20.0 CUMULATIVE EFFECTS ASSESSMENT

Cumulative effects result from of the interaction of effects of multiple past, present and future projects and/or activities on a particular component of the environment. Section 19(1)(a) of the *Canadian Environmental Assessment Act, 2012* requires that an environmental assessment (EA) of a designated project "must take into account cumulative environmental effects that are likely to result from the designated project in combination with other physical activities that have been or will be carried out". This chapter evaluates residual environmental effects of the Project (as assessed in Chapters 5 to 19) in the context of residual effects from past, present, ongoing and certain or reasonably foreseeable future physical activities (i.e., project or activities), to determine the potential for cumulative effects.

20.1 SCOPE AND METHODS

The approach used for conducting the cumulative effects assessment for the Project is described in the Canadian Environmental Assessment Agency's (CEAA) *Operational Policy Statement (OPS) for Assessing Cumulative Environmental Effects under the Canadian Environmental Assessment Act, 2012*, *Technical Guidance for Assessing Cumulative Environmental Effects under the Canadian Environmental Assessment Act,* 2012, and the Federal Environmental Impact Statement (EIS) Guidelines (Appendix 1A) and Provincial EIS Guidelines (Appendix 1B).

The effects of past and current projects contribute to existing conditions upon which Project effects are assessed (Chapters 5 to 19). Therefore, the focus of the cumulative effects assessment is on the combination of residual Project effects with the residual effects of reasonably foreseeable future projects and activities.

Two conditions must be met to initiate an assessment of cumulative effects on a valued component (VC):

- The Project is predicted to have adverse residual environmental effects on a VC
- The adverse residual effects from the Project overlap spatially and/or temporally with residual effects of other physical activities on a VC

If either condition was not met, an assessment of cumulative environmental effects was not completed. If the two conditions were met, then an assessment of cumulative effects on the VC was initiated. To determine if these two conditions were met, the following steps were completed:

- Selecting VCs for the cumulative effects assessment
- Defining the spatial and temporal boundaries of the assessment
- Identifying other past, present, ongoing, and future (i.e., certain or reasonably foreseeable) physical activities in the cumulative effects Regional Assessment Area (RAA) where residual environmental effects have potential to overlap spatially and/or temporally with those of the Project
- Where there is a spatial and/or temporal overlap, initiate a cumulative effects assessment by:
  - identification / estimation of potential cumulative environmental effects
  - identification of additional mitigation measures, if required

- determination of significance of potential adverse residual cumulative environmental effects
- identification of follow-up, if required

20.1.1 Identification of Valued Components

The cumulative effects assessment builds on the Project-specific residual effects assessments presented in Chapters 5 to 19. This information is necessary to identify potential effects on VCs that might act cumulatively with the effects of other physical activities. Adverse residual effects were predicted for all VCs (Chapters 5 through 19), and therefore, a cumulative effects assessment has been completed for each VC in accordance with the Federal EIS Guidelines. These VCs are:

- Atmospheric Environment
- Groundwater Resources
- Surface Water Resources
- Fish and Fish Habitat
- Vegetation, Wetlands, Terrain and Soils
- Avifauna
- Caribou
- Other Wildlife
- Community Services and Infrastructure
- Community Health
- Employment and Economy
- Land and Resource Use
- Indigenous Groups
- Historic Resources

Dam Infrastructure was selected as a VC for assessment in the EIS; however, as discussed in Chapter 19, residual adverse effects from the Project are predicted to be negligible. Therefore, given the VC is not anticipated to result in residual effects, a cumulative effects assessment on Dam Infrastructure is not required.

20.1.2 Spatial and Temporal Boundaries

The OPS (CEA Agency 2015) requires determination of spatial and temporal boundaries for the cumulative effects assessment, and suggests that spatial boundaries encompass potential environmental effects on the selected VC of the designated project in combination with other physical activities that have been or will be carried out. Temporal boundaries should consider future physical activities that are certain or reasonably foreseeable, and the degree to which potential environmental effects of these physical activities will overlap those predicted from the designated project.

The spatial boundaries for the assessment of cumulative environmental effects takes into consideration, for each VC, the Project Area, Local Assessment Area (LAA), and RAA as defined in the respective VC chapters (Chapters 5 to 19). Additionally, a cumulative effects RAA has been developed to encompass the other physical activities outside of the Project Area that have potential to interact cumulatively with the Project, as well as to account for the larger movements and distributions of the various biological and

socio-economic components. As discussed further in Section 20.1.3, the cumulative effects RAA (Figure 20-1) selected for the cumulative effects assessment encompasses the largest extents for each VC, with the exception of Employment and Economy VC, which uses a separate boundary to encompass NL.

Temporal boundaries for the assessment describes the timing and duration of Project activities during the Project construction, operation, and decommissioning, rehabilitation and closure. Timing of these phases is detailed in Section 2.2.6. These temporal boundaries are also appropriate for the cumulative effects assessment.

20.1.3 Sources of Potential Cumulative Effects

In accordance with the cumulative effects OPS (CEA Agency 2015), the cumulative effects assessment includes consideration of other physical activities that have been (past), are being (present and ongoing), and will be carried out (future) in the cumulative effects RAA. The OPS acknowledges that, “present-day conditions reflect the cumulative effects of many past and existing physical activities” (CEA Agency 2015). Existing conditions characterizations in Chapters 5 to 19 are therefore assumed to reflect effects from past and existing physical activities within their respective RAAs. Based on this assumption, the assessment of residual effects on VCs in Chapters 5 to 19 generally considers the effects from these past and existing physical activities. Thus, this assessment focuses on the combination of the Project-specific residual effects with the residual effects of ongoing and future physical activities; however, a summary of past and present interactions from physical activities is provided for each VC to demonstrate the completeness of the cumulative effects assessment.

With respect to future physical activities that will be carried out, the assessment considers (CEA Agency 2015):

- Future physical activities that are certain, meaning, the physical activity will proceed, or there is a high probability that the physical activity will proceed. For example, a proponent has received the necessary authorizations or is in the process of obtaining those authorizations.
- Future physical activities that are reasonably foreseeable, meaning the physical activity is expected to proceed. For example, a proponent has publicly disclosed its intention to seek the necessary EA or other authorizations to proceed.

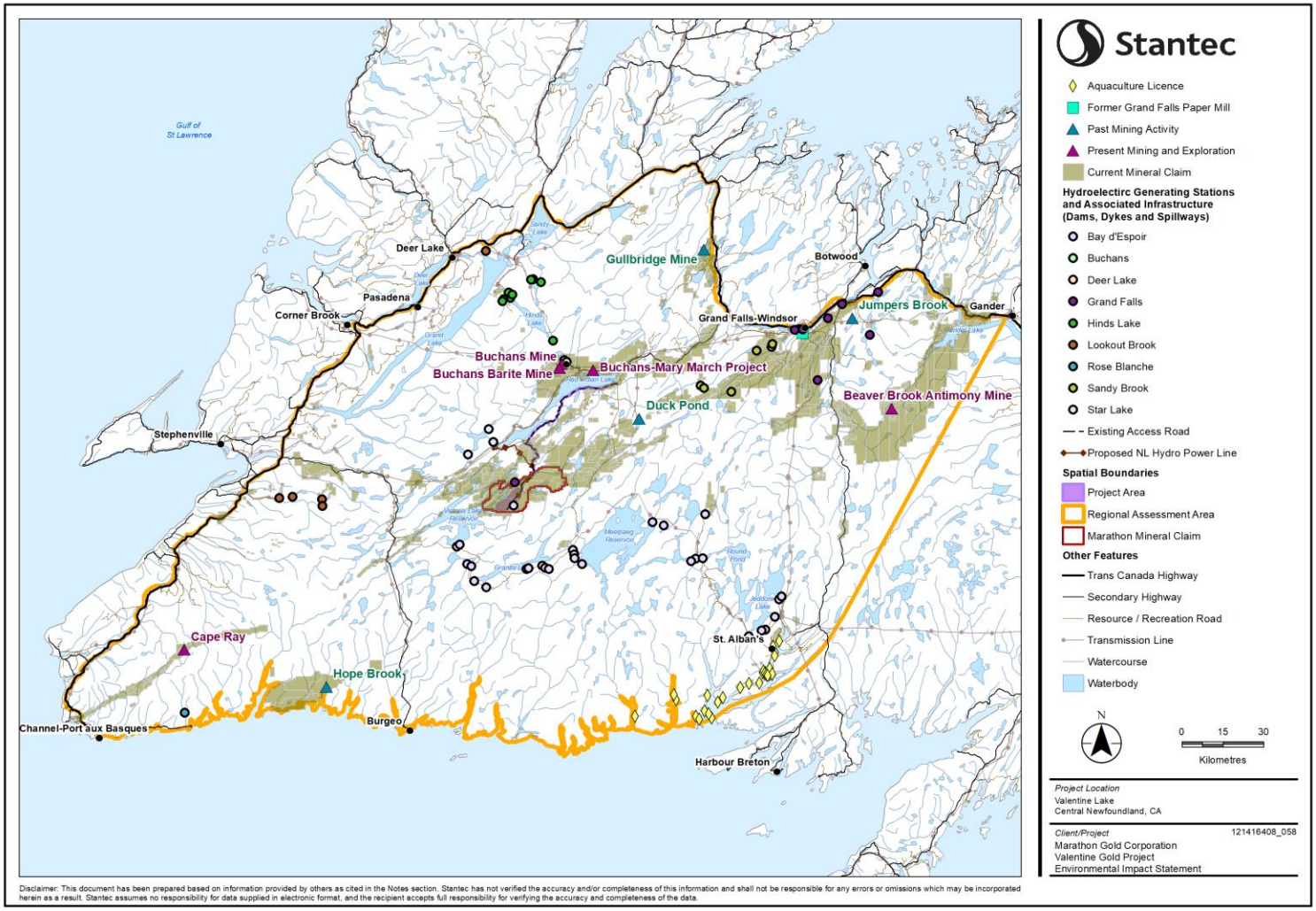

Figure 20-1 Other Projects and Activities Considered in the Cumulative Effects Assessment

The other past, present, ongoing and future physical activities considered in this assessment are identified in Table 20.1 and shown in Figure 20-1. These are considered in this cumulative effects assessment as they may have already influenced the existing conditions of the VCs being assessed (i.e., past and present physical activities) or may result in residual environmental effects (i.e., ongoing and future physical activities) that could interact cumulatively with (i.e., overlap spatially and temporally with) the residual environmental effects of the Project within the cumulative effects RAA. Past, present, ongoing and future projects and activities are identified based on government sources, local knowledge and desktop research. The list of reasonably foreseeable future projects and activities is based on information available up to August 2020. The identification and selection of specific projects and activities was based on a conservative assumption that a potential interaction may exist due to the nature of that activity, the surrounding environment, and the VCs assessed. The RAA selected for the cumulative effects assessment (Figure 20-1) encompasses the largest extent of the various VC RAAs to capture the potential cumulative effects, with the exception of Employment and Economy RAA, which covers the entire province as discussed in Section 20.12. Due to the large geographic extent of the cumulative effects RAA, not all the projects and activities in Table 20.1 will be relevant to each VC. Therefore, the cumulative effects assessment for each VC will determine which projects and activities have the potential to contribute to Project-specific residual effects resulting in a cumulative effect on that VC.

Table 20.1 Other Projects and Activities Considered in the Cumulative Effects Assessment

Project name or Physical Activity	Description	Approximate Direct Distance to the Mine Site	Status / Timing
Past or Present Project or Activities That Have Been Carried Out			
Mining and Exploration Mining is one of the largest and oldest industries in NL with the history of mining in the cumulative effects RAA dating back to prospecting activities in 1905, and construction of the first base metals (copper, zinc and lead) mine in 1926 by the Buchan Minerals Corporation. A summary of past or present mining and exploration activities that have been or are occurring in cumulative effects RAA is provided below.			
Buchans Barite Plant	• Between 1982 and 1984 Asarco, in addition to its mining operations, operated a barite plant (Buchans Barite Plant) supplying drilling mud to oil and gas exploration activities occurring off NL's coast (Barite Mud Services Inc. 2014) • The plant closed in 1984 (Barite Mud Services Inc. 2014)	47 km	Closed
Barite Mud Services (Former Buchans Mine Tailings Processing)	• Barite Mud Services Inc. recovers barite from the tailings remaining from past mining operations • In 2005, Atlantic Barite Ltd. began seasonal (May-October) operation at the Buchans barite plant suppling the oil and gas industry. Atlantic Barite Ltd. employed an annual average of 11 workers (Department of Natural Resources [DNR] n.d.) • By 2009, Atlantic Barite Ltd. had ceased its barite operation. In 2014, Barite Mud Service Inc. resumed seasonal operation at the Buchans barite plant • Barite Mud Services currently employs 18 workers	47 km	Ongoing / Seasonal

Table 20.1 Other Projects and Activities Considered in the Cumulative Effects Assessment

Project name or Physical Activity	Description	Approximate Direct Distance to the Mine Site	Status / Timing
Buchans Mine	• The construction of the Buchans mine was the first base metals (copper, zinc, and lead) mine in NL. It was opened in 1926 by the Buchans Minerals Corporation • Over 400 workers were employed during the early phases of mine / town development • Ore was produced from the first site 'Lucky Strike' in 1928 (Heritage NL 2020) • Continuous mining occurred in the area (at various sites – 'Lucky Strike', 'Oriental', 'Old Buchans', 'Rothermere' and 'MacLean') by various companies up until 1984 • Operations were substantially reduced in the mid-1970s with eventual closure in 1983 (Heritage NL 2020)	48 km	Closed
Buchans-Mary March Project	• The Buchans-Mary March Project is located 20 km northeast of, and within the same geological group of the former producing Buchans Mine • It is comprised of several contiguous properties, totaling approximately 39,000 ha • Phase I of a drill program was conducted in 2019 by Canstar and consisted of 1,901 m in five drill holes as well as downhole electromagnetic surveys on three of the five holes (Canstar Resources Inc. n.d.) • Further geochemical and geophysical studies are anticipated for this site	51 km	Exploration ongoing
Duck Pond Mine	• Duck Pond copper and zinc mine located near Millertown was the Island's largest underground mine, • Construction began in 2005 of the 'Duck Pond' copper-zinc mine • Construction of the Duck Pond mine in 2005 employed more than 200 workers while annual operations (2006-2015) employed more than 300 workers, with a peak workforce of roughly 400 workers in 2013 (Teck Resources Limited [Teck] 2001; Canadian Mining Journal 2013) • Teck ceased mining operation at Duck Pond in 2015 and decommissioning phases are ongoing, employing an annual average of nine persons	51 km	Operation ceased, in closure and rehabilitation phase
Hope Brook Mine	• The Hope Brook Project is a gold mine located 20 km west of Burgeo, Newfoundland and Labrador (NL) • The Hope Brook deposit was mined from 1987 to 1997 with a total production reported to be 752,163 ounces of gold • Copper concentrate was mined from 1993 to 1997 • In 2002, the Hope Brook mine site was returned to the Province (DNR n.d.)	91 km	Operation ceased, under the care of the Province
Gullbridge Mines	• Copper mine which operated from 1967 to 1971 by North American Talc Company • The mine was located near Gull Pond • The estimated annual employment was 205 people (DNR n.d.)	111 km	Closed

Table 20.1 Other Projects and Activities Considered in the Cumulative Effects Assessment

Project name or Physical Activity	Description	Approximate Direct Distance to the Mine Site	Status / Timing
Jumpers Brook - Terra Nova Granite (2007) Inc.	• Located at Jumpers Brook near Bishop's Falls in central NL • Produced blank monuments, architectural and landscape products, and countertop slabs mainly for export markets • Employed approximately 20 people at peak in 2010 • Operation is currently shut down (DNR n.d.)	137 km	Closed
Beaver Brook Antimony Mine	• Operation restarted in March 2019 after being placed on care and maintenance when operations were suspended in January 2013 • At full production, 160,000 tonnes of antimony ore will be mined per year and processed into stibnite concentrate (Government of NL 2019a) • The mine's expected life span is three and a half years • Generated approximately 101 person years of employment in 2019 (Government of NL 2019a)	139 km	Ongoing
Mineral Exploration	• Mineral exploration is a key indicator of the long-term viability of the mining industry as it leads to the discovery and subsequent development of mineral deposits (Natural Resources Canada [NRCan] 2020) • At the time of writing approximately 100 mineral exploration companies were active in NL • In addition to Marathon Gold, major mining exploration companies within the cumulative effects RAA include: Buchans Resources, NorZinc, Prominex / Buchans Resources, Spruce Ridge Resources, Antler Gold, Sokoman Iron, Moosehead, Matador Mining, First Gold Mining, Quadro Resources, Mountain Lake Minerals, and Silvertip Exploration (Government of NL 2019b)	N/A	Ongoing
Other			
Forestry	• Forestry, for the first 400 years, was used to support the fishery as wood was used for fuel, boat building, and the construction of stages and flakes used for splitting, salting, and drying codfish (Newfoundland and Labrador Department of Fisheries and Land Resources [NLDFLR] n.d.a.) • Forestry has been an integral part of the NL economy and a substantial portion of the province's forestry industry was once concentrated in the central area of the Island of Newfoundland to support the construction of the trans-island railway which was completed in 1898 • Most of Newfoundland's productive forest consists of softwood species, including balsam fir and black spruce • The province of NL is divided into 24 Forest Management Districts (FMDs), the Project Area is located within two FMDs, FMD 12 and 13 • Management of forestry activities include timber harvesting, construction of forest access roads, and silviculture activities such as planting, thinning, and site preparation	N/A	Ongoing

Table 20.1 Other Projects and Activities Considered in the Cumulative Effects Assessment

Project name or Physical Activity	Description	Approximate Direct Distance to the Mine Site	Status / Timing
	• Based on the five-year plan for FMDs 12 and 13 (2016-2020), it is planned for 1,400,000 m³ of timber to be harvested from FMD 12 and approximately 140 km of forestry access road to be constructed (Government of NL n.d.a.) • For FMD 13, it is planned that 150,000 m³ of timber will be harvested and approximately 12 km of forest access road will be constructed • Within the cumulative effects RAA, there has been forestry activity, including the construction of extensive forestry access roads		
Abitibi-Consolidated Inc. Mill	• Abitibi-Consolidated Inc.'s mill at Grand Falls-Windsor began operating in 1909 and closed in 2009 (CBC 2008) • The land area surrounding the mill site has since been expropriated and is managed by the Crown • The province issued a Call for Expressions of Interest in 2013 to develop these unallocated timber resources and although the formal process of the Call for Expressions has concluded, the provincial government continues to consider proposals from other proponents for this region (Newfoundland and Labrador Department of Finance [NLDF] 2016)	119 km	Closed
Hunting and Outfitting	• Hunting provides recreational opportunities for residents and non-residents, and contributes to the province's wildlife management programs and economy through local spending, and the outfitting industry (NLDFLR 2019a) • Primary species of interest for hunting are moose, caribou, black bear, small game (e.g., snowshoe hare) and migratory birds (e.g., geese, ducks and snipe)	N/A	Ongoing
Trapping	• A variety of furbearer species that are subject to trapping activity are found in the area	N/A	Ongoing
Angling / Fishing	• Inland waters are divided into scheduled salmon rivers, scheduled rainbow and brown trout waters, and non-scheduled inland waters • Angling occurs on a number of waterbodies in the cumulative effects RAA, mainly for salmon and brook trout, however, Arctic char are also targeted on select waterbodies • Recreational salmon fishing occurs within the cumulative effects RAA, however, only catch-and-release, Class 0 salmon rivers are present within the RAA • The Exploits River has the highest runs of sea-run Atlantic salmon in Newfoundland (Veinott et al. 2018). The lower river and tributaries from Grand Falls down to the river mouth are commonly used for salmon angling • The cumulative effects 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	N/A	Ongoing / Seasonal

Table 20.1 Other Projects and Activities Considered in the Cumulative Effects Assessment

Project name or Physical Activity	Description	Approximate Direct Distance to the Mine Site	Status / Timing
Aquaculture	• The aquaculture industry in NL began in the late 1800s, with modern aquaculture attempts in the 1970s (Newfoundland and Labrador Fisheries and Aquaculture 2014) • NL's aquaculture industry is focused on the following species: steelhead trout, Atlantic salmon, blue mussels, and Atlantic cod (NLDFLR n.d.b.) • Within the cumulative effects RAA, aquaculture activity occurs along the southern coast, with 27 aquaculture licences in the cumulative effects RAA • The nearest aquaculture license is 89 km from the Project Area	89 km	Ongoing / Seasonal
Off-road Vehicles (Snowmobiling and ATV)	• The use of off-road vehicles occurs in the cumulative effects RAA on official trails as well as unofficial use of Crown and private lands (typically along forestry roads and power lines) in the cumulative effects RAA for recreational purposes • The use of snowmobiles and all-terrain vehicles (ATVs) is regulated by the *Motorized Snow Vehicles and All-Terrain Vehicles Act* and the *Motorized Snow Vehicles and All-Terrain Vehicles Regulations* • Snowmobiling occurs throughout the Island of Newfoundland. The Newfoundland and Labrador Snowmobile Federation (NLSF) is the provincial governing body with 12 to 20 volunteer clubs across the island responsible for the maintenance of 3,300 km of trails (NLSF 2020) • There are two groomed snowmobile trails in the cumulative effects RAA leading to the communities of Buchans and Millertown • The T'Railway Provincial Park (located within the cumulative effects RAA) stretches almost 900 km, from St. John's to Port aux Basques along the main line of the old abandoned Canadian National railbed, and ATVs and snowmobiles are allowed on the T'Railway for access and year-round enjoyment	N/A	Ongoing / Seasonal
Hydroelectric Development	• The cumulative effects RAA is an area of substantial hydroelectric development, with the following hydroelectric generating stations in the cumulative effects RAA: – Bay d'Espoir – Buchans – Deer Lake – Grand Falls – Hinds Lake – Lookout Brook – Rose Blanche – Sandy Brook – Star Lake	500 m (Victoria Dam and Reservoir)	Ongoing

Table 20.1 Other Projects and Activities Considered in the Cumulative Effects Assessment

Project name or Physical Activity	Description	Approximate Direct Distance to the Mine Site	Status / Timing
	• The closest development to the Project is the Victoria Dam and Victoria Lake Reservoir, which are part of the Bay d'Espoir Hydroelectric Development and are located 500 m from the Project Area		
Existing Linear Features (i.e., highways / roads and power lines)	• Linear activities such as highways, roads and power lines occur throughout the cumulative effects RAA, including extensive forestry roads • There are primary roads in Buchans and Millertown, and provincial highways connect Millertown and Buchans to the Trans-Canada Highway • The Trans-Canada Highway (Route 1) goes directly through Grand Falls-Windsor • There is ongoing maintenance and upgrades to roads within the cumulative effects RAA (Section 13.2.2.8)	N/A	Ongoing
Future Project or Activities That Will Likely Be Carried Out			
Cape Ray Gold Project	• Located near Channel-Port aux Basques, NL • Matador Mining Ltd. proposes to construct, operate, decommission, and reclaim a gold / silver mine and milling complex (Nordmin Resource and Industrial Engineering Ltd. [Nordmin] 2016) • Production capacity will be approximately 600 t/d from underground operations and 1,500 t/d from open pit mining (Nordmin 2016) • It is estimated that the project will create approximately 100 to 150 jobs (at peak) during construction and approximately 30 full-time jobs during operation (Nordmin 2016)	126 km	Currently under environmental regulatory review process. Scheduled to operate from receipt of approval for six years.
Buchans Resources Limited Project	• On March 1, 2019 Buchans Resources Limited (Buchans) announced a new Mineral Resource Estimate for its Lundberg base metal deposit, located at the former Buchans Mine (Lucky Strike deposit) (Government of NL 2019a) • A NI 43-101 Technical Report was filed in April 2019, reporting a resource of more than 1.25 billion pounds zinc equivalent (Government of NL 2019a)	48 km	A new updated Preliminary Economic Assessment or a Preliminary Feasibility Study is being considered; specific timing unknown.
NL Hydro Power Line from Star Lake to the Project Area	• A power line from Star Lake to the mine site will be required for the Project and will be constructed and operated by NL Hydro • It will be subject to separate environmental approvals with NL Hydro as the proponent	Route to be determined	To be developed in 2022 in support of the Project

20.1.4 Assessing Cumulative Effects on Each Valued Component

20.1.4.1 Assessment Approach

VCs predicted to have adverse residual effects are carried through the cumulative effects assessment to determine if there is potential to interact with other physical activities and/or projects and to assess and characterize cumulative residual effects. The cumulative effects assessment includes the following steps:

- Description of Past and Ongoing Effects: This step considers the current (existing) condition of the VC, including past natural or anthropogenic factors which may have affected the VC's current condition.
- Potential Project-related Contributions to Cumulative Effects: This step describes the potential Project-related residual environmental effects that are assessed in Chapters 5 through 19, which may contribute to cumulative effects.
- Future Projects and Their Effects: This step provides an overview of the potential effect pathways associated with past, present and other certain, or reasonably foreseeable future physical activities in the cumulative effects RAA, and consideration of the spatial and temporal characteristics of these potential residual effects on each relevant VC. Should no spatial and/or temporal interactions be identified between the VC and past, present and other certain, or reasonably foreseeable future physical activities in the cumulative effects RAA, no further assessment is required for the VC.
- Potential Cumulative Environmental Effects: This step is the assessment of residual effects from the Project combined with other projects and activities. The assessment considers the context for cumulative environmental effects in the RAA, the nature and extent of the potential cumulative interactions, and technically and economically feasible mitigation measures that Marathon will implement to avoid or reduce potential residual effects (including cumulative). Residual cumulative environmental effects are characterized through application of the specific analysis criteria (i.e., magnitude, geographic extent, duration, frequency, reversibility and context) defined for each VC in its respective VC analysis chapter.
- Cumulative Effects Summary and Evaluation: Cumulative effects are summarized and evaluated for each VC.

20.1.4.2 Mitigation and Follow-up

Mitigation, monitoring and follow-up requirements are presented as appropriate, to reduce adverse cumulative environmental effects. This includes mitigation to be implemented by Marathon to reduce Project-related residual effects, as well as measures required by Marathon and other parties to reduce the contribution of effects from other projects and activities. Information on other projects and activities, their known or likely environmental effects, and planned mitigation measures has been obtained through existing and publicly available information sources, as well as relying on the professional experience of the EIS study team. The cumulative effects assessment considers the nature, location, and timing of these other projects, and their environmental effects in relation to the Project, as well as environmental protection measures that are known and/or required to be implemented in relation to them, including those required under applicable legislation, regulations and other requirements.

20.1.4.3 Determination of Significance

The significance of potential cumulative environmental effects is determined based on the same VC-specific thresholds used for the assessment of Project-related environmental effects in Chapters 5 to 19.

20.2 ATMOSPHERIC ENVIRONMENT

20.2.1 Past and Ongoing Effects

Existing conditions of the atmospheric environment within the Project Area and the LAA for the Atmospheric Environment VC, which would include past and ongoing effects, is provided in Chapter 5 (Section 5.2) and summarized below.

The mine site is in a remote area with limited human activity, and no substantive anthropogenic sources of air emissions, greenhouse gases (GHGs), noise or light occur within 50 km, with the exception of ongoing exploration work within the Project Area. The mine site is located approximately 49 km southwest of the Town of Buchans and 60 km southwest of the Town of Millertown. Within the LAA, there are approximately 35 seasonal dwellings (three active outfitters, two inactive outfitters and 30 cabins), which represent the nearest sensitive receptors to the Project Area.

Based on a review of Environment and Climate Change Canada's (ECCC's) National Pollutant Release Inventory (NPRI) data for the Island of Newfoundland, the nearest emissions sources to the mine site consist of two mines and the Corner Brook Pulp and Paper Mill. The two mine sites include the Teck Resources Duck Pond Mine and Barite Mud Services and are located approximately 57 km and 41 km northeast of the mine site, respectively. The Duck Pond Mine is no longer operational and is in the closure and rehabilitation phase, while Barite Mud Services is operational on a seasonal basis. Although both sites are no longer fully operational, potential exists for fugitive dust to be generated at each site. In addition, decommissioning activities are ongoing at the Duck Pond Mine, which could result in further fugitive dust emissions. The Corner Brook Pulp and Paper Mill is located approximately 90 km to the northwest of the mine site (outside of the cumulative effects RAA). Based on NPRI reporting data, substantive air contaminant emissions from the pulp and paper mill consist of combustion gases (NO_X, CO and SO_2), particulate matter, volatile organic compounds (VOCs) and selected trace metals.

Ambient air quality data collected near the Project Area by Stantec, by industry operating in NL, and by ECCC through the National Air Pollution Surveillance (NAPS) Program, show existing levels (near the Project Area) of NO_X, CO, SO_2, particulate matter, and selected trace metals to be low and well below ambient air quality standards. As there are also no existing local GHG emission sources that require reporting to ECCC through the National Greenhouse Gas Reporting Program within or nearby the Project Area, existing levels of GHGs in the Project Area are characterized by summarizing provincial and national inventory data. Emissions of GHGs were 11,000 kt CO_{2e}/year and 729,000 kt CO_{2e}/year for NL and Canada, respectively, during 2018 (ECCC 2020).

Existing sound pressure levels near the Project Area are representative of a quiet rural (L_{dn}< 45 dBA) to quiet suburban (L_{dn} 48 – 52 dBA) area, with limited to no existing sources of noise. Data (L_{dn}) measured near the Project Area ranged from 46.9 dBA to 47.4 dBA.

There are essentially no existing sources of artificial light contributing to the existing ambient light environment within the Project Area. Measurements of incident light and sky glow collected within the Project Area were less than 0.01 lux and between 21.84 to 22.81 mag/arc sec^2, respectfully. Based on the collected data, the existing ambient light environment within and surrounding the Project Area is considered a dark, rural environment representative of an unpolluted starry sky (Berry 1976; CIE 2017).

20.2.2 Potential Project-Related Contributions to Cumulative Effects

As described in Chapter 5, routine Project activities have the potential to change local air quality, atmospheric GHGs, sound levels, and lighting levels. The operation of heavy equipment, travel on unpaved roads, movement and handling of material, operation of site infrastructure, blasting, and use of exterior lighting during each Project phase has the potential to interact with the existing atmospheric environment. The Project, therefore, has potential to result in the following residual effects on the atmospheric environment:

- A change in air quality
- A change in atmospheric GHGs
- A change in sound quality
- A change in lighting

The Project-specific effects assessment for this VC includes a summary of residual environmental effects in Section 5.5 and the determination of significance in Section 5.6.

With the implementation of mitigation (Section 5.4), the effects of routine Project-only activities on the atmospheric environment are predicted to be not significant.

20.2.3 Other Projects and Activities and Their Effects

Table 20.2 summarizes past, present, ongoing, and future projects and activities in the cumulative effects RAA that have potential to cause a change in air quality, atmospheric GHGs, sound levels, and lighting levels, thereby affecting the atmospheric environment.

Table 20.2 Atmospheric Environment: Residual Effects from Other Projects and Activities in the Cumulative Effects RAA

Physical Activity	Potential Effects on this VC from Other Projects / Activities	VC-Specific Spatial / Temporal Considerations and Effect Pathways
Past, Present, and Ongoing Projects / Activities		
Mining and Exploration	• Change in atmospheric GHGs	• Project-related GHG emissions (presented in Chapter 5) have the potential to cumulatively increase atmospheric GHG emissions with the GHG emissions from other mining and exploration activities • Project-related residual effects on air quality, sound quality and lighting (presented in Chapter 5) consider past, present and ongoing activities. Therefore, there is no potential for further interaction.

Table 20.2 Atmospheric Environment: Residual Effects from Other Projects and Activities in the Cumulative Effects RAA

Physical Activity	Potential Effects on this VC from Other Projects / Activities	VC-Specific Spatial / Temporal Considerations and Effect Pathways
Forestry	• Change in atmospheric GHGs	• Project-related GHG emissions (presented in Chapter 5) have the potential to cumulatively increase GHG emissions from the area combined with the GHG emissions from forestry activities. • Project-related residual effects on air quality, sound quality and lighting (presented in Chapter 5) consider past, present and ongoing activities. Therefore, there is no potential for further interaction.
Hunting, Outfitting, Trapping, and Fishing	• N/A	• Hunting, outfitting, trapping and fishing have negligible air, GHG, noise emissions and light levels, and would not be distinguishable from baseline. Therefore, there is no potential for a cumulative interaction.
Aquaculture	• N/A	• Activities and projects associated with aquaculture have negligible air, GHG, noise emissions and light levels, and would not be distinguishable from baseline. Therefore, there is no potential for a cumulative interaction.
Off-road Vehicles (Snowmobiling and ATV)	• N/A	• Off-road vehicles have negligible air, GHG, noise emissions and light levels and would not be distinguishable from baseline. Therefore, there is no potential for a cumulative interaction.
Hydroelectric Developments	• Change in atmospheric GHGs	• Project-related GHG emissions (presented in Chapter 5) have the potential to cumulatively increase GHG emissions from the area combined with the GHG emissions from hydroelectric development. • Project-related residual effects on air quality, sound quality and lighting (presented in Chapter 5) consider past, present and ongoing activities related to hydroelectric development. Therefore, there is no potential for further interaction.
Existing Linear Features (i.e., highways / roads and power lines)	• Change in atmospheric GHGs	• Project-related GHG emissions (presented in Chapter 5) have the potential to cumulatively increase GHG emissions from the area combined with the GHG emissions from exiting linear facilities. • Project-related residual effects on air quality, sound quality and lighting (presented in Chapter 5) consider past, present and ongoing activities related to existing linear features. Therefore there is no potential for further interaction.

Table 20.2 Atmospheric Environment: Residual Effects from Other Projects and Activities in the Cumulative Effects RAA

Physical Activity	Potential Effects on this VC from Other Projects / Activities	VC-Specific Spatial / Temporal Considerations and Effect Pathways
Future Projects / Activities		
Cape Ray Gold Project	• Change in atmospheric GHGs	• Project-related GHG emissions (presented in Chapter 5) have the potential to cumulatively increase GHG emissions from the area combined with the GHG emissions from the Cape Ray Gold Project • Project-related residual effects on air quality, sound quality and lighting (presented in Chapter 5) will not overlap spatially with the Cape Ray Gold Project, and therefore there is no potential for a cumulative interaction.
Buchans Resources Limited Project	• Change in atmospheric GHGs	• Project-related GHG emissions (presented in Chapter 5) have the potential to cumulatively increase GHG emissions from the area combined with the GHG emissions from Buchans Resources Limited Project. • Project-related residual effects on air quality, sound quality and lighting (presented in Chapter 5) will not overlap spatially with the Buchans Resources Limits, and therefore there is no potential for a cumulative interaction.
NL Hydro Power Line from Star Lake to the Project Area	• Change in atmospheric GHGs • Change in Air Quality • Change in Sound Quality • Change in Light Levels	• Project-related GHG emissions (presented in Chapter 5) have the potential to cumulatively increase GHG emissions from the area combined with the GHG emissions from construction of the NL Hydro Power Line. GHG emissions are not expected to be released during operation of the NL Hydro Power Line. • Project-related residual effects on air quality, sound quality and lighting (presented in Chapter 5) have the potential to spatially and temporary overlap with the construction of the NL Hydro Power Line. Cumulative interactions are not expected during the operation of the NL Hydro Power Line.
N/A = No potential interactions with the atmospheric environment have been identified		

20.2.4 Potential Cumulative Environmental Effects

Past, present and ongoing physical activities identified in Table 20.2 include mining and exploration, forestry, hunting, outfitting, trapping, fishing, aquaculture, off-road vehicles, hydroelectric development and existing linear features. Past physical activities (i.e., not operating, closed or decommissioned facilities) will not have effects on air quality, sound quality or lighting as they do not overlap temporally with the Project, therefore, they cannot interact cumulatively. Ongoing present activities such as forestry, hunting, outfitting, trapping, fishing, aquaculture, and off-road vehicles have negligible air, GHG, noise emissions and light levels, and would not be distinguishable from baseline levels. As well, baseline ambient air quality concentrations, sound pressure levels and light levels provided in Section 5.2 account for currently active projects and activities that are sources of air and noise emissions (i.e., seasonal dwellings, industrial, commercial and natural environment), and light levels in the LAA for the atmospheric

environment. As such, the contribution of present projects and activities are considered in the assessment of Project residual effects (Section 5.5).

Cumulative effects on air quality, sound quality and light depend on the proximity of the Project to the future activities / projects. Changes in air quality, sound quality and light levels associated with an industrial facility tend to be the greatest near the facility and decrease with increasing distance from the facility. Furthermore, the zone of influence for transport and dispersion of gaseous air emissions is generally less than 10 km, and even lower for sound and light levels. The zone of influence is defined as the distance from the facility to the point where the air contaminant concentrations, sound levels and light levels decrease to background levels.

Future physical activities identified in Table 20.2 include the Cape Ray Gold Project, Buchans Resources Limited Project, and the NL Hydro Power Line from Star Lake to the Project Area.

Activities associated with the Cape Ray Gold Project and the Buchans Resources Limited Project are located further than 10 km from the Project Area and therefore, are not expected to have an overlapping effect with the Project with respect to air quality, sound quality and light. Activities associated with these projects will, however, result in releases of GHGs that have the potential to interact cumulatively in the atmosphere with GHG emissions from the Project.

The construction of the NL Hydro Power Line from Star Lake to the mine site will spatially and temporally overlap with the construction of the Project, and there is potential for cumulative interactions with the atmospheric environment to result in a change in GHGs, air quality, sound quality and lighting. The operation of the power line will have negligible emissions and light levels and therefore will not interact cumulatively with the Project.

The GHG emissions expected from reasonably foreseeable future projects and activities (i.e., the Cape Ray Gold Project, Buchans Resources Limited Project, and the NL Hydro Power Line) are expected to be low in magnitude compared to provincial and national GHG totals. While GHG emissions from a single project are negligible compared to global emissions, they do cumulatively contribute to global emissions which are responsible for causing climate change. The estimated GHG emissions from the Project are 92,118 tonnes CO_2e/year and are anticipated to contribute 0.013% of total annual national emissions. The Project-related GHG emissions may affect Canada's ability to meet the Paris Agreement emission reduction targets, though the GHG emissions are expected to be a small fraction (0.013%) of Canada's total emissions. Similarly, NL set targets to reduce GHG emissions by 35-45% below 1990 levels by 2030 and to reduce emissions by 30% below 2005 levels by 2030. Estimated GHG emissions from the Project are 92,118 tonnes CO_2e/year and are anticipated to contribute 0.84% of the total annual provincial emissions. The Project-related GHG emissions may affect NL's ability to meet their emissions reduction target, though the GHG emissions are anticipated to be a small fraction (0.84%) of NL's total emissions.

20.2.5 Cumulative Effects Summary and Evaluation

The cumulative effects on the atmospheric environment of past, present, ongoing, and reasonably foreseeable projects and activities, in combination with the environmental effects of the Project, are summarized in Table 20.3.

The potential cumulative effects on air quality, sound quality and lighting from the NL Hydro Power Line Project will be limited to the construction phase of that project, short term in duration, negligible in magnitude, irregular in frequency and reversible once the construction activities cease. The potential cumulative effects on air quality, sound quality and lighting are predicted to be not significant.

The Project will result in atmospheric GHGs, as will the construction and operation of other reasonably foreseeable projects. As discussed above, although GHG emissions from a single project are negligible compared to global emissions, they do cumulatively contribute to global emissions, which are responsible for causing climate change. The GHG emissions from the Project are estimated to be 92,118 tonnes CO_2e/year and are anticipated to contribute 0.013% of total annual national emissions. The Project-related GHG emissions may affect Canada's ability to meet the Paris Agreement emission reduction targets, though the GHG emissions are expected to be a small fraction (0.013%) of Canada's total emissions. Similarly, NL set targets to reduce GHG emissions by 35-45% below 1980 levels by 2030 and to reduce emissions by 30% below 2005 levels by 2030. The estimated GHG emissions from the Project are 92,118 tonnes CO_2e/year and are anticipated to contribute 0.84% of the total annual provincial emissions. The Project-related GHG emissions may affect NL's ability to meet their emissions reduction target, though the GHG emissions are expected to be a small fraction (0.84%) of NL's total emissions. The Project emissions are ranked as low during construction and moderate during operation.

Therefore, the potential cumulative effects of the Project and other reasonably foreseeable emission sources on GHG emissions are predicted to be negligible in magnitude (i.e., no measurable change). The geographic extent is anticipated to be within the cumulative effects RAA. Cumulative effects are predicted to be short-term in duration, irregular in frequency and reversible. The ecological and socio-economic context for the Atmospheric Environment VC is considered disturbed, as the geographic extent is the cumulative effects RAA, in which there have been anthropogenic sources of GHG emissions prior to the Project.

With mitigation, the cumulative effects from the Project and reasonably foreseeable future activities are expected to be not significant (Significance Definition provided in Section 5.3.2).

Table 20.3 Summary of Potential Cumulative Effects for Atmospheric Environment

Residual Cumulative Effect[A]	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological and Socio-economic Context
	A	N	RAA	ST	IR	R	D
Contribution from the Project to the Residual Cumulative Effect[A]	The Project will cumulatively contribute to annual provincial and federal GHG emissions, along with the Cape Ray Gold Project, the Buchans Resources Limits and NL Hydro Power Line, affecting their commitments to reducing GHG emissions, however, the impact is small. The operation contributes approximately 0.84% and 0.013% to the annual provincial and national emission totals, respectively. The Project will cumulatively interact with the construction of the NL Hydro Power Line to result in a change in air quality, sound quality and lighting.						

Table 20.3 Summary of Potential Cumulative Effects for Atmospheric Environment

Residual Cumulative Effect[A]	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological and Socio-economic Context
	A	N	RAA	ST	IR	R	D
Significance[B]	Although there are limitations in the available information of the effects from other present, past and future physical activities, a conservative approach was taken to estimate the cumulative effects (e.g., potential emissions from future physical activities). The predicted effects are similar to those that have occurred during other mining and power line projects / activities, thereby increasing the confidence in the assessment. The cumulative effects on GHG emissions are predicted to be not significant with a high prediction confidence. The cumulative effects on air quality, sound quality and lighting are predicted to be not significant with a high prediction confidence.						

Notes:
[A] Descriptors are provided in the respective VC chapters.
[B] Significance definitions are provided in the respective VC chapters.

20.3 GROUNDWATER RESOURCES

20.3.1 Past and Ongoing Effects

The Project Area lies within the Western Mountains and Central Uplands climate zone of NL, generally characterized by cloudy conditions, strong winds and heavy snowfall in winter (Heritage NL 2019). The shallow groundwater system in the area is predicted to be largely controlled by surface runoff and local recharge, while at moderate depths the flow system may be influenced by recharge at higher elevations (Tóth 2009).

Groundwater quality may be influenced by natural processes such as weathering of rocks, evapotranspiration, depositions due to wind, leaching from soil, runoff due to hydrological factors, and biological processes in the aquatic environment, leading to changes in the pH and alkalinity, phosphorus loading, increase in fluoride content, and high concentrations of sulphates (Kharti and Tyagi 2015). Natural processes affecting groundwater quantity include climate-related events, such as flooding or extended drought. Human activities affecting groundwater include effects due to hydroelectric development, mining, industrial / urban development, agriculture, fertilizers, pesticides, inefficient irrigation practices, forestry activities, aquaculture, pollution, and recreational activities, leading to elevated concentrations of heavy metals, mercury, coliforms, nutrient loads, change in groundwater storage, and destruction of forests (Kharti and Tyagi 2015; Ferencz et al. 2019; Chilton 1996). Climate change is also considered as one of the main driving forces of change in water availability (Mirchi et al. 2013).

Past, present and ongoing projects/activities in the vicinity of the Project may contribute to anthropogenic pressures on groundwater resources. However, the effects of previous activities and natural environmental influences are reflected in the existing conditions for the Groundwater Resources VC, as described in (Section 6.2), and the assessment of residual effects (Section 6.5). The assessment includes consideration of the current condition (e.g., quantity or quality) of potentially affected groundwater resources, as well as the potential resiliency or sensitivity to further environmental change resulting from the Project in combination with other ongoing projects and activities that may affect the same VC.

20.3.2 Potential Project-Related Contributions to Cumulative Effects

As described in Chapter 6, routine Project activities and components have the potential to affect groundwater resources via large-scale pumping and dewatering during operation of the open pits, and localized changes to groundwater quality in the vicinity of processing facilities, TMF and waste rock piles. The Project, therefore, has potential to result in the following residual effects on groundwater resources:

- A change in groundwater quantity
- A change in groundwater quality

The Project-specific effects assessment for this VC includes a summary of residual environmental effects in Section 6.5, and a determination of significance in Section 6.6. With the implementation of mitigation (Section 6.4), the effects of routine Project-only activities on groundwater resources are predicted to be not significant.

20.3.3 Other Projects and Activities and Their Effects

Table 20.4 summarizes past, present, ongoing, and future projects and activities in the cumulative effects RAA that have potential to cause a change in groundwater quantity and quality; thereby affecting groundwater resources.

Table 20.4 Groundwater Resources: Residual Effects from Other Projects and Activities in the Cumulative Effects RAA

Physical Activity	Potential Effects on this VC from Other Projects / Activities	VC-Specific Spatial / Temporal Considerations and Effect Pathways
Past, Present and Ongoing Projects / Activities		
Mining and Exploration	• N/A	• Groundwater effects from the past mining and ongoing exploration activities are limited to their LAAs based on the nature of the groundwater divides between the projects. The LAAs do not overlap the Project, and therefore no cumulative groundwater effects are anticipated.
Forestry	• N/A	• Forestry operations have the potential to temporarily change the groundwater recharge rate during the regrowth cycle. However, given the limited forest resource available within the LAA, such temporary changes to recharge are not anticipated to cumulatively affect groundwater resources.

Table 20.4 Groundwater Resources: Residual Effects from Other Projects and Activities in the Cumulative Effects RAA

Physical Activity	Potential Effects on this VC from Other Projects / Activities	VC-Specific Spatial / Temporal Considerations and Effect Pathways
Hunting, Outfitting, Trapping, and Fishing	• N/A	• These operations do not use groundwater, nor affect groundwater quality, therefore no cumulative effects are anticipated.
Aquaculture	• N/A	• Aquaculture activities could interact with groundwater if a groundwater source were to be used as a groundwater supply for an aquaculture project within the LAA. However, as no past or present aquaculture projects have occurred in the LAA no cumulative groundwater effects are anticipated.
Off-road Vehicles (Snowmobiling and ATV)	• N/A	• These operations do not use groundwater, nor affect groundwater quality, therefore no cumulative effects are anticipated.
Hydroelectric Developments	• N/A	• Past hydroelectric developments have resulted in a local change to the interactions between surface water and groundwater near the shore of Victoria Lake Reservoir. However, as groundwater effects are generally limited to upgradient areas of the Victoria Lake Reservoir, and not at Victoria Lake itself, no cumulative effects are anticipated.
Existing Linear Features (i.e., highways / roads and power lines)	• N/A	• These operations do not use groundwater, nor affect groundwater quality, therefore no cumulative effects are anticipated.
Future Projects / Activities		
Cape Ray Gold Project	• N/A	• Groundwater effects for the Project and the Cape Ray Gold Project are limited to the LAA for each project based on the nature of the groundwater divides between the projects. The LAAs do not overlap, and therefore no cumulative groundwater effects are anticipated.
Buchans Resources Limited Project	• N/A	• Groundwater effects from the Buchans Resources Limited Project are limited to the LAA based on the nature of the groundwater divides between the projects. The LAA is not anticipated to overlap with the Project, and therefore no cumulative groundwater effects are anticipated.
NL Hydro Power Line from Star Lake to the Project Area	• N/A	• The installation of power lines is not anticipated to interact with groundwater resources.
N/A = No potential interactions with groundwater have been identified		

20.3.4 Potential Cumulative Environmental Effects

Based on the pathways identified in Table 20.4, there are no pathways from past, present and ongoing projects / activities that would act cumulatively with the Project in the LAA resulting in a change in groundwater quantity or groundwater quality. Therefore, there are no potential cumulative effects of the Project and other reasonably foreseeable projects and activities.

20.3.5 Cumulative Effects Summary and Evaluation

There are no pathways for past, present and ongoing projects / activities to interact with a change in groundwater quantity or groundwater quality.

20.4 SURFACE WATER RESOURCES

20.4.1 Past and Ongoing Effects

As described in Chapter 7 (Surface Water Resources), the Project Area is located along a topographic divide that drains surface water to three primary receivers (Victoria Lake Reservoir, Valentine Lake and Victoria River) via small watersheds (maximum size of 2.2 km^2). Climate normal conditions for the Project Area have been represented by data from the Buchans Climate Station (Station ID 8400698) with a mean annual temperature of 3.8°C and mean annual precipitation of 1,236 mm. Victoria Lake Reservoir is the headwaters of the Bay d'Espoir hydroelectric system and was established through the construction of the Victoria Control Structure Dam. This altered the natural drainage of Victoria Lake Reservoir from north towards Red Indian Lake to south towards the Victoria Canal. The dam raised the Victoria Lake Reservoir levels from 290 to 325 masl and water levels can now vary up to four metres every year.

The existing land within the Project Area is generally undisturbed and surface water runoff characteristics are considered consistent with other watersheds located in the same hydrologic zone (Northeast Hydrologic Zone as described by AMEC 2014). A baseline streamflow coefficient of 62.5% was determined for the Project Area. This represents the total observed flow in relation to total precipitation over the watershed area and includes both overland flow and groundwater discharge contributions, and has the potential to be altered by project activities.

Surface water flows tend to peak twice a year, first in April / May due to snow melt, and again in November due to fall rainfall events. Minimum flows are expected during winter months from January to February, and late summer between July and September. Mean annual flow (MAF) and baseline environmental flow needs for both summer and winter were established for watersheds within the Project Area based on regional relationships outlined in Section 7.2.

Surface water quality in the Project Area was noted to vary substantially and to be dependent on the type of waterbody, location of the waterbody, and the time of year that samples were collected. The most distinct difference in water quality was noted in the large waterbodies of Victoria Lake Reservoir, Valentine Lake and Victoria River, which were seen to be more dilute in comparison with the smaller headwater streams located in the Project Area. Several parameters were noted to occur naturally at levels above Canadian Water Quality Guidelines for the Protection of Freshwater Aquatic Life (CWQG-FAL), including aluminum, iron, arsenic, cadmium, copper, lead, and zinc.

20.4.2 Potential Project-Related Contributions to Cumulative Effects

As described in Chapter 7, Project activities have the potential to alter surface water quantity in local watersheds through changes in upstream drainage patterns, construction of water management infrastructure, and alteration of ground cover and runoff. Emissions, discharges and wastes that enters

surface water from areas of mine development (i.e., pits, waste rock piles, TMF, sedimentation ponds) have the potential to alter surface water quality from existing conditions due to the altered geochemistry resulting from rock exposure and mining processes. The Project, therefore, has potential to result in the following residual effects on surface water:

- A change in surface water quantity
- A change in surface water quality

The Project-specific effects assessment for surface water includes a summary of residual environmental effects in Section 7.5 and a determination of significance in Section 7.6. With the implementation of mitigation (Section 7.4), the residual effects of routine Project-only activities on surface water are predicted to be confined to within the LAA and to be not significant.

20.4.3 Other Projects and Activities and Their Effects

Table 20.5 summarizes past, present, ongoing, and future projects and activities in the cumulative effects RAA that have potential to cause a change in surface water quantity and quality; thereby affecting surface water.

Table 20.5 Surface Water: Residual Effects from Other Projects and Activities in the Cumulative Effects RAA

Physical Activity	Potential Effects on this VC from Other Projects / Activities	VC-Specific Spatial / Temporal Considerations and Effect Pathways
Past, Present and Ongoing Projects / Activities		
Mining and Exploration	• Change in surface water quantity • Change in surface water quality	• Effects from past and current mining practices may temporally overlap with Project effects. • There is potential for residual effects from past and ongoing activities to spatially overlap Project effects. • Water quantity effects may include water management infrastructure built for past mining projects such as dams, ditches as well as changes in ground cover and runoff conditions. • Water quality effects may include changes resulting from bedrock exposure and resulting geochemical processes.
Forestry	• Change in surface water quantity • Change in surface water quality	• Effects from forestry activities may spatially and temporally overlap with Project activities. • Forestry activities potentially have similar effect pathways as the Project, including vegetation clearing and ground disturbance in or near streams or lakes affecting runoff and water quality (potential introduction of sediments and contaminants). • Water management and stream crossing activities associated with forestry may also result in changes in water levels in surrounding waterbodies.

Table 20.5 Surface Water: Residual Effects from Other Projects and Activities in the Cumulative Effects RAA

Physical Activity	Potential Effects on this VC from Other Projects / Activities	VC-Specific Spatial / Temporal Considerations and Effect Pathways
Hunting, Outfitting, Trapping, and Fishing	• Change in surface water quality	• Effects from past and ongoing practices may temporally overlap with the Project. • There is potential for residual effects from past and ongoing practices to spatially overlap with the Project. • Hunting, outfitting, trapping and fishing are not anticipated to result in water quantity effects, and therefore, cumulative effects are not expected. • Water quality effects may include increased sedimentation and erosion resulting from trail and road use.
Aquaculture	• Change in surface water quantity • Change in surface water quality	• Aquaculture activities on the south coast of the Island of Newfoundland will temporally overlap with Project activities. • Aquaculture activities occur on the south coast of the Island of Newfoundland and are located 89 km from the Project Area. Given the distance, cumulative effects are not anticipated.
Off-road Vehicles (Snowmobiling and ATV)	• Change in surface water quality	• Effects from past and ongoing practices may temporally overlap with the Project. • There is potential for residual effects from past and ongoing practices to spatially overlap with the Project. • Off-road vehicles are not anticipated to result in water quantity effects, and therefore, cumulative effects are not expected. • Water quality effects may include increased sedimentation and erosion resulting from trail and road use.
Hydroelectric Developments	• Change in surface water quantity	• Effects from past and ongoing practices may temporally overlap with the Project. • There is potential for residual effects from past and ongoing practices to spatially overlap with the Project. • Water quantity effects may include a change in waterbody levels in lakes managed by NL Hydro. • Hydroelectric development is not anticipated to result in water quality effects, therefore cumulative effects are not expected.
Existing Linear Features (i.e., highways / roads and power lines)	• Change in surface water quality	• Effects from past and ongoing practices may temporally overlap with the Project. • There is potential for residual effects from past and ongoing practices to spatially overlap with the Project. • Existing linear features are not anticipated to result in water quantity effects, therefore cumulative effects are not expected. • Water quality effects may include increased sedimentation and erosion resulting from trail and road use.

Table 20.5 Surface Water: Residual Effects from Other Projects and Activities in the Cumulative Effects RAA

Physical Activity	Potential Effects on this VC from Other Projects / Activities	VC-Specific Spatial / Temporal Considerations and Effect Pathways
Future Projects / Activities		
Cape Ray Gold Project	• Change in surface water quantity • Change in surface water quality	• The Cape Ray Gold Project may temporally overlap. • No spatial overlap is considered to exist with the Cape Ray Gold Project as it is located in a different watershed and therefore there is no potential for interaction with the Marathon Project. • Water quantity effects are not expected to overlap with the Project. • Water quality effects are not expected to overlap with the Project.
Buchans Resources Limited Project	• Change in surface water quantity • Change in surface water quality	• The Buchans Resources Limited Project may temporally overlap. • There is a potential for residual effects from the Buchans Resources Limited Project to spatially overlap with the cumulative effects RAA. Portions of the project drain through Valentine Lake, Victoria River and into Red Indian Lake, which is also downstream of the Buchans Resources Limited Project. • Water quantity effects are not expected to overlap with the Project. • Water quality effects are not expected to overlap with the Project.
NL Hydro Power Line from Star Lake to the Project Area	• Change in surface water quality	• The NL Hydro Power Line Project will temporally overlap with the Project. • There is a potential for residual effects from the NL Hydro Power Line Project to spatially overlap with the cumulative effects RAA. It is expected that the NL Hydro Power Line Project would require works in the cumulative effects RAA. • Water quality effects may overlap with the Project.
N/A = No potential interactions with surface water have been identified		

20.4.4 Potential Cumulative Environmental Effects

Past, present and ongoing activities / projects that are predicted to contribute to cumulative effects on surface water include mining and exploration, forestry, hunting, outfitting, trapping, and/or fishing, aquaculture, off-road vehicles, hydroelectric development, and existing linear features (Table 20.5). However, potential cumulative effects of these projects / activities have been accounted for in the existing conditions and residual environmental effects (Chapter 7) and are not discussed further.

Future activities / projects that are predicted to contribute to cumulative effects on surface water include the Cape Ray Gold Project, Buchans Resources Limited Project and the NL Hydro Power Line from Star Lake to the Project Area (Table 20.5). These projects have the potential to overlap with Project activities

temporally and spatially, and have similar effects pathways as effects arising from the Project, including a change in water quantity and water quality.

Effects from the Cape Ray Gold Project are not anticipated to cumulatively interact with the Project as it is geographically distanced from the Project and its downstream watersheds.

It is anticipated that the Buchans Resources Limited Project will employ best management practices, including being subject to MDMER, to reduce or eliminate potential residual effects on surface water quantity and quality. Due to the large assimilative capacity potential of Red Indian Lake and the Exploits River, residual effects experienced under normal operating conditions within the local area of the Buchan's Resources Limited Project are not expected to result in cumulative effects within the cumulative effects RAA.

It is anticipated that the NL Hydro Power Line will employ best management practices and design mitigation to reduce or eliminate potential residual effects for surface water quantity and quality (i.e., through effects on the natural flow regime from changes to surface vegetation cover and sedimentation and erosion rates) that may interact with the cumulative effects RAA. Localized residual effects resulting from the Project are expected for some watersheds within the LAA boundaries, as described in Chapter 7. The proposed route and construction methods for the NL Hydro Power Line are not currently known, however there is a potential that it could pass through watersheds noted to experience a local effect from Project activities on quantity and/or quality within the LAA. If this is found to be the case, an assessment of cumulative effects is warranted. If the NL Hydro Power Line avoids watersheds considered to experience localized effects from the Project, no cumulative effects assessment is required.

20.4.5 Cumulative Effects Summary and Evaluation

The cumulative effects on surface water of past, present, ongoing, and reasonably foreseeable projects and activities, in combination with the environmental effects of the Project, are summarized in Table 20.6.

Although the three identified reasonably foreseeable future projects are anticipated to have similar effects as the Project, only the NL Hydro Power Line is considered to have the potential for cumulative effects for surface water quantity and quality. Implementation of best practices and mitigation measures incorporated into design of the NL Hydro Power Line project will further reduce potential interactions. Therefore, the potential cumulative effects of the Project and other reasonably foreseeable project is predicted to be low magnitude (a measurable change in water quantity and quality within local watersheds but restricted to the LAA). Cumulative effects are predicted to be short to long-term in duration, continuous, and reversible. The ecological and socio-economic context for the Surface Water Resources VC is considered disturbed in the cumulative effects RAA.

With mitigation, the cumulative effects from the Project and reasonably foreseeable future activities are expected to be not significant (Significance Definition provided in Section 7.3.2).

Table 20.6 Summary of Potential Cumulative Effects for Surface Water

Residual Cumulative Effect[A]	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological and Socio-economic Context
	A	L	LAA	ST / LT	C	R	D
Contribution from the Project to the Residual Cumulative Effect[A]	Project related changes to surface water quantity and quality will be restricted to several local watersheds and not extend beyond the LAA. For surface water quantity, environmental flows are expected to be maintained in all but five watersheds throughout the Project phases. Surface water quality will experience similar local effects in watersheds immediately downstream of project Final Discharge Points (FDPs) but will return to baseline, or below CWQG-FAL within the LAA.						
Significance[B]	Although there are limitations in the available information of the effects from other present, past and future physical activities, a conservative approach was taken to estimate the cumulative effects (e.g., effects to surface water quality and quantity of future physical activities). The predicted effects are similar to those that have occurred during other mining and power line projects / activities, thereby increasing the confidence in the assessment. The cumulative effects on surface water are predicted to be not significant with a high prediction confidence.						

Notes:
[A] Descriptors are provided in the respective VC chapters.
[B] Significance definitions are provided in the respective VC chapters.

20.5 FISH AND FISH HABITAT

20.5.1 Past and Ongoing Effects

The LAA has been subject to substantial changes in water flow since the late 1960s, such as the development of the Victoria Dam in 1968 and the Victoria Canal in 1969 (Section 8.2). Due to these changes, Victoria Lake Reservoir is now part of the White Bear Watershed to the south of the Project as opposed to the Exploits River watershed, and is much larger in surface area (16,660 ha) than the former Victoria Lake Reservoir (approximately 4,200 ha). Valentine Lake is 820 ha in extent and is part of the Exploits River Watershed. Victoria Lake Reservoir drains to the Victoria River, flows northeast to Red Indian Lake, through the Millertown Dam, and into the Exploits River. Victoria River is a part of the Exploits River Watershed and drains a small portion of Victoria Lake Reservoir at the Victoria Dam.

Fish and fish habitat have been and continue to be affected by a variety of natural processes (e.g., water temperature changes, changes in prey species abundance and distribution), and human activities and policy decisions (e.g., hydroelectric dams, mining / industrial development, fishing activities, fishing restrictions, emissions, pesticides, and other pollution). These natural and human interactions have affected the presence, distribution, and abundance of fish species, and the overall size and health of fish populations. Warming temperatures and associated increases in water temperature may result in

changes in the distribution of salmonids, particularly brook trout, which may approach their maximum thermal tolerances.

Although the main interaction between human activities and fish and fish habitat in the region is through the development of hydroelectric dams and other industrial development, recreational fishing, such as salmon and trout fishing, including outfitter operations, also occur within the cumulative effects RAA. These activities are expected to continue at baseline levels and are not expected to affect fish habitat or fish health and survival in new ways. Fisheries management tools, including catch quotas, as well as the categorization of waterbodies into classes used for salmon angling, which determine the daily bag limit, have been used to help manage the health of fish stocks and protect fish habitat.

Fish and fish habitat in the cumulative effects RAA are therefore already subject to natural and anthropogenic disturbance to varying degrees. Past and present projects / activities in the vicinity of the Project that may contribute to anthropogenic pressures on fish and fish habitat include other mining and exploration, forestry, hunting, outfitting, trapping, fishing, aquaculture, hydroelectric development, and existing linear features (Table 20.7). These pressures may cause a change in habitat or mortality risk for fish within the region. However, the effects of previous activities and natural environmental influences are reflected in the existing conditions for the Fish and Fish Habitat VC (Section 8.2), and the assessment of residual effects (Section 8.5). The assessment includes consideration of the current condition (e.g., health or quality) of potentially affected fish populations and their habitats, as well as their potential resiliency or sensitivity to further environmental change resulting from the Project in combination with other ongoing projects and activities that may affect the same VC.

20.5.2 Potential Project-Related Contributions to Cumulative Effects

As described in Chapter 8, routine Project activities and components have the potential to interact with fish and fish habitat via a number of pathways, including the use of industrial equipment, vegetation clearing, excavating, grading, and installation of infrastructure in or near streams or lakes via the direct removal of riparian vegetation (affecting water quality via reduced shade or increased nutrient / energy inputs). In addition, alterations to stream flow, the introduction of sediments and contaminants and/or direct injury or death from the presence of equipment also have the potential to interact with fish and fish habitat. Other pathways include:

- The flooding of organic soils or terrestrial vegetation within the TMF and polishing pond resulting in potential sources of methylmercury to waterbodies
- Emissions, discharges and wastes released into the aquatic environment from sedimentation ponds; excavation of waste rock and subsequent alteration of groundwater
- Water management activities that result in changes in water levels in surrounding waterbodies
- Decommissioning, rehabilitation and closure activities that could leave behind stratified pit lakes, with anoxic bottom layers that may contain high concentrations of dissolved trace metals
- Increased recreational fishing pressure, and the use of explosives in or near water that could cause death or injury to fish

The Project, therefore, has potential to result in the following residual effects on fish and fish habitat:

- A change in fish habitat quantity
- A change in fish habitat quality
- A change in fish health and survival

The Project-specific effects assessment for this VC includes a summary of residual environmental effects in Section 8.5 and a determination of significance in Section 8.6. With the implementation of mitigation (Section 8.4), the effects of routine Project-only activities on fish and fish habitat are predicted to be not significant.

20.5.3 Other Projects and Activities and Their Effects

Table 20.7 summarizes past, present, ongoing, and future projects and activities in the cumulative effects RAA that have potential to cause a change in fish habitat quality and quantity, and/or a change in fish health and survival, thereby affecting fish and fish habitat.

Table 20.7 Fish and Fish Habitat: Residual Effects from Other Projects and Activities in the Cumulative Effects RAA

Physical Activity	Potential Effects on this VC from Other Projects / Activities	VC-Specific Spatial / Temporal Considerations and Effect Pathways
Past, Present and Ongoing Projects / Activities		
Mining and Exploration	• Change in fish habitat quantity • Change in fish habitat quality • Change in fish health and survival	• Most mining Projects listed in Table 20.1 are no longer in operation or are in the closure and rehabilitation phase. Therefore, temporal overlap will not occur. • Effects from mining and exploration activities may spatially overlap with Project activities. • Ongoing mining and exploration operations will overlap with Project activities and potentially have similar pathways as effects arising from the Project, including a change in habitat quality and quantity, or a change in fish health and survival. • Mining projects in the decommissioning, rehabilitation and closure phases may temporally overlap with Project activities and are anticipated to have similar adverse environmental effects associated with change in habitat quality and quantity, or a change in fish health and survival.
Forestry	• Change in fish habitat quality • Change in fish health and survival	• Forestry activities will spatially and temporally overlap with Project activities. • Forestry activities potentially have similar effect pathways as the Project, including vegetation clearing and ground disturbance in or near streams or lakes affecting runoff and water quality (potential introduction of sediments and contaminants). • Water management and stream crossing activities associated with forestry may also result in changes in water levels in surrounding waterbodies.

Table 20.7 Fish and Fish Habitat: Residual Effects from Other Projects and Activities in the Cumulative Effects RAA

Physical Activity	Potential Effects on this VC from Other Projects / Activities	VC-Specific Spatial / Temporal Considerations and Effect Pathways
Hunting, Outfitting, Trapping, and Fishing	• Change in fish habitat quantity • Change in fish habitat quality • Change in fish health and survival	• Effects from hunting, outfitting, trapping and fishing activities may spatially and temporally overlap with Project activities. • Hunting, outfitting, trapping and fishing activities can cause a change in fish health and survival. However, given fisheries regulations, such as catch quotas and seasonal closures, effects are anticipated to be low, affecting only individual fish and not populations.
Aquaculture	• Change in fish habitat quantity • Change in fish habitat quality • Change in fish health and survival	• Aquaculture activities on the south coast of the Island of Newfoundland will temporally overlap with Project activities. • Aquaculture activities occur on the south coast of the Island of Newfoundland and are located 89 km from the Project Area. A series of dams makes the passage of fish from one area to the other impossible. Therefore, cumulative effects are anticipated to be negligible.
Off-road Vehicles (Snowmobiling and ATV)	• N/A	• Off-road vehicles will spatially and temporally overlap with Project activities. However, they are not anticipated to interact with fish or fish habitat, given that they are terrestrial activities and do not result in substantial ground disturbance that would affect water quality of nearby waterbodies.
Hydroelectric Developments	• Change in fish habitat quantity • Change in fish habitat quality • Change in fish health and survival	• Hydroelectric developments will spatially and temporally overlap with the Project. • Hydroelectric development activities will have adverse environmental effects on fish and fish habitat. Effect pathways include a direct change in habitat quality and quantity, and fish health and survival resulting from changes to hydrological outputs, such as the amount or timing of water released to waterbodies. This can change the velocity of water flow, affecting the quality of habitat (e.g., suspended sediment), and change the water levels of surrounding waterbodies, affecting the quantity of habitat. These changes, as well as the presence of dam infrastructure, could also result in stranding of fish or fish injury, and thereby affect fish health and survival.
Existing Linear Features (i.e., highways / roads and power lines)	• Change in fish health and survival	• Existing linear features may spatially and temporally overlap with Project activities. • The presence of linear features, such as roads, may increase access to fishing areas and result in a change in fish health and survival from overfishing; however, given fisheries regulations, such as catch quotas and seasonal closures, effects are anticipated to be low, affecting only individual fish and not populations.

Table 20.7 Fish and Fish Habitat: Residual Effects from Other Projects and Activities in the Cumulative Effects RAA

Physical Activity	Potential Effects on this VC from Other Projects / Activities	VC-Specific Spatial / Temporal Considerations and Effect Pathways
Future Projects / Activities		
Cape Ray Gold Project	• Change in fish habitat quantity • Change in fish habitat quality • Change in fish health and survival	• The Cape Ray Gold Project may temporally overlap • Activities associated with the Cape Ray Gold Project potentially have similar pathways as effects arising from the Project. Pathways include a change in habitat quality and quantity, or a change in fish health and survival, as discussed further in Section 20.5.4.
Buchans Resources Limited Project	• Change in fish habitat quantity • Change in fish habitat quality • Change in fish health and survival	• The Buchans Resources Limited Project may temporally overlap • Activities associated with the Buchans Resources Limited Project potentially have similar pathways as effects arising from the Project. Pathways include a change in habitat quality and quantity or a change in fish health and survival, as discussed further in Section 20.5.4.
NL Hydro Power Line from Star Lake to the Project Area	• Change in fish habitat quality • Change in fish health and survival	• The NL Hydro Power Line from Star Lake to the Project Area will spatially and temporarily overlap with Project activities. • The NL Hydro Power Line will potentially have similar pathways as effects arising from the Project. Pathways include a change in habitat quality, as well as fish health and survival, as discussed further in Section 20.5.4.
N/A = No potential interactions with fish and fish habitat have been identified		

20.5.4 Potential Cumulative Environmental Effects

As indicated in Section 20.5.1, fish are subject to numerous influences, which can affect distribution, abundance and health. These include hydroelectric dams, mining / industrial development, fishing activities, fishing restrictions, emissions, pesticides and other pollution. Key cumulative effects pathways associated with the Project include:

- Removal of riparian vegetation
- Alterations to stream flow
- The introduction of sediments and contaminants
- Direct injury or death of fish from the presence of equipment
- Flooding within the TMF and polishing pond
- Emissions, discharges and wastes
- Alteration of surface water and groundwater
- Stratified pit lakes
- Increased fishing pressure due to workers on site
- The use of explosives in or near water

All of these pathways could potentially result in cumulative changes in fish habitat quality and quantity, and fish health and survival. This section describes the pathways of the cumulative effects resulting from the Project and other projects identified in Table 20.7, mitigation that could be implemented to reduce cumulative effects, and the nature of the cumulative effects in the context of the residual effects of other projects.

Past and present activities / projects that are predicted to contribute to cumulative effects on fish and fish habitat include other mining and exploration, forestry, hunting, outfitting, trapping, and/or fishing, aquaculture, hydroelectric development, and existing linear facilities features (Table 20.7). However, potential cumulative effects of these projects / activities have been accounted for in the existing conditions and residual environmental effects (Chapter 8) and are not discussed further.

Future activities / projects that are predicted to contribute to cumulative effects on fish and fish habitat include the Cape Ray Gold Project, Buchans Resources Limited Project, and NL Hydro Power Line from Star Lake to the Project Area (Table 20.7). These projects potentially have similar pathways as effects arising from the Project, including a change in fish habitat quantity and quality and a change in fish health and survival.

20.5.4.1 Change in Fish Habitat Quantity

The contribution of Project-related residual adverse effects to cumulative effects on change in fish habitat quantity will be low to moderate, with habitat quantity related to the direct loss (removal or destruction of fish habitat) and indirect loss (change in stream mean annual flow) of fish habitat resulting from change in watershed areas and stream water flow, fish passage, water extraction, and direct placement of infrastructure in fish habitat.

With standard mitigation, and based on the existing Project design, the Project is conservatively anticipated to result in the direct and indirect loss of 183,537 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. However, the Fish Habitat Offset Plan, which will be submitted as part of the Authorization, under the *Fisheries Act*, will reduce residual effects by offsetting the loss of fish habitat in the LAA.

Environmental assessment documents have not been submitted for the Cape Ray Gold Project, Buchans Resources Limited Project, or the NL Hydro Power Line, therefore, habitat loss estimates are not available. As discussed above, the Cape Ray Gold Project description describes habitat mapping that was completed by the previous owners that included waterways that were classified as good for spawning and/or rearing habitat for salmonid species (Nordmin 2016). The Cape Ray Gold Project EA review will determine whether effects on change in habitat quantity for fish are significant, however, given the distance from the Valentine Gold Project, it is anticipated that residual adverse effects will not contribute substantially to overall cumulative effects. Furthermore, the salmon population in the Project LAA is the Northeast Newfoundland Atlantic salmon population, which is Not-at-Risk, and therefore, cumulative environmental effects on sustainability of the salmon population are not anticipated.

