APPENDIX 10A

Valentine Gold Project: Caribou Baseline Information 2023 Update

Valentine Gold Project: Caribou Baseline Information

2023 Update

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Abbreviations

BSA	Baseline Study Appendix
CI	Confidence Interval
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
dBBMM	Dynamic Brownian Bridge Movement Model
EA	Environmental Assessment
EIS	Environmental Impact Statement
GIS	Geographic Information System
GPS	Global Positioning System
IAAC	Impact Assessment Agency of Canada
KDE	Kernal Density Estimation
km	kilometre
km^2	squared kilometre
LAA	Local Assessment Area
LCP	Least-cost Path
LiDAR	Light Detection and Ranging
m	metre
Marathon	Marathon Gold Corporation
n	Total Sample Size
$\hat{N}$	Population Estimate
NL	Newfoundland and Labrador
NLDECC	Newfoundland and Labrador Department of Environment and Climate Change
NLDFFA – Wildlife Division	Newfoundland and Labrador Department of Fisheries, Forestry and Agriculture – Wildlife Division
NSD	Net Squared Displacement
SARA	*Species at Risk Act*
SE	Standard Error
the Project	Valentine Gold Project
UD	Utilization Distribution
ZOI	Zone of Influence

1.0 INTRODUCTION

Marathon Gold Corporation (Marathon) proposed 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). On September 29, 2020, Marathon filed an Environmental Impact Statement (EIS) with the Impact Assessment Agency of Canada (IAAC) and Newfoundland and Labrador Department of Environment and Climate Change (NLDECC), assessing potential Project and cumulative effects of the Valentine Gold Project (the Project). The Project was released from the environmental assessment (EA) process by NLDECC on March 17, 2022, and by IAAC on August 24, 2022.

An assessment of Project effects on woodland caribou (*Rangifer tarandus)* was presented in Chapter 11 of the EIS, supported by baseline studies appended to the EIS (Marathon 2020), and supplementary information presented in the Caribou Supplemental Information Report (Marathon 2021). The EIS assessed the effects of the Project on four caribou herds (EIS Chapter 11): Buchans, Gaff Topsails, Grey River and La Poile herds. Adverse residual effects of the Project on caribou from the Gaff Topsails, Grey River and La Poile herds were predicted to be low in magnitude and not significant. Due to the overlap between the Project and the migration path used by over 50% of the Buchans herd, the residual effect on change in movement for the Buchans herd was predicted to be high in magnitude and was considered likely to occur. With implementation of mitigation measures, and taking into consideration various uncertainties, the residual adverse effect of change in movement for the Buchans herd was conservatively predicted to be significant.

Since the EIS submission, additional baseline information has been collected on the Buchans herd using remote camera surveys (Appendix A), aerial surveys (Appendix B) and caribou telemetry data. This report presents newly acquired baseline data on the Buchans herd, up to and including data collected during 2022 and provides a consolidated discussion of all baseline data collected to date. The new data goes up to the point when the Project was released from the federal EA process in August 2022, shortly after which the construction phase started. The data presented will be used as the baseline from which future monitoring programs will be compared as it consolidates available Project pre-construction information.

This document presents baseline information on caribou that is additional to the EIS; however, this information does not change the conclusions of the assessment as presented in the EIS.

1.1 BACKGROUND

1.1.1 Project Overview

The Project (Figure 1-1) is in central Newfoundland, approximately 57 kilometre (km) south of Buchans, and is comprised of two open pits, waste rock piles, crushing and stockpiling areas, conventional milling and processing facilities, a tailings management facility, personnel accommodations and supporting infrastructure including roads, on-site power lines, buildings and water and effluent management facilities. The mine site is accessed by an existing gravel road, approximately 82 km in length, which extends south from Millertown to the Project. Approximately 73 km of this existing access road will be upgraded and maintained by Marathon as part of the Project.

The spatial boundaries for the assessment of potential Project effects on caribou include the Project Area (Figure 1-1), defined as the mine site and access road (plus a 20 metre [m]-buffer on either side of the road), and the Local Assessment Area (LAA), which includes a 1 km-buffer surrounding the mine site and a 500 m-buffer surrounding the access road (Figure 1-1). The LAA encompasses the area in which Project-related environmental effects (direct or indirect) can be predicted or measured. The EIS also defined a Regional Assessment Area (Figure 1-2), to inform the assessment of cumulative effects, which includes the combined population ranges of the Buchans, Gaff Topsails, Grey River and La Poile caribou herds as determined by caribou telemetry data obtained from the Newfoundland and Labrador Department of Fisheries, Forestry and Agriculture – Wildlife Division (NLDFFA – Wildlife Division).

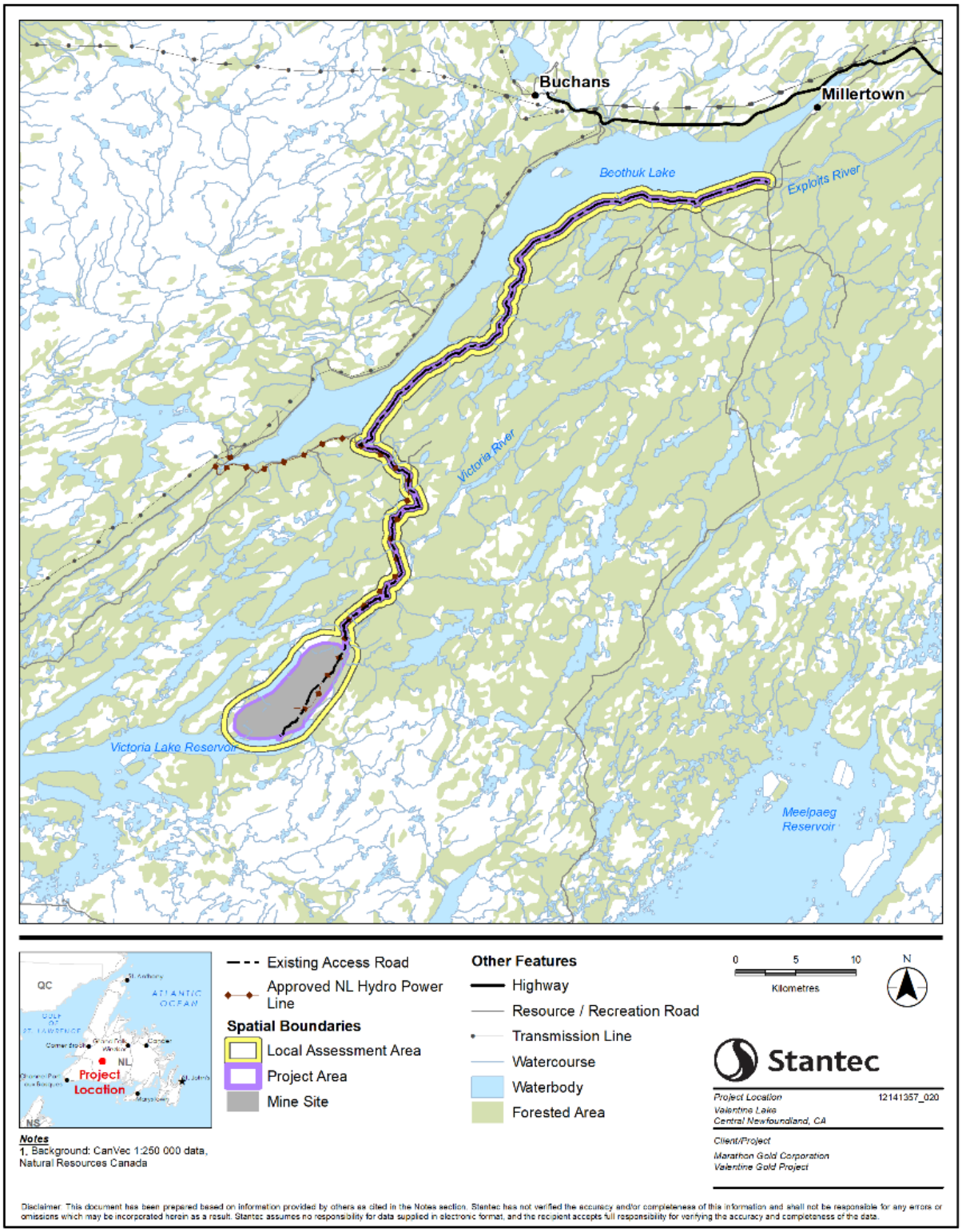


Figure 1-1 Project Location and Spatial Boundaries

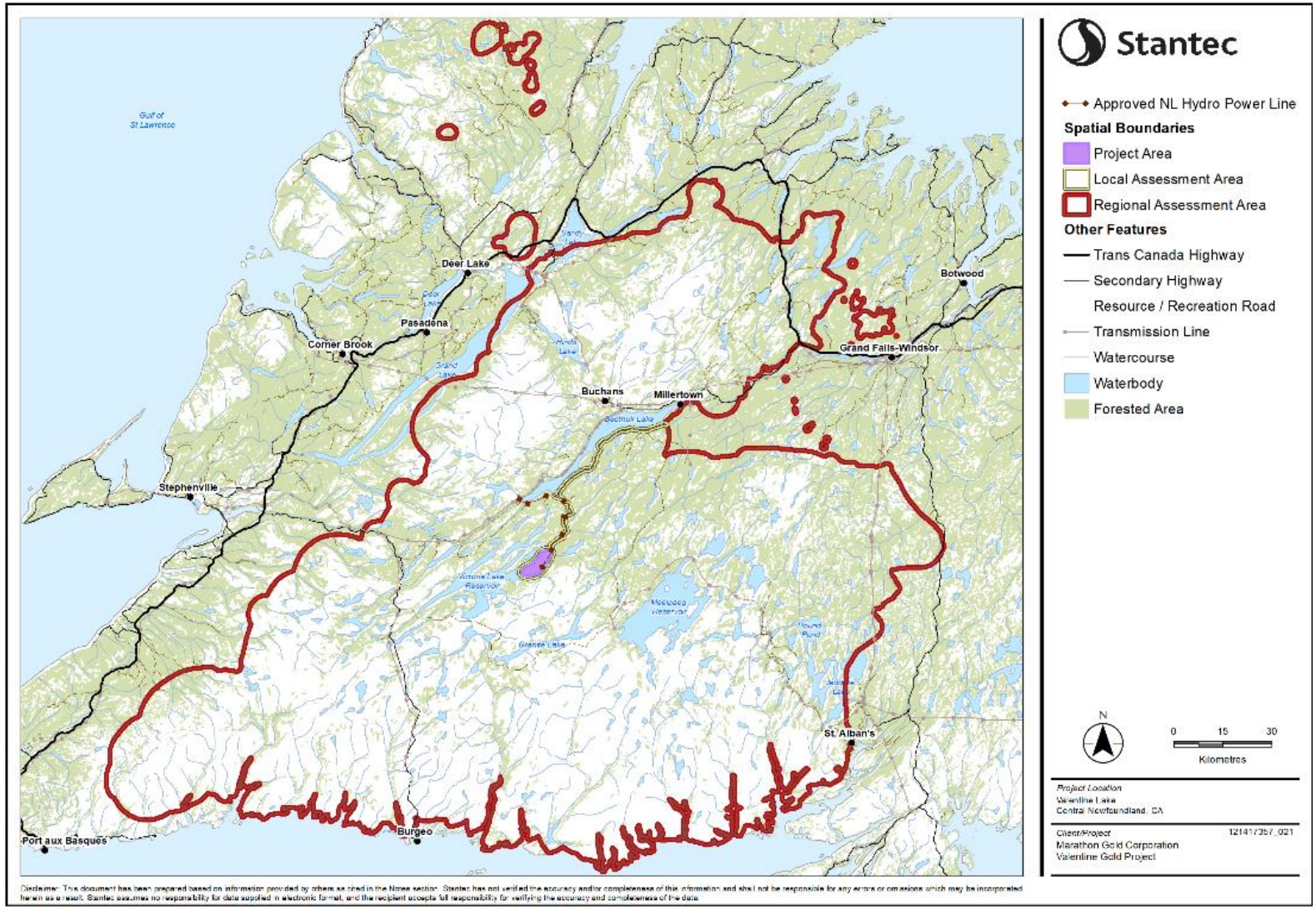


Figure 1-2 Caribou Regional Assessment Area

1.2 BUCHANS CARIBOU HERD

Woodland caribou are distributed across northern North America from Alaska to the Island of Newfoundland. Under the federal *Species at Risk Act* (SARA), woodland caribou on the Island of Newfoundland are recognized as a distinct population (Newfoundland Population) (Committee on the Status of Endangered Wildlife in Canada [COSEWIC] 2014) and were recently (August 2021) listed as a species of Special Concern under Schedule 1 of SARA (Government of Canada 2021), based on the 2014 COSEWIC status assessment that upgraded the population status to special concern from not at risk (COSEWIC 2014). At the time of writing, the Newfoundland Population of woodland caribou is not listed under the provincial *Endangered Species Act*.

The Newfoundland Population of caribou is comprised of several sub-populations that are differentiated by annual movement patterns, spatial affiliations, and genetic structure (Wilkerson 2010; Government of NL 2015). The four assessed herds in the EIS (i.e., Buchans, Gaff Topsails, Grey River and La Poile) are part of the South Coast sub-population (Wilkerson 2010; Schaefer and Mahoney 2013; Government of NL 2019) that undergo seasonal movements between ranges. These herds intermix on winter ranges near the southern shore between Burgeo and the Connaigre Peninsula (Weir et al. 2014) but have separate calving areas and summer ranges. Caribou from the Buchans herd undertake the largest movements between seasonal ranges, moving from central Newfoundland during the fall to wintering areas on the south coast.

Modeling completed as part of the EIS identified a single, distinct population-level migration path through the Project Area during both spring and fall migration periods (EIS Section 11.2.2.1). Up to 55.1% of the collared caribou used the dominant migration path during spring, and up to 58.4% used it in fall. While this result was based on collared caribou, the assumption is that the movement patterns are representative of the herd generally. This implies that over half of the Buchans herd uses this migration path during seasonal movements.

2.0 EXISTING CONDITONS – BUCHANS CARIBOU HERD

2.1 INFORMATION SOURCES

Information available for the EIS was included as a baseline study appendix to the EIS (Valentine Gold EIS: Baseline Study Appendix 2: Woodland Caribou [BSA.2]; Marathon 2020) and was incorporated into the body of the EIS, with additional baseline data were subsequently presented in the Caribou Supplemental Information document (Appendix G of the Valentine Gold Project: Amendment to the Environmental Impact Statement; Marathon 2021). This report compiles relevant data from the EIS, the Caribou Supplemental Information document, and available new data (i.e., from 2021 and 2022) to provide comprehensive updated baseline information for caribou. Information sources for the Updated Caribou Baseline report include:

- Updated estimates of seasonal herd ranges (kernel densities) based on caribou telemetry data from 2006 to 2013, 2015 to 2018, and 2022 **- new data**

- Updated dynamic Brownian bridge movement models (dBBMM) for the Buchans caribou herd, using available historical telemetry data from 2006 to 2013, 2015 to 2018, and 2022 **- new data**
- Caribou Alternate Migration Pathway Analysis to predict potential alternate migratory pathways that may be used by the Buchans herd (Appendix A of the Caribou Supplemental Information Report; Marathon 2021)
- Net squared displacement (NSD) analysis to identify Buchans caribou spring and fall migration timing and duration using telemetry locations of collared caribou from 2006 to 2013, 2015 to 2018, and 2022 **- new data**
- Delineation of heavily used wildlife trails (migration paths) in the mine site using Light Detection and Ranging (LiDAR) data (Valentine Gold EIS: BSA.2, Attachments 2-A and 2-B, Marathon 2020])
- Results from remote camera programs in fall 2019 (Appendix A [EIS BSA.2, Attachment 2-A]), spring 2020 (Valentine Gold EIS: BSA.2 Attachment 2-B; Marathon 2020), fall 2020 (Appendix B [Caribou Supplemental Information Report])
- Results from remote camera programs in spring and fall of 2021 and 2022 (Appendix A) **- new data**
- Aerial post-calving survey results from 2020 (Valentine Gold EIS: BSA.2, Attachment 2-C; Marathon 2020)
- Aerial post-calving survey results from 2020, 2021-2022 (Appendix B) **- new data**

2.2 OVERVIEW OF METHODS

2.2.1 Desktop Analyses of Seasonal Ranges and Movements of the Buchans Caribou Herd

As part of the EIS, caribou telemetry data (spanning 1994-2018) provided by the NLDFFA – Wildlife Division were used to estimate the seasonal range use and movements of collared caribou. Collar data and subsequent LiDAR analyses identified several caribou migration paths through the mine site, including one between the north end of Valentine Lake and the Victoria River. Movement models (dBBMM) were used to estimate utilization distributions (Kranstauber et al. 2012) to identify seasonal migration routes for the Buchans herd, the results of which identified a primary spring and fall migration corridor through the Project Area (Section 11.2.2.1 of the EIS).

Since the EIS submission, an additional 60 Global Positioning System (GPS) collars were purchased in 2020, with deployment by staff from the NLDFFA – Wildlife Division on caribou from the Buchans herds commencing in fall of that year. These collars were purchased by Marathon to provide additional baseline data on Buchans caribou and to support future environmental effects monitoring. Information from the new collars (2020-2022), combined with earlier data (2006-2017) was used to refine and update the seasonal ranges and migration routes of the Buchans herd.

2.2.1.1 Seasonal Range Use

Kernel or range density estimates were used to describe the location, area and seasonal range use of collared caribou in the Buchans herd. The dates for spring and fall migration used in this analysis (Table 2.1) were based on the results of the NSD analysis (Section 2.3.3), with remaining seasons informed by the general seasons for caribou on the Island of Newfoundland (Emera 2013).

Table 2.1 Caribou Seasonal Timing Periods for the Buchans Caribou Herd

General Seasons for Caribou on the Island of Newfoundland[A]		Seasons Identified using NSD Spring and Fall Migration Dates[B]	
Winter	December 16 – March 31	Fall Dispersal / Winter	November 27 – April 7
Spring Migration / Pre-calving	April 1 – May 19	Spring Migration	April 8 – May 2
Calving	May 20 – June 10	Pre-calving / Calving	May 3 – June 10
Post-Calving Migration / Dispersal	June 11 – June 30	Post-Calving Migration / Dispersal	June 11 – June 30
Post-Calving Rearing	July 1 – August 31	Post-Calving Rearing	July 1 – August 31
Fall Rut	September 1 – October 31	Fall Rut	September 1 – November 9
Fall Migration / Dispersal	November 1 – December 15	Fall Migration	November 10 – 26

Notes:
A. Source Emera 2013.
B. NSD dates are mean dates; refer to Section 2.2.1.2 (NSD methods) and Section 2.3.3 (NSD results).

Seasonal caribou ranges (or kernels) were estimated from telemetry data using a geographic information system (GIS). For each season, a utilization distribution was determined using the kernel density estimation (KDE) method in ArcGIS™ v.10.8.1 (ESRI 2022) using the Kernel Density tool. Two kernel sizes or contour intervals were determined for each seasonal range. The 50% contour area is a representation of the "core area" (i.e., areas where caribou are expected to spend more time), and the 95% contour area is a representation of the estimated seasonal home range boundary. Smoothed cross-validation was used as the smoothing parameter for the calculation. Figures were created for each season illustrating the collared caribou seasonal range (Section 2.3.1).

The seasonal range calculations included collared animals with at least 50 locations in the season of interest, based on recommendations for wildlife kernel analysis (Seaman et al. 1999; Barg et al. 2005; Tri et al. 2014). All GPS collars were programmed to collect locations every two hours.

