce noise. Project-related helicopter traffic (if required) will maintain a minimum ferrying altitude of 500 m, where feasible, to reduce noise disturbance, Project lighting will be limited to that which is safe for personnel and feasible, and lighting will be directional where practicable (Table 2.18). These mitigation measures will help reduce the sensory disturbance to wildlife during construction and operation.

Quantitative Analysis of Habitat Loss

Large Mammals

Both moose and black bear are habitat generalists, and suitable habitat is common in the ELCA. The amount of suitable habitat in the ELCA is the same for moose and black bear. For each species, up to 34.8 km^2 of high and moderate ranked habitat could be directly lost through vegetation clearing in the Project Area (Table 12.19). In addition, 50.9 km^2 of habitat could be lost due to indirect effects, including edge effects and sensory disturbance resulting from noise and light pollution. Overall, for both black bear and moose, the combined direct and indirect habitat loss accounts for up to 85.7 km^2, or 4.7% of the total ELCA. This indicates that both moose and black bear have an abundance of suitable habitat in the surrounding area, and the Project is not expected to limit the availability of habitat for these two species.

Table 12.19 Residual Project-Related Change in Habitat in the ELCA for Large Mammals

Representative Species	Existing Conditions in the ELCA[A] (km^2)			Maximum Direct Losss[A, B] (km^2)			Maximum Indirect Loss[A,C] (km^2)			Percent of High and Moderate Value Habitat Loss in ELCA[A] (Direct and Indirect Loss Combined) (%)
	Habitat Value Ranking									
	High	Moderate	Total	High	Moderate	Total	High	Moderate	Total	
Moose	422.5	1,405.3	1,827.8	10.9	23.9	34.8	27	24	50.9	4.7
Black Bear	1,130.7	697.1	1,827.8	27	7.8	34.8	40.5	10.4	50.9	4.7

Notes:
[A] Numbers rounded to one decimal place. Areas may not add up to total amounts due to rounding
[B] Values based on Project Area
[C] Values based on 200 m buffer around Project Area plus 100m buffer around access road
Values pertain to the portion of the Project Area and LAA with ELC data

Furbearers

Lynx have an abundance of suitable habitat in the ELCA, accounting for 1,130.7 km^2 (Table 12.20). Of this, a total of up to 49.6 km^2 is anticipated to be lost in the Project Area. A total of 40.5 km^2 of suitable habitat is also anticipated to be lost through indirect effects in the 200 m buffer around the mine site and

100 m buffer along the access road. In total, 8% of suitable habitat in the ELCA for lynx is anticipated to be lost through a combination of direct and indirect effects. Although this is the largest percentage of habitat loss of the nine focal species that were assessed, it remains a relatively small portion of habitat to be lost in the overall landscape for lynx.

Beavers have a total of 973.2 km^2 of suitable habitat in the ELCA, of which up to 14.2 km^2 will be directly lost in the Project Area. An additional 33.4 km^2 of habitat may be indirectly lost, largely through edge effects and sensory disturbance. In total, 4.9% of suitable beaver habitat will be lost in the ELCA through a combination of direct and indirect loss.

Muskrat have 706.7 km^2 of suitable habitat in the ELCA, of which 6.1 km^2 will be directly lost as a result of vegetation clearing in the Project Area, and an additional 8.7 km^2 may be indirectly lost due to sensory disturbance. In total, muskrat have the smallest percentage of habitat loss in the ELCA of the nine species assessed, at 2.1%. This is likely because muskrat prefer open water, open wetlands and exposed sand / gravel shorelines. These habitats are typically not abundant in the Project Area and will generally not be altered as a result of the Project.