As Buchans Resources Limited has not yet submitted a Project Description or Project Registration to regulators describing their project, a project area has not been defined and the existing environment is not described. A description of the Lundberg deposit on their website states that resources are contained within an optimized model pit shell measuring 860 m by 650 m and extends to a maximum depth of 240 m (Buchans Resources 2020), equal to less than 1 km^2 of surface area, which is less than both the Marathon and Leprechaun pits. Given that the proposed Buchans Resources Limited Project will have similar project activities, the potential effects on change in habitat quantity for fish may be at a smaller or similar scale as the Project, which has been determined to be not significant (Section 8.6). It is therefore anticipated that the resulting contribution to cumulative effects will not result in the alteration of fish habitat quantity that exceeds regulatory requirements, or causes a change in the productivity or sustainability of fish populations or fisheries within the cumulative effects RAA.

20.5.4.2 Change in Fish Habitat Quality

The contribution of Project-related residual adverse effects to cumulative effects on change in fish habitat quality will be low to moderate, with habitat quality effects related to surface runoff from areas of disturbance and direct discharges of effluent to waterbodies, changes to watershed areas and stream water flow, and work within water.

EA documents have not been submitted for the Cape Ray Gold Project, Buchans Resources Limited Project, or the NL Hydro Power Line. However, the Cape Ray Gold Project Registration document describes habitat mapping that was completed by the previous owners in 1989, along the Isle aux Morts River from the mouth at the Gulf of St. Lawrence to the headwaters upstream of the proposed mine site. Five sections of the river were mapped for fish habitat and four of the five sections were classified as good for spawning and/or rearing habitat for salmonid species (Nordmin 2016). The salmon population in the Cape Ray region is the South Newfoundland Atlantic salmon population, which are designated as Threatened by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC 2019). However, given that the salmon population in the LAA is the Northeast Newfoundland Atlantic Salmon population, which is Not-at-Risk, cumulative environmental effects from the Project and the Cape Ray Gold project on salmon habitat are not anticipated. The EA review for the Cape Ray Gold Project will determine whether its residual effects resulting in change in habitat quality for fish are significant. Given the distance from the Project, it is anticipated that residual adverse effects from the Cape Ray Gold Project will not contribute substantially to overall cumulative effects.

Buchans Resources Limited has not yet submitted a Project Registration document to regulators; therefore, a project area has not been defined and the existing environment is not described. The current indication of potential open pit size is an area equal to less than 1 km^2 of surface area, which is less than both the Marathon and Leprechaun pits. It is assumed that other projects will be required to comply with similar regulatory standards. Given that the proposed Buchans Resources Limited Project will have similar project activities, the potential effects on change in habitat quality for fish may be at a smaller or similar scale as the Project, which has been determined to be not significant (Section 8.6). It is therefore anticipated that the resulting contribution to cumulative effects will not result in the alteration of fish habitat quality that exceeds regulatory requirements or causes a change in the productivity or sustainability of fish populations or fisheries within the cumulative effects RAA.

The NL Hydro Power Line from Star Lake may result in a change in habitat quality for fish via the use of industrial equipment, vegetation clearing, excavating, and installation of infrastructure near streams or lakes, and the resulting direct removal of riparian vegetation, and the introduction of sediments and contaminants. The proposed route is shown on Figure 2-36 and a typical power line requires a cleared 15 m right-of-way. With the implementation of standard mitigation measures and industry best practices for the development of power lines, resulting adverse effects to fish habitat quality are anticipated to be low. Although required for the Project, the power line will be subject to its own environmental assessment review and will be required to implement industry-standard mitigation measures that reduce residual adverse effects resulting in changes in habitat quality for fish.

As EA documents have not been submitted for the Cape Ray Gold Project, Buchans Resources Limited Project, or the NL Hydro Power Line, habitat loss estimates are not available. As discussed above, a 2016 project description for the Cape Ray Gold Project describes habitat mapping that was completed by the previous owners which included waterways that were classified as good for spawning and/or rearing habitat for salmonid species (Nordmin 2016). However, given that the salmon population in the LAA is the Northeast Newfoundland Atlantic Salmon population, which is 'Not-at-Risk', cumulative environmental effects from the Project and the Cape Ray Gold Project on salmon habitat are not anticipated. The Cape Ray Gold Project EA review will determine whether effects on resulting in change in habitat quantity for fish are significant. However, given the distance from the Project, it is anticipated that residual adverse effects from the Cape Ray Gold Project will not contribute substantially to overall cumulative effects.

As described above, Buchans Resources Limited has not yet submitted a Project Description or Project Registration, however, a description of the Lundberg deposit on their website states that resources are contained within an area equal to less than 1 km² of surface area, which is less than both the Marathon and Leprechaun pits. It is also assumed that other projects will be required to meet similar regulatory standards. It is therefore anticipated that the resulting contribution to cumulative effects will not result in the alteration of fish habitat quantity that exceeds regulatory requirements or causes a change in the productivity or sustainability of aquatic resources within the cumulative effects RAA.

20.5.4.3 Change in Fish Health and Survival

Project-related residual adverse effects on change in fish health and survival are associated with use of industrial equipment in or near water, placement of Project infrastructure (e.g., culverts) in water, effluent management, use of explosives, water extraction causing impingement, and increased recreational fishing pressure. However, with mitigation, and given that discharges into streams or lakes will be authorized and in compliance with applicable regulatory discharge limits and testing, residual environmental effects are anticipated to be low to moderate (Section 8.5.3). Residual effects may result in a measurable change in the abundance or survival of local fish populations that is greater than the range of natural variability, however, will not affect the sustainability of fish populations.

The future Cape Ray Gold and Buchans Resources Limited mining projects could contribute nutrients and metals to the local downstream aquatic environment. However, these Projects would be required to also implement mitigation measures to protect water quality and fish health and survival, like those proposed for the Project. Effects to water quality, and consequently to fish health and survival, from other projects would likely be limited to a localized area downstream of the future mine. These areas are outside of the

LAA where Project residual effects have been identified and would not overlap spatially. Therefore, cumulative effects are not anticipated.

The NL Hydro Power Line from Star Lake may result in a change in fish health and survival via the direct removal of riparian vegetation, alterations to stream flow, the introduction of sediments and contaminants and/or direct injury or death from the presence of equipment. However, with the implementation of industry-standard mitigation measures, cumulative effects on change in fish health and survival are considered unlikely.

There are multiple Project-related interactions that have the potential to result in a change in fish health and survival; however, mitigation measures will reduce residual adverse effects. This is also generally considered to be the case for other future physical activities within the cumulative effects RAA. With the implementation of the Project's and other project's mitigation measures, it is anticipated that the cumulative environmental effects on change in fish health and survival will not result in a change to the productivity or sustainability of fish populations or fisheries within the cumulative effects RAA.

20.5.5 Cumulative Effects Assessment Summary and Evaluation

The potential cumulative effects on fish and fish habitat of past, present, ongoing, and reasonably foreseeable projects and activities, in combination with the environmental effects of the Project, are summarized in Table 20.8.

Although the three identified future projects are anticipated to have similar effects as the Project, the Project and reasonably foreseeable future activities and projects will have a small contribution to change in fish habitat quality and quantity in the cumulative effects RAA. It is assumed that other projects will be required to meet similar regulatory standards.

With the implementation of mitigation measures, the potential cumulative effects of the Project and other reasonably foreseeable projects are predicted to be low in magnitude (a measurable change in the abundance or survival of local fish populations that is greater than the range of natural variability, yet does not affect the sustainability of fish populations within the cumulative effects RAA). The geographic extent is anticipated to occur within the cumulative effects RAA. Cumulative effects are predicted to be long-term in duration, continuous in frequency, irreversible, and occurring in an ecological and socio-economic context that has been subject to past disturbance.

With mitigation, the cumulative effects from the Project and reasonably foreseeable future activities are expected to be not significant (Significance Definition provided in Section 8.3.2).

Table 20.8 Summary of Potential Cumulative Effects for Fish and Fish Habitat

Residual Cumulative Effect[A]	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological and Socio-economic Context
	A	L	RAA	LT	IR/C	I	R/D
Contribution from the Project to the Residual Cumulative Effect[A]	The contribution of Project-related residual adverse effects to cumulative effects on change in habitat quality and quantity will be low. The Project is anticipated to result in a change in water quality due to sedimentation, discharges, runoff and stream water flow, affecting habitat quality. The Project will result in habitat loss of 158,129 m^2 (0.158 km^2) within the LAA. This represents a small portion of available fish habitat within the cumulative effects RAA and the Fish Habitat Offset Plan will reduce residual effects by offsetting lost habitat in the LAA. With mitigation, residual adverse effects on fish health and survival are also anticipated to be low, with a measurable change in the abundance or survival of local fish populations that is greater than the range of natural variability, yet will not affect the sustainability of fish populations.						
Significance[B]	With mitigation, offsetting and environmental protection measures in place, the residual adverse cumulative environmental effects on fish and fish habitat are predicted to be not significant. Although there are limitations in the available information of the effects from other present, past and future physical activities, a conservative approach was taken to estimate the cumulative effects (e.g., loss of project areas and footprints of future physical activities). The predicted effects are similar to those that have occurred during other mining and power line projects / activities, thereby increasing the confidence in the assessment. The overall determination is made with a high level of confidence for the direct loss of fish habitat quantity, and moderate level for indirect loss of fish habitat quantity. A moderate level of confidence is given for a change in fish health and survival, since the Project-related effects to fish habitat (i.e., water quality) are based on the water quality modelling which used a conservative approach; however, the overall potentially affected fish species are well studied and their habitat preferences are well known to allow for prediction of effects associated with reasonably foreseeable future projects.						

Notes:
[A] Descriptors are provided in the respective VC chapters.
[B] Significance definitions are provided in the respective VC chapters.

20.6 VEGETATION, WETLANDS, TERRAIN AND SOILS

20.6.1 Past and Ongoing Effects

The Project is located within the Central Newfoundland Forest Ecoregion, which has the warmest summers and coldest winters on the Island, with potential for night frost year-round, which excludes some hardwood tree species from the area (NLDFLR 2019b2019a). The landscape is characterized by remote upland forests interspersed by wetlands (bogs / fens), krummholtz, barrens and waterbodies. The dense forests are composed of balsam fir (*Abies balsamea*) and black spruce (*Picea mariana*), common to Central Newfoundland Forests. While the majority of the area is in a relatively natural state, road

construction, timber harvesting, mineral exploration, mining, recreational use, hydro developments, and various other ground-disturbing activities have occurred in the past.

Species and community diversity, and wetland function may be influenced by natural processes such as disease, insect pests, severe weather events, or fires, and human activities, including industrial / urban development, pesticides, pollution, and the introduction of invasive species. Invasive species can outcompete and displace native species, particularly rare species which can be slow growing or have narrow habitat requirements. No vascular plant SAR were observed during field surveys, and three Species of Conservation Concern (SOCC) were observed (Section 9.2.2.2), two of which were observed within the Project Area, nodding water nymph (*Najas flexilis*, S2) and perennial bentgrass (*Agrostis perennans*, S2).

The landscape in central Newfoundland is characterized by upland forests and interspersed lowlands [i.e., wetlands (e.g., peatlands and treed wetlands)], and open water habitats (Section 9.2). Most landforms within the LAA and Project Area are not unique, and 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).

Soil, terrain and terrain stability conditions may be influenced by flooding, landslides, or wildfires, which can occur naturally or as a result of anthropogenic disturbance. 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. Changing temperatures, as a result of climate change, may also affect soil nutrient cycling patterns and micro – mesofauna habitats, which may affect soil quality.

Past, present and ongoing projects / activities in the vicinity of the Project that may contribute to anthropogenic pressures on vegetation, wetlands, terrain, terrain stability and soils include other mining and exploration, forestry, off-road vehicles, and hydroelectric development (Table 20.9). However, the effects of previous activities and natural environmental influences are reflected in the existing conditions for the Vegetation, Wetlands, Terrain and Soils VC (Section 9.2), and the assessment of residual effects (Section 9.5). This assessment includes consideration of the current condition (e.g., health or quality) of potentially affected vegetation, wetlands, terrain, terrain stability and soils, as well as the potential resiliency or sensitivity to further environmental change resulting from the Project in combination with other ongoing projects and activities that may affect the same VC.

20.6.2 Potential Project-Related Contributions to Cumulative Effects

As described in Chapter 9, routine Project activities and components have the potential to interact with vegetation, wetlands, terrain, terrain stability and soils through direct disturbance. Direct disturbance, primarily through construction activities, may cause changes in species diversity, community diversity, and wetland function by changing the occurrence of provincially-listed or federally-listed plant SAR or species of Indigenous importance, or by the introduction of invasive species, as well as through direct loss of vegetation communities, including wetlands. 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 cause a change in wetland area or wetland class or type, leading to a change in wetland function. Soil quality and quantity may be affected by ground disturbance and vegetation clearing. Compaction and contamination of soils are possible, as well as soil volume losses due to construction and operation activities. Construction activities such as vegetation clearing, soil salvage, road construction, grading, construction of water management areas, and drainage runoff ditches 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. The Project, therefore, has potential to result in the following residual effects on vegetation, wetlands, terrain, terrain stability and soils:

- A change in species diversity
- A change in community diversity
- A change in wetland function
- A change in soil quality and quantity
- A change in terrain (landforms) and terrain stability

The Project-specific effects assessment for this VC includes a summary of residual environmental effects in Section 9.5, and a determination of significance in Section 9.6. With the implementation of mitigation (Section 9.4), the effects of routine Project-alone activities on vegetation, wetlands, terrain, terrain stability and soils are predicted to be not significant.

20.6.3 Other Projects and Activities and Their Effects

Table 20.9 summarizes past, present, ongoing, and future projects and activities in the cumulative effects RAA that have potential to cause a change in species diversity, community diversity, wetland function, soil quality and quantity, and terrain (landforms) and terrain stability, thereby affecting vegetation, wetlands and soils.

Table 20.9 Vegetation, Wetlands, Terrain and Soils: Residual Effects from Other Projects and Activities in the Cumulative Effects RAA

Physical Activity	Potential Effects on this VC from Other Projects / Activities	VC-Specific Spatial / Temporal Considerations and Effect Pathways
Past, Present and Ongoing Projects / Activities		
Mining and Exploration	• A change in species diversity • A change in community diversity • A change in wetland function • A change in soil quality and quantity • A change in terrain (landforms) and terrain stability	• Most mining Projects listed in Table 20.1 are no longer in operation or are in the closure and rehabilitation phase. Therefore, temporal overlap will not occur. • Effects from ongoing mining and exploration activities in the cumulative effects RAA may temporally overlap with Project activities and are anticipated to have similar pathways as effects arising from the Project. Pathways include direct disturbance (primarily construction activities) that may result in changes in species diversity, community diversity and wetland function; or to soil quality or quantity, terrain and terrain stability; changes to hydrological outputs that

Table 20.9 Vegetation, Wetlands, Terrain and Soils: Residual Effects from Other Projects and Activities in the Cumulative Effects RAA

Physical Activity	Potential Effects on this VC from Other Projects / Activities	VC-Specific Spatial / Temporal Considerations and Effect Pathways
		could result in raising or lowering of the water table, in turn causing a change in wetland area, class, type, or function; compaction and contamination of soils and soil volume losses due to construction and operation activities. • Mining projects in the decommissioning, rehabilitation and closure phases may temporally overlap with Project activities and are anticipated to have similar adverse environmental effects associated with changes in species diversity, community diversity, and wetland function through deposition of dust from transportation, and ground disturbance associated with the removal of infrastructure. Changes to terrain stability could result from decommissioning which may result in changes to the natural or constructed landscape and change or increase the potential for mass movement events to occur.
Forestry	• A change in species diversity • A change in community diversity • A change in wetland function • A change in soil quality and quantity • A change in terrain (landforms) and terrain stability	• Effects from forestry activities may spatially and temporally overlap with Project activities. • Forestry activities potentially have similar effect pathways as those from the Project. Pathways include direct disturbance that may result in changes in species diversity, community diversity, and wetland function by changing the occurrence of species or by the introduction of invasive species; ground disturbance and vegetation clearing that may result in changes to soil quality and quantity; compaction and contamination of soils and soil volume losses due to construction and operation activities; and construction activities such as vegetation clearing, soil salvage, road construction, grading, construction of water management areas, and drainage runoff ditches that may result in changes to terrain and terrain stability.
Hunting, Outfitting, Trapping, and Fishing	• N/A	• Effects from hunting, outfitting, trapping, and fishing activities are not anticipated to interact with Project activities that would affect vegetation, wetlands, terrain, terrain stability and soils given that these activities are aimed at harvesting animals and do not result in ground disturbance that could change vegetation diversity, wetland function, soil quality or quantity, or terrain stability.
Aquaculture	• N/A	• Effects from aquaculture activities on the south coast of the Island of Newfoundland are not anticipated to interact with Project activities that would affect vegetation, wetlands, terrain and soils, given the distance from the Project Area (89 km). Aquaculture effects are primarily related to a change in habitat or mortality risk for marine animals and avifauna near the aquaculture activities (Barrett et al. 2019).

Table 20.9 Vegetation, Wetlands, Terrain and Soils: Residual Effects from Other Projects and Activities in the Cumulative Effects RAA

Physical Activity	Potential Effects on this VC from Other Projects / Activities	VC-Specific Spatial / Temporal Considerations and Effect Pathways
Off-road Vehicles (Snowmobiling and ATV)	• A change in species diversity • A change in community diversity • A change in wetland function	• Effects from off-road vehicles may spatially and temporally overlap with Project activities. • The use of off-road vehicles may promote the spread of invasive species, which may result in changes to species diversity, community diversity and wetland function by changing the occurrence of native species. • Off-road vehicles, although on a much smaller scale than mining activities, may also cause destruction of vegetation within and near ATV trails, and can alter wetland hydrology, area and function. However, given the small scale of destruction, it is not anticipated that the overall effect would result in a change in species diversity, community diversity, wetland function, overall soil quality and quantity, or terrain (landforms) and terrain stability on a landscape scale.
Hydroelectric Developments	• A change in species diversity • A change in community diversity • A change in wetland function • A change in soil quality and quantity • A change in terrain (landforms) and terrain stability	• Effects from hydroelectric developments may spatially and temporally overlap with Project activities. • Hydroelectric development activities are anticipated to have similar effects as those predicted from the Project that may result in changes in species diversity, community diversity, and wetland function, 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 cause a change in wetland area, class, type, and/or function, as well as changes in terrain or terrain stability, and changes to soil quality and quantity.
Existing Linear Features (i.e., highways / roads and power lines)	• A change in species diversity • A change in community diversity • A change in wetland function	• Effects from existing linear features may spatially and temporally overlap with Project activities. • The existence of linear features, such as roads, may increase traffic to the area and cause the spread of invasive species, which may result changes in species diversity, community diversity and wetland function by changing the occurrence of native species.
Future Projects / Activities		
Cape Ray Gold Project	• A change in species diversity • A change in community diversity • A change in wetland function • A change in soil quality and quantity • A change in terrain (landforms) and terrain stability	• The Cape Ray Gold Project may temporally overlap with Project activities. • Activities associated with the Cape Ray Gold Project potentially have similar effects as those arising from the Project. Pathways, which are discussed further in Section 20.6.4. .

Table 20.9 Vegetation, Wetlands, Terrain and Soils: Residual Effects from Other Projects and Activities in the Cumulative Effects RAA

Physical Activity	Potential Effects on this VC from Other Projects / Activities	VC-Specific Spatial / Temporal Considerations and Effect Pathways
Buchans Resources Limited Project	• A change in species diversity • A change in community diversity • A change in wetland function • A change in soil quality and quantity • A change in terrain (landforms) and terrain stability	• The Buchans Resources Limited Project may temporally overlap with Project activities. • Activities associated with the Buchans Resources Limited Project potentially have similar pathways as effects arising from the Project, which are discussed further in Section 20.6.4.
NL Hydro Power Line from Star Lake to the Project Area	• A change in species diversity • A change in community diversity • A change in wetland function • A change in soil quality and quantity • A change in terrain (landforms) and terrain stability	• The NL Hydro Power Line from Star Lake to the Project Area will spatially and temporally overlap with Project activities. • The NL Hydro Power Line will potentially have similar pathways as effects arising from the Project, including direct disturbance (primarily related to construction) that may result in changes in species diversity, community diversity, wetland function, terrain, and terrain stability; ground disturbance and vegetation clearing that may result in changes to soil quality and quantity; compaction and contamination of soils and soil volume losses due to construction and operation activities.
N/A = No potential interactions with vegetation, wetlands, terrain and soils have been identified		

20.6.4 Potential Cumulative Environmental Effects

As indicated in Section 20.6.1, vegetation, wetlands, terrain and soils are subject to numerous pressures which can affect species diversity, community diversity, wetland function, soil quality and quantity, and terrain (landforms) and terrain stability. These pressures include disease, insect pests, severe weather events, or fires, human activities, including industrial / urban development, pesticides, pollution, and the introduction of invasive species, as well as flooding, landslides, or wildfires, which can occur naturally or as a result of anthropogenic disturbance. Key cumulative effects pathways associated with the Project include direct ground disturbance and vegetation clearing, changes to hydrological outputs, compaction and contamination of soils due to construction and operation activities, and construction activities such as vegetation clearing, soil salvage, road construction, grading, construction of water management areas, and drainage runoff ditches that may result in changes to terrain and terrain stability. This section describes the pathways of the cumulative effects resulting from the Project and other projects identified in Table 20.9, mitigation measures to reduce cumulative effects, and the nature of the cumulative effects in the context of the residual effects of other projects.

Past, present and ongoing activities / projects that are predicted to contribute to cumulative effects on vegetation, wetlands, terrain and soils include mining and exploration, forestry, off-road vehicles, hydroelectric development, and existing linear features (Table 20.9). However, potential cumulative

effects of these projects / activities have been accounted for in the existing conditions and residual environmental effects (Chapter 9) and are not discussed further.

Future activities / projects that are predicted to contribute to cumulative effects on vegetation, wetlands, soils and terrain include the Cape Ray Gold Project, Buchans Resources Limited Project, and NL Hydro Power Line from Star Lake to the Project Area (Table 20.9). These projects potentially have similar pathways as effects arising from the Project, including a change in species diversity, community diversity, wetland function, soil quality and quantity, and terrain (landforms) and terrain stability.

20.6.4.1 Change in Species Diversity and/or Community Diversity

The primary cumulative environmental effects pathway for change in species diversity within the cumulative effects RAA is vegetation removal, resulting in a direct disturbance that may cause a change in species diversity by changing the occurrences or population attributes of secure, SAR, SOCC, and non-native (exotic) and invasive plants. Other pathways include transportation along access roads that could promote the spread of invasive or exotic species, or could 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). Project-related changes in hydrology as well as those from reasonably foreseeable future projects and activities may affect plant species and communities that cannot tolerate the changed hydrologic conditions.

The contribution of Project-related residual adverse effects to cumulative effects on change in species diversity will be low. In total (including all potential pathways), it is expected that plants within approximately 65.7 km^2 of vegetation habitat could be altered by the Project (Section 9.5). This represents approximately 3.6% of the 1,830.6 km^2 of vegetation habitat within the ELCA (which constitutes 20.5% of the Vegetation, Wetlands, terrain and Soils RAA, and therefore, the estimated proportion of Project-related change in habitat is conservative), and less than 0.16% of vegetation habitat within the cumulative effects RAA (41,641 km^2). This reduction in vegetation habitat could result in a change in species diversity through a decline in the number of occurrences of vascular plant SOCC, and some common traditional use plant resources important to Indigenous groups in the LAA, as well as a potential for increase in the occurrences of invasive plant species. The reduction could also result in a change in community diversity through a decline in the areal extent of ecological communities or vegetation types in the LAA. The change in species diversity will occur once during the construction phase and will continue throughout 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 on a change in species diversity is reversible, the loss of some habitats for SOCC within the mine site will be permanent. 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) develop over timeframes not considered within this assessment.

Environmental assessment documents have not been submitted for the Cape Ray Gold Project, Buchans Resources Limited Project, or the NL Hydro Power Line; therefore, habitat loss estimates are not available. The Cape Ray Gold Project EA review will determine whether residual effects resulting in change in species and/or community diversity for vegetation are significant. Given the distance from the Project, it is anticipated that residual adverse effects from the Cape Ray Gold Project will not contribute

substantially to cumulative effects, and residual cumulative effects will not threaten the long-term persistence, viability, or recovery of vegetation species in the cumulative effects RAA.

Buchans Resources Limited has not yet submitted a Project Registration to regulators; therefore, a project area has not been defined and existing conditions are not available. Resources of this project are within an area equal to less than 1 km^2 of surface area, which is less than both the Marathon and Leprechaun pits. The potential future Buchans Resource Limited mine will likely have similar project activities, the potential effects on change in species and/or community diversity for vegetation may be at a smaller or similar scale as the Project, which has been determined to be not significant (Section 9.6). It is therefore anticipated that the resulting contribution to cumulative effects will be low and the overall residual cumulative effects will not threaten the long-term persistence, viability, or recovery of vegetation species in the cumulative effects RAA.

The NL Hydro Power Line from Star Lake may result in a change in species and community diversity for vegetation via the permanent removal and clearing of vegetation. The proposed routing is shown on Figure 2-36 and a typical power line requires a cleared 15 m right-of-way. The power line will be subject to its own environmental assessment review and is anticipated to have industry-standard mitigation measures to reduce residual adverse effects resulting in change in species and community diversity for vegetation.

Although specific habitat requirements are not understood for many vascular plant species, high-level habitat for vegetation species, including SOCC, is relatively common throughout the cumulative effects RAA (NLDFLR 2019c). The Project and those projects and activities that may interact cumulatively are not likely to result in a reduction in the amount or composition of vegetation habitat that would threaten the persistence or viability of vegetation species within the cumulative effects RAA. For SOCC that may be affected by the Project, specific mitigation measures will be developed as required by regulatory agencies.

20.6.4.2 Change in Wetland Function

The primary cumulative environmental effect pathway for change in wetland function within the cumulative effects RAA is through direct disturbance or a change in hydrology, resulting in a loss of or disturbance to the areal extent of wetland ecosystems, or a change in wetland functions. Access road upgrades and realignments where vegetation clearing is necessary will also result in loss of wetland area and related changes to wetland function. Edge effects, through site preparation and other clearing, can affect wetlands by changing abiotic conditions for plants and increasing susceptibility of wetlands to invasive species.

The contribution of Project-related residual adverse effects to cumulative effects on change in wetland function will be low. In total, 30.2 km^2 of wetland habitat, or 4.0% of wetland habitat within the ELCA (which constitutes 20.5% of the Vegetation, Wetlands, Terrain and Soils RAA, and therefore, the estimated proportion of Project-related change in wetland function is conservative), may be directly or indirectly affected by the Project during construction and operation. This is equivalent to less than 0.07% of lost or altered wetland habitat from existing conditions within the cumulative effects RAA (41,641 km^2). This can result in a change in wetland function and will occur once during the construction phase,

however the effect 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, develop over timeframes not considered within this assessment.

Environmental assessment documents have not been submitted for the Cape Ray Gold Project, Buchans Resources Limited Project, or the NL Hydro Power Line, therefore, habitat loss estimates are not available. The 2016 Cape Ray Gold Project Description / Registration document states that no wetland information was available for the region at the time of its preparation and that it will be collected as part of the EA process during a baseline data collection program (Nordmin 2016). The EA review process will determine whether residual adverse effects resulting in change in wetland function are significant, however, it is anticipated that residual adverse effects will be compliant with section 5.1 of the NL *Policy for Development in Wetlands*, and will not result in a loss of more than 10% of wetland area within the Cape Ray Gold Project RAA. If wetland loss is similar to the expected loss caused by the Project (less than 0.07% of the cumulative effects RAA), the total residual cumulative percent of wetland habitat loss between the Project and the three other reasonably foreseeable future projects outlined here is not likely to amount to more than 10% of the cumulative effects RAA.

As described above, Buchans Resources Limited has not yet submitted a Project Description or Project Registration, however, a description of the Lundberg deposit on their website states that resources are contained within an area equal to less than 1 km² of surface area, which is less than both the Marathon and Leprechaun pits. Given that the Buchans Resources Limited Project will have similar activities to the Project, the potential effects resulting in change in wetland function may be at a smaller or similar scale as the Project, which has been determined to be not significant (Section 9.6) and contributes a less than 0.07% reduction in wetland area within the cumulative effects RAA.

The activities and potential footprint associated with the NL Hydro Power Line from Star Lake are described above. It has potential to result in a change in wetland function through ground disturbance and removal / clearing of vegetation. The power line is subject to its own EA review and will be required to implement industry-standard mitigation measures to reduce residual adverse effects resulting in change in wetland function.

20.6.4.3 Change in Soil Quality and Quantity and/or Terrain and Terrain Stability

The primary cumulative environmental effect pathway for change in soil quality and quantity are construction activities that involve ground disturbance and vegetation clearing, while activities that create dust are considered a secondary effect pathway on soil quality. The contribution of Project-related residual adverse effects to cumulative effects on change in soil quality and quantity and/or terrain and terrain stability will be low. Project activities that involve vegetation clearing, overburden removal (e.g., site preparation, pit construction, construction of water features), soil stockpile storage, dust effects, and upgrading / realigning of the access road during construction has the potential to effect 34.8 km² 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). This represents less than 0.09% of land area altered from existing conditions within the

cumulative effects RAA (41,641 km^2). Project-related residual effects on soils are not necessarily 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.

With mitigation, the Project is predicted to result in a low adverse residual effect on a change in soils quality and quantity. The duration of the effect will be long-term and will be reversible for soil quality, and irreversible for soil quantity. Changes in terrain stability may change the potential for mass movement processes that may affect Project facilities and infrastructure, terrain (unique landforms), fluvial processes, and soil erosion. Terrain stability has potential direct and indirect effects which can affect other ecosystem components, such as vegetation and aquatic habitats. With the implementation of mitigation, 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).

The 2016 Cape Ray Gold Project Description / Registration document described the characteristic soils of their project area as Ferro-Humic Podzols and Humo –Ferric Podzols, which are course textured, extremely stony and boulder, shallow, lacking in organic matter and nutrients, and therefore unsuitable for agricultural purposes. It also states that organic soils in the form of Typic Mesisols occur throughout the study area and Orthic Regosols occur on the lower terraces along the rivers and streams. These soils have poor moisture holding capacity because of their coarse textures and are susceptible to inundation because of their location (Nordmin 2016). The EA review will determine whether residual adverse effects resulting in change in soil quality and quantity and/or terrain and terrain stability are significant; however, given the distance from the Project, it is anticipated that residual adverse effects in combination with Project-related residual effects will not result in substantial residual cumulative effects.

As described above, Buchans Resources Limited has not yet submitted a Project Description or Project Registration, however, a description of the Lundberg deposit on their website states that resources are contained within an area equal to less than 1 km² of surface area, which is less than both the Marathon and Leprechaun pits. Therefore, the potential effects on change in soil quality and quantity, and/or terrain and terrain stability may be at a smaller or similar scale as the Project, which has been determined to be not significant (Section 9.6) and will likely affect less than 0.09% of the land area within the cumulative effects RAA.

The activities and potential footprint associated with the NL Hydro Power Line from Star Lake are described above. The power line will be subject to its own EA review and is anticipated to have mitigation measures to reduce effects on change in soil quality and quantity, and/or terrain and terrain stability.

There are multiple Project-related interactions that result in change in soil quality and quantity, and/or terrain and terrain stability; however, they are clearly associated with specific and finite Project phases and particular activities for which mitigation measures exist. This is also generally considered to be the case for other future physical activities within the cumulative effects RAA. With the implementation of the Project's mitigation measures, and the assumption that other, future potential projects will be required to have the same or similar standards, it is anticipated that the cumulative environmental effects on change

in soil quality and quantity, and/or terrain and terrain stability will not alter soils such that successful rehabilitation to self-sustaining ecosystems with an average capability relative to that present at existing conditions are prevented. Furthermore, cumulative effects on terrain will not substantially alter the function of ecologically or culturally important landforms, and unstable terrain will not be affected such that successful slope stability mitigation measures do not prevent and/or protect as per regulatory guidelines.

20.6.5 Cumulative Effects Summary and Evaluation

The cumulative effects on vegetation, wetlands, terrain and soils of past, present, ongoing and reasonably foreseeable projects and activities, in combination with the environmental effects of the Project, are summarized in Table 20.10.

Although the three identified reasonably foreseeable future projects are anticipated to have similar effects as the Project, the Project and reasonably foreseeable future activities and projects will have a small contribution to the overall cumulative environmental effects. With the implementation of mitigation measures and regulatory requirements, the overall cumulative environmental effect (i.e., the effect of all future foreseeable activities within the cumulative effects RAA) resulting in change in species diversity and community diversity of vegetation is predicted to be adverse, low in magnitude, occurring within the cumulative effects RAA, and long-term. Although the change in species diversity and community diversity will occur once during the construction phase of each project, the effects will be continuous throughout the life of each project and may be reversible in some cases and irreversible in the case of SAR and SOCC, which may be permanently lost. Effects will occur within disturbed environments.

The overall residual cumulative effects on wetland function are predicted to be adverse, low in magnitude (amounting to less than 10% reduction in wetland area within the Vegetation, Wetlands, Terrain and Soils RAA and cumulative effects RAA), occurring within the cumulative effects RAA, and long-term. Although the change in wetland function will occur once during the construction phases of each project, the effect will be continuous throughout each project and will be irreversible due to the loss of some wetland areas that may not recover over timeframes considered in this assessment. Effects will occur within disturbed environments.

Residual cumulative effects on change in soil quality and quantity, and/or terrain and terrain stability are predicted to be adverse, low in magnitude, occurring within the cumulative effects RAA, and long-term, as the change will extend beyond the life of the Project. Although the change in soil quality and quantity, and/or terrain and terrain stability will, in some cases occur once or as an irregular event during each project, the effects will be continuous throughout each project and will be reversible (except in some cases for soil quantity and changes in terrain). Effects will occur within disturbed environments.

With mitigation, the cumulative effects from the Project and reasonably foreseeable future activities are expected to be not significant (Significance Definition provided in Section 9.3.2).

Table 20.10 Summary of Potential Cumulative Effects for Vegetation, Wetlands, Terrain and Soils

Residual Cumulative Effect[A]	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological and Socio-economic Context
	A	L	RAA	LT	C	R/IR	D
Contribution from the Project to the Residual Cumulative Effect[B]	Project-related contributions to cumulative effects on change in species diversity, community diversity, wetland function, soil quality and quantity, and terrain (landforms) and terrain stability will be low, with 0.13 to 0.7% of land area lost or altered from existing conditions within the cumulative effects RAA. Overall, the Project will result in a low, adverse, long-term, irreversible residual effect within the LAA.						
Significance[B]	Cumulative effects resulting from the Project and reasonably foreseeable future activities are expected to be minor, as effects are anticipated to be low in magnitude. Some upland and wetland habitat will be lost or altered; however, vegetation and wetland habitat remain abundant and widespread throughout the cumulative effects RAA. Residual adverse effects on soil quality and quantity, and/or terrain and terrain stability are also anticipated to be low. With mitigation, the cumulative effects from the Project and reasonably foreseeable future activities are expected to be not significant (Significance Definition Section 9.3.2). Although there are limitations in the available information of the effects from other present, past and future physical activities, a conservative approach was taken to estimate the cumulative effects (e.g., permanent loss of project areas and footprints of future physical activities). The predicted effects are similar to those that have occurred during other mining and power line projects / activities, thereby increasing the confidence in the assessment. Given the level of confidence is moderate to high for Project-related residual effects significance, and the limitations associated with existing environment data and project details of the three identified future projects, the level of confidence is considered moderate in the conclusions of the cumulative effects assessment for the Vegetation, Wetlands, Terrain and Soils VC. This level of confidence is based on the quantity and quality of data available, the conservative approach taken to assessment (Section 9.3.5), professional judgement and experience with similar projects, and effectiveness of mitigation measures, which reflect best industry practices.						

Notes:
[A] Descriptors are provided in the respective VC chapters.
[B] Significance definitions are provided in the respective VC chapters.

20.7 AVIFAUNA

20.7.1 Past and Ongoing Effects

The Project lies within 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 (Protected Areas Association 2008). The region includes a variety of avifauna species commonly found in the boreal forest in Newfoundland. 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 Atlantic Canada Conservation Data Centre (AC

CDC), Breeding Bird Survey and field surveys (Section 10.2). Broadly, the avifauna groups present in this area include passerines, waterfowl, upland gamebirds and raptors, and are described further in Section 10.2.

Existing avifauna distribution, abundance and health for secure species, SAR and SOCC have been influenced by natural phenomena, such as weather, parasites, competition for food and territory, and predation, and by human activities, including industrial / urban development, hunting, emissions, pesticides, and other pollution. Natural and anthropogenic influences on the avifauna groups identified within the cumulative effects RAA are described below. Additional information on avifauna existing conditions are provided in Section 10.2.

Passerines are limited by forest fragmentation, climate change, forest harvesting and wetland removal, 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 (Cornell Lab 2020; Mowbray 1997; Arcese et al. 2002).

Waterfowl are subject to harvesting pressure and predation (Mowbray et al. 2002), as well as delayed snow melt, which results in late starts to nest initiation and smaller than average clutch size (Raveling 1978). Habitat alteration and other anthropogenic disturbances affect American black duck more intensively than other waterfowl (Longcore et al. 2000). Timing of availability and stratification in the water column of invertebrate prey, as well as competition, are also limiting factors for American black ducks (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 associated with hunting shots, which may cause reduced growth rates and decreased productivity (Cornell Lab 2020).

Raptors, such as northern harriers are limited by habitat loss, and alteration of wetlands and grasslands, principally to agriculture and urban development. Availability and abundance of prey species, such as meadow voles for northern harriers and fish for osprey, is one of the most important factors controlling populations (Sandilands 2005). Other limiting factors include the application of fire to control vegetation in grassland areas, the use of pesticides, hunting pressure (Ewins and Houston 1992), and inclement weather (Chubbs and Trimper 1998).

Upland gamebirds, such as ruffed grouse, are limited by habitat requirements and reduced mobility throughout all life stages (Nalcor Energy 2012), while predation and harvesting are likely the greatest sources of mortality for adult spruce grouse (Cornell Lab 2020). Hunting and trapping, habitat degradation, predation (primarily by birds of prey), and harvesting, as well as pesticides and other contaminants, have also been identified as limiting factors (Rusch et al. 2000; Sandilands 2005). 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).

There are multiple natural and anthropogenic pressures for the SAR observed in the vicinity of the Project. The olive-sided flycatcher is limited by 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 2018). Habitat loss and the use of pesticides that reduce insect prey availability are thought to be the primary limiting factors (Nalcor Energy 2012). Limiting factors for the 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). Mercury has also been determined to be a key threat to rusty blackbirds (Edmonds et al. 2010).

Caspian terns typically breed in colonies located on islands in large lakes or offshore islands. Given that the observed 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 observed, the low numbers of individuals present in the NL 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.

Past, present and ongoing projects / activities in the vicinity of the Project that may contribute to anthropogenic pressures on avifauna include other mining and exploration, forestry, hunting, outfitting, trapping, and/or fishing, off-road vehicles, hydroelectric development, and existing linear features (Table 20.11). These pressures may cause a change in habitat or mortality risk for avifauna within the region. The effects of previous activities and natural environmental influences are reflected in the existing conditions for the Avifauna VC (Section 10.2) and the assessment of residual effects (Section 10.5). This assessment includes consideration of the current condition (e.g., health or quality) of potentially affected bird populations and their habitats, as well as their potential resiliency or sensitivity to further environmental change resulting from the Project in combination with other ongoing projects and activities that may affect the same VC.

20.7.2 Potential Project-Related Contributions to Cumulative Effects

As described in Chapter 10, routine Project activities and components have the potential to result in adverse environmental effects on avifauna through direct and indirect loss of habitat, as well as an increased risk of mortality for avifauna species. Direct loss of habitat will occur during the construction and decommissioning phases of the Project through physical removal of vegetation. Indirect loss of habitat may extend into the LAA through habitat avoidance resulting from sensory disturbance during all phases of the Project. During the construction phase, clearing activities (vegetation removal) will be the primary pathway to Project-related change in mortality risk which could result in the direct mortality of eggs or flightless young birds. Project-related traffic during all phases of the Project could result in equipment and vehicles crushing or colliding with avifauna individuals and/or avifauna colliding with Project-related infrastructure or equipment. The Project, therefore, has potential to result in the following residual effects on avifauna, which could contribute to cumulative effects:

- A change in habitat
- A change in mortality risk

The Project-specific effects assessment for this VC includes a summary of residual environmental effects in Section 10.5 and a determination of significance in Section 10.6. With the implementation of mitigation (Section 10.4), the effects of routine Project-alone activities on avifauna are predicted to be not significant.

20.7.3 Other Projects and Activities and Their Effects

Table 20.11 summarizes past, present, ongoing, and future projects and activities in the cumulative effects RAA that have potential to cause a change in habitat and mortality risk, thereby affecting avifauna.

Table 20.11 Avifauna: Residual Effects from Other Projects and Activities in the Cumulative Effects RAA

Physical Activity	Potential Effects on this VC from Other Projects / Activities	VC-Specific Spatial / Temporal Considerations and Effect Pathways
Past, Present and Ongoing Projects / Activities		
Mining and Exploration	• Change in habitat • Change in mortality risk	• Most mining projects listed in Table 20.1 are no longer in operation or are in the closure and rehabilitation phase; therefore, once rehabilitated, no temporal overlap will occur. However decommissioning activities may temporally overlap with Project activities and are anticipated to have similar adverse environmental effects associated with change in mortality risk from collisions between avifauna and mining-related traffic, and positive effects associated with a change in habitat, as habitat is restored. • Effects from ongoing mining activity in the cumulative effects RAA may temporally overlap with Project activities and are predicted to have similar effect pathways as those from the Project, including a change in habitat resulting from sensory disturbance effects (e.g., noise and light emissions), as well as change in mortality risk from collisions between avifauna and mining-related traffic and equipment. • Effects from mineral exploration activities may temporally overlap with Project activities and are predicted to have similar effect pathways as those from the Project, including a direct change in habitat resulting from the physical removal of vegetation, and an indirect change in habitat resulting from sensory disturbance (e.g., noise and light emissions). A change in mortality risk is also expected from collisions between avifauna and exploration mining-related traffic and equipment.

Table 20.11 Avifauna: Residual Effects from Other Projects and Activities in the Cumulative Effects RAA

Physical Activity	Potential Effects on this VC from Other Projects / Activities	VC-Specific Spatial / Temporal Considerations and Effect Pathways
Forestry	• Change in habitat • Change in mortality risk	• Effects from forestry activities may spatially and temporally overlap with Project activities. • Forestry activities are predicted to have similar effect pathways as those from the Project, including a direct change in habitat resulting from the physical removal of vegetation and an indirect change in habitat resulting from sensory disturbance (e.g., noise emissions). A change in mortality risk may occur from collisions between avifauna and forestry-related traffic and equipment, or the crushing of eggs or flightless young birds during the removal of vegetation.
Hunting, Outfitting, Trapping, and Fishing	• Change in mortality risk	• Effects from hunting, outfitting, trapping, and fishing activities may spatially and temporally overlap with Project activities. • Hunting, outfitting, trapping, and fishing activities may cause a change in mortality risk; however, effects are anticipated to be low, affecting only individuals of avifauna and not populations.
Aquaculture	• N/A	• Effects from aquaculture activities on the south coast of the Island of Newfoundland are not anticipated to interact with Project activities given the distance from the Project Area (89 km), and change in mortality risk associated with aquaculture activities will also be within the immediate area of aquaculture activities.
Off-road Vehicles (Snowmobiling and ATV)	• Change in habitat • Change in mortality risk	• Effects from off-road vehicle use may spatially and temporally overlap with Project activities. • Off-road vehicles, although on a much smaller scale potentially, have similar effects as those arising from the Project. Effects include a direct change in habitat resulting in destruction of vegetation near ATV trails and an indirect change in habitat resulting from sensory disturbance (e.g., noise emissions). A change in mortality risk may occur from nest disturbance from ATVs or snowmobiles.
Hydroelectric Developments	• Change in habitat • Change in mortality risk	• Effects from hydroelectric developments may spatially and temporally overlap with Project activities. • Hydroelectric development activities potentially have similar effects as those arising from the Project. Effects include a direct change in habitat resulting from destruction or flooding of vegetation or habitat during the flooding phase of damming activities, and an indirect change in habitat resulting from sensory disturbance (e.g., noise emissions) during construction or maintenance operation. An indirect change in habitat may also result from effects on fish and invertebrate species that avifauna rely on as a food source. A change in mortality risk may occur from collisions between avifauna and hydroelectric-related traffic and equipment.

Table 20.11 Avifauna: Residual Effects from Other Projects and Activities in the Cumulative Effects RAA

Physical Activity	Potential Effects on this VC from Other Projects / Activities	VC-Specific Spatial / Temporal Considerations and Effect Pathways
Existing Linear Features (i.e., highways / roads and power lines)	• Change in mortality risk	• Effects from existing linear features may spatially and temporally overlap with Project activities. • Existing linear features will potentially result in a change in mortality risk by increasing access to avifauna by predators (due to edge effects), nest parasites and hunters, as well as avifauna collisions with power lines.
Future Projects / Activities		
Cape Ray Gold Project	• Change in habitat • Change in mortality risk	• The Cape Ray Gold Project may temporally overlap with Project activities. • Activities associated with the Cape Ray Gold Project are predicted to have similar effects as those arising from the Project, including a direct change in habitat resulting from removal of vegetation during construction and removal of infrastructure during decommissioning, as well as indirect change in habitat due to sensory disturbance effects (e.g., noise and light emissions). A change in mortality risk for avifauna is also anticipated through collisions between avifauna and Project-related traffic and equipment, exposure to TMFs and contact ponds, and increased predation resulting from increased access.
Buchans Resources Limited Project	• Change in habitat • Change in mortality risk	• The Buchans Resources Limited Project may temporally overlap with Project activities. • Expected activities associated with the Buchans Resources Limited Project are predicted to have similar effect pathways as those from the Project, including a direct change in habitat resulting from removal of vegetation during construction and removal of infrastructure during decommissioning, as well as indirect change in habitat due to sensory disturbance effects (e.g., noise and light emissions). A change in mortality risk for avifauna is also anticipated through collisions between avifauna and Project-related traffic and equipment, exposure to TMFs and contact water ponds, and increased predation resulting from increased access.
NL Hydro Power Line from Star Lake to the Project Area	• Change in habitat • Change in mortality risk	• The NL Hydro Power Line from Star Lake to the Project Area may spatially and temporarily overlap with Project activities. • The NL Hydro Power Line is predicted to have similar effect pathways as those from the Project, including a direct change in habitat resulting from removal of vegetation during construction, as well as indirect change in habitat due to sensory disturbance effects (e.g., noise and light emissions). A change in mortality risk for avifauna is also anticipated during construction of the power line through collisions between avifauna and NL Hydro Power Line-related traffic and equipment, as well as increased predation resulting from increased access through the creation of new linear features.
Note: N/A = No potential interactions with avifauna have been identified		

20.7.4 Potential Cumulative Environmental Effects

As indicated in Section 20.7.1, avifauna are subject to numerous pressures that can affect bird distribution, abundance and health. These pressures include industrial / urban development (e.g., mining and forestry), hunting, emissions, pesticides, and other pollution. Key cumulative effects pathways associated with the Project include removal of vegetation and construction activities, emissions (e.g., noise and light), and traffic collisions, which could potentially result in cumulative changes in habitat and mortality risk. This section describes the pathways of the cumulative effects resulting from the Project and other projects identified in Table 20.11, mitigation that could be implemented to reduce cumulative effects, and the nature of the cumulative effects in the context of the residual effects of other projects.

As described above in Section 20.7.1, past, present and ongoing activities / projects that are predicted to contribute to cumulative effects on avifauna include mining and exploration, forestry, hunting, outfitting, trapping, and/or fishing, off-road vehicles, hydroelectric development, and existing linear features (Table 20.11). However, potential cumulative effects of these projects / activities have been accounted for in the existing conditions and residual environmental effects (Chapter 10) and are not discussed further.

Future activities / projects that are predicted to contribute to cumulative effects on avifauna include the Cape Ray Gold Project, Buchans Resources Limited Project and NL Hydro Power Line from Star Lake to the Project Area (Table 20.11). These projects potentially have similar pathways as effects arising from the Project, including a change in habitat and a change in mortality risk.

20.7.4.1 Change in Habitat

The primary cumulative environmental effect pathway for change in habitat within the cumulative effects RAA is vegetation removal, resulting in a direct change in habitat, while indirect effects are associated with sensory disturbance (e.g., noise and light emissions) and resulting avoidance behaviour. The contribution of Project-related residual adverse effects to cumulative effects on change in habitat will be low, with approximately 34.8 km² of potential avifauna habitat removed within the Project Area and approximately 51 km² of avifauna habitat predicted to be changed due to sensory effects. This equates to less than 0.13% reduction from existing conditions within the cumulative effects RAA (41,641 km²).

Environmental assessment documents have not been submitted for the Cape Ray Gold Project, Buchans Resources Limited Project, or the NL Hydro Power Line, therefore, habitat loss estimates are not available. However, the Cape Ray Gold Project Description states that although information on waterfowl and passerines is not available, anecdotal reports suggest that the area may be used by migrating waterfowl in the spring and fall, and that waterfowl production in the project area is not considered substantial. Surveys revealed the presence of only one species of raptor, with two ospreys (*Pandion haliaetus*) recorded; however, they predict that other raptor species have the potential to occur in the project area (Nordmin 2016). The EA review for the Cape Ray Gold project will determine whether residual adverse effects resulting in change in habitat for avifauna are significant. Given the distance from the Project, it is anticipated that residual adverse effects will not contribute substantially to cumulative effects on avifauna habitat, and will not threaten the long-term persistence, viability, or recovery of an avifauna species population in the cumulative effects RAA.

Buchans Resources Limited has not yet submitted a Project Description or Project Registration; therefore, a project area has not been defined. As noted above, the Lundberg deposit is equal to less than one km^2 of surface, which is less than both the Marathon and Leprechaun pits. Given that the Buchans Resources Limited Project will have similar project activities, the potential residual adverse effects resulting in change in habitat for avifauna may be at a smaller or similar scale as the Project, which has been determined to be not significant (Section 10.6). It is therefore anticipated that the resulting contribution to cumulative effects will not threaten the long-term persistence, viability, or recovery of an avifauna species population in the cumulative effects RAA.

The NL Hydro Power Line from Star Lake will result in a change in habitat for avifauna via the permanent removal and clearing of vegetation and sensory disturbance during the construction and maintenance phases. The distance and route are not yet determined however a typical power line requires a cleared 15 m right-of-way, a portion of which will be within the Project Area. This power line will result in a direct loss of habitat within the cumulative effects RAA, as well as edge effects. The power line will be subject to a separate EA review and is anticipated to have mitigation measures to reduce effects on changes in habitat for avifauna.

Habitat for avifauna, including SAR and SOCC, is widespread throughout the cumulative effects RAA. Past and ongoing projects and activities (e.g., hydro and forestry and linear developments and historical mining), have affected individual occurrences of avifauna, including SAR and SOCC, which are reflected in the existing conditions (and status) for these species. It is unlikely, however, that Project effects, in combination with effects from other projects and activities, would result in a reduction in the amount or composition of habitats within the cumulative effects RAA that would threaten the persistence or viability of avifauna, including SAR and SOCC. This prediction assumes that other projects and activities in the cumulative effects RAA will be required to comply with various mitigation measures and regulations, including legal requirements to protect migratory birds such as clearing outside the bird breeding season.

20.7.4.2 Change in Mortality Risk

The primary cumulative environmental effect pathway for change in mortality risk within the cumulative effects RAA are vegetation clearing, traffic, and increased human and predator access. Increased mortality risk from the Project is primarily confined to the construction phase, and this phase carries the highest risk for nesting birds. Lower risk of mortality is associated with traffic-related collisions during all phases of the Project. Effects are not predicted to result in substantial change in the abundance of avifauna in the cumulative effects RAA, however, potential for temporary local shifts in distributions. Mortality risk will eventually return to existing conditions post-closure. The contribution of Project-related residual adverse effects to cumulative effects on change in mortality risk will also be low, as the residual adverse effect on avifauna for the Project is predicted to be within the normal variability of existing conditions and is not expected to affect the long-term persistence or viability of avifauna within the Avifauna RAA (Section 10.5). Environmental assessment documents have not been submitted for the Cape Ray Gold Project or the Buchans Resources Limited Project; however, it is predicted that effect pathways would be similar to those describe for the Valentine Gold Project. It is assumed that the Project's mitigation measures, as well as other project's mitigation measures, will reduce the risk of mortality for avifauna.

The NL Hydro Power Line from Star Lake to the Project Area may result in an increase in mortality risk during the construction phase of the project, through removal of vegetation. However, it is expected that NL Hydro will have industry-standard mitigation measures in place to reduce mortality to avifauna (e.g., nesting bird surveys), and therefore it is predicted that the increase in mortality risk will be low. The Power line may act as access routes for humans and predators. The greatest increase in mortality risk associated with the power line will be short-term, resulting from site clearing and construction. A change in mortality risk may also result from collisions between avifauna and project-related traffic throughout the region; however, the Project's mitigation measures, as well as NL Hydro's mitigation measures, will reduce the risk of mortality for avifauna.

As described in Section 10.5, there are multiple Project-related interactions that result in increased mortality risk; however, they are clearly associated with specific and finite Project phases and activities for which mitigation measures exist. It is assumed that other projects and activities in the cumulative effects RAA, including reasonably foreseeable future projects and activities, will be required to comply with similar mitigation measures and requirements from regulators. This is also generally considered to be the case for other future physical activities within the cumulative effects RAA. With the implementation of the Project's and other projects' mitigation measures, it is anticipated that the cumulative environmental effects resulting in change in mortality risk for avifauna will not affect the long-term persistence or viability of avifauna within the cumulative effects RAA.

20.7.5 Cumulative Effects Summary and Evaluation

The cumulative effects on avifauna of past, present, ongoing, and reasonably foreseeable projects and activities, in combination with the environmental effects of the Project, are summarized in Table 20.12.

Although ongoing activities (i.e., forestry) and the three identified reasonably foreseeable future projects are anticipated to have similar effects as the Project, the Project and reasonably foreseeable future activities and projects will have a minor contribution to the direct and indirect loss or alteration of avifauna habitat in the cumulative effects RAA, including for SAR and SOCC. The cumulative environmental effect on habitat is characterized as adverse, low magnitude (a measurable change in area of avifauna habitat that is unlikely to affect the long-term persistence or viability of wildlife within the cumulative effects RAA), short to long-term, a single event for construction and continuous for operation and decommissioning, reversible, and occurring in both disturbed and undisturbed environments in the cumulative effects RAA.

With the implementation of the mitigation measures, including mitigation measures and regulatory requirements implemented by other projects and activities in the cumulative effects RAA, the overall cumulative environmental effect (i.e., the effect of all future foreseeable activities within the cumulative effects RAA) on avifauna mortality risk is characterized as adverse, low magnitude (a measurable change in mortality risk that is unlikely to affect the long-term persistence or viability of avifauna within the cumulative effects RAA), regional (RAA), long-term, single (construction-related) to irregular event (traffic-related), reversible, and occurring in both disturbed and undisturbed environments in the cumulative effects RAA.

With mitigation, the cumulative effects from the Project and reasonably foreseeable future activities are expected to be not significant (Significance Definition provided in Section 10.3.2).

Table 20.12 Summary of Potential Cumulative Effects for Avifauna

Residual Cumulative Effect[A]	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological and Socio-economic Context
	A	L	RAA	LT	S-C	R	D
Contribution from the Project to the Residual Cumulative Effect[A]	Project-related contributions to cumulative effects on change in habitat will be low, with less than 0.13% reduction from existing conditions within the cumulative effects RAA, and less than 0.6% of the Project's Avifauna RAA. The amount of high and moderate value habitat lost for the majority of species is less than 5% of the ELCA. Project-related contributions to cumulative effects on change in mortality risk will be primarily confined to the construction phase, and this risk is highest for nesting birds. Lower risks are associated with traffic-related collisions during all phases of the Project. Effects are anticipated to be low in magnitude, affecting individual avifauna, with no substantial change in the abundance of avifauna in the cumulative effects RAA, however potential for temporary local shifts in distributions.						
Significance[B]	Cumulative effects resulting from the Project and reasonably foreseeable future activities are expected to be minor, as effects are anticipated to be low in magnitude. Some upland and wetland habitat will be lost or altered for avifauna, including SAR and SOCC; however, habitat remains abundant and widespread throughout the cumulative effects RAA. Future activities combined with potential Project effects (i.e., changes in habitat and mortality risk) are not expected to measurably affect the abundance or sustainability of avifauna in the cumulative effects RAA. With mitigation, the cumulative effects from the Project and reasonably foreseeable future activities are expected to be not significant. The prediction confidence in the final determination of significance is considered moderate. This level of confidence is based on the quantity and quality of data available, the conservative approach taken to assessment (Section 10.3.5.1), professional judgement and experience with similar projects, effectiveness of mitigation measures, which reflect best industry practices and regulatory requirements (e.g., preferentially clearing outside bird breeding season).						

Notes:
[A] Descriptors are provided in the respective VC chapters.
[B] Significance definitions are provided in the respective VC chapters.

20.8 CARIBOU

20.8.1 Past and Ongoing Effects

The four assessed caribou herds occur primarily within the Maritime Barrens, Long Range and Central Newfoundland Forest Ecoregions. Existing conditions for caribou in the cumulative effects RAA are influenced by natural occurrences such as predation, forage availability, parasites and weather. Caribou are also affected by human activities including development, forestry activities and hunting. Effects of natural and anthropogenic conditions on caribou in the cumulative effects RAA are described below. Additional information on the existing conditions for caribou is provided in Section 11.2.

The primary predators of caribou on the Island of Newfoundland are black bear and coyote. Predation is the primary cause of caribou mortality on the Island. While adult mortality rates have remained relatively consistent (i.e., rates from 2004-2011 are similar to 1979-1997), calf mortality rates have increased (i.e., higher in the early 2000s compared to 1979-1997) (Government of NL 2015). The calf survival rate (i.e., proportion of calves surviving to six months) between 1979 and 1997 was approximately 66%, however decreased to less than 8% in 2003 (Mahoney et al. 2015). Approximately 90% of calf deaths were attributed to predation (Lewis and Mahoney 2014). Calf survival may be improving as the calf survival rate was nearly 50% in 2012 (Mahoney et al. 2015).

Lichens are the most important vegetation for woodland caribou (Government of NL 2020a) and are consumed as forage in all seasons (Boertje 1984; Thomas et al. 1994; Thompson et al. 2015). In 2000, the caribou population on the Island of Newfoundland reached 94,000 (Government of NL 2015); however, since that time, numbers have declined to approximately 30,000 caribou (NLDFLR in Randell 2019). Research on the Island 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 (Schaefer et al. 2016), and a decrease in body size during the population decline (Mahoney et al. 2011) indicate that forage availability was limited by high caribou density.

Weather conditions affect several aspects of caribou ecology including distribution, movement, predation rates, calf survival and population size. Increasing snow depth has been shown to increase predation rates of other ungulate species (Post et al. 1999; Patterson and Messier 2000). On the Island of Newfoundland, the amount of early spring snowfall may affect site fidelity of the Buchans herd during calving (Mahoney and Schaefer 2002a). For some migratory caribou in Labrador and Quebec, the start and end of migration was linked to temperatures and amount of precipitation, possibly due to their effects on the snow (Le Corre at al. 2017). High amounts of snowfall during gestation can reduce calf birth weights (Adams 2005). While calf survival in some regions may be higher in years of early snow melt (Bergerud and Elliot 1986), Lewis and Mahoney (2014) found no relationship between climate and calf survival in on the Island.

Caribou require large interconnected, lichen-rich, mature coniferous forests interspersed with barrens and wetlands (Environment Canada 2012; Weir et al. 2014; Government of NL 2020a). 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) that provide the greatest amounts of lichen and other preferred forage. The avoidance of anthropogenic disturbance and its effects are well documented in 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. Avoidance of disturbance could shift caribou into less ideal habitat. Caribou home-range size and the size of calving ranges have been found to increase with increasing disturbance (McCarthy et al. 2011; Beauchesne et al. 2014), possibly to compensate for lost habitat. Avoidance of development could affect movement patterns and could result in increased energetic costs resulting from use of less efficient migration paths (Fullman et al. 2017; Wyckoff et al. 2018).

Historical migration paths for caribou in central Newfoundland were located at the east end of Victoria Lake Reservoir (Bergerud 1971, 1974; Bergerud et al. 1984), approximately where the Project is located. By the late 1970s, a portion of the caribou range had been flooded by several hydro developments, some of which overlapped the traditional migration corridor for the Buchans herd (Bergerud et al. 1984). The Star Lake hydro development, which overlapped the migration corridor for the Buchans herd, was completed in 1998 (Mahoney and Schaefer 2002a). Caribou were shown to avoid the Star Lake development and altered their timing of migration during construction (Mahoney and Schaefer 2002a). Subsequent research suggested that the change in timing of migration may have been influenced by the increasing population and forage limitation on the summer range (Mahoney and Schaefer 2002b). Analysis of existing telemetry data show continued use of these traditional corridors between 2005 and 2018.

Caribou distribution can also be affected by forestry. Caribou on the Island of Newfoundland 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 also been found to increase with increasing clearcut density, possibly to compensate for the change in habitat (Beauchesne et al. 2014). Areas burned by forest fire are avoided by caribou, particularly in winter, as caribou may select other undisturbed habitat types with higher amounts of lichen (Schaefer and Pruitt 1991).

The Project Area overlaps with Caribou Management Areas (CMAs) 62 and 63 (Figure 11-12), 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 / 2021 is 38 resident licenses and 37 non-resident licenses (Government of NL 2020b). Increased access to caribou habitat through development can increase harvest rates and access to caribou herds via winter roads can contribute to an increase in hunting efficiency (Boulanger et al. 2011). Following the construction of the Newfoundland railway across central Newfoundland in the late 1890s, hunters would aggregate along the railway line to hunt caribou as they migrated south in fall (Bergerud et al. 1984). Between 1900 and 1915, an estimated 15,000 caribou were hunted in this area (Bergerud 1971), although caribou continued to migrate across the railroad (Bergerud et al. 1984).

Past, present and ongoing projects / activities in the cumulative effects RAA that may contribute to anthropogenic pressures on caribou include mining and exploration, forestry, hunting, off-road vehicles, hydroelectric development, and existing linear features (Table 20.13). These pressures have likely affected a change in caribou habitat, movement, or mortality risk for caribou in the cumulative effects RAA, and the effects of previous activities and natural environmental influences are reflected in the existing conditions for the caribou VC in Section 11.2, and the assessment of residual effects (Section 11.5). The assessment includes consideration of the existing condition of caribou habitat, and caribou resiliency or sensitivity to further environmental change resulting from the Project in combination with other ongoing projects and future activities that may affect them.

20.8.2 Potential Project-Related Contributions to Cumulative Effects

As described in Chapter 11, Project activities and components have the potential to result in adverse environmental effects on caribou through a change in habitat directly and indirectly, avoidance of Project structures and activities, a disruption of an existing migration corridor or movement patterns, direct

mortality from vehicular collisions, and increased predation due to changes in predator abundance. These effects are adverse, and some have the potential to be long-term in the Caribou RAA. Therefore, Project residual effects have the potential to result in cumulative residual effects on caribou for:

- A change in habitat
- A change in movement
- A change in mortality risk

The Project-specific effects assessment for this VC includes a summary of residual environmental effects in Section 11.5 and a determination of significance in Section 11.6. With the implementation of mitigation measures (Section 11.4), Project residual effects on caribou are predicted to be significant.

20.8.3 Other Projects and Activities and Their Effects

Table 20.13 summarizes past, present, ongoing, and reasonably foreseeable future projects and activities that are known or could have residual effects on change in habitat, change in movement, or change in mortality risk for caribou in the cumulative effects RAA. These effects could act cumulatively with Project residual effects.

Table 20.13 Caribou: Residual Effects from Other Projects and Activities in the Cumulative Effects RAA

Physical Activity	Potential Effects on this VC from Other Projects / Activities	VC-Specific Spatial / Temporal Considerations and Effect Pathways
Past, Present and Ongoing Projects / Activities		
Mining and Exploration	• Change in habitat • Change in movement • Change in mortality risk	• Past mining and exploration activities (Table 20.1) have occurred within the cumulative effects RAA however are no longer active, therefore there is no temporal overlap. Previous vegetation clearing and construction of infrastructure will affect habitat availability, and remaining infrastructure may affect caribou movement. • Activities associated with the operational mines (e.g., Barite Mud Services and Beaver Brook Antimony Mine) may temporally overlap with Project activities (i.e., seasonal operation) and potentially have similar pathways as effects arising from the Project, including a change in habitat resulting from direct habitat loss and sensory disturbance (e.g., noise and light emissions), change in movement resulting from avoidance of activity and infrastructure during migration, change in mortality risk from vehicle collisions, and changes to predator density or hunting activity. • Ongoing mineral exploration (i.e., Buchans-Mary March Project and Mineral Exploration) may temporally overlap with Project activities and potentially have similar pathways as effects arising from the Project, including a change in habitat resulting from direct habitat loss and sensory disturbance (e.g., noise and light emissions), change in movement resulting from avoidance of activity and infrastructure during migration, and change in mortality risk

Table 20.13 Caribou: Residual Effects from Other Projects and Activities in the Cumulative Effects RAA

Physical Activity	Potential Effects on this VC from Other Projects / Activities	VC-Specific Spatial / Temporal Considerations and Effect Pathways
		from vehicle collisions, and changes to predator density or hunting activity. • Activities during closure and rehabilitation (e.g., Duck Pond Mine) may temporally overlap with Project activities and potentially have similar pathways as effects arising from the Project. While some habitat may be restored by rehabilitation, some habitat loss will persist. There may also be avoidance of activity and sensory disturbance. Change in movement may be affected by avoidance of closure activities and mortality may be affected by vehicle collisions or changes to predator density or hunting activity. The sensory disturbance and change to mortality risk resulting from closure and rehabilitation activities may not be as large as during construction.
Forestry	• Change in habitat • Change in movement • Change in mortality risk	• Effects from forestry activities in the cumulative effects RAA may temporally overlap with Project activities (i.e., seasonal operation) and are predicted to have similar effect pathways as those from the Project, including a change in habitat resulting from harvest and sensory disturbance (e.g., noise and light emissions), change in movement resulting from avoidance of activity and cut blocks during migration, change in mortality risk from vehicle collisions, and changes to predator density or hunting activity.
Hunting, Outfitting, Trapping, and Fishing	• Change in habitat • Change in movement • Change in mortality risk	• Effects from hunting, outfitting, trapping, and fishing activities in the cumulative effects RAA may temporally overlap with Project activities. They are predicted to have similar effect pathways as those from the Project, including change in mortality risk from increased hunter activity. These activities will not result in direct habitat loss, however human activity could cause sensory disturbance. Movement could also be affected by caribou avoidance of activity during migration.
Aquaculture	• N/A	• Effects from aquaculture activities on the south coast of the Island of Newfoundland are not anticipated to interact with Project activities given the distance from the Project Area (89 km). Therefore, effects on caribou associated with aquaculture are not anticipated to act cumulatively with Project residual effects in the cumulative effects RAA.
Off-road Vehicles (Snowmobiling and ATV)	• Change in habitat • Change in movement • Change in mortality risk	• Effects from off-road vehicle use in the cumulative effects RAA may temporally overlap with Project activities. • Effects of off-road vehicles will be similar to those arising from the Project. Effects include direct habitat change due to creation of trails, and indirect change due to sensory disturbance (e.g., noise). Caribou may avoid the trails or activity which could affect movement. There may also be a change in mortality due to collision with vehicles.

Table 20.13 Caribou: Residual Effects from Other Projects and Activities in the Cumulative Effects RAA

Physical Activity	Potential Effects on this VC from Other Projects / Activities	VC-Specific Spatial / Temporal Considerations and Effect Pathways
Hydroelectric Developments	• Change in habitat • Change in movement • Change in mortality risk	• Effects from hydroelectric developments may temporally overlap with Project activities and are predicted to have similar effect pathways as those from the Project, including a change in habitat resulting from direct habitat change due to clearing, indirect change due to sensory disturbance (e.g., noise and light emissions), change in movement due to avoidance of activity and infrastructure during migration, change in mortality risk due to potential vehicle collisions, and changes in predator density or hunter activity.
Existing Linear Features (i.e., highways / roads and power lines)	• Change in habitat • Change in movement • Change in mortality risk	• Effects from existing linear features potentially have similar pathways as effects arising from the Project. Use of these features may temporally overlap with Project activities. Effect pathways include avoidance of structures and sensory disturbance from vehicle activity (e.g., noise and light emissions), change in movement resulting from avoidance of activity and infrastructure during migration, and change in mortality risk from vehicle collisions.
Future Projects / Activities		
Cape Ray Gold Project	• Change in habitat • Change in movement • Change in mortality risk	• The Cape Ray Gold Project may temporally overlap with Project activities. • The Cape Ray Gold Project is 126 km from the Project's mine site. • Activities associated with the Cape Ray Gold Project potentially have similar effects as those arising from the Project, including a direct change in habitat within the Cape Ray Gold Project area resulting from removal of vegetation during construction and removal of infrastructure during decommissioning, and an indirect change in habitat due to sensory disturbance effects (e.g., noise and light emissions), which could extend beyond the Cape Ray Gold project area. The project could affect caribou movement through avoidance of activity and infrastructure during the migration. There may also be a change in mortality risk through collisions with project-related traffic and equipment, exposure to TMFs and contact ponds, and increased predation and harvesting.
Buchans Resources Limited Project	• Change in habitat • Change in movement • Change in mortality risk	• The Buchans Resources Limited Project may temporally overlap with Project activities. • The Buchans Resources Limited project area (not yet defined) is approximately 48 km from the Marathon Project mine site. • Activities associated with the Buchans Resources Limited Project potentially have similar pathways as effects arising from the Project, including a direct change in habitat within the project area resulting from removal of vegetation during construction and removal of infrastructure during decommissioning, and an indirect change in habitat due to sensory disturbance effects (e.g., noise and light emissions), which could extend beyond the Buchans

Table 20.13 Caribou: Residual Effects from Other Projects and Activities in the Cumulative Effects RAA

Physical Activity	Potential Effects on this VC from Other Projects / Activities	VC-Specific Spatial / Temporal Considerations and Effect Pathways
		Resources Limited project area. The project could affect caribou movement through avoidance of activity and infrastructure during the migration. A change in mortality risk may also occur through collisions with project-related traffic and equipment, exposure to TMFs and contact ponds, and increased predation and harvesting.
NL Hydro Power Line from Star Lake to the Project Area	• Change in habitat • Change in movement • Change in mortality risk	• The NL Hydro Power Line from Star Lake to the Project Area will spatially and temporally overlap with Project activities. • The NL Hydro Power Line will potentially have similar pathways as effects arising from the Project within the Project Area and LAA, including a direct change in habitat resulting from removal of vegetation during construction, as well as indirect change in habitat due to sensory disturbance effects (e.g., noise and light emissions). The NL Hydro Power Line could affect caribou movement through avoidance of activity and infrastructure during the migration. Increased mortality risk may result from collisions with project-related traffic and equipment and increased predation and harvesting.
N/A = No potential interactions with caribou have been identified		

20.8.4 Potential Cumulative Environmental Effects

Section 20.8.1 describes the factors that influence caribou distribution, abundance, movement, and mortality in the cumulative effects RAA. These factors include anthropogenic disturbances such as development (e.g., mining and forestry) and hunting. Key cumulative effects pathways associated with the Project include habitat loss from removal of vegetation and construction activities, sensory disturbance (e.g., noise and light), traffic collisions, and increased predation / harvesting, which could potentially result in cumulative changes in caribou habitat, movement and mortality risk. This section describes the pathways of potential cumulative effects resulting from the Project and the projects identified in Table 20.13, mitigation measures that will be implemented to reduce the Project's contribution to cumulative effects, and the nature of the cumulative effects in the context of the residual effects of other projects.