2.2.1.2 Buchans Caribou Herd Migration Models

Net Squared Displacement

NSD (Bunnefeld et al. 2011, Singh et al. 2016) was used to classify migratory behaviour and to identify timing and duration of spring and fall migration periods using GPS collared caribou data collected from 2006 to 2012, 2015-2017 and 2020-2022. NSD measures the straight-line distances between the starting location and subsequent locations for the movement path of an individual (Bunnefeld et al. 2011). The starting location was set to February 1 when caribou in the Buchans herd were still on their winter range. The NSD was used to evaluate the existing NLDFFA – Wildlife Division caribou migration dates and to inform the dBBMM analysis by estimating the start and end dates of spring and fall migration for individual collared caribou.

The data were initially screened to only include collared caribou that migrated between Buchans winter range and summer range. Only caribou with one or more full migration year(s) (February 1 to January 31) were used in the NSD analysis. GPS-collared caribou were excluded from the NSD analysis if they did not migrate (total sample size [n]=3) or were not considered a Buchan herd individual based on seasonal range distributions (i.e., Grey River caribou; n=9). In addition, individuals that were a poor fit (concordance criteria < 0.8) for the migration model were dropped from further analysis (n=2).

A total of 88 full migrations from 45 GPS-collared caribou were used to fit NSD models. NSD curves were visually inspected, and when necessary, start and end dates adjusted to improve accuracy of migration events (Aikens et al. 2020). Similarly, start and end dates were visually estimated from NSD curves for GPS-collared caribou with only spring or fall migration data. A total of 117 and 140 migrations from 77 and 79 GPS collared caribou were used to estimate start and end dates for spring and fall migration, respectively. NSD models were fit using the R package adehabitatLT version 0.3.26 (Calenge et al. 2022).

Dynamic Brownian Bridge Movement Model

The updated dBBMM used new collar data collected during 2020-2022 combined with previous GPS data collected during 2006-2017 to identify spring and fall caribou migration routes. The telemetry data was pooled across years because a separate dBBMM using migration data from 2020-2022 produced similar migration pathways to the previous data presented in the EIS. Similar to the previous analysis, GPS-collared caribou were excluded from the dBBMM analysis if they did not migrate, contain an entire migration period or were not considered a Buchans herd individual based on seasonal range distributions (e.g., Grey River caribou).

A total of 74 spring and 93 fall migration paths from 30 GPS-collared caribou were initially used to identify seasonal migration corridors of the Buchans herd (Section 11.2.1.3 of the EIS). During 2020-2022, 63 additional spring migration paths were identified using 47,571 GPS locations collected from 48 GPS collared caribou. During 2020-2021, additional fall migration paths were identified using 35,346 GPS locations collected from 37 GPS collared caribou. A total of 137 spring migration paths collected from 77 GPS-collared caribou and 130 fall migration paths from 79 GPS-collared caribou were used in the updated baseline dBBMM.

The updated dBBMM used the start and end dates of the spring and fall migration periods identified in the NSD for each collared caribou, which differed from the previous analysis that used NLDFFA – Wildlife Division migration dates. To generate the updated dBBMM the same model parameters (e.g., window size, grid cell size 100 m x 100 m) were used as the previous analysis completed for the EIS. For each pixel within the migration path, a utilization distribution (UD) was calculated, which represented the probability that an individual GPS-collared caribou was located within that grid cell during their spring or fall migration periods relative to other grid cells within the migration path. Because most caribou had more than one spring or fall migration recorded, probability cell values were summed and then rescaled to sum to 1 to represent one UD for each collared caribou within each season (Sawyer et al. 2009). A dBBMM was fit to each individual GPS-collared caribou for each season using the ‘move’ package version 4.1.10 (Kranstauber et al. 2020) in program R (R Core Team 2022). A population-level migration corridor was estimated by summing the UD for each collared caribou and rescaling cell values to sum to 1 (Sawyer et

al. 2009). The UD values for each population-level spring and fall migration corridor was classified into quartiles where the upper 25% quartile of the UD for each seasonal migration period was considered an area of high use and assumed to represent 'migratory stopovers' (e.g., resting, foraging) similar to Sawyer et al. (2009) and Sawyer and Kauffman (2011). The remaining quartiles (25-50% and 50-75%) were considered connecting movement pathways between stopover sites, and the last quartile (75-99%) represented relatively low use areas. This collection of migration paths identified by the dBBMM is referred to as a migration corridor.

2.2.1.3 Alternate Migration Pathway Analysis

To assist in understanding potential effects of the Project on migration patterns of caribou from the Buchans herd, a Caribou Alternate Migration Pathway Analysis was undertaken by Marathon (Appendix A of the Caribou Supplemental Information Report; Marathon 2021). This GIS-based analysis was supported by literature relating to caribou avoidance of disturbances, the presence of physical obstacles, energetic costs, predation risk, and the use of existing migration pathways outside of the identified primary migration corridor, which are historically used by some caribou from the Buchans herd. A least-cost path (LCP) analysis was undertaken to:

1. Predict potential alternate migratory pathways that may be used by the Buchans herd during spring and fall migrations during Project activities
2. Identify the habitat types within and along alternate migration paths; and
3. Estimate changes in energetic costs based on distance travelled

The analysis included modelling the relative energetic cost for an animal to move between locations, assuming complete avoidance of potential Zones of Influence (ZOIs) around the mine site (i.e., 1 km, 5 km, 10 km and 15 km), and under frozen and unfrozen scenarios. This model “determined” potential migratory paths around the pre-defined ZOIs, based on preferences identified through the baseline conditions as preferential. A ‘baseline’ movement pathway was predicted by running the LCP analysis with no ZOI to serve as a comparison to potential alternate pathways. The baseline LCP migration path and the dBBMM results (EIS Section 11.2 and below [Section 2.3.2]) had a high degree of congruence, suggesting the caribou were currently migrating along the shortest LCP, and that the LCP analyses could be reasonable predictors of potential alternate migration pathways.

As the analysis used models to predict potential migratory pathways around pre-defined ZOIs versus relying on GPS collar data, the Alternate Migration Pathway Analysis was not updated from the original analysis presented in the Caribou Supplemental Information Report.

2.2.2 Remote Camera Monitoring

2.2.2.1 Objectives

The remote camera monitoring program was initiated in fall 2019 to provide information on caribou group size and composition, as well as the timing and location of spring and fall migrations through the mine site.

2.2.2.2 Remote Camera Deployment

Camera placement (n=12) in 2019 was aligned with well-defined migration paths through the mine site (identified using LiDAR data and informed by input from NLDFFA – Wildlife Division), which had indicated a prominent caribou migration path through the Marathon pit (Government of NL 2019). Five general areas were selected for the deployment of 12 cameras (Figure 2-1): Valentine Lake outlet (VAL1, VAL2, VAL3), Marathon pit (MAR1, MAR2, MAR3, MAR4), Main Road (MAINRD, MARBOG), South Side of Victoria River (SS1 and SS2) and Victory pit (VIC1). The sites used for the fall 2019 program were also used for the spring 2020 and fall 2020 caribou programs to support a comparison among years (except SS2 because of challenges associated with retrieving the camera) and to inform subsequent camera monitoring initiatives.

In consultation with NLDFFA – Wildlife Division, the remote camera program was expanded in spring 2021 to a total of 26 cameras (Table 2.2). Locations for the deployment of these cameras were based on LiDAR imagery, dBBMM outputs, and the results of the Caribou Alternate Migration Pathway Analysis (Table 2.3). The program was further expanded in fall 2021 with the deployment of five additional cameras (Figure 2-2 and Table 2.2). Except for two cameras (12 and 13), the locations selected in 2021 differed from those used in 2019 and 2020. Table 2.3 summarizes the season and number of cameras deployed from 2019-2023 and final camera locations are shown in Figure 2-2 and Figure 2-3 superimposed on predicted migration routes during fall and spring, respectively.

Table 2.2 Summary of Remote Camera Deployments and Monitoring Periods, 2019-2022

Season	Camera ID	Total Cameras Deployed
Fall 2019[A]	VAL1 (#13)[B], VAL2 (#12)[B], VAL3, MAR1, MAR2, MAR3, MAR4, MAINRD, MARBOG, SS1, SS2, VIC1	12
Spring & Fall 2020[A]	VAL1 (#13)[B], VAL2 (#12)[B], VAL3, MAR1, MAR2, MAR3, MAR4, MAINRD, MARBOG, SS1, VIC1	11[C]
Spring 2021	1 to 26[B,D]	26
Fall 2021 Spring & Fall 2022 Spring 2023[E]	1 to 31[B,D]	31

Notes:
A. Camera locations used during 2019 and 2020 are presented in Figure 2-1.
B. Cameras 12 and 13 are the same locations as VAL2 and VAL1, respectively.
C. Eleven cameras were deployed in Spring 2020, but only 10 recorded data due to a camera malfunction.
D. Camera locations 1-31 are presented in Figure 2-2 and rational for their selection in Table 2.3.
E. Data from 2023 not available at the time of writing.

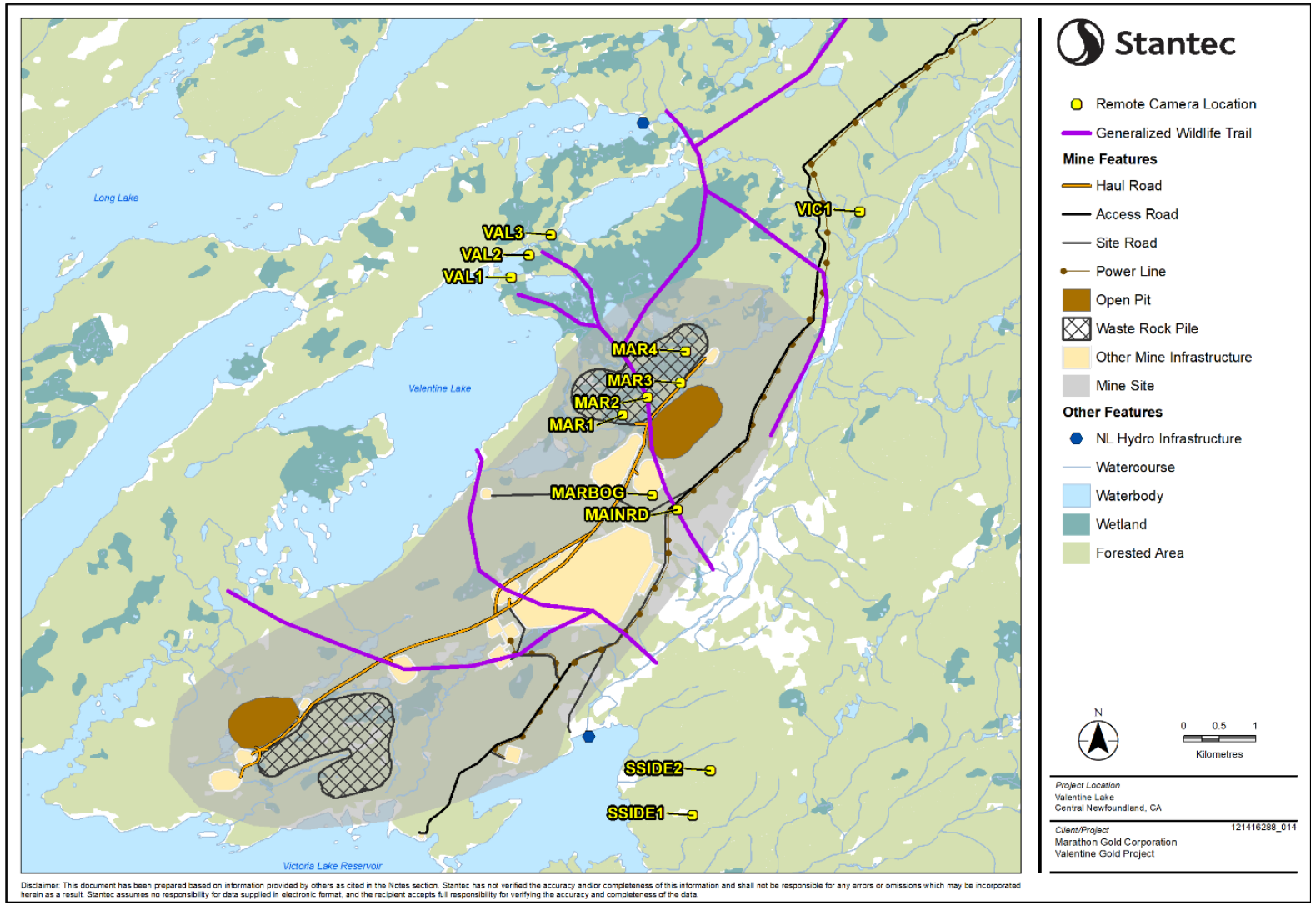


Figure 2-1 Camera Locations Used during the 2019 and 2020 Remote Camera Caribou Program

Table 2.3 Final Remote Camera Locations and Rationale

Camera Location[A]	Rationale			
	Aligns with wildlife trail identified from LiDAR data	Aligns with caribou migration paths identified by dBBMM[B]	Monitors caribou entry and exit points to the mine site	Aligns with potential alternate migration path identified by LCP[B] analysis
1		✓		✓(0 km ZOI[C], spring migration, frozen conditions)
2	✓	✓		✓(1 km ZOI, spring and fall migration, non-frozen conditions)
3		✓		✓(1 km ZOI, spring migration, non-frozen conditions)
4		✓		
5		✓		✓(1 km ZOI, spring migration, frozen conditions)
6		✓	✓	
7	✓	✓	✓	
8	✓	✓ (primary pathway)	✓	
9	✓	✓	✓	
10		✓	✓	
11	✓	✓	✓	
12[D]	✓	✓ (primary pathway)		
13[D]	✓	✓ (primary pathway)		
14	✓	✓	✓	✓(0 km ZOI, spring and fall migration, frozen and non-frozen conditions)
15	✓	✓	✓	
16	✓	✓ (primary pathway)	✓	
17	✓	✓	✓	
18	✓	✓		✓(0 km ZOI, spring migration, frozen and non-frozen conditions)
19		✓		
20		✓		✓(0 km ZOI, spring migration, frozen and non-frozen conditions)
21		✓		✓(1 km ZOI, spring migration, non-frozen conditions)
22		✓		
23		✓		✓(1 km ZOI, spring migration, frozen conditions)
24		✓		✓(1 km ZOI, spring migration, frozen and non-frozen conditions)
25		✓		✓(5 km ZOI, spring migration, non-frozen conditions)

Table 2.3 Final Remote Camera Locations and Rationale

Camera Location[A]	Rationale			
	Aligns with wildlife trail identified from LiDAR data	**Aligns with caribou migration paths identified by dBBMM[B]**	**Monitors caribou entry and exit points to the mine site**	**Aligns with potential alternate migration path identified by LCP[B] analysis**
26				✓(5 km ZOI, spring migration, non-frozen conditions)
27[E]		✓ (primary pathway)		
28[E]		✓ (primary pathway)		✓ (0 km and 1 km ZOI, spring and fall migration, non-frozen conditions)
29[E]		✓		
30[E]		✓		✓ (5 km ZOI, spring migration, frozen conditions)
31[E]		✓		✓ (5 km ZOI, fall migration, frozen conditions; 10 km ZOI, fall migration, non-frozen conditions)

Notes:

A. Camera locations are presented in Figure 2-2 and Figure 2-3, superimposed on predicted migration routes during fall and spring, respectively.

B. dBBMM = Dynamic Brownian Bridge movement models. LCP = Least Cost Pathway

C. ZOI = Zone of Influence (as defined in the EIS [Marathon 2020]).

D. Cameras 12 and 13 were the same locations as VAL2 and VAL1, respectively, previously used in 2019 and 2020.

E. New deployment location beginning fall 2021.

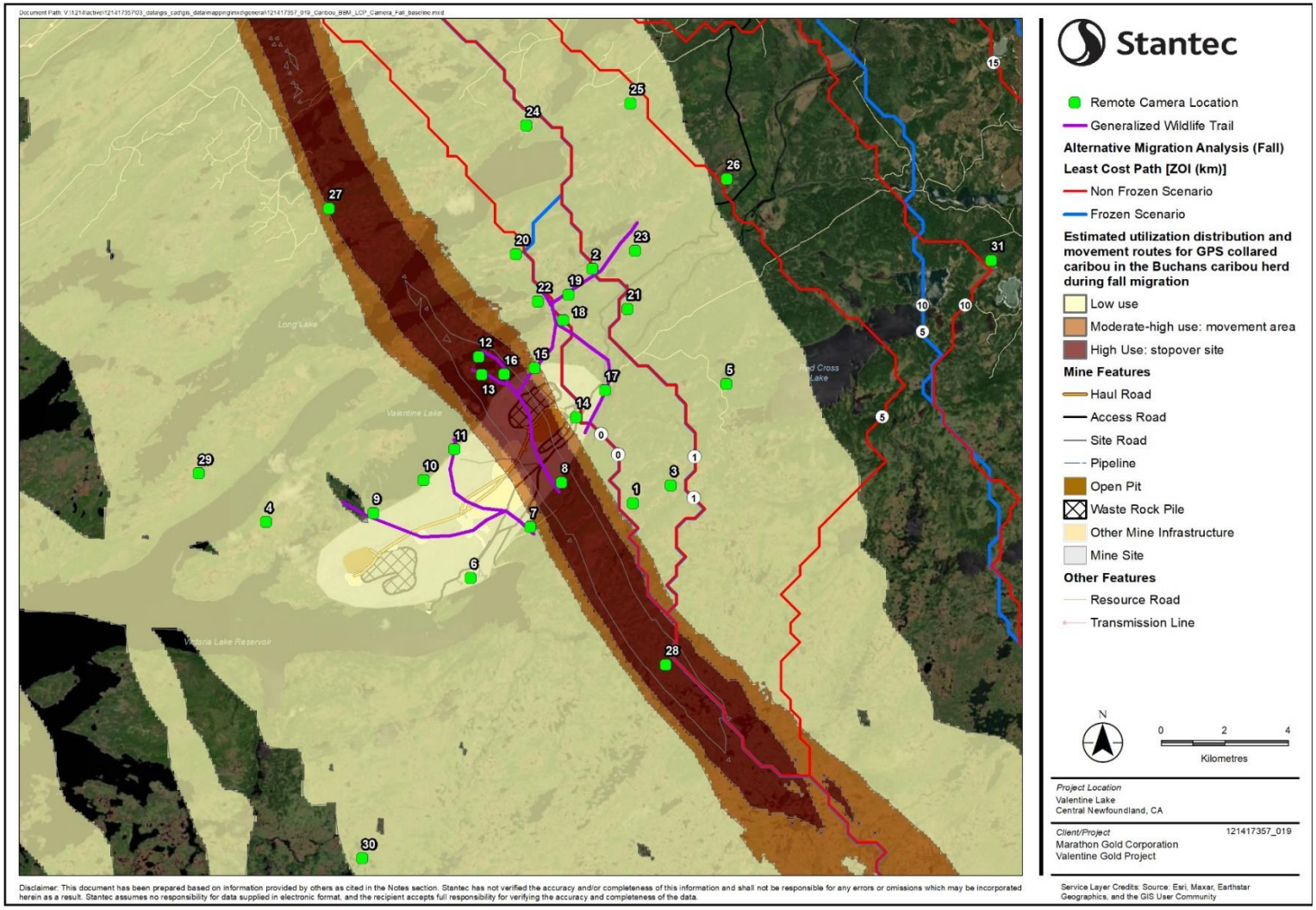


Figure 2-2 Remote Camera Locations used during the 2021 (26 Cameras) and 2022 (31 Cameras) Remote Camera Program Superimposed on Predicted Fall Movement Routes