Table 12.20 Residual Project-Related Change in Habitat in the ELCA for Furbearers

Representative Species	Existing Conditions in the ELCA[A] (km^2)			Maximum Direct Loss[A, B] (km^2)			Maximum Indirect Loss[A,C] (km^2)			Percent of High and Moderate Value Habitat Loss in ELCA[A] (Direct and Indirect Loss Combined) (%)
	Habitat Value Ranking									
	High	Moderate	Total	High	Moderate	Total	High	Moderate	Total	
Lynx	612.0	518.7	1,130.7	14.9	34.7	49.6	23.2	17.3	40.5	8.0
Beaver	521.1	452.2	973.2	3.7	10.5	14.2	14.1	19.5	33.5	4.9
Muskrat	408.5	298.2	706.7	1.3	4.8	6.1	2.8	5.8	8.7	2.1

Notes:
[A] Numbers rounded to one decimal place. Areas may not add up to total amounts due to rounding
[B] Values based on Project Area
[C] Values based on 200 m buffer around Project Area plus 100m buffer around access road
Values pertain to the portion of the Project Area and LAA with ELC data

Small Mammals

Meadow vole and red-backed vole are predicted to lose similar total amounts of high and moderate ranked habitat. These two species have a total of 1,419.3 km^2 and 1,411.0 km^2 of high and moderate ranked habitat in the ELCA, respectively (Table 12.21). Meadow vole are anticipated to lose up to 33.5 km^2 of high and moderate ranked habitat due to direct habitat loss, and up to 48.1 km^2 through indirect loss. Red-backed voles are anticipated to lose up to 31.6 km^2 of high and moderate ranked habitat through direct loss and up to 46.0 km^2 through indirect loss. Overall, meadow vole and red-backed vole are anticipated to lose a small proportion of high and moderate ranked habitat in the ELCA as a combined result of direct and indirect effects, at 5.7% and 5.5%, respectively.

Table 12.21 Residual Project-Related Change in Habitat in the ELCA for Small Mammals

Representative Species	Existing Conditions in the ELCA[A] (km^2)			Maximum Direct Loss[A, B] (km^2)			Maximum Indirect Loss[A,C] (km^2)			Percent of High and Moderate Value Habitat Loss in ELCA[A] (Direct and Indirect Loss Combined) (%)
	Habitat Value Ranking									
	High	Moderate	Total	High	Moderate	Total	High	Moderate	Total	
Meadow Vole	392.8	1,026.4	1,419.3	7.0	26.5	33.5	16.7	31.4	48.1	5.7
Red-backed Vole	950.3	460.8	1,411.0	23.7	7.9	31.6	29.6	16.5	46.0	5.5

Notes:
[A] Numbers rounded to one decimal place. Areas may not add up to total amounts due to rounding
[B] Values based on Project Area
[C] Values based on 200 m buffer around Project Area plus 100m buffer around access road
Values pertain to the portion of the Project Area and LAA with ELC data

SAR/SOCC

The northern-long eared bat has 1,287.2 km^2 of high and moderate ranked habitat in the ELCA (Table 12.22). Of this, up to 23.9 km^2 is anticipated to be lost directly in the Project Area, and up to 28.4 km^2 is anticipated to be indirectly lost through sensory disturbance and edge effects. Combined, these losses could result in a total loss of 4.1% of high and moderate ranked habitat in the ELCA.

Table 12.22 Residual Project-Related Change in Habitat in the ELCA for SAR/SOCC

Representative Species	Existing Conditions in the ELCA[A] (km^2)			Maximum Direct Loss[A, B] (km^2)			Maximum Indirect Loss[A,C] (km^2)			Percent of High and Moderate Value Habitat Loss in ELCA[A] (Direct and Indirect Loss Combined) (%)
	Habitat Value Ranking									
	High	Moderate	Total	High	Moderate	Total	High	Moderate	Total	
Northern Long-Eared Bat	539.3	748.0	1,287.2	16.6	7.3	23.9	21.4	7.0	28.4	4.1
Marten	490.7	388.0	878.7	13	9.6	22.6	11.0	14.6	25.6	5.5