Past, present and ongoing activities / projects that are predicted to contribute to cumulative effects on caribou include mining and exploration, forestry, hunting, outfitting, trapping, and/or fishing, off-road vehicles, hydroelectric developments, and existing linear features (Table 20.13). Potential cumulative effects of these projects / activities have been accounted for in the existing conditions and residual environmental effects (Chapter 11) and are not discussed further in this chapter.

Future activities / projects that are predicted to contribute to cumulative effects on caribou include the Cape Ray Gold Project, Buchans Resources Limited Project, and NL Hydro Power Line from Star Lake to

the Project Area (Table 20.13). These projects potentially have similar pathways as effects arising from the Project, including a change in caribou habitat, movement and mortality risk.

20.8.4.1 Change in Habitat

Future projects / activities have similar pathways as those of the Project (Section 11.5) and have the potential to result in a cumulative change in habitat during the construction, operation, and decommissioning, rehabilitation and closure phases of the Project. The primary pathways for change in caribou habitat are a direct change in habitat through vegetation clearing and mine construction, and an indirect change through sensory disturbance. Direct change of habitat from the Project will be restricted to the LAA and will be irreversible. Indirect change of habitat may extend into the Caribou RAA due to caribou avoidance of habitat because of sensory disturbance, which will occur in all Project phases. The contribution of Project-related residual adverse effects to cumulative effects on change in habitat is anticipated to be low, with only a small portion of suitable habitat changed in the ELCA (which constitutes 6.4% of the Caribou RAA, and therefore, the estimated proportion of Project-related change in habitat is conservative). Results indicate that the percentage of high and moderate-ranked change in habitat in the ELCA, including sensory disturbance, will be 5.5% (Section 11.5), which is 0.2% of the cumulative effects RAA (area: 40,484 km^2). This suggests that abundant suitable habitat will remain for all caribou in the ELCA, and especially so in the cumulative effects RAA.

Environmental assessment documents have not been submitted for the Cape Ray Gold Project, Buchans Resources Limited Project, or the NL Hydro Power Line; therefore, habitat loss estimates are not available. Based on existing telemetry data obtained from NLDFFA-Wildlife Division (locations from Atmospheric Research Geostationary Orbit Satellite and Global Positioning System (GPS) collars, 2005-2018), the summer ranges of the La Poile and Grey River herds are nearest to the Cape Ray Gold project. The 2016 Project Description for Cape Ray Gold Project identified caribou as the most abundant large mammal in the project area (Nordmin 2016) indicating some use of the area by uncollared caribou. The EA review for the Cape Ray Gold Project will determine if that project will have a significant residual adverse effect on caribou habitat. However, as the Cape Ray Gold Project appears to have little overlap with caribou ranges, it is anticipated that residual adverse effects from that project are not likely to interact cumulatively with the residual effects of the Project in the cumulative effects RAA.

As Buchans Resources Limited has not submitted a Project Description or Project Registration to regulators, the boundaries of its project area are not available. The project consists of four deposits: Lundberg deposit, Daniels Pond deposit, Bobbys Pond deposit, and Tulks Hill deposit. While information is not available for all deposits, resources in the Lundberg deposit are contained within an optimized model pit shell measuring approximately 860 m by 650 m (Buchans Resources Ltd. 2020), which is less than 1 km^2 of surface area and smaller than each of the Marathon pits. The Buchans Resources Limited Project is expected to have activities that are similar to the Project, with similar potential project effects on caribou habitat. Although the Buchans Resources Limited Project overlaps with the ranges of the Buchans and Gaff Topsails herds, its project effects on caribou are likely to be minor based on spatial extent, and therefore make a relatively small contribution to cumulative effects.

The NL Hydro Power Line from Star Lake will result in a change in habitat for caribou due to permanent vegetation removal during construction, and sensory disturbance during maintenance. The proposed

power line route is shown on Figure 2-36 and a typical power line right-of-way is approximately 15 m wide. The power line will be subject to its own EA review and is anticipated to include mitigation measures to reduce effects on change in habitat on caribou.

Vegetation clearing can result in habitat fragmentation, which can have particularly detrimental effects on species with large ranges, and that require large patches of interior forest or other types of homogenous habitat (e.g., caribou). As caribou require large, interconnected tracts of lichen-rich forest (Environment Canada 2012), changes in habitat that affect the interconnectivity between optimal habitat patches may have effects on caribou in addition to the change in habitat. Caribou have been shown to avoid assemblages of different habitats types and the boundaries between them (Stuart-Smith et al. 1997; Smith et al. 2000). Some forest fragmentation will occur as a result of the Project mine site and the future activities / projects, particularly the NL Hydro Power Line given it is located within the Caribou LAA and within the same corridor as the access road. As linear features such as roads and power lines are often avoided by caribou (Dyer et al. 2002; Vistnes et al. 2004), the creation of linear features within the cumulative effects RAA has the potential to fragment the habitat further.

Anthropogenic disturbances (sensory disturbance) are generally avoided by caribou. Caribou have been documented to have reduced use of areas within 2 to 11 km from mines (e.g., Weir et al. 2007; Polfus et al. 2011; Boulanger et al. 2012; Johnson et al. 2015), and within 250 m to 4 km of linear features (e.g., Dyer et al. 2001; Nellemann et al. 2003; Cameron et al. 2005; Leblond et al. 2014). The intensity of the sensory disturbance may also affect the degree of avoidance by caribou (Lesmerises et al. 2017, 2018).

As described in Section 11.5, Project-related light and noise emissions may result in avoidance due to sensory disturbance; however, they are associated with specific Project activities for which mitigation measures exist. This is also generally considered to be the case for other future physical activities within the cumulative effects RAA. With the implementation of the Project's mitigation measures, and of the assumed mitigation measures for other projects, it is anticipated that cumulative environmental effects resulting in change in habitat from sensory disturbance will not affect the long-term persistence or viability of the four assessed caribou herds within the cumulative effects RAA.

20.8.4.2 Change in Movement

The cumulative environmental effects pathways for change in caribou movement in the cumulative effects RAA are direct and indirect habitat loss and the alteration of caribou movement patterns. As caribou show avoidance of anthropogenic disturbance, developments have the potential to affect existing movement patterns. Documented effects of development on caribou movement include delays in crossing linear features, increased movement near disturbance, and avoidance of linear features and development (Murphy and Curatolo 1987; Dyer et al. 2002; Vistnes et al. 2004; MacNearney et al. 2016; Baltenspergber and Joly 2019). As caribou select migration paths based on features that include path efficiency, foraging opportunity, and reduced predation risk (Nicholson et al. 2016; Fullman et al. 2017; Baltenspergber and Joly 2019), disruptions to existing migration paths may result in caribou using lower suitability habitat during migration. Long term effects could include increased energetic demands (Fullman et al. 2017; Wyckoff et al. 2018), less suitable forage, and higher risk of predation.

The Project Area overlaps with the migration corridor for the Buchans herd. Existing telemetry data and data from remote cameras indicate that caribou move through the Project Area in fewer than seven days in the fall. Telemetry data showed the movement of collared caribou through the Project Area occurs over a two-week period during spring, although the dates were variable. However, data from the remote cameras indicated movement over a six week period: females moved through the Project Area during a two week period at the end of April, and male caribou moved through the area during a two week period at the end of May. The analysis of the migration corridor indicates that the preferred migration path overlaps the Project Area, meaning that much of the Buchans herd could be affected by construction of the Project. Mitigation measures such as temporal shut down during migration periods, delaying blasting activity if caribou are in the vicinity, facilitating caribou crossings across snowbanks or ditches, and aligning crossing points with existing migration paths will reduce the amount of sensory disturbance. However, these mitigation measures will not reduce the physical disruption to the existing migration path. The contribution of Project-related residual adverse effects to cumulative effects on change in caribou movement is predicted to be high. The residual adverse effects on caribou from the Project may be greater than the normal variability of existing conditions. Uncertainty in how caribou may respond to effects on their migration path affects the certainty of Project effects on the long-term persistence or viability of the Buchans caribou herd within the cumulative effects RAA (Section 11.5).

Future mining projects anticipated within the cumulative effects RAA (Cape Ray Gold and Buchans Resources Limited Projects) may affect caribou movement as those project sites may be avoided by caribou. However, while the activities of those projects are expected to have similar effects as the Project, neither the Cape Ray Gold nor Buchans Resources Limited mining projects appear to overlap a caribou migration corridor. Though there may still be some avoidance of these projects by caribou, the magnitude of effects is likely to be low if those developments do not overlap with a migration path. As such, the magnitude of effects on change in movement from future projects and activities may be less than for the Project. It is anticipated that the future developments will have mitigation measures in place to reduce project-related effects on movement.

The NL Hydro Power Line can also affect caribou movement. Power lines are avoided by caribou (Vistnes and Nellemann 2001; Plante et al. 2018), however some research has indicated that the degree of avoidance may decrease following the construction period (Eftestøl et al. 2016). As the NL Hydro Power Line to Star Lake will occur within the range of the Buchans herd, and will likely be situated near the existing migration corridor, it is possible that construction of the power line will incrementally contribute to cumulative effects. It is anticipated that mitigation measures designed to reduce the effects to caribou movement will be implemented by NL Hydro.

The Project has the potential to affect the migration of the Buchans herd. While the Cape Ray Gold and Buchans Resources Limited Projects are not anticipated to contribute to this effect, the NL Hydro Power Line may affect caribou movement within the cumulative effects RAA. With the implementation of the Project's mitigation measures, and assumed mitigation measures for the other projects, it is anticipated that cumulative environmental effects on change in movement may affect the long-term persistence or viability of the Buchans herd within the cumulative effects RAA. Uncertainty in how caribou may respond to cumulative effects on their migration path affects the certainty of cumulative effects on the long-term persistence or viability of the Buchans caribou herd within the cumulative effects RAA.

20.8.4.3 Change in Mortality Risk

The cumulative environmental effects pathways for change in mortality risk within the cumulative effects RAA are vegetation clearing and site preparation, vehicular collisions, and increased predation or hunting. Increased mortality risk as a result of Project-related vegetation clearing and site preparation will be primarily confined to the construction phase and mortality risk is expected to return to existing conditions post-closure. As only a small amount of habitat within the Caribou RAA will be affected by clearing and construction activities, the risk of direct mortality is low. Increased mortality risk due to vehicle collisions with caribou will occur in all Project phases however will be lowest during decommissioning when Project-related traffic is lowest. Most of the access road exists at baseline, and it may already be contributing to existing caribou mortality rates within the cumulative effects RAA.

Mortality risk may also be affected indirectly by the Project. Changes in the available habitat types resulting from habitat alteration may increase the densities of moose near the Project, which may lead to higher predation of caribou (James et al. 2004; Mumma et al. 2018). Additionally, linear features may be selected by black bears and coyotes, which could increase the amount of predation on caribou (Latham et al. 2013; Tigner et al. 2014; Hinton et al. 2015; Tomchuk 2019). Mitigation measures will be applied to reduce the risk of Project-related mortality. The contribution of Project-related residual adverse effects to cumulative effects on change in mortality risk for caribou are, therefore, anticipated to be low, as the residual adverse effect on caribou from the Project is anticipated to be within the range of normal variability of existing conditions, and is not expected to affect the long-term persistence or viability of the four assessed caribou herds within the cumulative effects RAA (Section 11.5).

The anticipated mining projects within the cumulative effects RAA (Cape Ray Gold and Buchans Resources Limited Projects) are expected to have similar effects on caribou, however the magnitude of the change in mortality risk is expected to be low and short to medium-term in duration as it will be primarily associated with site clearing and related activities during the construction phases of each project. The risk of caribou mortality may be affected by vehicular collisions with traffic related to the mining activities, or from changes in predator or alternative prey densities. Caribou mortality may also be increased through additional hunting. The Cape Ray Gold Project has a small amount of overlap with the ranges of the La Poile and Grey River herds, while the Buchans Resources Limited Project occurs within the range of the Gaff Topsails and Buchans herds. Mitigation measures to reduce caribou mortality risk will be applied to the Project including road safety measures to reduce the risk of collision, restricting public access to the Project, and banning hunting by employees. It is anticipated that future mining developments in the area will have similar mitigation measures.

The NL Hydro Power Line project also has the potential to increase caribou mortality risk. While unlikely, caribou mortality is possible during vegetation clearing activities during construction although this risk is likely to be short-term. The power line may act as an access route for humans and predators, although the right-of-way is not anticipated to create new access into previously undisturbed tracts of wilderness. Mitigation measures designed to reduce mortality risk will be applied for the Project. It is assumed that the NL Hydro Power Line project will also have mitigation measures aimed to reduce potential residual effects on caribou mortality risk.

There are multiple Project-related interactions that result in increased mortality risk (Section 11.5), for which mitigation measures will be applied (Section 11.4). It is assumed that when the mitigation measures associated with the future projects / activities are applied, then the cumulative environmental effects on change in caribou mortality risk from the Project and future projects are not expected to affect the long-term persistence or viability of the four assessed caribou herds within the cumulative effects RAA.

20.8.5 Cumulative Effects Summary and Evaluation

Cumulative effects on caribou resulting from past, present, ongoing, and reasonably foreseeable projects and activities, in combination with residual effects of the Project, are summarized in Table 20.14. Cumulative effects on change in habitat are characterized as adverse, low magnitude (a measurable change in area of caribou habitat that is unlikely to affect the long-term persistence or viability of the four assessed caribou herds within the cumulative effects RAA), regional (cumulative effects RAA), short to long-term, continuous, irreversible (direct change in habitat) and reversible (indirect change in habitat), and occurring in both disturbed and undisturbed environments in the cumulative effects RAA.

Cumulative effects on caribou movement are characterized as having a high magnitude (defined as a change of more than 50% of the proportion of caribou use in the migration corridor) effect on the Buchans herd and a low magnitude effect on the Gaff Topsails, La Poile and Grey River herds. The effect is predicted to be adverse, within the cumulative effects RAA, short to long-term, continuous, irreversible (developed areas will not be rehabilitated to existing conditions) and reversible (e.g., sensory disturbance), and occurring in both disturbed and undisturbed environments in the cumulative effects RAA. Cumulative effects on caribou mortality risk are characterized as adverse, low magnitude (a measurable change in mortality risk that is unlikely to affect the long-term persistence or viability of the four assessed caribou herds within the cumulative effects RAA), regional (cumulative effects RAA), long-term, irregular event, reversible, and occurring in both disturbed and undisturbed environments in the cumulative effects RAA.

With mitigation, the cumulative effects from the Project and reasonably foreseeable future activities are expected to be significant (significance definition provided in Section 11.3.2).

Table 20.14 Summary of Potential Cumulative Effects for Caribou

Residual Cumulative Effect[A]	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological and Socio-economic Context
	A	L-H	RAA	LT	C	IR	D
Contribution from the Project to the Residual Cumulative Effect[A]	Project-related contributions to cumulative effects on change in habitat will be low, with less than 0.2% change from existing conditions within the cumulative effects RAA. Project-related contributions to cumulative effects on change in movement have the potential to disrupt the preferred migration path of the Buchans herd. The magnitude of change in movement is high for this herd, as the Project has the potential to affect greater than 50% of the proportion of caribou use in the migration corridor. Project-related contributions to cumulative effects on change in mortality risk will be primarily confined to the construction and development phase although traffic-related collisions and increased predation / harvesting will occur in all Project phases. Effects are anticipated to be low in magnitude and may affect individual animals with no substantial change in long-term persistence or viability of the four assessed caribou herds within the cumulative effects RAA.						
Significance[B]	Cumulative effects resulting from the Project and reasonably foreseeable future activities are predicted to be high in magnitude. While a small amount of caribou habitat will be lost, suitable habitat remains abundant and widespread throughout the cumulative effects RAA. The movement of the Buchans herd may be affected due to overlap with the Project. The Project may contribute to a small change in caribou mortality risk; however, it is not anticipated to affect the viability of caribou in the RAA. Future activities combined with potential Project effects, specifically changes in movement, may measurably affect the abundance or sustainability of caribou (i.e., the Buchans herd) in the cumulative effects RAA. With mitigation, the cumulative effects from the Project and reasonably foreseeable future activities are expected to be significant. The prediction confidence in the final determination of significance is considered low to moderate. There is uncertainty in how the movement of the Buchans herd will be affected by the Project and from other future projects, as well as the effectiveness of the mitigation measures to reduce effects on change in movement. This level of confidence is based on: the quantity and quality of data available, the conservative approach taken in the assessment (Section 11.3.5.1), professional judgement and experience with similar projects, and the effectiveness of mitigation measures, which reflect best industry practices.						

Notes:
[A] Descriptors are provided in the respective VC chapters.
[B] Significance definitions are provided in the respective VC chapters.

20.9 OTHER WILDLIFE

20.9.1 Past and Ongoing Effects

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. Wildlife distribution, abundance, and health for secure species and SAR / SOCC has been influenced by natural phenomena, such as weather,

parasites, disease, competition for food and territory, predation, human activities, including industrial / urban development, hunting, emissions, pesticides, and other pollution. Natural and anthropogenic influences on the wildlife groups identified within the cumulative effects RAA are described below. Additional information on other wildlife existing conditions are provided in Section 12.2.

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). Predation rates may also increase with increasing snow depth as escape is more difficult (Huggard 1993). On the Island of Newfoundland, coyote and black bear are the primary moose predators. The predation rate from coyote and bears can limit moose populations (Ballenberghe and Ballard 1994; Zager and Beecham 2006).

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 often 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.

The largest pressure on furbearers comes from humans, particularly from hunting and trapping (e.g., beaver) (Nalcor Energy 2009; Stantec 2010; Government of NL n.d.b.). Human pressures also result in habitat loss and increased disturbance. For example, increasing road density may cause range contractions for Canada lynx (Bayne et al. 2008), and deforestation poses a large threat to forest-dependent furbearers. Predation pressure is also a limiting factor for furbearers such as muskrat and beaver. Predators of beaver and muskrat include Canada lynx, coyote, bears, owls and river otter (Payne 1985; Stantec 2010; Government 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 the muskrat population has been substantially reduced in some areas. Coyotes may be predators of Canada lynx (Government of NL n.d.b.). Winter starvation is a natural mortality for beaver in NL, which may be due to the sparse supply of deciduous trees for winter food (Payne 1985).

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 New York State in 2006. White-nose syndrome is caused by the dermatophyte fungus, *Pseudogymnoascus destructans*, which grows on the skin of bats during hibernation and eventually leads to death by starvation and/or dehydration (Verant et al. 2014; Frank et al. 2014; Cryan et al. 2010). White-nose syndrome was confirmed on the Island of Newfoundland in the winter of 2016 / 2017 (United States 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).

There are many factors that can limit marten populations. Sources of mortality for marten include predation by Canada lynx, great horned owls, hawk owls, fox (Government NL 2019c) 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 loss or alteration may result from forest harvesting, agricultural development, mining operations, hydroelectric projects, and the construction of roads and transmission / 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). Research in the Little Grand Lake / Red Indian Lake area of the Island of Newfoundland reported that trapping and snaring accounted for nearly 50% of marten mortalities (Hearn 2007).

Past, present and ongoing projects / activities in the vicinity of the Project that may contribute to anthropogenic pressures on other wildlife include other mining and exploration, forestry, hunting, outfitting, trapping, and/or fishing, off-road vehicles, hydroelectric development, and existing linear features (Table 20.15). These pressures may cause a change in habitat or mortality risk for wildlife within the region. However, the effects of previous activities and natural environmental influences are reflected in the existing conditions for the Other Wildlife VC, as described in Section 12.2, and the assessment of residual effects in Section 12.5. The assessment includes consideration of the current condition (e.g., health or quality) of potentially affected populations and their habitats, as well as their potential resiliency or sensitivity to further environmental change resulting from the Project in combination with other ongoing projects and activities that may affect the same VC.

20.9.2 Potential Project-Related Contributions to Cumulative Effects

As described in Chapter 12, routine Project activities and components can result in adverse environmental effects on other wildlife through direct and indirect loss of habitat, as well as an increased risk of mortality for other wildlife species. The three primary pathways for changes in habitat are vegetation clearing, sensory disturbance and edge effects. Direct loss of habitat will occur during the construction and decommissioning phases of the Project through physical removal of vegetation, stripping and stockpiling of organic and overburden material, and removal of infrastructure from the Project Area. 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). Indirect loss of habitat may extend into the LAA through habitat avoidance resulting from sensory disturbance and edge effects during all phases of the Project.

The pathways for change in mortality risk include vegetation clearing activities, vehicular collisions, human-wildlife conflicts, and predation and harvest pressure. During the construction phase, clearing activities (vegetation removal) will be the primary pathway to Project-related change in mortality risk which could result in the direct mortality of wildlife, particularly for young and/or immobile animals. During all phases of the Project, Project-related traffic could result in equipment and vehicles crushing or colliding with other wildlife individuals, and an increase of human presence in the area may lead to human-wildlife conflicts. The construction and/or upgrading of roads can increase access to the Project Area and LAA for both people and wildlife, which can result in increased hunting and predation pressure for furbearers and large game, including moose and black bear.

The Project, therefore, can result in the following residual effects on other wildlife which could contribute to cumulative effects:

- A change in habitat
- A change in mortality risk

The Project-specific effects assessment for this VC includes a summary of residual environmental effects in Section 12.5 and a determination of significance in Section 12.6. With the implementation of mitigation (Section 12.4), the effects of routine Project-alone activities on other wildlife are predicted to be not significant.

20.9.3 Other Projects and Activities and Their Effects

Table 20.15 summarizes past, present, ongoing, and future projects and activities in the cumulative effects RAA that have potential to cause a change in habitat or mortality risk, thereby affecting other wildlife.

Table 20.15 Other Wildlife: Residual Effects from Other Projects and Activities in the Cumulative Effects RAA

Physical Activity	Potential Effects on this VC from Other Projects / Activities	VC-Specific Spatial / Temporal Considerations and Effect Pathways
Past, Present and Ongoing Projects / Activities		
Mining and Exploration	• Change in habitat • Change in mortality risk	• Most mining Projects listed in Table 20.1 are no longer in operation; therefore, temporal overlap will not occur. Mining operations in the decommissioning, rehabilitation and closure phases are addressed below. • Effects of ongoing mining activity (e.g., Barite Mud Services and Beaver Brook Antimony Mine) may temporally overlap with Project activities and potentially have similar pathways as effects arising from the Project, including a change in habitat resulting from sensory disturbance effects (e.g., noise and light emissions), as well as change in mortality risk from collisions between other wildlife and mining-related traffic / equipment, and human-wildlife conflicts.

Table 20.15 Other Wildlife: Residual Effects from Other Projects and Activities in the Cumulative Effects RAA

Physical Activity	Potential Effects on this VC from Other Projects / Activities	VC-Specific Spatial / Temporal Considerations and Effect Pathways
		• Effects from exploration activities may temporally overlap with Project activities and potentially have similar pathways as effects arising from the Project, including a direct change in habitat resulting from the physical removal of vegetation and an indirect change in habitat resulting from edge effects, and sensory disturbance (e.g., noise and light emissions). A change in mortality risk may also occur as a result of collisions between other wildlife and exploration mining-related traffic / equipment, and human-wildlife conflicts. • Mining Projects in the decommissioning, rehabilitation and closure phases may temporally overlap with Project activities and are anticipated to have similar adverse environmental effects associated with change in habitat due to sensory disturbance and a change in mortality risk from collisions between other wildlife and mining-related traffic. Positive effects associated with a change in habitat may also occur as habitat is restored.
Forestry	• Change in habitat • Change in mortality risk	• Forestry activities will spatially and temporally overlap with Project activities. • Forestry activities potentially have similar pathways as effects arising from the Project, including a direct change in habitat resulting from the physical removal of vegetation and an indirect change in habitat resulting from edge effects and sensory disturbance (e.g., noise emissions). A change in mortality risk may occur from collisions between other wildlife and forestry-related traffic and equipment, particularly for young and immobile animals during site clearing activities.
Hunting, Outfitting, Trapping, and Fishing	• Change in mortality risk	• Effects from hunting, outfitting, trapping, and fishing activities may spatially and temporally overlap with Project activities. • Effects from hunting, outfitting, trapping, and fishing activities may cause a change in mortality risk. However, given regulatory quotas and protection for SAR, effects are anticipated to be low, affecting only individuals of other wildlife and not populations.
Aquaculture	• N/A	• Aquaculture activities on the south coast of the Island of Newfoundland are not anticipated to interact with Project activities given the distance from the Project Area (89 km).
Off-road Vehicles (Snowmobiling and ATV)	• Change in habitat • Change in mortality risk	• Effects from off-road vehicles may spatially and temporally overlap with Project activities. • Off-road vehicles, on a much smaller scale, are predicted to have similar effects as those arising from the Project. Effects include a direct change in habitat resulting in destruction of vegetation near ATV trails, and an indirect change in habitat resulting from sensory disturbance (e.g., noise emissions). A change in mortality risk may occur from collisions between other wildlife and ATVs or snowmobiles.

Table 20.15 Other Wildlife: Residual Effects from Other Projects and Activities in the Cumulative Effects RAA

Physical Activity	Potential Effects on this VC from Other Projects / Activities	VC-Specific Spatial / Temporal Considerations and Effect Pathways
Hydroelectric Developments	• Change in habitat • Change in mortality risk	• Effects from hydroelectric developments may spatially and temporally overlap with Project activities. • Hydroelectric development activities are predicted to have similar effects as those arising from the Project. Effects include a direct change in habitat resulting from destruction or flooding of vegetation or habitat during the flooding phase of damming activities, and an indirect change in habitat resulting from sensory disturbance (e.g., noise emissions) during construction or maintenance operations. An indirect change in habitat may also result from effects on fish and invertebrate species that other wildlife rely on as a food source. A change in mortality risk may occur from collisions between other wildlife and hydroelectric-related traffic and equipment.
Existing Linear Features (i.e., highways / roads and power lines)	• Change in mortality risk	• Effects from existing linear features may spatially and temporally overlap with Project activities. • Effects from existing linear features may potentially result in a change in mortality risk by increasing access to other wildlife by predators, nest parasites and hunters.
Future Projects / Activities		
Cape Ray Gold Project	• Change in habitat • Change in mortality risk	• The Cape Ray Gold Project may temporally overlap with Project activities. • Activities associated with the Cape Ray Gold Project potentially have similar effects as those arising from the Project, including a direct change in habitat within the project area resulting from removal of vegetation during construction and removal of infrastructure during decommissioning. Indirect changes in habitat due to edge effects and sensory disturbance effects (e.g., noise and light emissions) could extend slightly beyond the Cape Ray Gold Project area, 126 km from the Project's mine site. A change in mortality risk for other wildlife may also occur through collisions with project-related traffic and equipment, exposure to TMFs and sedimentation ponds, human-wildlife conflicts, and increased predation and harvesting resulting from increased access.

Table 20.15 Other Wildlife: Residual Effects from Other Projects and Activities in the Cumulative Effects RAA

Physical Activity	Potential Effects on this VC from Other Projects / Activities	VC-Specific Spatial / Temporal Considerations and Effect Pathways
Buchans Resources Limited Project	• Change in habitat • Change in mortality risk	• The Buchans Resources Limited Project may temporally overlap with Project activities. • Activities associated with the Buchans Resources Limited Project potentially have similar pathways as effects arising from the Project, including a direct change in habitat within the project area (not yet defined) resulting from removal of vegetation during construction, and removal of infrastructure during decommissioning. Indirect changes in habitat due to edge effects and sensory disturbance effects (e.g., noise and light emissions) could extend slightly beyond the Buchans Resources Limited project area, 48 km from the Project's mine site. A change in mortality risk for other wildlife may also occur through collisions with project-related traffic and equipment, exposure to TMFs and contact ponds, human-wildlife conflicts, and increased predation and harvesting resulting from increased access.
NL Hydro Power Line from Star Lake to the Project Area	• Change in habitat • Change in mortality risk	• The NL Hydro Power Line from Star Lake to the Project Area will spatially and temporarily overlap with Project activities. • The NL Hydro Power Line will potentially have similar pathways as effects arising from the Project within the Project Area and LAA, including a direct change in habitat resulting from removal of vegetation during construction, as well as indirect changes in habitat due to edge effects and sensory disturbance effects (e.g., noise and light emissions). A change in mortality risk for other wildlife is also anticipated during construction of the power line through collisions with NL Hydro Power Line -related traffic and equipment, as well as increased predation and harvesting resulting from increased access through the creation of linear features.
N/A = No potential interactions with other wildlife have been identified		

20.9.4 Potential Cumulative Environmental Effects

As indicated in Section 20.9.1, other wildlife are subject to numerous pressures that can affect their distribution, abundance and health. These pressures include industrial / urban development (e.g., mining and forestry), hunting, emissions, pesticides, and other pollution. Key cumulative effects pathways associated with the Project include removal of vegetation and construction activities, emissions (e.g., noise and light), traffic collisions, human-wildlife conflicts, and increased predation / harvesting, which could potentially result in cumulative changes in habitat and mortality risk. This section describes the pathways of the cumulative effects resulting from the Project and other projects identified in Table 20.15, mitigation that could be implemented to reduce cumulative effects, and the nature of the cumulative effects in the context of the residual effects of other projects.

Past, present and ongoing activities / projects that are predicted to contribute to cumulative effects on other wildlife include mining and exploration, forestry, hunting, outfitting, trapping, and/or fishing, off-road vehicles, hydroelectric development, and existing linear features (Table 20.15). However, potential cumulative effects of these projects / activities have been accounted for in the description of existing conditions and residual environmental effects (Chapter 12) and are not discussed further.

Future activities / projects that are predicted to contribute to cumulative effects on other wildlife include the Cape Ray Gold Project, Buchans Resources Limited Project, and the NL Hydro Power Line from Star Lake to the Project Area (Table 20.15). These projects potentially have similar pathways as effects arising from the Project, including a change in habitat and a change in mortality risk.

20.9.4.1 Change in Habitat

The three primary pathways for changes in habitat are vegetation clearing, sensory disturbance, and 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). Indirect loss of habitat may extend into the LAA through habitat avoidance resulting from sensory disturbance and edge effects during all phases of the Project. The contribution of Project-related residual adverse effects to cumulative effects on change in habitat will be low, with only a small portion of suitable habitat lost for the nine focal species in the ELCA (which constitutes 20.5% of the Other Wildlife RAA, and therefore, the estimated proportion of Project-related change in habitat is conservative). Results indicated that the percentage of habitat loss in the ELCA ranged from 2.1% (for muskrat) to 8.0% for Canada lynx (Section 12.5), which equates to less than 0.1% to 0.4% reduction from existing conditions within the cumulative effects RAA (41,641 km^2). This suggests that abundant suitable habitat will remain for all focal species in the ELCA, and especially so in the cumulative effects RAA. Habitat loss from construction is irreversible; however, it is assumed that animals who lose habitat in the LAA may be able to relocate to available habitat in other areas in the ELCA or cumulative effects RAA.

Environmental assessment documents have not been submitted for the Cape Ray Gold Project, Buchans Resources Limited Project, or the NL Hydro Power Line, therefore, habitat loss estimates are not available. However, the 2016 Cape Ray Gold Project Description / Registration document states that although information on other wildlife is not available, anecdotal reports and communication with local residents and outfitters provided some information on wildlife in the area. Both moose and black bear have been reported in the Cape Ray Gold project area; however, black bear are not considered to be abundant. Moose habitat exists within the project area, although is confined to the river valleys (Nordmin 2016). Historical reports suggest that the Cape Ray Gold project area provided habitat for small furbearing mammals, such as arctic hare, snowshoe hare, red fox, muskrat, mink, ermine, beaver, and otter (Nordmin 2016), similar to wildlife found in the Marathon Project Area (Section 20.9.1). The Cape Ray Gold EA review will determine whether effects resulting in changes in habitat for other wildlife are significant; however, given the distance from the Project and the large amount of suitable habitat within the cumulative effects RAA for other wildlife (Section 12.5), it is anticipated that residual adverse effects will not contribute substantially to cumulative effects on other wildlife habitat and will not threaten the long-term persistence, viability, or recovery of populations of other wildlife species in the cumulative effects RAA.

Buchans Resources Limited has not yet submitted a Project Description or Project Registration to regulators, therefore, a project area has not been defined. A description of the Lundberg deposit on their website states that resources are contained within an area of less than 1 km^2, which is less than the area of both Project pits (Buchans Resources Limited 2020). Given that the Buchans Resources Limited Project is anticipated to have similar project activities, the potential effects on change in habitat for other wildlife will likely be similar to, although on a smaller or similar scale as the Project, which has been determined to be not significant (Section 12.6). Given this and given there is a large amount of suitable habitat for other wildlife within the Other Wildlife RAA (Section 12.5), it is anticipated that the resulting contribution to cumulative effects will not threaten the long-term persistence, viability, or recovery of other wildlife species population in the cumulative effects RAA.

The NL Hydro Power Line from Star Lake will result in a change in habitat for other wildlife via the permanent removal and clearing of vegetation, the creation of habitat edges during construction, and sensory disturbance during maintenance. The proposed power line route is shown on Figure 2-36 and a typical power line requires a cleared 15 m right-of-way. This power line will result in a direct loss of habitat within the Other Wildlife RAA, as well as create edge effects. The power line will be subject to a separate an EA review and is anticipated to have mitigation measures proposed that will reduce effects on changes in habitat for other wildlife.

Vegetation clearing can result in habitat fragmentation, which can have particularly detrimental effects on species with larges ranges, and 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 and northern-long eared bats have been shown to be affected by habitat fragmentation (COSWEIC 2007; Henderson and Broders 2008) (Section 12.5). Some forest fragmentation will occur as a result of the Project (at the mine site) and the three reasonably foreseeable future projects. In particular, the NL Hydro Power Line, a linear feature, can fragment habitat for species that are unable or unwilling to cross them.

Vegetation clearing can result in the destruction of important habitat features, including dens, small mammal nests, or maternity roosts. However, there is abundant suitable habitat within the cumulative effects RAA for bats, large mammals, furbearers, small mammals and marten (Section 12.5). Vegetation clearing also results in the creation of habitat edges, and subsequently can create edge effects. Edge effects vary greatly by species. Species that are dependent on interior and mature forests as core habitat, such as marten and Canada lynx, may be the most adversely affected by edges and may avoid edge habitats. Other species such as moose preferentially choose edge habitats for foraging or travelling (Ardea Biological Consulting 2004). With regard to SAR, direct and indirect habitat loss will occur for little brown bat, northern long-eared bat and American marten, however, all species have abundant suitable habitat within the cumulative effects RAA. Overall, adverse edge effects on wildlife from the Project are anticipated to be minor. Given the large amount of available habitat within the cumulative effects RAA, it is anticipated that edge effects from other projects will not contribute substantially to cumulative effects on other wildlife habitat, and will not threaten the long-term persistence, viability, or recovery of other wildlife species population (including SAR) in the cumulative effects RAA.

As described in Section 12.5, Project-related light and noise emissions may result in avoidance due to sensory disturbance; however, they are associated with specific Project activities for which mitigation measures exist. This is also generally considered to be the case for other future physical activities within the cumulative effects RAA. With the implementation of the Project's and other project's mitigation measures, it is anticipated that the cumulative environmental effects on change in habitat from sensory disturbance will not affect the long-term persistence or viability of other wildlife within the cumulative effects RAA.

20.9.4.2 Change in Mortality Risk

The primary cumulative environmental effect pathways for change in mortality risk within the cumulative effects RAA are vegetation and overburden clearing, traffic, human-wildlife conflicts, and increased human and predator access. Increased mortality risk from the Project is primarily confined to the construction and development phase, and this risk is highest for young and/or immobile animals. This mortality risk will eventually return to existing conditions upon closure. It is also important to note that most of the access road already exists, and as such may already cause some wildlife mortality through vehicle-wildlife collisions, predation and harvesting. A Project-specific Waste Management Plan will reduce the attraction of wildlife (e.g., bears, red foxes, coyotes) to the Project Area and the subsequent risk of property damage, human injury, the development of wildlife dependence on human food sources, and requirement for lethal control of wildlife (Section 12.5). The contribution of Project-related residual adverse effects to cumulative effects on change in mortality risk will, therefore, be low, as the residual adverse effect on other wildlife for the Project is predicted to be within the normal variability of existing conditions, and is not expected to affect the long-term persistence or viability of other wildlife species within the cumulative effects RAA (Section 12.5).

With respect to the relative contribution of future mining activities to the overall cumulative increase in mortality risk for wildlife, the increase in mortality risk is expected to be minor and short-term for other mining activities and the Project, as it will be primarily associated with site clearing and related activities during the construction phases of each project. A change in mortality risk may also result from collisions between wildlife and project-related traffic throughout the region, human-wildlife conflicts, and predation and harvest pressure. However, the Project's road safety mitigation measures and Waste Management Plan, as well as other projects' mitigation measures will reduce the potential for risk of mortality for other wildlife.

The NL Hydro Power Line from Star Lake to the Project Area may result in an increase in mortality risk during the construction phase of the project, with removal of vegetation. However, it is expected that NL Hydro will have mitigation measures to reduce mortality to wildlife, and therefore it is predicted that the increase in mortality risk will be low. The power line right-of-way may act as an access route for humans and predators, although the ROW will not be creating new access into previously undisturbed tracts of wilderness. The greatest increase in mortality risk associated with the power line will be short-term, resulting from site clearing and construction. A change in mortality risk may also result from collisions between wildlife and project-related traffic throughout the region, human-wildlife conflicts, and predation and harvest pressure. The Project's road safety mitigation measures and Waste Management Plan, as well as NL Hydro's mitigation measures will reduce the risk of mortality for other wildlife.

As described in Section 12.3.4, there are multiple Project-related interactions that result in increased mortality risk; however, they are clearly associated with specific and finite Project phases and activities for which mitigation measures exist (Section 12.4). This is also generally considered to be the case for other future physical activities within the cumulative effects RAA. With the implementation of the Project's and other project's mitigation measures it is anticipated that the cumulative environmental effects on change in mortality risk for other wildlife will not affect the long-term persistence or viability of other wildlife species within the cumulative effects RAA.

20.9.5 Cumulative Effects Summary and Evaluation

The cumulative effects on other wildlife of past, present, ongoing, and reasonably foreseeable projects and activities, in combination with the environmental effects of the Project, are summarized in Table 20.16. Although the three identified future projects are anticipated to have similar effects as the Project, the Project and reasonably foreseeable future activities and projects will have a small contribution to the direct and indirect loss or alteration of wildlife habitat in the cumulative effects RAA, including for SAR and SOCC. The cumulative environmental effect is characterized as adverse, low to moderate magnitude (a measurable change in area of other wildlife habitat that is unlikely to affect the long-term persistence or viability of other wildlife species within the cumulative effects RAA), regional (cumulative effects RAA), short to long-term, continuous, irreversible (direct change in habitat) and reversible (indirect change in habitat), and occurring in disturbed and undisturbed environments in the cumulative effects RAA.

With the implementation of the project-specific mitigation measures and regulatory requirements for the protection of SAR and SOCC, the overall cumulative environmental effect (i.e., the effect of all future foreseeable activities within the RAA) on other wildlife mortality risk is characterized as adverse, low to moderate magnitude (a measurable change in mortality risk that is unlikely to affect the long-term persistence or viability of other wildlife species within the cumulative effects RAA), regional (cumulative effects RAA), short-to long-term, continuous and irregular events, reversible, and occurring in a disturbed environment in the cumulative effects RAA.

With mitigation, the cumulative effects from the Project and reasonably foreseeable future activities are expected to be not significant (Significance Definition provided in Section 12.3.2).

Table 20.16 Summary of Potential Cumulative Effects for Other Wildlife

Residual Cumulative Effect[A]	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological and Socio-economic Context
	A	L-M	RAA	ST-LT	IR-C	R	D
Contribution from the Project to the Residual Cumulative Effect[A]	Project-related contributions to cumulative effects on change in habitat will be low, with direct habitat loss ranging from less than 0.1% to 0.4% from existing conditions within the cumulative effects RAA. The percentage of habitat loss in the ELCA ranges from 2.1% (for muskrat) to 8.0% for Canada lynx. Project-related contributions to cumulative effects on change in mortality risk will be primarily confined to the construction and development phase, and this risk is highest for young or immobile animals. Lower risks are associated with traffic-related collisions, human-wildlife conflicts, and increased predation / harvesting during all phases of the Project. Effects are anticipated to be low-moderate in magnitude, affecting individual animals, with no substantial change in the abundance of other wildlife species in the cumulative effects RAA, however potential for temporary local shifts in distributions.						
Significance[B]	Cumulative effects resulting from the Project and reasonably foreseeable future activities are expected to be minor, as effects are anticipated to be low to moderate in magnitude. Some wildlife habitat will be lost or altered, including SAR and SOCC; however, habitat remains abundant and widespread throughout the cumulative effects RAA. Future activities combined with potential Project effects (i.e., changes in habitat and mortality risk) are not expected to measurably affect the abundance or sustainability of other wildlife in the cumulative effects RAA. With mitigation, the cumulative effects from the Project and reasonably foreseeable future activities are expected to be not significant. Although there are limitations in the available information of the effects from other present, past and future physical activities, a conservative approach was taken to estimate the cumulative effects (e.g., permanent loss of project areas and footprints of future physical activities). The predicted effects are similar to those that have occurred during other mining and power line projects / activities, thereby increasing the confidence in the assessment. The prediction confidence in the final determination of significance is considered high.						

Notes:
[A] Descriptors are provided in the respective VC chapters.
[B] Significance definitions are provided in the respective VC chapters.

20.10 COMMUNITY SERVICES AND INFRASTRUCTURE

20.10.1 Past and Ongoing Effects

The Project is located in a rural setting which has been influenced by past, present and ongoing activities and projects. The towns closest to the Project are Buchans and Millertown, which were founded in the early 1900s in support of mining and logging activities in the area and continued to support these industries until the 1980s. Buchans was established in 1927 as a mining town, with services and

infrastructure provided by the American Smelting and Refining Company. Buchans was considered a company town until the 1980s with housing built and allocated on the separation of residency by class (Skeard 2014). The mine closed in 1984 and despite economic incentives in the region, the population of Buchans has been slowly declining for the past several decades since the closure (Skeard 2014). In 2016, the population was 642, down nearly 8% from 2011 when the population was 696 (Statistics Canada 2017; 2020). In addition to the declining population, Buchans population is also in a state of aging with a medium age of 59 (Statistics Canada 2017). Millertown was established in 1900 to support logging activity and the sawmills continued to operate into the 1920s. In 1926, Millertown moved to higher ground due to the construction of the Exploits Dam, which flooded the original location (Town of Millertown n.d.). The population of Millertown has been declining, with a decreased of 18% percent between 2011 and 2016, from 99 to 81 (Statistics Canada 2017).

Other communities within the cumulative effects RAA include Buchans Junction, Grand Falls-Windsor, Badger, and the Town of Bishop's Falls. Similarly, these communities were founded to support the resources industries. Buchans Junction is situated at the junction where the railway lines from Buchans and Millertown met. While the railway closed in 1977, the community remains. In 2016, Buchans Junction had a population of 77, down from 79 in 2011 (Statistics Canada 2017).

Grand Falls-Windsor was established in 1905 for its timber resources, hydroelectricity potential and a deep-water port in the nearby community of Botwood. It is the sixth largest urban community in the province with a population of 14,171 in 2016, up 3% from 13,725 in 2011 (Statistics Canada 2017). It is a service hub providing municipal, health, education, retail, and other services to a region of approximately 50,000 people in communities from the Baie Verte area to the north and the central coast region of St. Alban's and Harbour Breton, to the south.

Badger began as a logging town when the Exploit Lumber Company established a sawmill there around 1900. Logging has remained important to the people of Badger, though many residents have found employment with mines in the area or commute to Grand Falls-Windsor for work and school (Town of Badger 2020). The population of Badger was 704 in 2016, decreasing 11% from 2011 when the population was 793 (Statistics Canada 2017).

The Town of Bishop's Falls was established around 1900 with arrival of the Newfoundland Railroad. It continued to grow with the construction of a pulp mill in 1909, which ceased operation in 1952. Between 2011 and 2016, the population of Bishop's Falls decreased 5.5% from 3,341 to 3,156 (Statistics Canada 2017).

Past, present and ongoing projects / activities in the vicinity of the Project have contributed to changes in infrastructure and services. The effects of previous activities are reflected in the existing conditions for the Community Services VC (Section 13.2) and the assessment of residual effects (Section 13.5). This includes considering the current condition of infrastructure and services, and its capacity to further change as a result of the Project in combination with other ongoing projects and activities that may affect the same VC.

20.10.2 Potential Project-Related Contributions to Cumulative Effects

As described in Chapter 13, routine Project activities and changes to the population due to the presence of Project workers can place additional demands on existing services and infrastructure, including health, emergency, education, recreation, transportation, and utilities. Project workers may also place additional demands on the existing supply of local housing and temporary accommodations. The Project, therefore, can result in the following residual effects on community services and infrastructure:

- A change in local housing and accommodations
- A change in local services and infrastructure

The Project-specific effects assessment for this VC includes a summary of residual environmental effects in Section 13.5 and a determination of significance in Section 13.6. With the implementation of mitigation (Section 13.4), the effects of routine Project-alone activities on community services and infrastructure are predicted to be not significant.

20.10.3 Other Projects and Activities and Their Effects

Table 20.17 summarizes past, present, ongoing, and future projects and activities in the cumulative effects RAA that can cause a change in local housing and accommodations and local services and infrastructure, thereby affecting community services and infrastructure.

Table 20.17 Community Services and Infrastructure: Residual Effects from Other Projects and Activities in the Cumulative Effects RAA

Physical Activity	Potential Effects on this VC from Other Projects / Activities	VC-Specific Spatial / Temporal Considerations and Effect Pathways
Past, Present and Ongoing Projects / Activities		
Mining and Exploration	• N/A	• Most mining Projects listed in Table 20.1 are no longer in operation; therefore, temporal overlap will not occur. • Labour force requirements for ongoing projects are so small as not to act cumulatively with the Project (i.e., will not create additional demands on services and infrastructure in the LAA/RAA).
Forestry	• N/A	• Effects from forestry activities are not predicted to have similar effects as those arising from the Project.
Hunting, Outfitting, Trapping, and Fishing	• N/A	• Effects from hunting, outfitting, trapping and fishing activities are not predicted to have similar effects as those arising from the Project. • The number of people involved in these activities at any one time will not act cumulatively with the Project labour force to create additional demands on community services and infrastructure.

Table 20.17 Community Services and Infrastructure: Residual Effects from Other Projects and Activities in the Cumulative Effects RAA

Physical Activity	Potential Effects on this VC from Other Projects / Activities	VC-Specific Spatial / Temporal Considerations and Effect Pathways
Aquaculture	• N/A	• Effects from aquaculture are not predicted to overlap spatially with Project activities. • Labour force requirements for ongoing aquaculture projects are anticipated to be local hires near the aquaculture facilities and would require different specializations compared to a mining project. Furthermore, the labour force requirements are so small as not to act cumulatively with the Project (i.e., will not create additional demands on services and infrastructure in the LAA/RAA).
Off-road Vehicles (Snowmobiling and ATV)	• N/A	• Effects from off-road vehicle use are not predicted to have similar effects as those arising from the Project activities.
Hydroelectric Developments	• Change in local services and infrastructure	• Hydroelectric developments may have positive effects if upgrades to infrastructure add capacity to the power system. • Labour force requirements to maintain developments are small and would not create additional demands on community services and infrastructure.
Existing Linear Features (i.e., highways / roads and power lines)	• Change in local services and infrastructure	• Existing linear features may have positive effects if upgrades to infrastructure add capacity to the power and transportation systems. • Labour force requirements to maintain infrastructure are small and would not create additional demands on community services and infrastructure
Future Projects / Activities		
Cape Ray Gold Project	• N/A	• While the Cape Ray Gold Project may temporally overlap with the Project, it does not overlap spatially with the Project LAA/RAA. Therefore, community services and infrastructure in the LAA/RAA will not see demands from the Cape Ray Gold Project and it will not act cumulatively with the Project.
Buchans Resources Limited Project	• Change in local housing and accommodations • Change in local services and infrastructure	• The Buchans Resources Limited Project will spatially and temporarily overlap with the LAA/RAA and Project activities. • Activities associated with the Buchans Resources Limited Project potentially have similar pathways as effects arising from the Project. The labour force required for the Buchans Resources Limited Project may result in an increase in the LAA/RAA population leading to increased demands on housing and accommodations and local services and infrastructure.

Table 20.17 Community Services and Infrastructure: Residual Effects from Other Projects and Activities in the Cumulative Effects RAA

Physical Activity	Potential Effects on this VC from Other Projects / Activities	VC-Specific Spatial / Temporal Considerations and Effect Pathways
NL Hydro Power Line from Star Lake to the Project Area	• Change in local housing and accommodations • Change in local services and infrastructure	• The NL Hydro Power Line will spatially and temporarily overlap with the LAA/RAA and Project construction activities. • Activities associated with the NL Hydro Power Line potentially have similar pathways as effects arising from the Project. The labour force for the NL Hydro Power Line would likely come from outside the region, which may result in an increase in the LAA/RAA population leading to temporary increased demands on accommodations for the installation crew and local services and infrastructure.
N/A = No potential interactions with community services and infrastructure have been identified		

20.10.4 Potential Cumulative Environmental Effects

Past, present and ongoing activities / projects that are predicted to contribute to cumulative effects on community services and infrastructure include hydroelectric development and linear features. The potential cumulative effects of these projects / activities have been accounted for in the existing conditions and residual environmental effects (Chapter 13) and are not discussed further. Community service and infrastructure improvements, such as hydroelectric development and highway / road and power line upgrades generally benefit the Project and local communities as these projects will increase capacity of local services and infrastructure.

Future projects and physical activities are predicted to act cumulatively with the Project to affect community services and infrastructure if they occur at the same time as the Project and require the temporary presence of a workforce in the LAA/RAA communities. Workers from other projects may place additional demands on housing and temporary accommodations, as well as health and emergency, education, and municipal services and infrastructure, possibly beyond their capacity.

The Buchans Resources Limited Project may have a workforce large enough to require an accommodations camp; however, this project will only act cumulatively with the Project if there is temporal overlap and that information is not currently known. For the Marathon Project, it is expected that the construction labour force will primarily live in the accommodations camp at the Project site, and so it is not likely to compete with other projects for housing and temporary accommodations.

The NL Hydro Power Line from Star Lake to the Project Area will be constructed to support the Project's energy requirements and will lessen the demands created by the Project on the existing power services and infrastructure. The size of the labour force for the installation of the power line may increase the population of the area in the short-term, placing additional demands on local services and infrastructure in the LAA/RAA. However, it is likely that the workforce will be relatively small, and therefore is not anticipated to result in cumulative effects.

Project mitigation and management measures for community services and infrastructure are described in Section 13.4. These measures, particularly the use of an accommodations camp, will reduce the likelihood of cumulative effects on local services and infrastructure. It is also expected that current and reasonably foreseeable future projects and physical activities will be required to apply standard mitigation and other management measures to avoid or reduce their effect on infrastructure and services (e.g., emergency response plans) and comply with applicable regulatory requirements.

Marathon will continue to communicate with local communities and service providers with respect to scheduling so they may prepare for potential increased demands on local services and infrastructure.

20.10.5 Cumulative Effects Summary and Evaluation

The cumulative effects on community services and infrastructure of past, present, ongoing and reasonably foreseeable projects and activities, in combination with the environmental effects of the Project, are summarized in Table 20.18. With application of mitigation measures, cumulative effects on community services and infrastructure are expected to be adverse, low in magnitude, short-to medium-term, continuous, reversible, and will occur in a resilient socio-economic context.

With mitigation, the cumulative effects from the Project and reasonably foreseeable future activities are expected to be not significant (Significance Definition provided in Section 13.3.2).

Table 20.18 Summary of Potential Cumulative Effects for Community Services and Infrastructure

Residual Cumulative Effect[A]	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological and Socio-economic Context
	A	L	LAA/RAA	S-M	C	R	R
Contribution from the Project to the Residual Cumulative Effect[A]	The Project contribution to the cumulative environmental effect is expected to be low in magnitude, with capacity of community services and infrastructure occurring at or near to existing conditions. Cumulative effects on community services and infrastructure are not anticipated to result in demands on services and infrastructure above and beyond current capacity such that standards of service are routinely and persistently reduced below current levels for an extended period. The use of an accommodations camp and the implementation of other mitigation and management measures will reduce additional Project-related demands on community services and infrastructure.						

Table 20.18 Summary of Potential Cumulative Effects for Community Services and Infrastructure

Residual Cumulative Effect[A]	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological and Socio-economic Context
	A	L	LAA/RAA	S-M	C	R	R
Significance[B]	Residual adverse cumulative effects are predicted to be not significant with a high level of confidence. Although there are limitations in the available information of the effects from other present, past and future physical activities, a conservative approach was taken to estimate the cumulative effects (e.g., permanent loss of project areas and footprints of future physical activities). The predicted effects are similar to those that have occurred during other mining and power line projects/activities, thereby increasing the confidence in the assessment.						

Notes:
[A] Descriptors are provided in the respective VC chapters.
[B] Significance definitions are provided in the respective VC chapters.

20.11 COMMUNITY HEALTH

20.11.1 Past and Ongoing Effects (Existing Conditions)

The Project is located in a rural area with the nearest communities to the Project being Buchans and Millertown, which were founded in the early 1900s in support of mining and logging activities in the area. Past, present and ongoing activities/projects have contributed to cumulative effects on community health, including mining and exploration, forestry, and hydroelectric development activities. Community health is closely linked to the assessment of cumulative effects on the atmospheric environment (Section 20.2) and surface water (Section 20.4). Effects from past and present activities on the atmospheric environment and surface water could therefore influence community health. The health and well-being of a community is also closely related to population stability and employment and business opportunities and associated income. Given the complexity of community health, it is not practical to attempt in this EIS to identify and describe how past and ongoing development projects and other processes and activities have influenced and otherwise affected community health. It is also acknowledged that the well-being of a community represents intangible values, which are largely subjective and conditional, reflecting perceptions, values, and qualitative experience.

Potential community health risks associated with past, present and ongoing projects and activities (i.e., residential, industrial, commercial and natural environment) in the LAA, have been captured in the baseline assessment of existing community health risks (Section 14.2). As such, the contribution of present projects and activities are considered in the assessment of Project residual effects (Section 14.5).

20.11.2 Potential Project-Related Contributions to Cumulative Effects

As described in Chapter 14, routine Project activities and components can affect community well-being due to Project-related employment and income and changes in population. Depending on an individual's pre-employment situation, securing employment with the Project could result in positive effects, including increased disposable income and increased time for participation in recreational, subsistence, and family-related activities and physical exercise. While the Project is assessed as having positive and adverse effects on community health, in accordance with assessment methods described in Section 20.1, only adverse effects of the Project are considered in the cumulative effects assessment. Adverse effects on well-being related to increased disposable income include access to negative coping mechanisms such as overeating, smoking, heavy drinking, and illicit drug use. Project-related population change could change the demographics and social structure of nearby communities and out-of-region workers place additional demands on the existing health, housing, and education services and infrastructure, adversely affecting community well-being. Project activities may decrease access to traditional activities and harvested foods and Project-related emissions may affect the viability reliance on of country foods. The perception of decreased environmental quality (as a result of Project activities) could also lead to decreased consumption of country foods among area harvesters.

The Project, therefore, has potential to result in the following residual effects on community health:

- A change in community well-being
- A change in consumption of country foods

The Project-specific effects assessment for this VC includes a summary of residual environmental effects in Section 14.5 and a determination of significance in Section 14.6. With the implementation of mitigation (Section 14.4), the effects of routine Project-alone activities on Community Health are predicted to be not significant.

20.11.3 Other Projects and Activities and Their Effects

Table 20.19 summarizes past, present, ongoing, and future projects and activities in the cumulative effects RAA that have potential to cause a change in community well-being and consumption of country foods; thereby affecting community health.

Table 20.19 Community Health: Residual Effects from Other Projects and Activities in the Cumulative Effects RAA

Physical Activity	Potential Effects on this VC from Other Projects / Activities	VC-Specific Spatial / Temporal Considerations and Effect Pathways
Past, Present and Ongoing Projects / Activities		
Mining and Exploration	• Change in consumption of country foods	• Most mining Projects listed in Table 20.1 are no longer in operation; therefore, temporal overlap will not occur. • Labour force requirements for ongoing projects are so small as not to act cumulatively with community well-being (i.e., cause effects resulting from changes in employment and income and population in the LAA/RAA). • Ongoing mining and exploration activity in the LAA/RAA is conducted by a variety of mining companies, and may temporally overlap with Project activities and potentially have effects on consumption of country foods. Pathways include potential effects to the viability of country foods through changes to hunting, fishing and harvesting activities.
Forestry	• Change in consumption of country foods	• Effects from forestry activities may spatially and temporally overlap with Project activities. • Labour forces required for ongoing projects are small as not to act cumulatively with community well-being (i.e., cause effects resulting from changes in employment and income and population in the LAA/RAA). • Forestry activities potentially have similar pathways as effects arising from the Project, including potential effects to the viability of country foods as a result of vegetation removal.
Hunting, Outfitting, Trapping, and Fishing	• N/A	• Effects from hunting, outfitting, trapping and fishing activities may overlap spatially and temporally with Project activities; however, they do not have similar pathways as the Project, and therefore are not predicted to result in cumulative effects.
Aquaculture	• N/A	• Effects from aquaculture activities do not overlap spatially with Project activities and therefore are unlikely to affect community health in LAA/RAA activities. • Labour forces required for ongoing projects are small as not to act cumulatively with the Project (i.e., will not create additional demands on services and infrastructure in the LAA/RAA)
Off-road Vehicles (Snowmobiling and ATV)	• N/A	• Effects from off-road vehicles may spatially and temporally overlap with Project activities; however, they do not have similar pathways as the Project, and therefore are not predicted to result in cumulative effects.

Table 20.19 Community Health: Residual Effects from Other Projects and Activities in the Cumulative Effects RAA

Physical Activity	Potential Effects on this VC from Other Projects / Activities	VC-Specific Spatial / Temporal Considerations and Effect Pathways
Hydroelectric Development	• Change in consumption of country foods	• Effects from hydroelectric developments may spatially and temporally overlap with Project activities. • Labour force requirements to maintain ongoing projects are small as not to act cumulatively with community well-being (i.e., cause effects resulting from changes in employment and income and population in the LAA/RAA). • Hydroelectric development activities potentially have similar pathways as effects arising from the Project, including potential effects to the viability of country foods.
Existing Linear Features (i.e., highways / roads and power lines)	• Change in consumption of country foods	• Maintenance of existing linear features will spatially and temporally overlap with Project activities. • Labour forces required for ongoing maintenance are small and will not act cumulatively with community well-being (i.e., cause effects resulting from changes in employment and income and population in the LAA/RAA). • Activities associated with the maintenance of existing linear features potentially have effects on consumption of country foods. Pathways include potential effects to the viability of country foods as a result of vegetation removal.
Future Projects / Activities		
Cape Ray Gold Project	• N/A	• The Cape Ray Gold mine may temporally overlap; however, it does not overlap spatially with the Project LAA/RAA. Therefore, community health in the LAA/RAA will not be affected by the Cape Ray Gold Project and it will not act cumulatively with the Project.
Buchans Resources Limited Project	• Change in community well-being • Change in consumption of country foods	• The Buchans Resources Limited Project will spatially and temporarily overlap with the LAA/RAA and Project activities. • The Buchans Resources Limited Project may have effects on consumption of country foods. Pathways include contamination that may affect the viability of country foods. The labour force for the Buchans Resources Limited Project may increase the population of the LAA/RAA leading to effects resulting from changes in population, such as increased demand for health services and infrastructure in the LAA/RAA.

Table 20.19 Community Health: Residual Effects from Other Projects and Activities in the Cumulative Effects RAA

Physical Activity	Potential Effects on this VC from Other Projects / Activities	VC-Specific Spatial / Temporal Considerations and Effect Pathways
NL Hydro Power Line from Star Lake to the Project Area	• Change in community well-being • Change in consumption of country foods	• The NL Hydro Power Line from Star Lake to the Project Area will spatially and temporarily overlap with the LAA/RAA and Project construction activities. • The NL Hydro Power Line will potentially have effects on consumption of country foods. Pathways include contamination that may affect the viability of country foods. • It is likely that the construction phase of the NL Hydro Power Line project and the construction phase of the Project will temporally overlap. As such, cumulative demand for labour from both projects has the potential to contribute to a temporary increase in demand for health services and infrastructure in the LAA/RAA; however, it is likely that the labour force for the NL Hydro Power Line would come from outside the region and therefore not likely to result in cumulative effects.
N/A = No potential interactions with community health have been identified		

20.11.4 Potential Cumulative Environmental Effects

Past, present and ongoing activities / projects that are predicted to contribute to cumulative effects on community health include mining and exploration, forestry, hydroelectric development, and existing linear features. The potential cumulative effects of these projects / activities have been accounted for in the existing conditions and residual environmental effects (Chapter 14) and are not discussed further.

The Project overlaps spatially and temporally with the Buchans Resources Limited Project and the NL Hydro Power Line. Employment and income associated with the Buchans Resource Limited Project and the NL Hydro Power Line may cause adverse effects on well-being as increased disposable income will decrease financial barriers to negative coping mechanisms, such as smoking and drug use.

Physical activities associated with construction and operation of the Buchans Resources Limited Project and the NL Hydro Power Line may lead to adverse effects on the viability of country foods through released emissions to the atmosphere, water and soil. This may affect the health of LAA/RAA residents who consume these foods. This may also lead to a perceived decrease in the quality of country foods, which will result in a change in consumption of foods that are important to the well-being of some LAA/RAA residents.

The labour forces associated with the Buchans Resources Limited Project may temporarily increase the population of LAA/RAA communities and create additional demands on local health services and infrastructure. The potential increase in the LAA/RAA population may also lead to adverse interactions between workers and community residents and other changes in social connectivity.

Mitigation and management measures for community health are described in Section 14.4. These measures, including the use of an accommodations camp to reduce interactions with LAA/RAA residents and reliance on local health services, as well as training for employees, covering topics such as healthy lifestyle choices, anti-harassment training, and cultural awareness training, will reduce the likelihood of cumulative effects on community health. It is also expected that current and reasonably foreseeable future projects and physical activities will be required to apply standard mitigation and other management measures to avoid or reduce their effects on community health (e.g., emergency response plans) and comply with applicable regulatory requirements.

20.11.5 Cumulative Effects Summary and Evaluation

The cumulative effects on community health of past, present, ongoing, and reasonably foreseeable projects and activities, in combination with the environmental effects of the Project, are summarized in Table 20.20.

With the implementation of mitigation and management measures, residual adverse cumulative effects are anticipated to be low in magnitude, occur in the LAA/RAA, be short- to medium-term, continuous, and reversible. Residual cumulative effects will occur in a resilient socio-economic context.

With mitigation, the cumulative effects from the Project and reasonably foreseeable future activities are expected to be not significant (Significance Definition provided in Section 14.3.2).

Table 20.20 Summary of Potential Cumulative Effects for Community Health

Residual Cumulative Effect[A]	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological and Socio-economic Context
	A	L	LAA/RAA	S-M	C	R	R
Contribution from the Project to the Residual Cumulative Effect[A]	The Project contribution to the cumulative environmental effect is expected to be low in magnitude, as there will be a measurable cumulative effect on community health through changes in community well-being and physical health conditions; however, it will be within the range of normal variation in baseline conditions. The implementation of mitigation and management measures, including an accommodations camp, sensitivity training, measures to increase local hiring, and adherence to meet health-based guidelines will be applied to reduce adverse effects. It is anticipated that other reasonably foreseeable projects would also be required to implementation similar mitigation measures, where appropriate.						
Significance[B]	Residual adverse cumulative effects are predicted to be not significant with a moderate level of confidence. The known success of proposed standard mitigation measures and the resilience of the existing socio-economic environment of the LAA/RAA contribute to increased confidence in the prediction of residual effects. However, due to the nature of social interactions and differences in individual actions, behaviours and influences, as well as uncertainty regarding the extent to which Project employment will be realized by local residents, prediction confidence with respect to changes in community health is moderate.						

Notes:
[A] Descriptors are provided in the respective VC chapters.
[B] Significance definitions are provided in the respective VC chapters.

20.12 EMPLOYMENT AND ECONOMY

The cumulative effects assessment for employment and economy is provided in the following sections. It is important to note that two sets of study boundaries (RAA) apply to the assessment. For the effects 'change in regional labour force', 'change in regional business', and 'change in 'economy' the RAA is defined as the province of NL (Chapter 15). This spatial boundary is larger than that identified in Section 20.1.3 and therefore includes a greater number of projects and activities (past, present, ongoing, and reasonably foreseeable) than identified in Table 20.1 and Table 20.21. The RAA for the assessment of 'change in economic activities of outfitters' is defined as a 5 km buffer around the Project Area, encompassing Victoria River and Red Indian Lake, as well as the communities of Millertown, Buchans, and Buchans Junction (Chapter 16) and falls within the spatial boundary described in Section 20.1.2.

20.12.1 Past and Ongoing Effects

Past, present and ongoing projects / activities in the vicinity of the Project that may contribute to pressures on economy and employment include other mining and exploration, forestry, and hunting, outfitting, trapping, and/or fishing (Table 20.21). These activities may cause a change in regional labour force, change in regional business, change in economic activities of outfitters, and change in economy. Labour demand from past, present and ongoing projects / activities have contributed / continue to affect existing regional business conditions in the RAA, including existing levels of labour scarcity and wage inflation. Site clearing, physical / site management activities, and the presence of workers associated with past, present and ongoing projects / activities (i.e., changes in land use) have defined / continue to affect the area available for / quality of outfitting within the RAA.

Mining, in particular, is one of the largest and oldest industries in NL and has a measurable effect on the provincial economy (Government of NL 2020). The history of mining within the RAA dates back to prospecting activities in 1905 and construction of the first base metals mine in 1926 (Heritage NL n.d.). Although mining operation has largely slowed in the RAA, the most recent downturn associated with the 2015 closure of Teck's Duck Pond copper-zinc mine, the existing labour force is well positioned to respond to increased demand for construction and mining-related activities.

Effects of past and ongoing projects and activities on the regional labour force, regional businesses, economic activities of outfitters, and economy are reflected in the description of existing conditions provided in Chapter 15 Employment and Economy (Section 15.2).

20.12.2 Potential Project-Related Contributions to Cumulative Effects

As described in Chapter 15, Project expenditures on goods and services and demand for labour will affect the regional labour supply and regional businesses (resulting in adverse, positive and neutral effects) while changes in land use are expected to affect the economic activities of outfitters (adverse effects). While the Project is assessed as having positive, neutral and adverse effects on employment and economy, in accordance with assessment methods described in Section 20.1, only adverse effects of the Project are considered in the cumulative effects assessment. Benefits of the Project are identified in Chapter 2. Adverse Project-related effects on employment and economy include:

- A low magnitude adverse change in regional business (due to the Project's contribution to labour drawdown and wage inflation) that occurs during Project construction and operation and of which extends to the RAA.
- A negligible to low magnitude adverse change in the economic activity of outfitters (due to Project-related changes in land use and associated changes in the cost of delivering outfitting services) occurring during the Project's construction, operation and decommissioning, rehabilitation and closure phases. Adverse effects extend to the LAA.

The Project-specific effects assessment for this VC includes a summary of residual environmental effects in Section 15.5 and a determination of significance in Section 15.6. With the implementation of mitigation (Section 15.4), the effects of routine Project-alone activities on employment and economy are predicted to be not significant.

20.12.3 Other Projects and Activities and Their Effects

Table 20.21 summarizes past, present, ongoing and future projects and activities in the RAA that have the potential to cause an adverse change in regional business and/or an adverse change in economic activities of outfitters; thereby adversely affecting employment and economy.

Table 20.21 Employment and Economy: Residual Effects from Other Projects and Activities in the RAA

Physical Activity	Potential Effects on this VC from Other Projects / Activities	VC-Specific Spatial / Temporal Considerations and Effect Pathways
Past, Present, and Ongoing Projects / Activities		
Mining and Exploration	• Change in regional business (contribution to labour drawdown and wage inflation) • Change in economic activities of outfitters	• Labour demand from past, present and ongoing projects/activities have contributed / continue to contribute to existing regional business conditions in the RAA, including existing levels of wage inflation. • Site clearing, physical / site management activities, and the presence of workers associated with past, present and ongoing projects / activities, for the most part, have and/or continue to affect the availability of area, quality and cost of outfitting within the RAA. Aquaculture activities, however, occur on the south coast of the Island of Newfoundland and are located 89 km from the Project Area. A series of dams makes the passage of fish from one area to the other impossible. Therefore, cumulative effects are not anticipated.
Forestry		
Hunting, Outfitting, Trapping, and Fishing		
Aquaculture		
Off-road Vehicles (Snowmobiling and ATV)		
Hydroelectric Development		
Existing Linear Features (i.e., highways / roads and power lines)		

Table 20.21 Employment and Economy: Residual Effects from Other Projects and Activities in the RAA

Physical Activity	Potential Effects on this VC from Other Projects / Activities	VC-Specific Spatial / Temporal Considerations and Effect Pathways
Future Projects / Activities		
Cape Ray Gold Project	• Change in regional business (contribution to labour drawdown and wage inflation) • Change in economic activities of outfitters	• It is likely that the operation phase of the Cape Ray Gold Project will temporally overlap with Project activities. Cumulative demand for labour from both projects could contribute to labour drawdown and wage inflation within the RAA. • Changes in land and resource use (e.g., site clearing, physical / site management activities, and the presence of workers) and associated changes in the cost of outfitting services (in response to adaptive actions taken by area outfitters to address adverse effects) can adversely affect the economic activity of outfitters.
Buchans Resources Limited Project	• Change in regional business (contribution to labour drawdown and wage inflation) • Change in economic activities of outfitters	• Should it proceed, the construction and operation phases of the Buchans Resources Limited Project could temporally overlap with the operation phase of the Project. Cumulative demand for labour from both projects could cumulatively contribute to labour drawdown and wage inflation within the RAA. • Changes in land and resource use (e.g., site clearing, physical / site management activities, and the presence of workers) and associated changes in the cost of outfitting services (in response to adaptive actions taken by area outfitters to address adverse effects) have the potential to adversely affect the economic activity of outfitters.
NL Hydro Power Line from Star Lake to the Project Area	• Change in regional business (contribution to labour drawdown and wage inflation) • Change in economic activities of outfitters	• It is likely that the construction phase of the NL Hydro Power Line project and the construction phase of the Project will temporally overlap. As such, cumulative demand for labour from both projects has the potential to contribute to a temporary labour drawdown and wage inflation within the RAA; however, it is likely that the labour force for the NL Hydro Power Line would come from outside the region and therefore not likely to result in cumulative effects. • Changes in land and resource use (e.g., site clearing, physical / site management activities, and the presence of workers) and associated changes in the cost of outfitting services (in response to adaptive actions taken by area outfitters to address adverse effects) have the potential to adversely affect the economic activity of outfitters.

N/A = No potential interactions with employment and economy have been identified

Notes:

Because the RAA for the assessment of 'change in regional business' is defined as the province of NL, it is impractical to list in Table 20.21 all past, present, ongoing and reasonably foreseeable future projects and activities within the RAA that have the potential to cause an adverse change in regional business. Rather, the assessment assumes that all projects/activities that source labour from NL have contributed (past, present and ongoing projects/activities) or will contribute (reasonably foreseeable future projects), in some degree, to labour drawdown (i.e., workers leave current employers to secure employment with projects/activities due to wage differentials or a desire to work on specific project/activity) and wage inflation (i.e., to attract and retain workers local employers may have to increase compensation paid to workers) within the RAA

20.12.4 Potential Cumulative Environmental Effects

Past, present and ongoing activities / projects that are predicted to contribute to cumulative effects on employment and economy include hunting, outfitting, trapping, and fishing, aquaculture, off-road vehicles (snowmobiling and ATV), hydroelectric development, and existing linear features (i.e., highways / roads and power lines). Labour demand from past, present and ongoing projects / activities have contributed / continue to affect existing regional business conditions in the RAA, including existing levels of labour scarcity and wage inflation. Site clearing, physical / site management activities, and the presence of workers associated with past, present and ongoing projects / activities (i.e., changes in land use) have defined / continue to affect the area available for / quality of outfitting within the RAA. The potential cumulative effects of these projects / activities have been accounted for in the existing conditions and residual environmental effects (Chapter 15) and are not discussed further.