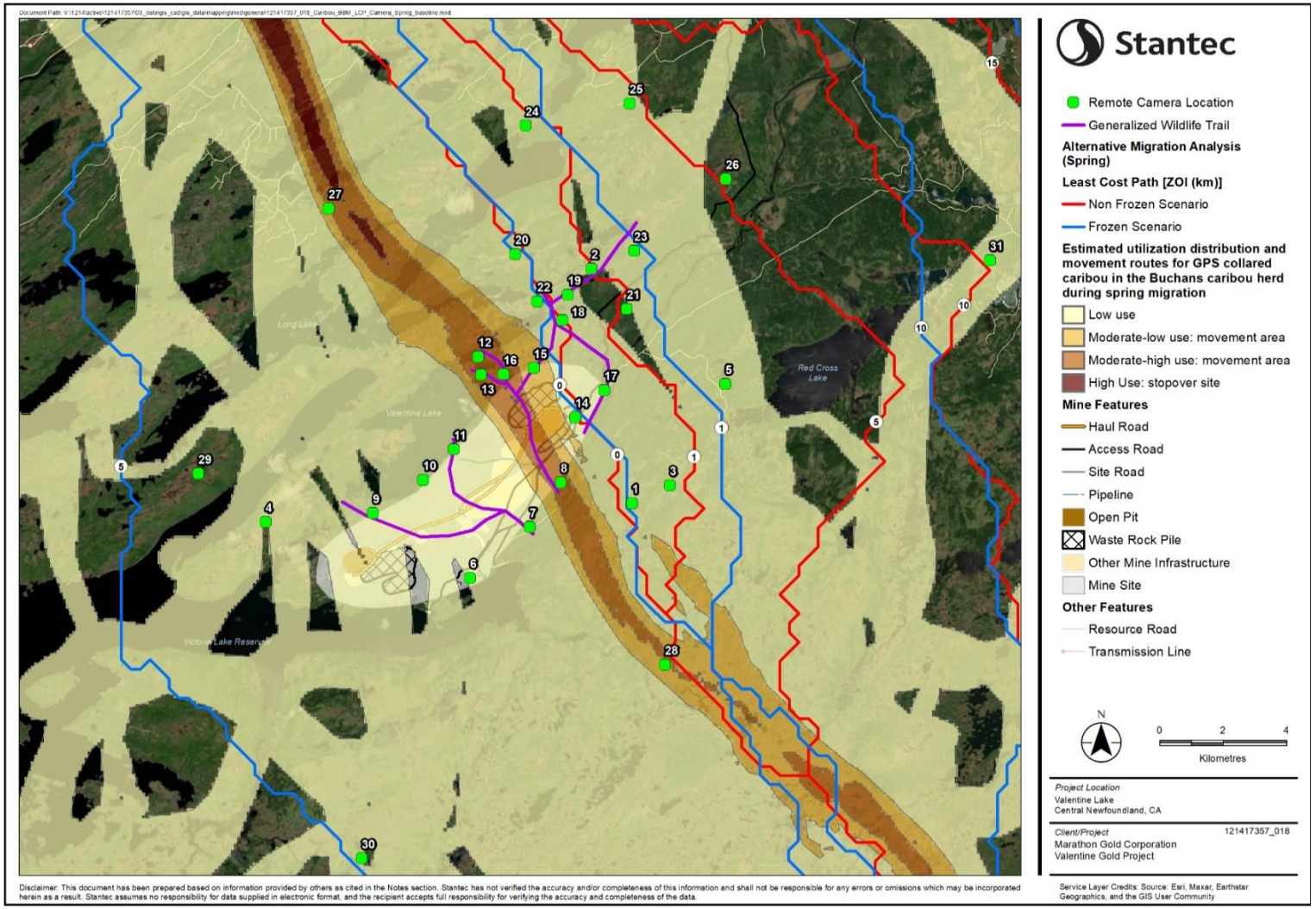


Figure 2-3 Remote Camera Locations used during the 2021 (26 Cameras) and 2022 (31 Cameras) Remote Camera Program Superimposed on Predicted Spring Movement Routes

Two camera models were used during the initial surveys, *Reconyx HS2X Hyperfire 2 Security Covert IR* and *Browning Dark Ops HD Pro X*, with the Browning model phased out in after the fall 2021 season. Both models have similar settings, which include infrared night vision illuminators to allow photography at night (Table 2.3). Camera settings were selected to increase the probability of wildlife detection and identification (Stantec 2015). Lithium-ion batteries and 64 gigabyte memory cards were used in the cameras.

The cameras were deployed at each site using a standardized set-up to allow for consistency among sites and to reduce potential effects of camera placement or setup on wildlife detection. Cameras were deployed at least 500 m from one another to improve likelihood of independence (Stantec 2015), although some cameras are purposefully on the same trail at entry and exit points (e.g., cameras 7 and 11; cameras 8 and 16).

Cameras were mounted on trees with diameters of at least 20 centimetres. At sites where the camera mount needed additional stability, trees were braced with logs to reduce movement caused by wind. At sites with no suitable trees, tripods were installed as camera mounts. Cameras were placed approximately 1 to 1.5 m above ground to increase the probability of large mammal detection (Stantec 2015). Each camera was positioned facing a game trail to increase the path length of animals through the frame (Rovero et al. 2010). To reduce the incidence of false positives (i.e., camera is triggered by something other than wildlife such as branches or grasses moving in the wind), visible vegetation within the camera's field of view was trimmed where necessary. A walk test was completed before leaving the site to assess camera angle, position and path length along the game trail to improve likelihood of detection.

2.2.2.3 Data Analysis

Remote camera photos were reviewed using the program Timelapse v.2.2.5.1, an image analysis software program that extracts photograph metadata and facilitates the management of photo results (Greenberg 2023). Photos were analyzed based on independent events identified from a photo series. For the analysis, an event was defined as beginning when one or a group of animals entered the frame and ending when they had exited the frame for more than two minutes (Rowcliffe et al. 2008, Stantec 2015). The likelihood of overestimating the number of individual caribou was reduced through a combination of camera placement and image classification techniques. Cameras were positioned perpendicular to the migration paths and, as such, most of the caribou captured by the cameras were moving across the frame. Additionally, most of the caribou moved across the frame either singly or in small groups, or in longer 'strings' comprised of many animals. When viewed in chronological order, it was possible to mark the progression of individual caribou across the frame based on their relative proximity to landmarks and other caribou. Only new animals entering the frame were counted and added to the total for that discrete event (as opposed to summing the total number of caribou in each image). This technique reduced the likelihood of overestimating the number of individual caribou.

Detected caribou were classified as: calves (i.e., neonates); yearlings = one to two years; and adults > two years. The category of "unknown" included caribou of all age classes whose sex could not be determined. The category of "total caribou" included adults, yearlings, calves and unknown. Caribou were

classified based on presence of a vulva or penis, head and body size, and antler characteristics (e.g., presence or absence, shape). “Total adults” included adults of known and unknown sex.

Survey effort was calculated for each annual season using the number of camera-days (i.e., total number of cameras deployed times the number of days each camera was operational). The number of independent events, total number of caribou detected in each event and the mean (±standard error [SE]) number of daily caribou events (detections/day) were calculated. The following values were also summarized for each season (but not intended to provide an annual population, sex and age ratio estimate): male:100 females; percent males (males/total caribou x 100); calf:100 females; percent calves (calves/total caribou x 100); and percent yearlings (yearlings/total caribou x 100).

The start of the peak movement period was defined as the first Julian day when the proportion of caribou events exceeded 5% of the total observations for each season and the end as when the cumulative total exceeded 80% of caribou events.

Note that the summary of the data includes detections from the total camera deployment period and, as such, in years with extended deployment periods (e.g., spring 2022) have a greater chance of including resident Grey River caribou, based on seasonal ranges for this herd that indicate their presence in the vicinity of the mine site during calving (May 20 to June 10; Figure 11-9 in the EIS).

Descriptive statistics were calculated in the statistical computing software R (version 4.2.2) (R Core Team 2022).

2.2.3 Post-calving Aerial Surveys

Aerial surveys were undertaken in 2021 and 2022 to estimate the population of caribou in the Buchans herd calving grounds survey area and to determine caribou group size and composition, including the number of calf:female pairs (i.e., classification survey), for caribou in the Buchans herd calving grounds survey area and on calving grounds within the Project’s ZOI. Surveys were completed in accordance with methods and conditions outlined in Scientific Research Permits issued by NLDFFA – Wildlife Division, and following direction (timing and extent of survey area) from NLDFFA – Wildlife Division who also had a representative participate on the surveys.

The spatial range for the Buchans herd calving grounds (5,229.6 square kilometres [km^2]) was estimated from telemetry data from 2007-2012 and 2016-2017, plus a 5-km buffer, and boundaries recommended by the NLDFFA – Wildlife Division (Figure 2-3). Criteria used to delineate the Buchans herd calving grounds are described in detail in Valentine Gold EIS BSA.2, Attachment 2-C (Marathon 2021). The ZOI (871.4 km^2) was defined as a 17-km buffer around the mine site and a 4-km buffer along the south side of the access road. The 17-km buffer was selected as a conservative buffer based on results from noise modelling completed for the Project, which predicted a return to baseline sound pressure levels 5 km from the mine site (EIS, Chapter 5) and ZOIs presented in the literature indicating caribou avoidance of mines ranging from 2 km to 18.7 km (Weir et al. 2007; Polfus et al. 2011; Boulanger et al. 2012 and 2021; LeBlond et al. 2014; Johnson et al. 2015; Eftestøl et al. 2019). The 4-km buffer along the road was similarly selected based on ZOIs in the literature which show caribou avoidance of roads up to 4-km (Dyer et al. 2001; Vistnes sand Nellemann 2001; Nellemann et al. 2003; Polfus et al. 2011). While the herd affiliation for caribou that calve within the ZOI is uncertain, the ZOI does overlap with the calving range of

the Grey River herd. It is therefore assumed that most caribou in the calving grounds within the ZOI are resident Grey River caribou. Caribou from both the Buchans and Grey River herds have the potential to occur in the Project Area and LAA.

Note that the overall delineation of the Buchans herd calving grounds has remained unchanged throughout the annual post-calving surveys from 2020 to 2022. However, the boundary separating the calving grounds within the ZOI from the Buchans herd has changed, per direction from NLDFFA – Wildlife Division. Initially in 2020, there was an area of overlap between the Buchans and resident caribou survey areas that was subdivided to complete separate analyses for the two herds (dark dashed line in Figure 2-4). Beginning in 2021, the boundary for the resident caribou survey area was modified to be mutually exclusive from the Buchans herd survey area (i.e., only the portion of the ZOI that is outside the Buchans herd calving grounds was considered the resident caribou survey area).

For each survey year, aerial surveys were completed along parallel transects within the calving grounds and two transects south of the access road (Figure 2-4). The combined total transect distance was 2,515 km, with approximately 2,093 km and 422 km associated with the Buchans herd and resident caribou, respectively. Transects within the calving grounds were spaced 2.5 km apart and oriented east-west, and surveys for the road were completed along transects that were 1 km and 4 km south of the road. Dates for annual surveys targeted the period early after the calves have been born, based on generalized dates for caribou calving on the Island of Newfoundland (May 20 – June 10; Emera 2013). Per direction from NLDFFA – Wildlife Division, the survey in 2022 was divided into two separate survey periods to align with the survey objectives (i.e., census survey first, followed by the classification survey), whereas in 2020 and 2021 the census and classification surveys were completed concurrently (Table 2.4). Refer to Valentine Gold EIS BSA.2, Attachment 2-C (Marathon 2020) and Appendix A for individual reports from 2020 and 2021-2022, respectively. Note that in modeling the population size for Buchans herd caribou, the data from 2021 was revisited to omit additional observations of caribou that were collected during the classification component of the survey (i.e., only those caribou counted while on the survey transects were included). Thus, the population estimate from 2021 and 2022 are comparable.

Table 2.4 Survey Dates for Annual Post-Calving Aerial Surveys

Year	Date	
	Census Survey	**Classification Survey**
2020	June 9 – 13	
2021	June 7 – 11	
2022	June 6 – 8	June 9 and June 12

Note: Dates for annual surveys targeted early after calves were born, based on generalized dates for caribou calving on the Island of Newfoundland (May 20 – June 10; Emera 2013).

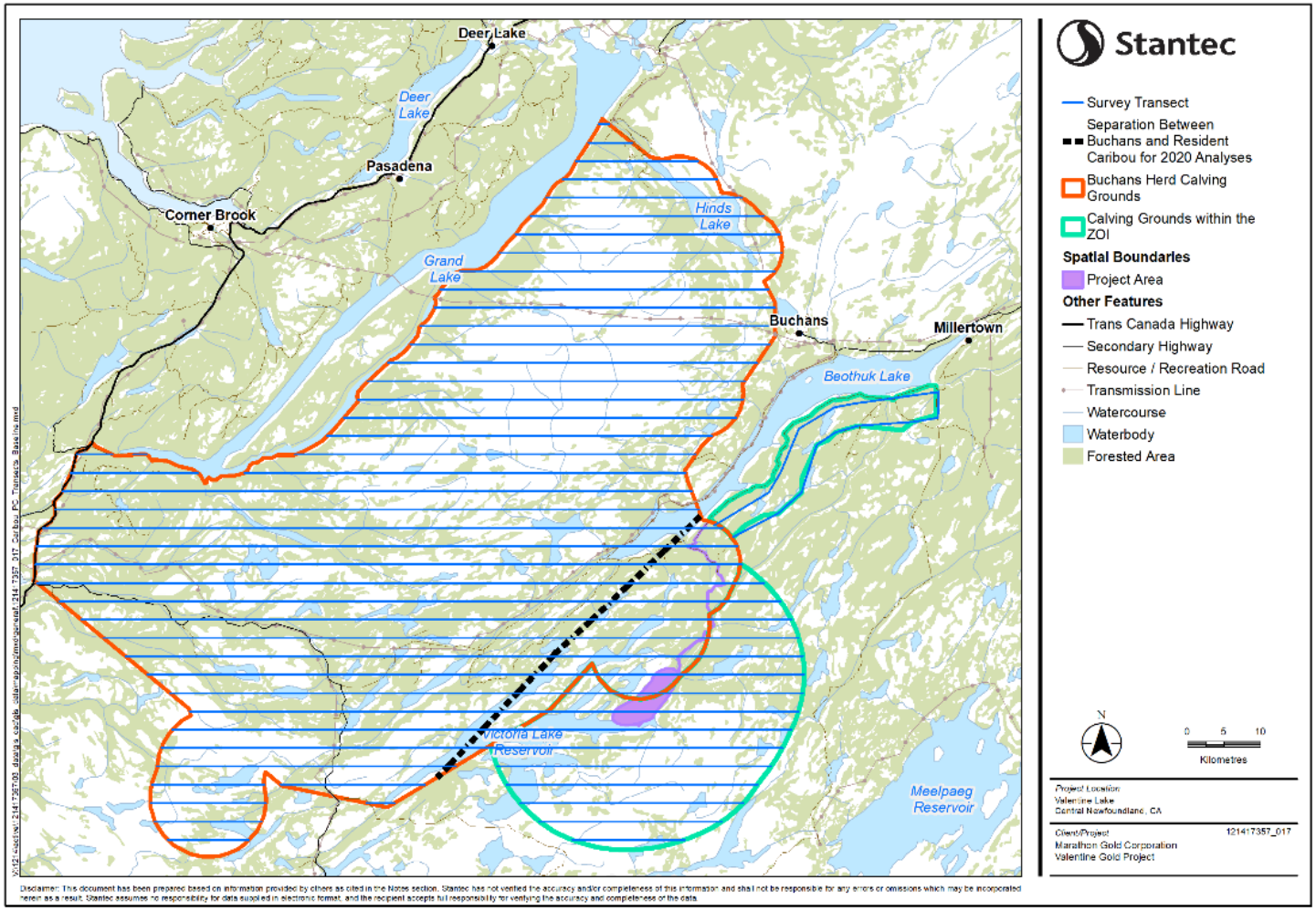


Figure 2-4 Survey Area for Post-Calving Aerial Surveys

Note: Dashed line representing the area of separation between the two herds was only used in 2020. Subsequent analyses used the entire calving grounds for the Buchans herd (orange boundary), and the remaining area of calving grounds within the ZOI (i.e., area outside the Buchans herd calving ground) as the boundary for resident caribou.

Group composition (i.e., group size, sex ratios and age classes) metrics summarized for the Buchans herd calving grounds survey area and resident caribou in the ZOI include the following: male:100 adult ratio, female:100 adult ratio, calf:100 females ratio, percent females (females/total caribou x 100), percent males (males/total caribou x 100), percent yearlings (yearlings/total caribou x 100), and percent calves (calves/total caribou x 100). Calculations only included caribou located within the survey area (i.e., incidental observations from outside the survey area were omitted).

A population estimate for the Buchans herd calving grounds survey area was calculated for 2021 and 2022 only; in its review of the EIS and supporting documentation, the NLDFFA – Wildlife Division raised concerns about the methods used in the 2020 post-calving aerial survey (Valentine Gold EIS BSA.2, Attachment 2-C; Marathon 2020) and therefore a 2020 population estimate for the Buchans herd is not available. Population estimates were calculated using distance sampling methods (census data) and caribou detections. There are several key assumptions in distance sampling (Buckland et al. 2001), which were satisfied through survey design and field methods. Caribou detections were analyzed using R 3.5.3 (R Core Team 2022) and the R Distance package (Miller et al. 2019).

2.3 RESULTS OF BASELINE STUDIES

2.3.1 Seasonal Ranges of the Buchans Caribou Herd: 2006-2022

The Buchans herd has an annual range of approximately 14,237 km^2 (Table 2.5) between Sandy Lake to the north and the south coast of the Island of Newfoundland, and between Highways 480 and 360. Caribou from the Buchans herd generally move between seasonal ranges, migrating from central Newfoundland during the fall to wintering areas on the south coast (Figure 2-5), although there are some caribou that may deviate from this strategy (e.g., six collared caribou from earlier data sets were excluded from the NSD analysis because they did not return to the same winter range). Generally, the post-calving migration / dispersal range (June 11 – June 30) is primarily north of the Project Area, while the remaining seasons include areas near the south coast (Figure 2-5). The sizes of the seasonal ranges for the Buchans herd, based on NSD migration dates (Section 2.3.3) are provided in Table 2.5.

Table 2.5 Seasonal Home Range Size for the Buchans Caribou Herd

Seasons based on NSD Migrations	No. of Collared Caribou[A]	Area (km^2)[B,C,D]	
		50% KDE	95% KDE
Fall Dispersal / Winter	87	3,270	7,659
Spring Migration	83	3,647	10,826
Pre-calving / Calving	84	1,563	6,492
Post-Calving Migration / Dispersal	81	672	2,129
Post-Calving Rearing	85	1,876	5,387
Fall Rut	83	1,074	4,432
Fall Migration	86	2,848	6,883

Notes:

A. Number of collared caribou used in the analysis, based on GPS telemetry data from the following years: 2006-2013, 2015-2018, 2020-2022.