Notes:
[A] Numbers rounded to one decimal place. Areas may not add up to total amounts due to rounding
[B] Values based on Project Area
[C] Values based on 200 m buffer around Project Area plus 100m buffer around access road
Values pertain to the portion of the Project Area and LAA with ELC data

Marten has 878.7 km^2 of high and moderate ranked habitat in the ELCA. Direct loss through vegetation clearing in the Project Area will result in a loss of up to 22.6 km^2 of suitable habitat. Indirect loss will account for a reduction of up to another 25.6 km^2 of high and moderate ranked habitat. Overall, indirect and direct habitat loss as a result of the Project could account for a total loss of 5.5% of high and moderate ranked habitat in the ELCA for marten.

These results indicate that the overall percentage of habitat loss in the ELCA is low for both SAR.

12.5.1.3 Summary

With mitigation, the Project is anticipated to result in adverse effects to change in habitat. For the representative large mammal, furbearer and small mammal species, and for northern long-eared bat, the changes in habitat are anticipated to be low in magnitude. For marten, the magnitude of the change in habitat is anticipated to be moderate. The assessment of direct habitat loss (e.g., vegetation clearing) assumed that all habitat in the Project Area will be lost. However, as there will be some localized areas within the Project Area where vegetated areas will be retained, the estimated amounts of Project-related habitat loss are conservative. The effects of change in habitat are expected to occur at the geographic extent of the LAA, to be long term in duration and occur continuously. Changes in habitat will occur during all Project phases and are adverse in direction. The Project Area has been previously disturbed from the ongoing mineral exploration and forestry in the area.

An analysis of direct and indirect habitat loss for nine focal species indicates that only a small portion of high and moderate ranked habitat will be lost for each species in the ELCA. Results indicate that the anticipated percentage of high and moderate ranked habitat loss in the ELCA for the representative large mammal, furbearer and small mammal species will be up to 2.1% for muskrat to 8.0% for lynx. For the SAR, it is anticipated that 4.1% of high- and moderate-ranked habitat will be lost in the ELCA for northern long-eared bat, and 5.5% will be lost for marten. Direct and indirect habitat loss will occur within the LAA, and the proportions of habitat loss are higher in the LAA than in the ELCA.

Habitat loss from some construction activities will be irreversible, as some vegetation communities are not expected to return to existing conditions following decommissioning, rehabilitation and closure, and some Project features (e.g., flooded open pits) will be permanent features on the landscape. As well, following decommissioning, rehabilitation and closure, the site is expected to gradually progress from open habitats to forested habitat, reversing some habitat loss for other wildlife species.

12.5.2 Change in Mortality Risk

12.5.2.1 Project Pathways

Construction

There are several mechanisms by which Project construction may affect wildlife mortality risk. During construction, wildlife mortality can occur through collisions with vehicles or heavy machinery. During construction activities, there will be a relatively high level of traffic on the access road, and collisions could occur with many types of wildlife including (although not limited to) moose, bear, coyotes, voles and mice.

Site clearing activities could also result in mortality, particularly for young and immobile animals. For example, clearing mature trees could result in the destruction of a bat maternity colony and the subsequent mortality of young bats that are present. Vegetation removal could also destroy the nests of small mammals, such as voles.

The presence of people on site could result in human-wildlife conflicts. The presence of Project workers could result in increased hunting / harvesting activity. The presence of garbage on site could attract some animals, and wildlife can become dependent on garbage as a food source. Animals that become accustomed to people, particularly bears, can become a threat to human safety. The presence of pets on site could pose a threat to some wildlife species, including small mammals.

Operation

During Project operation, traffic is the primary mechanism for wildlife mortality. On-site traffic will increase due to ore hauling, and traffic on the access road will increase due to the transport of personnel, supplies and equipment. Mortality risk increases with increased vehicle speeds and will likely be highest along the access road. Mortality risk also varies temporally; for example, 75% of moose-vehicle collisions on the Island of Newfoundland occur between dusk and dawn, and 70% occur between June and October (Joyce and Mahoney 2001).