Cumulative demand for labour from the Project and reasonably foreseeable future projects could result in additive contributions to labour drawdown and wage inflation that adversely affect regional businesses in the RAA. To mitigate the Project's contribution to cumulative effects, Marathon will pay its direct workforce wages that are consistent with NL's mining industry. Similar mitigation and management measures are anticipated to be implemented by proponents of reasonably foreseeable future projects. Because reasonably foreseeable future projects / activities identified in Table 20.21 are in early planning stages it is conservatively assumed that residual effects of these projects / activities are similar in magnitude (i.e., low) and extent (extending to the RAA) as the Project.

With respect to the economic activities of outfitters, cumulative changes in land and resource use (affecting the quality of experience of area outfitting perceived by potential clients or realized by current clients) from the Project and reasonably foreseeable future projects could increase the cost of operating outfitting services in the RAA (as a result of adaptive actions taken by area outfitters to address adverse effects of projects / activities). To mitigate the Project's contribution to cumulative effects Marathon will implement mitigation measures identified in Atmospheric Environment (Chapter 5), Fish and Fish Habitat (Chapter 8), Vegetation, Wetlands, Terrain and Soil (Chapter 9), Avifauna (Chapter 10), Caribou (Chapter 11), Other Wildlife (Chapter 12) and Land and Resource Use (Chapter 16). Similar mitigation and management measures are anticipated to be implemented by proponents of reasonably foreseeable future projects. Because reasonably foreseeable future projects / activities identified in Table 20.21 are in early planning stages it is conservatively assumed that residual effects of these projects / activities are similar in magnitude (i.e., negligible to low) and extent to those of the Project.

20.12.5 Cumulative Effects Summary and Evaluation

The cumulative effects on employment and economy of past, present, ongoing and reasonably foreseeable projects and activities, in combination with the environmental effects of the Project, are summarized in Table 20.22.

Due to the early planning stages of resonably foreseeable future projects (Section 20.1) quantifiation of cumualtive labour demand is not possible. Assuming similar levels of labour demand as the Project, reasonably foreseeable future projects / activities are anticipated to result in low magnitude residual

changes in regional business (due to their respective contributions to labour drawdown and wage inflation) within the RAA. Given this, as well as the physical extent of the RAA, the location of projects / activities, shared workforce characteristics (workers employed in construction- and mining-related industries and occupations in trades, transport and equipment operation and natural resource production), and the potential for temporal overlap, cumulative demand for labour from the Project and reasonably foreseeable projects / activities is anticipated to result in negligible to moderate magnitude adverse changes in regional business (due to labour drawdown and wage inflation). Effects are expected to be the most pronounced (i.e., moderate magnitude) within neighbouring communities to projects / activities and to diminish (to negligible) outside a reasonable commuting distance (one-hour commute) of each project / activity. Effects occur continuously over the long-term (overlapping periods of construction and operation) and are reversible following the completion of decommissioning and closure phases (coinciding with periods of reduced labour demand). Effects occur within a resilient socio-economic context.

The cumulative effects assessment completed for land and resource use (see Section 20.13) concludes that the Project and reasonably foreseeable future activities and projects will have a small contribution to the direct and indirect loss or alteration of land and resource use. The cumulative environmental effect is characterized as negligible to low, occurring within the RAA, is expected to be short to long-term, irregular to continuous in frequency, reversible, and occurring on both disturbed and undisturbed land. Because reasonably foreseeable future projects are in early planning stages (see Section 20.1) it is conservatively assumed that these projects / activities result in similar residual adverse changes in the economic activities of outfitters as those of the Project (i.e., negligible to low and that effects occur within a one kilometre buffer of project / activity areas; see Section 15.5). Given this, the additive nature of project / activity residual effects, and in consideration of the physical extent of the RAA, cumulative adverse changes in the economic activity of outfitters are anticipated to be low in magnitude. Effects occur continuously over the long-term (construction, operation, and decommissioning and closure) and are classified as irreversible because it is unclear when lands will be made available for outfitting following completion of decommissioning and closure phases. Effects occur within a resilient socio-economic context.

With mitigation, the cumulative effects from the Project and reasonably foreseeable future activities are expected to be not significant (Significance Definition provided in Section 15.3.2).

Table 20.22 Summary of Potential Cumulative Effects for Employment and Economy

Residual Cumulative Effect[A]	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological and Socio-economic Context
Change in regional business (contribution to labour drawdown and wage inflation)	**A**	**N-M**	**RAA**	**LT**	**C**	**R**	**R**
Change in economic activities of outfitters	**A**	**L**	**RAA**	**LT**	**C**	**R**	**R**
Contribution from the Project to the Residual Cumulative Effect[A]	A low magnitude adverse change in regional business (due to the Project's contribution to labour drawdown and wage inflation) that occurs during Project construction and operation and which extends to the RAA. A low magnitude adverse change in the economic activity of outfitters (due to Project-related changes in land use and associated changes in the cost of delivering outfitting services) that occurs during all Project phases and extends to the LAA.						
Significance[B]	A significant effect on employment and economy is defined as one that is distinguishable from current conditions and trends and cannot be managed or mitigated through adjustments to programs, policies, plans, or through other mitigation. A significant adverse effect occurs if there are residual adverse effects disproportionately experienced by one or more identified sub-populations. Because adverse cumulative effects on employment and economy are anticipated to be low to moderate in magnitude, effects are not assessed as being highly distinguishable from current conditions. With the implementation of mitigation and management measures, cumulative adverse effects on employment and economy are predicted to be not significant. There is a moderate degree of confidence in the assessment of cumulative effects on employment and economy because of uncertainty about future economic conditions in RAA (province) and residual effects of reasonably foreseeable future projects. The degree to which outfitters within the RAA adjust existing operations in response to cumulative changes in land and resource use is also unknown.						

Notes:
[A] Descriptors are provided in the respective VC chapters.
[B] Significance definitions are provided in the respective VC chapters.

20.13 LAND AND RESOURCE USE

20.13.1 Past and Ongoing Effects

Land use within the cumulative effects RAA has been influenced by past, present and ongoing activities and land in the cumulative effects RAA is currently used for resource extraction, including hunting and outfitting, trapping, angling / fishing, mining and exploration, forestry and hydroelectric development. Recreational use of the land includes leisure activities in which people take part on the land within the Project RAA, LAA and Project Area (e.g., hiking, fishing, snowmobiling).

The cumulative effects RAA is an area of substantial hydroelectric development; however only the Victoria Dam and spillway, which are part of the Bay d'Espoir Hydroelectric Development, are located within the LAA.

Existing designated land use, as well as mining and quarrying, forestry, and power generation and transmission may be influenced by natural processes such as severe weather events, geological hazards, or wildfires, and human activities, including other industrial / urban development. Extreme weather events that could affect these activities, include severe storms, hurricanes, drought, extreme precipitation, low temperatures, fog, thunder, lightning, hail, and occasionally tornadoes. Geological hazards that could result in a disaster include landslides, rockfalls, erosion, subsidence, and seismic activity. These natural hazards can result in damage to existing infrastructure, power outages, delays in operations, changes to production levels, damage to vehicles or equipment, and injury to personnel, residents, and/or visitors. Land use is also affected by anthropogenic processes, such as hydroelectric / industrial / urban development and forestry activities. The area has been subject to substantial hydroelectric development and flooding, leaving large portions of land unavailable for land users.

Natural and anthropogenic influences on protected areas would be similar to those influences on plants or animals, as discussed in Sections 20.5 through 20.9, as well as influences discussed above, causing destruction of areas, such as severe weather events, geological hazards, wildfires, and hydroelectric / industrial / urban development.

Natural and anthropogenic influences on hunting, outfitting, trapping, and angling / fishing, as well as the recreational activity of berry picking, include the influences on harvested plants or animals, as discussed in Sections 20.5 through 20.9, as well as influences discussed below, causing destruction of, or affecting access to areas, such as severe weather events, geological hazards, wildfires, forestry activities, and hydroelectric / industrial / urban development, with hydroelectric development being a major contributor to effects on resource use in the Land and Resource Use RAA.

The natural areas throughout the cumulative effects RAA host a variety of other non-consumptive recreational land use activities such as hiking, backcountry camping, snowmobiling, ATV use, swimming, beach combing, boating (including canoeing and kayaking), and sightseeing. Recreational land and resource use may be influenced by natural processes such as severe weather events, geological hazards, or wildfires. Human activities, including hydroelectric development, industrial / urban development, use of pesticides, pollution, fires and the introduction of invasive species may also influence recreational land and resource uses, with hydroelectric development being a major contributor to effects on recreational use in the Land and Resource Use RAA.

Land and resource use are also largely influenced by the availability of harvested species and the economy, both local and international (outfitting). A discussion of population trends and assessment of Project effects for harvested species is provided in Chapters 10 to 12 and a discussion of economy is provided in Chapter 15.

Past, present and ongoing projects / activities in the vicinity of the Project that may contribute to anthropogenic pressures on land and resource use include other mining and exploration, forestry, hydroelectric development, and existing linear features (Table 20.23). Of these, hydroelectric

development and forestry activities have been major contributors to past and ongoing anthropogenic effects on land and resource use in the Land and Resource Use RAA. However, the effects of previous activities and natural environmental influences are reflected in the existing conditions for the Land and Resource Use VC, as described in (Section 16.2) and the assessment of residual effects (Section 16.5). The assessment includes consideration of the current condition (e.g., health or quality) of potentially affected land and resource use, as well as the potential resiliency or sensitivity to further environmental change resulting from the Project in combination with other ongoing projects and activities that may affect the same VC.

20.13.2 Potential Project-Related Contributions to Cumulative Effects

As described in Chapter 16, routine Project activities and components have the potential to result in degradation and disturbance effects on land use, resource use and recreational use through the loss of area or resources (e.g., timber, wildlife, fish), and the restriction of access to designated lands, including provincial Crown lands, protected areas, and hunting, trapping or fishing areas. Noise and light disturbance may affect cabin and recreational users (including hunters, trappers, outfitters, and anglers), as well as wildlife presence, which may cause a reduction in wildlife hunting success. A change in visual aesthetics may result in a change in perception of the area and discourage use. Seasonal snow clearing of the existing site access road may increase access to users. The Project, therefore, has potential to result in the following residual effects on land and resource use:

- A change in land use
- A change in resource use
- A change in recreational use

The Project-specific effects assessment for this VC includes a summary of residual environmental effects in Section 16.5 and a determination of significance in Section 16.6. With the implementation of mitigation (Section 16.4), the effects of routine Project-alone activities on land and resource use are predicted to be not significant.

20.13.3 Other Projects and Activities and Their Effects

Table 20.23 summarizes past, present, ongoing, and future projects and activities in the cumulative effects RAA that have potential to cause a change in land use, resource use, and recreational use, thereby affecting land and resource use.

Table 20.23 Land and Resources Use: Residual Effects from Other Projects and Activities in the Cumulative Effects RAA

Physical Activity	Potential Effects on this VC from Other Projects / Activities	VC-Specific Spatial / Temporal Considerations and Effect Pathways
Past, Present and Ongoing Projects / Activities		
Mining and Exploration	• Change in resource use • Change in recreational use	• Most mining Projects listed in Table 20.1 are no longer in operation; therefore, temporal overlap will not occur. • Ongoing mining and exploration activity in the cumulative effects RAA is conducted by a variety of mining companies, and will temporally overlap with Project activities and potentially have similar pathways as effects arising from the Project. Pathways include degradation and disturbance effects on resource and recreational use (e.g., timber, wildlife, fish, and hunting, trapping, and angling activities) due to noise disturbance, alteration of areas and sites, visual aesthetics, as well as change in access and loss of wildlife habitat and timber resources. The presence of workers that may result in an increase in competition for species harvested by hunters, trappers and anglers. • Mining projects in the decommissioning, rehabilitation and closure phases may temporally overlap with Project activities and are anticipated to have similar effects as the Project, including beneficial effects through the removal of Project infrastructure and restoration of lands to a natural condition, access restrictions and sensory disturbance (e.g., noise, dust, visual) to land and resource users, and the presence of workers that may result in an increase in competition for species harvested by hunters, trappers and anglers.
Forestry	• Change in resource use • Change in recreational use	• Forestry activities will spatially and temporally overlap with Project activities. • Forestry activities potentially have similar pathways as effects arising from the Project. Pathways include degradation and disturbance effects on resource and recreational use (e.g., wildlife, fish, and hunting, trapping and angling activities) due to noise disturbance, damage to areas and sites, visual aesthetics, as well as change in access and loss of wildlife habitat, as well as the presence of workers that may result in an increase in competition for species harvested by hunters, trappers and anglers.
Hunting, Outfitting, Trapping, and Fishing	• Change in resource use • Change in recreational use	• Hunting, outfitting, trapping, and fishing activities will spatially and temporally overlap with Project activities. • If the species of interest to harvesters are not harvested sustainably, the residual environmental effects of present hunting, trapping, gathering, and fishing activity in the cumulative effects RAA could cause a change in harvesting due to resource depletion and increased hunting pressures.

Table 20.23 Land and Resources Use: Residual Effects from Other Projects and Activities in the Cumulative Effects RAA

Physical Activity	Potential Effects on this VC from Other Projects / Activities	VC-Specific Spatial / Temporal Considerations and Effect Pathways
Aquaculture	• N/A	• Aquaculture activities on the south coast of the Island of Newfoundland will temporally overlap with Project activities. • Given the distance from the Project Area (89 km) cumulative environmental effects are anticipated to be unlikely.
Off-road Vehicles (Snowmobiling and ATV)	• N/A	• Given that off-road vehicle use is considered recreational use (land a resource use) and considering the limited effects it has on resources (i.e., wildlife and fish and their habitats, as well as vegetation, wetlands, terrain, terrain stability and soils [Sections 20.5, 20.6, 20.7, 20.8, 20.9]), residual effects on other land and resource uses are not anticipated and therefore, will not contribute to cumulative effects.
Hydroelectric Development	• Change in resource use • Change in recreational use	• Hydroelectric development will spatially and temporally overlap with Project activities. • Hydroelectric development activities potentially have similar effects as those arising from the Project, including degradation (from flooding and construction) and disturbance effects on resource and recreational use (e.g., fish presence and angling activities) due to noise disturbance, damage to areas and sites, visual aesthetics, as well as change in access and loss of fish habitat.
Existing Linear Features (i.e., highways / roads and power lines)	• Change in resource use • Change in recreational use	• Existing linear features will spatially and temporally overlap with Project activities. • Existing linear features will potentially result in an increased access to some areas and therefore, increased competition for species harvested by hunters, trappers, outfitters, and anglers.
Future Projects / Activities		
Cape Ray Gold Project	• Change in resource use • Change in recreational use	• The Cape Ray Gold mine may temporally overlap with Project activities. • Activities associated with the Cape Ray Gold mine potentially have similar pathways as effects arising from the Project, including degradation and disturbance effects on resource and recreational use (e.g., timber, wildlife, fish, and hunting, trapping, and angling activities) due to noise disturbance, alternation of areas and sites, visual aesthetics, as well as change in access and loss of wildlife habitat and timber resources.

Table 20.23 Land and Resources Use: Residual Effects from Other Projects and Activities in the Cumulative Effects RAA

Physical Activity	Potential Effects on this VC from Other Projects / Activities	VC-Specific Spatial / Temporal Considerations and Effect Pathways
Buchans Resources Limited Project	• Change in resource use • Change in recreational use	• The Buchans Resources Limited Project may temporally overlap with Project activities. • Activities associated with the Buchans Resources Limited Project potentially have similar pathways as effects arising from the Project, including degradation and disturbance effects on resource and recreational use (e.g., timber, wildlife, fish, and hunting, trapping, and angling activities) due to noise disturbance, alteration of areas and sites, visual aesthetics, as well as change in access and loss of wildlife habitat and timber resources.
NL Hydro Power Line from Star Lake to the Project Area	• Change in land use • Change in resource use • Change in recreational use	• The NL Hydro Power Line from Star Lake to the Project Area will spatially and temporally overlap with Project activities. • The NL Hydro Power Line will potentially have similar pathways as effects arising from the Project, including degradation and disturbance effects on resource and recreational use (e.g., timber, wildlife, fish, and hunting, trapping, and angling activities) due to noise disturbance, alteration of areas and sites, visual aesthetics, as well as change in access and loss of wildlife habitat and timber resources. The creation of a linear feature may increase access to some areas and thereby increase competition for species harvested by hunters, trappers, outfitters, and anglers.
N/A = No potential interactions with land and resource use have been identified		

20.13.4 Potential Cumulative Environmental Effects

As indicated in Section 20.13.1, land and resource use is subject to numerous pressures, which can affect land, resource and recreational use. These pressures include natural processes such as severe weather events, geological hazards, or wildfires; and human activities, including other hydroelectric / industrial / urban development. Key cumulative effects pathways associated with the Project include degradation and disturbance effects on land, resource and recreational use (e.g., restriction of access; timber, wildlife, and fish resources; and hunting, trapping, and angling activities) due to noise disturbance, damage to areas and sites, visual aesthetics, as well as change in access and loss of wildlife habitat and timber resources. This section describes the pathways of the cumulative effects resulting from the Project and other projects identified in Table 20.23, mitigation that could be implemented to reduce cumulative effects, and the nature of the cumulative effects in the context of the residual effects of other projects.

Past, present and ongoing activities / projects that are predicted to contribute to cumulative effects on land and resource use include mining and exploration; forestry; hunting, trapping, and fishing; hydroelectric development; and existing linear features (Table 20.23). However, potential cumulative effects of these projects / activities have been accounted for in the existing conditions and residual environmental effects (Chapter 16) and are not discussed further.

Future activities / projects that are predicted to contribute to cumulative effects on land and resource use include the Cape Ray Gold Project, Buchans Resources Limited Project, and NL Hydro Power Line from Star Lake to the Project Area (Table 20.23). These projects potentially have similar pathways as effects arising from the Project, including a change in land use, a change in resource use, and a change in recreational use.

The mine site occupies approximately 32 km² of provincial Crown land. Project activities are not anticipated to affect current provincially protected areas established under the NL Parks and Protected Areas legislation. Given the distance of the Project from the area within the Victoria Steadies Sensitive Wildlife Area that is the focus of protection and with mitigation (Section 16.4), the function of the sensitive wildlife area can be maintained and residual effects to designated lands are anticipated to be low. Project activities may affect nearby cabin users due to sensory disturbances, air emissions, and visual aesthetics for cabin users; however, effects were anticipated to be low (Section 16.5). Project effects on land use are expected to occur within the Project Area (direct loss of area) and LAA (indirect sensory disturbances), are expected to be short-term and irregular in frequency for the construction phase, medium-term (long-term for visual), and continuous in frequency occurring over the operation phase, and reversible upon Project rehabilitation (Section 16.5). The contribution of Project-related residual adverse effects to cumulative effects on change in land use will be low, with approximately 34.8 km² of land area within the Project Area. This represents only a 0.08% reduction from existing conditions within the cumulative effects RAA (41,641 km^2).

The contribution of Project-related residual adverse effects to cumulative effects on change in resource use will be negligible to low. Project activities, such as site clearing, will lead to a loss of area for resource use in the Project Area and the creation of restricted access zones surrounding construction activities. Access to the mine site will be restricted for the life of the Project. The Project Area overlaps less than 1% of the Moose and Bear Management Areas 17 and 18, and less than 1% of the total area of Caribou Management Areas 62 and 63. The Project Area overlaps with Trap Zones 14, 83, 221, and 239. The nearest active outfitter lodge is located 11 km from the LAA, and harvesting activities associated with outfitting have been noted near the Project Area, including hunting activity for moose and black bear.

Land clearing at the mine site will remove commercially harvestable timber in FMD 13. As the mine site accounts for less than 1% of the total area of FMD 13, the Annual Allowable Cut (AAC) may still be achieved by relocating harvesting activities; therefore, effects are anticipated to be low in magnitude. The Project is in a remote area, with low levels of resource use and there are alternate areas within the LAA where resource users could pursue these harvesting activities. Noise and dust effects on nearby resource users are anticipated to be below regulatory thresholds. Project effects on resource use are expected to occur within the Project Area (direct loss of area) and LAA (indirect sensory disturbances). Residual effects related to hunting, trapping, outfitting, and fishing will be short-term (for construction) to medium-term (for sensory disturbance) and long-term for visual, irregular to continuous in frequency, and reversible following Project rehabilitation. The adverse effect on AAC will be continuous and occur over the medium term because the affected forest land will remain deforested for the duration of the Project (Section 16.5).

The contribution of Project-related residual adverse effects to cumulative effects resulting in change in recreational use will be low in magnitude. There are a variety of recreational land use and water-based (i.e., canoeing / kayaking) activities that take place in the cumulative effects RAA, and to a lesser extent, the LAA. Within the Project Area, recreational activities are mainly restricted to ATV and snowmobile use along forestry access roads, and back country hiking / camping. Direct residual effects from Project construction will primarily occur at the mine site, where access will be restricted, which could displace recreational users to other areas of the LAA and elsewhere. The Project is in a remote area with low levels of recreational use, and alternative areas are available outside of the Project Area to support these activities. Noise and dust effects to nearby users are anticipated to be below regulatory thresholds. Project effects on land use are expected to occur within the Project Area (direct loss of area) and LAA (indirect sensory disturbances). Residual effects will be short-term (for construction) to medium-term (for sensory disturbance) and long-term for visual, irregular to continuous in frequency, and reversible following Project rehabilitation.

Environmental assessment documents have not been submitted for the Cape Ray Gold Project, Buchans Resources Limited Project, or the NL Hydro Power Line, therefore, land area loss estimates are not available. The Cape Ray Gold Project Description does not include a description of the existing human environment or the potential effects of the project on land and resource use. The Cape Ray Gold mine EIS will determine whether effects on land and resource use are significant, although given the distance from the Project (126 km), it is anticipated that residual adverse effects will not contribute substantially to cumulative effects.

The Buchans Resource Limited project has not yet submitted a Project Description or Project Registration; therefore, a project area has not been defined. A description of the Lundberg deposit on their website states that resources are contained within an and equal to less than 1 km^2 of surface, which is less than both the Marathon pits (Buchans Resources 2020). Given that Buchans Resources Limited Project will have similar project activities, the potential effects on land and resource use may be at a smaller or similar scale as the Project, which has been determined to be not significant (Section 16.6). It is therefore anticipated that the resulting contribution to cumulative effects will not be substantial.

The NL Hydro Power Line from Star Lake may result in a change in species diversity for vegetation via the permanent removal and clearing of vegetation. The distance and route are not yet determined however a typical power line requires a cleared 15 m right-of-way. The power line is subject to its own environmental assessment process and is anticipated to have industry-standard mitigation measures to reduce effects on land and resource use.

The Project and those projects and activities that may interact cumulatively are not likely to result in residual cumulative effects that will conflict with established federal, provincial, or municipal land use designations, policies, or by-laws; or create a change or disruption that restricts or degrades present land and resource use capacity within the cumulative effects RAA to a point where activities cannot continue at or near current levels over the long-term and where compensation is not possible.

20.13.5 Cumulative Effects Summary and Evaluation

The cumulative effects on land and resource use of past, present, ongoing and reasonably foreseeable projects and activities, in combination with the environmental effects of the Project, are summarized in Table 20.24.

Although the three identified future projects are anticipated to have similar effects as the Project, the Project and reasonably foreseeable future activities and projects will have a small contribution to the direct and indirect loss or alteration of land and resource use. The cumulative environmental effect is characterized as negligible to low, occurring within the cumulative effects RAA, expected to be short to long-term, irregular to continuous in frequency, reversible, and occurring on both disturbed and undisturbed land.

With mitigation, the cumulative effects from the Project and reasonably foreseeable future activities are expected to be not significant (Significance Definition provided in Section 16.3.2).

Table 20.24 Summary of Potential Cumulative Effects for Land and Resource Use

Residual Cumulative Effect[A]	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological and Socio-economic Context
	A	N-L	RAA	ST-LT	IR/C	R	U/D
Contribution from the Project to the Residual Cumulative Effect[A]	The contribution of Project-related residual adverse effects to cumulative effects on change in land and resource use will be negligible to low, with approximately 34.8 km² of land area removed within the Project Area. This represents a 0.3% reduction from existing conditions within the Land and Resource Use RAA and a 0.08% reduction from existing conditions within the cumulative effects RAA. Effects will occur within the Project Area (direct loss of area) and LAA (indirect sensory disturbances), are expected to be short-term and irregular in frequency for the construction phase, medium-term (long-term for visual) and continuous in frequency occurring over the operation phase, and reversible upon Project rehabilitation.						
Significance[B]	Cumulative effects resulting from the Project and reasonably foreseeable future activities are expected to be minor, as effects are anticipated to be negligible to low in magnitude. The Project as well as other foreseeable future projects will not conflict with established federal, provincial, or municipal land use designations, policies, or by-laws. The Project as well as other foreseeable future projects will not create a change or disruption that restricts or degrades present land and resource use capacity within the cumulative effects RAA to a point where activities cannot continue at or near current levels over the long-term and where compensation is not possible. With mitigation and environmental protection measures, the residual cumulative environmental effects on land and resource use are predicted to be not significant. Although there are limitations in the available information of the effects from other present, past and future physical activities, a conservative approach was taken to estimate the cumulative effects (e.g., permanent loss of project areas and footprints of future physical activities). The predicted effects are similar to those that have occurred during other mining and power line projects / activities, thereby increasing the confidence in the assessment.						

Table 20.24 Summary of Potential Cumulative Effects for Land and Resource Use

Residual Cumulative Effect[A]	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological and Socio-economic Context
	A	N-L	RAA	ST-LT	IR/C	R	U/D
	The prediction confidence in the determination of significance is considered moderate to high. This is based on information collected as part of desktop data compilation and understanding of current existing conditions, GIS data analyses, understanding of Project and other project activities, locations and described interactions, the known effectiveness of mitigation measures, and experience of the assessment team. A moderate level of confidence was given because some of the desktop data were limited in terms of availability (e.g., intensity of recreational usage) or scale (e.g., big game hunting areas to support harvest evaluation), and details of other project's activities were limited. However, environmental effects mechanisms are well-understood. The degree to which outfitters adjust existing operations in response to Project and future project-related changes in land and resource use is unknown.						

Notes:
[A] Descriptors are provided in the respective VC chapters.
[B] Significance definitions are provided in the respective VC chapters.

20.14 INDIGENOUS GROUPS

20.14.1 Past and Ongoing Effects

The Federal EIS Guidelines (Part 2, Section 5) identify Qalipu First Nation (Qalipu) and Miawpukek First Nation (Miawpukek) as Indigenous groups that may be affected by the Project. The Mi'kmaq from Cape Breton were travelling to the Island of Newfoundland to hunt since at least the early-middle 17th century. Initially, Mi'kmaq in Newfoundland regularly returned to Cape Breton; however, by the end of the 18th century or early 19th century, Mi'kmaq families were settling permanently in southern and southwestern Newfoundland, hunting caribou, trapping and, later, serving as guides for European explorers and sportsmen (Pastore 1978). Past and ongoing activities in the cumulative effects RAA have, to varying degrees, interacted with Indigenous groups, depending on their location, nature, and scale in relation to the groups, activities, and other components and interests of individual Indigenous groups.

Section 17.2 provides an overview of current socio-economic characteristics and conditions of Indigenous groups in the cumulative effects RAA that reflects past and ongoing effects. However, given the long and complex history of Indigenous peoples, it is not practical to attempt in this EIS to identify and describe how past and ongoing development projects and other processes and activities have influenced and otherwise affected Indigenous peoples. It is acknowledged that the experience of Indigenous peoples on the land, cultural identity, and spiritual connections represent intangible values which are largely subjective and conditional, reflecting beliefs, perceptions, values, and qualitative experience. Where possible and applicable, Section 17.2 identifies how certain socio-economic components, such as

traditional land use patterns, may have been influenced by previous and ongoing development activities and other factors.

20.14.2 Potential Project-Related Contributions to Cumulative Effects

As described in Chapter 17, routine Project activities and components can result in associated effects to Indigenous health through changes in air quality, changes in noise, changes in water quality, and country foods. There is also potential for health and socio-economic effects to Indigenous peoples through lack of availability and/or access to country foods to harvest or effects to the perceived quality of country food. Project activities may result in the disruption to physical and cultural heritage from the loss of or change in access to heritage sites and traditional cultural and spiritual sites and areas due to the changes in the environment as a result of the Project. Project activities may not be compatible with activities currently practiced by Indigenous people (current use) occurring near the Project area and may result in loss of access to areas currently used for hunting, trapping, fishing and/or gathering. Adverse effects on current use could indirectly lead to changes in health, socio-economic, and well-being conditions or cultural heritage of affected Indigenous groups. The Project, therefore, has potential to result in the following residual effects on Indigenous groups:

- A change in Indigenous health conditions
- A change in Indigenous socio-economic conditions
- A change in current land and resource use for traditional purposes
- A change in physical and cultural heritage

The Project-specific effects assessment for this VC includes a summary of residual environmental effects in Section 17.5 and a determination of significance in Section 17.6. With the implementation of mitigation measures (Section 17.4), the effects of routine Project-alone activities on Indigenous groups are predicted to be not significant.

20.14.3 Other Projects and Activities and Their Effects

Table 20.25 summarizes past, present, ongoing, and future projects and activities in the cumulative effects RAA that can cause a change in Indigenous health conditions, Indigenous socio-economic conditions, current use, and physical and cultural heritage; thereby affecting Indigenous groups.

Table 20.25 Indigenous Groups: Residual Effects from Other Projects and Activities in the Cumulative Effects RAA

Physical Activity	Potential Effects on this VC from Other Projects / Activities	VC-Specific Spatial / Temporal Considerations and Effect Pathways
Past, Present, and Ongoing Projects / Activities		
Mining and Exploration	• Change in Indigenous health conditions • Change in Indigenous socio-economic conditions • Change in current use • Change in physical and cultural heritage	• Most mining Projects listed in Table 20.1 are no longer in operation; therefore, temporal overlap will not occur. • Ongoing mining and exploration activity in the cumulative effects RAA includes mining and exploration operations by is conducted by a variety of mining companies and effects from these activities may temporally overlap with Project activities and potentially have similar pathways as effects arising from the Project. Pathways include degradation and disturbance effects on current use (e.g., hunting, trapping, gathering and angling activities) from noise disturbance, clearing areas and sites, visual aesthetics, as well as change in access and loss of wildlife habitat resources. This may result in associated changes to Indigenous health and socio-economic conditions. There is also potential for a change in physical and cultural heritage, should the project / activity occur in cultural and spiritual landscapes or areas. • Effects from mining projects in the decommissioning, rehabilitation and closure phases may temporally overlap with Project activities and are anticipated to have similar effects as the Project, including beneficial effects through the removal of Project infrastructure and restoration of lands to a natural condition, access restrictions and sensory disturbance (e.g., noise, dust, visual) to Indigenous groups as well as associated Indigenous health and socio-economic effects.
Forestry	• Change in Indigenous health conditions • Change in Indigenous socio-economic conditions • Change in current use • Change in physical and cultural heritage	• Effects from forestry activities may spatially and temporally overlap with Project activities. • Forestry activities are predicted to have similar effect pathways as those from the Project. Pathways include degradation and disturbance effects on current use (e.g., hunting, trapping, gathering and angling activities) due to noise disturbance, damage to areas and sites, visual aesthetics, as well as change in access and loss of wildlife habitat. This may result in associated changes to Indigenous health and socio-economic conditions. There is also potential for a change in physical and cultural heritage, should the project / activity occur in cultural and spiritual landscapes or areas.

Table 20.25 Indigenous Groups: Residual Effects from Other Projects and Activities in the Cumulative Effects RAA

Physical Activity	Potential Effects on this VC from Other Projects / Activities	VC-Specific Spatial / Temporal Considerations and Effect Pathways
Hunting, Outfitting, Trapping, and Fishing	• Change in Indigenous health conditions • Change in Indigenous socio-economic conditions • Change in current use • Change in physical and cultural heritage	• Effects from hunting, outfitting, trapping, and fishing activities may spatially and temporally overlap with Project activities. • If the species of interest to Indigenous harvesters are not harvested sustainably, the residual environmental effects of present hunting, trapping, gathering, and fishing activity in the cumulative effects RAA could cause a change in current use for future Indigenous harvesters due to resource depletion. This may result in associated changes to Indigenous health and socio-economic conditions. There is also potential for a change in physical and cultural heritage, should the project / activity occur in cultural and spiritual landscapes or areas.
Aquaculture	• N/A	• Effects from aquaculture activities on the south coast of the Island of Newfoundland may temporally overlap with Project activities. However, given the distance from the Project Area (89 km), residual environmental effects contributing to cumulative effects are anticipated to be low.
Off-road Vehicles (Snowmobiling and ATV)	• Change in Indigenous health conditions • Change in Indigenous socio-economic conditions • Change in current use • Change in physical and cultural heritage	• Effects from off-road vehicles may spatially and temporally overlap with Project activities. • Off-road vehicles are predicted to result in an increased access to some areas and therefore, increased competition for species harvested by Indigenous groups. This may result in associated changes to Indigenous health and socio-economic conditions. There is also potential for a change in physical and cultural heritage, should the project / activity occur in cultural and spiritual landscapes or areas.
Hydroelectric Developments	• Change in Indigenous health conditions • Change in Indigenous socio-economic conditions • Change in current use • Change in physical and cultural heritage	• Effects from hydroelectric developments may spatially and temporally overlap with Project activities. • Hydroelectric development activities are predicted to have similar effects as those arising from the Project, including degradation (from flooding and construction) and disturbance effects on land, resource and recreational use (e.g., fish presence and angling activities) due to noise disturbance, damage to areas and sites, visual aesthetics, as well as change in access and loss of fish habitat.

Table 20.25 Indigenous Groups: Residual Effects from Other Projects and Activities in the Cumulative Effects RAA

Physical Activity	Potential Effects on this VC from Other Projects / Activities	VC-Specific Spatial / Temporal Considerations and Effect Pathways
Existing Linear Features (i.e., highways / roads and power lines)	• Change in Indigenous health conditions • Change in Indigenous socio-economic conditions • Change in current use • Change in physical and cultural heritage	• Effects from existing linear features may spatially and temporally overlap with Project activities. • Existing linear features are predicted to result in an increased access to some areas and therefore, increased competition for species harvested by hunters, trappers, outfitters, and anglers.
Future Projects / Activities		
Cape Ray Gold Project	• Change in Indigenous health conditions • Change in Indigenous socio-economic conditions • Change in current use • Change in physical and cultural heritage	• The Cape Ray Gold mine may temporally overlap with Project activities. • Activities associated with the Cape Ray Gold mine potentially have similar pathways as effects arising from the Project, including degradation and disturbance effects on current use (e.g., hunting, trapping, gathering, and angling activities) due to noise disturbance, clearing areas and sites, visual aesthetics, as well as change in access and loss of wildlife habitat resources. This may result in associated changes to Indigenous health and socio-economic conditions. There is also potential for a change in physical and cultural heritage, should the project / activity occur in cultural and spiritual landscapes or areas.
Buchans Resources Limited Project	• Change in Indigenous health conditions • Change in Indigenous socio-economic conditions • Change in current use • Change in physical and cultural heritage	• The Buchans Resources Limited Project may spatially and temporally overlap with Project activities. • Activities associated with the Buchans Resources Limited Project potentially have similar pathways as effects arising from the Project, including degradation and disturbance effects on current use (e.g., hunting, trapping, gathering, and angling activities) due to noise disturbance, clearing areas and sites, visual aesthetics, as well as change in access and loss of wildlife habitat resources. This may result in associated changes to Indigenous health and socio-economic conditions. There is also potential for a change in physical and cultural heritage, should the project / activity occur in cultural and spiritual landscapes or areas.

Table 20.25 Indigenous Groups: Residual Effects from Other Projects and Activities in the Cumulative Effects RAA

Physical Activity	Potential Effects on this VC from Other Projects / Activities	VC-Specific Spatial / Temporal Considerations and Effect Pathways
NL Hydro Power Line from Star Lake to the Project Area	• Change in Indigenous health conditions • Change in Indigenous socio-economic conditions • Change in current use • Change in physical and cultural heritage	• The NL Hydro Power Line from Star Lake to the Project Area will spatially and temporally overlap with Project activities. • The NL Hydro Power Line will potentially have similar pathways as effects arising from the Project, including degradation and disturbance effects on current use (e.g., hunting, trapping, gathering, and angling activities) due to noise disturbance, clearing areas and sites, visual aesthetics, as well as change in access and loss of wildlife habitat resources. This may result in associated changes to Indigenous health and socio-economic conditions. There is also potential for a change in physical and cultural heritage, should the project / activity occur in cultural and spiritual landscapes or areas.
N/A = No potential interactions with Indigenous groups have been identified		

20.14.4 Potential Cumulative Environmental Effects

Over time, Indigenous groups have experienced changes to their way of life from natural processes such as severe weather events, geological hazards, or wildfires; and human activities, including hydroelectric / industrial / urban development. Key cumulative effects pathways associated with the Project include loss of access to areas currently used for hunting, trapping, fishing and/or gathering; a change in quantity, quality, and/or availability of harvested species; changes in air quality, changes in noise, changes in water quality, and country foods; and disruption to physical and cultural heritage from the loss of or change in access to heritage sites and traditional cultural and spiritual sites. This section describes the pathways of the cumulative effects resulting from the Project and other projects identified in Table 20.25, mitigation that could be implemented to reduce cumulative effects, and the nature of the cumulative effects in the context of the residual effects of other projects. It is assumed that other projects and activities in the cumulative effects RAA, including future projects and activities, will be required to comply with various mitigation measures and regulatory requirements, including engagement with Indigenous groups and communication of project activities and schedules.

Past, present and ongoing activities / projects that are predicted to contribute to cumulative effects on Indigenous groups include mining and exploration; forestry; hydroelectric development; and existing linear features (Table 20.25). However, potential cumulative effects of these projects / activities have been accounted for in the existing conditions and residual environmental effects (Chapter 17) and are not discussed further.

Future activities / projects that are predicted to contribute to cumulative effects on land and resource use include the Cape Ray Gold Project, Buchans Resources Limited Project, and NL Hydro Power Line from

Star Lake to the Project Area (Table 20.25). These projects potentially have similar pathways as effects arising from the Project, including a potential change in Indigenous health conditions, Indigenous socio-economic conditions, current use, and physical and cultural heritage.

The contribution of Project-related residual adverse effects to cumulative effects on change in Indigenous health conditions will be low in magnitude. Environmental effects from Project construction and operation are focused on the identified Project pathways related to changes in air quality, changes in water quality, changes in country foods (quality, access, and availability), and changes in sound quality. These effects will primarily occur at the mine site, in a remote area with low levels of current use; therefore, it is unlikely that the consumption of country foods from this location constitute a substantial portion of an Indigenous person's diet. Given the low potential for air emissions and water discharges to affect the quality of country foods combined with the limited harvesting activities, the potential for a change in Indigenous health related to country foods consumption is considered to be low. With the implementation of mitigation measures described in Section 5.4, noise and dust effects to nearby users are anticipated to be below regulatory thresholds. Project effects on Indigenous health conditions are expected to occur within the Project Area (direct loss of area) and LAA (indirect sensory disturbances). Residual effects will be short-term (for construction) to medium-term (for sensory disturbance) and long-term for visual, irregular to continuous in frequency, and reversible following Project rehabilitation.

The contribution of Project-related residual adverse effects to cumulative effects resulting in change in Indigenous socio-economic conditions will be low in magnitude. A change in revenue for an Indigenous group through a change in physical access restrictions to harvesting areas, a change in harvested species distribution and abundance, the creation of competition for other industries or commercial harvest, and the creation of sensory disturbance effects (i.e., noise, dust, visual) are anticipated to be limited to the Project Area and LAA. The Project is in a remote area with low levels of current use, and alternative areas are available outside of the Project Area to support harvesting activities and associated socio-economic conditions. Project effects on Indigenous socio-economic conditions are expected to occur within the Project Area (direct loss of area) and LAA (indirect sensory disturbances). Residual effects will be short-term (for construction) to medium-term (for sensory disturbance) and long-term for visual, irregular to continuous in frequency, and reversible following Project rehabilitation.

The contribution of Project-related residual adverse effects to cumulative effects resulting in change in current use will be low in magnitude. Direct residual effects from Project construction will primarily occur at the mine site, where access will be restricted, which could displace current users to other areas of the LAA and elsewhere. The Project is in a remote area with low levels of current use, and alternative areas are available outside of the Project Area to support these activities. Noise and dust effects to nearby users are anticipated to be below regulatory thresholds. Project effects on current land use for traditional purposes are expected to occur within the Project Area (direct loss of area) and LAA (indirect sensory disturbances). Residual effects will be short-term (for construction) to medium-term (for sensory disturbance) and long-term for visual, irregular to continuous in frequency, and reversible following Project rehabilitation. Marathon will continue to engage with Indigenous groups for the identification, review, and analysis of existing and available information on Indigenous land and resource use activities throughout Project planning and design.

The contribution of Project-related residual adverse effects to cumulative effects resulting in change in physical and cultural heritage will be low in magnitude. Direct residual effects from Project construction will primarily occur at the mine site, where access will be restricted, which could displace physical and cultural sites. The Project is in a remote area and there are no known registered heritage sites and, at the time of filing, no cultural and spiritual sites within this area had been identified by Indigenous groups through Project-related engagement. A Heritage and Cultural Resources Protection Plan will be developed and will include mitigation in the event of an accidental discovery. Project effects on physical and cultural heritage are expected to occur within the Project Area (direct loss of area) and LAA (indirect sensory disturbances). Residual effects will be short-term (for construction) to medium-term (for sensory disturbance) and long-term for visual, irregular to continuous in frequency, and reversible following Project rehabilitation.

Environmental assessment documents have not been submitted for the Cape Ray Gold Project, Buchans Resources Limited Project, or the NL Hydro Power Line, therefore, land area loss estimates are not available. The Cape Ray Gold Project Description does not include a description of the existing human environment or the potential effects of the project on Indigenous groups. The Cape Ray Gold mine EIS will determine whether effects on Indigenous groups are significant; however, given the distance from the Project, it is anticipated that residual adverse effects will not contribute substantially to cumulative effects.

The Buchans Resource Limited project has not yet submitted a Project Description or Project Registration; therefore, a project area has not been defined. A description of the Lundberg deposit on their website states that resources are contained within an and equal to less than 1 km^2 of surface, which is less than both the Marathon pits (Buchans Resources 2020). Given that Buchans Resources Limited Project is within the same forest ecoregion as the Project (Central Newfoundland Forest Ecoregion) and will have similar project activities, the potential effects on Indigenous groups may be at a smaller or similar scale as the Project, which has been determined to be not significant (Section 17.6). It is therefore anticipated that the resulting contribution to cumulative effects will not be substantial.

The NL Hydro Power Line from Star Lake may result in a change in species diversity for vegetation via the permanent removal and clearing of vegetation. The distance and route are not yet determined however a typical power line requires a cleared 15 m right-of-way. The power line is subject to its own environmental assessment process and is anticipated to have mitigation measures to reduce effects on Indigenous groups.

20.14.5 Cumulative Effects Summary and Evaluation

As discussed above, over time, Indigenous groups have experienced changes to their way of life from natural processes such as severe weather events, geological hazards, or wildfires and human activities, including hydroelectric / industrial / urban development. Past and ongoing activities in the cumulative effects RAA have, to varying degrees, interacted with Indigenous groups, depending on their location, nature, and scale in relation to the groups, activities, and other components and interests of individual Indigenous groups. The cumulative effects on Indigenous groups of past, present, ongoing, and reasonably foreseeable projects and activities, in combination with the environmental effects of the Project, are summarized in Table 20.26. Although the three identified future projects are anticipated to

have similar effects as the Project, the Project and reasonably foreseeable future activities and projects will have a small contribution to the direct and indirect effects to Indigenous groups. It is assumed that other projects and activities in the cumulative effects RAA, including future projects and activities, will be required to comply with various mitigation measures and regulations, including engagement with Indigenous groups and communication of project activities and schedules. The cumulative environmental effect is characterized as low, occurring within the cumulative effects RAA, expected to be short to long-term, irregular to continuous in frequency, reversible, and occurring on both disturbed and undisturbed land.

With mitigation, the cumulative effects from the Project and reasonably foreseeable future activities are expected to be not significant (Significance Definition defined in Section 17.3.2).

Table 20.26 Summary of Potential Cumulative Effects for Indigenous Groups

Residual Cumulative Effect[A]	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological and Socio-economic Context
	A	L	RAA	ST-LT	IR	R	D
Contribution from the Project to the Residual Cumulative Effect[A]	The contribution of Project-related residual adverse effects to cumulative effects on change in Indigenous groups will be negligible to low, with approximately 34.8 km² of land area removed within the Project Area. This represents an approximate 2% reduction from existing conditions with the LAA and 0.08% reduction from existing conditions within the cumulative effects RAA. Effects will occur within the Project Area (direct loss of area) and LAA (indirect sensory disturbances), are expected to be short-term and irregular in frequency for the construction phase, medium-term (long-term for visual) and continuous in frequency occurring over the operation phase, and reversible upon Project rehabilitation.						
Significance[B]	Cumulative effects resulting from the Project and reasonably foreseeable future activities are expected to be minor, as effects are anticipated to be negligible to low in magnitude. The Project as well as other foreseeable future projects are unlikely to cause a loss in areas relied upon for traditional use practices, or the loss of traditional use areas within the cumulative effects RAA. Socio-economic conditions of affected Indigenous groups are unlikely to be affected, such that there are associated detectable and sustained decreases in the quality of life of a community. With mitigation and environmental protection measures, the residual cumulative environmental effects on Indigenous groups are predicted to be not significant. The prediction confidence in the final determination of significance is considered moderate. This is based on information collected as part of desktop data compilation and understanding of current existing conditions, GIS data analyses, understanding of Project and other project activities, locations and described interactions, the known effectiveness of mitigation measures, and experience of the assessment team. A moderate level of confidence was given because some of the desktop data were limited in terms of availability (e.g., intensity of current use) or scale (e.g., big game hunting areas to support harvest evaluation). Furthermore, the qualitative and subjective nature of assessing Indigenous health conditions, Indigenous socio-economic conditions, and Indigenous physical and cultural heritage, the views of Indigenous groups may differ from the findings of this assessment. Marathon will continue to engage with Indigenous groups for the identification, review, and analysis of existing and available information on Indigenous land and resource use activities, to consider this throughout Project planning and design.						

Notes: [A] Descriptors are provided in the respective VC chapters
[B] Significance definitions are provided in the respective VC chapters.

20.15 HISTORIC RESOURCES

20.15.1 Past and Ongoing Effects

Historic resources, particularly archaeological resources, are present either immediately upon or close beneath the present ground surface. Natural phenomena, such as erosion, weather and changes to the level of bodies of water can affect the preservation and location of archaeological resources. Due to the nature of archaeological resources it is not possible to accurately assess natural and anthropogenic influences.

Ground disturbance may disturb or destroy objects of historic value as well as their context within the archaeological record. Alterations to the landscape and increased human activity resulting from improved access to areas previously in accessible or less accessible also increase the likelihood that environmental effects could occur. Past, present and ongoing activities / projects that contribute to cumulative effects on historic resources include mining and exploration, forestry, hunting, outfitting, trapping, and fishing, off-road vehicles, hydroelectric development, and existing linear features.

Archaeological assessment in the vicinity of the LAA has been limited; therefore, assessment of archaeological potential in the Project Area is based in part on a review of archaeological sites recorded to date from the Historic Resources RAA. These sites may be classified into four main groupings:

- A cluster of historic-period Beothuk and precontact sites on Red Indian Lake, northeast of the Project Area
- A widely-dispersed group of sites recorded on various interior lakes south and southwest of the Project Area
- Miscellaneous sites of 20th century date recorded in locations surrounding the Project Area
- A series of ten archaeological sites recently identified on an 1875 map of Victoria River, believed to have been drawn and/or annotated by geologist J.P. Howley. These sites include both observed Beothuk wigwams dating to the 18th or 19th centuries, and the locations of Howley's own campsites. These sites have not been ground-truthed; however, they have been registered as archaeological sites, with approximate coordinates, in the Provincial Archaeology Office site inventory. Three of these sites potentially lie in the vicinity of the Project Area.

A review of aerial imagery and LIDAR imagery identified 24 locations within the LAA with potential to yield archaeological resources. Most of these sites are associated with points of land and constrictions in lakes and stream confluences / river mouths. High-potential locations may, in many cases, have been affected by previous logging activities and hydroelectric development in the region; however, evidence from Red Indian Lake in particular indicates that sites may survive in whole or in part, despite these effects.

Although these areas lie within the claim block, only one of these locations (in the area of Marathon's existing exploration camp) lies within the Project Area. While this area of potential is within the Project Area, it does not overlap with the current footprint of Project infrastructure.

20.15.2 Potential Project-Related Contributions to Cumulative Effects

As described in Chapter 18, routine Project activities and components that involve initial ground disturbance may disturb or destroy objects of historic value and the context (the horizontal and vertical depositional relationships between historic objects) from which they derive much of their value. Alterations to the landscape and increased human activity resulting from improved access to the area also increase the likelihood that environmental effects will occur by making historic resources that may be present available to human disturbance.

The Project, therefore, has potential to result in the following residual effect on historic resources:

- Loss or disturbance of historic resources

The Project-specific effects assessment for this VC includes a summary of residual environmental effects in Section 18.5 and a determination of significance in Section 18.6. With the implementation of mitigation (Section 18.4), the residual effects of routine Project-alone activities on historic resources are predicted to be not significant.

20.15.3 Other Projects and Activities and Their Effects

Table 20.27 summarizes past, present, ongoing, and future projects and activities in the cumulative effects RAA that have potential to cause loss or disturbance of historic resources; thereby affecting historic resources.

Table 20.27 Historic Resources: Residual Effects from Other Projects and Activities in the Cumulative Effects RAA

Physical Activity	Potential Effects on this VC from Other Projects / Activities	VC-Specific Spatial / Temporal Considerations and Effect Pathways
Past, Present and Ongoing Projects / Activities		
Mining and Exploration	• Loss or disturbance of historic resources	• Most mining Projects listed in Table 20.1 are no longer in operation; therefore, temporal overlap will not occur. • Effects from mining and exploration activities potentially have similar pathways, including initial ground disturbance which may disturb or destroy objects of historic value and their context, as well as disturbance to historic resources from increased human activity.
Forestry	• Loss or disturbance of historic resources	• Effects from forestry activities may overlap spatially and temporally with Project activities. • Forestry will potentially have similar pathways, including initial ground disturbance which may disturb or destroy objects of historic value and their context, as well as disturbance to historic resources from increased human activity.

Table 20.27 Historic Resources: Residual Effects from Other Projects and Activities in the Cumulative Effects RAA

Physical Activity	Potential Effects on this VC from Other Projects / Activities	VC-Specific Spatial / Temporal Considerations and Effect Pathways
Hunting, Outfitting, Trapping, and Fishing	• Loss or disturbance of historic resources	• Effects from hunting, outfitting, trapping, and fishing activities may overlap spatially and temporally with Project activities. • Hunting, outfitting, trapping, and fishing activities will potentially have similar pathways, including disturbance to historic resources from increased human activity.
Aquaculture	• N/A	• Effects from aquaculture activities do not overlap spatially with Project activities.
Off-road Vehicles (Snowmobiling and ATV)	• Loss or disturbance of historic resources	• Off-road vehicles will spatially and temporally overlap with Project activities. • Off-road vehicle activities will potentially have similar pathways, including disturbance to historic resources from increased human activity.
Hydroelectric Development	• Loss or disturbance of historic resources	• Hydroelectric development will spatially and temporally overlap with Project activities. • Hydroelectric development activities potentially have similar pathways as effects arising from the Project, including initial ground disturbance which may disturb or destroy objects of historic value and their context (e.g., through flooding), as well as disturbance to historic resources as a result of increased human activity.
Existing Linear Features (i.e., highways / roads and power lines)	• Loss or disturbance of historic resources	• Maintenance of existing linear features will spatially and temporally overlap with Project activities. • Maintenance of existing linear features potentially have similar pathways as effects arising from the Project, including initial ground disturbance which may disturb or destroy objects of historic value and their context, as well as disturbance to historic resources as a result of increased human activity.
Future Projects / Activities		
Cape Ray Gold Project	N/A	• The Cape Ray Gold mine may temporally overlap; however, it does not overlap spatially with Project activities. Therefore, historic resources in the cumulative effects RAA will not be affected by the Cape Ray Gold mine and it will not act cumulatively with the Project.
Buchans Resources Limited Project	• Loss or disturbance of historic resources	• The Buchans Resources Limited Project overlaps temporally and spatially with Project activities. • Activities potentially have similar pathways as effects arising from the Project, including initial ground disturbance which may disturb or destroy objects of historic value and their context, as well as disturbance to historic resources from increased human activity.

Table 20.27 Historic Resources: Residual Effects from Other Projects and Activities in the Cumulative Effects RAA

Physical Activity	Potential Effects on this VC from Other Projects / Activities	VC-Specific Spatial / Temporal Considerations and Effect Pathways
NL Hydro Power Line from Star Lake to the Project Area	• Loss or disturbance of historic resources	• The NL Hydro Power Line from Star Lake to the Project Area will spatially and temporally overlap with the cumulative effects RAA and Project activities. • Activities potentially have similar pathways as effects arising from the Project, including initial ground disturbance which may disturb or destroy objects of historic value and their context, as well as disturbance to historic resources from increased human activity.
N/A = No potential interactions with historic resources have been identified		

20.15.4 Potential Cumulative Environmental Effects

For historic resources, and in accordance with the *Historic Resources Act*, the threshold criterion beyond which a residual environmental effect is considered significant is the unauthorized disturbance or destruction of a historic resource that is determined by the Provincial Regulator to be a significant historic resource, and that cannot be mitigated.

Past, present and ongoing activities / projects that are predicted to contribute to cumulative effects on historic resources include mining and exploration, forestry, hunting, outfitting, trapping, and fishing, off-road vehicles, hydroelectric development, and existing linear features. Areas within the cumulative effects RAA with high potential for historic resources have been affected by these activities (e.g., flooding from hydro facilities); however, it is known that registered historic resources are still present within the Historic Resources RAA despite these impacts. The potential cumulative effects of these projects / activities have been accounted for in the existing conditions and residual environmental effects (Chapter 18) and are not discussed further. Further, given the mitigation for the identification and protection of historic resources for the Project, there will not be cumulative interaction with past projects or activities.

Cumulative effects resulting from the Buchans Resources Limited Project and the NL Hydro Power Line may lead to the disturbance or loss of historic resources during initial ground disturbance activities. Because historic resources are static and finite, any environmental effect which did occur would be adverse, permanent and irreversible. However, all development activities in the province are subject to the *Historic Resources Act*. As such, new or ongoing projects will be governed by routine application of the legislation related to archaeological resources, which serve to reduce potential adverse effects on historic resources.

20.15.5 Cumulative Effects Summary and Evaluation

The cumulative effects on historic resources of past, present, ongoing, and reasonably foreseeable projects and activities, in combination with the environmental effects of the Project, are summarized in Table 20.28. Past, present and ongoing activities / projects that contribute to cumulative effects on

historic resources include mining and exploration, forestry, hunting, outfitting, trapping, and fishing, off-road vehicles, hydroelectric development, and existing linear features.

The Project contribution to the cumulative environmental effect is expected to be low in magnitude due to the effects of past logging activities and hydroelectric development which may have led to the loss or disturbance of historic resources along waterways and the implementation of mitigation procedures to reduce potential for presently unknown sites to be inadvertently disturbed or lost. With this mitigation, the residual adverse cumulative effect of the Project will result in a negligible to low loss or disturbance of known historic resources within the Project Area. Effects will occur as a single event, be permanent, irreversible, and occur in a socio-economic context that is both disturbed and undisturbed.

With mitigation, the cumulative effects from the Project and reasonably foreseeable future activities are expected to be not significant (Significance Definition provided in Section 18.3.2).

Table 20.28 Summary of Potential Cumulative Effects for Historic Resources

Residual Cumulative Effect[A]	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological and Socio-economic Context
	A	N/L	PA	P	S	I	U
Contribution from the Project to the Residual Cumulative Effect[A]	The Project contribution to the cumulative environmental effect is expected to be negligible to low in magnitude due to the effects of past logging activities and hydroelectric development which may have led to the loss or disturbance of historic resources along waterways and the implementation of mitigation procedures to reduce potential for presently unknown sites to be inadvertently disturbed or lost. Measures will be implemented to identify and mitigate the unexpected discovery of historic resources.						
Significance[B]	Residual adverse cumulative effects are predicted to be not significant with a high degree of confidence Although there are limitations in the available information of the effects from other present, past and future physical activities, a conservative approach was taken to estimate the cumulative effects (e.g., permanent loss of project areas and footprints of future physical activities). The predicted effects are similar to those that have occurred during other mining and power line projects / activities, thereby increasing the confidence in the assessment.						
Notes: [A] Descriptors are provided in the respective VC chapters. [B] Significance definitions are provided in the respective VC chapters.							

20.16 SUMMARY OF CUMULATIVE EFFECTS

Residual adverse effects from Project activities may combine with other mining projects, exploration activities, forestry, hunting, outfitting, trapping, and/or fishing; off-road vehicles, hydroelectric development, and linear features (i.e., power lines) to result in cumulative environmental effects. With the exception of caribou, the remaining VCs are not anticipated to experience adverse effects that would

contribute cumulatively to significant residual effects. Future activities, combined with potential Project effects specifically changes in caribou movement, are expected to contribute to the high magnitude effect as described in Chapter 11, and may measurably affect the abundance and/or sustainability of caribou (i.e., the Buchans herd) in the cumulative effects RAA.

VC-specific mitigation and management measures included as part of the Project-specific environmental effects assessment (Chapters 5 to 19) are applicable to the cumulative effects assessment. In recognition of existing pressures caused by other projects and activities, various mitigation measures are being implemented to reduce adverse environmental effects, including measures to comply with regulations, guidelines, statements of practice and administrative restrictions. It is assumed that other projects and activities in the cumulative effects RAA, including future projects and activities, will be required to implement various mitigation measures and comply regulatory requirements, therefore also reducing cumulative effects. No additional or revised monitoring or follow-up is required or proposed specifically for potential cumulative environmental effects beyond standard measures that are implemented in the regular course of operations for other projects and activities.

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21.0 ACCIDENTAL EVENTS

21.1 APPROACH

In accordance with section 7.6.1 of the Federal Environmental Impact Statement (EIS) Guidelines (Appendix 1A) and section 4.1.6.2 of the Provincial EIS Guidelines (Appendix 1B), this chapter assesses environmental effects of accidents or malfunctions that may occur as a result of the Project. Accidents or malfunctions are events that occur outside the normal planned function or activity of the Project, and through good planning and Project design, the risks of accidents or malfunctions can be reduced or controlled. Furthermore, Marathon will develop emergency response and contingency plans to help mitigate adverse environmental effects should an accidental event or malfunction occur.

Numerous environmental management plans will be developed for the construction, operation and decommissioning, rehabilitation and closure of the Project. These plans will include environmental protection plans, follow-up and monitoring plans, and emergency response and contingency plans, which will serve to manage, mitigate and remediate adverse effects resulting from accidental events or malfunctions. Many of these plans are required under various provincial and federal regulations and conditions of regulatory approvals and, in some cases, there is crossover with health and safety plans. The various plans are typically aligned under an overarching Environmental Management System (EMS). Rather than referencing individual plans or a list of plans that may apply to a particular aspect of the Project, this section references the overarching EMS.

Accidents and malfunctions were assessed using the following approach:

- Selection of accidents or malfunctions that could occur during construction, operation and decommissioning, rehabilitation and closure of the Project (Section 21.4) and result in potential environmental effects that require assessment
- Description of the accidental event and malfunction scenarios selected above and identification of the Project design and safety measures that will be implemented to reduce or control the potential of each accident or malfunction (Section 21.5)
- Assessment of the potential residual adverse effects (after design and safety measures and emergency response measures have been applied) on Valued Components (VCs) that would result from each accident or malfunction selected above (Section 21.5)
- Determination of the significance of residual effects (after design and safety measures and emergency response measures have been applied) of each accident or malfunction (Section 21.6)

Project effects of accidents or malfunctions are described for VCs where applicable, using the same spatial boundaries (Figures 21-1 and 21-2), residual effects criteria, and methods and thresholds for determining significance as used for Project environmental effects (Chapters 5 to 19). Quantitative analysis was used, where possible, to characterize residual effects, including for worst-case scenarios. Qualitative considerations were used where quantitative analysis was not possible, such as for a fire.

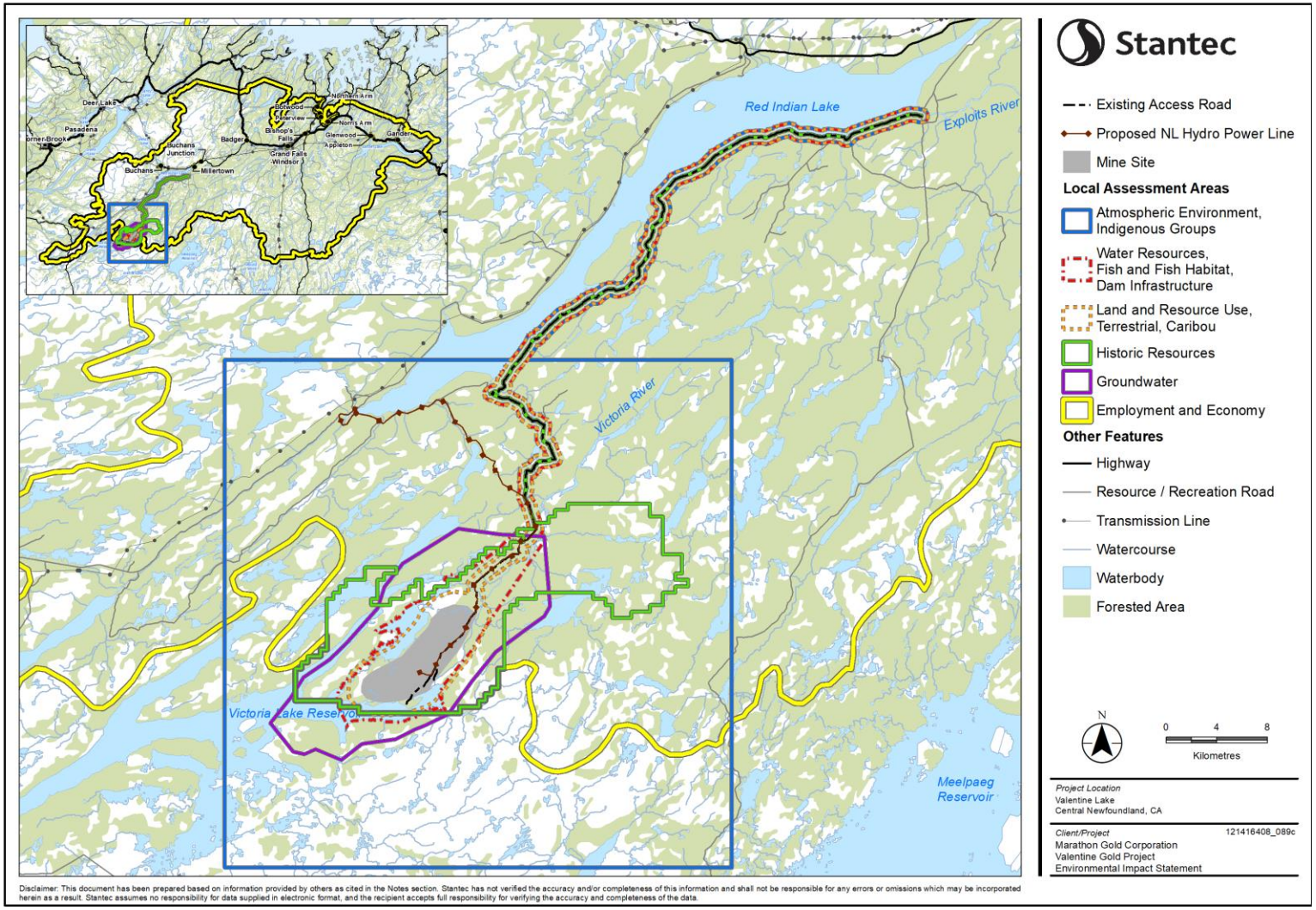

Figure 21-1 Combined Local Assessment Areas for the VCs

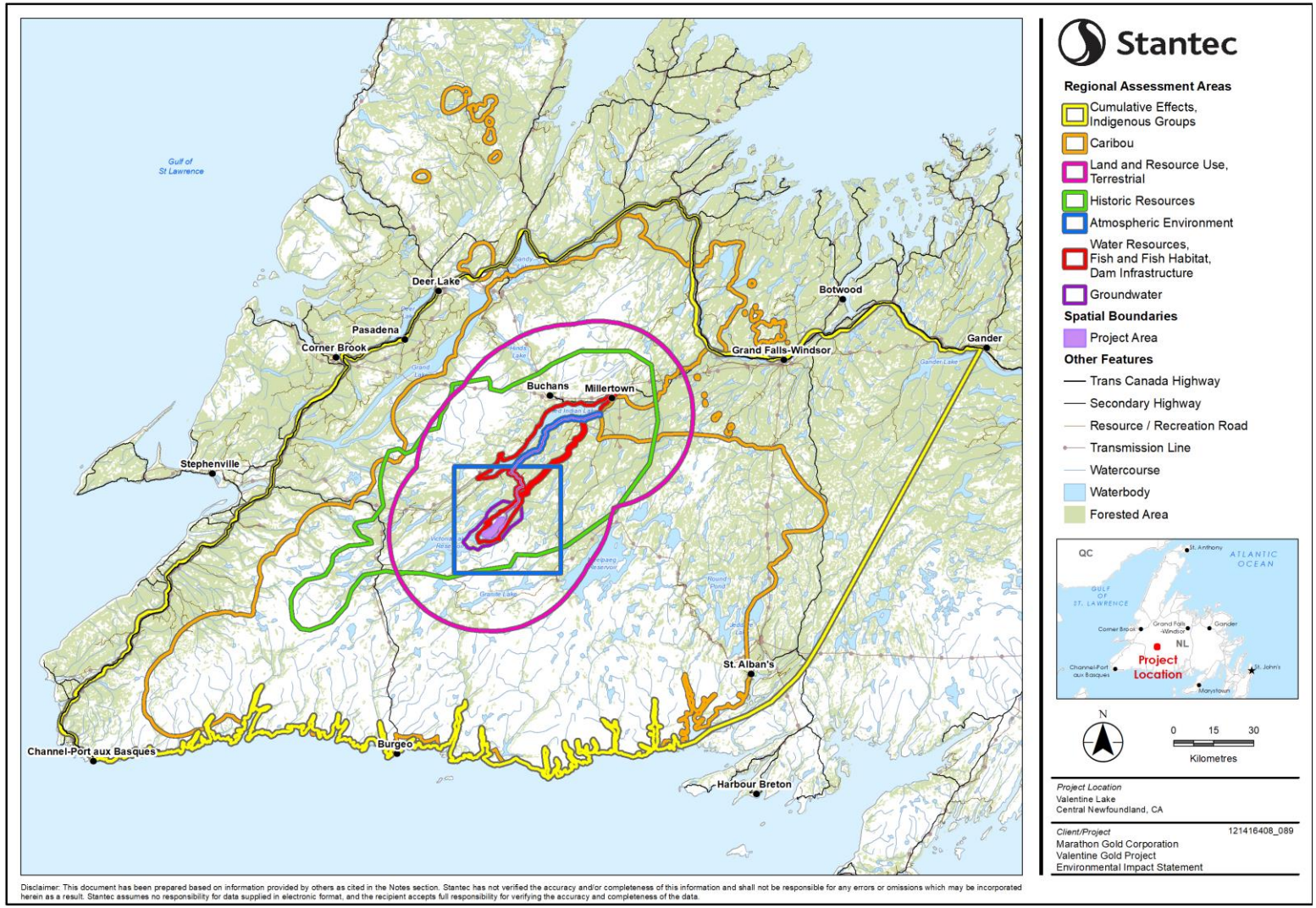

Figure 21-2 Combined Regional Assessment Areas for the VCs

21.2 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 accidental events are detailed below. Note that general concerns related to the effects of the Project on components of the environment have been included below, as these expressed concerns relate to Project effects that could arise from either routine activities or accidental events.

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

- Design and operation of the tailing management facility (TMF), 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.
- Water quality and water treatment
- Limitation of access to lands and resources for traditional use
- Need for ongoing engagement

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

- Need for ongoing engagement
- The need for treatment to protect water quality
- 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 impact on Miawpukek land and resource use
- Potential loss of historic or cultural sites

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

- 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
- The supply of medical services to mine personnel and plans for medical services on-site
- Accidental events including a tailing dam breach, chemical spill or ground water aquifer fracture and their downstream effects on fish and fish habitat, wildlife and human life, and the need to plan for worst-case scenarios and mitigate for them in advance

- 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:

- 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)
- The Project's use of roads and frequency of truck movements
- Whether the proximity of the proposed mine to other mining operations pose a special threat in the event of a tailings pond breach
- The impact of dam failure on water quality
- Water quality including the potential for contamination, the potential for acid rock drainage (ARD), and the need for the protection of small ponds near the Project Area

21.3 MARATHON'S APPROACH TO ACCIDENT PREVENTION AND EMERGENCY RESPONSE PLANNING

Marathon's environmental management policy is based on evolving best-practice standards for environmental performance in the mining industry. Marathon's approach to preventing accidents and emergency response planning is built on the same principles. Marathon understands the importance of preventing accidents and planning for emergencies before they occur. Regarding accident prevention, Marathon will achieve this using the following framework:

- Review the individual steps involved in Project construction, operation and decommissioning, rehabilitation and closure activities prior to the start of each phase
- Analyze each step in the process to verify and update, if needed, the accident scenarios identified in this assessment of accidental events
- Review available best practice documents for each potential accident scenario
- Prepare site-specific accident prevention, emergency response and contingency plans with tactical plans, to be maintained on-site, and reviewed annually

While accident scenarios can be identified in advance and best practices can be in place to reduce the potential for occurrence, Marathon will also undertake the following steps and measures to be ready should an accident or emergency occur:

- Adopt an incident command system (ICS)
- Conduct annual emergency response exercises under the ICS system, including annual refresher training for key response personnel

- Review the potential accident scenarios annually and update as required with new best practices or newly identified potential accident scenarios, as applicable
- Maintain on site the supplies required to respond to the potential accident scenarios which will be identified in the emergency response plans

During an emergency, Marathon's hierarchy of key priorities and objectives is as follows:

- People – protect human life including Marathon employees and in the surrounding communities
- Environment – reduce harm to the environment
- Property – protect Marathon property and assets and respond to reduce additional negative impacts
- Business – facilitate business continuity

21.4 SELECTION OF ACCIDENTAL EVENTS OR MALFUNCTIONS FOR FURTHER ASSESSMENT

21.4.1 Potential Accidents or Malfunctions

Based on the design of the Project, professional expertise, and the Marathon team's experience with other mining projects, and in the absence of consideration for Marathon's diligent planning, approach to accident prevention throughout Project execution, and compliance with regulatory requirements, the following potential accidents or malfunction scenarios have been identified as having the potential to occur during the construction, operation and/or decommissioning, rehabilitation and closure phases of the Project:

- TMF Malfunction
- Open Pit Slope Failure
- Low-Grade Ore (LGO) and High-Grade Ore (HGO) Stockpiles, and Waste Rock Piles Slope Failure
- Fuel and Hazardous Materials Spill
- Unplanned Release of Contact Water (either from the failure of stormwater management infrastructure [e.g., ditching, ponds, erosion control] or the water treatment)
- Sewage Treatment Plant Failure
- Over Blasting
- Fire / Explosion
- Vehicle Accident
- Watercourse Crossing Failure

Within each of these broader accident categories, there is a range of scenarios that could occur. The assessment presented in this chapter focuses on the worst-case scenario(s) in each category. Of the potential incidents listed above, the following were not further assessed for the reasons described below: Open Pit Slope Failure; Sewage Treatment Plant Failure; Over Blasting; and Watercourse Crossing Failure.

21.4.1.1 Open Pit Slope Failure

The Leprechaun and Marathon sites will be developed as an open pit mine operation. The Leprechaun pit design comprises three mining phases and has maximum approximate dimensions of 1,010 m southwest to northeast by 660 m southeast to northwest, and a maximum depth of 285 m below current ground level. The Marathon pit design includes three mining phases and has maximum approximate dimensions of 1,250 m southwest to northeast by 670 m southeast to northwest, and a maximum depth of 270 m below current ground level.