B. Areas calculated using only collars with more than 50 locations.

C. Areas rounded to the nearest integers.

D. Seasonal home range boundaries using KDE are shown on Figure 2-5.

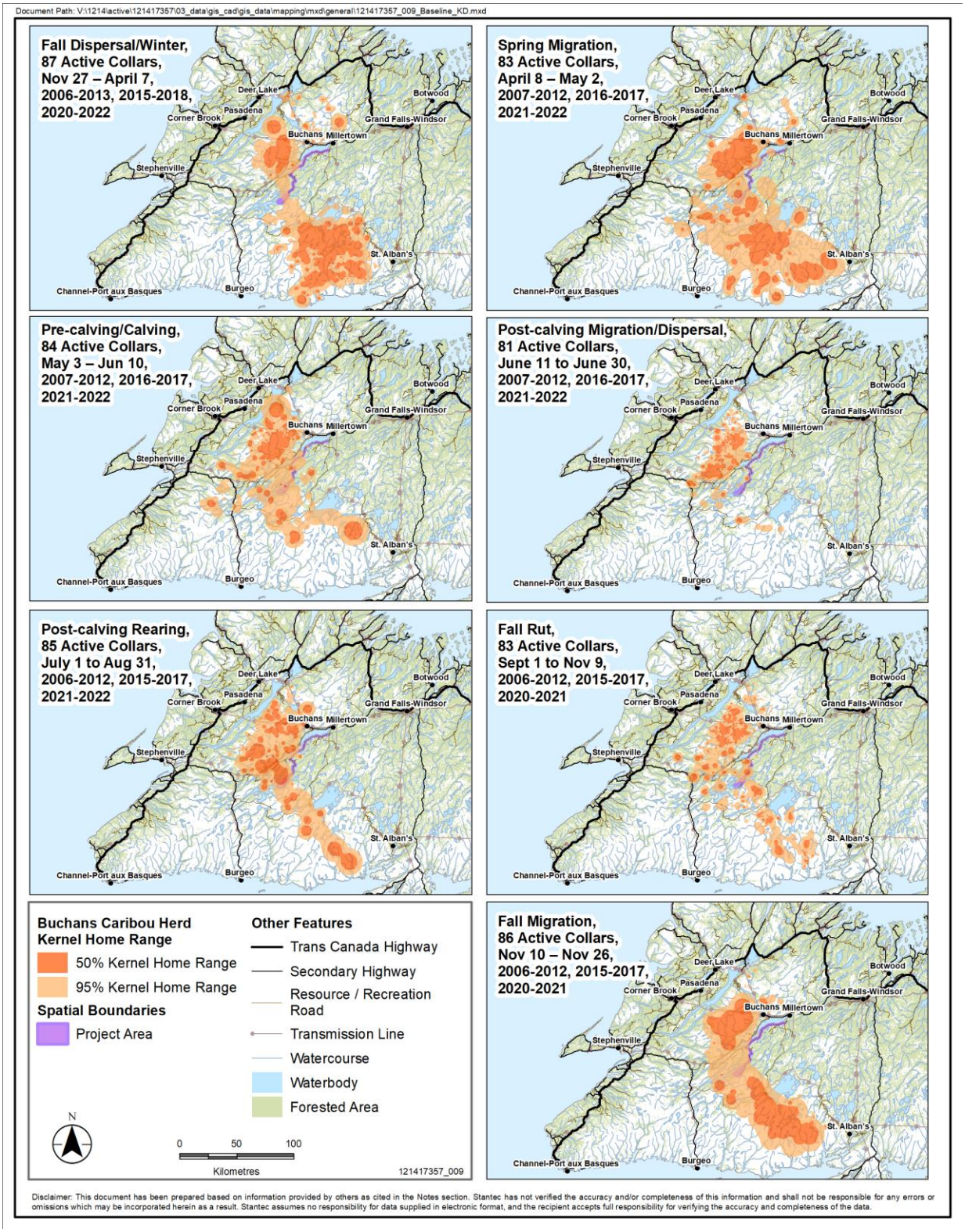


Figure 2-5 Seasonal Ranges for the Buchans Caribou Herd

2.3.2 Fall and Spring Migration Corridors

The updated dBBMM identified areas where individual GPS-collared caribou occurred during seasonal migration periods, which included a network of travel paths that extended approximately 30 to 80 km wide. However, there was only one distinct population-level pathway (i.e., primary pathway) identified that is used by the Buchans caribou herd during both fall (Figure 2-6) and spring (Figure 2-7) migrations.

Both the spring and fall primary pathways include areas of relative high use (stopover sites) connected by moderate-high use movement areas, with a network of surrounding moderate-low and low-use travel paths (Table 2.6, Figure 2-6 and Figure 2-7). The fall migration corridor (Figure 2-6) included a relatively narrow network of low use travel paths compared to spring, when travel paths are more dispersed (e.g., some individuals travelled west of Victoria Lake Reservoir and others across Beothuk Lake) (Figure 2-7).

The fall migration corridor had five stopover areas (Figure 2-6), covering a combined area of 19.95 km^2. There was one relatively larger stopover area at the east end of Victoria Lake Reservoir that overlapped the Project Area (4.56 km^2 overlap), and four small stopover sites (<0.03 km^2 overlap): three small areas in south of Star Lake near the west end of Beothuk Lake, and a second stopover site near the south arm of Granite Lake.

The spring migration corridor similarly had one larger and three smaller stopover areas (Figure 2-7), covering a combined area of 11.4 km^2. The large stopover area was located south of Star Lake near the west end of Beothuk Lake and overlapped the same high use areas used during fall migration. The three smaller stopover sites were located east of Victoria Lake Reservoir, two of which overlapped with the Project Area (<0.03 km^2 overlap). The approximate area of utilization for high-, moderate- and low-use areas during spring and fall migration, based on the results of the dBBMM, is presented in Table 2.6.

Table 2.6 Approximate Area of Utilization by Collared Caribou from the Buchans Herd during Spring and Fall Migration

Migration Utilization	Approximate Area of Utilization (km^2)[A,B]	
	Spring Migration	Fall Migration
High use: stopover site	11	20
Moderate-high use: movement area	48	73
Moderate-low use: movement area	88	129
Low use (general)	4,097	3,236

Notes:
A. Based on the following GPS telemetry data: 2006-2013 and 2015-2018 (30 collared caribou) and 2020-2022 (49-54 collared caribou).
B. Areas rounded to the nearest integers.

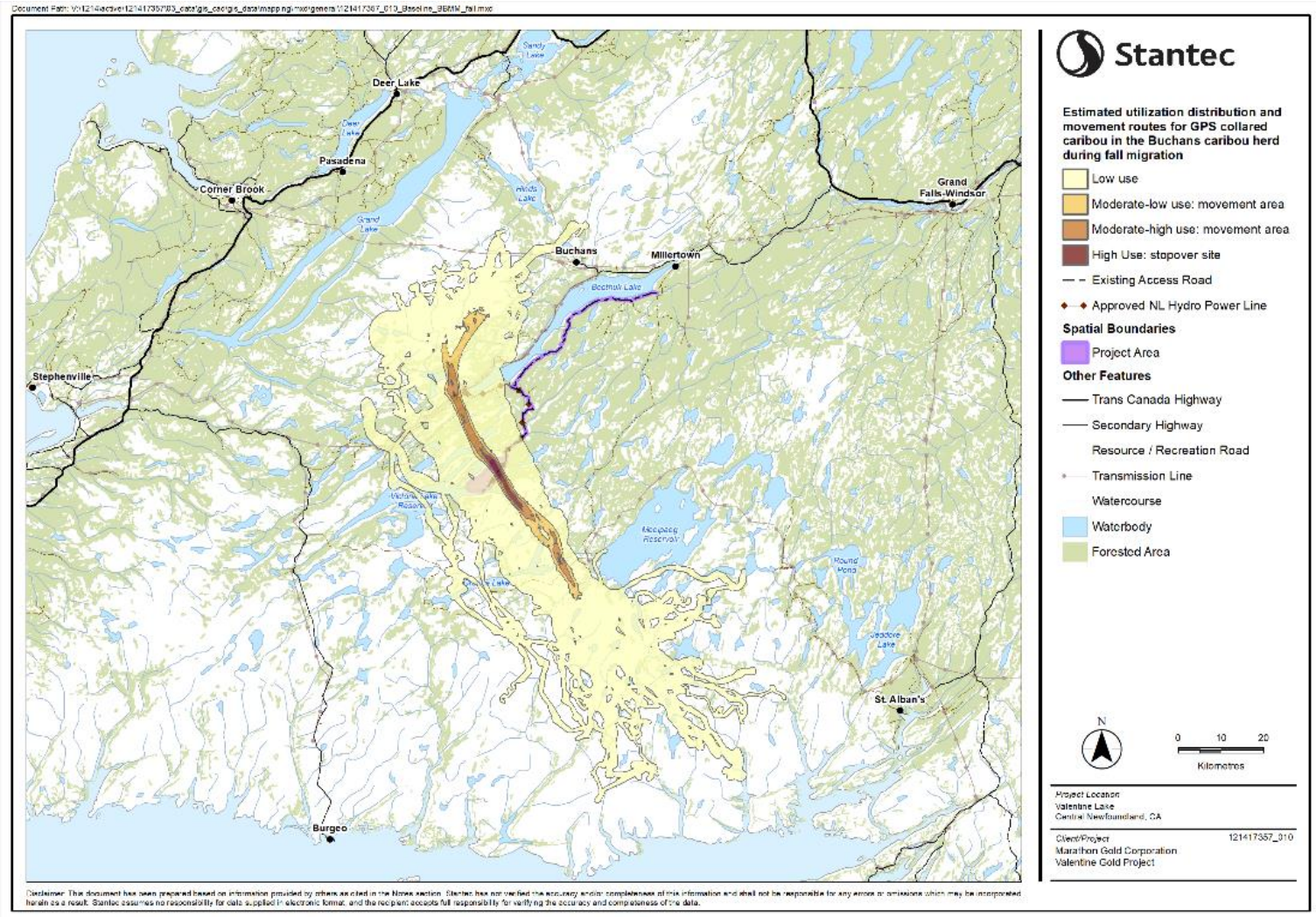


Figure 2-6 Estimated Utilization Distribution and Migration Corridors for GPS Collared Caribou in Buchans Herd: Fall Migration

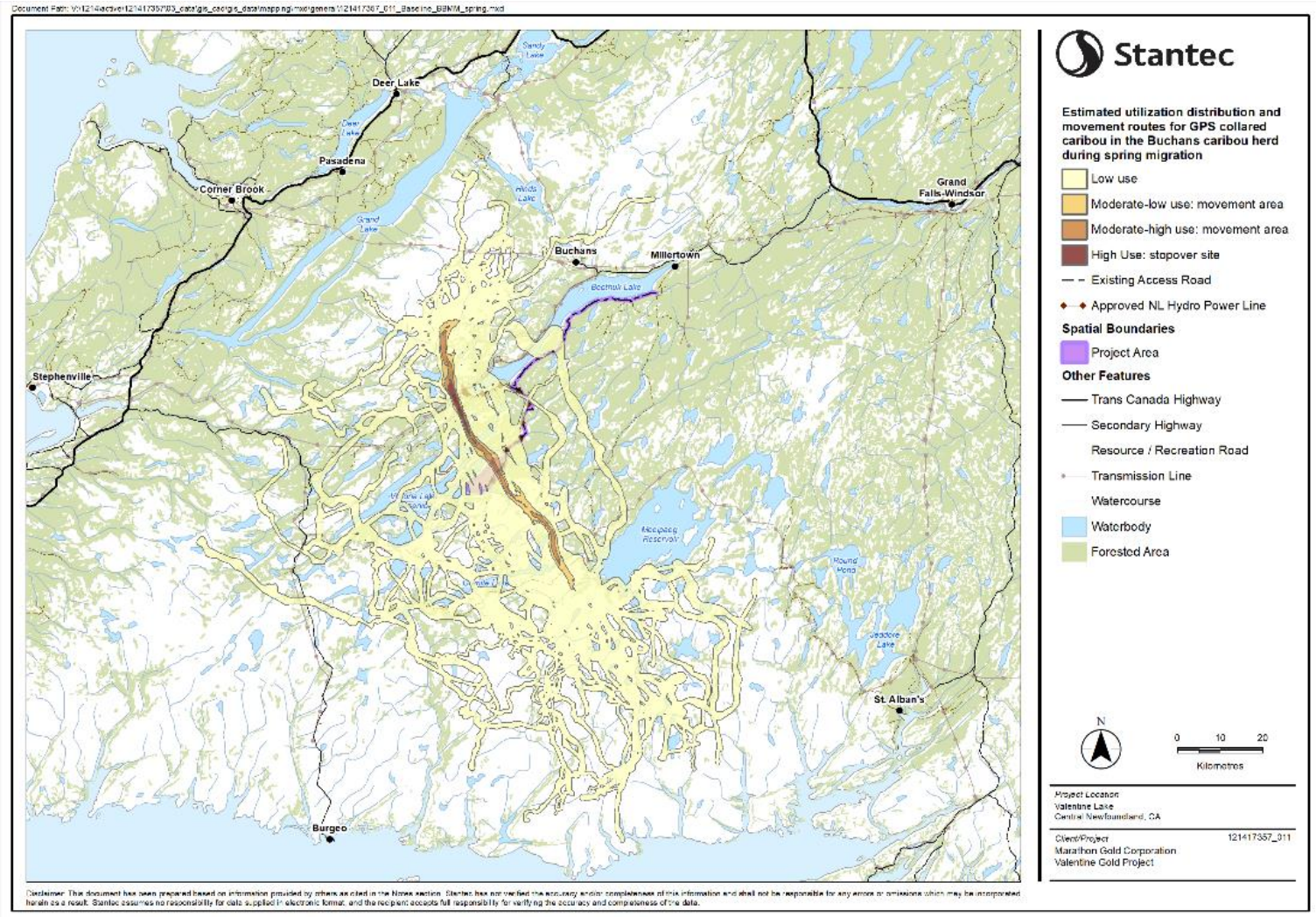


Figure 2-7 Estimated Utilization Distribution and Migration Corridors for GPS Collared Caribou in Buchans Herd: Spring Migration

Results of the LCP analysis indicated that if caribou alter their primary migration path because of the Project, caribou would travel between 0 km and 13 km farther than the baseline LCP during frozen conditions, and 6 km to 30 km farther than the estimated baseline LCP during unfrozen conditions (spring and fall migration combined). The associated relative energetic costs of these alternative pathways range from 1.01 to 1.41 times greater than the baseline LCP. Baseline and alternate pathways traverse primarily open habitats (e.g., coniferous forest, low shrub and wetland-shrub types), with proportions of open coniferous habitats decreasing with increasing ZOI distance (up to 13% less at the 15 km ZOI). While the decreased proportion of open habitats on the predicted alternate pathways suggest that those paths may have higher resistance values and be more energetically demanding during migration, the habitats on the alternate pathways are largely similar to the baseline pathway. The full report from the LCP analysis is found in Appendix A of the Caribou Supplemental Information Report (Marathon 2021).

2.3.3 Timing and Duration of Migration

The NSD analysis of seasonal migrations indicated interannual variation in both the initiation and duration of fall (Figure 2-8 and Figure 2-9) and spring (Figure 2-10 and Figure 2-11) migration. In addition, timing of migration varied by individual collared caribou. Most caribou commenced migration over a period of consecutive days, however, there were a few outliers that started much earlier or much later than the majority (Figure 2-8 and Figure 2-10). The mean start and end dates of seasonal migrations was from November 10 to November 26 (16 days duration) for fall migration and from April 8 to May 2 (24 days duration) for spring migration (Table 2.7). The NSD dates overlap with general spring and fall migration periods for caribou on the Island of Newfoundland (Table 2.1) but occur over a shorter period (approximately three weeks shorter in spring and four weeks shorter in fall).

Table 2.7 Seasonal Migration Metrics for Buchans Caribou Herd, 2006-2022

Metric	Spring (n = 117)[A]			Fall (n = 140)[B]		
	Start Date	End Date	Duration Days	Start Date	End ate	Duration Days
Mean (95% CI)[C]	Apr 8 (Apr 7-10)	May 2 (Apr 30-May 4)	24 (23-26)	Nov 10 (Nov 4–16)	Nov 26 (Nov 21–Dec 2)	16 (14-18)
Median	Apr 10	May 1	21	Nov 15	Nov 29	14

Notes:
A. Migration metrics were calculated using NSD estimates from 77 GPS collared caribou over 117 spring migrations.
B. Migration metrics were calculated using NSD estimates from 79 GPS collared caribou over 140 spring migrations.
C. CI = confidence interval

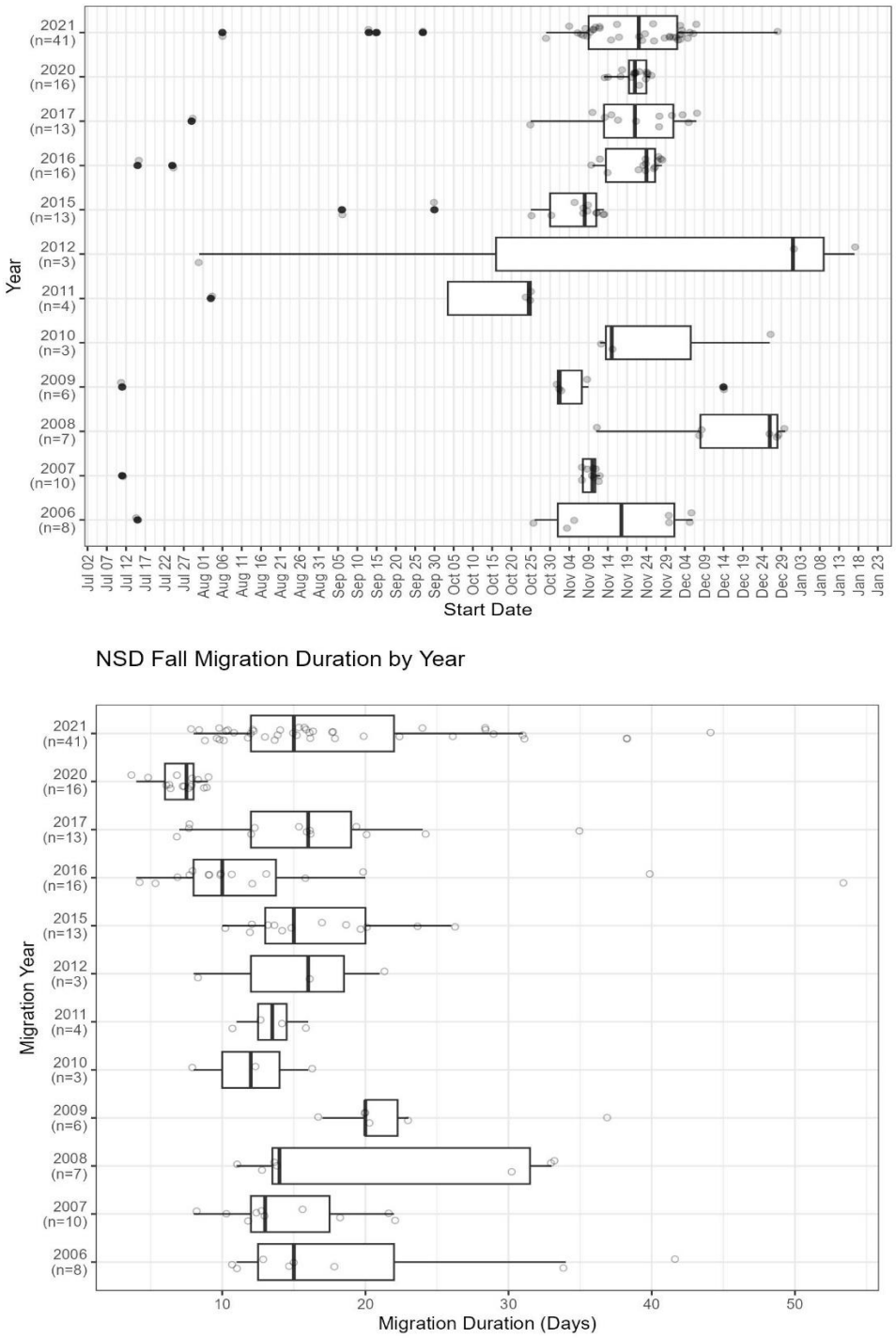


Figure 2-8 Annual Variation in the Start Date (top) and Duration (bottom) of Fall Migration for the Buchans Caribou Herd