Wildlife mortality could result from the accidental release of toxic substances or wastes. Accidental events are discussed in Chapter 21. During the processing of mined ore, the ore is treated with a weak cyanide solution. Cyanide can be toxic to wildlife at certain concentrations; however, the Project has been designed so the use of cyanide will be entirely enclosed within the processing plant. Tailings will be treated to remove cyanide prior to disposal in the engineered TMF. The water in the TMF, tailings, sedimentation and polishing ponds could have exceedances of MDMER for total cyanide, unionized NH3 (product of cyanide decomposition), and copper (either added as a catalyst during cyanide destruction or leached from the ore). Ingestion and/or absorption of this water could affect mortality risk. Wildlife have been reported drinking from TMFs and associated ponds (Eisler and Wiemeyer 2004; Donato et al. 2007) and could also be exposed by ingesting aquatic flora and fauna within the TMF. The TMF embankments will be maintained free of vegetation, which will limit attraction of wildlife to the tailings pond and thereby limit the potential for exposure. If wildlife interactions with the TMF pond are determined to be a concern through ongoing monitoring initiatives, an adaptive management framework will be developed and implemented to identify additional mitigation measures that could be implemented (e.g., fencing). As required, effluent will be treated prior to discharge to the receiving environment to meet regulatory effluent criteria. As the greatest risk of mortality due to exposure to toxic substances or wastes is anticipated to be associated with accidents and malfunctions and is addressed in Chapter 21, the potential adverse effects from cyanide on wildlife during routine operation are not assessed further in this chapter.

The largest road associated with the Project (i.e., the access road) already exists and new roads developed for the Project will be within the mine site and public access will be restricted. The Project will therefore not include new roads that could facilitate hunter access into previously inaccessible areas and affect mortality risk through hunting. The Project will result in the increase in roads on the mine site and forest edges, which may increase access for predators. Some predators, including coyotes (Crête and Larivière 2003; Thibault and Ouellet 2005) and red foxes (Halpin and Bissonnette 1988; Frey and Conover 2006), may use roads for hunting and travel to reduce the energetic cost of locomotion, particularly if snow cover is deep.

The Project could affect the mortality risk of bats. Sensory disturbance from operation activities, such as excavation and blasting, have the potential to cause hibernating bats to arouse from torpor, which in turn could cause arousals in nearby bats (ECCC 2015). Repeated arousals could result in increased fat consumption and premature energy depletion, starvation, and reduced energy reserves for reproduction (ECCC 2015). Female reproductive success depends on spring fat reserves (Jonasson and Willis 2011), therefore a decrease in body condition during torpor could affect reproductive success. Additionally, white-nose syndrome results in more frequent arousals during hibernation (Verant et al. 2014; Cryan et al. 2010; ECCC 2015). As bats with white-nose syndrome have more frequent arousal episodes, the effects of arousals from disturbance within hibernacula with white-nose syndrome could be considerable (ECCC 2015).

Decommissioning, Rehabilitation and Closure

Wildlife mortality risk is predicted to be lower during decommissioning, rehabilitation and closure than during construction and operation. The risk of vehicle-wildlife collisions remains present during this Project phase, although traffic levels will be lower than during previous phases.

Wildlife mortality could occur during the removal of Project infrastructure. For example, if bats have established a maternity colony in a building, the destruction of the building could result in bat mortality, particularly for young bats that are not yet able to fly.

12.5.2.2 Residual Effects

The Project will result in changes to mortality risk, particularly during the construction and operation phases (Table 12.15). The primary pathways for change in mortality risk are through vegetation clearing and earthworks, vehicular collisions, human-wildlife conflicts, and predation.