Terrane Geoscience Inc. (Terrane) completed a geotechnical assessment of the Marathon and Leprechaun deposits (Appendix 2C). The proposed slope design takes into consideration the overall slope stability of a pit wall (i.e., all the benches and ramps from the pit floor to the surface) and the bench design (i.e., bench width, bench face angle, and bench height) (Terrane 2020, Appendix 2C). The slope angle, inter-ramp angle and bench face angles are designed to comply with the Newfoundland and Labrador (NL) *Occupational Health and Safety Regulations* and are based on acceptable probability of failure (Terrane 2020, Appendix 2C). At the bench scale, local rock structure or combinations of structures are the primary failure mechanisms affecting stability, which involve the movement of intact rock masses along one or more discontinuity sets. These failures commonly classified in three categories or three kinematic failure modes, including planar sliding, wedge sliding and toppling instabilities (Terrane 2020, Appendix 2C).

While bench face angles could be designed to avoid all possible failures, this would result in uneconomically flat slope angles and therefore, the proposed design assumes that some relatively small, intermittent failures will occur and will be contained by the catch benches. Catch benches are designed to add protection against rock fall at the bench scale in open pit mines. These kinematic failures are not anticipated to involve failure of the entire bench, rather small blocks on the bench face (Terrane 2020, Appendix 2C). It is considered best practice to include an extra wide catch bench at regular intervals in large open pits, for the purpose of providing additional safety to operators and equipment and the project design has incorporated them accordingly.

Slope failure in the open pit could occur due to unanticipated geological or hydrogeological conditions (Chapter 22), which could cause areas around the open pit to slump into the open pit. Ground conditions mapping and slope behavior monitoring will be routine as part of pit slope management. While there is potential to affect Project operation or infrastructure, as well as the health and safety of Project workers, slope failure is anticipated to be confined to the Project Area, and specifically within the open pits, and thus unlikely to result in residual adverse effect on the VCs; therefore, no further effects assessment is required. Health and safety concerns of Project workers is addressed in Section 2.2.5, as well as under the emergency response plans discussed in Section 21.3.

21.4.1.2 Sewage Treatment Plant and Discharge

Sewage will be collected via an underground sanitary sewer network to a common location, where it will be treated by an above-grade mechanical sewage treatment plant. Malfunction of the sewage treatment plant and sewer network could result in the release of untreated effluent, domestic sewage, or reagents in the treatment plant area. Failure of the treated effluent discharge pipeline could result in the release of

treated effluent. However, the sewage treatment facility will be built to applicable industry standards and codes and will be maintained and inspected on a regular basis. Sewage effluent will be treated and monitored in accordance with the NL *Environmental Control Water and Sewage Regulations* prior to discharge to the environment. A secondary attenuation will be provided by pumping the discharge to the TMF or to a designated septic field. Were effluent from the discharge pipeline to be accidentally released to the environmental via a leak or spill, this effluent will have already been treated to meet applicable regulatory requirements. Therefore, negligible residual adverse effects on VCs are anticipated, and no further effects assessment is required.

21.4.1.3 Over Blasting

Over blasting describes the event where rock fragmentation is displaced behind or below the intended blast boundaries due to improper stemming of the blastholes or over-drilling resulting in excessive noise or vibration. While an uncontrolled explosion also has the potential to occur where proper safety measures are not applied as required, an uncontrolled explosion would only occur as a result of negligence, and therefore is not discussed further.

In-situ rock is drilled and blasted in 12 m benches in waste rock and 6 m benches in ore to create suitable fragmentation for efficient loading and hauling of both ore and waste rock. Topsoil and overburden material will not require blasting. The blasting activities will be included under a contract service agreement with the explosive's supplier (who will have a valid blasters certificate issued by the NL Department of Environment, Climate Change and Municipalities [NLDECCM]).

Marathon will develop operating procedures to carry out blasting safely during operation. This will comply with the *NL Occupational Health and Safety Regulations*, and will include standards related to employee responsibilities, notification, inspections, signage, clean-up, and the safe use of materials and equipment. An Explosives and Blasting Management Plan will also be developed by Marathon and its selected, licenced blasting contractor(s) to provide direction for the safe storage, handling and use of explosives and explosive components at the Project site, to address the safety of the public and Project personnel, and protection of both the environment and Project components.

Dust and fly rock, as well as excess noise and vibration, could result from over blasting, which could extend beyond defined boundaries. However, dust, noise and vibration effects from an over blasting event would be infrequent, short in duration, and similar to the effects assessed in Chapter 5 to 19 for routine blasting. These effects include wildlife sensory disturbances (i.e., avoidance behaviors from noise), changes in fish health, growth and survival (e.g., from concussion, fly rock and runoff contaminated with the byproduct of explosives), as well as changes to the composition, abundance, and distribution of periphyton, plankton, and benthic invertebrate communities. Blasting operation will be carried out in accordance with applicable regulations to reduce the potential for an uncontrolled explosion and the buffer around the open pit was developed to safeguard VCs from the potential effects of fly rock. Given the safety measures and buffers in place, no residual adverse effects on VCs are anticipated beyond those effects assessed for routine blasting, and no further effects assessment is required.

21.4.1.4 Watercourse Crossing Failure

Failure of a watercourse crossing could result from a precipitation or snowmelt event that exceeds the design capacity, causing the loss of channel form due to erosion, or damage to other watercourse crossings downstream. Failure of drainage culverts included along Project roads could result in an impediment to fish movement and sedimentation to downstream waterbodies. This would result in potential adverse effects on surface water resources and fish and fish habitat. Culverts will be inspected periodically for stability and to remove accumulated material and debris. With watercourse crossings designed to address the appropriate design precipitation events including climate change parameters, regular maintenance and monitoring, and timely and effective response to watercourse crossing failures, the potential for effects will be reduced. In the unexpected event there is an extreme condition leading to flooding or culvert damage, repairs will be quickly undertaken, and flows restored. Given the implementation of proposed mitigation measures, negligible residual adverse effects on VCs are anticipated, and therefore no further effects assessment is required.

21.4.2 Accidents or Malfunctions Requiring Further Assessment

The accidents or malfunctions further assessed for the Project are summarized in Table 21.1. Detailed descriptions of these accidents or malfunctions are discussed in Section 21.5.

In the instance where a major accidental event or malfunction results in the Project being temporarily suspended, there is potential for a low magnitude adverse effect to local and regional economies by effects to wages, government revenues, and depending on the length of the suspension, gross domestic product. There may also be increased localized spending with short-term benefit to nearby communities for businesses supplying goods and services in support of the emergency responses. Effects to the economic environment would be short term in duration and likely reversible within approximately one month; therefore, residual effects to employment and economy from an accident or malfunction are not discussed further.

While emergency response capabilities at the mine site (e.g., firefighting and health care) will be sufficient for most accidents, a major incident has the potential to require additional support from surrounding communities. Emergency response services will be available at the Project site, and fire departments in Grand Falls-Windsor, Buchans, and Millertown and the hospital in Buchans may be called to aid in larger fires or emergencies. However, such support would not be frequent and would not put an excessive demand on these external capabilities. Effects to community services and infrastructure would be short term in duration; therefore, residual effects to community services and infrastructure from an accident or malfunction are not discussed further.

Table 21.1 Accidents and Malfunctions Scenarios Requiring Further Assessment

Accident / Malfunction	Description of Scenario	Description of Potential Adverse Effects	VCs Potentially Affected	Key Mitigation / Project Design
Tailings Management Facility Malfunction	A dam break could occur as a result of earthquakes, landslides, overtopping, internal erosion or piping, foundation failure, and slope failures (Golder 2020a; BSA.1. Attachment 1-A). The most common causes of recorded dam failures include piping and overtopping failures (ICOLD 1995 in Golder 2020a; BSA.1. Attachment 1-A).	In the event of a dam failure, liquid tailings would be released to the environment, affecting nearby waterbodies. Tailing solids could also be deposited along low-lying areas extending from the breach location, potentially causing localized infilling of vegetated areas and waterbodies. Adverse effects to vegetated areas and waterbodies could result in adverse effects to fish, wildlife, and resource users. There is also potential for impacts to infrastructure.	• Groundwater Resources • Surface Water Resources • Fish and Fish Habitat • Vegetation, Wetlands, Terrain and Soils • Avifauna • Caribou • Other Wildlife • Community Health • Land and Resource Use • Indigenous Groups • Historic Resources	• Designed, constructed, operated and closed in accordance with the Canadian Dam Association (CDA), Global Industry Standards on Tailings Management, and Mining Association of Canada (MAC) guidelines, as well as applicable provincial requirements
Overburden, Low-Grade Ore, High-Grade Ore, and Waste Rock Piles Slope Failure	Failure or slumping of materials in stockpiles / waste rock piles would result in the release of waste rock, ore or soils outside the storage areas and increase the footprint of the stockpile.	There is the potential for the release of contaminants or contact water into surface water resources and fish habitat.	• Surface Water Resources • Fish and Fish Habitat	• Progressive rehabilitation • Incorporation of appropriate geotechnical design parameters and factors of safety, and proper construction
Fuel and Hazardous Materials Spill	A fuel and hazardous material spill could occur as a result of equipment leakage / failure, storage tank leak or rupture, spill from vehicles on-site, and/or spill from vehicles off-site (i.e., along the access road).	A large spill may contaminate soil, groundwater and surface water resources, thereby potentially adversely affecting the quality of fish and fish habitat, and vegetated habitat, and resulting in the ingestion/uptake of contaminants by wildlife and affect access to these resources by Indigenous and non-Indigenous users.	• Groundwater Resources • Surface Water Resources • Fish and Fish Habitat • Vegetation, Wetlands, Terrain and Soils • Avifauna • Caribou • Other Wildlife • Community Health • Land and Resource Use • Indigenous Groups • Historic Resources	• Meet or exceed federal and provincial regulations including federal *Sulphur in Diesel Fuel Regulations*, and provincial *Storage and Handling of Gasoline and Associated Products Regulations* • Transportation of hazardous materials will be conducted in compliance with the federal *Transportation of Dangerous Goods Act*

Table 21.1 Accidents and Malfunctions Scenarios Requiring Further Assessment

Accident / Malfunction	Description of Scenario	Description of Potential Adverse Effects	VCs Potentially Affected	Key Mitigation / Project Design
				and the provincial *Dangerous Goods Transportation Act* • Marathon will regularly inspect and monitor Project infrastructure and equipment and take required action to maintain, repair and upgrade infrastructure / equipment as needed
Unplanned Release of Contact Water	Malfunction of the catchment sumps, ditches and channels, and sedimentation ponds could lead to the release of insufficiently treated contact water into the receiving environment.	Given that the water collection system is located throughout the Project Area, including near waterbodies, an unplanned release of contact water to the environment has the potential to adversely affect groundwater, surface water quality, fish and fish habitat, vegetation and wetlands.	• Groundwater Resources • Surface Water Resources • Fish and Fish Habitat • Vegetation, Wetlands, Terrain and Soils	• Water management infrastructure for the Project is designed to reduce operational risks and environmental impacts, as described in Section 21.5.4.2. System to be monitored and maintained over life of Project.
Fire / Explosions	Accidental events associated with Project activities, such as equipment malfunction or uncontrolled explosions could result in a fire related directly to Project infrastructure and facilities, or within the Project Area as a forest fire.	A fire could result in release of emissions to the atmosphere, affect surface water quality and fish habitat, affect forests and wildlife habitat adjacent to the Project Area, and restrict the ability of land in the surrounding area to support Indigenous and non-Indigenous resource users. Fires arising from other causes and potentially affecting the Project are assessed as an Effect of the	• Atmospheric Environment • Surface Water Resources • Fish and Fish Habitat • Vegetation, Wetlands, Terrain and Soils • Avifauna • Caribou • Other Wildlife • Community Health • Land and Resource Use • Indigenous Groups	• Fire and explosion prevention measures and management, including on-site equipment and trained personnel, as described in Section 21.5.5.2

Table 21.1 Accidents and Malfunctions Scenarios Requiring Further Assessment

Accident / Malfunction	Description of Scenario	Description of Potential Adverse Effects	VCs Potentially Affected	Key Mitigation / Project Design
		Environment on the Project (Chapter 22).		
Vehicle Accident	Vehicle accidents, including single vehicle accidents, could result in the release of hydrocarbon, sodium cyanide, or ammonium nitrate to the environment, and accidental collisions from the operation of Project vehicles or heavy equipment could also result in human mortality or injury.	A vehicle collision could adversely affect wildlife and/or members of the public using the access road. Potential effects resulting from a spill from a vehicle accident are discussed in the assessment of a fuel or hazardous material spill (Section 21.5.3). Potential adverse effects caused by vehicle collisions with wildlife are assessed in Avifauna, Caribou, and Other Wildlife Chapters (Chapters 10, 11, and 12, respectively).	• Avifauna • Caribou • Other Wildlife • Community Health	• Marathon will develop and implement a Traffic Management Plan to manage transportation of workers and materials to site, product leaving site, and the number of vehicles accessing the site • Several traffic safety measures will be implemented to reduce the potential for vehicle malfunctions or accidents

21.5 EFFECTS ASSESSMENT FOR SELECTED ACCIDENTS OR MALFUNCTIONS

21.5.1 Tailings Management Facility Malfunction

Tailings will be managed for the first nine years of operation in the TMF. After Year 9 of operation, tailings will be pumped via pipeline to the exhausted Leprechaun open pit until the cessation of milling operation. The TMF will be designed to store 30 million tonnes (Mt) of tailings, and constructed from mine waste rock and locally sourced borrow materials with a final maximum crest elevation of 408.5 metres above sea level (masl) and a maximum embankment height of 48 m. The total area of the TMF is 1.88 km^2. Additional detail on the TMF design is provided in Section 2.3.4.

Tailings will be deposited as a thickened slurry primarily from high ground on the northwest side of the TMF or from the perimeter embankment, allowing the formation of a tailings beach, sloping from deposition points down to the perimeter embankment. This enhances storage capacity and reduces stability and seepage risks. To limit the volume of discharge, excess water from the TMF will be reclaimed to the process plant to offset process water demand. Tailings samples generated from Leprechaun and Marathon ores are classified as non-potentially acid generating (PAG). Water in the TMF and pore water in tailings will likely exceed the *Metal and Diamond Mining Effluent Regulations* (MDMER) limits for total cyanide, un-ionized ammonia, and copper based on ageing and column tests.

A water treatment plant and polishing pond will allow for the treatment and discharge of the excess water to Victoria Lake Reservoir. The polishing pond is located downstream of the TMF, with a footprint area of 4.1 hectares (ha) and operational capacity of 44,000 cubic metres (m^3). A retention time of five days was assumed based on a nominal flow through rate of 115 cubic metres per hour (m^3/h) and a peak flow rate of 280 m^3/h, which is sufficient to treat runoff, precipitation, and process flows for up to a 25-year wet precipitation year.

21.5.1.1 Description of Scenario

Historically, there have been several failure mechanisms that have resulted in dam breaks, including earthquakes, landslides, overtopping, internal erosion or piping, foundation failure, and slope failures (Golder 2020a; BSA.1. Attachment 1-A). The most common causes of recorded dam failures include piping and overtopping failures (ICOLD 1995 in Golder 2020a; BSA.1. Attachment 1-A). Piping, the internal erosion of the embankment material due to the flow of water, can develop as a result of construction and design issues as well as over time due to burrowing animals, decaying root systems below the pond reservoir level, or cracking caused by deformation. Piping manifests in the form of concentrated seepage and erosion of the dam fill, which can cause a collapse of the dam crest (Golder 2020a; BSA.1. Attachment 1-A). Dam overtopping, when the inflow to the pond exceeds its storage and discharge capacities and therefore a rise of water level higher than the dam crest, has the potential to result in rapid down cutting as the dam fill is eroded by the flowing water. Piping and overtopping, if not identified and corrected, may lead to a rapid breach of the dam section through progressive erosion of the fill materials and an uncontrolled release of the impounded water (Golder 2020a; BSA.1. Attachment 1-A).

21.5.1.2 Project Design and Safety Measures to Reduce Environmental Effects

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 (MAC) guidelines, Global Industry Standards on Tailings Management, as well as applicable provincial requirements. They will be inspected, maintained and repaired in accordance with the NL *Water Resources Act.*

As described in Section 2.3.4, the design of the TMF was carried out to meet or exceed the minimum allowable factors of safety under static and pseudo-static loading conditions recommended in the current CDA *Dam Safety Guidelines*. The proposed TMF includes a tailing dams and polishing pond dam that incorporates current regulatory requirements into the design, including the CDA (2013) design standards. Design of the tailings dam crest and invert elevation of associated spillways are determined by considering the Inflow Design Flood (IDF), the Environmental Design Flood (EDF), the Normal Operating Water Level (NOWL), the Low Operating Water Level (LOWL), and freeboard.

An emergency spillway will be located on the northeastern abutment of the dam and is an open cut channel with an invert elevation of 389.5 masl and widths between 6 and 20 m (Golder 2020a; BSA.1. Attachment 1-A). The maximum normal operating level is 1 m below the spillway invert, which provides sufficient storage for the EDF. EDF is defined as the most severe flood (i.e., largest design runoff event) that can be stored and does not result in an unscheduled discharge of water to the environment (Golder 2020; BSA.1. Attachment 1-A). The 100-year, 24-hour event (75 mm of rain) was selected as the EDF, which is on top of the 25-year return period wet hydrological conditions (Golder 2020b). The overall design objective of the TMF is to protect the regional groundwater and surface water resources during both mine operation and long term (post-closure), achieve safe and efficient tailings storage and effluent management during operation, and achieve effective rehabilitation upon mine closure. The design of the TMF has considered the following:

- Reducing potential adverse effects to fish and fish habitat and risks to the surrounding environment and the Victoria Lake Reservoir and Dam, in the event of a dam failure
- Permanent, secure and total confinement of tailings materials within the engineered TMF
- Control, collection and removal of effluent from the tailings during operation for recycling as process water to the maximum practical extent
- The inclusion of monitoring features for the facility to demonstrate that facility performance goals are achieved, and design criteria and assumptions are met
- Staged development of the TMF over the life of the Project to defer capital cost and allow for efficient use of rock materials from open pit development as construction materials for the TMF

The accumulation of water in the TMF has been modelled for the mean and 25-year wet annual precipitation conditions. A water treatment plant and polishing pond will allow for the treatment and discharge of the excess water to Victoria Lake Reservoir. Treatment and discharge will occur for eight months a year during operation (avoiding discharges during winter months). The TMF has been sized to store the excess water during the non-discharge period, including appropriate design precipitation events.

As outlined in the CDA *Dam Safety Guidelines*, dam surveillance is a critical component of dam safety for all phases of the life of most dams. Dam surveillance will start with construction, utilizing a comprehensive construction monitoring plan, including inspections by the Engineer of Record. Once constructed, pre-operational inspections will be completed by Marathon, the Engineer of Record, and if feasible, the engineer who will conduct the annual inspections and Dam Safety Reviews.

Prior to operation, emergency preparedness and response plans (e.g., MDMER Emergency Response Plan for effluent and tailings release) and the TMF Operations, Maintenance and Surveillance (OMS) manual will be developed which will provide a comprehensive plan for operation, inspection, and emergency response using the best practices outlined by the CDA and MAC. From a dam safety perspective, the OMS manual will prescribes the type, frequency, and intensity of dam inspections to be completed, including daily observational inspections, weekly and monthly formal inspections completed by trained staff, and third party annual inspections and Dam Safety Reviews (for Project TMF dams, required every five years based on “very high” dam classification). The Project Rehabilitation and Closure Plan and Financial Assurance will contain provisions for post-closure monitoring and maintenance of Project dams for 100 years, in the event that Marathon defaults on the Project at any time.

Dam monitoring and surveillance instrumentation will provide a record of key TMF dam performance data, including TMF water levels and flows, internal dam and downstream groundwater levels, groundwater quality upstream (natural) and downstream of the TMF, and settlement or movement of the dam itself.

The detailed engineering design (for construction) will be submitted to the Water Resources Management Division, NLDECCM to obtain the necessary approvals (permits) for construction and operation of the TMF dams. Pre-operational plans (Emergency Response Plans, OMS) will also be submitted to the appropriate regulators for review. The Project OMS will include a reporting plan and structure to provide dam safety information (inspection reports, monitoring data) to regulators and NL Hydro.

CDA requires that a Public (Stakeholder) Safety Plan be developed which will identify the notifications procedures, warnings and alarms to be implemented in the event of a catastrophic failure. Furthermore, under MDMER, there is a requirement for a tailings / effluent emergency response plan which will outline how a failure would be managed. The TMF will be monitored throughout the life of the facility to demonstrate performance goals are achieved and design criteria and assumptions are met.

21.5.1.3 Emergency Response Measures

In the event of a TMF dam failure, initial response would include the following steps:

- Stop / shut down pumping of tailings to the TMF
- Notification to authorities, emergency responders and others who are to be notified under the Public (Stakeholder) Safety Plan
- Notification to Engineer of Record

- Immediately engaging the MDMER tailings/effluent emergency response plan and developing a remedial action and monitoring plan for the event, and initiate remedial action such as deploying earthworks equipment to reduce further damage to the dam and stabilize escaped tailings to the extent feasible, establishing additional containment as needed around the inundation area, and deploying turbidity curtains and/or other similar mitigation within affected watercourses
- Given that the Project access road crosses the Victoria River and Exploits River downstream of NL Hydro dams, Marathon will engage with NL Hydro regarding mutual emergency notification and response procedures in the event of an identified risk, concern or accident / malfunction

21.5.1.4 Environmental Effects Assessment

In accordance with the dam classification methodology presented in the CDA *Dam Safety Guidelines*, the TMF dams have been provisionally classified as having a “very high” consequence of failure based on the following:

- Environmental and cultural values – significant loss or deterioration of critical fish or of wildlife habitat in the Victoria River and potentially further downstream
- Loss of life: 100 or fewer
- Infrastructure and economics – low economic losses, area contains limited infrastructure or services

Golder conducted a dam breach and inundation assessment for the TMF for the Project (Golder 2020a; BSA.1. Attachment 1-A). While embankments and dams can potentially fail at any location, the dam breach locations selected for the assessment were chosen based on dam configurations and the topography to represent the worst-case scenarios. The largest dam height location was selected, corresponding to the location where the difference in elevation between the dam crest and the toe of the dam is the greatest and has the potential to result in the largest plausible breach outflow volume for that dam (Golder 2020a; BSA.1. Attachment 1-A). The TMF East, South, and West dams were selected for analysis. Given the amount of tailings solids and water that would be released during a dam failure is dependent on the volume of water and climatic conditions at the time of failure, both fair-weather (sunny day) and flood-induced (rainy day) conditions were considered. Piping and dam overtopping (as described in Section 21.5.1) were identified as the most plausible malfunctions to occur at this site. Therefore, the following scenarios were assessed:

- Scenario A – fair-weather conditions for the TMF East Dam by the piping failure mode, with the maximum operating water level at 388.5 masl
- Scenario B – flood-induced conditions for the TMF East Dam, by the piping (Scenario B1) and overtopping failure modes (Scenario B2) with the probable maximum flood level at 390.5 masl, obtained by routing the probable maximum precipitation
- Scenario C - flood-induced conditions for the TMF South Dam by the piping failure mode, with the probable maximum flood level at 390.5 masl, obtained by routing the probable maximum precipitation
- Scenario D – flood-induced conditions for the TMF West Dam by seismic loading coupled by poor construction or defective materials resulting in slope instability

The breach of the TMF East and South Dams have the potential to release water tailings to Red Indian Lake via the Victoria River. It is predicted that the increase in water surface elevation of Red Indian Lake as a result of a breach in the TMF dam will be in the order of millimetres only. Most of the released tailings are predicted to be deposited along the Victoria River main channel and flood plains, with some of the suspended tailings travelling downstream into Red Indian Lake (Golder 2020a; BSA.1. Attachment 1-A). There are no impacts or effects predicted beyond the mixing zone in Red Indian Lake.

In consideration of potential loss of life there are two potential considerations: the public downstream of the TMF, and site infrastructure and people downstream. A cabin and outfitter lodge are located along the Victoria River flow path, approximately 40 km and 60 km downstream of the TMF, respectively. In the event of a TMF failure, these structures will not be impacted; they are not within the inundation zone and therefore would not be affected by the failure alone. However, in evaluating the potential 'rainy day' failure scenario, it has been determined that the magnitude of the probable maximum flood (PMF) event would flood these structures irrespective of a TMF failure. If the TMF failure coincided with the PMF event, it would only add about 1.1% to the runoff volume from the PMF event itself, with no incremental impacts predicted as a result. In terms of a potential TMF failure, these structures are also far enough downstream that there would be sufficient warning time (i.e., more than 10 hours) for evacuation.

In the event of a failure of the TMF East Dam (Scenarios A and B), the impoundment water and suspended tailings would be released, potentially rupturing the polishing pond walls and releasing its containment. The consequential surge wave from both breaches would run downstream along the Victoria River towards Red Indian Lake (Golder 2020a; BSA.1. Attachment 1-A). For the fair-weather conditions (Scenario A), the peak outflow will be attenuated by 68% after having travelled 1.6 km with the peak flood wave at the inlet of Red Indian Lake being 3.2 m^3/s above baseline conditions (Golder 2020a; BSA.1. Attachment 1-A). The peak flow at Crossing 1 (located downstream TMF along Victoria River) is 480 m^3/s above baseline conditions. No potential loss of life is anticipated for this scenario. The estimated volume of tailings release for Scenario A would be 181,400 m^3 (approximately 1% of the ultimate tailings volume within the impoundment). For the flood-induced failure by piping (Scenario B1), the flood wave is anticipated to reach nearby cabins and outfitter lodge within 13 hours from the time of the breach and the Red Indian Lake within 14 hours from the time of the breach (Golder 2020a; BSA.1. Attachment 1-A). The peak water flow is anticipated to be an incremental increase of 31 m^3/s, with the peak outflow attenuated by 67% after having travelled a distance of 1.6 km (Golder 2020a; BSA.1. Attachment 1-A). The estimated volume of tailings release for Scenario B would be 323,500 m^3 (approximately 1.7% of the ultimate tailings volume within the impoundment). No potential loss of life is anticipated for this scenario.

In the event of a failure of the TMF South Dam (Scenario C), the impoundment water and tailings with the surge wave is anticipated to travel towards the upstream reach of Victoria River, just south of the facility (Golder 2020a; BSA.1. Attachment 1-A). The flood wave resulting from the dam breach would mostly propagate downstream the Victoria River with a peak flow equal to 320 m^3/s, and a peak flow equal to 3.5 m^3/s would propagate towards the downstream toe of the Victoria Dam. At the downstream toe of the Victoria Dam, the maximum depth and velocity reached is 0.5 m and 0.3 m/s, respectively and at this depth and velocity, there would be no adverse effects on the dam. The estimated volume of tailings release for Scenario C would be 267,500 m^3 (approximately 1.5% of the ultimate tailings volume within the impoundment).

There is no water ponded on the western portion (TMF West Dam; Scenario D) of the TMF (even during extreme events); therefore, it is assumed that the most plausible cause for a geotechnical failure would be seismic loading coupled by poor construction or defective materials resulting in slope instability (Golder 2020; BSA.1. Attachment 1-A). A breach of the dam would release approximately 740,000 m³ of tailings and potentially impact site facilities (i.e., the process plant and the truck shop) with 120,000 m³ anticipated to runout towards Victoria River. In the event of a failure of the TMF West Dam under liquefaction, the process plant will be impacted and potentially cause life loss to the operational personnel within. The TMF West Dam is only constructed for the Ultimate Stage in year 7; therefore, there is no risk of a breach in this area before that year (Golder 2020a; BSA.1. Attachment 1-A). Also, this analysis does not account for the mill pad elevation or other physical features in the area. As part of the ongoing Project planning and engineering design, Marathon is reviewing all options to reduce or, more likely, eliminate this risk. There could also be people (temporary or transient) on the access road downstream of the TMF. This possibility has already been considered in the classification of the dam, therefore associated mitigation measures have been incorporated into the design.

The majority of the tailings released from the TMF would occur in the event of a breach of the TMF East and South Dams, which would be deposited on the downstream slope and in the Victoria River along the flood wave path with some tailings settled in the river's flood plain. Some tailings will be introduced into Red Indian lake in suspension, with higher concentrations during the probable maximum flood event (Golder 2020a; BSA.1. Attachment 1-A). No potential loss of life or critical infrastructure is anticipated due to the breach failure of the TMF East and South dams (Golder 2020a; BSA.1. Attachment 1-A). Depending on the timing and extent of a potential failure, effects to groundwater, surface water resources, fish and fish habitat, vegetation and wetlands, and wildlife habitat, may occur. Effects on these environmental components could then affect local land uses and historic resources as described below. Marathon will develop contingency planning and implement engineering and quality controls during the design, construction, and operation phases to mitigate adverse environmental effects.

Groundwater Resources

In the event of a TMF malfunction, groundwater quality may be affected depending on the magnitude of the failure and the time elapsed before emergency response measures are implemented. Topography and the horizontal hydraulic gradient in the area of the TMF slope toward the Victoria River. It may therefore be expected that the effect on groundwater quality, as a result of a TMF failure, would extend from the TMF toward these surface water features. Tailings solids may be deposited near the breach location and downgradient low-lying areas; however, these would be cleaned up where feasible to limit infiltration and long-term effects to groundwater. If tailings solids cannot be remediated, the potential for long-term effects to groundwater quality exists in downgradient low-lying areas. As discussed in Section 21.5.1.1, groundwater monitoring will be conducted during pre-construction, construction, operation, and closure stages to monitor potential flow pathways.

Residual adverse effects on groundwater are predicted to be of low magnitude in areas where tailings solids are remediated, within the Groundwater Resources Local Assessment Area (LAA), long term, and potentially irreversible if tailings cannot be effectively removed from the ground surface.

Surface Water Resources

A TMF malfunction would have the potential to affect water quality and quantity of nearby waterbodies, depending on the location of the leak or breach. An Assimilative Capacity Study was conducted by Golder (Golder 2020c; BSA.1. Attachment 1-B) to assess the water quality impacts downstream of the TMF in the event of a failure. As discussed in the report, a failure of the TMF East Dam would release the impounded water and suspended tailings downstream towards the Victoria River and subsequently Red Indian Lake, resulting in loading of chemical mass from the TMF to these waterbodies. Parameters of potential concern (POPCs) identified in TMF water include nitrate, aluminum, silver, arsenic, cadmium, cobalt, copper, iron, mercury, and selenium. Although the effects of water quality are predicted to be short term, the concentrations of POPCs were compared to long-term (chronic) Canadian Council of Ministers of the Environment (CCME) *Canadian Water Quality Guidelines for the Protection of Freshwater Aquatic Life* (CWQG-FAL), as few short-term (acute) CWQG-FAL criteria are available.

In the event of a TMF East Dam breach, modelling shows that limited assimilative capacity exists in the Victoria River under the fair-weather (“sunny day”) scenario. Predicted concentrations at Station 2 (located downstream of Red Cross Lake confluence) are above long-term CWQG-FAL criteria for all POPCs identified in TMF water (Golder 2020c; BSA.1. Attachment 1-B). Attenuation of breach water peak flow rates and additional assimilative capacity at stations downstream of Station 2 results in a progressive decline in POPC concentrations, with only aluminum, cobalt, and copper remaining above the long-term CWQG-FAL criteria at Station 7 (located at Red Indian Lake). Under the probable maximum precipitation event (“rainy day”) scenario, additional assimilative capacity results from increased non-contact water flows. Only aluminum, copper, cobalt, and mercury are predicted to occur at concentrations greater than long-term CWQG-FAL criteria at Station 2. Mercury is estimated to be less than CWQG-FAL criteria beyond Station 2, while aluminum, cobalt, and copper concentrations remain above CWQG-FAL criteria at all stations, reflecting the baseline condition for aluminum, and highly elevated concentration of cobalt and copper in TMF water (Golder 2020c; BSA.1. Attachment 1-B).

Modelling for Red Indian Lake predicts copper concentrations above the long-term CWQG-FAL criteria as a result of the dam breach. Concentrations of copper are only slightly below CWQG-FAL criteria at baseline, resulting in minimal assimilative capacity (Golder 2020c; BSA.1. Attachment 1-B).

Overall, POPC concentrations are typically greater closer to the breach and in the fair-weather scenario. The duration of POPC concentrations greater than long-term CWQG-FAL criteria are typically greater further downstream, as a result of peak flow attenuation. The modeled conditions are considered to be fully reversible over a relatively short period of time once all inundated areas have returned to ambient water levels (Golder 2020c; BSA.1. Attachment 1-B).

A failure of the TMF could also result in the transport of sediments downstream and the infilling of the waterbodies with solid tailings and TMF dam materials. This may in turn affect natural drainage patterns where this material settles. Increased flow velocities through constricted channels, localized rises in water levels due to full or partial stream blockages and infilling of deep pools may result. Should sediment and solids make it to Red Indian Lake, it is likely they would be deposited in an alluvial fan around the outlet of the Victoria River. This could damage aquatic vegetation and alter the local bathymetry.

In the event of a TMF failure, residual adverse effects on surface water resources are of high magnitude, potentially extending to the Surface Water Resources Regional Assessment Area (RAA) dependent on the magnitude of the malfunction, both short and long-term and both reversible and irreversible (given large amounts of sediment may remain).

Fish and Fish Habitat

In the event of a TMF malfunction, the failure of the TMF East Dam would release the impounded water and suspended tailings into Victoria River and ultimately reaching Red Indian Lake. Such a failure has the potential to result in adverse effects to aquatic life as a result of increased concentrations of dissolved constituents, sediment deposition in fish habitat, habitat alternation / destruction and potential change in fish health, growth, or survival due to lethal or sublethal effects.

The primary pathways of effects on fish and fish habitat are changes in water and sediment quality, sediment deposition and increased turbidity. Fish and benthic invertebrate communities may experience injury or mortality from smothering or lethal toxicity from impounded water and suspended tailings. These effects could extend downstream of the dam breach along Victoria River to Red Indian Lake; the extent of these effects vary depending on dam breach scenarios as modelled by Golder (2020c; BSA.1. Attachment 1-B). Fish and benthic invertebrate communities may also experience chronic toxicological effects from the uptake of contaminants from sediments given they live in and on the sediment. As discussed in the surface water resources section above, the modelled conditions are considered to be fully reversible over a relatively short period of time once all inundated areas have drained to ambient water levels (Golder 2020c; BSA.1. Attachment 1-B).

If a TMF dam breach were to occur during spawning, sediment deposition could also smother fish eggs, as well as potentially alter physical substrate characteristics such that substrates are no longer suitable for spawning. Benthic and aquatic plant communities may be lost which may take a long time to recover or require rehabilitation of disturbed areas. Depending on the magnitude and location of the release, this disturbance has the potential to affect the productivity of fish and fish habitat; however, the populations would eventually return to pre-breach levels (i.e., in decades). There are no aquatic species at risk (SAR) known to occur with the Project Area, LAA or RAA that are listed under the *Species at Risk Act* (SARA).

In the unlikely event of a TMF failure, residual adverse effects on fish and fish habitat are of high magnitude, potentially extending beyond the Fish and Fish Habitat LAA, and be long-term and reversible.

Vegetation, Wetlands, Terrain and Soils

A TMF malfunction would result in the release of tailings and associated water into local vegetation communities, which may result in native plant species or communities being lost or altered, and/or direct loss of wetland area or change in wetland form, as well as a change in soil quality. Changes in water levels due to tailings and tailings effluent inundation may have a limited and temporary effect on vegetation, wetlands and soils. The magnitude of adverse effects would depend on the size and location of the TMF malfunction. As noted in Section 9.2.2.2, Chapter 9 (Vegetation, Wetlands, Terrain and Soils), no vascular plant SAR were observed during the surveys conducted in support of the Project. Three vascular plant species of conservation concern (SOCC) were observed, including short-scale sedge

(*Carex deweyana*, S2), nodding water nymph (*Najas flexilis*, S2) and perennial bentgrass (*Agrostis perennans*, S2). These species are not located near the TMF (Figure 9-4), therefore, effects to plant SOCC are not anticipated.

If a TMF malfunction occurred, where feasible, tailings solids as well as potentially contaminated soil would be removed, and residual solids would be stabilized and/or covered on site, allowing for natural filtration by the vegetation itself as it reestablishes after reclamation. Depending on the magnitude of the TMF malfunction, natural vegetation may generally reestablish over subsequent growing seasons, although different vegetation communities may establish relative to what was present prior to the TMF malfunction. Vegetation community types surrounding the TMF are common throughout the LAA; therefore, no landscape-level changes to vegetation communities are expected if a TMF malfunction occurred.

Residual adverse effects on vegetation, wetlands, terrain and soils are moderate in magnitude, within the Vegetation, Wetlands, Terrain and Soils RAA, medium to long term, and potentially irreversible depending on the effectiveness of rehabilitation.

Avifauna, Caribou and Other Wildlife

TMF malfunction may result in the direct loss or alteration of wildlife habitat, change in movement patterns, increased mortality risk, and/or changes to wildlife health. During Project construction and operation, the Project Area is not expected to provide habitat for most wildlife species due to vegetation clearing, habitat fragmentation and ongoing sensory disturbance from Project activities. The risk of wildlife mortality and wildlife habitat loss in the event of a TMF malfunction results in tailings and/or effluent extending to would be reduced within the Project Area (given reduced presence of wildlife within the Project Area); however, adverse effects on wildlife and wildlife habitat may extend into the Avifauna, Caribou and Other Wildlife LAAs and RAAs depending on the size and location of the TMF breach.

If a TMF malfunction results in tailings and/or effluent extending to the Avifauna, Caribou and Other Wildlife LAA or RAA, solid tailings and contaminated water may infiltrate low-lying areas or nearby vegetation; however, these effects would be limited with prompt reclamation and stabilization, and the vegetation would be expected to reestablish after several growing seasons. In addition to the change in habitat directly and indirectly, the Project is also predicted to result in a change to caribou movement. The primary migration path for the Buchans herd, which may be used by over 50% of the herd, overlaps the Project Area. Due to the importance of this migratory path, effects of a potential TMF malfunction would be additive to the predicted high magnitude effect of routine Project activities on movement of the Buchans caribou herd, particularly if a failure were to occur during the migration period for the herd.

The Victoria Steadies Sensitive Wildlife Area, located along the Victoria River, contains habitat for waterfowl (NL-EHJV 2008) (Figure 10-4). This area was established for the protection of wetland habitat used as breeding, brood rearing, and staging grounds for waterfowl. The NL Department of Fisheries, Forestry and Agriculture (NLDFFA) has indicated that the waterfowl habitat that was likely the focus of this designation are “steadies” on the Victoria River system located north of the mine site, before the river drains into Red Indian Lake (B. Adams, pers. comm, 2020). As indicated above, a failure of the TMF could also result in the transport of sediments downstream and the infilling of waterbodies with solid

tailings and TMF dam materials. This may in turn affect natural drainage patterns where this material settles. Increased flow velocities through constricted channels, localized rises in water levels due to full or partial stream blockages and infilling of deep pools may result. This could damage aquatic vegetation and alter the local bathymetry, resulting in alteration of productive waterfowl habitat associated with Victoria Steadies.

In addition to change in habitat quality, there is a potential for mortality risk associated with the release of impounded water. As indicated in Chapter 10, this water could have potential exceedances of MDMER for cyanide total, 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 TMFs and associated contact ponds (Eisler and Wiemeyer 2004; Donato et al. 2007) and could also be exposed by ingesting aquatic flora and fauna. Depending on the time of year of a malfunction and downstream extent of the event, individual birds present in the area of the Victoria Steadies could experience injury or mortality.

In the event of a TMF failure, wildlife population stability at the Avifauna, Caribou and Other Wildlife LAAs or RAAs level is not expected to be affected, although there is uncertainty with respect to effects on waterfowl present in the Victoria Steadies area as this will depend on the timing and nature of the failure. Residual adverse effects on wildlife and wildlife habitat are predicted to be moderate to high in magnitude, within the LAA, medium to long-term, and potentially irreversible.

Community Health

As indicated above, in the event of a TMF breach, there would be adequate time to warn community members who may be located in downstream cabins or outfitter lodges. Water discharges could increase concentrations of POPCs in soil, sediment and water which can lead to increases of these chemicals in vegetation, wild meat and fish tissue. Possible changes in country food, water, and soil quality may therefore affect the health of human receptors who live nearby or may engage in harvesting (i.e., hunting, trapping, fishing and berry picking) and recreational activities. While there is potential for these effects to occur, the health risks associated with a TMF breach is expected to be low given remediation measures, including capping and/or removing the affected soils, would limit the potential for contact with wildlife and thereby reducing associated health risks. The terrestrial area affected would likely be small, representing a small fraction of the home range of larger mammals, and therefore their exposures to affected soils would be limited. Given the limited interaction with wildlife, health risks for people who eat terrestrial country foods are not anticipated.

As noted above, although fish populations would eventually return to pre-breach levels (in decades), there could be persistent contamination of fish tissue due to long-term contamination of bottom sediments, which may require decades to return to pre-breach levels. If a TMF malfunction occurred, fish advisories would likely be issued until monitoring of fish tissues can confirm levels are safe for consumption. While this would reduce health risks from fish consumption, fish advisories may affect health through reduced availability of country foods. While Red Indian Lake is not a waterbody or watershed that contributes to the water supply of the downstream communities, public advisories related to consumption of water from Red Indian Lake would also be issued if needed until monitoring establishes water quality appropriate for human consumption.

As noted above, in the event of a failure of the TMF West Dam under liquefaction, the process plant will be impacted and could potentially cause life loss to the operational personnel within (Golder 2020a; BSA.1. Attachment 1-A). As previously noted, Marathon will be reviewing the results of this assessment and developing mitigation to reduce or eliminate the risk of potential loss of life under this scenario. In general, monitoring of the dam, and preparing emergency notification procedures and emergency response plans will reduce the risk associated with a potential dam failure, and also address the health and safety of Project workers.

Residual adverse effects on community health would be of low to high (in the event of loss of life) magnitude, potentially extending beyond the Community Health LAA, and be medium term and reversible, except in the event of a loss of life.

Land and Resource Use

Effects to wildlife from a release of tailings from the TMF has the potential to affect land and resource uses, such as hunting, trapping, gathering, and fishing. Residual adverse effects on vegetation communities, fish and fish habitat, and wildlife and wildlife habitat could occur due to TMF malfunction, as described in the sections above. These effects could in turn affect land and resource use in the Land and Resource Use LAA, as well as extending in the Land and Resources Use RAA. An effect on fish and wildlife habitat could result in localized reductions in fish and wildlife abundance, health or condition that could limit the quality of the fishing, trapping, and hunting resources within the Project Area, LAA and RAA.

While land and resource use is not anticipated within the Project Area during Project construction and operation, and land and resource use is limited within the LAA, resource and recreational use does occur in the RAA, particularly along Red Indian Lake. In the event a TMF release reaches Red Indian Lake, this may result in restrictions to activities (such as fishing) due to area closure to allow for clean-up activities or because hazardous material could cause contamination to foods. If the affected area were to overlap an area used for resource or recreational purposes, effects to the users are anticipated to be temporary in nature. As noted above, limited interaction with wildlife is anticipated, and therefore, health risks for people who eat terrestrial country foods are not anticipated.

Residual adverse effects on land and resource use are predicted to be low magnitude, limited to the Land and Resource Use RAA, short term and potentially irreversible.

Indigenous Groups

In the event of a TMF failure, there is potential adverse effects to Indigenous health and socio-economic conditions, Indigenous physical and cultural heritage and current use of lands and resources for traditional purposes (hereafter referred to as ‘current use’). Residual adverse effects on vegetation communities, fish and fish habitat, and wildlife and wildlife habitat could occur due to TMF malfunction, as described in the sections above. Access to and availability of harvested species may therefore be adversely affected. Adverse effects may also occur from increased concentrations of POPCs in soil, sediment and water, which can lead to increases of these chemicals in vegetation, wild meat and fish tissue. Possible changes in country food, water and soil quality may therefore affect the health of human

receptors who live nearby or may engage in harvesting (i.e., hunting, trapping, fishing and berry picking) and recreational activities. If the affected area were to overlap an area used for harvesting activities, effects to the Indigenous groups are anticipated to be medium term. As noted above, limited interaction with wildlife is anticipated, and therefore, health risks for Indigenous people who eat terrestrial country foods are not anticipated.

If a TMF malfunction occurred, fish advisories for Victoria River and Red Indian Lake would likely be issued until monitoring of fish tissues can confirm levels are safe for consumption. While this would reduce health risks from fish consumption, fish advisories may affect health through reduced availability of country foods. Public advisories related to consumption of water from Red Indian Lake would also be issued if needed until monitoring establishes water quality appropriate for human consumption.

With mitigation in place, residual adverse effects on Indigenous groups are predicted to be low in magnitude, limited to the Indigenous Groups RAA, medium term and potentially irreversible.

Historic Resources

The potential for effects on historic resources may include disruption of known or unknown heritage sites and would depend upon the size and location of the TMF malfunction and the proximity to known and potential historic resources. Known archaeological sites exist south of the TMF and along the Victoria River. In the event of TMF malfunction, there would be localized temporary flooding, sedimentation and erosion near the TMF.

In the event of a TMF failure, as per the Historic Resources and Cultural Protection Plan, an archeologist would be required to be on site should the tailings be removed to verify the soil of the potential area is not disturbed further. Limited equipment would be used over the potential area to avoid additional disturbance and compression.

Residual adverse effects historic resources are predicted to be moderate in magnitude, limited to the Heritage Resources LAA, permanent and irreversible.

Dam Infrastructure

As part of ongoing Project engagement activities, Marathon has documented interests and concerns about the Project received from communities, governments, Indigenous groups and stakeholders. As described in Section 19.1.2, early feedback identified concerns related to Victoria Dam and the initial location of the TMF. Water Resources Management Division of NLDECCM is the primary regulator of dams in the province, and identified their concerns with respect to dam safety and tailings management in general, and also concerns with respect to Marathon's initial plans to construct the TMF immediately upstream of the Victoria Dam. Marathon has also met and exchanged information with NL Hydro (Nalcor) regarding their hydroelectric assets, and NL Hydro provided information regarding their concerns with Marathon's initial plans regarding the TMF location (upstream of the Victoria Dam). Subsequent information provided by NL Hydro has been used in the relocation of the TMF and the overall environmental assessment (EA) as it relates to the Victoria Dam and Victoria Lake Reservoir. Marathon and NL Hydro continue to consult and exchange information regarding Marathon's Project and any interactions with NL Hydro's assets.

As a result of this engagement and additional environmental baseline information, Marathon completed a new, full scope siting study and design review for the TMF. This work resulted in a change in the location of the TMF, downstream of the Victoria Lake Reservoir and Dam as detailed in the Project Description (Chapter 2). This reduces the potential for a TMF failure to affect the Victoria Dam, as described below.

In the event of a failure of the TMF South Dam (Scenario C), the impoundment water and tailings with the surge wave are anticipated to travel towards the upstream reaches of Victoria River, just south of the facility (Golder 2020a; BSA.1. Attachment 1-A). The flood wave resulting from the dam breach would mostly propagate downstream in the Victoria River, with a peak flow equal to 320 m^3/s; a peak flow equal to 3.5 m^3/s would propagate towards the downstream toe of the Victoria Dam (Golder 2020a; BSA.1. Attachment 1-A). At the downstream toe of the Victoria Dam, the maximum depth and velocity reached would be 0.5 m and 0.3 m/s, respectively, and at this depth and velocity, there would be no adverse effects on the dam. The other modelled TMF failure scenarios would not affect the Victoria Dam.

Marathon will continue to engage with NL Hydro over the life of the Project. This will include reviewing the results of the monitoring (e.g., blast monitoring, water monitoring, Project dam inspections / safety reviews) to confirm that performance is in line with the design. Marathon will also engage with NL Hydro with respect to NL Hydro's access to the Victoria Dam (shared access road), and NL Hydro's emergency notification procedures with respect to the Victoria Dam, noting that in the event of an issue, the Project access road crosses the Victoria River and Exploits downstream of NL Hydro dams.

With the application of the identified mitigation measures, residual adverse effects on dam infrastructure from an accidental event are predicted to be negligible to low in magnitude, limited to the Dam Infrastructure RAA, medium term and reversible.

21.5.2 Topsoil, Overburden, Low and High-Grade Ore Stockpiles and Waste Rock Pile Slope Failure

There will be five types of piles required for the Project including: topsoil, overburden, LGO, HGO, and waste rock. These are described in detail in Section 2.X and summarized below.

Topsoil stockpiles are estimated to be 250 kt at the Marathon pit and 200 kt at the Leprechaun pit. Geochemical testing indicates that acid rock drainage / metal leaching (ARD/ML) potential of topsoil is low. Overburden stockpiles consist of overburden (glacial till) that will be excavated as the open pits are expanded. Overburden stockpiles are estimated to be 7.5 Mt in volume at the Marathon pit and 3.1 Mt at the Leprechaun pit and based on geochemical testing, overburden is expected to have low potential for ARD/ML. As described in Section 2.3.2, there are designated topsoil and overburden stockpiles for the open pits. There are no designated overburden and topsoil stockpiles for other areas of the mine site; however, most of these materials will be windrowed along road corridors and along the edges of areas, like the mill pads. Marathon will also use the 'future footprint' of mine components, such as the waste rock piles and TMF, and around the pit, to store topsoil and overburden temporarily for progressive rehabilitation. This will be further defined as part of a materials balance completed as part of the Rehabilitation and Closure Plan, as well as for site development to reduce material movement and reduce the size of the various stockpiles.

Low-grade ore not immediately destined for the processing plant will be stockpiled for future processing, either for potential blending with higher grade ore, or towards the end of the mine life. There will be a LGO stockpile adjacent to each pit (estimated capacity of 4.3 Mt at the Leprechaun pit and 8.0 Mt at the Marathon pit) and a HGO stockpile near the processing plant (estimated capacity of 3.0 Mt). The LGO stockpile at the Leprechaun pit is not expected to generate ARD. Approximately 50% of the LGO from Marathon is conservatively classified as a PAG material and, therefore, LGO stockpile effluent has been segregated from other component flow streams in the design, to facilitate collection and further treatment, if required. In LGO from both deposits, concentration of metals in neutral leachates from humidity cells are substantially below MDMER discharge limits. Based on the static testing, approximately 11% and 56% of samples are classified as PAG material from Leprechaun and Marathon HGOs, respectively. The drainage from the HGO stockpile flows to the TMF and any potential acidity will be neutralized in the pond or in the mill during pH adjustment required for gold recovery by cyanide. No exceedances of the MDMER limits are observed in leachates from ore samples.

There will be two waste rock piles, one located southeast of the Leprechaun pit (136 Mt) and one located northwest of the Marathon pit (145 Mt). The geological block model indicates that less than 0.5% of Leprechaun waste rock may be PAG. Approximately 14% of Marathon waste rock is estimated to be PAG based on the testing completed to date. To achieve neutralization, blending PAG and non-PAG rock will be conducted and PAG waste will be placed on non-PAG rock and encapsulated with non-PAG rock (e.g., no PAG rock deposited within 10 m of final waste rock pile base/shell). As a result, overall drainage from waste rock is not expected to be acidic. Concentration in leachates from waste rock humidity cells are two to three orders of magnitude below MDMER discharge limits (to be confirmed with further testing).

21.5.2.1 Description of Scenario

Failure or slumping of materials in stockpiles / waste rock piles would result in the release of waste rock, ore or soils outside the storage areas and increase the footprint of the stockpile. Should a failure occur, solid material from the stockpile areas could enter adjacent areas to the stockpile, which may include lakes and streams.

While overburden, LGO and HGO stockpiles may result in slumping, these stockpiles are temporary and in the event of a failure, released material will be re-instated in a timely manner. Adverse effects are therefore not anticipated as a result of overburden, LGO and HGO stockpile failure. This scenario is therefore focused on the failure or slumping of materials from the waste rock pile.

21.5.2.2 Project Design and Safety Measures to Reduce Environmental Effects

Waste rock piles will be benched and constructed to an overall slope of 3H:1V to promote long term stability. Mine waste disposal piles will be constructed according to design requirements for closure (i.e., long-term slope stability factors of safety) and assume a final closure slope angle of 30°. To accomplish this, the waste rock piles will be constructed in single lifts with a 35° face angle and a 6.1 m safety bench. Waste rock piles will be progressively rehabilitated as benches or sections are completed (ongoing over life of Project). Waste rock piles will be constructed from the ground up using slopes and benches of 10 m height. When a bench is finished in one area, the horizontal bench and slope will be covered with overburden / organics (anticipated 0.3 m in total thickness) and revegetated.

Mitigation measures will be applied to reduce the potential for waste rock slumping, including displacement monitoring / surveys to identify potential instability and early movements, and progressive rehabilitation (e.g., placement of soil cover and vegetation over waste rock piles) of the pile to reduce infiltration into waste rock piles by increasing evapotranspiration capacity to the extent feasible. As part of Project planning and design, Marathon is undertaking geotechnical and hydrogeological investigations which will be used to support the design, including incorporating appropriate geotechnical design parameters and factors of safety, and proper construction.

21.5.2.3 Emergency Response Measures

Emergency response measures and standard operating procedures for slope failure, including stopping work in that area, developing a specific response plan, installing silt fencing and berms as necessary, return and recontour material, will be developed during detailed Project design.

21.5.2.4 Environmental Effects Assessment

The worst-case failure scenario would be a large-scale failure of a waste rock pile, which could result in slumping and release of mine rock. The waste rock material will be coarse-grained and angular. Waste rock piles will be designed to maintain stability; however, there is potential for material to enter surface water resources and fish habitat at some locations. Adverse effects on these components are discussed below.

Surface Water Resources

Slope failure related to the waste rock piles has the potential to affect surface water quantity. The failed slope could block an adjacent watercourse and cause either ponding (upstream) and/or loss of flow (downstream) if the watercourse is completely blocked. There is also the potential to affect surface water quality through increased sedimentation and through an increase in the concentration of POPCs in downstream watercourses and waterbodies.

The waste rock pile associated with the Leprechaun Complex drains toward Victoria Lake, and effects of slope failure may occur in Victoria Lake Reservoir and its tributaries. The waste rock pile associated with the Marathon Complex drains toward the Victoria River and Valentine Lake, and a slope failure may affect both of these and their tributaries based on the failure to collect contact water from the ditches surrounding the pile.

As the water quality expected from the piles is expected to meet regulatory criteria and with the anticipated collection of most sediment releases to the seepage collection ditches and ponds, residual adverse effects on surface water resources are predicted to be moderate in magnitude, localized to the Surface Water Resources LAA, short term, and reversible.

Fish and Fish Habitat

A waste rock pile slope failure can result in an increase in suspended solids into a waterbody, which has the potential to cause acute mortality in fish, with sediment deposition resulting in potential affects to

spawning habitats. Mortality of fish would be a one-time event and risk of mortality is not anticipated to persist over time. Furthermore, fish communities would be anticipated to recover over time.

As described in Section 8.2.2.4, brook trout, ouananiche (landlocked Atlantic salmon), Arctic char and threespine stickleback are known to occur in the Victoria River watershed and Victoria Lake Reservoir (Pippy 1966; Porter et al. 1974). Arctic char also has the potential to occur in Valentine Lake, as well as Atlantic salmon, brook trout and threespine stickleback are known to be present. There are no aquatic SAR known to occur within the Project Area, LAA or RAA that are listed under the SARA.

In the unlikely event of a slope failure, emergency response procedures would be undertaken; however, material may be left in place if it is considered to cause further disturbance during the removal of material. If left in place, it is anticipated that fish habitat could be restored to ecologically functional habitat naturally or through remedial measures.

Residual adverse effects on fish and fish habitat are predicted to be moderate in magnitude, limited to the Fish and Fish Habitat LAA, short-term, and potentially reversible.

21.5.3 Fuel and Hazardous Materials Spill

Fuel and hazardous materials (reagents) will be required throughout the life of the Project. Reagents are chemicals used to separate the desired material (i.e., the target metal) from the unwanted material (i.e., tailings) and include quicklime, sodium cyanide, frother, promoter, flocculant, hydrochloric acid, copper sulphate pentahydrate, sodium metabisulphite, sodium hydroxide, activated carbon, and smelting fluxes.

21.5.3.1 Description of Scenario

A spill of fuel and/or hazardous material could occur as a result of factors such as equipment or vehicle malfunction, human error, or severe weather conditions (as described in Chapter 22 – Effects of the Environment on the Project). Potential spill mechanisms including the following:

- Equipment leakage / failure: Relatively small spills of fuel may occur during construction or operation through refuelling of or leaks from machinery including the potential for hydraulic hose leaks from construction equipment. The volume of material from these spills is usually less than a few litres. These spills are typically highly localized and readily cleaned up by on-site crews using standard equipment and materials
- Storage tank leak or rupture: A spill from a storage tank could occur as a result of structural failure of the tank or as a result of an accidental impact to a tank from a vehicle, for example. Failure of the fuel storage and fueling stations would result in the release of petroleum-based pollutants
- Spill from vehicles on-site: An on-site vehicle accident could result in an unplanned release of fuel or hazardous materials used by the Project, on site roads or haul roads within the Project Area. In general, this scenario is considered less of a concern than a vehicle accident along the access road given drainage collection around the mine site would possibly direct free product back towards the TMF, where it could be collected and cleaned up. Additionally, due to the relatively low level of wildlife activity expected in the immediate areas of work and the restricted public access of the mine site (i.e.,

requirement to maintain a safety zone for blasting), there is less chance for a spill on site to interact with wildlife or resource users

- Spill from vehicles along the access road: A worst-case scenario would be considered a large spill of fuel or hazardous material resulting from vehicle accidents or malfunctions during any phase of the Project. Fuels, reagents, and combustibles used for the Project will be transported to the site via the access road; therefore, there is a risk of an accident / collision, resulting in a spill of these transported materials. Spills may also occur if a vehicle malfunctions, or if non-transport vehicles collide, leading to the release of fluids or lubricants from these vehicles onto the ground. A spill, as a result of a vehicle accident or malfunction, has the potential to affect surface water resources if the spill occurs near a waterbody either on site or along the access road

A spill has the potential to affect land or water within the mine site or outside of the mine site if not remediated in a timely manner. Adverse environmental effects can result from an accidental release of hazardous liquids due to their ability to flow in an uncontrolled manner and seep into porous material and the toxicity of some liquids to plants and wildlife. There is also potential for air emissions of volatile components from a fuel spill. However, adverse effects will be generally localized, rapidly dispersed, and not of high enough concentrations to affect wildlife, which tend to avoid a spill and cleanup activities.

21.5.3.2 Project Design and Safety Measures to Reduce Environmental Effects

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.* Regular vehicle and equipment inspections and maintenance will be carried out to reduce the potential effects of hydraulic fluid spills. Marathon will consider the use of biodegradable hydraulic fluid in compatible machinery.

Reagent preparation and storage facilities will be located within containment areas designed to accommodate more than the content of the largest tank. Where required, each reagent system will be located within its own containment area to facilitate its return to its respective storage vessel and to avoid the mixing of incompatible reagents. Storage tanks will be equipped with level indicators, instrumentation and alarms to prevent spills. Appropriate ventilation, fire and safety protection, eyewash stations, and Safety Data Sheet (SDS) stations will be located throughout the facilities. Sumps and sump pumps will be installed for spillage control. Temporary storage and fueling locations and procedures will conform to applicable regulatory criteria.

In addition, areas in which chemicals are used or stored shall have spill containment systems constructed with impermeable floors, walls, dykes or curbs as applicable and be configured, maintained, inspected and repaired as follows:

- No discharge to the environment
- Effective secondary containment capacity of at least 110% of the chemical storage tank capacity, in the case of a single storage container
- Where there is more than one storage container, the spill containment system will be able to retain no less than 110% of the capacity of the largest container or 100% of the capacity of the largest container plus 10% of the aggregate capacity of all additional containers, whichever is greater

- Kept clear of material that may compromise the containment capacity
- Include a floor drain system provided that the floor drains, and the place or device to which they drain, are configured in such a manner that the required effective secondary containment capacity is maintained
- Will be visually inspected annually for their liquid-containing integrity, with repairs made as required
- Spill containment systems will be inspected every ten years, by a means other than visual inspection, for their liquid-containing integrity, with repairs made as required

Emergency response and spill contingency plans under the EMS will be developed and implemented by Marathon to facilitate responses to emergency situations that occur at the mine site (Section 21.3). These plans will include consideration of spills and releases of hazardous substances, including petroleum products, accidents involving hazardous substances, medical emergencies, explosion, and fire. In the event of a spill at the mine site, the spill would be immediately contained and cleaned up using on-site spill kits and appropriate absorbent materials. In the event of a spill, available resources including trained responders, and spill response equipment and supplies, would be redirected to the spill area to provide response. Given quick response, it is anticipated that relatively small spills (i.e., generally less than a few litres) would have limited potential to affect water resources, as it would be confined to the soils and excavated before migrating to the groundwater table. To determine the requirement for further excavation, soils will be tested for hydrocarbon in the vicinity of a spill.

Transportation will be by road for fuels, reagents, and combustibles; therefore, there is a risk of a collision or accident resulting in a spill of these transported materials both on and off site. Transportation safety measures which will be implemented to reduce the potential for a vehicle accident include, although are not limited to, the following:

- Transportation of hazardous materials will be conducted in compliance with the federal *Transportation of Dangerous Goods Act* and the provincial *Dangerous Goods Transportation Act.*
- Haul roads, site roads and the access road will be maintained in good condition. This will include periodically re-topping, regrading and ditching to improve water flow, reduce erosion, and by managing vegetation growth
- Vehicles will use existing roads / trails while operating at the mine site
- Project vehicles will be required to comply with posted speed limits on the access road, site roads and haul roads. Speed limits will be set in accordance with provincial regulations and industry standards (e.g., for haul roads), as well as safety / environmental concerns (wildlife)
- 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
- Appropriate Project personnel will be trained in fuel handling, equipment maintenance, and fire prevention and response measures
- Fuels and lubricants used during construction and operation 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 numerous locations on-site during construction and operation

- Marathon will regularly inspect and monitor Project infrastructure and equipment and take required action to maintain, repair and upgrade infrastructure / equipment as needed

21.5.3.3 Emergency Response Measures

As described in Section 21.3, emergency and response plans, including a spill response plan will be developed and implemented by Marathon. This will include measures for emergency response, training, responsibilities, clean-up, and contact and reporting procedures in the event of a spill. Appropriate Project personnel will be trained in fuel handling, equipment maintenance, and fire prevention and response measures. In the event of a large spill as a result of a vehicle collision along the access road, Marathon will liaise with local emergency providers so that roles and responsibilities are understood, and that the necessary resources required to respond are in place.

21.5.3.4 Environmental Effects Assessment

As described in Section 21.5.3.1, there is potential for spills resulting from equipment leakage / failure, storage tank leak or rupture, and spills from vehicles on-site and along the access road. In the event of a fuel or hazardous material spill, the worst-case scenarios include spills of hydrocarbon (i.e., diesel fuel), cyanide, and ammonium nitrate at the bridge crossing of the Victoria River. The bridge crossing of the Victoria River was selected as the location for the worst-case scenario based on concerns identified through engagement activities regarding potential effects on the Exploits River. This location represents the highest probability of adverse effects from within the Project Area reaching the Exploits River. A hazardous material spill model of potential spills of diesel fuel, sodium cyanide, and ammonium nitrate into the Victoria River was conducted. The spill study area focused on the 100 m extent of the Victoria River downstream of the bridge crossing, approximately 14 km of Red Indian Lake, and the Exploits River Dam. Detailed information about the ambient water quantity and quality of the study area is available in Appendix 21A. In addition, Appendix 21A presents the modelling approach and results of the hazardous materials spill modelling. A summary of the hazardous material spill modelling is presented below.

A two-dimensional (2D) hydrodynamic model was built using MIKE 21 Flow Model Flexible Mesh (FM) model. The MIKE 21 Particle Tracking (PT) add on was used to model diesel, sodium cyanide and ammonium nitrate concentrations after the hypothetical spill. Horizontal eddy viscosity, flow, water level boundary conditions, wind speed and direction, horizontal dispersion coefficient, decay rate, and the total amount of spill for each parameter were considered as the model inputs. Available provincial and federal records were used for the water level and flow data requirements. A background review of past diesel fuel, sodium cyanide and ammonium nitrate spills was also conducted to estimate the possible spill parameters into the Victoria River. Sodium is a relatively environmentally benign product, and therefore, only cyanide was modelled. Ammonia and nitrate were simulated separately since ammonium nitrate dissociates in the water. The average range of diesel fuel spills was estimated at 12,000 litres spilling into the river within an hour. It was also assumed that 47 kg of sodium cyanide and 108.70 kg of ammonium nitrate spilled into the river within an hour, resulting in the release of 25 kg of cyanide, 25 kg of nitrate, and 83.75 kg of ammonia according to their molar masses.

The annual minimum 7-day average flow (7Q1), the mean annual flow, and the 1:30 year high flow (Q30) were considered as three potential flow scenarios to estimate the inflow from each watercourse into Red

Indian Lake. Low-flow and peak-flow frequency analyses were conducted to estimate the annual minimum 7-day average streamflow and the 1:30 year high flow. Modelling scenarios are summarized in Table 21.2.

Table 21.2 Flow Scenarios to Red Indian Lake

Modelling Scenario	Water Level (m)	Wind Speed and Direction	Inflow into the Lake
Scenario 1	Annual 7 day low	Calm	7Q1
Scenario 2	Mean annual	Average wind speed; wind direction from the southwest	Mean annual
Scenario 3	Monthly annual maximum	Calm	Q30

The MDMER limits were used as a guide to set the toxicity thresholds. CWQG-FAL provided science-based goals for the quality of aquatic and terrestrial ecosystems. The analytical requirements and limits for cyanide, un-ionized ammonia and nitrate are summarized in Table 21.3. Un-ionized ammonia concentration is reported at pH 7.5, temperature 15°C, which is the lowest expected value for RAA (lower pH and temperature values increase un-ionized ammonia concentration and therefore the lowest pH and temperature values for RAA were considered to determine the allowable concentration limit of un-ionized ammonia).

Table 21.3 MDMER and CWQG-FAL Allowable Concentration Limits

Parameter	MDMER (mg/L)	CCME CWQG-FAL (mg/L)
Cyanide[A]	2.000	0.005
Un-ionized ammonia (expressed as nitrogen)[B]	1.000	1.83
Nitrate	N/A	550[C]
Diesel	-	-

Notes:
[A] Maximum Authorized Concentration in a Grab Sample
[B] Ammonia concentration under different pH and temperature, See table at: http://st-ts.ccme.ca/en/index.html?chems=5&chapters=1
[C] 550 mg/L for short term exposure and 13 mg/L for long term exposure

The simulated concentration plumes of cyanide and diesel immediately after the spill (day 1) is presented on Figure 21-3 for the three scenarios. Similarly, the simulated concentration when the plumes reach the Exploits River Dam are presented on Figure 21-4 for the three scenarios.

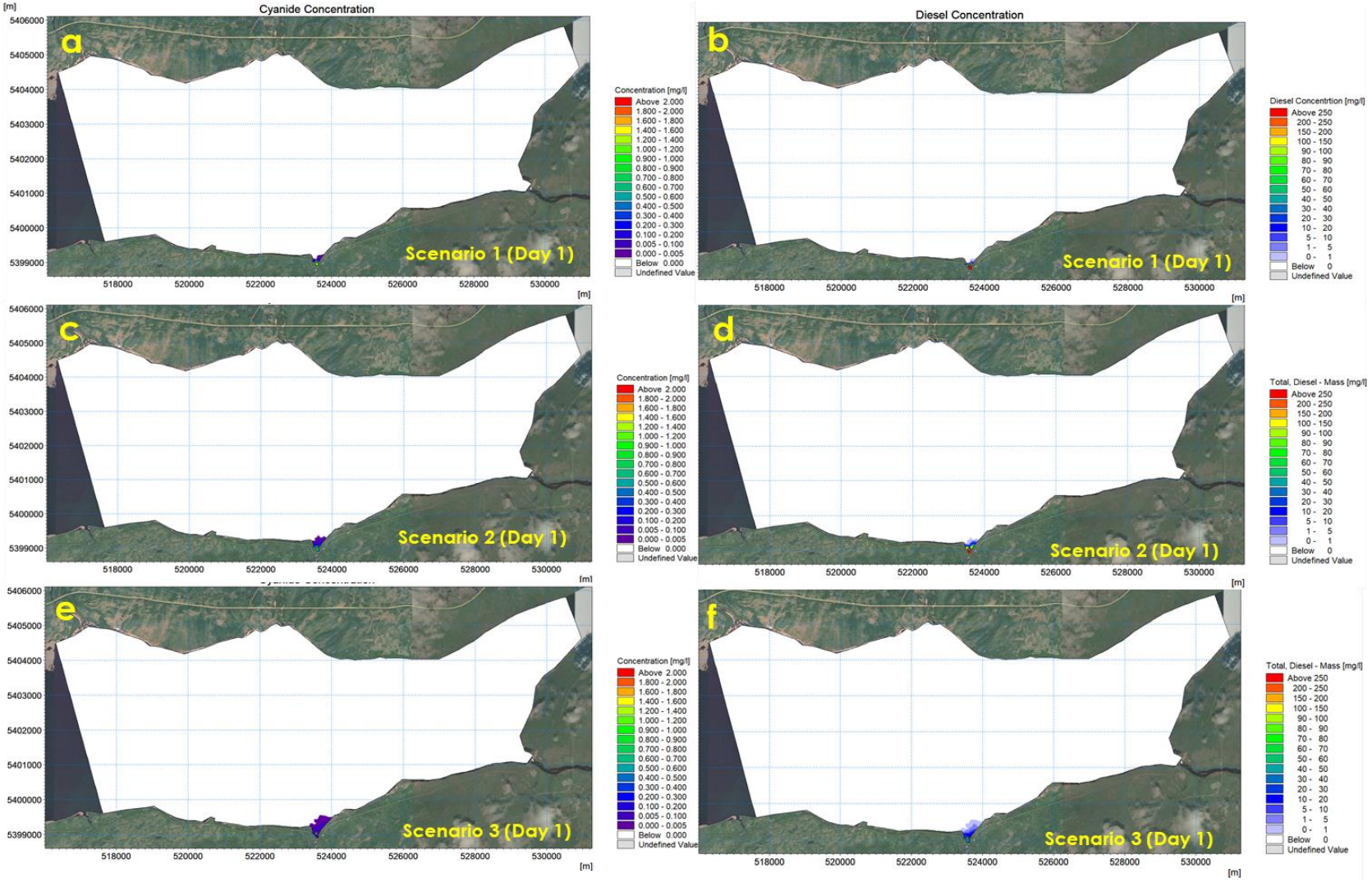

Figure 21-3 Cyanide and Diesel Concentrations Results on Day 1 of the Spill

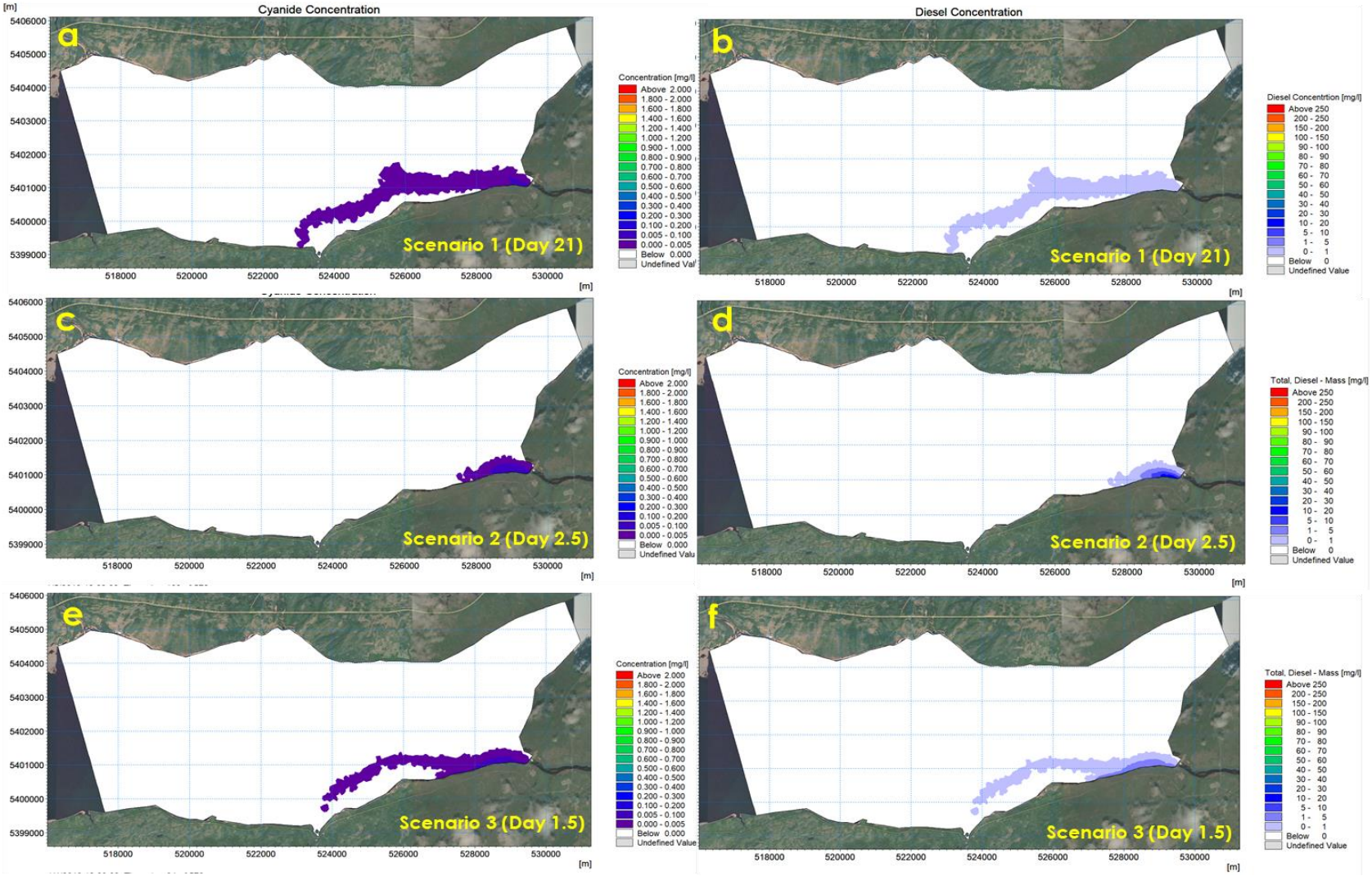

Figure 21-4 Cyanide and Diesel Concentrations Results When Plume Reaches the Exploits River Dam

The initial concentrations of the simulated POPCs are dependent on the volume of water in Red Indian Lake on the date of release. This volume is dependent on the water level in the lake, and the flow rates into and out of the Lake. The lake volume is the smallest for Scenario 1, therefore the initial plume concentrations are the highest, as shown on Figure 21-3 for diesel and cyanide. Conversely, the lake volume for Scenario 3 is the largest, resulting in the lowest initial plume concentrations for the three scenarios.