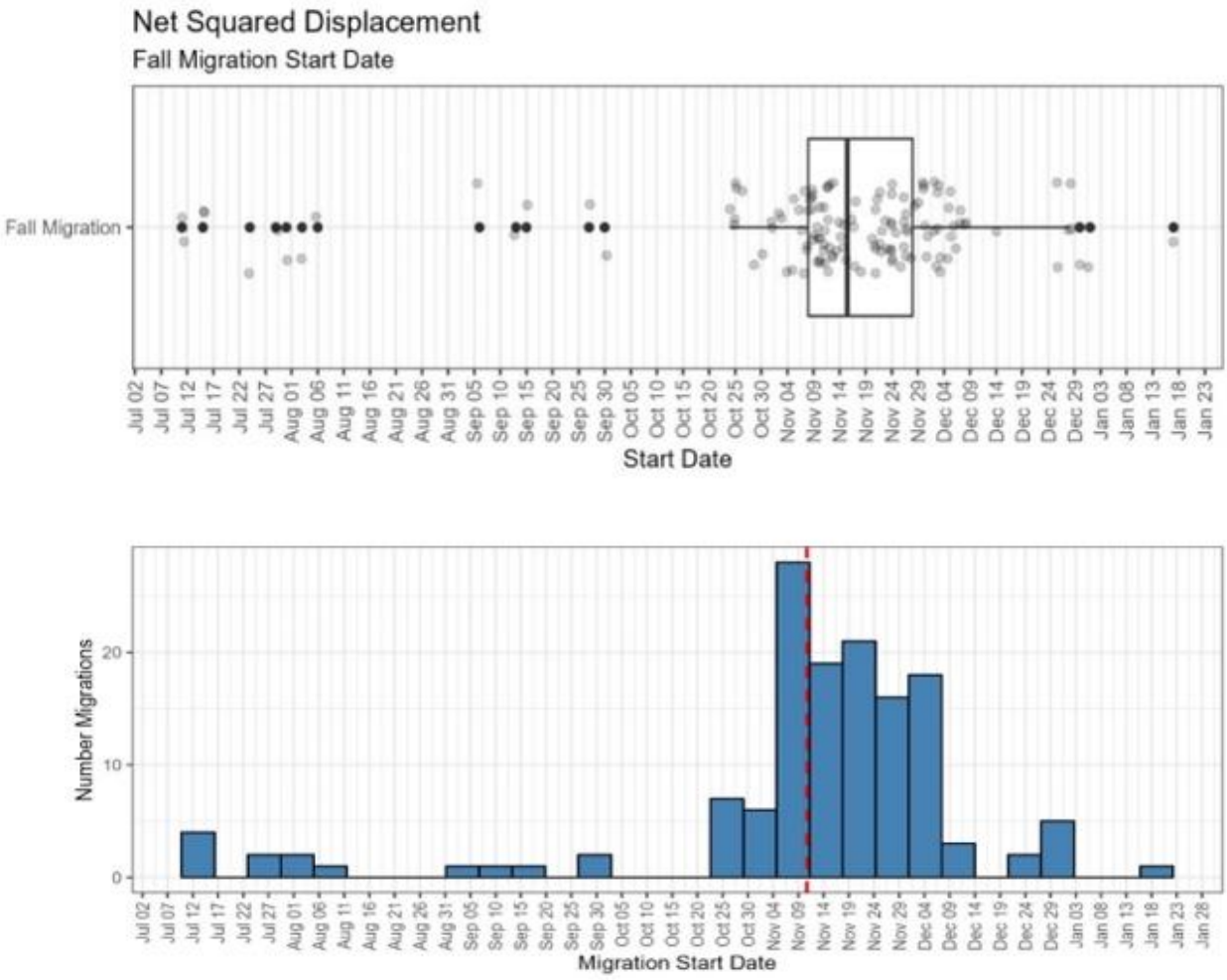
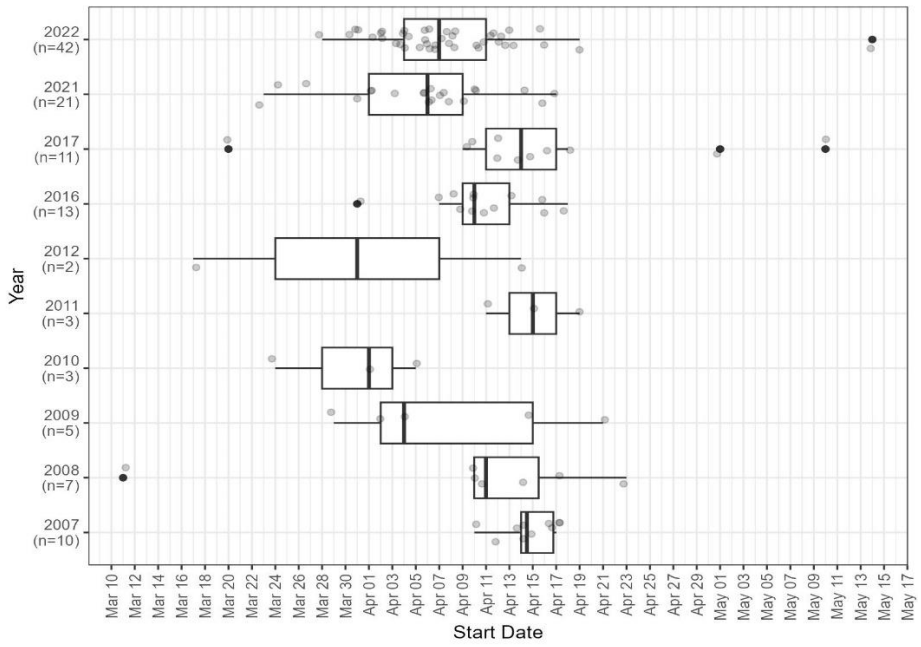


Figure 2-9 Fall Migration Start Date (All Years) for the Buchans Caribou Herd

Top graph: Boxplot of median fall migration start dates. The vertical line represents the median, and the ends of the box represent the first (25%) and third (75%) quartile. The ends of the horizontal line represent minimum and maximum values based on ± 1.5 times the interquartile range. Circles that occur beyond the ends of the horizontal line represent outliers. Bottom graph: Frequency distribution of fall migration start dates (n = 140 migrations). Vertical dashed line indicates mean migration start date.



NSD Spring Migration Duration by Year

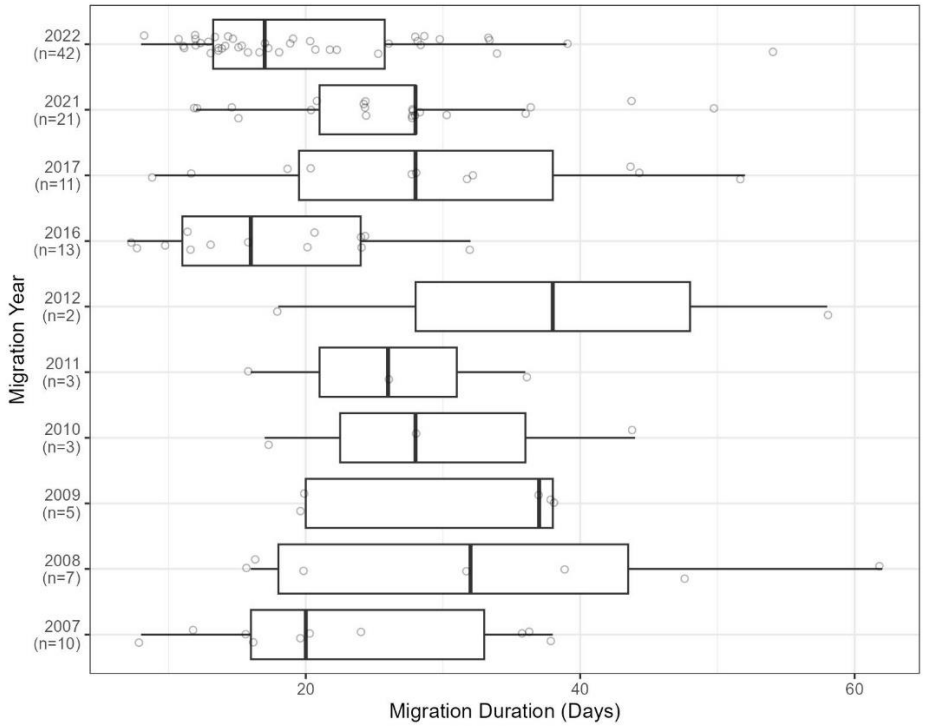


Figure 2-10 Annual Variation in the Start Date (top) and Duration (bottom) of Spring Migration for the Buchans Caribou Herd

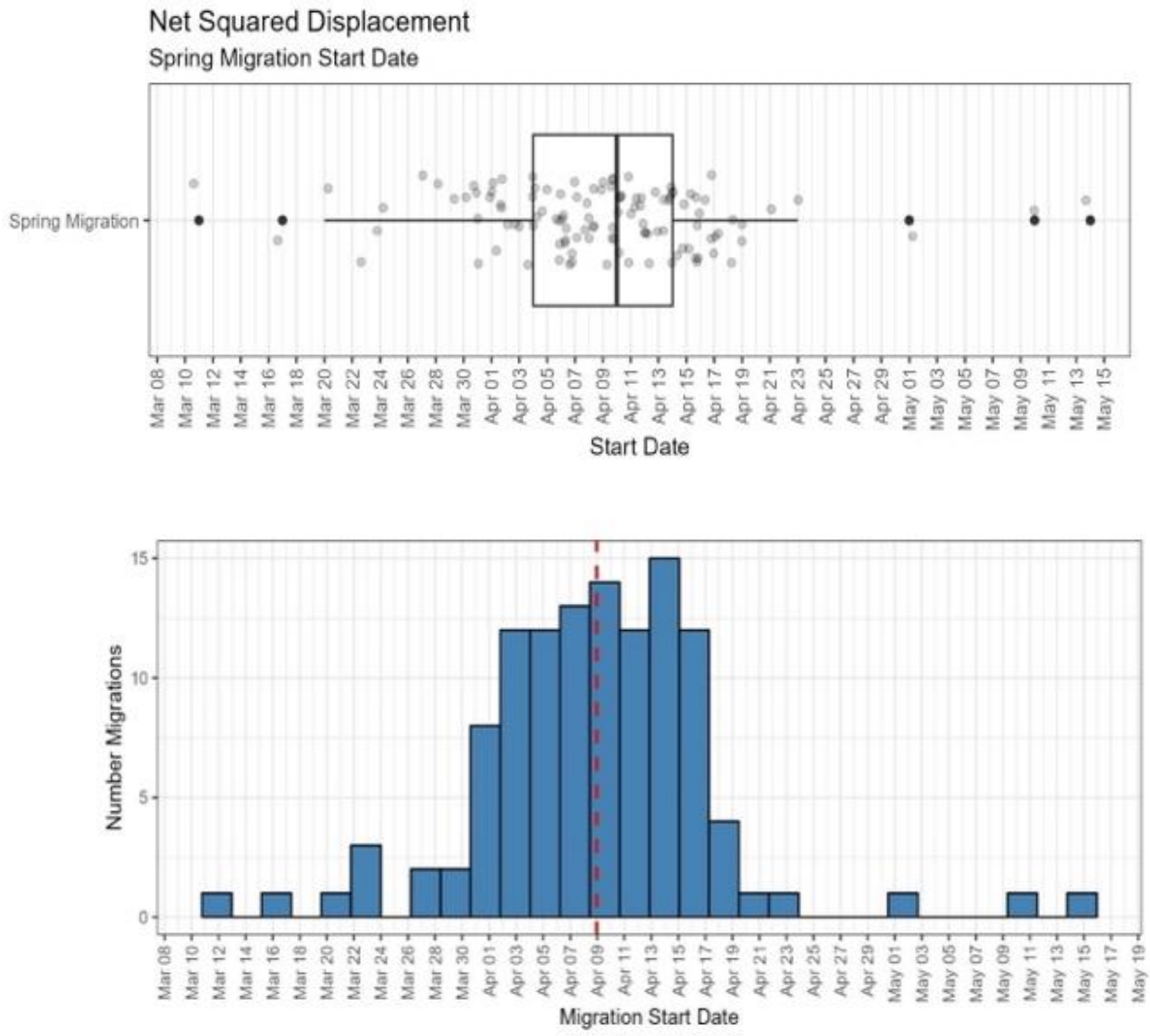


Figure 2-11 Spring Migration Start Date (All Years) for the Buchans Caribou Herd

Top graph: Boxplot of median spring migration start dates. The vertical line represents the median, and the ends of the box represent the first (25%) and third (75%) quartile. The ends of the horizontal line represent minimum and maximum values based on ± 1.5 times the interquartile range. Circles that occur beyond the ends of the horizontal line represent outliers.

Bottom graph: Frequency distribution of spring migration start dates (n = 117 migrations). Vertical dashed line indicates mean migration start date.

2.3.4 Remote Camera Monitoring: 2019-2022

2.3.4.1 Seasonal Summaries

Sampling effort for annual remote camera monitoring is summarized in Table 2.8. It is assumed that caribou detected by the remote cameras are most likely migrating Buchans caribou, based on the overlap of the migration corridor with the Project Area; however, there is potential for a small number of resident Grey River caribou to be included in the data summaries presented, particularly for seasons with longer camera deployment periods (e.g., spring 2022).

Table 2.8 Sampling Effort during Remote Camera Surveys: 2019-2022

Year	Fall Migration			Spring Migration		
	Deployment Period[A]	No. Cameras	Total Camera-Days	Deployment Period[A]	No. Cameras	Total Camera-Days
2019	Oct 5 – Dec 18	7	518	-	-	-
	Oct 5 – Dec 26	1	82			
	Oct 5 – Jan 11	1	98			
	Oct 5 – Jan 26	2	226			
	Oct 5 – Feb 11	1	129			
2020	Sep 27 – Nov 19[B]	1	53	Mar 26 – May 25[C]	1	60
	Sep 27 – Jan 19	4	456	Mar 26 – Jun 12	1	78
	Sep 28 – Jan 19	1	113	Mar 26 – Jun 14	1	80
	Sep 28 – Feb 23	4	592	Mar 26 – Jun 15	2	162
	Sep 28 – Feb 24	1	149	Mar 26 – Jun 16	2	164
				Mar 26 – Jun 18	3	252
2021	Oct 6 – Jan 27	19	2,147	Apr 9 – Jun 14	12	792
	Oct 7 – Jan 27	11	1,232	Apr 10 – Apr 13[D]	1	3
	Oct 9 – Jan 28	1	111	Apr 10 – Jun 14	12	780
				Apr 10 – Jun 24	1	75
2022	Oct 4 – Dec 21	30	2340	Mar 31 – Jul 12	30	3,090
	Oct 24 – Jan 7	1	75	Apr 4 – Oct 24	1	203

Note:
A. Annual camera deployment dates considered the general (non-herd specific) migration periods for caribou on the Island of Newfoundland and movements of GPS collared caribou in any given year. Retrieval dates were subject to suitable weather conditions and/or accessibility (camera 7 is typically retrieved by ground vs. air).
B. Remote camera MAINRD only recorded data up to November 19, 2020, due to battery failure.
C. Remote camera MAR4 only recorded data up to May 25, 2020, when it ceased to function.
D. Remote camera 10 only recorded data up to April 13, 2021, due to a SD memory card malfunction.

The mean number of caribou events per monitoring day ranged from 0.04 (±0.02 SE) in fall 2021 to 0.26 in spring 2020 (±0.02 SE) and spring 2022 (±0.06 SE) (Table 2.9 and Figure 2-12). During fall, the mean number of caribou events per camera-day was similar in 2019 (0.17 ±0.05 SE) and 2020 (0.18 ±0.06 SE) (Table 2.9). The mean number of caribou events detected during 2021 and 2022 were also similar (0.04 ± 0.02 SE and 0.05 ± 0.02SE, respectively) but were lower compared to 2019 and 2020 (Table 2.9). During spring, the mean number of events was similar in 2020 (0.26 ±0.05 SE) and 2022 (0.26 ± 0.06 SE) and greater than reported in 2021 (0.15 ± 0.03 SE) (Table 2.9).

Table 2.9 Caribou Events and Detections During Remote Camera Programs: 2019-2022

Camera Summary[A]	Fall				Spring		
	2019	2020	2021	2022	2020	2021	2022
Number of Cameras[B]	12	11	31	31	10[C]	26	31
Camera-Days[C]	1,053	1,363	3,490	2,415	796	1,650	3,293
Total Number of Caribou Events	165	180	127	113	205	248	821
Mean Number of Caribou Events per Camera-Day	0.17	0.18	0.04	0.05	0.26	0.15	0.26
Standard Error	0.05	0.06	0.02	0.02	0.05	0.03	0.06
Range	0-40	0-22	0-9	0-16	0-9	0-4	0-10
Total Number of Caribou Detected[D]	2,072	1,847	918	592	701	374	2,732

Notes:

A. Information presented for fall and spring migration is based on all camera sampling days and not bounded by known seasonal migration dates for caribou (i.e., general migration periods for caribou on the island of Newfoundland or NSD migration dates).

B. Camera locations are provided in Figure 2-2.

C. Number of cameras deployed x number of days operational.

D. The total number of caribou detected is not standardized by camera-day and is expected to include caribou that have been counted more than once. The total number of caribou detected could also include caribou from the Grey River herd, particularly for seasons with a longer camera deployment period (e.g., Spring 2022). Thus, total caribou detected should not be compared among the remote camera sampling seasons or to the population estimate for the Buchans caribou herd.

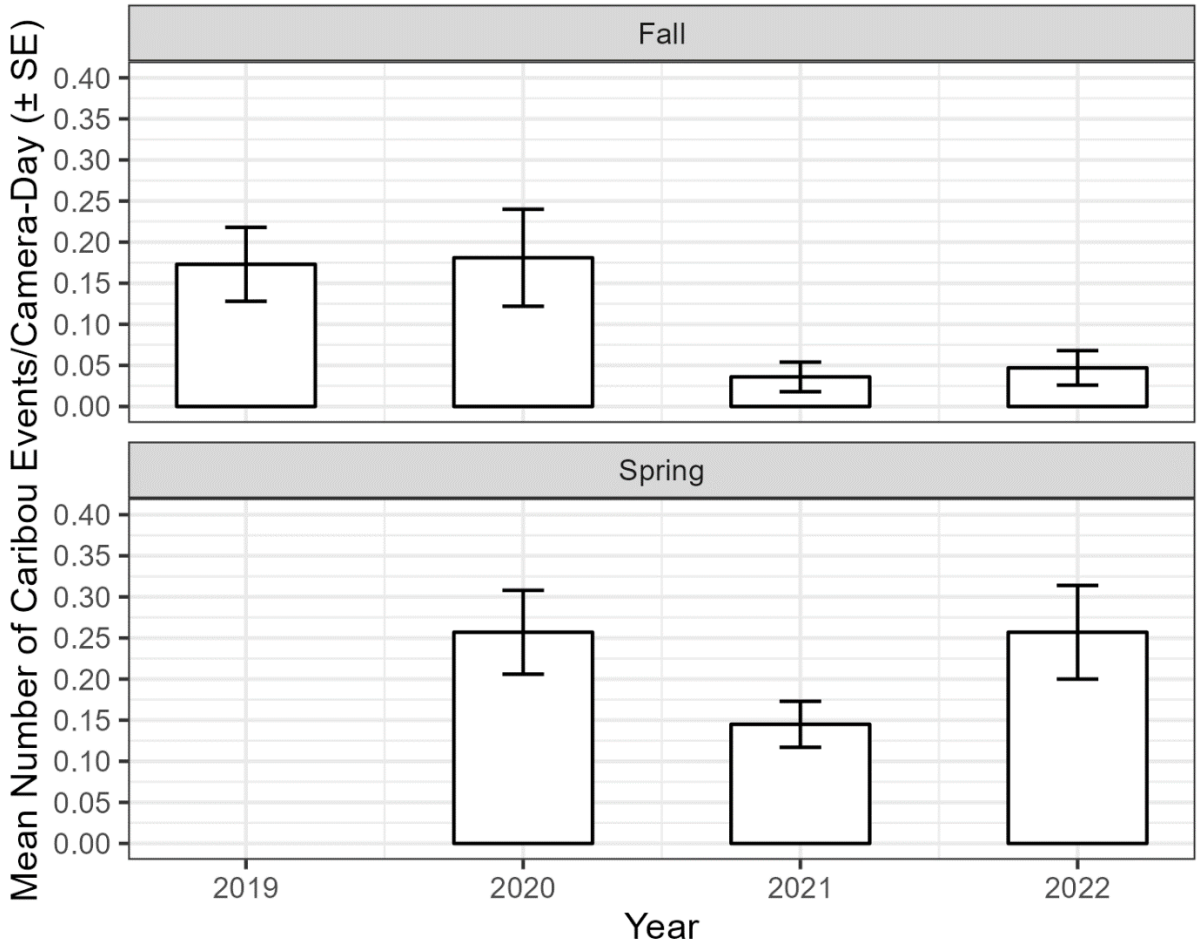


Figure 2-12 Mean Number of Caribou Events by Year and Season: 2019-2022

Note: Means calculated based on all camera sampling days (i.e., total deployment period) and not bounded by known seasonal migration dates for caribou (i.e., general migration periods for caribou on the island of Newfoundland or NSD migration dates).