Vegetation Clearing and Earthworks

Vegetation clearing has the potential to remove important habitat features, including dens, small mammal nests, and bat roosting trees. If these features are removed while animals are present, they could be injured or killed. Newborn or young animals are particularly vulnerable to this threat, as they may not be mobile, and therefore cannot move out of the way of vegetation clearing machinery. The risk of incidental mortality during vegetation clearing can be reduced through the application of timing windows. Mitigation that is in place for breeding birds (e.g., avoiding clearing during the breeding bird season) will also offer some protection to other breeding wildlife, on account of overlapping breeding seasons (Section 10.5). Mitigation will also include the identification of sensitive areas (e.g., bat roost trees) prior to construction, flagging these areas, and maintaining appropriate buffers, where feasible.

There is the potential for the Project to affect the mortality risk of bats. While there are no known hibernacula within the Project Area, it is possible that there are hibernacula within the Project Area. Effects of repeated disturbance to hibernating bats include arousals during torpor, which could affect body condition and possible survival. Additionally, as white-nose syndrome results in more frequent arousals, the effects of disturbance can be greater in hibernacula infected with white-nose syndrome.

Vehicular Collisions

Some accidental wildlife fatalities may occur through wildlife-vehicle collisions; however, such incidents are expected to be infrequent. Many factors influence rates of wildlife-vehicle collisions, including vehicle speeds, traffic volume, animal speeds, seasonality and time of day (Litvaitus and Tash 2008; Seiler 2003). During the construction period, Project-related traffic on the access road volume is anticipated to be six vehicles per day, with a peak of 18 vehicles per day on rotation change days. During operation, Project-related traffic will consist of five vehicles per day, with a peak of 10 vehicles per day on rotation change days (once a week). Most Project-related travel on the access road will occur during the daytime. Mitigation measures will be implemented to reduce overall traffic volumes. For example, multiple employees will be transported to site together on a bus during coordinated rotation changes. Project vehicles will be required to comply with posted speed limits on the access roads, haul roads and site roads. Speed limits will be set in accordance with provincial regulations and industry standards (e.g., for haul roads). While adherence to speed limits will likely reduce the risk of collisions for large mammals (Bertwistle 1999; Young and Vokurka 2007), it is uncertain whether this measure will also reduce the risk for small mammals, as they are more difficult to see and avoid. Overall, the application of mitigation measures is predicted to reduce the likelihood of wildlife-vehicle collisions.

Human-Wildlife Conflicts

The increase of human presence in the area may lead to human-wildlife conflicts. Adverse human-wildlife encounters may result from improper waste management (e.g., food, garbage, litter) and subsequent attraction of wildlife (e.g., bears, red foxes, coyotes) to the Project Area. Such situations can result in property damage, human injury, the development of wildlife dependence on human food sources, and lethal control of wildlife. A Project-specific Waste Management Plan will be implemented to address the collection, storage and transportation of waste, thereby reducing the likelihood of adverse human-wildlife conflicts.

Human-wildlife conflicts could also arise if pets (e.g., dogs) were to be brought to site. This could result in wildlife attraction, or unintended injury or mortality to wildlife. Personal pets will be prohibited on site, which will reduce the potential for human-wildlife conflict.

Predation and Harvest Pressure

The construction and / or upgrading of roads can increase access to the Project Area and LAA for both people and wildlife. Increasing access for people can result in increasing hunting pressure for furbearers and large game, including moose and black bear. To reduce this pressure, hunting / harvesting of wildlife will be strictly prohibited on the mine site. Workers will not be permitted to hunt / harvest while staying at the accommodations camp and will not be permitted to bring firearms or angling gear to site. Marathon will also implement traffic control measures, which may include gating approaches, and placing large boulders and/or gated fencing to restrict public access to the mine site.

Linear features like roads can result in increased access to interior habitat for predators, which can result in shifts in predator-prey relationships. The primary linear feature in the Project Area is the access road, which existed prior to the start of the Project. Although the existing road will be upgraded and used for site access, the Project is contributing few new roads to the area. Site access and predator-prey relations are therefore anticipated to be largely unchanged.