The evolution of the diesel and cyanide plumes were simulated to predict the travel time from the release point to the Exploits River Dam. As shown on Figure 21-4, the plumes are predicted to reach the Exploits River Dam within 21 days of the spill for Scenario 1, 2.5 days for Scenario 2, and 1.5 days after for Scenario 3. The increased water level and flow rates at Red Indian Lake for Scenario 3 resulted in the shortest travel time for the three scenarios.

The plumes predicted for Scenarios 1 and 3 presented on Figure 21-3 show a plume that extends from the source zone to the Exploits River Dam. However, the plume predicted for Scenario 2 shows the migration of most of the plume closer to Exploits River Dam. This change in plume is due to the increased wind action in Scenario 2 that resulted in a faster movement of the plume and the reduction of the mixing rate of the plume with water in the lake. This caused a higher plume concentration at the dam and a lower dispersion rate of the plume into the lake. The shorter travel time of the plume also reduced the volatilization of diesel, which resulted in a higher concentration of diesel compared to Scenarios 1 and 3.

Additional modelling results for nitrate, ammonia, cyanide, and diesel are discussed in detail in Appendix 21A, and are summarized on Table 21.4. The results are compared to the MDMER limits as they represent the toxicity thresholds for fish, and to the CWQG-FAL that represent safe levels for aquatic life. As shown on Table 21.4, the initial concentrations of ammonia and cyanide are predicted to be toxic to fish for Scenarios 1 and 2 at the release point. However, the concentrations at the source zone are not persistent, and are simulated to decline relatively quickly to CWQG-FAL within one to seven days under the range of scenarios.

The maximum concentration of the POPCs at the Exploits River Dam are predicted to meet the CWQG-FAL for all scenarios, with the exception of cyanide which remained slightly above the CWQG-FAL in Scenarios 1 and 2. The modelling results under each scenario showed that changes in the flow rate, wind action, and water level resulted in changes in the plume concentration and travel time. The cyanide, ammonia and nitrate are not expected to persist in the environment, nor result in potential bioaccumulation.

Diesel may attach to nearshore and shoreline vegetation and shallow sediments and thus the potential exists for some further persistence of diesel in the environment. None of the fate and transport modelling considered spill response, particularly for diesel where the deployment of spill diversion, collection and sorbent booms and product recovery would be reasonably implemented. Therefore, the modelling is considered to be conservative and represents a worst-case condition.

Table 21.4 Maximum Total Concentration of Cyanide, Ammonia, Nitrate, and Diesel Immediately after the Spill and at the Exploits River Dam

Hazardous Material	Scenario	Maximum concentration immediately after spill (mg/L)	Maximum Concentration at the Exploits River Dam (mg/L)	Travel Time to the Exploits River Dam (days)	CWQG-FAL Guideline (mg/L)	MDMER Limit (mg/L)
Cyanide	Scenario 1	**2.600**	0.013	21	0.005	2.000
	Scenario 2	**2.000**	0.070	2.5		
	Scenario 3	0.210	0.004	1.5		
Ammonia	Scenario 1	**2.690**	0.103	21	1.830	1.000
	Scenario 2	**2.090**	0.160	2.5		
	Scenario 3	0.300	0.094	1.5		
Nitrate	Scenario 1	9.110	0.160	21	13	-
	Scenario 2	2.410	0.350	2.5		
	Scenario 3	0.390	0.125	1.5		
Diesel	Scenario 1	1,100	0.11	21	-	-
	Scenario 2	285	17	2.5		
	Scenario 3	28	1.2	1.5		

Notes:
Underlined values exceed the CWQG-FAL Guidelines
Bold values exceed the MDMER Limits

Surface Water Resources

A spill of fuel or hazardous material as a result of a vehicle accident along the access road has the potential to affect surface water quality if it occurs in or near a watercourse or waterbody or if it enters groundwater and re-enters surface water at a point downstream from the spill. As described above, spill modelling of diesel fuel, sodium cyanide and ammonium nitrate into the Victoria River was conducted to assess the worst-case scenario. The modelling results showed that the MDMER limits representing toxicity thresholds were exceeded for ammonia; however, the exceedance duration was not persistent and ranged from one to seven days under different modelling scenarios. The CWQG-FAL limits representing the water quality thresholds were exceeded for ammonia and cyanide; however, the exceedance was not persistent, and the ammonia concentration reached below the CWQG-FAL limits from one to five days. Cyanide, ammonia and nitrate are not expected to persist in the environment, or to result in bioaccumulation. Diesel may attach to nearshore and shoreline vegetation and shallow sediments and thus the potential exists for increased persistence of diesel in the environment.

Fuels and lubricants used during construction and operation / maintenance will be stored in designated areas according to regulated methods. Refueling, servicing, and equipment and waste storage will not take place within 30 m of a watercourse or waterbody to reduce the likelihood that these substances will enter them. As described in Section 21.3, emergency response plans, including a spill response plan, will be developed and implemented by Marathon. Transportation of hazardous materials will be conducted in

compliance with the federal *Transportation of Dangerous Goods Act* and provincial *Dangerous Goods Transportation Act*. Spill kits will be maintained at numerous locations on-site during construction and operation and in the event of a spill, deployment of spill diversion, collection and sorbent booms and product recovery would be reasonably implemented.

In the event of a worst-case scenario spill (as described above), residual adverse effects on surface water resources are predicted to be moderate (elevated above baseline, however within acceptable limits) to high (elevated above acceptable limits or regulatory objectives) in magnitude, limited to the Surface Water Resources RAA, short-term in duration as contaminants are flushed downstream (becoming diluted), and reversible.

Fish and Fish Habitat

A spill of fuel or hazardous material near fish habitat may lead to localized fish mortality. Fish mortality may range from a few fish (not affecting the sustainability and productivity of a fishery), to larger scale levels of fish mortality (which could have a temporary effect on localized fish populations), depending on the location of the event, the size of the spill and the toxicity of the materials being transported. Toxicity to fish populations can result in changes in fish health, growth or survival (e.g., number of fish mortalities, fish tissue metal concentration, fish community composition). As described above, the cyanide, ammonia and nitrate are not expected to persist in the environment, nor result in potential bioaccumulation.

Refined fuels, such as diesel, generally have high aquatic toxicity values given their relatively high content of naphthalenes, and while toxic to aquatic organisms, diesel evaporates or disperses rapidly into the water column (NOAA 2020). In stream and rivers with high suspended sediment loads, diesel is more likely to adhere to fine-grained suspended sediments, settle out and become deposited on the bottom (NOAA 2020). Diesel may also attach to nearshore and shoreline vegetation, and thus the potential exists for further persistence of diesel in the environment. A study of the effects of a 26,500 litre diesel fuel spill in a small trout stream in New York resulted in a fish kill estimated at 92% of total fish abundance of rainbow trout (*Oncorhyncus mykiss*), white sucker (*Catostomus commersonii),* blacknose dace (*Rhinichthys atratulus*) and darters (*Etheostoma* spp.) (Lytle and Peckarsky 2001). It was concluded in the study that the diesel fuel spill substantially reduced the taxonomic richness (by 50%) at least 5.0 km downstream, with density recovering within a year. Species diversity continued to be low 15 months after the spill, suggesting that a longer period was required for full recovery (Lytle and Peckarsky 2001).

Experiments indicate that salmon species have some capability for detection of hydrocarbon concentrations shown to cause mortality, and subsequently avoid the contaminated water (Weber et al. 1981; Alvarez Piñeiro et al. 1996; Stagg et al. 1998). Fish populations affected by mortality from contaminated material are anticipated to reestablish themselves within one or two generations.

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. As described in Section 21.3, emergency response plans, including a spill response plan, will be developed and implemented by Marathon. Transportation of hazardous materials will be conducted in compliance with the federal *Transportation of Dangerous Goods Act* and the provincial *Dangerous Goods Transportation Act*. Spill kits will be maintained at several locations on-

site during construction and operation and in the event of a spill, deployment of spill diversion, collection and sorbent booms and product recovery would be reasonably implemented.

In the event of a worst-case scenario spill (as described above), residual adverse effects on fish and fish habitat are predicted to be moderate to high in magnitude, limited to the Fish and Fish Habitat LAA, short-term and reversible.

Vegetation, Wetlands, Terrain and Soils

A spill of fuel or hazardous material would have the potential to affect vegetation, wetlands, terrain and soils, depending on the location and extent of the spill and the time elapsed until cleanup. Effects may include direct loss or alteration of native vegetation communities, SOCC or traditional use plant species, direct loss or alteration of wetland area or function, and/or changes to soil quality.

The potential for a smaller spill on site to interact with vegetation, wetlands, terrain and soils will be reduced as vegetation will be cleared during site preparation. A spill as a result of a vehicle collision on the access road has the potential to interact with vegetated areas along the road. A release of petroleum fuel products, such as gasoline and diesel, from a land-based spill has the capacity to chemically burn vegetation and to disrupt nutrient cycling processes. Effects vary depending on length of exposure, time of year (dormancy) and the characteristics of the plant species affected; however, the spill response plan will lessen environmental effects and the geographic extent of the potentially impacted area. Soil and vegetation affected by a spill can be remediated through standard response and clean-up procedures such that long-term effects are not anticipated. Mitigation measures will also reduce the potential for deleterious substances to enter adjacent wetlands or waterbodies.

In the event of a spill, residual adverse effects on vegetation, wetlands, terrain and soils are predicted to be low in magnitude, limited to the Vegetation, Wetlands, Terrain and Soils LAA, short-term and reversible. Vegetated areas affected by a spill can be remediated through standard response and clean-up procedures, such that long-term effects are not anticipated.

Avifauna, Caribou and Other Wildlife

A spill of fuel or hazardous material (i.e., cyanide and ammonium nitrate) along the access road may result in the direct loss or alteration of wildlife habitat, change in movement, increased mortality risk, and/or changes to wildlife health. If a spill reaches the Avifauna, Caribou and Other Wildlife LAAs or RAAs, contaminated water may infiltrate low-lying areas or nearby vegetation; however, these effects would be limited with prompt reclamation and stabilization, and the vegetation would be expected to reestablish after several growing seasons. Additionally, due to the relatively low level of wildlife activity expected in the immediate areas of work, there is less chance for a spill on site to interact with wildlife. While a spill can result in ingestion / uptake of contaminants by wildlife, the scope of this potential is limited.

In addition to the change in habitat directly and indirectly, the Project is also predicted to result in a change to caribou movement. The primary migration path for the Buchans herd, which may be used by over 50% of the herd, overlaps the Project Area. Due to the importance of this migratory path, effects of a fuel or hazardous material spill and subsequent clean-up efforts would likely cause caribou to avoid the

areas, and in the event of a large spill effects may be additive to the high magnitude effect predicted for the Buchans caribou herd, particularly if a spill were to occur during the migration period for the herd. This disturbance would likely be short term and limited to a single migration season. Overall, wildlife population stability at the Avifauna, Caribou and Other Wildlife LAAs or RAAs level is not expected to be affected by spill.

The Victoria Steadies Sensitive Wildlife Area is located along the Victoria River containing important waterfowl habitat (NL-EHJV 2008) (Chapter 9 and 10). This area was established for the protection of wetland habitat used as breeding, brood rearing, and staging grounds for waterfowl. 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 2020, pers. comm.). A spill at the bridge crossing of the Victoria River has the potential to affect the last 100 m of the river and has the potential to result in a change of mortality risk and/or change in habitat quality for waterfowl. The possible physical effects of exposure of birds to hydrocarbons include changes in thermoregulatory capability (hypothermia) and buoyancy (drowning) due to feather matting (Clark 1984; Montevecchi et al. 1999), as well as physiological effects of ingestion from excessive preening (Hartung 1995). Depending on the time of year and location of a spill, individual birds present along the Victoria River downstream of the bridge could experience injury or mortality.

In the event of a spill, residual adverse effects on wildlife and wildlife habitat are predicted to be moderate to high in magnitude within the LAA, short to medium term and potentially irreversible.

Community Health

In the event of a spill along the access road, discharges could increase POPC concentrations in soil, water and sediment, which may lead to a loss of access to country foods. However, as previously described, the cyanide, ammonia and nitrate are not expected to persist in the environment, nor are they predicted to result in bioaccumulation. Petroleum hydrocarbons (i.e., diesel) also do not tend to accumulate in animal tissues, nor are they readily absorbed and accumulated into plant tissues. If a spill were to occur, a monitoring plan would be developed (depending on the type of material spilled, quantity spilled and location of the spill) to address potential effects from contamination. Furthermore, where required, public notices would be issued and access to the area would be restricted if there were any issues with public exposure. Clean up activities should restore the area to acceptable conditions, and with proper monitoring and notification procedures in place, a spill is unlikely to result in residual effects on community health.

In the event of a spill and with mitigation in place, residual adverse effects on human health are predicted to be low magnitude within the Community Health LAA, short-term and reversible.

Land and Resource Use

A spill of fuel or hazardous materials along the access road may affect the viability of, restrict access to, or cause loss of areas used for harvesting or recreation uses (such as fishing, trapping or hunting) in the area surrounding the release site. Residual adverse effects on vegetation communities, fish and fish habitat, and wildlife and wildlife habitat could occur due to the spill of fuel or hazardous materials, which

could in turn affect land and resource use in the LAA and potentially the RAA. An effect on fish and wildlife habitat could result in localized reductions in fish and wildlife abundance, health or condition that could limit the quality of the fishing, trapping, and hunting resources within the LAA. In the event a spill reaches Red Indian Lake, this may result in restrictions to activities (such as fishing) to allow for clean-up activities or because hazardous material could cause contamination to country foods. If the affected area were to overlap an area used for resource or recreational purposes, effects to users are anticipated to be temporary in nature and limited geographically. As noted above, limited interaction with wildlife is anticipated, and therefore, health risks for people who eat terrestrial country foods are not anticipated.

In the event of a spill, residual adverse effects on land and resource use are predicted to be low in magnitude, within the Land and Resource Use RAA, short term and reversible.

Indigenous Groups

In the event of a spill of fuel or hazardous material along the access road, there is potential adverse effects to Indigenous health and socio-economic conditions, Indigenous physical and cultural heritage and current use. These effects may occur as a result of a change in access to (due to area closure to allow for clean-up) and availability of (increased mortality risk, and/or changes to wildlife health) harvested species. Discharges could also increase POPC concentrations in soil, water, and sediment, which may lead to a loss of country food. If the affected area were to overlap an area used for harvesting activities, effects to the Indigenous groups are anticipated to be temporary in nature and limited geographically. As noted above, limited interaction with wildlife is anticipated, and therefore, health risks for people who eat terrestrial country foods are not anticipated.

In the event of a spill, residual adverse effects on Indigenous groups are predicted to be low in magnitude, within the Indigenous Groups RAA, short term and reversible.

Historic Resources

The potential for effects on historic resources may include disruption of known or unknown archaeological sites and would depend upon the size and location of the spill and the proximity to known and potential historic resources. As discussed in Section 18.2.3, there are 24 locations within the Historic Resources LAA with potential to yield archaeological resources. In the event of a spill near a site identified as having archaeological potential, an archeologist would be required to be on-site during removal of contaminated material to verify that soils in the area of archaeological potential are not disturbed further. Equipment use would be limited in areas of archaeological potential to avoid additional disturbance and compression.

In the event of a spill, residual adverse effects on historic resources are predicted to be low in magnitude, limited to the Historic Resources LAA, permanent and irreversible.

21.5.4 Unplanned Release of Contact Water

Contact water is any runoff, groundwater or process water that has come into direct contact with mine rock, tailings, or terrain where mine workings and infrastructure occur. Contact water will be collected and managed through a variety of drainage ditches, pipes and sump pits constructed around Project infrastructure and directed to either the TMF or sedimentation ponds. Water collected in the sumps and/or

small ponds and during open pit dewatering will be pumped to sedimentation ponds located at each site. Contact water will be held and/or treated as required to meet MDMER requirements prior to being discharged directly to the environment at identified Final Discharge Points (FDPs). The mine site is divided into the three water management complexes, with independent functioning:

- Marathon complex - ditches and ponds will discharge to tributaries of Valentine Lake (30% of discharges) or the Victoria River (70% of discharges)
- Process plant and TMF complex - excess runoff is routed through a water treatment plant and polishing pond prior to discharge via a pipeline to Victoria Lake Reservoir, as described in Section 21.5.1. Runoff from process plant yard and adjacent stockpiles to be treated through the same process.
- Leprechaun complex - runoff to be collected in drainage ditches and directed to sedimentation ponds, and discharged directly to Victoria Lake Reservoir or its tributaries

21.5.4.1 Description of Scenario

Malfunction of the catchment sumps, ditches and channels, and sedimentation ponds could lead to the unplanned release contact water into the receiving environment. There is also potential for accidental seepage wherever contact water is stored. Seepage water associated with the TMF will be collected and pumped back to the TMF (Section 21.5.1); however, excess seepage could result from a damaged TMF dam liner (due to improper construction or installation, or damage during operation), which could overwhelm the downstream sumps and cause uncontrolled discharge to the environment. Accidental discharge from the collection or seepage of mining effluent has the potential to cause changes to groundwater, surface water and sediment quality, as well as indirect or direct effects on fish (e.g., toxicity, bioaccumulation, avoidance of area, alteration of planktonic and benthic communities).

21.5.4.2 Project Design and Safety Measures to Reduce Environmental Effects

A Water Management Plan (Appendix 2A) has been developed and will be implemented to support and guide the construction, operation and closure of the Project. The water management design for contact water treatment is focused on sedimentation, as sedimentation will reduce total suspended solids (TSS) concentrations and the particulate fraction of metals. ARD/ML studies are ongoing and based on the work completed over the past 2 years, ARD/ML issues are not expected to impact requirements for the treatment of contact water. Further information on water quality predictions are presented in the Surface Water Resources VC, Chapter 7.

Water management infrastructure for the Project is designed to reduce operational risks and environmental impacts, with the following objectives:

- Reduce water inventory through perimeter berms, separation of groundwater and surface water flows and promote overland flow of non-contact runoff
- Effectively control potential high precipitation events and provide water management design that produces effluent achieving regulatory effluent criteria
- Reduce FDPs through grading of ditches and construction of diversion channels to combine discharge points to collective effluent discharge points and or sedimentation ponds

- Maintain flow to fish-bearing streams and wetlands/bogs by maintaining pre-development catchments
- Reduce water management costs during operation through gravity drainage, where feasible, thus reducing pump requirements

Water management across the site will be implemented and operated as follows:

- Diversion of non-contact water where feasible. Channels and berms will be constructed around the crest of the open pits and up-hill of waste disposal piles and other developed areas in order to divert natural precipitation and surface runoff away to natural water drainage areas and away from contact with the mining operation, where feasible.
- Precipitation and groundwater entering the open pits will be managed in-pit via sloped pit floors and catchment sumps, as required. These catchment sumps are the first opportunity to reduce sedimentation and chemistry impacts (e.g., residual ammonia), and appropriately sized sumps with screened intakes and hydrocarbon absorption booms will be employed in-pit. Water collecting in these in-pit sumps will be pumped to the crest of the pit and discharged into an engineered sedimentation pond.
- Sedimentation ponds are appropriately sized for retention and removal (by gravity) of suspended solids (sediment), such that discharge is expected to comply with the applicable regulatory requirements including the MDMER pursuant to the *Fisheries Act*.
- 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 similar to those to be constructed for management of water from the open pits.
- Sedimentation ponds will be constructed in-ground, and/or using earthen berms and till, or synthetic liners, where required, for water retention. The current design does not require the construction of dams (per CDA guidelines) for these sedimentation ponds.
- Sedimentation ponds have been sited based on topography and geotechnical conditions. Where feasible, water collected in pit, or in the sedimentation ponds will be used for other purposes on site rather than discharged to the environment.

Design parameters for water management infrastructure includes a 15 m setback from fish-bearing waterbodies; consideration of climate change-associated precipitation events and associated flow; and maintaining flow to fish-bearing waterbodies where feasible (draining mine site components to pre-development catchment areas, where practicable).

Contact runoff from the piles will be managed by perimeter ditches and treated for sediment prior to release to the environment. Sedimentation pond embankments are designed to reduce seepage and will be constructed out of locally sourced, low permeability glacial till. Erosion protection will be provided through riprap lining of the embankment and spillway and a scour pad at the toe of slope of spillways. A geotextile or granular soil filter layer will be placed between materials to reduce the opportunity for piping. The design of the sedimentation ponds accounts for climate change, ice thickness during the winter, operating water levels, inactive storage to promote settling, and freeboard requirements.

Sedimentation ponds are designed with multiple outlets to incorporate system flexibility to manage water under variable climatic conditions. These ponds are designed to store runoff from the Project component areas for storm events up to 1:100 annual exceedance probability (AEP) with spring snowmelt, and

emergency spillways to accommodate the 1:200 AEP flow. The capacity of the sedimentation pond is designed such that effluent is discharged gradually from the pond, to enhance baseflow augmentation in order to provide flood attenuation and reduce downstream scour and erosion.

The sedimentation ponds are designed such that effluent is expected to meet MDMER limits prior to release to the receiving environment. Berms were designed to be constructed lower than 2.5 m from the toe of the downstream slope to the dam crest and therefore do not trigger CDA safety guidelines. In order to reduce effects to the environment, the footprint of the water management infrastructure avoids fish-bearing watercourses and waterbodies and, therefore, associated discharge of a deleterious substances into natural waterbodies.

Surface water and groundwater quantity and quality monitoring programs will be implemented to confirm compliance with regulatory requirements, support predictions of effects of the Project on water quality, identify changes in drainage patterns and surface water flow, and determine if additional mitigation measures are required. The Water Management Plan (Appendix 2A) 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. Additional details on the water monitoring programs are provided in Chapter 7 and the Water Management Plan (Appendix 2A).

21.5.4.3 Emergency Response Measures

Sediment fencing will routinely be deployed, inspected and maintained as needed adjacent to wetlands and slow-moving watercourses. In the event of the unplanned release of contact water due to failure of the water management system, sediment fencing would serve to reduce potential effects and, where feasible, contact water would be pumped back into the collection system. This may require the installation of additional pumps should the volume of pump-back water exceed predicted rates in the TMF seepage collection ditches. The water management structure would be repaired and/or improved as required to avoid re-occurrence. Affected waterbodies would be monitored and remedial actions and reporting, if required, would take place in consultation with regulators.

21.5.4.4 Environmental Effects Assessment

Given contingency planning, the implementation of engineering and quality controls, and monitoring programs during the design, construction and operational phases to mitigate risks, the likelihood of an accidental release of contact water during construction and operation have been classified as low.

Unplanned release of contact water could occur in the event of a failure of, or seepage from, the water management system and/or sedimentation ponds. Given that water collection systems will extend throughout the Project Area, including near waterbodies, an unplanned release of contact water to the environment has the potential to adversely affect groundwater, surface water quality, fish and fish habitat, and vegetation and wetlands. Waterbodies in the Surface Water Resources / Fish and Fish Habitat LAA that could potentially be affected include Victoria River, and Victoria Lake Reservoir, Valentine Lake and their tributaries.

Groundwater Resources

There is potential to affect groundwater quality through an unplanned release of contact water, depending on the magnitude of the release and the time elapsed until implementation of response measures. An unplanned release of contact water has the potential to affect groundwater and surface water quality where groundwater discharges to surface water. Based on a Drilled Well Location Request submitted to the NLDECCM, the nearest known residences with domestic wells are located in the vicinity of Buchans and Millertown, approximately 49 km and 60 km from the mine site, respectively (NLDMAE 2020). Therefore, an unplanned release of contact water is not predicted to occur in areas where groundwater supply users are identified.

In the event of an unplanned release of contact water, residual adverse effects on groundwater are predicted to be low in magnitude, mainly localized to the Project Area (however, may extend to the Groundwater LAA), short term and reversible.

Surface Water Resources

Surface water quality may be affected through an unplanned release of contact water from collection ditches and/or the water management systems. The magnitude of adverse effects would depend on the location, time of year, source of the contact water, and quantity of contact water released. The water quality monitoring program (Water Management Plan, Appendix 2A) to be implemented during normal operating conditions would also be used to detect exceedances of water quality guidelines in the event of an accidental release of contact water. If exceedances were detected, either through visual observations or results from water quality monitoring, remedial steps will be taken to reduce and stop the release through repairs to the drainage ditches or water management systems.

The water quality from the waste rock pile seepage collection ditches flow through sedimentation ponds that serve as FDPs. The water quality is predicted to meet MDMER limits at the outlet of the sedimentation ponds, therefore the release of sediment laden water would be expected to temporarily increase the TSS in Victoria River, Victoria Lake Reservoir, Valentine Lake, or their tributaries. This would be a short-duration release, and could be managed by the temporary installation of sediment fencing in slow-moving watercourses and pumping of contact water back into the collection system, where feasible, which would reduce effects on surface water resources in the event of a failure.

The water collected in the TMF seepage collection ditches is pumped back to the TMF. In the event that excess seepage from a damaged TMF dam liner (due to improper construction or installation, or damage during operation) exceeded the capacity of the downstream sumps, uncontrolled discharge of TMF water to the Victoria River or its tributaries could occur. This can be mitigated by the installation of additional pumps in the short-term; however, it is likely that liner damage sufficient to overwhelm the capacity of the pumps would be a failure mechanisms that could result in a dam breach. Therefore, the potential effects from this type of release are described in the TMF malfunction scenario described in Section 21.5 and are not considered here further.

In the event of an unplanned release of contact water, residual adverse effects to surface water resources are predicted to be low in magnitude based on the expected contact water quality in the collection ditches

and water management systems, localized to the Surface Water Resources LAA, short term in duration and reversible.

Fish and Fish Habitat

Given the low magnitude of adverse environmental effects to surface water quality, an unplanned release of contact water would not be expected to result in lethal or sub-lethal effects on fish due to changes in water quality. Depending on the volume of contact water released into a waterbody, there is the potential for the physical disturbance of fish habitat, including alteration of existing habitat due to erosion of bank material and the suspension and deposition of eroded material, as well as a temporary reduction in water quality. Fish, including eggs, if present during the event, could be affected by sedimentation through smothering (reduction of water flow and oxygen delivery) of eggs, reduced ability of fish to forage, behavioral and physiological changes (Sweka and Hartman 2001; Herbert and Merkens 1961; Kjelland et al. 2015), temporary changes in benthic community composition and/or alteration of the availability of benthic food sources. Effects would be temporary because benthic and fish communities would be expected to recover from such an event. Waterbodies that could potentially be affected are Victoria River, and Victoria Lake Reservoir, Valentine Lake and their tributaries. Species potentially present in these waterbodies include brook trout, Ouananiche, Arctic char and threespine stickleback.

In the event of an unplanned release of contact water, residual adverse effects on fish and fish habitat are predicted to be moderate in magnitude, limited to the Fish and Fish LAA, short term and reversible.

Vegetation, Wetlands, Terrain and Soils

An unplanned release of contact water would have the potential to affect vegetation, wetlands, terrain and soils, depending on the location and magnitude of the release. Potential effects include direct loss or alteration of native vegetation communities, SOCC or traditional use plant species. There is also potential for direct loss or alteration of wetland area or function or alteration of surface or groundwater flow patterns.

Adverse effects to vegetation, wetlands and/or soils would be reduced through the implementation of containment measures. Sediment fencing would be installed on land adjacent to wetlands and in slow-moving watercourses and, where feasible, contact water would be pumped back into the collection system. Although many vegetation species could be affected by an unplanned release of contact water, nearly all observed plant species are common and no changes to population attributes of common species are predicted. Affected areas are expected to reestablish over time through natural dispersion from unaffected portions of either the same community, or adjacent communities, depending on the scale of the release. Mitigation measures, including immediate response and containment, will reduce the potential for deleterious substances to enter adjacent wetlands or waterbodies.

In the event of an unplanned release of contact water, residual adverse effects on vegetation, wetlands, terrain and soils are predicted to be low in magnitude, mainly localized to the Project Area (however may extend to the Vegetation, Wetlands, Terrain and Soils LAA), short to medium term and reversible.

21.5.5 Fire / Explosion

Accidental events associated with Project activities, such as equipment malfunction, human error or uncontrolled explosions could result in a fire related directly to Project infrastructure and facilities, or within the Project Area as a forest fire.

Non-Project-related fires, such as fires resulting from lightning strikes, offsite forest fires or undefined causes, are assessed as an effect of the environment on the Project in Chapter 22.

21.5.5.1 Description of Scenario

The potential for fire or explosion exists from Project activities including, although not limited to, vehicle or equipment accidents or malfunctions, uncontrolled explosions, smelter or kiln malfunctions, electrical accidents, welding activities, kitchen fires, or human carelessness. The scenario(s) for this accident includes a fire or explosion within the processing facility or, a fire and/or explosion resulting from a fuel spill that could spread outside of the Project Area, as well as a fire arising from an off-site (i.e., along the access road) vehicle accident. A fire and/or explosion in a processing facility may occur due to the failure / malfunctioning of technology or equipment. Fire or explosion may also occur as a result of fuel transfer operation during construction and operation. Fires arising from non-Project causes, such as lightning strikes or off-site forest fires, and potentially affecting the Project are assessed in Chapter 22 (Effects of the Environment on the Project).

21.5.5.2 Project Design and Safety Measures to Reduce Environmental Effects

Fire and explosion prevention measures and management will reduce the likelihood of accidents and potential fires to as low a level as is reasonably practical. Facilities will have a fire suppression system in accordance with the structure's function and in accordance with regulatory requirements, including NL *Occupational Health and Safety Act* and *Occupational Health and Safety Regulations*. For the most part, fire water will be used with an underground ring main network around the facilities, which will be supplied by the bottom section of the raw water tank. All buildings will have hose cabinets and handheld fire extinguishers. Electrical and control rooms will be equipped with dry-type fire extinguishers. Automatic sprinkler systems will be installed in ancillary buildings. Appropriate fire suppression systems will be provided for reagents according to their SDS. Additionally, all mine water trucks will be fitted with fire-fighting equipment and foam injection tanks.

A gated, 150 m by 150 m explosives storage and mixing area will be constructed for mine operation. It will be located northwest of the TMF and consist of bulk ammonium nitrate storage, bulk emulsion storage, an explosives magazine, storage for explosive and blasting accessories (e.g., detonators, boosters, detonating cords), bulk transfer facilities, garage for mobile equipment, and trailers for personnel. The explosives storage and production facilities will meet government regulations including required separation distances as regulated by the Explosives Regulatory Division of Natural Resources Canada (NRCAN). All explosives and accessories will be stored at the planned NRCAN approved magazine site and explosive storage facility. Explosives and accessories will be transported to the open pits as needed. An Explosives and Blasting Management Plan will also be prepared for the safe use and storage of explosives, in accordance with environmental protection measures, provincial and federal legislation and

guidelines, and corporate policies for explosives. Plans will be prepared prior to the use of explosives at Project sites.

The above measures and reasonable precautions will be taken to avoid fires and limit the potential for fires beyond the Project Area. Buffers will be provided, as required, between infrastructure and equipment. Equipment will be maintained in good working order. Employee training in fuel handling, fire prevention, and emergency response measures will be completed as part of the Project-wide EMS, and Health and Safety management systems. Fire prevention and suppression systems, as well as response equipment and supplies, will be maintained on site at designated locations.

21.5.5.3 Emergency Response Measures

The emergency response plans to be developed for the Project will include measures to be implemented in the event of a fire or explosion, including actions to limit the immediate risk to the safety of employees and the public, and communication and reporting requirements. While emergency response capabilities at the mine site (e.g., firefighting and health care) will be sufficient for most accidents, a major accident may require additional support from surrounding communities. Fire departments in Grand Falls-Windsor, Buchans and Millertown, and the hospital in Buchans may be called to aid in response to larger fires or emergencies. In the event that Project activities inadvertently result in a forest fire, the appropriate provincial authorities will be notified immediately. The management, monitoring and control of forest fires in NL are the responsibility of the Department of Forestry, Fisheries and Agriculture. Forest fires would be reported to the Provincial Forest Fire Communications Centre (or respective regional centres). In developing, reviewing and updating emergency response plans, Marathon will consult with appropriate local, provincial and federal emergency response departments / agencies, as appropriate.

21.5.5.4 Environmental Effects Assessment

In the event of a fire (particularly in the event a fire spread from the Project Area into surrounding forests), the immediate concern would be for human health and safety, as well as concerns for habitat loss, direct mortality to wildlife and loss or damage of property. A fire also has the potential to remove riparian vegetation near watercourses, resulting in temporarily elevated water temperature and increased sedimentation. Potential environmental effects resulting from a Project-related accidental fire and/or explosion include temporary effects to air quality. Depending on the extent of a fire, effects to atmospheric environment, surface water resources, fish and fish habitat, vegetation and wetlands, and wildlife, may occur. Effects on these environmental components could then affect local land uses and resources as described below.

Atmospheric Environment

There is a potential for adverse effects to the atmospheric environment as a result of a fire. The emissions from a fire generally consist of smoke (particulate matter) and carbon dioxide, however, may also include carbon monoxide, nitrogen oxides, sulfur dioxide, and other products of incomplete combustion. In the event of a fire, the timely implementation of emergency response procedures would limit the extent and duration of releases to the atmospheric environment, including the extent of a smoke plume. A fire would be a temporary and localized source of emissions (assuming rapid and effective

response) and the atmospheric environment would be expected to return to pre-fire conditions shortly after the fire is extinguished.

In the event of a fire / explosion, residual adverse effects on atmospheric environment are predicted to be low in magnitude, limited to the Atmospheric Environment LAA (however could extend into the RAA were a forest fire to spread beyond the Project Area), short term and reversible.

Surface Water Resources

In the event of a fire, there may be indirect adverse effects on surface water resources due to surface runoff containing ash, sediment, or chemicals, or from the extraction of surface water used to control the fire. The potential environmental effects of a fire on surface water are likely to be localized in extent and primarily relating to temporary increases in suspended particulate matter (e.g., ash or sediment) with minor traces of hydrocarbon possible. These types of environmental effects would not persist in surface water for more than a season, typically being flushed out over time or during the first large precipitation event following the fire.

In the event of a fire / explosion, residual adverse effects on surface water resources are predicted to be low in magnitude, limited to the Surface Water Resources LAA (however could extend into the RAA were a forest fire to spread beyond the Project Area), short term and reversible.

Fish and Fish Habitat

Fire can have indirect environmental effects on fish and fish habitat associated with surface runoff containing ash, sediment, or chemicals, as discussed above. The runoff from the resulting fire water could enter the aquatic environment and potentially cause harmful alteration to fish habitat in adjacent waterbodies from increases in suspended particulate matter (e.g., ash or sediment) with minor traces of hydrocarbon possible. The potential environmental effects of a fire on fish and fish habitat are likely to be localized in extent and primarily relating to temporary increases in suspended particulate matter (e.g., ash or sediment) and is not likely to persist in the aquatic environment for more than a season, typically being flushed out over time or during the first large precipitation event following the fire.

In the event of a fire / explosion, residual adverse effects on fish and fish habitat are predicted to be low in magnitude, limited to the Fish and Fish Habitat LAA (however could extend into the RAA were a forest fire to spread beyond the Project Area), short term and reversible.

Vegetation, Wetlands, Terrain and Soils

In the event of a fire that impacts the natural vegetation in the Project Area or in the event a fire spread from the Project Area into surrounding forests, the potential effects on the vegetated environment may result in a partial or complete removal of vascular plants from an area of variable size. The effects of a forest fire are highly variable, depending on factors, such as wind, forest structure and composition, precipitation, topography, and fine fuel moisture. The effects of fire are anticipated to be reversible over several generations of growth. The central uplands ecosystem has evolved with fire as a major disturbance regime and the vegetation community has a natural resilience to forest fire. For example, black spruce (*Picea mariana*), which dominates the LAA, is specially adapted to fires, having semi-

serotinous cones which allows this species to take advantage of high temperatures from fire to open the cones and release large amounts of seed within a short window of time.

In the event of a fire / explosions, residual adverse effects on vegetation, wetlands, terrain and soils are predicted to be low in magnitude, limited to the Vegetation, Wetlands, Terrain and Soils LAA (however could extend into the RAA were a forest fire to spread beyond the Project Area), short term and reversible.

Avifauna, Caribou and Other Wildlife

A fire, particularly in the event a fire spread from the Project Area into surrounding forests, could result in an alteration of wildlife habitat, direct mortality to wildlife (especially if the fire were to occur during the breeding season), and influence the sustained presence of wildlife populations or communities. Fire can result in the loss of breeding, nesting, rearing, or other habitat for birds and other wildlife species. Additionally, fragmentation may occur for some species which regularly move around in a landscape, exploiting resources that are seasonally available and other species that require large home ranges.

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 they may provide both food availability and increased predator detection due to openness (Skatter et al. 2017).

Although a fire may result in adverse effects, it is unlikely that habitat loss or mortality (either direct or indirect) would result in a population level effect and most species are anticipated to move into adjacent areas, with habitat loss being reversible over the longer term.

Residual adverse effects on avifauna and other wildlife are predicted to be low in magnitude, however, effects may be additive to the high magnitude effect of routine Project activities on movement of the Buchans caribou herd. The residual adverse effects will be limited to the Avifauna, Caribou and Other Wildlife LAAs, however, could extend into the RAA were a forest fire to spread beyond the Project Area, and are considered short term and reversible.

Community Health

Community health has to the potential to be affected, were a fire to spread from the Project Area into surrounding forests. If meteorological conditions were such that a fire was to rapidly spread, there is risk to land and resource users and cabin owners in the area both from fire and smoke inhalation. Any fire originating from Project activities would be reported immediately and a quick response time should limit the potential for uncontrolled spread. Emergency response procedures will be developed to provide timely and effective response to fires, and containment within the Project Area. In developing, reviewing and updating emergency response plans, Marathon will consult with appropriate local, provincial and federal emergency response departments / agencies, as appropriate. Protocols for communication with local authorities will also be included in these emergency response procedures.

In the event of a fire / explosion, residual adverse effects on community health are predicted to be low in magnitude, limited to the Community Health LAA (however could extend into the RAA were a forest fire to spread beyond the Project Area), short term and reversible.

Land and Resource Use

In the event a fire spread from the Project Area into surrounding forests, use of the potentially affected area would be temporarily limited for various activities including fishing, hunting and other recreational uses. The extent and duration of any fire would be dependent on response efforts and meteorological conditions. This could also reduce the availability of harvested species in the affected area as well as the ability to travel on the land and could result in loss of cabins. While a fire that spread to forested areas would be expected to change land use in the burned over areas possibly for several decades, this effect would be geographically limited to the directly impacted areas. Loss or damage to property, such as cabins, as a result of a Project-related fire would be addressed by Marathon via compensation.

In the event of a fire, residual adverse effects on land and resources use are predicted to be low in magnitude, limited to the Land and Resource Use LAA (however could extend into the RAA were a forest fire to spread beyond the Project Area), short term and reversible.

Indigenous Groups

In the event a fire spread from the Project Area into surrounding forests, there is potential for adverse effects to Indigenous health and socio-economic conditions, Indigenous physical and cultural heritage and current use. The extent and duration of any fire would be dependent on response efforts and meteorological conditions. It could result in the reduced of availability of harvested species in the affected area as well as the ability to travel on the land. While a fire that spread to forested areas would be expected to change land use in the burned over areas possibly for several decades, this effect would be geographically limited to the directly impacted areas.

In the event of a fire, residual adverse effects on Indigenous groups are predicted to be low in magnitude, limited to the Indigenous Groups LAA (however could extend into the RAA were a forest fire to spread beyond the Project Area), short term and reversible.

Dam Infrastructure

Adverse effects to Project and non-Project dam infrastructure (the Victoria Dam), were considered in the event of a fire or explosion. A fire is not expected to directly affect the stability of dam infrastructure, however the change in surface runoff characteristics adjacent to the dam as a result of fire damage to vegetation could result in erosion at or near dam abutments or toes where vegetation is present.

Any accidental explosion would likely be relatively small and surface-based (i.e., from Project infrastructure or facilities not located within an open pit) based on the types of explosive materials to be present at the site (e.g. propane tanks). The explosive energy from a ground surface explosion is primarily directed upward into the atmosphere, and the event would not likely create ground vibrations that could affect the stability of the Project or non-Project dams. As discussed in Section 19.5.3, an initial

blasting impact assessment has been completed and estimated the vibrational loading is considered minor and is not expected to affect the stability of the Victoria Dam (BSA.1, Attachment 1-C).

In the event of an explosion, residual adverse effects on dam infrastructure are predicted to be negligible to low in magnitude, limited to the Dam Infrastructure RAA, short term and reversible.

21.5.6 Vehicle Accident

The access road to the mine site will include an existing gravel access road from Millertown, of which the initial 8 km are owned, operated, and maintained by the province. The next 80 km of class D gravel road will be upgraded (where required) to a Class A standard 7.3 m-wide driving surface and will include ditching on both sides and cross drainage by culverts. There is a 20 m-wide buffer on either side of the existing access road included in the Project Area to accommodate upgrading activities (where required) and will provide better visibility.

21.5.6.1 Description of Scenario

Vehicle accidents, including single vehicle accidents, could result in the release of hydrocarbon, sodium cyanide, or ammonium nitrate to the environment (as assessed in Section 21.5.3). Accidental collisions from the operation of Project vehicles or heavy equipment could also result in human mortality or injury. A vehicle accident could result in a fire, which is discussed further in Section 21.5.5.

21.5.6.2 Project Design and Safety Measures to Reduce Environmental Effects

Several traffic safety measures will be implemented to reduce the potential for vehicle malfunctions or accidents as a result of the Project. These include, although are not limited to, the following:

- 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 by managing vegetation growth
- Project vehicles will be required to comply with posted speed limits on the access road, site roads and haul roads. Speed limits will be set in accordance with road conditions, and provincial regulations and industry standards (e.g., for haul roads)
- 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, which may include gating approaches, placing large boulder and/or gated fencing to restrict public access to the mine site
- Project vehicles will be driven by trained and competent drivers who will use approved routes
- Project vehicles will be manually inspected on a regular schedule to confirm serviceability
- Driving safety will be a part of the employee orientation program
- Workers will be bussed from nearby communities to the mine site for shifts to reduce effects of traffic on the access road, which will also reduce potential for a vehicle collision

21.5.6.3 Emergency Response Measures

Emergency response services will be available at the Project site, as well as fire departments in Grand Falls-Windsor, Buchans and Millertown, and the hospital in Buchans to aid in emergencies. Marathon will consult and establish communications with appropriate local, provincial and federal emergency response departments as determined to be required for environmental and health and safety related emergencies. Marathon will cooperate with local officials in the incident investigation process and conduct an internal incident investigation. Where necessary, remedial action will be taken by Marathon in accordance with the results of the investigations.

21.5.6.4 Environmental Effects Assessment

Access to the Project is via an existing gravel access road from Millertown. This road is owned by the Crown and will be upgraded and maintained (e.g., grading, snow clearing) by Marathon. There will also be site roads and haul roads at the mine site. The presence of Project-related vehicles has the potential to increase the number of collisions on the access road, resulting in temporary delays to road traffic, damage to vehicles, or injury or death to individuals involved, including potential injury or mortality to wildlife. Vehicles accidents on the site roads and haul roads also have the potential to result in damage to vehicles, or injury or death to individuals involved, including potential injury or mortality to wildlife.

Avifauna, Caribou and Other Wildlife

Vehicle-related wildlife mortality has the potential to affect a wider range of species, including migratory birds, SAR and SOCC, and large mammals. Vehicles will abide by posted speed limits and multi-passenger vehicles will be used, where practical, to reduce the potential for wildlife-vehicle collisions. Residual effects from a vehicle accident on wildlife are further described in Chapters 10, 11 and 12. To reduce the risk of caribou-vehicle collisions, caribou will have the 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 the road.

Community Health

A vehicle accident has the potential to result in injury to or loss of life. Although public injury or mortality as a result of a vehicle accident cannot be ruled out, the likelihood is very low given the mitigation and emergency response prescribed above. In the unlikely event of a vehicle collision resulting in serious injury or loss of life, residual adverse effects on community health would be high in magnitude and irreversible.

21.6 SUMMARY

Residual adverse effects from accidents or malfunctions (including TMF failure, stockpile slope failure, fuel, and hazardous material spill, unplanned release of contact water, fire / explosion, and vehicle accident) to VCs are characterized in Section 21.5. The Project will be planned, designed, constructed, operated and monitored to avoid accidents or malfunctions through adherence to regulations, guidelines and best practices. In the event of an accident or malfunction, emergency response procedures and

contingency measures (Section 21.3) will be implemented to reduce adverse effects to the environment. Environmental management plans applicable to the Project, which will include communication roles and responsibilities, training requirements, requirements for on-site response infrastructure and equipment, and mitigation / response measures in the event of an unplanned accident or malfunction, are further described in Section 2.7.3.

In the unlikely event of a major industrial accident or malfunction which results in a large-scale release into the environment (e.g., major TMF failure with discharges of tailings into local waterbodies and other habitats outside the Project Area, or a spill of hazardous materials into Victoria River from a vehicle malfunction or collision), there is a potential for significant residual adverse effects to surface water resources, fish and fish habitat, caribou, and community health (Table 21.5). A significant effect may also occur in the unlikely event of major accident resulting in a loss of life (e.g., vehicle accident or TMF failure). However, a significant effect is unlikely to occur given the Project design and safety measures in place to reduce the likelihood of an accident or malfunction, and the emergency response plans and contingency measures that will be in place to limit the extent and nature of potential environmental effects in the event of an accident or malfunction. This includes conformity with industry standards (e.g., dam design and monitoring, and emergency response and contingency planning) and legislated regulatory requirements. The prediction of significant adverse effects for the VCs identified in Table 21.5 also assumes worst-case scenarios for the events assessed. The residual effects from accidental events with a higher likelihood of occurring (e.g., small hydrocarbon spills from equipment) are not likely to be significant, as these will be contained within the mine site and readily cleaned up).

Table 21.5 Summary of Significance Determinations

VC Name	Accident or Malfunction Scenario					
	TMF Malfunction	**Slope Failure**	**Fuel and Hazardous Material Spills**	**Unplanned Release of Contact Water**	**Fire / Explosion**	**Vehicle Accident**
Atmospheric Environment	NS	NS	NS	NS	NS	NS
Groundwater Resources	NS	NS	NS	NS	NS	NS
Surface Water Resources	S*	NS	NS	NS	NS	NS
Fish and Fish Habitat	S*	NS	NS	NS	NS	NS
Vegetation, Wetlands, Terrain and Soils	NS	NS	NS	NS	NS	NS
Avifauna	NS	NS	NS	NS	NS	NS
Caribou	S*	NS	NS	NS	S*	NS
Other Wildlife	NS	NS	NS	NS	NS	NS
Community Services and Infrastructure	NS	NS	NS	NS	NS	NS
Community Health	S*	NS	NS	NS	NS	S*
Employment and Economy	NS	NS	NS	NS	NS	NS
Land and Resource Use	NS	NS	NS	NS	NS	NS

Table 21.5 Summary of Significance Determinations

VC Name	Accident or Malfunction Scenario					
	TMF Malfunction	Slope Failure	Fuel and Hazardous Material Spills	Unplanned Release of Contact Water	Fire / Explosion	Vehicle Accident
Indigenous Groups	NS	NS	NS	NS	NS	NS
Historic Resources	NS	NS	NS	NS	NS	NS
Dam Infrastructure	NS	NS	NS	NS	NS	NS
Note: * Unlikely to occur						

This determination of significance has been made with a moderate to high level of confidence, with a higher level of confidence associated with the minor accidental events or malfunctions that may occur (e.g., small to medium sized spills). A moderate level of confidence has been assigned for larger scale and far less likely events, such as a TMF failure or fuel / hazardous material spill outside the confines of the mine. Given this lower level of predictability, a worst-case assumption has been used in this assessment in the determination of significance. Furthermore, Marathon will develop contingency plans and implement engineering and quality controls during the design, construction and operation phases to mitigate potential adverse environmental effects that could result from accidental events and malfunctions. During the operation phase, monitoring (including passive monitoring with technology and active monitoring with scheduled inspections and opportunity inspections during heavy rain and/or runoff events) for scenarios with higher potential to result in substantial adverse environmental effects (e.g. slope failures) will be part of standard operating procedures.

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22.0 EFFECTS OF THE ENVIRONMENT ON THE PROJECT

As required by both the Federal Environmental Impact Statement (EIS) Guidelines (Appendix 1A) and the Provincial EIS Guidelines (Appendix 1B), this chapter provides a discussion of the potential effects of the environment on the Project, including its design, construction, operation, and decommissioning, rehabilitation and closure phases. It considers how local conditions and natural hazards could adversely affect the Project and provides details of planning, design, construction and operation strategies that aim to reduce the potential for adverse environmental effects of the environment on the Project. A key concern is that severe weather events or natural hazards (e.g., earthquakes, extreme precipitation events, extreme wind events) could affect or damage Project infrastructure, resulting in failures, malfunctions or accidental events, which in turn could result in adverse effects to the environment.

Effects of the environment on the Project are largely addressed through sound Project planning and design. Engineering design will adhere to applicable provincial, national, and international codes and standards. These codes and standards document the proper engineering design for site-specific normal and extreme physical environmental conditions and provide design criteria that regulatory agencies consider satisfactory for withstanding the potential physical environmental conditions. These codes consider physical environmental criteria such as temperature, wind, snow and ice loading, drainage, and climate change. The design life of the Project will be taken into consideration so that materials are chosen with sufficient durability and corrosion resistance.

Marathon will also develop and implement comprehensive prevention and response plans and procedures aimed at unplanned or accidental events (e.g., prevention and response procedures for forest fires). The Project will be designed, operated and managed in a manner intended to reduce effects of the environment on the Project, recognizing that in addition to causing adverse effects on Project infrastructure, equipment, schedules, and operational performance, these effects could also result in adverse effects to the environment (e.g., water control malfunctions affecting downstream habitats).

22.1 SCOPE OF ASSESSMENT

Effects of the environment on the Project to be considered in this assessment are those resulting in:

- A substantial change of the Project schedule
- A long-term interruption in Project operations
- Damage to Project infrastructure or equipment that results in a release of hazardous materials into the environment
- Damage to Project infrastructure resulting in a substantial increase in risks to the health and/or safety of Project personnel and/or the public, or substantial risks of a business interruption
- Damage to Project infrastructure resulting in repairs that could not be technically or economically implemented

The Government of Canada lists earthquakes, flooding, wildfires, hurricanes, landslides, severe storms, storm surges, tornados and tsunamis amongst Newfoundland and Labrador's (NL's) regional

environmental hazards in the federal *Get Prepared* campaign (Government of Canada 2018a). The Federal EIS Guidelines (Appendix 1A) include flooding, drought, ice jams, landslides, avalanches, erosion, subsidence, fire, outflow conditions and seismic events as factors to consider. The Provincial EIS Guidelines (Appendix 1B) require the EIS to predict how local conditions and natural hazards, such as severe and/or extreme weather conditions and external events (e.g., flooding, dam breach, ice jams, rock slides, landslides, fire, outflow conditions and seismic events) could adversely affect the Project and how this in turn could affect the environment (e.g., environmental emergencies due to extreme environmental conditions). Specifically, the Provincial EIS Guidelines require consideration of:

- Potential geotechnical and geophysical hazards within the Project Area
- Potential effects on foundation stability of major Project components from geological fractures and faults
- Potential effects of the groundwater level on mining operations or potential effects of mining operations on groundwater flow and occurrence
- Potential effects of climate change on the Project

In consideration of the above, the assessment of the effects of the environment on the Project considers the following potential environmental conditions / events:

- Climate and climate change (including extreme weather)
- Geologic hazards (including seismic activity, erosion, landslides, and subsidence)
- Forest fires

Changes to hydrological and hydrogeological regimes, including surface water withdrawals and effects of groundwater regimes on mining operations are assessed in Groundwater Resources (Chapter 6) and Surface Water Resources (Chapter 7) and are not further considered in this chapter.

Environmental components that are applicable within the context of the geographical location of the Project are further outlined in Table 22.1.

Table 22.1 Scope of Factors Considered for Effects of the Environment on the Project

Source of Environmental Effect	Environmental Category	Environmental Component
Weather and Climate	Climate	Temperature
		Precipitation (e.g., rain, snow)
		Wind
		Fog
	Extreme Weather Events	Snow
		Rain
		Wind
	Climate Change	Climate Projections

Table 22.1 Scope of Factors Considered for Effects of the Environment on the Project

Source of Environmental Effect	Environmental Category	Environmental Component
Natural Hazards	Geological	Landslides
		Rockfalls
		Subsidence
		Erosion
		Avalanches
		Earthquakes
	Forest Fires	Forest Fires

Note that the current COVID-19 global pandemic is an environmental factor that could potentially affect the Project (e.g., if pandemic restrictions were in place at the start of construction and required modification of Project working conditions or schedule to maintain health and safety of workers). However, with construction scheduled to commence in 2022, there is uncertainty with respect to whether restrictions related to COVID-19 will be in place at that time. Marathon's response measures related to COVID-19 are addressed in Community Health (Chapter 14).

This assessment is closely linked to Accidental Events (Chapter 21) which considers and assesses the following accidental events:

- Tailings Management Facility (TMF) Malfunctions
- Open Pit Slope Failure
- Low-Grade Ore and High-Grade Ore Stockpiles, and Waste Rock Piles Slope Failure
- Fuel and Hazardous Materials Spill
- Unplanned Release of Contact Water (either from the failure of water management infrastructure [e.g., ditching, ponds, erosion control] or the water treatment plant)
- Sewage Treatment Plant Failure
- Over Blasting
- Fire / Explosion
- Vehicle Accident
- Watercourse Crossing Failure

22.1.1 Influences of Engagement on Effects of the Environment

Engagement with government agencies, stakeholders, and local Indigenous groups has been ongoing throughout the environmental assessment (EA) process and will continue over the life of the Project. Engagement with Indigenous groups, communities and stakeholders did not identify issues related to effects of the environment on the Project, other than concerns about the effects of COVID-19 on the Project schedule. This concern was raised by members of the Miawpukek First Nation (Miawpukek) and identified through community and stakeholder engagement. As indicated above, Marathon's response to COVID-19 is further discussed in Community Health (Chapter 14). A summary of issues and concerns

with respect to the Project identified during engagement with the public, Indigenous groups and other stakeholders is provided in Chapter 3.

22.2 BOUNDARIES

22.2.1 Spatial Boundaries

The Project Area identified for assessing effects of the environment on the Project consists of the mine site and access road, with a 20 m buffer on either side of the existing access road (Figure 22-1). A Local Assessment Area (LAA) and Regional Assessment Area (RAA) are not defined for effects of the environment on the Project. Adverse environmental effects of the environment on the Project are those that would have the potential to directly affect schedules, infrastructure, and operations, which are contained within the Project Area. Effects on the Project from the environment, such as damage to infrastructure, can adversely contribute to and/or complicate malfunctions and accidental events. Project malfunctions and accidental events, with relevant spatial boundaries, are addressed in Chapter 21.

22.2.2 Temporal Boundaries

The temporal boundaries for the Project involve the following main phases:

- 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

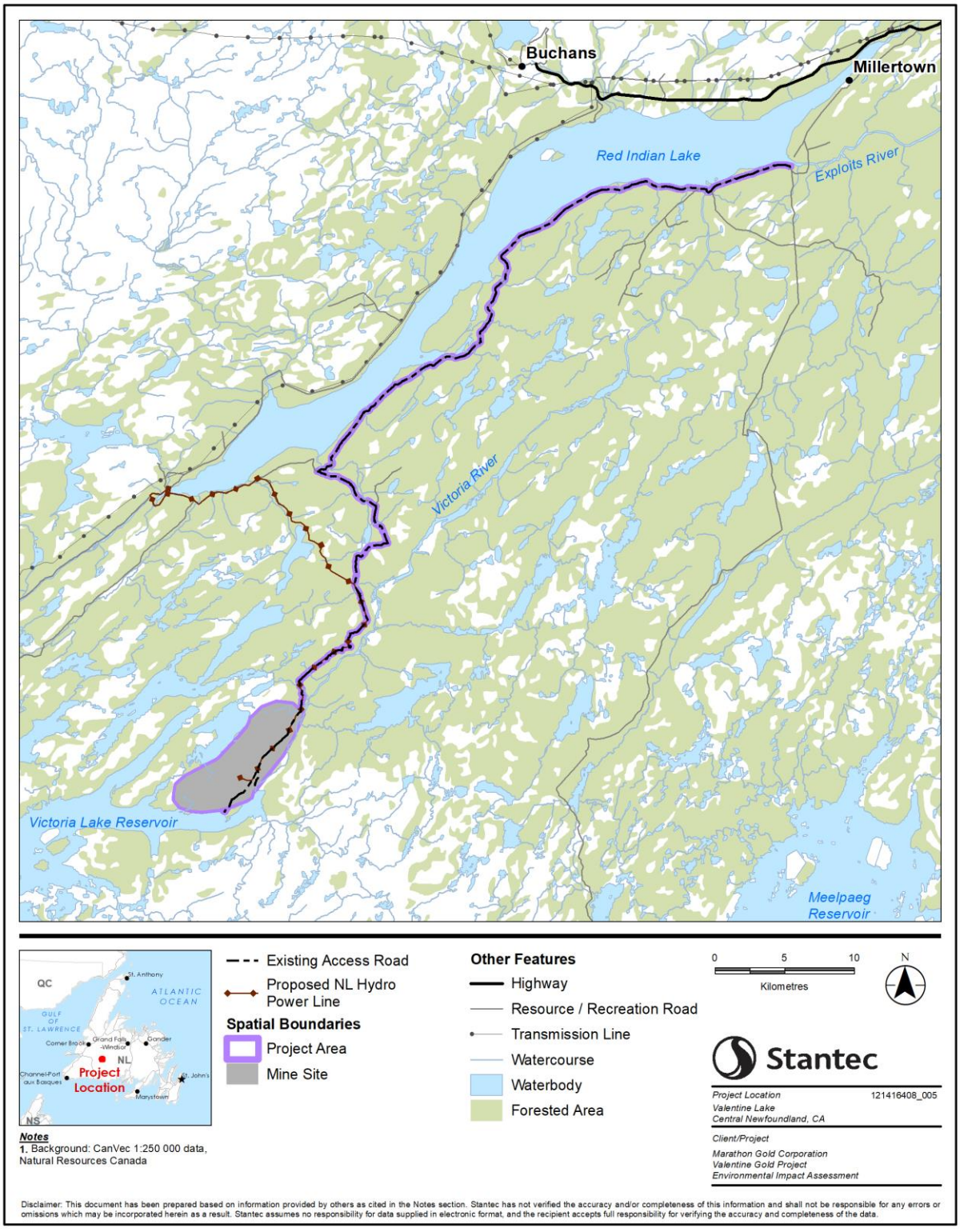

Figure 22-1 Spatial Boundaries for Effects of the Environment on the Project

22.3 ASSESSMENT OF EFFECTS OF THE ENVIRONMENT ON THE PROJECT

As outlined in Section 22.1, the effects of the environment on the Project considered for this assessment stem from two categories: weather and climate; and natural hazards. These conditions / events are described in further detail below, including a description of current conditions, potential effects on the Project, proposed mitigation, and potential adverse residual effects.

22.3.1 Weather and Climate

22.3.1.1 Existing Conditions

Climate

Climate describes the statistical average (mean and variability) of weather conditions over a substantial period of time (typically 30 years) (Catto 2006). The most valuable data when developing historical climate profiles are typically surface variables, such as temperature, precipitation, fog, and wind data collected from nearby weather stations. Environment and Climate Change Canada (ECCC) have developed 30-year statistical summaries of data (1981 to 2010) collected from weather stations located throughout Canada, (i.e., climate normal data). Not all weather stations have complete data sets, and their years of operation vary considerably; many are no longer in operation. Furthermore, not all weather stations collect data for all required variables (i.e., temperature, precipitation, wind, visibility). It is therefore not always possible to find representative weather stations that have been collecting complete information for the past 30 years and are also central to the location. In the case that no single weather station meets all requirements, it is necessary to assess data from two or more stations. The ECCC weather data available near the Project Area are presented in Table 22.2 (ECCC 2019) and Figure 22-2.

Table 22.2 Available ECCC Historical Weather Data Near the Project Area

Station Name	Nearest Distance to Project Area (km)	Weather Variables Available	Climate Normals Available	Years of Recorded Data	
				First	Last
Exploits Dams	1	Temperature, Precipitation,	1981-2010	1956	2008
Millertown RCS	8	Temperature, Wind	N/A	2013	2020 (Present)
Buchans	10	Temperature, Precipitation	1981-2010	1965	2011
Burnt Pond	22	Temperature, Precipitation	1981-210	1972	2020 (Present)
Badger	45	Temperature, Wind	N/A	1986	2020 (Present)
Deer Lake	69	Temperature, Precipitation, Wind, Visibility	1981-2010	1933	2020 (Present)

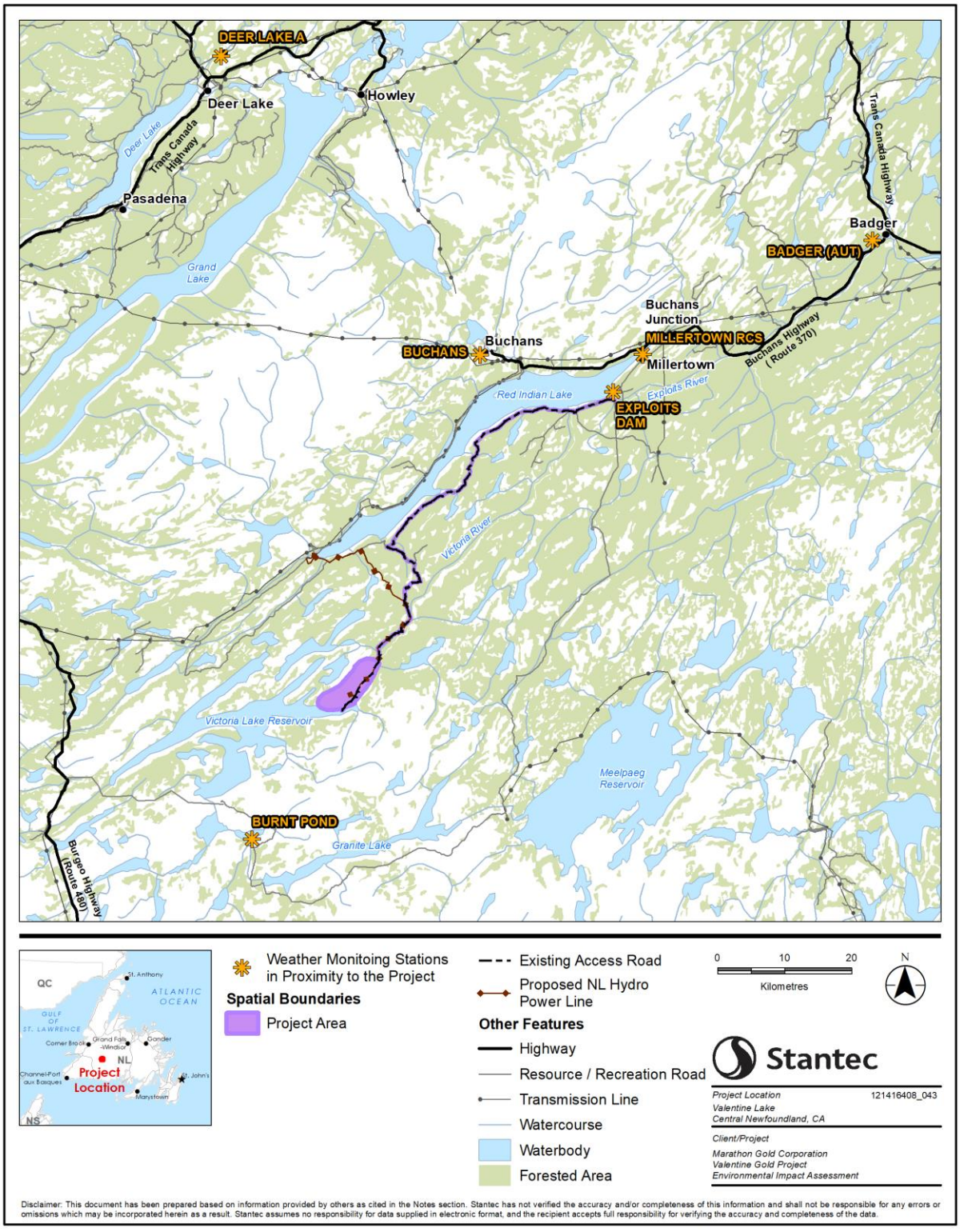

Figure 22-2 Weather Stations in Proximity to the Project

In Section 5.2, the existing climate was discussed using 1981 to 2010 climate normals for the Buchans station, with the exception of wind data which, due to non-availability, were sourced from the Deer Lake station. The data presented in this chapter are consistent with those presented in Section 5.2, except for wind and fog. The wind data presented in Section 5.2 focused on the most-recent 5-year data, as opposed to a 30-year climate normal presented here. Climate data related to fog were not previously presented in Section 5.2, as they do not affect air quality or greenhouse gas (GHG) predictions.

Temperature

The 30-year normal temperature data for Buchans were previously presented in Chapter 5, Table 5.4. Daily average temperatures at Buchans range between -8.4°C to 16.3°C, with the lowest average temperatures occurring in February and the highest occurring in July. Extreme historical daily maximum and minimum temperatures range between -33.5°C (occurring in February 1993) to 33°C (occurring in July 1995). The annual average temperature is 3.8°C.

Precipitation

The 30-year normal precipitation data for Buchans are provided in Chapter 5, Table 5.4. Total annual average precipitation at Buchans is 1,236 mm, with 359 cm of snow and 877 mm of rain. Monthly average precipitation ranges between 86 to 123 mm, with the least occurring in April and the most occurring in December. A daily rainfall historical extreme of 139 mm was recorded during the month of August in 1983. On average, there have been 30.7 days each year with rainfall greater than 10 mm, and 7.1 days each year with rainfall greater than 25 mm. From the 30-year climate normal data (1981-2010), the minimum annual precipitation occurred in 2001, when Buchans experienced 1,028.8 mm of precipitation.

Average monthly snowfall peaks at 88.3 cm in January, with the most snowfall typically observed from December to February. A daily snowfall historical extreme of 70 cm was recorded during the month of March in 2005. On average, there have been 15.1 days each year with snowfall greater than 10 cm and 1 day each year with snowfall greater than 25 cm. On average, 148 days per year have a snow depth >1cm.

Wind

Monthly average wind speeds from the 30-year climate normals measured at the Deer Lake station range from 11.7 to 15.3 kilometres per hour (km/hr), with an annual average wind speed of 13.6 km/hr (Table 22.3). The dominant wind direction is from the southwest for all months except for April and May when the dominant wind direction is from the northeast.

Maximum hourly wind speeds range from 59 km/hr (recorded in June and July) to 93 km/hr (recorded in January). Maximum gusts for the same period range from 89 km/hr (recorded in September) to 133 km/hr (recorded in January).

On average, there have been 4.7 days each year with hourly mean winds greater than 52 km/hr and 0.8 days each year with hourly winds greater than 63 km/hr.

Table 22.3 Wind Climate Normals, Deer Lake, Newfoundland and Labrador (1981-2010)

Parameter		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Speed (km/hr)		14.8	14.6	15.3	15.2	14.1	13.3	12.3	11.7	12.0	12.4	13.5	14.5	13.6
Most Frequent Direction		SW	SW	SW	NE	NE	SW	SW	SW	SW	SW	SW	SW	SW
Maximum Hourly Speed (km/hr)		93	65	72	64	64	59	59	65	65	74	78	70	--
Date (yyyy/dd)		1986/ 14	1982/ 24	1967/ 18	1968/ 07	1966/ 08	1986/ 18	1982/ 01	1979/ 14	2010/ 05	1987/ 02	1988/ 29	1984/ 07	--
Direction of Maximum Hourly Speed		SW	W	SW	SW	SW	S	SW	SW	SW	SW	SW	SW	--
Maximum Gust Speed (km/hr)		133	111	105	102	97	96	111	107	89	129	107	102	--
Date (yyyy/dd)		1986/ 14	1976/ 03	1967/ 18	1992/ 14	1966/ 08	1986/ 18	1982/ 01	1979/ 14	1965/ 17	1974/ 20	1986/ 14	1979/ 17	--
Direction of Maximum Gust		SW	SW	SW	SW	SW	S	SW	W	W	S	W	S	--
Mean No. of Days with Winds	≥52 km/hr	1.0	0.7	0.4	0.4	0.2	0.1	0.1	0.1	0.1	0.3	0.5	0.8	4.7
	≥63 km/hr	0.2	0.1	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.1	0.1	0.2	0.8
Source: ECCC 2019														

Fog

Fog is defined as a ground-level cloud and consists of tiny water droplets suspended in the air and with visibility reduced to less than 1 kilometre (km) (ECCC 2017). Only climate stations that report hourly data contain visibility (fog) data. The nearest meteorological station to the Project Area with available visibility data climate normals is Deer Lake, approximately 95 km north of the mine site. The 1981 to 2010 climate normals for visibility for the Deer Lake station are presented in Table 22.4. There is a measured increase in the hours of reduced visibility (less than 1 km) in fall and winter relative to the summer months (ECCC 2019) (Table 22.4). The Deer Lake station has experienced, on average, 79.6 hours (3.32 days) per year when visibility is less than 1 km.

Table 22.4 Hours with Visibility Climate Normals, Deer Lake (1981-2010)

Distance Visible	Visibility (hours with)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
< 1 km	16.3	9.7	5.5	3.0	2.2	2.2	3.2	6.0	9.6	7.5	4.3	10.0	79.6
1 to 9 km	166	128	97.1	59.2	47.8	38.1	39.8	45.9	42.7	40.1	84.5	150	939
> 9 km	562	538	641	658	694	680	701	69	668	696	631	584	7,745
Source: ECCC 2019													

Extreme Weather Events

Extreme weather events that could affect the Project and occur at or near the Project Area include severe storms, hurricanes and tornadoes, and drought. Severe storms can occur throughout the year on the Island of Newfoundland, and can result in threats to public safety, disruptions to transportation systems, and damage to utilities and/or property. Winter storm events can consist of high winds, snow, ice, and freezing rain. During the summer and fall months, the Island is prone to hurricanes and tropical storms, which can bring strong winds and heavy rains. Other forms of severe weather can develop during warmer months including thunder, lightning, hail, and occasionally tornadoes.