2.3.4.2 Summary by Camera

Fall 2019 to Fall 2020

Caribou were detected at 10 of 12 (83.3%) remote camera stations during fall 2019 and 8 of 11 (72.7%) stations during fall 2020 (Table 2.10). During spring 2020, caribou were detected at 10 of 11 (90.9%) stations (Table 2.11). The cameras with the highest detection rates were in the primary migration corridor identified by the dBBMM. During fall, most recorded caribou events occurred at camera locations MAR1 (in the Marathon pit area) and MAINRD (on the existing access road) (Table 2.10 and Figure 2-12) and during spring at camera 13 (north of the Project Area) (Table 2.11 and Figure 2-13). MAR1 had the highest mean number of caribou events per monitoring day during fall 2019 (0.87 ±0.55 SE) whereas the highest mean number of caribou events was recorded at MAINRD in 2020 (1.17 ±0.51 SE) (Table 2.10 and Figure 2-13). Mean events were highest at cameras 12 (0.35 ±0.08 SE) and 13 (1.12 ±0.21 SE) in

the spring (Table 2.11 and Figure 2-13). Remaining camera locations had mean number of caribou events ranging from 0.01 (±0.01 SE) to 0.61 (±0.22 SE) per monitoring day during fall 2019-2020 and 0.01 (±0.01 SE) to 0.35 (±0.08 SE) events per monitoring day in spring 2020 (Table 2.10). As per direction from the NLDFFA – Wildlife Division, camera locations were revised prior to the 2021 survey with the result that there is no additional data from most of the camera locations used in 2019-2020, the exception being cameras 12 and 13.

Table 2.10 Summary of Caribou Events at Remote Camera Monitoring Locations: Fall 2019-2020

Camera ID[A]	No. of Monitoring Days		No. Days with Events		No. Events		No. Caribou		Events / Monitoring Day			
	2019	2020	2019	2020	2019	2020	2019	2020	2019		2020	
									Mean	SE	Mean	SE
12	114	149	10	7	30	13	212	120	0.26	0.11	0.09	0.04
13	83	149	3	2	3	3	4	3	0.04	0.02	0.02	0.01
MAR1	75	151	12	21	65	92	1,228	1,158	0.87	0.55	0.61	0.22
MAR2	75	151	5	1	14	1	122	1	0.19	0.10	0.01	0.01
MAR3	75	151	1	1	1	1	1	1	0.01	0.01	0.01	0.01
MAR4	75	151	3	1	3	1	3	2	0.04	0.02	0.01	0.01
MAINRD	75	53	7	11	46	62	499	521	0.61	0.36	1.17	0.51
SS1	130	150	1	-[B]	1	-	1	-	0.01	0.01	-	-
SS2	99	0	-	NA[C]	-	NA	-	NA	-	-	NA	NA
VAL3	114	149	1	-	1	-	1	-	0.01	0.01	-	-
VIC1	75	114	1	-	1	-	1	-	0.01	0.01	-	-
MARBOG	75	115	-	1	-	7	-	40	-	-	0.06	0.06

Notes:
A. Camera locations are provided in Figure 2-1.
B. "-" = no caribou detected
C. NA = not applicable (SS2 was not deployed in 2020)

Table 2.11 Summary of Caribou Events at Remote Camera Monitoring Locations: Spring 2020

Camera ID[A]	No. of Monitoring Days	No. Days with Events	No. Events	No. Caribou	Events / Monitoring Day	
					Mean	SE
12	83	20	29	81	0.35	0.08
13	82	35	92	442	1.12	0.21
MAR1	81	15	20	86	0.25	0.07
MAR2	85	8	13	20	0.15	0.06
MAR3	85	13	20	25	0.24	0.07
MAR4[B]	61	5	12	20	0.20	0.09
MAINRD	-[C]	NA[D]	NA	NA	NA	NA
SS1	78	8	13	21	0.17	0.06
VAL3	83	1	1	1	0.01	0.01
VIC1	82	4	4	4	0.05	0.02
MARBOG	85	1	1	1	0.01	0.01

Notes:

A. Camera locations are provided in Figure 2-1.
B. Possible malfunction – only detected caribou until May 24, 2020
C. Camera malfunction
D. NA = not applicable due to camera malfunction

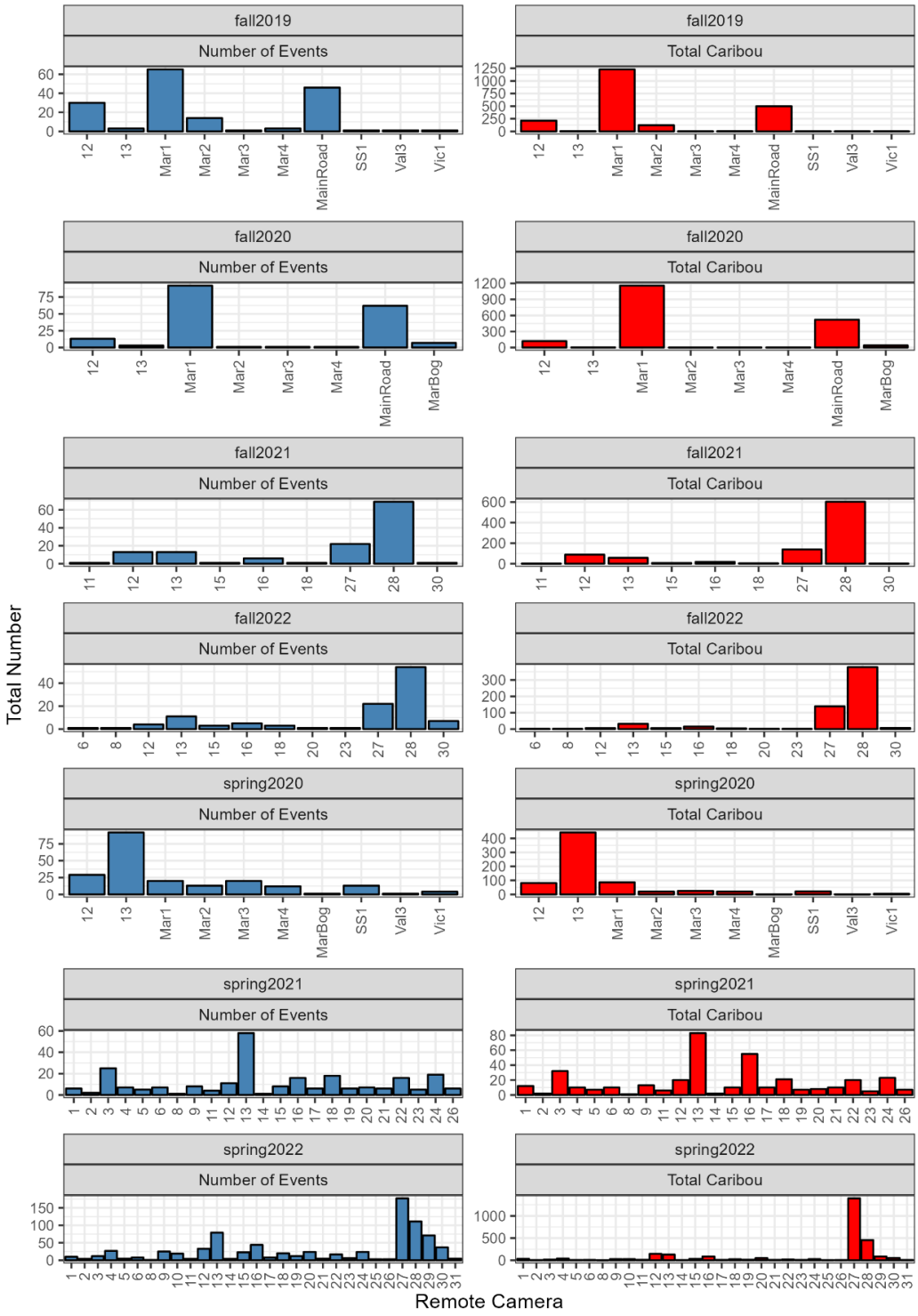


Figure 2-13 Number of Caribou Observed and Number of Caribou Events by Season and Remote Camera Location: 2019-2022

Spring 2021 to Fall 2022

Caribou were detected at 9 of 31 (29.0%) remote camera stations during fall 2021 and 12 of 31 (38.7%) stations during fall 2022 (Table 2.12). Both the total number of caribou and caribou events (Figure 2-13) was highest at cameras 27 and 28 during surveys in fall 2021 (combined total of 742 caribou detections over 91 caribou events) and in fall 2022 (518 caribou detected over 76 caribou events), representing approximately 81% and 88% of total caribou detections each year, respectively. The mean number of caribou events per monitoring day at camera 27 ranged from 0.19 (±0.04 SE) to 0.28 (±0.10 SE) and at camera 28 from 0.61 (±0.12 SE) to 0.68 (±0.26 SE) (Table 2.12). These two camera locations align with the large high-use stopover area identified using the dBBMM for fall migration (Table 2.3 and Figure 2-2).

Table 2.12 Summary of Caribou Events at Remote Camera Monitoring Locations: Fall 2021 and 2022

Camera ID[A]	No. of Monitoring Days		No. Days with Events		No. Events		No. Caribou		Events / Monitoring Day			
									2021		2022	
	2021	2022	2021	2022	2021	2022	2021	2022	Mean	SE	Mean	SE
1	114	79	-[B]	-	-	-	-	-	-	-	-	-
2	114	79	-	-	-	-	-	-	-	-	-	-
3	113	79	-	-	-	-	-	-	-	-	-	-
4	114	79	-	-	-	-	-	-	-	-	-	-
5	113	79	-	-	-	-	-	-	-	-	-	-
6	113	79	-	1	-	1	-	1	-	-	0.01	0.01
7	115	76	-	-	-	-	-	-	-	-	-	-
8	113	79	-	1	-	1	-	1	-	-	0.01	0.01
9	114	79	-	-	-	-	-	-	-	-	-	-
10	114	79	-	-	-	-	-	-	-	-	-	-
11	114	79	1		1		1		0.01	0.01	-	-
12	114	79	9	3	13	4	88	6	0.11	0.04	0.05	0.03
13	114	79	11	8	13	11	57	32	0.11	0.03	0.14	0.05
14	113	79	-	-	-	-	-	-	-	-	-	-
15	114	79	1	1	1	3		6	0.01	0.01	0.04	0.04
16	114	79	5	4	6	5	18	15	0.05	0.02	0.06	0.03
17	113	79	-	-	-	-	-	-	-	-	-	-
18	114	79	1	3	1	3	4	4	0.01	0.01	0.04	0.02
19	114	79	-	-	-	-	-	-	-	-	-	-
20	114	79	-	1	-	1	-	1	-	-	0.01	0.01
21	114	79	-	-	-	-	-	-	-	-	-	-
22	114	79	-	-	-	-	-	-	-	-	-	-

Table 2.12 Summary of Caribou Events at Remote Camera Monitoring Locations: Fall 2021 and 2022

Camera ID[A]	No. of Monitoring Days		No. Days with Events		No. Events		No. Caribou		Events / Monitoring Day			
	2021	2022	2021	2022	2021	2022	2021	2022	2021		2022	
									Mean	SE	Mean	SE
23	114	79	-	1	-	1	-	1	-	-	0.01	0.01
24	114	79	-	-	-	-	-	-	-	-	-	-
25	114	79	-	-	-	-	-	-	-	-	-	-
26	114	79	-	-	-	-	-	-	-	-	-	-
27	113	79	18	13	22	22	139	139	0.19	0.04	0.28	0.10
28	113	79	34	13	69	54	603	379	0.61	0.12	0.68	0.26
29	113	79	-	-	-	-	-	-	-	-	-	-
30	113	79	1	4	1	7	1	7	0.01	0.01	0.09	0.05
31	113	79	-	-	-	-	-	-	-	-	-	-

Notes:
A. Camera locations are provided in Figure 2-2.
B. "-" = no caribou detected

Caribou were detected at 23 of 26 (88.5%) remote camera stations during spring 2021 and 30 of 31 (96.8%) stations during spring 2022 (Table 2.13). Camera 13 had the greatest number of caribou detections (n=83) and caribou events (n=58) overall in 2021, accounting for approximately 22% and 23% of the total observations, respectively, and the mean number of caribou events per monitoring day was 0.87 (±0.14 SE). In spring 2022, both the total number of caribou and caribou events was highest at cameras 27 and 28 (Figure 2-13 and Table 2.13), with a combined total of 1,850 caribou detections (68% of total detections) over 288 caribou events (35% of total events). Camera 27 alone accounted for just over half (51%) of all caribou detections; this camera is located north of the Project Area in the primary migration pathway identified by the dBBMM (Table 2.3 and Figure 2-3). The mean number of caribou events per monitoring day at camera 27 was from 1.70 (±0.21 SE) and at camera 28 was 1.07 (±0.17 SE) (Table 2.13).

Table 2.13 Summary of Caribou Events at Remote Camera Monitoring Locations: Spring 2021-2022

Camera ID[A]	No. of Monitoring Days		No. Days with Events		No. Events		No. Caribou		Events / Monitoring Day			
	2021	2022	2021	2022	2021	2022	2021	2022	2021		2022	
									Mean	SE	Mean	SE
1	66	104	5	9	6	10	12	32	0.09	0.04	0.10	0.03
2	66	104	2	4	2	4	2	4	0.03	0.02	0.04	0.02
3	67	104	19	11	25	12	32	17	0.37	0.08	0.12	0.03

Table 2.13 Summary of Caribou Events at Remote Camera Monitoring Locations: Spring 2021-2022

Camera ID[A]	No. of Monitoring Days		No. Days with Events		No. Events		No. Caribou		Events / Monitoring Day			
									2021		2022	
	2021	2022	2021	2022	2021	2022	2021	2022	Mean	SE	Mean	SE
4	67	104	7	23	7	27	10	41	0.10	0.04	0.26	0.05
5	67	104	3	5	5	5	7	6	0.07	0.05	0.05	0.02
6	67	104	7	8	7	8	10	9	0.10	0.04	0.08	0.03
7	76	208	-[B]	-	-	-	-	-	-	-	-	-
8	67	104	1	1	1	1	1	1	0.01	0.01	0.01	0.01
9	67	104	8	19	8	25	13	26	0.12	0.04	0.24	0.05
10	4	104	-	11	-	19	-	26	-	-	0.18	0.06
11	66	104	2	4	4	4	6	12	0.06	0.05	0.04	0.02
12	67	104	8	20	11	33	20	145	0.16	0.06	0.32	0.09
13	67	104	31	39	58	79	83	129	0.87	0.14	0.76	0.13
14	66	104	1	4	1	4	2	4	0.02	0.02	0.04	0.02
15	67	104	7	20	8	23	10	30	0.12	0.04	0.22	0.05
16	67	104	7	30	16	44	55	87	0.24	0.10	0.42	0.08
17	66	104	6	8	6	8	10	10	0.09	0.04	0.08	0.03
18	67	104	13	17	18	20	21	24	0.27	0.07	0.19	0.05
19	67	104	4	11	6	12	7	14	0.09	0.05	0.12	0.03
20	67	104	4	21	7	24	8	49	0.10	0.06	0.23	0.05
21	67	104	4	2	6	5	10	10	0.09	0.05	0.05	0.03
22	67	104	15	14	16	17	20	20	0.24	0.06	0.16	0.04
23	67	104	4	6	5	6	5	8	0.07	0.04	0.06	0.02
24	67	104	14	21	19	24	23	26	0.28	0.07	0.23	0.05
25	67	104	-	3	-	3	-	3	-	-	0.03	0.02
26	67	104	4	3	6	3	7	5	0.09	0.05	0.03	0.02
27	NA[C]	104	NA	68	NA	177	NA	1395	NA	NA	1.70	0.21
28	NA	104	NA	53	NA	111	NA	455	NA	NA	1.07	0.17
29	NA	104	NA	37	NA	71	NA	71	NA	NA	0.68	0.12
30	NA	104	NA	25	NA	37	NA	50	NA	NA	0.36	0.07
31	NA	104	NA	5	NA	5	NA	7	NA	NA	0.05	0.02

Notes:

A. Camera locations are provided in Figure 2-3.

B. "-" = no caribou detected.

C. NA = not applicable; cameras were not deployed in spring 2021.

Distribution of Caribou Detections

The mean number of caribou events per camera day detected by cameras outside of the primary pathway (i.e., moderate-low and low use pathways, including cameras aligned with alternate pathways, wildlife trails and entry/exit points to the mine site) is presented in Table 2.14, for the three seasons when all 31 cameras were deployed. During fall migration, the mean number of caribou per camera day inside the primary migration path ranged from 0.16 (±0.08 SE) to 0.18 (±0.09 SE), while the mean number of caribou events per camera day outside of this path ranged from 0.001 (±0.001 SE) to 0.007 (±0.004 SE), in 2021 and 2022, respectively. During spring migration, the mean number of caribou events per camera day inside the primary migration path was 0.71 (±0.25 SE) and outside of this path was 0.15 (±0.03 SE). This preliminary analysis indicates that caribou were detected less frequently in low use migration areas and alternate pathways despite the increased sample size in these areas compared to high/moderate use areas.

Table 2.14 Summary of Caribou Events Inside and Outside the Primary Migration Pathway

	Events / Camera Day			
	Inside Primary Pathway (high- and moderate-high use pathways)		Outside Primary Pathway (moderate-low and low use pathways)	
Season	Mean	SE	Mean	SE
Fall 2021[A]	0.16	0.08	0.001	0.001
Fall 2022[A]	0.18	0.09	0.007	0.004
Spring 2022[B]	0.71	0.25	0.15	0.03

Notes:
A. Based on 7 cameras inside and 24 cameras outside the primary pathway identified by the dBBMM for fall migration.
B. Based on 6 cameras inside and 25 cameras outside the primary pathway identified by the dBBMM for spring migration.

Caribou use of alternate pathways is summarized in Table 2.15. Excluding camera 28, which is in both on an alternate pathway and aligns with the primary migration corridor (Figure 2.3), the highest mean number of caribou events per camera day occurred at camera 30 during both spring (0.36 ±0.07 SE) and fall (0.09 ±0.05 SE in 2022) migration. Compared to spring migration, when caribou are generally more spread-out geographically as they approach the site, relatively few of the cameras along LCP migration paths detected caribou during fall migration.