12.5.2.3 Summary

Successful implementation of the mitigation measures described in Section 12.4 is key to reducing the magnitude and duration of potential Project effects on mortality risk. After the implementation of these mitigation measures, the number of direct mortalities resulting from the Project is expected to be small relative to existing sources of mortality within the RAA, including from the existing access road. The magnitude of change in mortality risk is anticipated to be low in the construction and operation phases, and low to negligible during decommissioning. Effects are anticipated to be limited to the geographic extent of the Project Area and are expected to be short or medium term in duration. Mortality events are expected to occur at an irregular frequency. It is also important to note that the access road already exists, and as such may already cause some wildlife mortality through vehicle-wildlife collisions. Like other wildlife species, the magnitude of these effects is also anticipated to be low for SAR.

12.5.3 Summary of Project Residual Environmental Effects

Residual environmental effects that are likely to occur as a result of the Project are summarized in Table 12.23. The significance of residual adverse effects is considered in Section 12.6.

Overall, with the implementation of mitigation and management measures, residual effects on other wildlife (including SAR) are adverse. Residual effects to habitat are anticipated to be low in magnitude for all assessed species except marten, where the magnitude is anticipated to be moderate. Residual effects to mortality risk are anticipated to be low in magnitude. The duration of effects ranges from short term to long term, and the frequency of effects ranges from irregular to continuous, as shown in Table 12.23. While adverse effects on a change in mortality risk are anticipated to be reversible, change in habitat will be irreversible, as some vegetation communities are not expected to return to existing conditions following decommissioning, rehabilitation and closure, and some Project features (e.g., flooded open pits) will be permanent features on the landscape.

Table 12.23 Project Residual Effects on Other Wildlife

Residual Effect	Residual Effects Characterization							
	Project Phase	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological and Socio-economic Context
Change in Habitat	C	A	L-M	LAA	LT	C	I/R	D
	O	A	L-M	LAA	LT	C	R	D

Table 12.23 Project Residual Effects on Other Wildlife

Residual Effect	Residual Effects Characterization							
	Project Phase	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological and Socio-economic Context
	D	A	L-M	LAA	LT	C	R	D
Change in Mortality Risk	C	A	L	PA	MT	IR	R	D
	O	A	L	PA	MT	IR	R	D
	D	A	L-N	PA	ST	IR	R	D

KEY
See Table 12.14 for detailed definitions

Project Phase
C: Construction
O: Operation
D: Decommissioning

Direction:
N: Neutral
P: Positive
A: Adverse

Magnitude:
N: Negligible
L: Low
M: Moderate
H: High

Geographic Extent:
PA: Project Area
LAA: Local Assessment Area
RAA: Regional Assessment Area

Duration:
ST: Short term
MT: Medium term
LT: Long term
P: Permanent

N/A: Not applicable

Frequency:
S: Single event
IR: Irregular event
R: Regular event
C: Continuous

Reversibility:
R: Reversible
I: Irreversible

Ecological/Socio-Economic Context:
D: Disturbed
U: Undisturbed

12.6 DETERMINATION OF SIGNIFICANCE

The predicted residual environmental effects from the Project do not threaten the long-term persistence or viability of other wildlife species in the RAA, and are not contrary or inconsistent with the goals, objectives, and activities of recovery strategies, action plans and management plans. The residual effects to mortality risk are anticipated to be low in magnitude. The residual effects to habitat are anticipated to be low in magnitude for all species assessed, except marten, which is anticipated to have a moderate magnitude effect. Although Project-related activities may result in some adverse effects on other wildlife, including habitat loss through vegetation clearing, an increase in edge effects, sensory disturbance, and a potential increase in mortality events, these effects will be localized and will primarily occur during the construction and operation phases. The assessment of direct habitat loss assumes that all habitat in the Project Area will be lost. However, as vegetation will be retained in localized areas within the Project Area, the area of Project-related habitat loss is conservative. Most adverse effects are reversible after the Project has concluded (with the exception of change to habitat, which is irreversible, as some vegetation communities are not expected to return to existing conditions following decommissioning, rehabilitation and closure, and some Project features [e.g., flooded open pits] will be permanent features on the landscape) and will not threaten the long-term viability of wildlife species discussed in the chapter, including the three species of SAR (little brown bat, northern long-eared bat and American marten). With the application of mitigation and environmental protection measures, the residual adverse environmental effects on other wildlife are predicted to be not significant.