The worst hurricane to hit the Island since 1935 was Hurricane Igor in 2010, a Category 1 hurricane that affected the entire island (ECCC 2013). Hurricane Igor had maximum sustained landfall winds of 140 km/hr, and extreme rainfalls reaching as high as 238 mm in the St. Lawrence area, ranking it a 1-in-100-year storm (Pasch and Kimberlain 2011).

The Government of Canada's *National Tornado Database: Verified Tracks (1980-2009)* only has one listed verified tornado on the Island of Newfoundland, which occurred in Gander Bay on July 29, 2007 (Government of Canada 2018b). This tornado was an F0 rating (lowest rating) on the Fujita Scale (which rates tornado intensity on the damage that is inflicted on vegetation and human-built structures, from F0 to F5), with wind speeds of 60 to 110 km/hr. However, a 2011 CBC article interviewing an ECCC meteorologist indicated that several historical tornadoes had occurred throughout the Island of Newfoundland; the strongest was an F2 rated tornado in 1996 in Trinity and the closest to the Project was an F0 in 1998 in Buchans (CBC News 2011).

Agriculture and Agri-Food Canada (AAFC) publishes monthly records of droughts dating back to 2002 through their *Canadian Drought Monitor* tool (AAFC 2020). The records were reviewed for the surrounding area from 2002 to end of 2019. There were several months in which most or part of the surrounding area was classified as “Abnormally Dry” and one month in which a “Moderate Drought” occurred. There were no occurrences of severe, extreme, or exceptional droughts, although these events are categorized as occurring less frequently (e.g., every 50 years for exceptional droughts). Droughts as they relate to hydrogeology and the Project (including outflow) are discussed further in Section 6.2.2.1.

Historical intensity-duration-frequency (IDF) curve data for precipitation can be used as a method to characterize and assess extreme adverse weather events. The NL Office of Climate Change published IDF data for several locations within the province that were developed by Memorial University of Newfoundland (MUN) in 2018 and are available online (Government of NL 2019). Historical IDF curves for the Buchans station are not available; however, they are available for the Deer Lake station and results corresponding to durations of 1-hour and 24-hour precipitation events are presented in Table 22.5. In addition, 1-hour and 24-hour duration data from historical IDF curves for Burgeo and Port aux Basques are also presented for comparison.

Table 22.5 Historical IDF Precipitation Curves for Locations Near the Project (mm)

Station	Duration	Return Interval (years)					
		2	5	10	25	50	100
Burgeo	1-hr	19.65	24.19	27.19	30.98	33.79	36.58
	24-hr	71.89	86.22	95.70	107.69	116.58	125.41
Deer Lake	1-hr	13.3	16.51	18.63	21.32	23.31	25.29
	24-hr	44.93	55.7	62.83	71.84	78.53	85.16
Port aux Basques	1-hr	17.49	22.77	26.26	30.68	33.95	37.2
	24-hr	67.14	84.86	96.58	111.4	122.39	133.3
Source: Government of NL 2019							

Climate Change

While climate refers to the historical average weather conditions, climate change is an acknowledged change in climate that has been documented over two or more periods, each with a minimum duration of 30 years (Catto 2006). The Intergovernmental Panel on Climate Change (IPCC) defines climate change as “a change in the state of the climate that can be identified (e.g., by using statistical tests) by changes in the mean and/or the variability of its properties and that persists for an extended period, typically decades or longer” (IPCC 2014). Climate change can be a result of naturally occurring internal processes (e.g., volcanic activity), external forces (e.g., solar cycles), or anthropogenic activities altering the composition of the atmosphere or land use (IPCC 2014). The United Nations Framework Convention on Climate Change (UNFCCC) distinguishes between climate change attributed to anthropogenic activities and the variability attributed to natural causes. The UNFCCC defines “Climate Change” as the change that is attributed, whether directly or indirectly, to human activities, which is in addition to the naturally occurring climate variability observed over comparable periods (IPCC 2007).

In 2018, the Government of NL funded Finnis and Daraio (2018) to conduct an update to their *Climate Projections Study* to identify the changing climate throughout the twenty first century at 28 locations within the Province (Government of NL 2019). Climate change projections often refer to four different GHG concentration trajectories known as representative concentration pathways (RCPs). RCPs represent different ranges of potential radiative forcing values (the difference between sunlight absorbed by the earth and energy radiated back to space), that could result in GHG-related heating of the planet by the year 2100 (relative to pre-industrial values) (Moss et al. 2010). The four RCP values are RCP2.6, RCP4.5, RCP6.0, and RCP8.5, and represent GHG-related heating of the planet at rates of 2.6 Watts per square metre (W/m^2), 4.5 W/m^2, 6 W/m^2, and 8.5 W/m^2, respectively. Finnis and Daraio (2018) focused on the RCP8.5 (business as usual) scenario.

The Provincial EIS Guidelines request that climate change projections be considered for four locations on the Island of Newfoundland: Port Aux Basques, Burgeo, Bay d'Espoir and Exploits Dam. The precipitation and temperature results from the Climate Projections Study (MUN 2018) at these four locations are presented in Tables 22.6 and 22.7, respectively. The twentieth century data represent historical trends observed from 1968 to 2000.

The mean daily precipitation, mean intensity of precipitation events, and mean annual precipitation are expected to increase at each of the four locations annually, and during each of the seasonal periods presented. Exploits Dam is expected to have the largest increase in mean annual precipitation, increasing 16% (from 20th century averages) from 1,097 mm to 1,273 mm by mid-century and increasing 23% from 1,097 mm to 1,354 mm by end of century. Exploits Dam is the closest of the assessed locations to the Project and climate projections for its location are most representative of how climate may change within the Project Area.

The daily mean temperature, daily minimum temperature, and daily maximum temperature are expected to increase at the four locations annually and during each of the seasonal periods assessed. The largest increase in mean annual temperature is expected at Exploits Dam, which will see an increase of 203% (from 20th century averages) from 3.3°C to 6.8°C by mid-century and an increase of 265% from 3.3°C to 8.9°C by end of century.

In addition to increases in mean precipitation and temperatures, climate change is expected to increase the intensity, frequency, and duration of adverse weather events. The life of the Project, including the decommissioning, rehabilitation and closure phase, is expected to end by approximately 2045, which corresponds with the beginning of the mid-century climate-induced projected changes.

IDF curve projections for precipitation can be used to quantify projected changes of extreme adverse weather events. IDF predictions for 1-hour and 24-hour precipitation prepared by MUN (2018) for mid-century and end of century are presented in Tables 22.8 and 22.9, respectively, for Burgeo, Deer Lake and Port aux Basques (Government of NL 2019). These IDF curves can be compared to historical curves presented in Table 22.5.

Table 22.6 Precipitation Projections at Select Locations on the Island of Newfoundland

Location	Period	Mean Daily Precipitation (mm)			Mean Intensity of Precipitation Events (mm)			Mean Annual Precipitation (mm)		
		20th Century	2041-2070 Projection	2071-2100 Projection	20th Century	2041-2070 Projection	2071-2100 Projection	20th Century	2041-2070 Projection	2071-2100 Projection
Bay d'Espoir	December-February	6.2	6.3	6.7	13.5	13.5	14.4	561	563	602
	March-May	4.3	4.7	5.0	10.8	11.3	12.0	393	433	464
	June-August	3.8	4.7	4.8	10.0	11.6	11.7	352	428	439
	September-November	5.1	5.5	5.5	11.6	13.9	14.5	461	500	496
	Annual	4.8	5.3	5.5	11.5	12.6	13.1	1,767	1,924	2,001
Burgeo	December-February	5.0	6.1	6.6	10.6	12.3	13.3	449	549	592
	March-May	4.2	4.8	5.1	10.6	11.3	12.0	385	437	470
	June-August	4.6	4.9	4.9	11.8	12.2	12.2	423	453	453
	September-November	5.2	5.4	5.3	12.6	13.3	13.8	472	493	485
	Annual	4.7	5.3	5.5	11.4	12.3	12.8	1,729	1,932	2,000
Exploits Dam	December-February	3.1	3.7	4.1	8.5	8.7	9.5	281	333	365
	March-May	2.6	3.0	3.3	7.6	7.8	8.3	236	276	300
	June-August	3.0	3.6	3.8	8.5	9.3	9.8	277	331	354
	September-November	3.3	3.7	3.7	9.2	10.2	10.6	302	333	335
	Annual	3.0	3.5	3.7	8.4	9.0	9.6	1,097	1,273	1,354
Port Aux Basques	December-February	4.2	5.0	5.5	8.8	9.8	10.7	382	454	491
	March-May	3.4	3.9	4.2	9.3	9.9	10.4	315	360	384
	June-August	3.6	3.9	4.0	11.0	11.1	11.5	333	357	364
	September-November	4.3	4.7	4.7	10.6	11.5	12.2	395	425	425
	Annual	3.9	4.4	4.6	9.9	10.6	11.2	1,426	1,596	1,664

Source: Government of NL 2019

Table 22.7 Temperature Projections at Select Locations on the Island of Newfoundland

Location	Period	Daily Mean Temperature (°C)			Daily Minimum Temperature (°C)			Daily Maximum Temperature (°C)		
		20th Century	2041-2070 Projection	2071-2100 Projection	20th Century	2041-2070 Projection	2071-2100 Projection	20th Century	2041-2070 Projection	2071-2100 Projection
Bay d'Espoir	December-February	-5.3	2.3	4.3	-10.2	-5.3	-2.7	-0.4	3.3	5.3
	March-May	2.6	5.7	7.6	-2.4	0.3	2.3	7.7	9.7	11.4
	June-August	14.9	16.6	18.4	9.3	12.5	14.4	20.5	23.4	25.1
	September-November	7.3	11.5	13.5	2.7	6.0	8.1	12.0	15.2	17.2
	Annual	4.9	9.0	11.0	-10.2	-5.3	-2.7	20.5	23.4	25.1
Burgeo	December-February	-4.4	-0.5	1.7	-8.0	-3.5	-1.1	-0.8	2.6	4.5
	March-May	1.3	4.2	6.1	-2.0	1.0	3.0	4.6	7.4	9.2
	June-August	12.6	15.5	17.3	9.4	12.2	14.1	15.8	18.8	20.6
	September-November	7.0	9.9	12.0	3.6	6.8	8.9	10.5	13.0	15.1
	Annual	4.1	7.3	9.3	-8.0	-3.5	-1.1	15.8	18.8	20.6
Exploits Dam	December-February	-7.1	-2.6	-0.2	-11.8	-6.7	-3.9	-2.4	1.4	3.5
	March-May	0.5	3.8	5.7	-4.7	-1.1	1.0	5.8	8.7	10.4
	June-August	14.1	17.1	19.0	7.9	11.0	13.0	20.2	23.1	25.0
	September-November	5.9	8.8	11.0	1.2	4.3	6.4	10.5	13.4	15.5
	Annual	3.3	6.8	8.9	-11.8	-6.7	-3.9	20.2	23.1	25.0
Port Aux Basques	December-February	-3.7	0.1	2.2	-6.7	-2.5	-0.2	-0.8	2.7	4.6
	March-May	1.2	4.2	6.1	-1.8	1.5	3.5	4.1	7.0	8.8
	June-August	12.9	15.9	17.8	9.9	12.8	14.7	16.0	19.0	20.8
	September-November	7.5	10.4	12.4	4.5	7.5	9.7	10.4	13.2	15.2
	Annual	4.5	7.7	9.6	-6.7	-2.5	-0.2	16.0	19.0	20.8

Source: Government of NL 2019

Table 22.8 Projected IDF Precipitation Curves for Mid-century (2041-2070) Near the Project Area (mm)

Station	Duration	Return Interval (years)					
		2	5	10	25	50	100
Burgeo	1-hr	23.2	28.34	31.74	36.05	39.24	42.4
	24-hr	83.09	99.35	110.12	123.72	133.82	143.83
Deer Lake	1-hr	16.46	21.02	24.03	27.84	30.67	33.48
	24-hr	55.55	70.83	80.95	93.74	103.22	112.64
Port aux Basques	1-hr	20.18	25.57	29.14	33.65	36.99	40.31
	24-hr	76.16	94.25	106.23	121.37	132.59	143.74
Source: Government of NL 2019							

Table 22.9 Projected IDF Precipitation Curves for End of the Century (2071-2100) Near the Project Area (mm)

Station	Duration	Return Interval (years)					
		2	5	10	25	50	100
Burgeo	1-hr	25.35	31.47	35.51	40.63	44.42	48.1
	24-hr	89.9	109.23	122.03	138.2	150.2	162.11
Deer Lake	1-hr	18.31	23.78	27.39	31.96	35.35	38.72
	24-hr	61.75	80.08	92.22	107.55	118.93	130.22
Port aux Basques	1-hr	22.46	29.55	34.24	40.17	44.57	48.94
	24-hr	83.83	107.62	123.38	143.29	158.05	172.71
Source: Government of NL 2019							

A comparison of the IDF projections (Tables 22.8 and 22.9) to the historical IDF results (Table 22.5) indicates that an increase in precipitation accumulation can be expected for both 1-hour and 24-hour rainfall events at each of the assessed locations. With climate change, the frequency of intense rainfall episodes is expected to increase, with what was historically considered a 100-year storm now expected to occur in the worst-case presented, every 10 years. For example, a historical 100-year storm at Deer Lake received 85.16 mm of precipitation over a 24-hour duration, while by mid-century, a 25-year storm at Deer Lake is expected to receive 93.74 mm of precipitation over a 24-hr duration, and by end of century, a 10-year storm is expected to receive 92.22 mm of precipitation over a 24-hour duration. Although by end of the century, a 10-year storm may result in more rainfall in the Project area than what was historically considered a 100-year storm, the Project will be ending when mid-century climate change projections become applicable.

22.3.1.2 Potential Effects

Climate and climate change are important considerations in Project planning, as interactions may occur that could result in changes to schedules or cause damage to Project infrastructure. Examples of potential effects of climate change on the Project from extreme temperatures, heavy precipitation, fog, winds and storms include, although are not limited to:

- Reduced visibility and inability to maneuver construction and operation equipment
- Delays in receipt of materials and/or supplies and delays in product delivery to market
- Changes to the ability of workers to access the site (e.g., road wash out)
- Damage to infrastructure and equipment (e.g., increased structural loading)
- Loss of electrical power resulting in potential loss of production
- Additional snow clearing efforts
- Delays to construction activities
- Interruptions to Project operations

Extreme precipitation and associated surface water runoff from snowmelt, rainfall and freezing rain events have the potential to cause flooding, erosion, washout of site roads, haul roads and the access road, and overload of the Project's water management infrastructure and the TMF. These events could lead to the erosion of topsoil, the degradation of soil quality, structure and stability, changes to slope stability, the failure of erosion or sedimentation control structures and failure of Project infrastructure. These events could, in turn, result in the release of sediment to surface waterbodies, the unplanned release of contact water (assessed in Chapter 21) or a TMF malfunction (assessed in Chapter 21). Failure of a watercourse crossing could result from a precipitation or snowmelt event that exceeds the design capacity, causing the loss of channel form due to erosion, or damage to other watercourse crossings downstream (assessed in Chapter 21). In the event of access road washout, access to and from the site could be restricted, thereby delaying the transport of materials, products, and workers.

Extreme snowfall can cause delays to winter construction and winter mining operations, delays in delivery of materials and shipping of products, or delays in workers getting to site due to affected access to facilities. Construction and mining operations could be halted during an extreme snow event or ice storm if safety becomes a concern. Extreme snowfall and ice storms can also require additional effort for clearing and removal and could affect regular maintenance schedules. Any delays however are expected to be of short duration. Extreme snow and ice also have the potential to increase loadings on buildings and other Project infrastructure and result in damage if the accumulated loading exceeds design loads. Ice accumulation on power lines and associated infrastructure could cause power outages and delays to operational activities. Extreme snow and ice could also increase the risk of vehicle accidents on Project and access roads (assessed in Chapter 21), which could result in a spill of hazardous materials (assessed in Chapter 21), damage to equipment or injury to vehicle operators.

Low temperatures in the winter can result in increased ice thickness on local lakes, including Victoria Lake Reservoir where Project water intake and discharge occurs. Ice can also constrain the flow in water and effluent lines, thereby affecting water intake and effluent discharge. Very low temperatures can reduce construction material flexibility, making them more susceptible to breakage.

Reduced visibility can be caused by fog, heavy rainfalls, and extreme winds causing blowing snow, dust, or debris. Reduced visibility could make maneuvering of equipment difficult and result in possible delays to construction schedules, mining operations, material movement, and/or the receipt of equipment and supplies. The operation of equipment could be halted during heavy fog if safety is a concern; however, periods of heavy fog are expected to be of short duration and predictably occur in the early part of the day.

Droughts could reduce water levels in surrounding watersheds, such as Victoria Lake Reservoir, where the Project water intake will be located. In the event of a drought, the quantity of intake water may be reduced, which in turn could affect production levels. The assessment of raw water needs for the Project in Chapter 7 indicates that the current water supply, under normal and moderate drought conditions, is adequate for the needs of the Project, and the Project will be ending mid-century, which corresponds to the beginning of the mid-century climate change projection. However, water levels within Victoria Lake Reservoir are controlled by NL Hydro based on power supply requirements and potential flooding seasons, among other factors and there is uncertainty regarding drought-condition water levels and potential effects on mine operation.

Extreme weather events over the life of the Project could cause adverse residual effects such as schedule delays; however, these potential effects have been, and will continue to be, considered and mitigated through proactive planning, design, and scheduling.

It is expected that future climate change could result in increased temperatures, increased frequency and intensity of precipitation, an increase in the frequency and magnitude of storm events, and increased incidence of flooding and erosion in the Project area. However, the Project, including decommissioning, rehabilitation and closure, will be ending as mid-century climate change projections become applicable.

Potential effects of climate and climate change on the Project have the potential to result in damage to Project infrastructure and equipment (e.g., water control structures and dams), which could therefore result in effects to the environment (e.g., releases to surface water and fish habitat). Adverse environmental effects from the malfunction of Project infrastructure are assessed in Chapter 21.

22.3.1.3 Mitigation

To address the potential effects of climate and climate change (e.g., increased air temperature, precipitation, fog and visibility, winds and extreme weather events) on the Project, and in consideration of the potential normal and extreme conditions that might be encountered throughout the life of the Project, proactive design, materials selection, planning, and maintenance are required. For example, the access road route was selected in consideration of ease of snow clearing during winter months and construction and operation schedules will include allowances and procedures for delays due to poor weather. Furthermore, environmental management plans, including an Environmental Protection Plan, will be developed and implemented prior to the start of Project activities; these will include a Traffic Management Plan, a Water Management Plan, and an Erosion and Sediment Control Plan. Specific mitigation measures related to the management of groundwater and surface water to reduce adverse environmental effects (including erosion, flooding, infrastructure damage, runoff, sedimentation) are provided in Chapters 6 and 7. As described in Chapter 21, emergency response and spill contingency plans will be

developed under the Environmental Management System (EMS) and implemented by Marathon to facilitate responses to emergency situations. These plans will include consideration of spills and releases of hazardous substances, including tailings, effluent, petroleum products, accidents involving hazardous substances, medical emergencies, explosion and fire. Mitigation measures presented in Table 22.10 will help manage the interactions between climate / climate change and the Project.

Table 22.10 Summary of Mitigation: Weather and Climate Change

Category	Mitigation	C	O	D
Effects of the Environment on the Project – Weather and Climate Change	• The Project will be designed and constructed to meet applicable engineering codes, standards and best management practices, such as the *National Building Code of Canada, the National Fire Code of Canada,* and *the Canadian Dam Association Guidelines*. The codes and standards account for weather variables, including extreme conditions, that could affect the structural integrity of buildings and infrastructure. Designs will also consider projected climate change over the life of the Project. For example, the NBCC contains design requirements to account for extreme weather on infrastructure such as: – critical structures, piping, tanks and steel selection to prevent brittle fracture at low ambient temperatures – electrical grounding structures for lightning protection – maximum motor ambient temperature – ice and freeze protection	✓	✓	✓
	• The potential effects of extreme weather including storms, precipitation, flooding/ice jams, and drought will be considered in Project planning, design and operation and maintenance strategies, including the selection of materials and equipment, and design of components, such as water management infrastructure and the TMF. These designs will consider projected climate change conditions over the life of the Project.	✓	✓	✓
	• Marathon will regularly inspect and monitor Project infrastructure and equipment that may be impacted by the environment (in addition to its normal function) and take required action to maintain, repair and upgrade infrastructure / equipment as needed.	✓	✓	✓
	• Work activities will include allowance / procedures for delays due to poor weather.	✓	✓	✓
	• Contingency plans, including emergency back-up power for necessary operations, will be in place to manage delays, such as temporary power outages.	✓	✓	✓
	• Weather forecasts will be considered when planning construction and operation activities that may be affected by adverse conditions, such as TMF embankment raises, receipt of materials and supplies, and product deliveries, particularly deliveries of chemicals, reagents and diesel fuel. Where required, these activities will be scheduled for periods of favourable weather conditions.	✓	✓	✓
	• Weather forecasts will be regularly monitored and prior to extreme weather events, appropriate preventative measures will be taken to reduce the risk of damage to the Project. This will include site inspection by staff to secure loose items and identify other risks (for wind events), and inspection / maintenance of sediment and erosion control measures prior to and following precipitation events.	✓	✓	✓
Notes: C – Construction Activities; O – Operation Activities; D – Decommissioning, Rehabilitation and Closure Activities				

22.3.1.4 Residual Effects

To reduce the potential for damage to Project infrastructure and equipment, weather and climate effects will be considered during the planning and design of all Project phases. Routine maintenance, inspections, and monitoring will be regularly conducted to prevent deterioration of Project infrastructure and equipment, and support Project compliance with applicable design criteria, codes and standards, and to identify potential problems and promptly apply mitigation measures. Climate change projections will be incorporated into the design criteria, although the life of the Project (including the decommissioning, rehabilitation and closure phase) would be ending as mid-century climate change projections become applicable. Project delays due to poor weather will be anticipated and allowance for them will be included in the construction and operational schedules. Extreme weather conditions could also increase the potential for spills of various materials and magnitudes. Marathon's EMS, which would include emergency response plans to meet various requirements, will be comprehensive and will detail spill avoidance and response procedures to reduce the potential for adverse environmental effects on valued components (VCs) from spill events. Environmental effects from Project-related accidents and malfunctions are assessed in Chapter 21.

22.3.2 Geological Hazards

The Geological Survey of NL defines a geological disaster as one "that occurs when natural geological processes impact on our activities, either through loss of life, injury, or economic loss" (NL Department of Natural Resources [NLDNR] 2020). Geological hazards that could result in a geological disaster and require review for the Project include landslides, rockfalls, erosion, subsidence, and seismic activity. Further information on these hazards and a discussion on topographical features of the Project Area and how they relate to potential geographic hazards are found in Section 9.2.2.

22.3.2.1 Existing Conditions

Surficial Geology

Details regarding the surficial geology of the site are provided in Section 9.2.2.5. In general, the surficial geology of the Project Area may be summarized as organic soil, overlying glacial till which in turn overlies bedrock.

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. Outside the boggy areas, the organic soil layer consists of vegetative rootmat, peat and topsoil, with a combined thickness typically less than 1 m, and localized areas up to 2 m thick. Beneath the organic soils, a compact layer of glacial till ranging in thickness from <0.5 m to greater than 8 m was encountered.

The glacial till is classified as discontinuous morainal till with variable thickness (Smith 2011). Till comprises approximately 67% of mapped surficial material in the Project Area, with the remainder consisting of organic soils (boggy areas) and exposed bedrock. Till is also found underlying organic and

fluvial deposits along valley bottoms. Exploration drilling indicates the till ranges in thickness from 0.1 to 17.1 m, with an average thickness of 3.8 m (GEMTEC 2020; BSA.3, Attachment 3-D). The thickest accumulations of overburden are associated with the hummocky and blanket till deposits in the areas of the Marathon pit and waste rock pile. The thinnest areas of overburden are located within the TMF and Leprechaun pit areas.

Bedrock Geology

The bedrock geology of the site is based on descriptions by Tettelaar and Dunsworth (2016).

Within the vicinity of the Leprechaun and Marathon open pits and waste rock piles the bedrock consists of the Valentine Lake Intrusive Complex, described as an elongate zoned intrusive body of Precambrian quartz porphyry monzonite, trondhjemite, gabbro, and diorite. A well-defined northeast trending thrust fault defines the southeast margin of the complex. The Valentine Lake Intrusive Complex hosts the gold mineralization of the Project.

Underlying the TMF, plant, and accommodations camp, the bedrock consists of mixed sedimentary units and lesser gabbroic and mafic volcanic rocks of the Victoria Lake Group, comprised of Cambrian to mid-Ordovician rocks. The group consists of dark grey to black shale and siltstone containing thin, felsic, tuffaceous beds. The black shale layers transform into a mélange with felsic volcanic blocks near major faults.

The Rogerson Lake Conglomerate lies along the southeastern margin of the Valentine Lake Intrusive Complex and occurs as a narrow, elongate contact between the Valentine Lake Intrusive Complex and the Victoria Lake Group. The Rogerson Lake Conglomerate consists of Silurian-aged siliciclastic conglomerate.

Seismic Activity

The Island of Newfoundland, including the Project Area, is categorized as having a low seismic hazard by the Geological Survey of Canada (Figure 22-3). Seismic hazard maps produced by the Geological Survey of Canada indicate the probability of experiencing damaging ground motions caused by earthquakes. The Geological Survey of Canada data is used in the National Building Code to design and construct buildings that are resistant to seismic activity. While from 1985 to the present, there have been a total of 21 earthquakes on the Island of Newfoundland, none were recorded within the Project Area and all were small, ranging in magnitude from 1.9 to 2.9 (NRCAN 2020).

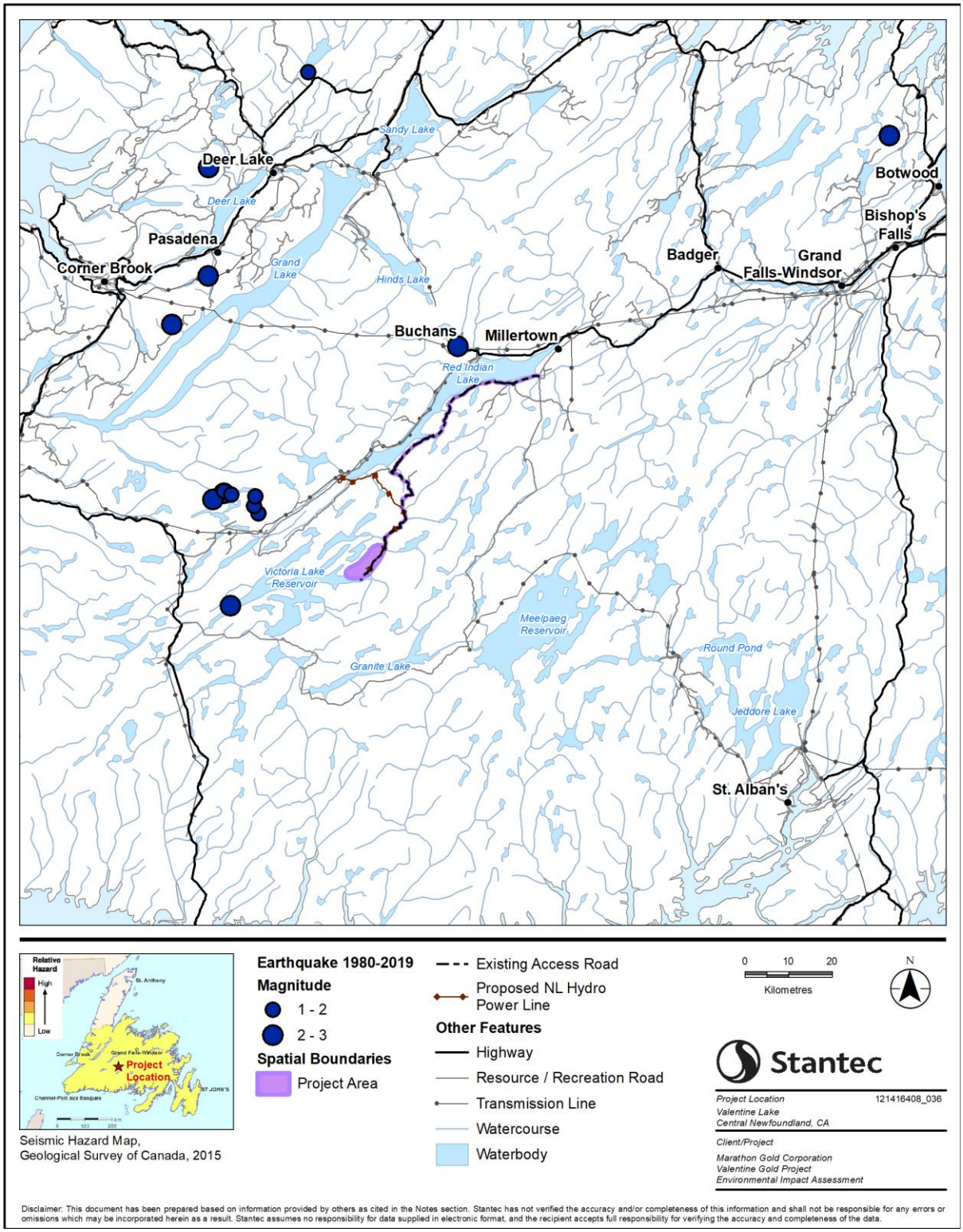

Figure 22-3 Earthquakes Recorded in Proximity to the Project

Terrain Stability (Landslides, Rockfalls, Erosion, Subsidence, and Avalanches)

Landslides are the down-slope movement of unconsolidated material (mass of rock, debris or earth) under the influence of gravity (NLDNR 2020c). Like landslides, rockfalls are the downslope movement of blocks of rock, either through free fall (where the rock breaks away and falls through the air) or by rolling. The landscape within the Project Area is gently sloping with rolling hills, with no exposed high relief bedrock ridges. The combination of site topography with the overburden and bedrock characteristics limits the potential for landslides and rockfalls. There are no recorded cases of landslides in the Project Area (NLDNR 2020c), and there is no evidence of landslide deposits in the Project Area based on spatial and field data (Stantec 2015).

The sediment cycle starts with the process of erosion, whereby particles or fragments are weathered from geological material and transported from one location to another though action by water, wind, glaciers, or plant and animal activities (ECCC 2020). Based on the soil types and topography in the Project Area, the potential for erosion-related geological hazards is low (Section 9.2.2).

Subsidence refers to sinking ground or soil due to underground material movement (National Oceanographic and Atmospheric Administration 2020). Removal of ground water, soil compaction, karstic (limestone) bedrock conditions, earthquakes, and isostatic rebound are common causes of subsidence. Based on the soil and bedrock conditions and seismic hazard within the Project Area, the risk related to subsidence is low.

Historically, there have been no recorded avalanches in the Project or surrounding areas (NLDNR 2020d), indicating that the topography is not conducive to avalanches. The risk of landslides and slope instability will be evaluated during detailed site design and engineering through a geotechnical assessment.

22.3.2.2 Potential Effects

Geological hazards have the potential to impact Project infrastructure and equipment, which could result in effects to the environment (e.g., releases to surface water and fish habitat). Adverse environmental effects from the malfunction of Project infrastructure are assessed in Chapter 21.

Seismicity

While there are no past seismic events in the immediate Project Area and the risk of adverse seismic activity in NL is low, all Project infrastructure (e.g., buildings, dams, ore, waste rock piles, and overburden stockpiles) will be designed accounting for any potential seismic event in accordance with as per the recommendations provided by the NBCC (National Research Council of Canada 2015) and the *Canadian Foundation Engineering Manual* (CANFEM; Canadian Geotechnical Society 2006).

Considering the low seismic hazard risk of the Project Area combined with the adoption of the nationally accepted design standards, the probability of a seismic event occurring in the Project Area that would have the potential to result in Project damage or interruption is low.

Terrain Stability (Landslides, Rockfalls, Erosion and Subsidence)

There is no evidence of landslides or rockfalls in the Project Area, and the probability of such an event occurring is considered low based on a review of the terrain and geological conditions.

Erosion can result in sedimentation, removal or movement of topsoil, the degradation of soil quality, structure and stability, and related adverse environmental effects. It can also damage roads, dams, water management infrastructure, and other surface infrastructure with shallow foundations. However, based on the soil types and topography in the Project Area, the potential for erosion is low (Section 22.3.1.2). Mitigation measures to reduce further concerns regarding erosion are discussed in Chapter 9.

Subsidence could cause damage to Project infrastructure or equipment by potentially causing structure collapse or power outage due to gradual or sudden changes in terrain stability. Road and underground infrastructure may also be damaged due to twisting movements during ground shifts, leading to cracks or breaks. A full description of the existing terrain conditions is presented in Section 9.2.2. The risk of subsidence in the Project Area is low due to the geological conditions in the area.

Slope failure in the open pits could occur due to unanticipated geological or hydrogeological conditions, which could cause areas around the open pit to slump into the open pit. While there is potential to affect Project operation or infrastructure, as well as the health and safety of Project workers, slope failure is anticipated to be confined to the Project Area; this is further discussed in Chapter 21.

22.3.2.3 Mitigation

Mitigation measures presented in Table 22.11 will help manage the interactions between geological hazards and the Project.

Table 22.11 Summary of Mitigation Measures: Geological Hazards

Category	Mitigation	C	O	D
Effects of the Environment on the Project – Geological Hazards	• The Project will be designed and constructed to meet applicable engineering codes, standards, and BMPs, including the NBCC and CANFEM, which provide standards of safety to account for geological hazards, including seismic activity.	✓	✓	✓
	• Water retaining structures, including dams for the TMF, will be designed, constructed, operated and closed in accordance with the recommendations provided by CDA; these guidelines also outline the minimum design criterion to account for geological hazards.	✓	✓	✓
	• Implementation of site-specific erosion and sedimentation control plans that will be developed during detailed design phase of the Project.	✓	✓	✓
	• Geotechnical investigations for all site infrastructure, open pits, and waste and ore piles will be completed prior to construction to further assess the site-specific conditions and associated risk of geological hazards; information obtained from these site-specific investigations will be used to complete the designs and meet the requirements as presented in NBCC, CANFEM and CDA.	✓	-	-
Notes: C – Construction Activities; O – Operation Activities; D – Decommissioning, Rehabilitation and Closure Activities				

22.3.2.4 Residual Effects

Consideration of and design for geological hazards reduces the potential for damage to infrastructure and equipment, and for unplanned changes to construction or operation schedules of the Project. With the use of the design standards and guidelines listed above, geological hazards are not foreseen to have any substantial adverse residual effects on the Project. In the event of an accident or malfunction, the environmental effects associated with these unplanned events, including a TMF failure or release of untreated contact water, are assessed in Chapter 21.

22.3.3 Forest Fires

22.3.3.1 Existing Conditions

Although forest fires occur in the area surrounding the Project, they are infrequent, mainly due to relatively long winters and abundant precipitation in the region (Section 22.3.1). The *Canadian National Fire Database* is a collection of forest fire data from various sources and indicates the perimeters of past forest fire locations. In total, there have been seven forest fires within 100 km of the Project site from 1986 to 2018 (Figure 22-4). The closest fire, approximately 40 km from the Project Area, occurred in 1986 along the Burgeo Highway and the most recent fire occurred in 2012 near Buchans. Forest fires caused by lightning are infrequent in NL as the occurrence of lightning is low, so most forest fires in the area are caused by people. Proper fire breaks will be considered and cleared where warranted during clearing and site layout.

22.3.3.2 Potential Effects

Forest fires could cause the following adverse effects on the Project:

- Reduced visibility due to smoke, causing difficulty in maneuvering equipment on site, or delays in the receipt and/or delivery of materials and supplies
- Health and safety concerns for personnel who inhale smoke
- Delays in schedule and subsequent loss of production
- Damage to infrastructure and/or equipment, or obstruction of roads
- Effects to site accessibility if the access road becomes impassable due to forest fire
- Explosion caused by contact of a forest fire with fuel storage tanks or explosives storage facility
- Loss of electrical power

Forest fires are distinguished from fires that could result from Project activities and spread to surrounding areas. Marathon's response to and the potential effects of Project-related fire and explosion scenarios are addressed in Chapter 21.

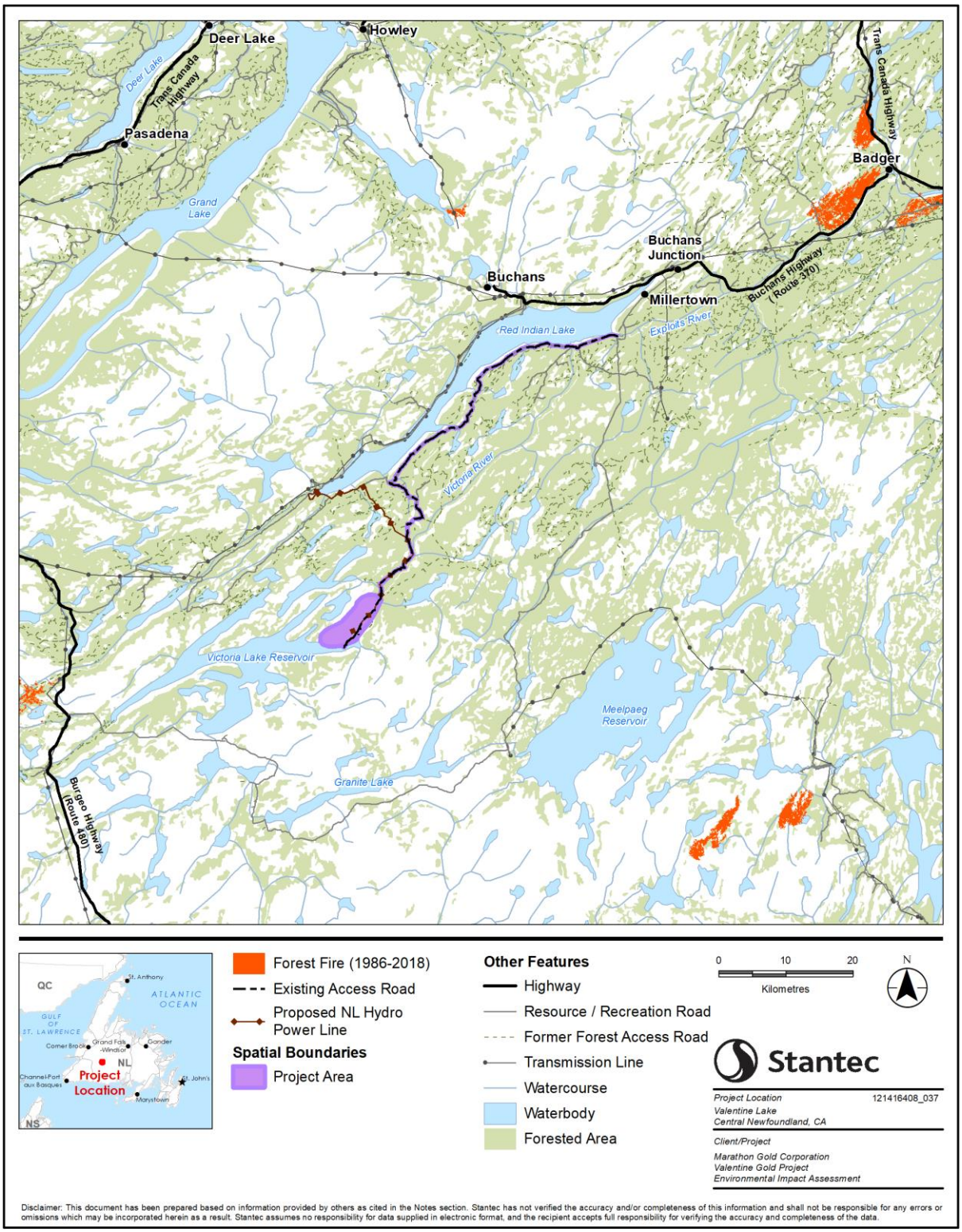

Figure 22-4 Forest Fires that have Occurred in Proximity to the Project

Potential effects of forest fires on the Project have the potential to damage Project infrastructure and equipment, which could in turn result in effects to the environment (e.g., socio-economic effects related to mine shutdown). Adverse environmental effects from the malfunction of Project infrastructure are assessed in Chapter 21.

The management, monitoring and control of forest fires in NL are the responsibility of the NL Department of Department of Fisheries, Forestry and Agriculture (NLDFFA) under the *Forestry Act*, including through the *Forest Fire Regulations*, *Forest Fire Offence and Penalty Regulations*, *Forest Fires Liability and Compensation Regulations* and annual Forest Fire Season Order. Forest fires are reported to the Provincial Forest Fire Communications Centre (or respective regional centres).

22.3.3.3 Mitigation

Mitigation measures presented in Table 22.12 will help manage the interactions between forest fires and the Project.

Table 22.12 Summary of Mitigation Measures: Forest Fires

Category	Mitigation	C	O	D
Effects of the Environment on the Project – Forest Fires	• Marathon's EMS will describe emergency response measures, training requirements, roles and responsibilities, and contact and reporting procedures in the event of a fire at or near the mine site or along the access road.	✓	✓	✓
	• Marathon will actively monitor wildfires that could affect the mine site and/or access road and coordinate with provincial authorities with respect to response, including the need for potential shutdown and evacuation of employees.	✓	✓	✓
	• On-site fire prevention and response equipment will be provided and maintained, and Marathon will have employees / teams that will be trained in safe fire response. While the purpose of this response training and equipment is to respond to fire scenarios on the mine site, NLDFFA would be responsible for response to a forest fire in the area not related to the Project.	✓	✓	✓
	• Project-related activities will be adjusted in case of a severe fire and as needed to protect the health and safety of employees.	✓	✓	✓
Notes: C – Construction Activities; O – Operation Activities; D – Decommissioning, Rehabilitation and Closure Activities				

22.3.3.4 Residual Effects

If a forest fire were to occur within the Project Area, Marathon’s emergency response plans will enable personnel to quickly mobilize, coordinate with provincial responders and implement appropriate response measures. These actions would reduce the risk to the health and safety of Project personnel and to Project infrastructure. The same fire prevention and response measures identified in Chapter 21 to respond to a fire / explosion scenario would also be applied were a forest fire to reach the mine site.

If a large forest fire were not brought under control by the NLDFFA and was to spread to the mine site, substantial damage to mine infrastructure could occur, including damage to buildings, equipment and other infrastructure. Reagents, diesel fuel and blasting material stored within the mine site would also create the risk of explosion. Damage resulting from a fire could therefore result in a substantial delay in mine production. Given the history of forest fire in the region, however, the risk of a large, uncontrolled forest fire affecting the mine site is considered low. The environmental effects of fire / explosion are assessed in Chapter 21.

22.4 SUMMARY

Potential adverse effects on the Project by the physical environment through climate normal NL weather, extreme weather events linked to climate change, geological hazards, and forest fires have been, and will continue to be, an important consideration throughout the planning and engineering stages of the Project. These potential effects will continue to be considered during the construction, operation and decommissioning, rehabilitation and closure stages. The Project will rely on design standards and proven mining methods and technologies that have been tested and proven successful in similar environments across Canada. Marathon will also follow industry standards and best practices in designing for and preventing adverse effects of the environment on the Project, reducing the potential for:

- A substantial change of the Project schedule
- A long-term interruption in Project operations
- Damage to Project infrastructure or equipment that results in a release of hazardous materials into the environment
- Damage to Project infrastructure resulting in a substantial increase in risks to the health and/or safety of Project personnel and/or the public, or substantial risks of a business interruption
- Damage to Project infrastructure resulting in repairs that could not be technically or economically implemented

The design of the Project, including the development of mitigation measures, will reduce the potential for substantial adverse effects of the environment on the Project. Adverse environmental effects from accidental events and malfunctions are assessed in Chapter 21.

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23.0 SUMMARY AND CONCLUSIONS

Marathon proposes to develop an open pit gold mine near Valentine Lake, located in the Central Region of the Island of Newfoundland, southwest of the Town of Millertown, Newfoundland and Labrador (NL). The Project will consist primarily of two open pits, waste rock piles, crushing and stockpiling areas, conventional milling and processing facilities (the mill), a tailings management facility (TMF), personnel accommodations, and supporting infrastructure including roads, on-site power lines, buildings, and water and effluent management facilities. The construction of the Project is expected to take place over a period of approximately 16 to 20 months, followed by an estimated mine operation life of 12 years. Upon the conclusion of mining, the operation will be closed, and the site components will be rehabilitated and monitored in accordance with applicable regulations at the time of closure.

This Environmental Impact Statement (EIS) has been prepared in accordance with the requirements of *Canadian Environmental Assessment Act*, *2012* (CEAA 2012) and the provincial *Environmental Protection Act* (NL EPA). The methods used to prepare this EIS have been developed in consideration of the federal requirements under the CEAA 2012 and the NL EPA, as well as by the regulatory requirements within the Federal EIS Guidelines (Appendix 1A) and Provincial EIS Guidelines (Appendix 1B).

This chapter provides a summary of the following:

- Potential Project-related effects
- Residual environmental effects, including cumulative effects and accidental events
- Mitigation, monitoring, and follow-up commitments
- Economic and social benefits of the environmental assessment (EA) and Project
- Capacity of renewable resources likely to be affected by the Project to meet present and future needs
- Comments from government, Indigenous, public, and stakeholder engagement
- Conclusions

23.1 SUMMARY OF POTENTIAL EFFECTS

The EIS includes an evaluation of the potential environmental effects for each valued component (VC) that may result from routine Project activities and potential accidental events. The EIS also includes an evaluation of potential cumulative effects, considering whether residual environmental effects of the Project could interact cumulatively with the residual environmental effects of other past, present, or future (i.e., certain or reasonably foreseeable) physical activities near the Project.

Environmental effects were assessed for the following VCs:

- Atmospheric Environment
- Groundwater Resources
- Surface Water Resources
- Fish and Fish Habitat
- Vegetation, Wetlands, Terrain and Soils

- Avifauna
- Caribou
- Other Wildlife
- Community Services and Infrastructure
- Community Health
- Employment and Economy
- Land and Resource Use
- Indigenous Groups
- Historic Resources
- Dam Infrastructure

Potential environmental effects from routine Project activities were assessed for each phase of the Project, including construction, operation and decommissioning, rehabilitation and closure. For each potential effect, the physical activities that may interact with the VC, and therefore result in an environmental effect, were identified and assessed further as summarized in Section 23.3.

23.2 SUMMARY OF RESIDUAL EFFECTS

23.2.1 Routine Project Activities

The residual environmental effects for construction, operation and decommissioning, rehabilitation and closure for each VC are presented in Chapters 5 to 19. There are no federal lands located within 45 km of the Project Area and 76 km of the mine site, therefore based on the assessment provided in Chapter 5 to 19, adverse effects to federal lands are not anticipated. Table 23.1 summarizes the residual effect findings for each VC and indicates the significance of these effects. Where an effect is predicted to be significant (refer to Chapters 5 to 19 for significance criteria for each VC), the likelihood of that effect occurring is also presented. As shown in Table 23.1, the residual environmental effects of routine Project activities are assessed to be not significant for all VCs, with the exception of caribou.

Residual effects for change in caribou habitat and mortality risk are predicted to be low in magnitude. However, the magnitude of residual effects for change in movement of caribou is assessed to be high in magnitude due to the amount of overlap of the Project with an existing migration corridor of the Buchans herd, one of four herds in the Regional Assessment Area (RAA), and the proportion of collared Buchans caribou that use the path overlapping the Project.

A significant adverse effect for caribou 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) 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. While caribou may be able to circumnavigate the Project, it is unclear what effects a deviation from a migratory corridor will have on the Buchans herd, some of which may not be realized for several years. Given these uncertainties and additional uncertainties related to the effectiveness of planned mitigation, the residual adverse effect of change in movement for the Buchans herd is conservatively predicted to be significant.

Table 23.1 Summary of Residual Effects for Routine Operations

Valued Components	Area of Federal Jurisdiction (CEAA, 2012 s.5 "environmental effect")	Potential Effect	Project Phase	Mitigation Reference	Residual Effect Characterization						Significance of Residual Effect	Likelihood of Significant Effect
					Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological/Socio-Economic Context		
Atmospheric Environment	s.5(1)(a)(iv) s.5(1)(c)(i)	Change in Air Quality	C	Refer to Section 5.4	L-M	LAA/RAA	ST	C	R	U	N	N/A
			O		M	LAA/RAA	MT	C	R	U	N	N/A
			D		L	PA	ST	R	R	U	N	N/A
		Change in Greenhouse Gas Emissions	C		L	N/A	ST	C	I	D	N	N/A
			O		M	N/A	MT	C	I	D	N	N/A
			D		N	N/A	ST	IR	I	D	N	N/A
		Change in Sound Quality	C		L	LAA/RAA	ST	C	R	U	N	N/A
			O		M	LAA/RAA	MT	C	R	U	N	N/A
			D		L	LAA/RAA	ST	R	R	U	N	N/A
		Change in Light Levels	C		L	LAA/RAA	ST	IR	R	U	N	N/A
			O		L	LAA/RAA	MT	C	R	U	N	N/A
			D		L	LAA/RAA	ST	IR	R	U	N	N/A
Groundwater Resources	s.5(1)(a)(iv) s.5(1)(c)(i)	Change in Groundwater Quantity	C	Refer to Section 6.4	L	PA	ST	C	R	U	N	N/A
			O		M	LAA/RAA	LT	C	I	U	N	N/A
			D		L	LAA/RAA	LT	C	I	U	N	N/A
		Change in Groundwater Quality	C		-	-	-	-	-	-	-	-
			O		L	LAA/RAA	LT	C	I	U	N	N/A
			D		L	LAA/RAA	LT	C	I	U	N	N/A
Surface Water Resources	s.5(1)(a)(iv) s.5(1)(c)(i) s.5(1)(c)(iii)	Change in Surface Water Quantity	C	Refer to Section 7.4	L	LAA	LT	C	R / I	U	N	N/A
			O		L	LAA	LT	C	R / I	U	N	N/A
			D		L	LAA	LT	C	R / I	U	N	N/A
		Change in Surface Water Quality	C		L	LAA	LT	C	R / I	U	N	N/A
			O		L	LAA	LT	C	R / I	U	N	N/A
			D		L	LAA	LT	C	R / I	U	N	N/A
Fish and Fish Habitat	s.5(1)(a)(i) s.5(1)(c)(i) s.5(1)(c)(iii)	Change in Fish Habitat Quantity	C	Refer to Section 8.4	M	PA	LT	C	I	D	N	N/A
			O		M	PA	LT	C	I	D	N	N/A
			D		M	PA	LT	C	I	D	N	N/A
		Change in Fish Habitat Quality	C		L	LAA	LT	C	I	D	N	N/A
			O		L	LAA	LT	C	I	D	N	N/A
			D		L	LAA	LT	C	I	D	N	N/A
		Change in Fish Health and Survival	C		L/M	LAA	LT	C	I	R	N	N/A
			O		N/L	LAA	LT	C	I	R	N	N/A
			D		L/M	LAA	LT	C	I	R	N	N/A

Table 23.1 Summary of Residual Effects for Routine Operations

Valued Components	Area of Federal Jurisdiction (CEAA, 2012 s.5 "environmental effect")	Potential Effect	Project Phase	Mitigation Reference	Residual Effect Characterization						Significance of Residual Effect	Likelihood of Significant Effect
					Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological/Socio-Economic Context		
Vegetation, Wetlands, Terrain and Soils	s.5(1)(a)(ii) s.5(1)(c)(i) s.5(1)(c)(iii)	Change in Species Diversity	C	Refer to Section 9.4	L	LAA	LT	C	R/I	D	N	N/A
			O		L	LAA	LT	C	I	D	N	N/A
			D		L	LAA	MT	C	R	D	N	N/A
		Change in Community Diversity	C		L	LAA	LT	C	I	D	N	N/A
			O		L	LAA	LT	C	I	D	N	N/A
			D		L	LAA	MT	C	R	D	N	N/A
		Change in Wetland Function	C		L	LAA	LT	C	I	D	N	N/A
			O		L	LAA	LT	C	I	D	N	N/A
			D		L	LAA	MT	C	I	D	N	N/A
		Changes in Soil Quality	C		L	LAA	LT	C	R	D	N	N/A
			O		L	LAA	LT	C	R	D	N	N/A
			D		L	LAA	LT	C	R	D	N	N/A
		Changes in Soil Quantity	C		L	PA	ST	S/IR	R/I	D	N	N/A
			O		L	PA	MT	S/IR	R/I	D	N	N/A
			D		L	LAA	LT	S/IR	R/I	D	N	N/A
		Changes in Terrain (unique landforms)	C		L	LAA	LT	C	I	D	N	N/A
			O		L	LAA	LT	C	I	D	N	N/A
			D		L	LAA	LT	C	I	D	N	N/A
		Changes in Terrain Stability	C		L	LAA	LT	IR	R	D	N	N/A
			O		L	LAA	LT	IR	R	D	N	N/A
			D		L	LAA	LT	IR	R	D	N	N/A
Avifauna	s.5(1)(a)(iii) s.5(1)(c)(i) s.5(1)(c)(iii)	Change in Habitat	C	Refer to Section 10.4	L-M	LAA	LT	C	I	D	N	N/A
			O		L-M	LAA	MT	C	R	D	N	N/A
			D		L-M	LAA	MT	C	R	D	N	N/A
		Change in Mortality Risk	C		L	LAA	ST	IR	R	D	N	N/A
			O		L	LAA	MT	IR	R	D	N	N/A
			D		L	LAA	MT	IR	R	D	N	N/A
Caribou	s.5(1)(a)(iv) s.5(1)(c)(i) s.5(1)(c)(iii)	Change in Habitat	C	Refer to Section 11.4	L	RAA	LT	C	I	D	N	N/A
			O		L	RAA	LT	C	I	D	N	N/A
			D		L	RAA	LT	C	I	D	N	N/A
		Change in Movement	C		H	RAA	LT	C	I	D	S	L
			O		H	RAA	LT	C	I	D	S	L
			D		H	RAA	LT	C	I	D	S	L
		Change in Mortality Risk	C		L	RAA	MT	IR	R	D	N	N/A
			O		L	RAA	MT	IR	R	D	N	N/A
			D		L	RAA	ST	IR	R	D	N	N/A

Table 23.1 Summary of Residual Effects for Routine Operations

Valued Components	Area of Federal Jurisdiction (CEAA, 2012 s.5 "environmental effect")	Potential Effect	Project Phase	Mitigation Reference	Residual Effect Characterization						Significance of Residual Effect	Likelihood of Significant Effect
					Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological/Socio-Economic Context		
Other Wildlife	s.5(1)(a)(iv) s.5(1)(c)(i) s.5(1)(c)(iii)	Change in Habitat	C	Refer to Section 12.4	L-M	LAA	LT	C	I/R	D	N	N/A
			O		L-M	LAA	LT	C	R	D	N	N/A
			D		L-M	LAA	LT	C	R	D	N	N/A
		Change in Mortality Risk	C		L	PA	MT	IR	R	D	N	N/A
			O		L	PA	MT	IR	R	D	N	N/A
			D		L-N	PA	ST	IR	R	D	N	N/A
Community Services and Infrastructure	s.5(1)(a)(iv) s.5(1)(c)(i)	Change in Local Housing and Accommodation	C	Refer to Section 13.4	N	LAA/RAA	ST	C	R	R	N	N/A
			O		N	LAA/RAA	MT	C	R	R	N	N/A
			D		N	LAA/RAA	ST	C	R	R	N	N/A
		Change in Local Services and Infrastructure	C		L	LAA/RAA	ST	C	R	R	N	N/A
			O		L	LAA/RAA	MT	C	R	R	N	N/A
			D		L	LAA/RAA	ST	C	R	R	N	N/A
Community Health	s.5(1)(a)(iv) s.5(1)(c)(i)	Change in Community Well-Being	C	Refer to Section 14.4	L	LAA/RAA	ST	C	R	R	N	N/A
			O		L	LAA/RAA	MT	C	R	R	N	N/A
			D		L	LAA/RAA	ST	C	R	R	N	N/A
		Change in Physical Health Conditions	C		N-L	PA/LAA	ST-MT	C	R	D	N	N/A
			O		N-L	PA/LAA	ST-MT	C	R	D	N	N/A
			D		N-L	PA/LAA	ST-MT	C	R	D	N	N/A
Employment and Economy	s.5(1)(a)(iv) s.5(1)(c)(i)	Change in Regional Labour Force	C	Refer to Section 15.4	H*	LAA/RAA	ST	C	R	R	N	N/A
			O		H*	LAA/RAA	MT	C	R	R	N	N/A
			D		M	LAA/RAA	ST	C	I	R	N	N/A
		Change in Regional Business	C		L	LAA/RAA	ST	C	R	R	N	N/A
			O		L	LAA/RAA	MT	C	R	R	N	N/A
			D		L	LAA/RAA	ST	C	I	R	N	N/A
		Change in Economic Activity of Outfitters	C		N-L	LAA	ST	C	R	R	N	N/A
			O		N-L	LAA	LT	C	R	R	N	N/A
			D		N-L	LAA	LT	C	R	R	N	N/A
		Change in Economy	C		L*	LAA/RAA	ST	C	R	R	N	N/A
			O		M*	LAA/RAA	MT	C	R	R	N	N/A
			D		L*	LAA/RAA	ST	C	R	R	N	N/A

Table 23.1 Summary of Residual Effects for Routine Operations

Valued Components	Area of Federal Jurisdiction (CEAA, 2012 s.5 "environmental effect")	Potential Effect	Project Phase	Mitigation Reference	Residual Effect Characterization						Significance of Residual Effect	Likelihood of Significant Effect
					Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological/Socio-Economic Context		
Land and Resource Use	s.5(1)(a)(iv)	Change in Land Use	C	Refer to Section 16.4	L	PA/LAA	ST	IR	R	R	N	N/A
			O		L	PA/LAA	MT-P	C	R / IR	R	N	N/A
			D		L	PA/LAA	ST	IR	R / IR	R	N	N/A
		Change in Resource Use	C		N-L	PA/LAA	ST	IR	R	R	N	N/A
			O		N-L	PA/LAA	MT-P	C	R / IR	R	N	N/A
			D		N-L	PA/LAA	ST	IR	R / IR	R	N	N/A
		Change in Recreational Use	C		N-L	PA/LAA	ST	IR	R	R	N	N/A
			O		N-L	PA/LAA	MT-P	C	R / IR	R	N	N/A
			D		N-L	PA/LAA	ST	IR	R / IR	R	N	N/A
Indigenous Groups	s.5(1)(c)	Change in Current Use	C	Refer to Section 17.4	N-L	PA / LAA	ST	IR / C	R	R	N	N/A
			O		N-L	PA / LAA	ST-P	IR / C	R / IR	R	N	N/A
			D		N-L	PA / LAA	ST-P	IR / C	R / IR	R	N	N/A
		Change in Health Conditions	C		N-L	PA / LAA	ST	C	R	R	N	N/A
			O		N-L	PA / LAA	ST-MT	C	R	R	N	N/A
			D		N-L	PA / LAA	ST-MT	C	R	R	N	N/A
		Change in Socio-economic conditions	C		N-L	PA / RAA	ST	IR / C	R	R	N	N/A
			O		N-L	PA / LAA	ST-MT	C	R	R	N	N/A
			D		N-L	PA / RAA	ST-P	IR / C	R / IR	R	N	N/A
		Change to Physical and Cultural Heritage (inside Project footprint)	C		N-L	PA / RAA	ST-P	IR / C	R / IR	R	N	N/A
			O		N-H	PA	ST-P	S	R / IR	R	N	N/A
			D		-	-	-	-	-	-	-	-
		Change to Physical and Cultural Heritage (outside Project footprint)	C		-	-	-	-	-	-	-	-
			O		N-L	PA / LAA	ST	IR / C	R	R	N	N/A
			D		N-L	PA / LAA	ST-P	IR / C	R / IR	R	N	N/A
Historic Resources	s.5(1)(c)(ii)	Loss or Disturbance of Historic Resources	C	Refer to Section 18.4	N-L	PA / LAA	ST-P	IR / C	R / IR	R	N	N/A
			O		N-L	PA	P	S	I	U/D	N	N/A
			D		N-L	PA	P	S	I	U/D	N	N/A
Dam Infrastructure	s.5(1)(c)(i)	Change in Surface Water Quantity	C	Refer to Section 19.4	-	-	-	-	-	-	-	-
			O		N	LAA	LT	C	R	U	N	N/A
			D		N	LAA	LT	C	R	U	N	N/A
		Change in Surface Water Quality	C		N	LAA	LT	C	R	U	N	N/A
			O		N	LAA	LT	C	R	U	N	N/A
			D		N	LAA	LT	C	R	U	N	N/A
		Change in Dam Stability	C		N	LAA	LT	C	R	U	N	N/A
			O		N	LAA	LT	R	R	U	N	N/A
			D		N	LAA	LT	R	R	U	N	N/A
					N	LAA	LT	R	R	U	N	N/A

Table 23.1 Summary of Residual Effects for Routine Operations

Valued Components	Area of Federal Jurisdiction (CEAA, 2012 s.5 "environmental effect")	Potential Effect	Project Phase	Mitigation Reference	Residual Effect Characterization						Significance of Residual Effect	Likelihood of Significant Effect
					Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological/Socio-Economic Context		
					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	**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 R: Resilient N: Not resilient	**Significance:** S: Significant N: Not Significant	**Likelihood:** U: Unlikely L: Likely N/A: Not applicable

Key/Note:

* Indicates a positive effect

VC specific definitions included for each VC in Chapters 5-19.

Environmental Effects under CEAA 2012:

5(1)

(a) a change that may be caused to the following components of the environment that are within the legislative authority of Parliament:
- (i) fish as defined in section 2 of the *Fisheries Act*,
- (ii) aquatic species as defined in subsection 2(1) of the *Species at Risk Act*,
- (iii) migratory birds as defined in subsection 2(1) of the *Migratory Birds Convention Act*, 1994, and
- (iv) any other component of the environment that is set out in Schedule 2 of [CEAA 2012];

(b) a change that may be caused to the environment that would occur
- (i) on federal lands,
- (ii) in a province other than the one in which the act or thing is done or where the physical activity, the designated project or the project is being carried out, or
- (iii) outside Canada; and

(c) with respect to Aboriginal peoples, an effect occurring in Canada of any change that may be caused to the environment on
- (i) health and socio-economic conditions,
- (ii) physical and cultural heritage,
- (iii) the current use of lands and resources for traditional purposes, or
- (iv) any structure, site or thing that is of historical, archaeological, paleontological or architectural significance.

Certain additional environmental effects must be considered under section 5(2) of CEAA 2012 where the carrying out of the physical activity, the designated project, or the project requires a federal authority to exercise a power or perform a duty or function conferred on it under any Act of Parliament other than CEAA 2012.

5(2)

(a) a change, other than those referred to in paragraphs (1)(a) and (b), that may be caused to the environment and that is directly linked or necessarily incidental to a federal authority's exercise of a power or performance of a duty or function that would permit the carrying out, in whole or in part, of the physical activity, the designated project or the project; and

(b) an effect, other than those referred to in paragraph (1)(c), of any change referred to in paragraph (a) on
- (i) health and socio-economic conditions,
- (ii) physical and cultural heritage, or any structure, site or thing that is of historical, archaeological, paleontological or architectural significance.

23.2.2 Cumulative Effects

Residual adverse effects from Project activities may combine with other mining projects; exploration activities; forestry; hunting, outfitting, trapping, and/or fishing; off-road vehicles; hydroelectric development; and linear features (e.g., power lines) to result in cumulative environmental effects. With the exception of caribou, the VCs are not anticipated to experience adverse effects that would contribute cumulatively to significant residual effects. As summarized in Section 23.2.1, the Project is conservatively predicted to result in significant adverse effects on caribou, specifically related to change in movement for the Buchans herd. Future activities associated with other projects are expected to combine with potential Project effects contributing to the predicted high magnitude effect on movement of the Buchans herd, as described in Chapter 11, and may measurably affect the abundance and/or sustainability of the Buchans herd in the RAA.

VC-specific mitigation and management measures have been identified in Chapters 5 to 19 and will be applied during Project activities to reduce and/or avoid adverse environmental effects resulting from the Project. It is assumed that other projects and activities in the RAA, including future projects and activities, will also be required to comply with various mitigation measures and regulatory requirements, therefore also reducing cumulative effects. No additional or revised monitoring or follow-up is required or proposed specifically for potential cumulative environmental effects beyond the mitigation and monitoring proposed for the Project and those assumed to implemented as part of the regular course of operations for other projects and activities.

23.2.3 Accidental Events

In accordance with section 7.6.1 of the Federal EIS Guidelines (Appendix 1A) and section 4.1.6.2 of the Provincial EIS Guidelines (Appendix 1B), this EIS assesses environmental effects of accidents or malfunctions that may occur as a result of the Project. Accidents and malfunctions were assessed using the approach outlined in Section 21.1 and the same spatial boundaries, residual effects criteria, and methods and thresholds for determining significance as were used for the assessment of environmental effects resulting from routine Project activities. The following potential accidents or malfunction scenarios have been identified as having the potential to occur during the Project:

- TMF Malfunction
- Open Pit Slope Failure
- Low-Grade Ore and High-Grade Ore Stockpiles and Waste Rock Piles Slope Failure
- Fuel and Hazardous Materials Spill
- Unplanned Release of Contact Water
- Sewage Treatment Plant Failure
- Over Blasting
- Fire / Explosion
- Vehicle Accident
- Watercourse Crossing Failure

Of the potential accidental event scenarios listed above, four – Open Pit Slope Failure; Sewage Treatment Plant Failure; Over Blasting; and Watercourse Crossing Failure – were not assessed further for the reasons described in Chapter 21, primarily pertaining to their limited ability to interact with the identified VCs. For the remaining identified incidents, potential effects and key mitigation measures are summarized in Table 23.2.

Table 23.2 Summary of Potential Effects and Mitigation Measures for Accidents and Malfunctions

Accident / Malfunction	Summary of Potential Adverse Effects	Key Mitigation / Project Design
TMF Malfunction	In the event of a dam failure, tailings and tailings effluent would be released to the environment, affecting nearby waterbodies. Tailing solids could also be deposited along low-lying areas extending from the breach location, potentially causing localized infilling of vegetated areas and waterbodies. Adverse effects to vegetated areas and waterbodies could result in adverse effects to fish, wildlife, and resource users. There is also potential for impacts to infrastructure and human health and safety.	• Designed, constructed, operated and closed in accordance with the Canadian Dam Association (CDA), Global Industry Standards on Tailings Management, and Mining Association of Canada (MAC) guidelines, as well as applicable provincial requirements
Overburden, LGO, HGO, and Waste Rock Piles Slope Failure	There is the potential for the release of contaminants or contact water into surface water and fish habitat.	• Progressive rehabilitation • Incorporation of appropriate geotechnical design parameters (based on investigations) and factors of safety, and proper construction
Fuel and Hazardous Materials Spill	A large spill may contaminate soil, groundwater and surface water, thereby potentially adversely affecting the quality of fish and fish habitat, and vegetated habitat, and resulting in the ingestion/uptake of contaminants by wildlife and affect access to these resources by Indigenous and non-Indigenous users.	• Meet or exceed federal and provincial regulations including federal *Sulphur in Diesel Fuel Regulations*, and provincial *Storage and Handling of Gasoline and Associated Products Regulations* • Transportation of hazardous materials will be conducted in compliance with the federal *Transportation of Dangerous Goods Act* • Marathon will regularly inspect and monitor Project infrastructure and equipment and take required action to maintain, repair and upgrade infrastructure / equipment as needed
Unplanned Release of Contact Water	Given that water management infrastructure is located throughout the Project Area, including near waterbodies, an unplanned release of contact water to the environment has the potential to adversely affect groundwater, surface water quality, fish and fish habitat, vegetation and wetlands.	• Water management infrastructure for the Project is designed to reduce operational risks and environmental impacts and the system will be monitored and maintained over life of Project

Table 23.2 Summary of Potential Effects and Mitigation Measures for Accidents and Malfunctions

Accident / Malfunction	Summary of Potential Adverse Effects	Key Mitigation / Project Design
Fire / Explosions	A fire could result in release of emissions to the atmosphere, affect surface water quality and fish habitat, affect forests and wildlife habitat adjacent to the Project Area, and restrict the ability of land in the surrounding area to support Indigenous and non-Indigenous resource users. There is also risk to human health and safety. Fires arising from other causes and potentially affecting the Project are assessed as an Effect of the Environment on the Project (Chapter 22).	• Fire and explosion prevention measures, including on-site equipment and trained personnel • Emergency Response Plans will be developed, including emergency response measures, training, responsibilities, response equipment and materials, and contact and reporting procedures
Vehicle Accident	A vehicle collision could adversely affect wildlife and human health and safety. Potential effects resulting from a spill from a vehicle accident are discussed in the assessment of a fuel or hazardous material spill. Potential adverse effects caused by vehicle collisions with wildlife are assessed in Avifauna, Caribou and Other Wildlife Chapters (Sections 10.5, 11.5 and 12.5, respectively).	• Marathon will develop and implement a Traffic Management Plan to manage transportation of workers and materials to site, product leaving site, and the number of vehicles accessing the site • Traffic safety measures will be implemented to reduce the potential for vehicle malfunctions or accidents

Marathon's environmental management policy is based on evolving best-practice standards for environmental performance in the mining industry. Marathon's approach to preventing accidents and emergency response planning is built on the same principles. Marathon understands the importance of preventing accidents and planning for emergencies before they occur. Regarding accident prevention, Marathon will achieve this using the following framework:

- Review the individual steps involved in Project construction, operation and decommissioning, rehabilitation and closure activities prior to the start of each Phase
- Analyze each step in the process to verify and update, if needed, the accident scenarios identified in this assessment of accidental events
- Review available best practice documents for each potential accident scenario
- Prepare site-specific accident prevention and emergency response plans with tactical plans, to be maintained on-site, and reviewed annually

While accident scenarios can be identified in advance and best practices can be in place to reduce the potential for occurrence, Marathon will also undertake the following steps and measures to be ready should an accident or emergency occur:

- Adopt an incident command system (ICS)
- Conduct annual emergency response exercises under the ICS system, including annual refresher training for key response personnel

- Review the potential accident scenarios annually and update as required with new best practices or newly identified potential accident scenarios, as applicable
- Maintain on site the supplies required to respond to the potential accident scenarios which will be identified in the emergency response plans

During an emergency, Marathon's hierarchy of key priorities and objectives is as follows:

- People – protect human life including Marathon employees and in the surrounding communities
- Environment – reduce harm to the environment
- Property – protect Marathon property and assets and respond to reduce additional negative impacts
- Business – facilitate business continuity

As indicated above, in the event of an accident or malfunction, emergency response procedures (Section 21.3) will be implemented to reduce adverse effects to the environment. Environmental management plans applicable to the Project are listed in Section 2.7.3. Residual adverse effects from accidents or malfunctions are characterized in Section 21.5.

In the unlikely event of a major industrial accident or malfunction which results in a large-scale release into the environment, there is a potential for significant residual adverse effects to VCs (Table 23.3). A significant effect may also occur in the unlikely event of a worst-case major accident resulting in a loss of life (e.g., vehicle accident or TMF failure). However, the risk of a significant effect occurring is low given the Project design and safety measures in place to reduce the likelihood of an accident or malfunction, and the emergency response plans and contingency measures that will be in place to limit the extent and nature of potential environmental effects in the event of an accident or malfunction. For minor incidents with a higher likelihood of occurrence (e.g., small hydrocarbon spills from equipment), the residual effects are not likely to be significant, as these will be contained within the mine site and readily cleaned up. The prediction of significant adverse effects for the VCs identified in Table 23.3 also assumes worst-case scenarios for the events assessed. However, the risk of a significant effect occurring is low (or very low), given the Project design and safety measures that will be in place to reduce the likelihood of an accident or malfunction.