Table 2.15 Summary of Caribou Detections on Alternate Pathways Identified by the LCP Analysis

Camera ID[A]	LCP[B] Migration Path	Events / Camera Day							
		FALL 2021		FALL 2022		SPRING 2021		SPRING 2022	
		Mean	SE	Mean	SE	Mean	SE	Mean	SE
1	0 km ZOI[B] (spring)	-[C]	-	-	-	0.09	0.04	0.1	0.03
2	1 km ZOI (spring and fall)	-	-	-	-	0.03	0.02	0.04	0.02
3	1 km ZOI (spring)	-	-	-	-	0.37	0.08	0.12	0.03

Table 2.15 Summary of Caribou Detections on Alternate Pathways Identified by the LCP Analysis

Camera ID[A]	LCP[B] Migration Path	Events / Camera Day							
		FALL 2021		FALL 2022		SPRING 2021		SPRING 2022	
		Mean	SE	Mean	SE	Mean	SE	Mean	SE
5	1 km ZOI (spring)	-	-	-	-	0.07	0.05	0.05	0.02
14	0 km ZOI (spring and fall)	-	-	-	-	0.02	0.02	0.04	0.02
18	0 km ZOI (spring)	0.01	0.01	0.04	0.02	0.27	0.07	0.19	0.05
20	0 km ZOI (spring)	-	-	0.01	0.01	0.1	0.06	0.23	0.05
21	1 km ZOI (spring)	-	-	-	-	0.09	0.05	0.05	0.03
23	1 km ZOI (spring)	-	-	0.01	0.01	0.07	0.04	0.06	0.02
24	1 km ZOI (spring)	-	-	-	-	0.28	0.07	0.23	0.05
25	5 km ZOI (spring)	-	-	-	-	-	-	0.03	0.02
26	5 km ZOI (spring)	-	-	-	-	0.09	0.05	0.03	0.02
28	0 km and 1 km ZOI (spring and fall)	0.61	0.12	0.68	0.26	NA[D]	NA	1.07	0.17
30	5 km ZOI (spring)	0.01	0.01	0.09	0.05	NA	NA	0.36	0.07
31	5 km and 10 km ZOI (fall)	-	-	-	-	NA	NA	0.05	0.02

Notes:
A. Camera locations are provided in Figure 2-3.
B. LCP = Least Cost Pathway; ZOI = Zone of Influence.
C. "-" = no caribou detected.
D. NA = not applicable; cameras were not deployed in spring 2021.

2.3.4.3 Timing of Caribou Detections

The timing of caribou movements (total caribou and total caribou events) as captured by the remote camera program from 2019–2022 is shown in Figure 2-14. Note that while the remote camera program was designed to acquire additional information on caribou migration through the Project Area, camera deployment locations were also selected strategically, with bias, to better understand caribou use of preferred and potential alternate migration pathways.

During the fall, the total number of caribou events and the number of caribou detected occurred over relatively few days compared to spring when caribou were detected almost daily throughout the camera deployment period (Figure 2-14). In fall, both the greatest number of caribou and caribou events occurred on the same day, whereas in spring (except 2022), the date with the greatest number of total caribou preceded the date with the greatest total caribou events (Table 2.16). Males and females generally migrated at the same time during fall migration, but females tended to migrate earlier than males during spring migration (Figure 2-15).

Most caribou moved through the camera study area from five days to five weeks in fall, and from 4–10 weeks in spring (Table 2.15). Caribou were detected by cameras earlier than either the mean NSD or general migration initiation dates during fall migration, but later than these dates during spring migration.

As the camera data represent both collared and non-collared animals, and include males, females, and calves, the variation in the timing and duration of caribou movements is larger than the reported NSD dates (i.e., NSD results are based only on the collared female cohort, and not on the broader group of migrating caribou).

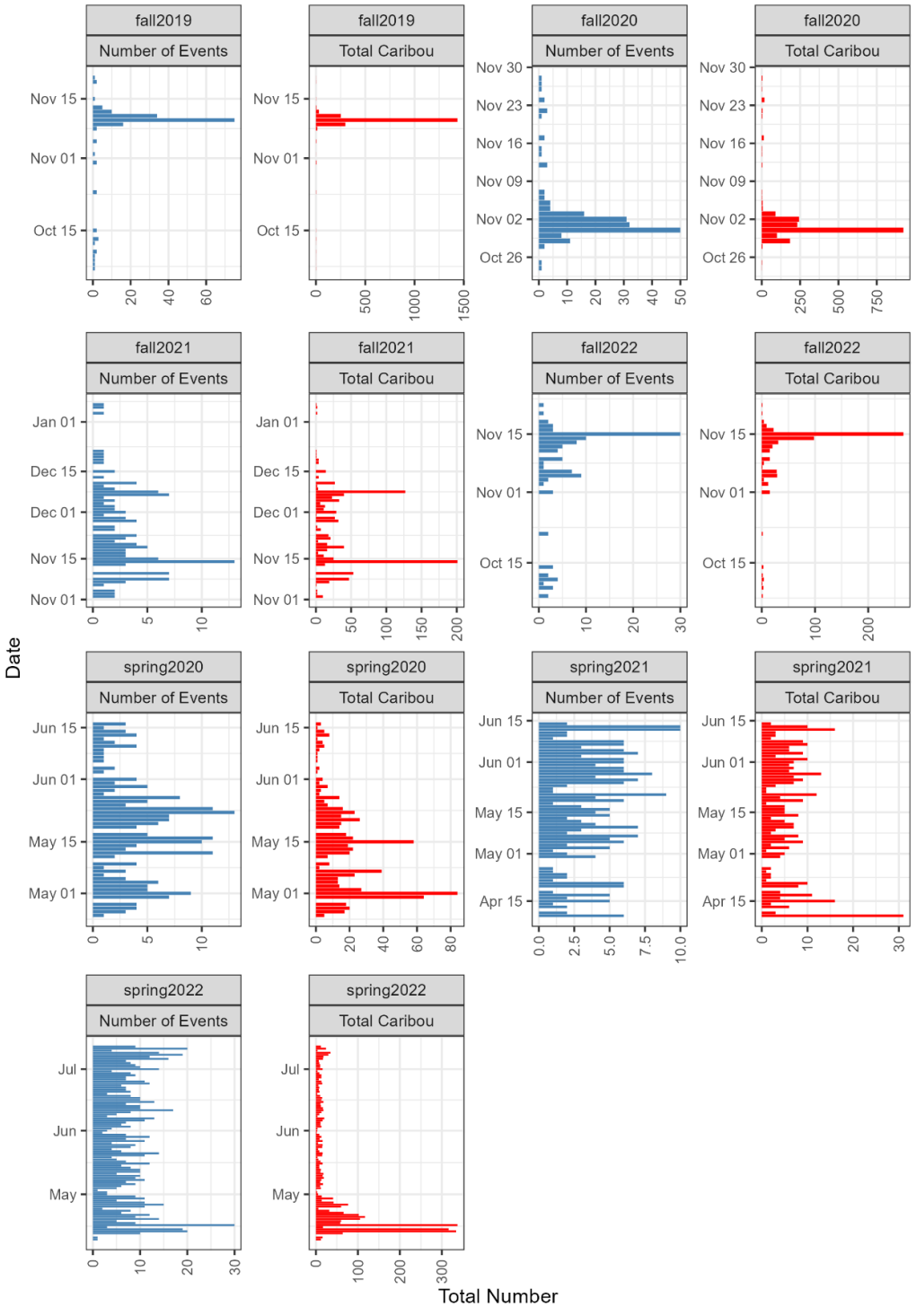


Figure 2-14 Total Caribou and Caribou Events during Fall and Spring Sampling Seasons: 2019-2022

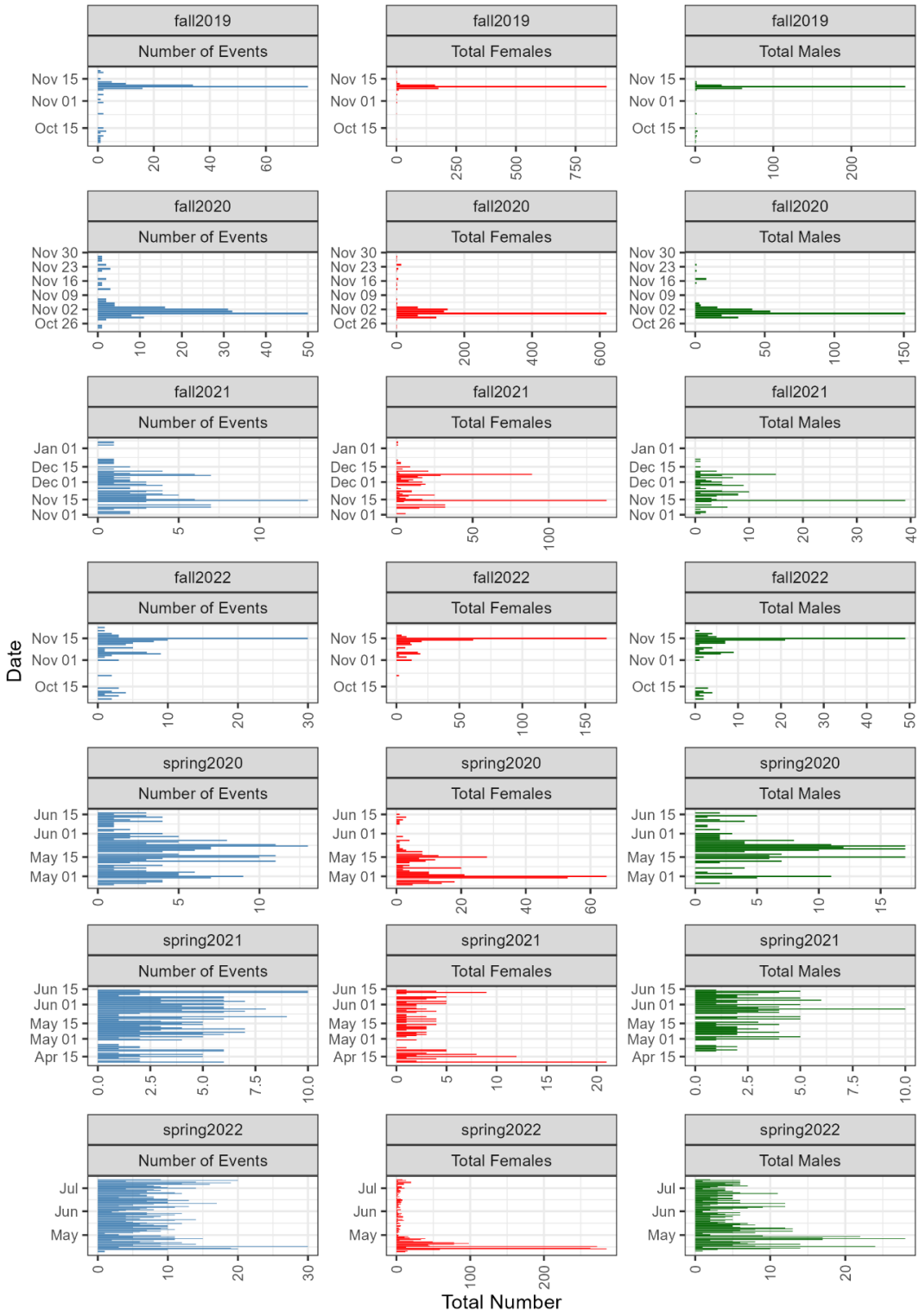


Figure 2-15 Total Number and Events of Female and Male Caribou Detected at Remote Camera Sites during Fall and Spring Sampling Seasons: 2019-2022

Table 2.16 Peak Movement Period of the Buchans Caribou Herd based on Remote Camera Monitoring Detections: 2019-2022

Year	Fall Migration Dates			Spring Migration Dates		
	Peak Movement Period[A]	Maximum Number of Caribou Events	Maximum Number of Caribou Detected	Peak Movement Period[A]	Maximum Number of Caribou Events	Maximum Number of Caribou Detected
2019	Oct 13 – Nov 11	Nov 10	Nov 10	-[B]	-	-
2020	Oct 29 – Nov 3	Oct 31	Oct 31	Apr 28 – May 27	May 23	May 1
2021	Nov 6 – Dec 7	Nov 14	Nov 14	Apr 15 – Jun 4	May 28	Apr 10
2022	Oct 10 – Nov 15	Nov 15	Nov 15	Apr 14 – Jun 27	Apr 16	Apr 16

Notes:

A. The start of the peak movement period was defined as the first Julian day when the proportion of caribou events exceeded 5% of the total for each season and the end was defined as when the cumulative total exceeded 80% of all caribou events. Calculations were based on caribou events for all camera sampling days (total deployment period), which varied across seasons and years.

B. "-" indicates that no studies were completed during that season / year.

2.3.4.4 Caribou Group Size and Composition (Remote Camera Detections)

The total number of caribou detected by remote cameras during fall surveys ranged from 592 in fall 2022 to 2,072 in fall 2019 (Table 2.17). During fall, group size ranged from 1 to 178 caribou, with a mean group size of between 5 and 13 (Table 2.17). The percentage of males and ratio of males:100 females were generally consistent from fall 2019 to fall 2021, but both increased slightly in fall 2022 (Table 2.17 and Figure 2-16). There was a similar pattern for the percentage of calves and ratio of calves:100 females, while the percentage of yearlings detected increased slightly from fall 2019 to fall 2022 (Table 2.17 and Figure 2-16). Females consistently comprised more than 60% of the total caribou detected (Figure 2-16).

Table 2.17 Caribou Group Size and Composition based on Remote Camera Results from Fall (2019-2022) and Spring (2020-2022) Monitoring Programs

Classification	Fall Totals				Spring Totals		
	2019	2020	2021	2022	2020	2021	2022
Total Caribou[A]	2,072	1,847	918	592	701	374	2,732
Total Adults[B]	1,641	1,555	770	534	538	333	2,411
Adult Females	1,260	1,200	586	351	351	162	1,786
Adult Males	381	330	165	137	187	131	551
Adult Unknown[C]	-[D]	25	19	46	-	40	74
Yearlings	7	42	30	30	52	20	238
Calves	203	198	89	24	3	12	39
Unknown[E]	221	52	29	4	108	9	44
Females:100 Adults[F]	77	77	76	66	65	49	74

Table 2.17 Caribou Group Size and Composition based on Remote Camera Results from Fall (2019-2022) and Spring (2020-2022) Monitoring Programs

Classification	Fall Totals				Spring Totals		
	2019	2020	2021	2022	2020	2021	2022
Males:100 Adults[F]	23	21	21	26	35	39	23
Males:100 Females[F]	30	28	28	39	53	81	31
Calves:100 Females[F]	16	17	15	7	1	7	2
Precent Females[F] (%)	61	65	64	59	50	43	65
Percent Males[F] (%)	18	18	18	23	27	35	20
Percent Calves[F] (%)	10	11	10	4	<1	3	1
Percent Yearlings[F] (%)	<1	2	3	5	7	5	9
Mean Group Size[F] (range)	13 (1-164)	10 (1-178)	7 (1-73)	5 (1-65)	3 (1-39)	2 (1-18)	3 (1-133)
Number of Collared Caribou[G]	3	10	30	17	0	4	60[G]

Notes:

A. Total caribou is for the total camera deployment period in each season (refer to **Error! Reference source not found.**).
B. Total adults = adult females + adult males + adult unknown.
C. Adult Unknown = adults of unknown sex.
D. "-" = no caribou detected.
E. Unknown includes caribou of unknown sex and/or age class.
F. Numbers rounded to the nearest whole number.
G. In some cases, the number of collar detections exceeds the number of collars deployed (n=40); this is because some collared caribou are detected by more than one camera (e.g., cameras positioned along the primary migration corridor would detect the same caribou as it migrated along).

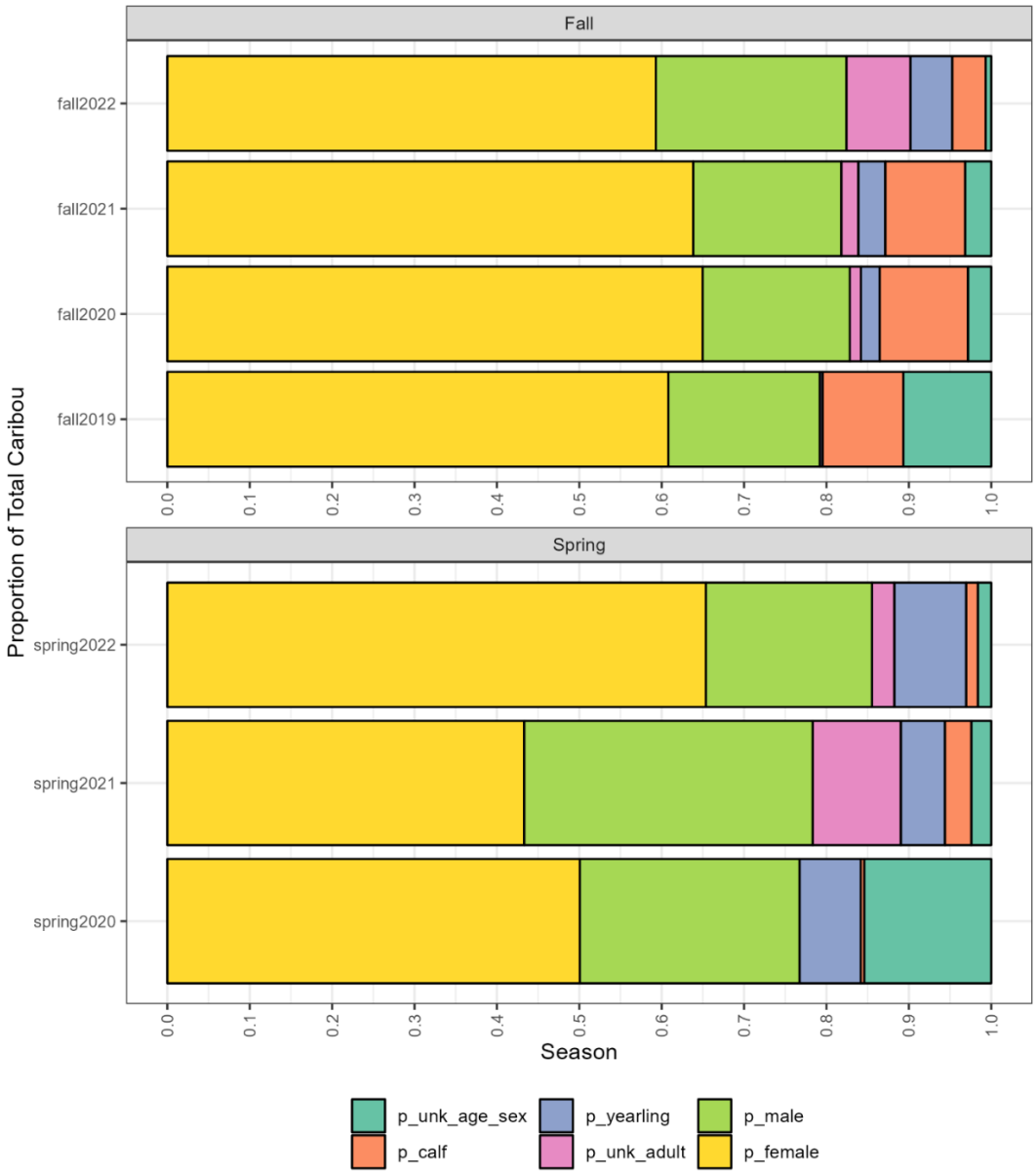


Figure 2-16 Proportion of Total Caribou Detected by Age and Sex: 2019-2022

Note: p = proportion of caribou; unk = unknown

During spring, the total number of caribou detected by remote cameras ranged from 374 in 2021 to 2,732 in 2022 (Table 2.17). Group size ranged from 1 to 133 caribou, with a mean group size of between 2 and 3 (Table 2.17). The percentage of males and ratio of males:100 females varied across the spring surveys, with highest numbers detected in spring 2021 (Table 2.17 and Figure 2-16). Compared to fall surveys, the proportion of calves detected during the spring was lower (Figure 2-16) and the ratio of calves to females was three calves:100 females or less (Table 2.17). The percentage of females and yearlings varied across spring sampling but was highest in 2022 (Table 2.17 and Figure 2-16).