12.7 PREDICTION CONFIDENCE

The level of confidence in the predictions for Project-related residual effects on other wildlife is moderate to high. The predictions are based on information collected as part of desktop data compilation, and an understanding of existing conditions, GIS data analyses, understanding of Project activities, baseline studies in the area, the known effectiveness of mitigation measures, and experience of the assessment team. The level of confidence for the prediction is moderate (and not high) because habitat requirements and use in the Project Area are not fully understood for all other wildlife species. For example, it is not known if bats hibernate in the Project Area or LAA. Ecological processes are complex, which adds some uncertainty to the confidence level of predictions. However, a conservative approach was employed to identify suitable wildlife habitat and predict habitat loss, and this compensates for some uncertainty. Habitat occurrence and loss was mapped using available GIS data, which allowed for a detailed quantitative analysis. Many of the mitigation measures identified in Section 12.4 are standard practice and have been implemented and demonstrated to be effective in previous mining projects.

12.8 PREDICTED FUTURE CONDITION OF THE ENVIRONMENT IF THE UNDERTAKING DOES NOT PROCEED

The Project is located in an area with previous mining activity and ongoing forestry and mineral exploration, and it is possible that other mining projects would occur in this area if this Project were not to proceed. It can be anticipated that future projects would result in similar effects on wildlife. Should mineral reserves associated with the Project remain undeveloped, the predicted future condition of other wildlife would be relatively unchanged from what is discussed in the existing environment portion of this assessment (Section 12.2). Wildlife populations vary over time because of natural processes including fire, disease, population and community dynamics, and major weather events. Major changes in wildlife populations, communities and distribution could occur over time as a result climate change.

There are three SAR discussed in this chapter: two species of bat (little brown and northern long-eared), and marten. The largest threat to bat populations on the Island of Newfoundland is currently white-nose syndrome. The effects of white-nose syndrome combined with Project-related disturbance could have a greater effect of bat body condition and subsequent survival. Marten face multiple threats, including habitat loss and trapping. The Project Area and LAA overlap a small portion of the proposed designated critical habitat for this species (41.8 km^2 of proposed critical habitat occurs in the LAA, accounting for 6.7% of the total critical habitat of 6,200 km^2). If the Project were to not proceed, that habitat may not be disturbed.

12.9 FOLLOW-UP AND MONITORING

Follow-up and monitoring programs will be conducted for bats and for marten. Baseline surveys for bats have not yet been conducted and, as recommended by the NLDFFA-Wildlife Division (Government of NL 2020c), acoustic monitoring for bats will be conducted in the Project Area and LAA both before and during construction and during operation. The purpose of these surveys will be to gather information on bat presence in the area. Marathon will continue to consult with NLDFFA-Wildlife Division in planning and conducting these baseline studies prior to Project construction. While acoustic monitors can confirm the presence of bats, they cannot provide information on the presence of important habitat features, including maternity roosts and hibernacula. However, acoustic surveys can provide information on which species are present, general habitat use, and seasonal variation of bat occurrence.

The follow-up program for marten will include conducting hair snag trap surveys. These surveys were conducted at three sites during the winters of 2013 and 2018 to obtain baseline information of marten presence in the area. These surveys will be repeated during construction and operation, and again during or after decommissioning, to assess changes in marten presence compared to existing conditions. If feasible, the same three locations will be surveyed to allow for a direct comparison.

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