Table 23.3 Summary of Significance Determinations

VC Name	Accident or Malfunction Scenario					
	TMF Malfunction	**Slope Failure**	**Fuel and Hazardous Material Spills**	**Unplanned Release of Contact Water**	**Fire / Explosion**	**Vehicle Accident**
Atmospheric Environment	NS	NS	NS	NS	NS	NS
Groundwater Resources	NS	NS	NS	NS	NS	NS
Surface Water Resources	S*	NS	NS	NS	NS	NS
Fish and Fish Habitat	S*	NS	NS	NS	NS	NS
Vegetation, Wetlands, Terrain and Soils	NS	NS	NS	NS	NS	NS
Avifauna	NS	NS	NS	NS	NS	NS
Caribou	S*	NS	NS	NS	S*	NS

Table 23.3 Summary of Significance Determinations

VC Name	Accident or Malfunction Scenario					
	TMF Malfunction	Slope Failure	Fuel and Hazardous Material Spills	Unplanned Release of Contact Water	Fire / Explosion	Vehicle Accident
Other Wildlife	NS	NS	NS	NS	NS	NS
Community Services and Infrastructure	NS	NS	NS	NS	NS	NS
Community Health	S*	NS	NS	NS	NS	S*
Employment and Economy	NS	NS	NS	NS	NS	NS
Land and Resource Use	NS	NS	NS	NS	NS	NS
Indigenous Groups	NS	NS	NS	NS	NS	NS
Historic Resources	NS	NS	NS	NS	NS	NS
Dam Infrastructure	NS	NS	NS	NS	NS	NS

Note:
*Unlikely to occur

23.3 SUMMARY OF COMMITMENTS

23.3.1 Summary of Mitigation Measures

Many of the potential adverse environmental effects identified in this EIS can be managed effectively with standard operating procedures and standard mitigation measures. Mitigation measures proposed to reduce or eliminate potential adverse effects as a result of the Project are found in Table 23.4. Each VC assessment describes how the mitigation measures will reduce or eliminate potential adverse effects on the VC. Marathon will implement and adhere to relevant environmental mitigation requirements outlined in applicable legislation and regulations, including commitments made in this EIS, and eventually required as enforceable conditions of an environmental assessment (EA) approval.

Table 23.4 Summary of Mitigation Measures

Category	Mitigation	C	O	D	EIS Section Reference
Site Clearing, Site Preparation and Erosion and Sediment Control	• Project footprint and disturbed areas will be limited to the extent practicable.	✓	-	-	• Section 6.4 • Section 7.4 • Section 8.4 • Section 9.4 • Section 10.4 • Section 11.4 • Section 12.4 • Section 16.4 • Section 17.4
	• The boundaries of areas to be cleared will be well marked prior to the start of clearing activities.	✓	-	-	• Section 9.4
	• 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.	✓	-	-	• Section 9.4 • Section 10.4 • Section 12.4
	• Existing riparian vegetation will be maintained to the extent practicable.	✓	-	-	• Section 9.4 • Section 10.4 • Section 12.4
	• Vegetation will be maintained around high activity areas to the extent practicable, to act as a buffer to reduce sensory (light and noise) disturbance.	✓	-	-	• Section 9.4 • Section 11.4 • Section 12.4
	• 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.	✓	-	-	• Section 9.4
	• Vegetation will be removed from development areas in accordance with cutting permits.	✓	-	-	• Section 9.4
	• 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).	✓	-	-	• Section 8.4 • Section 9.4
	• 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.	✓	-	-	• Section 7.4 • Section 8.4 • Section 9.4
	• 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.	✓	-	-	• Section 9.4
	• 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	✓	-	-	• Section 9.4

Table 23.4 Summary of Mitigation Measures

Category	Mitigation	C	O	D	EIS Section Reference
	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.	✓	-	-	• Section 9.4
	• 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.	✓	-	-	• Section 8.4
	• Merchantable timber will be salvaged and used, or it will be made available to local communities for fuelwood.	✓	-	-	• Section 9.4 • Section 16.4
	• Construction materials (soils and rock) will not be sourced from locations known to contain invasive plant species.	✓	-	-	• Section 9.4
	• 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.	✓	-	-	• Section 9.4 • Section 10.4 • Section 12.4
	• 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.	✓	-	-	• Section 9.4
	• Grading will be directed away from wetlands, where possible, and will be reduced within wetland boundaries unless required for site specific purposes.	✓	-	-	• Section 9.4
	• Ground level cutting / mowing / mulching of wetland vegetation will be conducted instead of grubbing, where practicable.	✓	-	-	• Section 9.4
	• 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	✓	-	-	• Section 9.4
	• 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.	✓	✓	-	• Section 8.4 • Section 9.4

Table 23.4 Summary of Mitigation Measures

Category	Mitigation	C	O	D	EIS Section Reference
	• Signage will be installed around the mine site to alert the public and land users of the presence of the Project and its facilities.	✓	✓	✓	• Section 16.4 • Section 17.4
	• Movement of equipment / vehicles will be restricted to defined work areas and roads, and specified corridors between work areas.	✓	✓	✓	• Section 8.4 • Section 9.4
	• 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.	✓	✓	✓	• Section 9.4
	• 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.	✓	✓	-	• Section 9.4
Soil Management	• During excavation, organic and mineral topsoil will be separated from cleared trees and brush and stored for future use during rehabilitation.	✓	-	-	• Section 9.4
	• Care will be taken to reduce topsoil and subsoil mixing during excavation.	✓	-	-	• Section 9.4
	• 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.	✓	-	-	• Section 9.4
	• Organic and mineral topsoil will be stored and kept separate from subsoil or rock material used for construction.	✓	✓	-	• Section 9.4
	• 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.	✓	✓	-	• Section 8.4 • Section 9.4
	• Topsoil and organics will be stored in stable piles to decrease compaction effects.	✓	✓	-	• Section 9.4
	• 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.	✓	✓	-	• Section 9.4
	• Longer term stockpiles will be seeded to reduce erosion due to wind and precipitation.	✓	✓	-	• Section 9.4
	• Marathon will develop and implement a soil 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.	✓	✓	✓	• Section 9.4
	• 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 waterbodies. Sediment control fences will be inspected and maintained over the	✓	✓	✓	• Section 6.4 • Section 8.4 • Section 9.4

Table 23.4 Summary of Mitigation Measures

Category	Mitigation	C	O	D	EIS Section Reference
	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.				
Works In or Near Fish Habitat	• In-water work will be planned to respect DFO timing windows to protect fish in Newfoundland and Labrador.	✓	-	-	• Section 8.4
	• 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.	✓	-	-	• Section 8.4
	• Waste material (i.e., organic waste material, waste rock or construction debris) material will be stabilized or contained.	✓	✓	✓	• Section 8.4
	• 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.	✓	-	✓	• Section 8.4
	• 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.	✓	-	-	• Section 8.4
	• 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.	✓	-	-	• Section 8.4
	• Use of explosives in or near water will be avoided, however, if required, will follow DFO blasting guidelines.	✓	-	-	• Section 8.4
	• 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.	✓	-	-	• Section 8.4
	• Fish screens and/or other barriers will be installed and maintained to prevent fish from entering water withdrawal intakes.	✓	✓	✓	• Section 8.4

Table 23.4 Summary of Mitigation Measures

Category	Mitigation	C	O	D	EIS Section Reference
Blasting	• The explosives storage and production facilities will meet government regulations including required separation distances as regulated by the Explosives Regulatory Division of Natural Resources Canada (NRCAN). All explosives and accessories will be stored at the planned NRCAN approved magazine site and explosive storage facility.	✓	✓	-	• Section 21
	• Best practices from Blaster's Handbook (ISEE 2016) and Environmental Code of Practice for Metal Mines (ECCC 2009) will be followed to reduce and monitor noise emissions during blasting.	✓	✓	-	• Section 5.4
	• An Explosives and Blasting Management Plan will be developed by Marathon and its selected, licenced blasting contractor(s) to provide direction for the safe storage, handling and use of explosives and explosive components at the Project site, to address the safety of the public and Project personnel, and protection of both the environment, Project components and the Victoria Dam. The Explosives and Blasting Management Plan will include requirements for Blast Design vibration limits and seismic monitoring for blasting activities.	✓	✓	-	• Section 19.4 • Section 20
	• Blasting activities will be included under a contract service agreement with the explosives supplier and who will have a valid blasters certificate issued by the NL Department of Environment, Climate Change and Municipalities (NLDECCM).	✓	✓	-	• Section 19.4
	• Blasting activities will be limited to only those areas required to achieve foundation grades for site development or open pit pioneering.	✓	-	-	• Section 19.4
	• Blasting for site development will be done by a certified blasting contractor who will develop a conservative Blast Design for engineering review and approval prior to carrying out the work. The Blast Design will be required to meet strict seismic (vibrational) limits at appropriate distances from any existing structures (Victoria Dam), developing infrastructure, and fish habitat.	✓	✓	-	• Section 19.4
	• Engagement with NL Hydro regarding blasting requirements, timing, vibration thresholds and monitoring	✓	✓	-	• Section 19.4
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.	✓	✓	✓	• Section 5.4 • Section 8.4 • Section 9.4 • Section 10.4

Table 23.4 Summary of Mitigation Measures

Category	Mitigation	C	O	D	EIS Section Reference
	• During dry periods, water will be applied to the access road, site roads and haul roads as needed to mitigate dust emissions. The application of water will be limited to non-freezing temperatures to avoid icing that can present a safety hazard. Watering is most effective immediately after application, and repeated watering several times a day might be required, depending on surface and meteorological conditions. Water used for dust suppression will be sourced from site contact water, not natural waterbodies.	✓	✓	✓	• Section 5.4
	• The application of dust suppressants other than water to roads as an alternative option to watering will be considered in consultation with NLDECCM. Dust suppression would be applied on an as-needed basis during high wind conditions or if measured ambient particulate matter (PM) concentrations are in exceedance of the Newfoundland and Labrador Ambient Air Quality Standards, and if an increase of watering is determined ineffective or unfeasible at the time. The chosen dust suppressant will be approved by the NLDECCM prior to application. These suppressants, if required, will be applied, as per the manufacturer's recommendations.	✓	✓	✓	• Section 5.4
	• Ambient air quality and noise monitoring programs will be implemented throughout the life of the Project, as required and in accordance with Project permitting and conditions of approval.	✓	✓	✓	• Section 5.4
	• When loading stockpiles, drop heights will be reduced to be as close to the pile as possible.	✓	✓	-	• Section 5.4
	• Surfaces of topsoil and overburden stockpiles will be stabilized during extended periods between usage by means of vegetating or covering the exposed surfaces.	✓	✓	-	• Section 5.4 • Section 9.4
	• Conveyors will be covered to reduce fugitive dust emissions.	-	✓	-	• Section 5.4
	• Select exhaust sources will be equipped with emission control technologies to reduce contaminant emissions. Exhaust controls are listed as follows: – Lime silo: baghouse – Sodium cyanide mix tank: dust collector – Copper sulphate storage tank: dust collector – Sodium metabisulphate mix tank: dust collector – PAX storage tank: baghouse – Lime mix/storage: baghouse – Elution electrowinning: mist eliminator – ICU Electrowinning: mist eliminator – Barring furnace: baghouse – Carbon regeneration kiln: scrubber	-	✓	-	• Section 5.4

Table 23.4 Summary of Mitigation Measures

Category	Mitigation	C	O	D	EIS Section Reference
	• A Greenhouse Gas Management Plan will be created to manage Project GHG emissions, and outline and track the effectiveness of mitigation measures, including follow-up and monitoring activities. Additional details are provided in Chapter 5.	✓	✓	✓	• Section 5.4
Vehicles / Equipment / Roads	• Engines and exhaust systems of construction and mining equipment will be subject to a comprehensive equipment preventative maintenance program to maintain fuel efficiency and performance. To reduce emissions, equipment and vehicle idling times, and cold starts will be reduced to the extent possible. Marathon will develop an idling policy to this effect	✓	✓	✓	• Section 5.4
	• Vehicles and heavy equipment will be maintained in good working order and will be equipped with appropriate mufflers to reduce noise.	✓	✓	✓	• Section 5.4 • Section 10.4 • Section 11.4 • Section 12.4
	• Haul roads and infrastructure will be designed to reduce transportation and haul distances where possible.	✓	✓	-	• Section 5.4
	• 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.	✓	✓	✓	• Section 7.4 • Section 8.4 • Section 9.4
	• 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.	✓	✓	✓	• Section 9.4 • Section 10.4 • Section 11.4
	• 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.	✓	✓	✓	• Section 5.4 • Section 10.4 • Section 11.4 • Section 12.4
	• 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	✓	✓	✓	• Section 11.4 • Section 12.4

Table 23.4 Summary of Mitigation Measures

Category	Mitigation	C	O	D	EIS Section Reference
	• Project-related air traffic (helicopter, airplane) will maintain a minimum ferrying altitude of 500 m to the extent feasible.	✓	✓	✓	• Section 11.4 • Section 12.4
	• 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.	✓	✓	✓	• Section 10.4 • Section 11.4 • Section 13.4
	• 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.	✓	✓	✓	• Section 10.4 • Section 11.4 • Section 12.4 • Section 16.4 • Section 17.4
	• Project vehicles will be driven by trained and competent drivers who will use approved routes.	✓	✓	✓	• Section 21.5.6
	• Driving safety will be a part of the employee orientation program.	✓	✓	✓	• Section 21.5.6
	• Highway laws will be obeyed, including seasonal weight restrictions, speed limits, traffic signage and requirements for permit for oversized loads.	✓	✓	✓	• Section 21.5.6
	• Project vehicles will be manually inspected on a regular schedule to confirm serviceability	✓	✓	✓	• Section 21.5.6
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.	✓	✓	✓	• Section 5.4 • Section 10.4 • Section 11.4 • Section 12.4
	• Lighting will be located so that the lights are not directed toward oncoming traffic on nearby roads on or off site because of the objectionable nuisance and safety hazard this may present.	✓	✓	✓	• Section 5.4
	• Lights will be designed to avoid excessive use of mobile flood lighting units and will be turned off when they are not required.	✓	✓	✓	• Section 5.4
	• 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.	✓	✓	✓	• Section 5.4 • Section 10.4 • Section 11.4 • Section 12.4
	• Full cut-off luminaires will be used wherever practicable to reduce glare, light trespass and sky glow from Project lighting.	✓	✓	✓	• Section 5.4

Table 23.4 Summary of Mitigation Measures

Category	Mitigation	C	O	D	EIS Section Reference
Noise Emissions	• Project facilities and infrastructure will be designed to limit noise emissions.	-	✓	-	• Section 5.4 • Section 10.4 • Section 11.4 • Section 12.4
	• 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.	✓	✓	-	• Section 5.4 • Section 12.4 • Section 16.4
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. 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.	✓	✓	✓	• Section 6.4 • Section 8.4 • Section 9.4
	• 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.	✓	✓	✓	• Section 7.4 • Section 8.4
	• Existing drainage patterns will be maintained to the extent feasible with the use of culverts and bridges.	✓	✓	-	• Section 7.4 • Section 8.4 • Section 9.4
	• Existing culverts along the site access road will be maintained or upgraded as necessary. This will include placement of culverts of the same size or larger, at the same inlet and outlet elevations, and in a manner to not cause flooding or ice jams.	✓	-	-	• Section 7.4
	• Project water storage features (i.e., sedimentation ponds) will be used to attenuate peak discharges to the environment.	✓	✓	✓	• Section 7.4 • Section 8.4
	• Standard construction methods, such as seepage cutoff collars, will be used where trenches extend below the water table to mitigate preferential flow paths.	✓	-	-	• Section 6.4
	• Water management ditches will be designed to allow wildlife crossing opportunities, aligned with wildlife trails where practicable.	✓	✓	✓	• Section 11.4 • Section 12.4
	• 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.	✓	✓	-	• Section 8.4

Table 23.4 Summary of Mitigation Measures

Category	Mitigation	C	O	D	EIS Section Reference
	• Site ditching will be designed to reduce erosion and sedimentation through use of rock check dams, silt fences, plunge pools, and grading as appropriate.	✓	✓	✓	• Section 8.4 • Section 9.4
	• 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.	✓	✓	-	• Section 8.4
	• Culverts will be inspected periodically to remove accumulated material and debris upstream and downstream of the culverts.	✓	✓	✓	• Section 7.4 • Section 8.4 • Section 9.4
	• Perimeter grading and access roads will be used to divert runoff away from the open pit and reduce the amount of dewatering required.	✓	✓	-	• Section 7.4
	• 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.	✓	✓	✓	• Section 6.4 • Section 7.4 • Section 8.4
	• Where possible, contact water will be recycled for use on-site (e.g., dust suppression).	✓	✓	✓	• Section 7.4
	• 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.	✓	✓	✓	• Section 7.4 • Section 8.4
	• Water withdrawals from Victoria Lake Reservoir and Valentine Lake, for the purposes of expediting the filling of the open pits, will be done in accordance with a pumping operations plan. This plan will be developed to reduce effects on the lakes.	-	-	✓	• Section 7.4
	• 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.	-	✓	-	• Section 7.4 • Section 8.4
	• 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.	✓	✓	✓	• Section 7.4 • Section 8.4
	• 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 *Metal and Diamond Mining Effluent Regulation* (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.	✓	✓	✓	• Section 7.4 • Section 8.4

Table 23.4 Summary of Mitigation Measures

Category	Mitigation	C	O	D	EIS Section Reference
	• 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.	✓	✓	✓	• Section 7.4 • Section 8.4
	• 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.	✓	✓	✓	• Section 7.4 • Section 8.4
	• 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).	✓	✓	✓	• Section 7.4 • Section 8.4
	• Effluent discharge rates will be maintained to below the highest rate used in the Assimilative Capacity Assessment (Appendix 7C).	✓	✓	✓	• Section 7.4 • Section 8.4
	• The potable water treatment plant will be designed to meet the Guidelines for Canadian Drinking Water Quality and monitored in accordance with NL monitoring and reporting requirements.	✓	✓	-	•
	• A maintenance schedule will be developed and implemented to provide for regular maintenance and inspection of site water management infrastructure, including culverts.	✓	✓	✓	• Section 9.4
	• Groundwater quality and quantity will be monitored and adaptively managed, if required, using a network of groundwater monitoring wells to document Project effects on groundwater flow and quality. Monitoring locations will be maintained until the water levels and water quality have stabilized post-closure.	✓	✓	✓	• Section 6.4
Tailings Management	• The dams required for the tailings impoundment will be designed, constructed, operated and closed in accordance with the Canadian Dam Association (CDA), Global Industry Standards on Tailings Management, and Mining Association of Canada (MAC) guidelines, as well as applicable provincial requirements	✓	✓	✓	• Section 8.4
	• As required by the CDA, an Operations, Maintenance and Surveillance manual will be developed for the TMF which will dictate the frequency of dam inspections and dam safety reviews.	✓	✓	✓	• Section 21.5.1
	• As required by the CDA, a Public (Stakeholder) Safety Plan will be developed, which will identify the notifications procedures, warnings and alarms to be implemented in the event of a failure.	✓	✓	✓	• Section 21.5.1

Table 23.4 Summary of Mitigation Measures

Category	Mitigation	C	O	D	EIS Section Reference
	• The TMF dam will be designed to maintain water storage to contain the Environmental Design Flood, a 100-year return hydrologic event (24-hour storm or freshet event (75 mm)) with no discharge through the spillway (Golder 2020).	-	✓	✓	• Section 7.4
	• To address extreme weather events, an emergency spillway will be maintained to safely pass the Inflow Design Flood while maintaining minimum freeboards requirements to protect the structural integrity of the dam. The Inflow Design Flood is generated by the theoretical maximum precipitation that could fall in the area.	-	✓	✓	• Section 7.4 • Section 21.5.1
	• The TMF closure spillway will be upgraded to meet closure requirements developed during detailed design.	-	-	✓	• Section 7.4
	• The TMF will be designed and managed to reduce the area of exposed dry surfaces, where possible, to reduce the potential for windblown dust emissions.	-	✓	-	• Section 5.4
	• 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.	✓	✓	✓	• Section 7.4 • Section 8.4
	• Shallow groundwater seepage from the TMF will be intercepted by seepage collection ditches and pumped back to the TMF via sump pumps.	✓	✓	✓	• Section 6.4 • Section 7.4 • Section 8.4
	• Contact and process water from the TMF will be recycled for ore processing to the extent possible.	-	✓	-	• Section 7.4
	• The tailings deposition strategy to deposit thickened tailings as beaches will reduce porewater lock-up in comparison to sub-aqueous deposition and will reduce the quantity of porewater seepage in closure.	-	✓	✓	• Section 7.4
	• 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.	-	✓	-	• Section 6.4 • Section 8.4 • Section 10.4 • Section 11.4 • Section 12.4
	• 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.	-	✓	-	• Section 7.4 • Section 8.4
	• A polishing pond will receive discharge from the water treatment plant to further advance the treatment of water prior to discharge to the environment.	-	✓	✓	• Section 7.4
	• The TMF will be monitored throughout the life of the facility to demonstrate performance goals are achieved and design criteria and assumptions are met.	✓	✓	✓	• Section 21.5.1

Table 23.4 Summary of Mitigation Measures

Category	Mitigation	C	O	D	EIS Section Reference
	• Reclaim water will be taken from the TMF during Years 10 to 12 and will subsequently be pumped to Leprechaun pit as part of the tailings slurry for deposition. Using reclaim water from the TMF in the process plant will reduce the amount of freshwater needed to be taken from Victoria Lake Reservoir.	-	✓	-	• Section 7.4
	• 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.	-	✓	-	• Section 8.4
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.	✓	✓	✓	• Section 12.4
	• 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.	✓	✓	✓	• Section 9.4 • Section 13.4
	• 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.	✓	✓	✓	• Section 11.4
	• 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.	✓	✓	-	• Section 7.4 • Section 8.4
	• 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.	✓	-	-	• Section 7.4 • Section 8.4
	• 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.	-	✓	-	• Section 8.4 • Section 21.5.3
	• Sumps and sump pumps will be installed in reagent storage areas for spillage control.	-	✓	-	• Section 21.5.3
	• Appropriate ventilation, fire and safety protection, eyewash stations, and Safety Data Sheet stations will be located throughout storage facilities for reagents.	-	✓	-	• Section 14.4 • Section 21.5.3

Table 23.4 Summary of Mitigation Measures

Category	Mitigation	C	O	D	EIS Section Reference
	• 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.*	✓	✓	✓	• Section 5.4 • Section 8.4 • Section 21.5.3
	• 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.	✓	✓	✓	• Section 8.4 • Section 21.5.3
	• 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.	✓	✓	✓	• Section 8.4
	• Transportation of hazardous materials will be conducted in compliance with the federal *Transportation of Dangerous Goods Act* and the provincial *Dangerous Goods Transportation Act*	✓	✓	✓	• Section 21.5.3
	• 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.	✓	✓	✓	• Section 8.4 • Section 9.4
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.	✓	✓	✓	• Section 11.4
	• 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.	✓	✓	✓	• Section 11.4
	• 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.	✓	✓	✓	• Section 11.4 • Section 12.4

Table 23.4 Summary of Mitigation Measures

Category	Mitigation	C	O	D	EIS Section Reference
	• 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).	✓	✓	✓	• Section 11.4
	• 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.	✓	✓	-	• Section 11.4
	• 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 NLDFFA-Wildlife Division on this issue.	✓	✓	✓	• Section 11.4
	• 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.	✓	✓	✓	• Section 11.4
	• 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.	✓	✓	✓	• Section 11.4
	• 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.	✓	✓	✓	• Section 11.4
	• 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.	✓	✓	-	• Section 11.4
	• 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).	✓	✓	✓	• Section 12.4

Table 23.4 Summary of Mitigation Measures

Category	Mitigation	C	O	D	EIS Section Reference
	• 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.	✓	-	-	• Section 12.4
	• 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.	✓	✓	✓	• Section 12.4
	• 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.	✓	✓	✓	• Section 12.4
	• Use of sticky traps for problem rodents will be avoided, as bats are often attracted to these.	✓	✓	✓	• Section 12.4
	• 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.	✓	-	-	• Section 12.4
	• 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.	✓	-	-	• Section 12.4
	• Pets will be prohibited on site.	✓	✓	✓	• Section 11.4
	• 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.	✓	✓	✓	• Section 10.4

Table 23.4 Summary of Mitigation Measures

Category	Mitigation	C	O	D	EIS Section Reference
	• 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.	✓	-	-	• Section 10.4
	• 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.	✓	✓	✓	• Section 10.4
	• 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.	✓	✓	✓	• Section 10.4 • Section 16.4
	• 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.	✓	✓	-	• Section 10.4
	• 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.	✓	✓	-	• Section 10.4
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.	✓	✓	✓	• Section 8.4 • Section 11.4 • Section 12.4 • Section 16.4 • Section 17.4
	• Marathon will work to develop cooperative protocols with responsible agencies to address access of Project personnel to emergency and other medical services, including employee medicals and check-ups.	✓	✓	✓	• Section 13.4 • Section 14.4
	• Workforce education will be provided to address topics such as: – healthy lifestyle choices – anti-harassment training – cultural awareness training – Marathon's health and safety policies	✓	✓	✓	• Section 13.4 • Section 14.4 • Section 17.4
	• Marathon will provide an Employee Assistance Program to Project personnel.	✓	✓	✓	• Section 13.4 • Section 14.4

Table 23.4 Summary of Mitigation Measures

Category	Mitigation	C	O	D	EIS Section Reference
	• Work schedules / rotations for Project workers, and the requirement to stay at the mine site accommodations camp during their rotation will deter workers from spending time in local communities and accessing community recreation services and facilities outside of working hours.	✓	✓	✓	• Section 13.4 • Section 14.4
	• Rotation changes will be scheduled so that all workers do not arrive in and leave the site at the same time, limiting Project-related demands on both road and air services and infrastructure.	✓	✓	✓	• Section 13.4
	• Workers will be bussed from nearby designated communities to the mine site for rotations to reduce effects of traffic on roads in the communities and the access road.	✓	✓	✓	• Section 11.4 • Section 16.4 • Section 17.4
	• Arrivals / departures of employee traffic will be scheduled to occur earlier than the existing observed morning peak hour for local traffic and later than the existing observed afternoon peak hour, if needed.	✓	✓	✓	• Section 13.4
	• A Gender Equity and Diversity Plan will be implemented that meets the approval of the Minister of Industry, Energy and Technology and Minister Responsible for the Status of Women and Marathon will engage with both Indigenous groups during the development of the Plan. A business access strategy for members of underrepresented populations will be included in the plan.	✓	✓	✓	• Section 14.4 • Section 15.4 • Section 17.4
	• A Benefits Agreement will be implemented that meets the approval of the Minister of Industry, Energy and Technology and Minister Responsible for the Status of Women.	✓	✓	✓	• Section 14.4 • Section 15.4
	• Marathon will communicate employment information to local communities and Indigenous groups in a timely manner so that local and Indigenous residents have an opportunity to acquire the necessary skills to qualify for potential Project-related employment.	✓	✓	✓	• Section 14.4 • Section 15.4 • Section 17.4
	• Marathon will work with the Province, educational and training institutions, Indigenous groups and stakeholders to identify skilled trade shortages relative to the Project and to identify training needs and opportunities to contribute to a sustainable Project workforce.	✓	✓	✓	• Section 15.4
	• On-the-job training programs and apprenticeship opportunities will be made available.	✓	✓	✓	• Section 15.4
	• Summary reports will be provided to the provincial regulator that include information on the number of persons employed by 4-digit National Occupational Classification (NOC), the number of full- and part-time employed, the number of apprentices (by level) and journey persons for each applicable 4-digit NOC code, gender and source of the workforce.	✓	✓	✓	• Section 15.4

Table 23.4 Summary of Mitigation Measures

Category	Mitigation	C	O	D	EIS Section Reference
	• Procurement packages will be developed with consideration for capacity and capabilities of local and regional Indigenous and non-Indigenous businesses.	✓	✓	✓	• Section 14.4 • Section 15.4 • Section 17.4
	• Project purchasing requirements will be posted in a timely manner so that local and regional businesses can position themselves to compete to supply goods and services needed for Project construction and operation.	✓	✓	✓	• Section 15.4
Site Facilities and Services	• An accommodations camp will accommodate construction, operation and closure workers.	✓	✓	✓	• Section 13.4
	• Power, water and wastewater treatment at the Project site and accommodations camp will be provided by Marathon and will not rely on resources within the Local Assessment Area communities.	✓	✓	✓	• Section 13.4
	• Project-specific environmental management plans and monitoring programs will be developed, including a Waste Management Plan that sets out procedures for reducing Project-related waste and limiting demands on the regional landfill.	✓	✓	✓	• Section 12.4 • Section 13.4
	• Security services will be established on-site.	✓	✓	✓	• Section 13.4
	• An on-site first aid facility will be provided with paramedic / nurse / ambulatory technician and an ambulance, as required. Designated, trained personnel will provide transport to the nearest hospital when required. During Project construction and operation, first aid stations and equipment will be distributed through the site, as appropriate.	✓	✓	✓	• Section 13.4 • Section 14.4
	• Marathon will implement COVID-19 protocols as necessary.	✓			• Section 14.4
	• Catering and recreation opportunities will be provided at the accommodations camp, including fitness equipment. The design of facilities will also consider culturally appropriate spaces.	✓	✓	✓	• Section 13.4
	• The worker accommodations will be designed with sufficient ventilation systems to reduce the need to open the windows. This can also be supported through closed-window policies with requirements highlighted during mandatory site orientations for employees, contractors and visitors.	✓	✓	✓	• Section 5.4

Table 23.4 Summary of Mitigation Measures

Category	Mitigation	C	O	D	EIS Section Reference
Engagement with Stakeholders, Indigenous Groups and the Public	• Marathon will continue to engage with cabin owners within the Project Area to discuss their occupancy, potential future use of these cabins, and potential applicable mitigation measures.	✓	✓	-	• Section 16.4
	• Marathon will consult with NLDFFA in advance of construction to incorporate the harvesting of forestry resources in the Project Area as part of site preparation.	✓	-	-	• Section 16.4
	• Marathon will continue to engage with local resource users (hunters, outfitters, trappers, anglers) regarding the overlap of the Project with hunting, trapping, and fishing areas in the Project Area. This will include the communication of Project information, updates on ongoing and planned activities, and a discussion of issues and concerns and a potential means of addressing them.	✓	✓	✓	• Section 16.4
	• Project activities, locations, and timing will continue to be communicated to Indigenous groups, affected land and resource users, environmental non-government organizations, the provincial government, and local authorities throughout the life of the Project. In particular, Marathon will communicate in advance with respect to Project activities that may limit/affect use of the access road (i.e., upgrading activities or transport of large loads or equipment). This information will be communicated through local town councils, local radio stations and social media.	✓	✓	✓	• Section 16.4 • Section 17.4
	• Marathon will continue to engage with Indigenous groups, including Indigenous resource users, throughout the life of the Project. This will include the communication of Project information, updates on ongoing and planned activities, and a discussion of issues and concerns and a potential means of addressing them. This will also include a discussion of the development and implementation of Project-specific environmental management and monitoring plans.	✓	✓	✓	• Section 17.4
	• Marathon will continue to engage with Indigenous groups for the identification, review, and analysis of existing and available information on Indigenous land and resource use activities, to consider this early and throughout Project planning, design and implementation.	✓	-	-	• Section 17.4

Table 23.4 Summary of Mitigation Measures

Category	Mitigation	C	O	D	EIS Section Reference
	• Marathon will continue to engage with local communities, including through the negotiation of Community Cooperation Agreements with the six communities in proximity to the Project Area. Community engagement will include regular updates on planned and ongoing Project activities, the timely dissemination of environmental, employment, contracting, and procurement information, and sponsorship of community programs, activities and initiatives, consistent with Marathon's corporate sponsorship policy and values.	✓	✓	✓	• Section 13.4
Rehabilitation and Closure	• Marathon will develop a Rehabilitation and Closure Plan that meets the requirements of the Department of Industry, Energy and Technology, NLDECCM, and NLDFFA-Wildlife Division. The plan will be reviewed and updated regularly until implemented.	✓	✓	✓	• Section 8.4 • Section 9.4 • Section 10.4 • Section 11.4
	• 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.	✓	✓	✓	• Section 9.4
	• 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.	✓	✓	✓	• Section 9.4
	• 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.	-	✓	✓	• Section 6.4 • Section 7.4 • Section 9.4
	• Measures will be taken to address public health and safety requirements throughout rehabilitation and closure.	✓	✓	✓	• Section 15.4 • Section 16.4
	• Desired land and resource end-uses will be considered in the preparation of the Rehabilitation and Closure Plan.	-	-	✓	• Section 16.4 • Section 17.4
	• 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.	-	-	✓	• Section 10.4
	• 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.	-	-	✓	• Section 11.4 • Section 12.4

Table 23.4 Summary of Mitigation Measures

Category	Mitigation	C	O	D	EIS Section Reference
	• 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.	-	-	✓	• Section 8.4
	• Wells on site will be decommissioned in compliance with the Guidelines for Sealing Groundwater Wells (Government of NL 1997).	-	-	✓	•
	• Pre-mining site drainage patterns will be re-established to the extent practicable.	-	-	✓	• Section 8.4 • Section 9.4
	• 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.	-	-	✓	• Section 9.4
	• 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.	-	-	✓	• Section 7.4 • Section 8.4
	• Open pit filling will be accelerated at closure, which will return groundwater levels to baseline conditions in a shorter timeframe.	-	-	✓	• Section 6.4
Accidental Event Prevention and Response	• Marathon will liaise with local emergency providers so that roles and responsibilities are understood, and that the necessary resources required to respond are in place.	✓	✓	✓	• Section 13.4
	• Mandatory safety orientations will be provided for employees.	✓	✓	✓	• Section 14.5
	• Emergency response plans will be developed, including spill prevention and response, emergency response measures, training, responsibilities, clean-up equipment and materials, and contact and reporting procedures.	✓	✓	✓	• Section 13.4
	• Appropriate project personnel will be trained in fuel handling, equipment maintenance and fire prevention and response measures.	✓	✓	✓	• Section 13.4
	• Fire prevention and suppression systems will be maintained on site, including fire response vehicles and associated equipment, fire water distribution, sprinklers, fire extinguishers and other firefighting equipment.	✓	✓	✓	• Section 13.4

Table 23.4 Summary of Mitigation Measures

Category	Mitigation	C	O	D	EIS Section Reference
	• Facilities will have a fire suppression system in accordance with the structure's function and in accordance with regulatory requirements, including NL *Occupational Health and Safety Act* and *Occupational Health and Safety Regulations*. For the most part, fire water will be distributed via an underground ring main network around the facilities, which will be supplied from the bottom section (a reserve) of the raw water tank. All buildings will have hose cabinets and handheld fire extinguishers. Electrical and control rooms will be equipped with dry-type fire extinguishers. Automatic sprinkler systems will be installed in ancillary buildings. Appropriate fire suppression systems will be provided for reagents according to their SDS. Additionally, all mine water trucks will be fitted with fire-fighting equipment and foam injection tanks.	✓	✓	✓	• Section 21.5.5
Discovery and Protection of Heritage Resources	Mitigation measures to be applied with approval and appropriate permits issued by the Provincial Archaeology Office: • Field assessment surveys will be undertaken prior to construction wherever the Project Area has potential to interact with identified areas of high potential for archaeological resources. • Ground-truthing of the three identified Victoria River sites will be undertaken in the event that the Project Area expands to interact with their hypothesized locations. • Review of historical fieldnotes pertaining to the Victoria River sites that are presently housed in the Provincial Archives will be undertaken in association with further field assessment. • Archaeological field assessment and testing of road routes and other required infrastructure (new and upgraded) at selected river crossings and lakeshores will be undertaken prior to construction once development plans are finalized.	✓	-	-	Section 18.4
	Measures to be included in the Heritage and Cultural Resources Protection Plan to mitigate the potential of adverse effects on historic resources resulting from an accidental discovery: • Prior to construction, personnel will be made aware of potential historic resources in the area and understand their responsibility should they identify potential historic resources. • Personnel will be advised to report unusual findings to the Site Supervisor and not to touch such findings. • Work will be suspended in the immediate area should a potential resource be identified. • If features are found using heavy equipment, the equipment will not be moved so that historical information and evidence is left intact and not further disturbed.	✓	-	-	• Section 17.4

Table 23.4 Summary of Mitigation Measures

Category	Mitigation	C	O	D	EIS Section Reference
	• The area of findings will be flagged to protect it from looting and further disturbance. • A qualified archaeologist or historic resources professional will be contacted by the Site Supervisor to conduct an assessment of the site.				
Effects of the Environment on the Project – Weather and Climate Change	• The Project will be designed and constructed to meet applicable engineering codes, standards and best management practices, such as the *National Building Code of Canada* (NBCC), *the National Fire Code of Canada,* and *the Canadian Dam Association Guidelines*. The codes and standards account for weather variables, including extreme conditions, that could affect the structural integrity of buildings and infrastructure. Designs will also consider projected climate change over the life of the Project.	✓	✓	✓	• Section 22.3.1
	• The potential effects of extreme weather including storms, precipitation, flooding/ice jams, and drought will be considered in Project planning, design and operation and maintenance strategies, including the selection of materials and equipment, and design of components, such as water management infrastructure and the TMF. These designs will consider projected climate change conditions over the life of the Project.	✓	✓	✓	• Section 22.3.1
	• Marathon will regularly inspect and monitor Project infrastructure and equipment that may be impacted by the environment (in addition to its normal function) and take required action to maintain, repair and upgrade infrastructure / equipment as needed.	✓	✓	✓	• Section 22.3.1
	• Work activities will include allowance / procedures for delays due to poor weather.	✓	✓	✓	• Section 22.3.1
	• Contingency plans, including emergency back-up power for necessary operations, will be in place to manage delays, such as temporary power outages.	✓	✓	✓	• Section 22.3.1
	• Weather forecasts will be considered when planning construction and operation activities that may be affected by adverse conditions, such as TMF embankment raises, receipt of materials and supplies, and product deliveries, particularly deliveries of chemicals, reagents and diesel fuel. Where required, these activities will be scheduled for periods of favourable weather conditions.	✓	✓	✓	• Section 22.3.1
	• Weather forecasts will be regularly monitored and prior to extreme weather events, appropriate preventative measures will be taken to reduce the risk of damage to the Project. This will include site inspection by staff to secure loose items and identify other risks (for wind events), and inspection / maintenance of sediment and erosion control measures prior to and following precipitation events.	✓	✓	✓	• Section 22.3.1

Table 23.4 Summary of Mitigation Measures

Category	Mitigation	C	O	D	EIS Section Reference
Effects of the Environment on the Project – Geological Hazards	• The Project will be designed and constructed to meet applicable engineering codes, standards, and BMPs, including the NBCC and CANFEM, which provide standards of safety to account for geological hazards, including seismic activity.	✓	✓	✓	• Section 22.3.2
	• Water retaining structures, including dams for the TMF, will be designed, constructed, operated and closed in accordance with the recommendations provided by CDA; these guidelines also outline the minimum design criterion to account for geological hazards.	✓	✓	✓	• Section 22.3.2
	• Implementation of site-specific erosion and sedimentation control plans that will be developed during detailed design phase of the Project.	✓	✓	✓	• Section 22.3.2
	• Geotechnical investigations for all site infrastructure, open pits, and waste and ore piles will be completed prior to construction to further assess the site-specific conditions and associated risk of geological hazards; information obtained from these site-specific investigations will be used to complete the designs and meet the requirements as presented in NBCC, CANFEM and CDA.	✓	-	-	• Section 22.3.2
Effects of the Environment on the Project – Forest Fires	• Marathon's environmental management system will describe emergency response measures, training requirements, roles and responsibilities, and contact and reporting procedures in the event of a fire at or near the mine site or along the access road.	✓	✓	✓	• Section 22.3.3
	• Marathon will actively monitor wildfires that could affect the mine site and/or access road and coordinate with provincial authorities with respect to response, including the need for potential shutdown and evacuation of employees.	✓	✓	✓	• Section 22.3.3
	• On-site fire prevention and response equipment will be provided and maintained, and Marathon will have employees / teams that will be trained in safe fire response. While the purpose of this response training and equipment is to respond to fire scenarios on the mine site, NLDFFA would be responsible for response to a forest fire in the area not related to the Project.	✓	✓	✓	• Section 22.3.3
	• Project-related activities will be adjusted in case of a severe fire and as needed to protect the health and safety of employees.	✓	✓	✓	• Section 22.3.3

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

23.3.2 Summary of Environmental Monitoring and Follow-up

As per CEAA 2012, a follow-up program is a program for "verifying the accuracy of the environmental assessment (EA) of a designated project" and "determining the effectiveness of any mitigation measures." Proposed follow-up and monitoring programs identified as part of this environmental assessment will be used to:

- Verify the accuracy of environmental predictions
- Measure compliance with applicable licences, permits and other approvals
- Confirm adherence to general and specific mitigation measures
- Assess the effectiveness of mitigation and management measures
- Identify Project effects requiring further mitigation

Factors considered in determining the need for a follow-up program include:

- The nature and significance of predicted Project effects on VCs, especially environmentally sensitive areas, protected areas or areas under consideration for protection, and/or Species at Risk / Species of Conservation Concern
- The nature and extent of Indigenous, stakeholder and public concerns raised about Project effects on a VC
- The level of confidence in effects assessment predictions
- The level of confidence in the effectiveness of mitigation measures
- The potential for and nature of cumulative environmental effects
- Data gaps in the effects assessment related to existing conditions or limited scientific knowledge regarding potential effects

As required by the Federal and Provincial EIS Guidelines, Marathon will develop follow-up and monitoring programs in consultation with government departments, Indigenous groups and stakeholders, and as required by conditions of EA approval. Results of the follow-up monitoring will be reported to required government department. Where monitoring results fall outside of those predicted in the EIS, the appropriate regulatory authorities will be consulted to determine the necessary course of action (for example, the development of additional mitigation, adaptive management, or further follow-up or monitoring). It is anticipated that the follow-up program will change and evolve over the life of the Project in response to monitoring results, new and relevant academic and applied research, new and emerging technologies, and evolving industry best practices.

An overview of the conceptual follow-up and monitoring programs for the Project by VC is provided in Table 23.5.

Table 23.5 Conceptual Follow-up Program Elements

Targeted VCs	Follow-up and Monitoring Plan Basis	Overview of Follow-up / Monitoring Program / Study	Associated Plans
Atmospheric Environment (Chapter 5)	• Change in Air Quality • Change in Greenhouse Gas Emissions • Change in Sound Quality • Change in Light Levels	• The Air Quality Management Plan will specify the mitigation measures for the management and reduction of air emissions during Project construction, operation and decommissioning, and the proposed ambient air quality monitoring program • An ambient air quality (TSP, PM_{10} and $PM_{2.5}$ concentrations) monitoring program will be implemented and will be used to assess the effectiveness of the dust mitigation • Ambient meteorology monitoring will include meteorological monitoring (wind speed and wind direction) • Management of Project GHG emissions will be done in accordance with relevant GHG emissions management legislation • Sound pressure level monitoring programs, as required, will be conducted near the most affected receptor locations, including the work camp • An indoor sound monitoring program will be conducted at the accommodations camp to confirm daytime and nighttime noise levels • No follow-up monitoring recommended with respect to ambient lighting	• Air Quality Management Plan • Greenhouse Gas Management Plan
Groundwater Resources (Chapter 6)	• Change in groundwater quantity • Change in groundwater quality	As part of the Water Management Plan, a groundwater monitoring program will be implemented to monitor groundwater levels and groundwater quality including: • Monitoring wells at select locations around the open pit • Monitoring wells / drive point piezometers in the vicinity of, but not limited to, Valentine Lake, Victoria Lake Reservoir and Victoria River • Monitoring wells upgradient, cross gradient, and downgradient of the TMF and waste rock piles • Groundwater quality samples from monitoring wells will be monitored for general chemistry and select dissolved metals in spring, summer, and fall during construction, operation and closure (with the frequency progressively reduced based on monitoring results and Project phase) • Groundwater monitoring locations and requirements are addressed in the Operations C of A for the project.	• Water Management Plan

Table 23.5 Conceptual Follow-up Program Elements

Targeted VCs	Follow-up and Monitoring Plan Basis	Overview of Follow-up / Monitoring Program / Study	Associated Plans
Surface Water Resources (Chapter 7)	• Change in surface water quantity • Change in surface water quality	As part of operation, the following monitoring programs will be implemented: • Mine water effluent discharge, recycled tailings water, freshwater makeup, process water and potable water volumes will be recorded on a daily basis through gauges installed in distribution lines • Select monitoring locations will be equipped with real-time monitoring equipment in consultation with the Water Resources Management Division, NLDECCM, in accordance with a Real Time Water Quality Monitoring Agreement to be established for the Project • Hydrometric monitoring will be conducted at the final discharge points as well as at existing streams that are adjacent to the open pits • Flow monitoring of pumping equipment will be conducted, including the open pit dewatering, water withdrawal from Victoria Lake Reservoir, potable water to the water treatment plant, effluent discharge from TMF, and reclaim and tailings deposition rates • Surface water quality will be monitored at monitoring sites during all phases of the Project as outlined in the Surface Water Monitoring Plan (Section 7.9.1)	• Water Management Plan • Erosion and Sediment Control Plan • Soil and Rock Management Plan • Waste Management Plan • Surface Water Monitoring Plan
Fish and Fish Habitat (Chapter 8)	• Change in fish habitat (quality) • Change in fish habitat (quantity) • Change in fish health and survival	Compliance monitoring will be conducted to confirm that mitigation measures are properly implemented, including: • Surface water quality monitoring during all phases of the Project • Monitoring effectiveness of the implemented Fish Habitat Offsetting Plan as authorized and required under the *Fisheries Act;* should the monitoring program indicate that the offsetting objectives are not being met, remedial actions or additional offsets as described in the Habitat Offsetting Plan would be considered, following consultation with DFO • An Environmental Effects Monitoring (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	• Fish Habitat Offsetting Plan • Water Management Plan • Erosion and Sediment Control Plan • Soil and Rock Management Plan • EEM under MDMER (when 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)

Table 23.5 Conceptual Follow-up Program Elements

Targeted VCs	Follow-up and Monitoring Plan Basis	Overview of Follow-up / Monitoring Program / Study	Associated Plans
		• Monitoring of pit lake water quality (decommissioning, rehabilitation and closure, and post-closure) to demonstrate that closure strategies are performing as intended	
Vegetation, Wetlands, Terrain and Soils (Chapter 9)	• Change in species diversity • Change in community diversity • Change in wetland function • Change in soil quality • Change in soil quantity • Change in terrain (landforms) and terrain stability	• 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 • Stockpile monitoring for soil quality and soil management measures to reduce site soil loss • Follow-up and monitoring will focus on soil stockpiles, the TMF, water management infrastructure, waste rock piles and open pit slopes • The potential for soil erosion and sedimentation of watercourses and waterbodies will be routinely assessed and mitigated • Follow-up surveys will be conducted over the mine life to allow for better prediction of potential areas of instability, and will allow for closure planning to take into account management of known residual instability • Unique landforms, including wetlands and eskers (if identified) will be observed though monitoring for compliance with identified mitigation measures	• Environmental Protection Plan • Soil and Rock Management Plan • Erosion and Sediment Control Plan • Rehabilitation and Closure Plan
Avifauna (Chapter 10)	• Change in habitat • Change mortality risk	• There will be regular inspection of facilities to determine if birds are nesting on or near anthropogenic structures during Project operation to comply with the *Migratory Birds Convention Act* (MBCA) and *Species at Risk Act* (SARA) and develop onsite bird control features to deter nesting on or near mine infrastructure, as applicable • Follow-up surveys will be conducted 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 will be conducted at varying distances from the mine infrastructure to determine accuracy of effects predictions on avifauna	• Avifauna Management Plan

Table 23.5 Conceptual Follow-up Program Elements

Targeted VCs	Follow-up and Monitoring Plan Basis	Overview of Follow-up / Monitoring Program / Study	Associated Plans
Caribou (Chapter 11)	• Change in habitat • Change in movement • Change in mortality risk	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 anticipated zone of influence • 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 zone of influence • Continuation of remote camera deployment and analysis of migration in spring and fall Marathon is proposing an adaptive management approach to address the potential Project-related adverse effects on caribou migration and populations in the Project Area.	• Wildlife Monitoring and Management Plan • Traffic Management Plan
Other Wildlife (Chapter 12)	• Change in Habitat • Change in Mortality Risk	• A follow-up program will be conducted for bats. Acoustic monitoring for bats will be conducted in the Project Area and LAA before and during construction and during operation, to determine species presence, general habitat use, and seasonal variation of bat occurrence. • A follow up program will be conducted for marten using snag trap surveys. Hair trap 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, operation and during and/or after decommissioning, to assess for changes in marten presence in comparison to existing conditions. If feasible, the same three locations will be surveyed to allow for a direct comparison.	• Wildlife Monitoring and Management Plan
Community Services and Infrastructure (Chapter 13)	• Change in local housing and temporary accommodations	A dedicated follow-up and monitoring program is not proposed for this VC	N/A

Table 23.5 Conceptual Follow-up Program Elements

Targeted VCs	Follow-up and Monitoring Plan Basis	Overview of Follow-up / Monitoring Program / Study	Associated Plans
	• Change in local services and infrastructure		
Community Health (Chapter 14)	• Change in community well-being • Change in consumption of country foods	A dedicated follow-up and monitoring program is not proposed for this VC	N/A
Employment, Economy, and Business (Chapter 15)	• Change in regional labour force • Change in regional business • Change in economic activities of outfitters • Change in economy	Follow-up and monitoring will be implemented in accordance with the Project's Benefits Agreement and Gender Equality and Diversity Plan. As part of this, quarterly summary reports for each phase of the Project will be developed.	• Gender Equality and Diversity Plan
Land and Resource Use (Chapter 16)	• Change in Land Use • Change in Resource Use • Change in Recreational Use	A dedicated follow-up and monitoring program is not proposed for this VC	N/A
Indigenous Groups (Chapter 17)	• Change in Indigenous health conditions • Change in Indigenous socio-economic conditions • Change in current use • Change in physical and cultural heritage	A dedicated follow-up and monitoring program is not proposed for this VC. Marathon will continue to engage with the Indigenous groups throughout the life of the Project.	N/A
Historic Resources (Chapter 18)	Loss of information about or alteration to historic resource(s) and their context	The Heritage and Cultural Resources Protection Plan will detail required follow-up monitoring in the event of an accidental discovery of historic sites or materials of significance.	• Heritage and Cultural Resources Protection Plan

Table 23.5 Conceptual Follow-up Program Elements

Targeted VCs	Follow-up and Monitoring Plan Basis	Overview of Follow-up / Monitoring Program / Study	Associated Plans
Dam Infrastructure (Chapter 19)	• Change in surface water quantity • Change in surface water quality • Change in non-Project dam stability	Monitoring related to routine blasting will include: • Seismic (blast) monitoring at the Victoria Dam and Project dams, and possibly at closer distances to the blasting activity to measure vibrations directly at the structures • Use of other Project TMF monitoring data (settlement/movement, pore pressure) to further assess the potential blast impact • Use of the data collected to further assess and confirm the results of the current assessment by Golder	• Explosives and Blasting Management Plan
NA = Not Applicable			

23.4 SUMMARY OF THE ECONOMIC AND SOCIAL BENEFITS OF THE EA AND THE PROJECT

23.4.1 Economic and Social Benefits of the Project

Based on an independent economic assessment completed by Strategic Concepts Inc., the Project will have substantial economic impacts for both NL and Canada. Marathon will spend approximately $2.0 billion Canadian dollars (CAD) to develop and operate the Project over its planned 15-year life (includes construction and closure). This includes $272 million in pre-production capital expenditures, $288 million in post-production capital expenditures, and $1.4 billion in operating expenditures. The key economic impacts on the economy and the federal and provincial treasuries are[1]:

- Creation of over 19,000 full-time equivalents (FTE) of total employment (direct, indirect and induced) in Canada, including approximately 11,000 FTEs in NL
- Average annual employment of nearly 1,300 FTEs of employment annually in Canada, including an average of 725 FTEs annually within NL
- Generation of approximately $1.3 billion in income to workers and business within Canada, including $750 million to workers and businesses located within NL
- Contribution of $3.6 billion to Canada's gross domestic product (GDP), which includes $2.9 billion to NL's GDP
- Generation of $292 million in federal government revenues
- Contribution of approximately $400 million ($27 million on an average annual basis) in incremental revenues to the treasury of NL

23.4.2 Benefits of the EA Process

In addition to outlining the economic and social benefits of the Project, the Provincial EIS Guidelines (Appendix 1B) require the EIS to identity the benefits of the EA process to the people of Newfoundland and Labrador. These are outlined below. Note that the economic and social benefits listed above also represent the benefits to the socio-economic environment as assessed in Chapters 14 and 15 and further discussed below in Section 3.4.2.3.

23.4.2.1 Public Participation

The provincial and federal EA process benefits the people of Newfoundland and Labrador by outlining Marathon's obligations in relation to public participation and defining how public input is to be gathered, recorded and incorporated into the EA. The EA process requires that Marathon conduct a planned program of public participation and consultation, with minimum requirements outlined in the Federal and Provincial EIS Guidelines.

[1]Treasury impacts based on US$1,350 per ounce of gold and an exchange rate of $0.75 US/CAD. A full-time equivalent of employment is typically equivalent to approximately 2,000 hours of work. For this model, 2,000 hours was used to measure full-time equivalents of employment from capital expenditures and 2,190 hours per year for operation jobs. The latter is based on the planned work schedule of a 24-hour operation with two 12-hour shifts.

Chapter 3 summarizes the public consultation and stakeholder engagement activities undertaken by Marathon to date. The EIS identifies key stakeholder groups, summarizes comments heard, identifies key issues of concern raised by the public and indicates Marathon's response to the concerns identified. This process ensures that public engagement activities are fulfilled, and that issues and concerns raised by stakeholders, as well as Marathon's responses, are documented and incorporated throughout the EIS.

The EA process has also served as a mechanism for Marathon to incorporate results of engagement in early Project planning to reduce and avoid environmental effects. As described in Section 2.1, several important aspects of the Project concept and engineering design have been modified, refined, and adapted to reduce potential adverse effects for incorporation into the EIS. These changes have been made during the Project Pre-Feasibility Study and in consideration of discussions with regulators, stakeholders and Indigenous groups, and in response to input received during public, Indigenous and regulatory review of the Registration / Project Description submitted to the federal and provincial governments in April 2019.

Marathon is committed to continuing and meaningful engagement with Indigenous groups, communities and stakeholders. Building and maintaining positive relationships with the people, communities and groups which are interested in or likely to be affected by the Project is key to securing and preserving the Project's social licence. Marathon's approach to public engagement is based on openness, transparency and inclusivity. Marathon has met and communicated with Indigenous groups, communities and a wide range of stakeholders to provide Project-related information on an ongoing basis and to create opportunities for dialogue to enhance Marathon's understanding of and inform its responses to issues and concerns.

Information which has been provided to Marathon through meetings, correspondence, workshops and other sessions has been taken into account in Project design process (for example, the decision not to use heap leach and the reconfiguration of the Project layout to reduce adverse impacts). Information generated through engagement has been incorporated into the description of baseline conditions of a number of VCs including Chapter 17 (Indigenous Groups), Chapter 13 (Community Services and Infrastructure), Chapter 14 (Community Health) and Chapter 16 (Land and Resource Use). The information provided has also influenced the assessment of potential Project effects for all VCs directly or indirectly. Public participation in the EA process via comments provided to regulators has the potential to further influence the environmental assessment of the Project.

As described in Chapter 3 (Consultation and Engagement) Marathon is committed to continued engagement and consultation over the course of the Project life cycle. Marathon plans to hold a workshop with representatives of Indigenous groups to review proposed mitigation measures and has committed to involve each Indigenous group in monitoring. Marathon also plans to hold meetings with both Indigenous groups and communities following submission of the EIS to review the assessment results. Marathon has met and will continue to meet with fish and wildlife associations as well as other civil society organizations to discuss mitigations of specific, potential Project effects relating to fish and fish habitat and wildlife, and future monitoring requirements. Marathon will carefully consider the views expressed during ongoing engagement activities as the Project progresses and continue to consider these views in Project planning, design and execution.

23.4.2.2 Increases in Scientific Knowledge

Ongoing monitoring and analysis of data related to caribou movement and presence in the vicinity of the Project, as well as herd demographics such as proportion of calves for both migratory and resident caribou, will contribute to scientific knowledge both specifically regarding the caribou herds themselves (e.g., responses to sensory disturbance and altered migration) and more generally regarding caribou responses to industrial projects.

23.4.2.3 Community and Social Benefits

Marathon has committed to an approach to Project execution which will avoid or reduce adverse impacts and to create and enhance benefits. A central element of this approach is the development of positive working relationships with the communities in proximity to the Project. As described in Chapter 3 (Consultation and Engagement), Marathon provides Project-related information to Indigenous groups, communities and stakeholders on an ongoing basis and maintains regular contact with each community through meetings (in-person, virtual and by conference call), e-mails and other forms of communication such as the quarterly newsletter. Ongoing efforts to hire local residents and to use local businesses to supply goods (groceries, fuel, hardware supplies) to the exploration camp will be increased as the Project progresses toward execution.

In February 2020, Marathon conducted a community survey to determine the specific interests and concerns of community residents. The majority of residents identified the socio-economic aspects of the Project, both positive and negative, as the subject of greatest interest. Recognizing the central importance of socio-economic concerns, Marathon has publicly committed to execute the Project to create and enhance local benefits. This commitment will be given formal expression in the Benefits Agreement and Gender Equity and Diversity Plan, which will be submitted for the approval of the Provincial government.

At the community level, Marathon has concluded Community Cooperation Agreements with five communities and is currently negotiating the terms of a sixth agreement. These agreements provide a framework for ongoing communication in relation to employment and business opportunities in order to foster the fair and equitable representation of residents and local businesses in the Project workforce and the award of contracts. Marathon has made similar commitments respecting workforce and contracting participation to Indigenous groups and will continue to provide information respecting employment and business opportunities to all relevant parties.

As an integral aspect of Marathon’s commitment to local benefits, Marathon has carried out a community investment program including sponsorship of local initiatives, such as the Red Indian Lake Fishing Derby and the Grand Falls-Windsor Minor Peewee AA Braves tournament. It has also contributed to industry initiatives such as the Mineral Resources Review 2019.

Marathon will continue to respond to individual requests for sponsorship support, building on the community-based approach to sponsorship and investment implemented in 2020. Under this approach, the communities of Buchans, Millertown, Buchans Junction, Badger, Grand Falls-Windsor and Bishop’s Falls each received an allotment to be applied to community projects and activities, consistent with

Marathon's corporate values. The identification of appropriate initiatives was undertaken by each community in consultation with Marathon. The allotments have been used by the communities to fund a wide range of initiatives ranging from seasonal community events (Bishop's Falls Winter Carnival), to support for local services (equipment for Millertown volunteer fire department, backhoe repairs) and enhancement of community infrastructure (Buchans stadium upgrades, Buchans Junction bridge repairs). Marathon's aim in providing the allotment is to support initiatives and events which:

- Are inclusive and promote broad-based community participation
- Are aimed at strengthening community cohesion
- Offer a demonstrable benefit to many community sectors
- Strengthen the community and leave a positive, long-term corporate legacy without creating dependency

In addition to the community allotment, in 2020, Marathon contributed $90,000 to local and regional initiatives to respond to community needs in the wake of COVID-19. Marathon's COVID-19 community response represented a matching investment of that awarded to Marathon via the Junior Exploration Assistance Program, back into the communities of central Newfoundland to help offset the adverse impacts that many essential local service organizations experienced on their normal fund-raising activities. This funding was distributed on a community and regional basis. The funding was applied on a community basis to support food security (gift cards, food), community wellness (upgrades to walking trails, support for Special Olympics, support for volunteer and charitable organizations), health and safety (PPE for essential workers, service groups) and educational support initiatives (purchase of Chromebooks, scholarship support). The regional component of the funding was donated to the South and Central Health Foundation and used for low-contact medical equipment, remote diagnostic tools, and support for long-term patients.

Marathon's commitment to sponsorship and community investment reflects the value that Marathon places on corporate social responsibility and the objective of establishing and maintaining positive relationships with the communities in proximity to the Project. As formalized by the terms of the individual Community Cooperation Agreements, Marathon will continue to work with each community to identify opportunities for the funding of programs, initiatives, events and activities that support community capacity, well-being and cohesion. It will also continue to engage with communities, Indigenous groups and stakeholders to discuss Project design and execution with the goal of enhancing local benefits.

23.4.2.4 Benefits Agreement and Gender Equity and Diversity Plan

Marathon is committed to the promotion of the values of gender equity, diversity and inclusion. These values will be integrated into all aspects of Marathon's operations and provide the foundation for both a Benefits Agreement and a Gender Equity and Diversity Plan which will be submitted for the approval of the Minister of Industry, Energy and Technology (formerly the Department of Natural Resources) and the Minister for the Status of Women. Work on both the Agreement and the Gender Equity and Diversity Plan has commenced, and Marathon has met with representatives of the provincial government to discuss the applicable legal requirements. Marathon has also contacted relevant industry organizations, such as Trades NL and the Office to Advance Women Apprentices and has committed to engage with Indigenous groups and communities in the development of both the Agreement and the Plan.

The Benefits Agreement with the province will entrench the principle of local benefits in employment, training and business opportunities. The components of the Agreement will be incorporated into a Benefits Plan which will be binding on both Marathon and its contractors and supported by a corporate Benefits Policy. The Gender Equity and Diversity Plan will address access to training, employment and procurement and contracting opportunities for women, Indigenous persons and members of other underrepresented groups, such as persons with disabilities and visible minorities. This Plan will be binding on both Marathon and its contractors and be supported by corporate policies respecting diversity and inclusivity.

Both the Benefits Agreement and the Gender Equity and Diversity Plan will provide for ongoing collaboration with industry, government, educational and training institutions, Indigenous groups, communities and stakeholders to formulate strategies directed at local benefits creation and diversity and inclusion in the carrying out of the Project. The Plans will outline the goals and initiatives that will be implemented throughout the Project and the measures that will be implemented to ensure, to the extent possible, that there is fair and equitable access to the benefits associated with the Project.

23.5 CAPACITY OF RENEWABLE RESOURCES

Renewable resources that may be affected by the Project:

- Atmospheric Environment
- Groundwater Resources
- Surface Water Resources
- Fish and Fish Habitat
- Vegetation, Wetlands, Terrain and Soils
- Avifauna
- Caribou
- Other Wildlife

In accordance with Section 4.1.6.3 of the Provincial Guidelines (Appendix 1B), effects of the Project were thoroughly assessed for Atmospheric Environment (Chapter 5), Groundwater Resources (Chapter 6), Surface Water Resources (Chapter 7), Fish and Fish Habitat (Chapter 8), Vegetation, Wetlands, Terrain and Soil (Chapter 9), Avifauna (Chapter 10), Caribou (Chapter 11), Other Wildlife (Chapter 12). The assessment concluded that significant effects are not likely, and therefore, adverse Project-related effects on the capacity of renewable resources to meet the needs of the present and those of the future are not anticipated, with the exception of caribou.

Woodland caribou on the Island of Newfoundland are recognized as a distinct population (Newfoundland Population) and are considered of Special Concern by COSEWIC (COSEWIC 2014). The RAA for the Caribou VC is based on the ranges of the following assessed herds: Buchans, Grey River, Gaff Topsails and La Poile (Government of NL 2019, 2020). Collectively, these herds represent approximately 36% of the total caribou population on the Island of Newfoundland (Government of NL 2019). The Buchans herd has an overall range of approximately 15,650 km2 between Sandy Lake to the north and the south coast of the Island of Newfoundland and represents approximately 13.7% of the Island’s caribou population.

Potential Project residual effects of change in habitat and mortality risk are predicted to be low magnitude for all four herds. The magnitude for change in movement for the Gaff Topsails, Grey River and La Poile herds is also predicted to be low. However, the residual effect for change in movement for one herd, the Buchans herd, is predicted to be high in magnitude 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.

Marathon is committed to an extensive follow-up and monitoring program, as described above, to reduce the likelihood that the Project will have a significant effect on the Buchans herd.

23.6 SUMMARY OF COMMENTS FROM GOVERNMENT, INDIGENOUS, PUBLIC, AND STAKEHOLDER ENGAGEMENT

The aspects determined to be within the scope of the Project were examined using a precautionary approach to avoid, reduce or mitigate adverse environmental effects. Throughout the EA process for the Project, opportunities have been and will continue to be provided for meaningful Indigenous and stakeholder participation, including opportunities to provide comment on the Project Description, draft guidelines, EIS and the draft EA Report to be prepared by the Impact Assessment Agency of Canada (IAAC).

Marathon is committed to operating the Project within a sustainable development framework which reduces harm to the environment, contributes to local communities, respects human and Indigenous rights, and adheres to openness and transparency in operations. One of the key principles of sustainable development is meaningful engagement with the individuals, communities, groups and organizations interested in or potentially affected by the Project to build and maintain positive, long term and mutually beneficial relationships. Consistent with its corporate values (Respect, Accountability, Transparency, Inclusion and Prosperity), Marathon is committed to ensuring that those whose interests may be affected by the Project, including Indigenous groups and stakeholders (regulators, communities, associations and non-governmental organizations), are appropriately informed and meaningfully engaged regarding the company's ongoing and planned activities. As discussed in Chapter 3, Marathon will continue providing opportunities for such participation and will pursue positive and constructive relationships with Indigenous groups and stakeholders throughout the life of the Project. Information gathered during engagement activities has informed the EIS including the EA methods.

Marathon has implemented an expansive approach to engagement which encompasses relevant government departments and agencies, Indigenous groups, and stakeholder organizations, including communities, business and industry organizations, fish and wildlife organizations, environmental non-governmental organizations, and individuals, including cabin owners (Chapter 3). The Federal EIS Guidelines (Part 2, Section 5) identify Qalipu First Nation (Qalipu) and Miawpukek First Nation (Miawpukek) as Indigenous groups that may be affected by the Project. No other Indigenous groups have come forward or have been identified by either level of government or by Marathon Gold as having an interest in, or being potentially affected by, the Project. Marathon has provided each Indigenous group with opportunities to learn about the Project, including its location, design, potential effects and proposed mitigation measures, to provide input respecting the potential effects of the Project upon Indigenous

interests and activities and to discuss potential mitigation, avoidance and monitoring measures. Additionally, an Aboriginal Traditional Knowledge Study was completed in 2020 by Qalipu to further Marathon's understanding of current use in central Newfoundland by the Qalipu.

Through ongoing engagement, it is Marathon's understanding that the principal issues which have been identified by Qalipu and Miawpukek are as follows:

- Need for continuing engagement and cooperation
- Access to economic opportunities, with specific reference to education and training, employment and access to contracting opportunities
- Environmental stewardship and involvement in monitoring initiatives
- Potential adverse effects on wildlife (particularly caribou) and resulting effects on current use of land and resources
- Effects on Species at Risk
- Potential effects on water quality and quantity and fish habitat
- Design of tailings facility and use of cyanide
- Socio-economic effects including positive effects on employment and business opportunities

Marathon's responses to the issues raised by Indigenous groups, as well as issues raised and responses to government departments and agencies and stakeholder organizations, including communities, business and industry organizations, fish and wildlife organizations, environmental non-governmental organizations, and individuals, including cabin owners, are addressed throughout the EIS, and the associated EIS references can be found in Chapter 3.

23.7 CONCLUSIONS

This EIS documents the results of the environmental assessment of the Valentine Gold Project proposed by Marathon Gold Corporation. This EIS has been prepared in accordance with the requirements of CEAA 2012 and the provincial NL EPA.

Fifteen VCs were identified as relevant and important to the environmental assessment based on regulatory requirements and engagement with Indigenous groups and stakeholders. These were: Atmospheric Environment; Groundwater Resources; Surface Water Resources; Fish and Fish Habitat; Vegetation, Wetlands, Terrain and Soils; Avifauna; Caribou; Other Wildlife; Community Services and Infrastructure; Community Health; Employment and Economy; Land and Resource Use; Indigenous Groups; Historic Resources; and Dam Infrastructure.

The assessment included a characterization of the existing conditions within the spatial boundaries of each VC, including a discussion of the influences of past and present physical activities on the VC, leading to the current conditions. The assessment followed standard EA methods for describing Project interactions with each of the VCs and determining the potential environmental effects, including areas of federal jurisdiction, associated with the Project for the construction, operation, and decommissioning, rehabilitation and closure phases. The environmental effects assessment used a precautionary, conservative approach. Conservative assumptions have been made, so that potential adverse effects are generally overestimated rather than underestimated. Mitigation and environmental protection measures

have been identified to reduce or eliminate adverse effects and the residual environmental effects have been characterized including a determination of their significance.

The environmental assessment predicts that routine Project activities will not cause significant adverse environmental effects on any of the VCs, with the exception of caribou. Similar results were determined for cumulative effects, where Project effects are considered in combination with the effects of other projects (past, present, and reasonably foreseeable future projects).

The general results of the assessment that relate to the key issues raised by regulators, Indigenous groups, and stakeholders, are summarized as follows:

- Employment and Economic Benefits: There are substantial employment and economic benefits to flow from the Project to the benefit of local communities, the central region of NL, and the province. The development of an on-site accommodations camp for all workers, on-site medical and emergency response resources will reduce potential effects on local community infrastructure and services. Local hiring and contracting policies for direct employment and contracts, and induced employment and business in the region will result in substantial benefits to the local and regional economy over a 15-year period (including construction, operation and decommissioning, rehabilitation and closure).
- Water Resources: The environmental assessment has determined there are no significant residual effects on groundwater or surface water resources resulting from routine Project activities, or from the cumulative effects of the Project in combination with other past, present, or reasonably foreseeable future projects. In the event of an accidental event such as a large spill of hazardous materials or effluent release, the risk of effects occurring is reduced based on contingency and emergency response plans. For a dam breach of the full-height TMF, there will be surface water effects in the Victoria River and a relatively small portion of Red Indian Lake only, and the effects are substantially reduced 2 km downstream from the TMF, in the Victoria River.
- Fish and Fish Habitat: The environmental assessment has determined there are no significant effects on fish and fish habitat that will result from routine Project activities, or from the cumulative effects of the Project in combination with other past, present, or reasonably foreseeable future projects. Some small streams and ponds on site will be affected by Project development and operation, most of which is habitat for threespine stickleback only. Marathon will develop and implement a Fish Habitat Offsetting Plan in consultation and with approval of Fisheries and Oceans Canada (DFO) that will create replacement habitat in a nearby location. For accidental events, a potential TMF dam breach carries the most substantial risk. The assessment has determined that for the worst-case TMF dam breach, effects will be limited to the Victoria River and a relatively small area of Red Indian Lake, and therefore will not affect Atlantic salmon resources in the Exploits River.
- Caribou: Potential Project residual effects of change in habitat and mortality risk are predicted to be low magnitude for all four herds. The magnitude for change in movement for the Gaff Topsails, Grey River and La Poile herds is also predicted to be low. However, the residual effect for change in movement for the Buchans herd is predicted to be high due to the amount of overlap of the Project with an existing migration corridor, and the proportion of collared caribou that use the path overlapping the Project. The Buchans herd, which is part of South Coast sub-population, represents 13.7% of the total caribou population on the Island. The prediction of a significant effect is established

on a conservative basis, and reflects both the uncertainty in how Project activities may affect the migratory movement of the Buchans herd and what the long-term effects on the herd may be, and the uncertainty of success of the proposed mitigation measures. Marathon is committed to working with regulators, Indigenous groups and stakeholders to develop comprehensive programs to monitor migration patterns and populations of the caribou herds in the area, and in particular the Buchans herd. Marathon is currently working with provincial regulators to conduct ongoing baseline monitoring programs and plans to continue and adapt these monitoring programs over the life of the Project.

- Victoria Lake Reservoir and Victoria Dam: The environmental assessment has determined there are no significant effects on Victoria Lake Reservoir or Victoria Dam resulting from routine Project activities, or from the cumulative effects of the Project in combination with other past, present, or reasonably foreseeable future projects. Due to Marathon's re-location of the TMF downstream of the Victoria Dam, a worst-case TMF dam breach is also not expected to impact the Victoria Dam.

Follow-up and monitoring programs have been proposed for other VCs, as applicable, to verify the accuracy of the residual effects assessment, determine the effectiveness of mitigation measures, and monitor compliance with regulatory approvals, permits and authorizations.

In the unlikely event of a worst-case industrial accident or malfunction which results in a large-scale release into the environment, there is a potential for significant residual adverse effects to VCs. However, the risk of a significant effect occurring is low, given the Project design, maintenance and monitoring measures that will be in place to reduce the risk of an accident or malfunction occurring. In addition, emergency response plans and contingency measures will be in place to limit the extent and nature of potential environmental effects in the event of an accident or malfunction.

Marathon is committed to the successful development and operation of the Valentine Gold Project, and envisions an enterprise balancing commercial success with a safe working environment, effective environmental management, and the creation of lasting social benefit. Marathon will implement high standards of environmental performance as part of its commitment to safe and responsible environmental, social and economic development.

23.8 REFERENCES

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