2.3.5 Post-Calving Aerial Surveys

2.3.5.1 Caribou Classifications 2020-2022: Buchans Herd Calving Grounds Survey Area

2020 Aerial Survey

The 2020 aerial survey detected 307 groups of caribou (Table 2.18 and Table 2.19). Mean group size was six caribou, and the largest group detected was 108 caribou. Most caribou groups were found more than 30 km north of the mine site, although there was a second, smaller concentration of caribou near the south-west end of the survey area. Most of the detected groups consisted of single caribou (25%) and pairs (32%) (Table 2.18). More female caribou were observed than males, with a ratio of 16 males:100 adults and 74 females:100 adults (Table 2.19). Of the 798 females observed, 516 were calf:female pairs. The calf:100 female ratio was 65, with calves accounting for 30% of total caribou observed (Table 2.19). In the concentration of caribou north of the mine site, over 80% of the observed caribou were females and calves. In the concentration of caribou in the south-west portion of the survey area, females and calves contributed 75% of observed caribou. The distribution of females (both single and with calves) and yearlings was primarily concentrated in the area north of the mine site while the distribution of males was more dispersed throughout the survey area.

Table 2.18 Frequency of Caribou Group Sizes from 2020-2022 Aerial Surveys of Buchans Herd Calving Grounds

Group Size	Frequency (Percent of Total Groups Detected)[A,B]		
	2020[C]	2021	2022[D]
1	77 (25%)	107 (38%)	44 (27%)
2	98 (32%)	73 (26%)	33 (20%)
3-4	57 (19%)	36 (13%)	19 (12%)
5-10	35 (12%)	28 (10%)	26 (16%)
11-20	16 (5%)	19 (7%)	20 (12%)
21+	20 (7%)	19 (7%)	20 (12%)
Total Groups	307	282	162
Largest Group	108	259	103

Notes:
A. Includes all caribou detected in Buchans herd calving grounds survey area.
B. Percentages may not add up to 100% due to rounding.
C. Boundary of Buchans herd calving grounds survey area differed in 2020 (refer to Section 2.2.3).
D. Per direction from NLDFFA – Wildlife Division, the survey in 2022 was divided into two separate survey periods to align with the survey objectives (i.e., census survey first, followed by the classification survey), whereas in 2020 and 2021 the census and classification surveys were completed concurrently.

Table 2.19 Group Demographics from 2020-2022 Aerial Surveys of Caribou Calving Grounds: Buchans Herd Calving Grounds Survey Area

Classification	Group Demographics[A,B]		
	2020[C]	2021	2022[D]
Total Number of Groups	307	282	162
Mean Group Size (Range)[E]	6 (1-108)	7 (1-259)	9 (1-103)
Total Caribou Detected from Classification	1,700	1,837	1,504
Total Adults	1,075	1,268	964
Adult Females	798	862	820
Adult Males	171	382	103
Unknown Adults	106	24	41
Yearlings	109	145	100
Calves	516	424	440
Calf:Female Pairs	516	422	436
Female:100 Adults	74	68	85
Males:100 Adults	16	30	11
Males:100 Females	21	44	13
Calves:100 Females	65	49	54
Percent Females (%)	47	20	55
Percent Males (%)	10	21	7
Percent Calves (%)	30	23	29
Percent Yearlings (%)	6	8	7
Number of Collars Observed	4	20	21
Transect Distance (km)	1,765	2,093	
Survey Area (km^2)	4,840	5,230	

Notes:

A. Includes all caribou detected in Buchans herd calving grounds survey area.

B. Percentages may not add up to 100% due to rounding.

C. Boundary for the Buchans herd calving grounds survey area differed in 2020 (refer to Section 2.2.3).

D. Per direction from NLDFFA – Wildlife Division, the survey in 2022 was divided into two separate survey periods to align with the survey objectives (i.e., census survey first, followed by the classification survey), whereas in 2020 and 2021 the census and classification surveys were completed concurrently.

E. Means calculated from raw data. All values are rounded to the nearest whole integer.

2021 Aerial Survey

In 2021, there were 282 groups of caribou detected (Table 2.18 and Table 2.19). Mean group size was seven caribou, and the largest group detected was 259 caribou. Most groups consisted of single caribou (38%) and pairs (26%) (Table 2.18). More female than male caribou were detected, with ratios of 30 males:100 adults (15% males) and 68 females:100 adults (33% females) (Table 2.18). Caribou detections included 422 calf:female pairs and a calf:100 female ratio of 49, with calves comprising 23% of detections (Table 2.19). The greatest concentration of caribou was detected on the Buchans Plateau, between Hinds Lake and Lloyd's Lake, and there was a smaller cluster approximately 2.5 km northwest of the mine site. The greatest concentration of single females and calf:female pairs were on the Buchans Plateau, however they were also dispersed south-west of the Buchans Plateau. Yearlings were primarily distributed on the Buchans Plateau as well, however with fewer detections in the south-western portion of the survey area. Males were detected throughout much of the survey area (although not detected south of Grand Lake) and were concentrated on the Buchans Plateau.

2022 Aerial Survey

In 2022, 162 groups of caribou were detected (Table 2.18 and Table 2.19). Mean group size was nine caribou, and the largest group detected was 103 caribou. Most groups were comprised of single caribou (27%) and pairs (20%) (Table 2.18). More female than male caribou were detected, with ratios of 11 males:100 adults (7% males) and 85 females:100 adults (55% females) (Table 2.19).There were 436 calf:female pairs and a calf:100 female ratio of 54 (Table 2.19). Calves comprised 29% of caribou detected (Table 2.19). The greatest concentration of caribou was detected on the Buchans Plateau; this is also where the greatest concentration of single females, calf:female pairs, and yearlings were found. A smaller concentration of caribou was detected at the margin of the survey area, approximately 2.5 km northwest of the mine site, comprised of a mix of single females, calf:female pairs, yearlings, and males. Males were detected throughout much of the survey area, with concentrations on the Buchans Plateau and the area between the plateau and the Project Area.

2.3.5.2 Caribou Classifications 2020-2022: Resident Caribou Calving Grounds in the ZOI

2020 Aerial Survey

The 2020 aerial survey detected 212 caribou in 82 groups within the ZOI (Table 2.20 and Table 2.21). Mean group size was three, and the largest group consisted of 15 caribou. Most caribou / caribou groups were detected approximately 10 km west of the mine site; caribou in these groups were approximately 63% females. Males constituted 32% of observed caribou with a ratio of 44 males:100 adults (Table 2.21). The proportion of calves was 11% of total caribou detected with a calf:100 female ratio of 31 (Table 2.21). Twenty-four calf:female pairs were observed. The distribution of females (both single and with calves) and yearlings was primarily concentrated in the area directly west of the mine site, while the distribution of males was more dispersed throughout the survey area.

Table 2.20 Frequency of Caribou Group Sizes from 2020-2022 Aerial Surveys of Resident Caribou Calving Grounds in the ZOI

Group Size	Frequency (Percent of Total Groups Detected) [A,B]		
	2020[C]	2021	2022[D]
1	35 (43%)	11 (31%)	15 (63%)
2	19 (23%)	7 (19%)	4 (17%)
3-4	16 (20%)	13 (36%)	1 (4%)
5-6	8 (10%)	3 (8%)	1 (4%)
7-8	1 (1%)	2 (6%)	1 (4%)
9-10	1 (1%)	-[E]	1 (4%)
11-12	1 (1%)	-	-
13-14	-	-	-
15+	1 (1%)	-	1 (4%)
Total Groups	82	36	24
Largest Group	15	7	17

Notes:

A. Includes all caribou detected in the resident caribou calving grounds survey area (i.e., calving grounds in the ZOI [zone of influence]). The ZOI is defined as the area of a 17-km buffer around the mine site that is outside of the Buchans herd calving grounds, plus a 4-km buffer along the south side of the access road (refer to Section 2.2.3).

B. Percentages may not add up to 100% due to rounding.

C. Boundary of the survey area differed in 2020 (refer to Section 2.2.3).

D. Per direction from NLDFFA – Wildlife Division, the survey in 2022 was divided into two separate survey periods to align with the survey objectives (i.e., census survey first, followed by the classification survey), whereas in 2020 and 2021 the census and classification surveys were completed concurrently.

E. "-" = no groups of that size detected

Table 2.21 Group Demographics from 2020-2022 Aerial Surveys of Caribou Calving Grounds in the ZOI: Resident Caribou Survey Area

Classification	Group Demographics[A,B]		
	2020[C]	2021	2022[D]
Total Number of Groups	82	36	24
Mean Group Size (Range)[E]	3 (1-15)	3 (1-7)	3 (1-17)
Total Caribou	212	98	66
Total Adults	154	74	50
Adult Females	77	41	29
Adult Males	67	31	19
Unknown Adults	10	2	2
Yearlings	34	8	5
Calves	24	30	11
Calf:Female Pairs	24	30	11

Table 2.21 Group Demographics from 2020-2022 Aerial Surveys of Caribou Calving Grounds in the ZOI: Resident Caribou Survey Area

Classification	Group Demographics[A,B]		
	2020[C]	2021	2022[D]
Female:100 Adults	50	55	58
Male:100 Adults	44	42	38
Calf:100 Females	31	73	38
Percent Females (%)	36	42	44
Percent Males (%)	32	32	29
Percent Calves (%)	11	31	17
Percent Yearlings (%)	16	8	8
Number of Collars Observed	1	0	0
Transect Distance (km)	575	423	
Survey Area (km^2)	1,262	871	

Notes:

A. Includes all caribou detected in the resident caribou calving grounds survey area (i.e., calving grounds in the ZOI [zone of influence]). The ZOI is defined as the area of a 17-km buffer around the mine site that is outside of the Buchans herd calving grounds, plus a 4-km buffer along the south side of the access road (refer to Section 2.2.3).

B. Percentages may not add up to 100% due to rounding.

C. Boundary of the survey area differed in 2020 (refer to Section 2.2.3).

D. Per direction from NLDFFA – Wildlife Division, the survey in 2022 was divided into two separate survey periods to align with the survey objectives (i.e., census survey first, followed by the classification survey), whereas in 2020 and 2021 the census and classification surveys were completed concurrently.

E. Means calculated from raw data. All values are rounded to the nearest whole integer.

2021 Aerial Survey

In 2021, 98 caribou were detected in 36 groups in the ZOI, with a mean group size of three (Table 2.20 and Table 2.21). The largest group was 14 caribou. The greatest concentration of caribou was detected approximately 10 km west of the mine site, near Victoria Lake Reservoir. Several mid-sized groups, single females, and calf:female pairs were also detected northeast of the mine and small groups were dispersed within the survey area south of the mine site. Most of the detected groups consisted of single caribou (31%), pairs (19%), and groups of three (36%) (Table 2.20). Males constituted 32% of detected caribou with a ratio of 42 males:100 adults, and the percent females was 42% with a ratio of 55 females:100 adults (Table 2.21). The percent of calves was 31% of total caribou detected, and 30 calf:female pairs were detected (Table 2.21).

2022 Aerial Survey

In 2022, 66 caribou from 24 groups were classified in the ZOI (Table 2.20 and Table 2.21). Mean group size was three and the largest group size detected was 17 (Table 2.21). Most detections consisted of single caribou (63%). Males comprised 29% of caribou with a ratio of 38 males:100 adults, females comprised 44% with a ratio of 58 females:100 adults and calves comprised 17% with a calf:100 female ratio of 38 (Table 2.21). A total of 11 calf:female pairs were detected (Table 2.21). Caribou groups were detected throughout the survey area, although observations of single females, calf:female pairs and

yearlings occurred over a smaller area compared to males. Single females and calf:female pairs were primarily found in two locations: northeast of the mine site near the ZOI boundary, and west of the mine site near the ZOI boundary. The largest group of yearlings (n=3) and males (n=6) was also detected in the area west of the mine site. Elsewhere, males were mostly single individuals scattered throughout the survey area.

2.3.5.3 Buchans Herd Caribou Calving Grounds Population Survey: 2021-2022

The population estimate for the Buchans herd in 2021 was 1,278 caribou (95% CI: 812-2,011) and in 2022 was 1,724 caribou (95% CI: 1,090-2,726) (Table 2.22 and Figure 2-17). The best fit model estimated a mean group size of approximately 4.30 caribou in 2021 and 3.65 caribou in 2022 (Table 2.22).

Table 2.22 Population Estimate from the 2021 and 2022 Aerial Survey of the Buchans Herd Calving Grounds Survey Area

Year	Model Results[A]					
	Number of Detections	$\hat{N}1$[B]	SE ($\hat{N}$)[B]	CI[B]	Mean Group Size	SE Group Size
2021	235	1,278	289.39	812 – 2,011	4.30	0.56
2022[C]	313	1,724	396.09	1,090 – 2,726	3.65	0.31

Notes:

A. Model is based on census data only (i.e., classification data was not included). Only caribou detections with a distance calculation and habitat information were included.

B. $\hat{N}$ = population estimate, CI = 95% confidence interval, SE = standard error.

C. Per direction from NLDFFA – Wildlife Division, the survey in 2022 was divided into two separate survey periods to align with the survey objectives (i.e., census survey first, followed by the classification survey), whereas in 2020 and 2021 the census and classification surveys were completed concurrently.

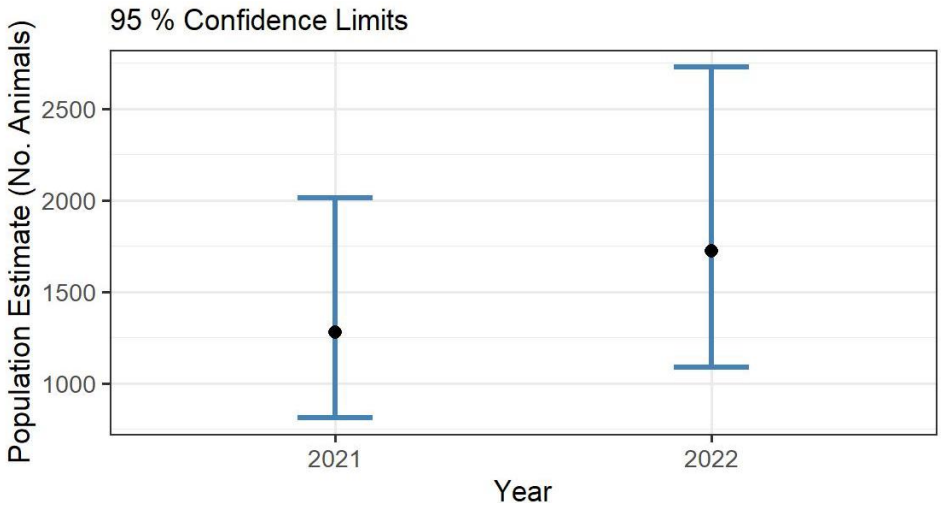


Figure 2-17 Population Estimate and 95% Confidence Intervals

Caribou in the LAA

During the three post-calving aerial surveys completed in 2020, 2021 and 2022, 38 caribou were detected in the LAA, 17 of these were within the Project Area (i.e., mine site and access road):

- In 2020, nine caribou were detected in the LAA; none of these were within the Project Area.
- In 2021 there was one caribou detected within the mine site area, and two single caribou, a group of two and a group of three were detected on the southern transect along the access road. Two other groups (n=5 and n=7) were detected in the LAA (i.e., in the portion of the LAA outside of the Project Area).

In 2022, five caribou were detected within the mine site area, comprised of one single caribou and one group of three during the census survey, and a single male during the classification survey. There were also two groups of two caribou detected along the access road. There were no caribou detected in the portion of the LAA outside of the Project Area.

3.0 SUMMARY AND DISCUSSION

3.1 DISTRIBUTION AND MOVEMENTS OF THE BUCHANS CARIBOU HERD

3.1.1 Seasonal Ranges

The caribou population on the Island of Newfoundland is comprised of several sub-populations differentiated by annual movement patterns, spatial affiliations and genetic structure (Wilkerson 2010; Government of NL 2015). The Buchans herd is part of the South Coast sub-population, which is comprised of three herds in addition to the Buchans herd: Gaff Topsails, Grey River and La Poile (Wilkerson 2010; Schaefer and Mahoney 2013; Government of NL 2019). The South Coast caribou herds intermix on winter ranges near the southern shore between Burgeo and the Connaigre Peninsula (Weir et al. 2014), however generally have separate calving areas and summer ranges.

Caribou tend to display site fidelity in their seasonal ranges, with highest fidelity expected during the spring, calving and post-calving periods (Ferguson and Elkie 2004). However, caribou are also known to deviate from this strategy. During the 2000s, the Buchans herd showed increased site fidelity compared to the 1990s, spending six more weeks on their calving and summer ranges in the 2000s than in the 1990s (Schaefer and Mahoney 2013). Differences in calving site fidelity may be influenced by the amount of snowfall in early spring (Mahoney and Schaefer 2002).

Consistent with this description, the seasonal range of the Buchans herd during post-calving migration/dispersal, estimated based on recent GPS telemetry data (50% kernel) and results of the NSD analysis, is concentrated north of the Project Area on the Buchans Plateau. Aerial post-calving surveys undertaken from 2020-2022 confirm a consistent concentration of caribou in this area during early June. The fall dispersal/winter seasonal range generally occurs near the southern shore, although there is also a relatively small concentration of caribou that appear to remain on the Buchans Plateau year-round. The remaining seasons have ranges near both the Buchans Plateau and the southern shore. Overall, while the distribution of GPS-collared caribou includes the Buchans Plateau and southern shore for most seasons, caribou appeared to show high fidelity to the Buchans Plateau during post-calving migration/dispersal.

3.1.2 Migration Timing

Documented herd-specific migration dates for the Buchans herd indicate high variability in the timing of migration among years, for both spring and fall migration. Between 1995 and 2000, Mahoney and Schaefer (2002) found that the median dates of spring and fall migration differed by more than one month, with observed median spring migration dates from April 17 to May 23 and fall migration dates from October 8 to November 7. The start of fall migration, for example, shifted from mid-November in the 1960s to mid-October in the late-1990s (Mahoney and Schaefer 2002). Variability around the timing of fall migration may be influenced by weather conditions (LeCorre et al. 2017), such as snow accumulation (Joly et al. 2021) and vegetation senescence (Cameron et al. 2021).

The NSD analysis found interannual variation in both the initiation and duration of fall and spring migration, with the timing of migration varying by individual collared caribou. The mean start and end dates of seasonal migrations extended from November 10 to November 26 (16 days duration) for fall migration and from April 8 to May 2 (24 days duration) for spring migration. While most caribou commenced migration over a period of consecutive days, there were a few outliers that started much earlier or much later than the majority (e.g., some animals began moving as early as July 12 in fall and as early as March 11 in the spring). The mean migration dates overlap with the general (non-herd specific) migration periods for caribou on the Island of Newfoundland for fall migration (November 1 to December 15) and spring migration (April 1 to May 19).

Calculations of annual peak movements based on the remote camera surveys (defined as the first Julian day when the proportion of caribou events exceeded 5% of the total observations for each season and the end as when the cumulative total exceeded 80% of caribou events) also suggested variability in the timing of caribou movements. The start of peak movement varied by up to four weeks during fall sampling and two weeks during spring sampling. The duration of peak movement also varied by season, with most caribou moving through the camera study area from five days to five weeks in fall and from four to 10 weeks in the spring, with caribou detected by cameras almost daily during spring migration. The peak movements captured by the cameras in the spring are consistent with the findings of the NSD analysis of a longer mean duration in the timing of spring vs. fall migration. In terms of the initiation of the peak movement period, caribou were detected by the cameras earlier than either the mean NSD or general migration initiation dates for fall migration, but later than for spring migration. As discussed in Section 2.3.4.3, the remote camera data represents both collared and non-collared caribou, which included non-collared males, females, and calves whereas the NSD analysis is based on collared females only (i.e., is a subset of the total). As a result, the variation in the timing and duration of caribou movements is larger than the reported NSD dates.

3.1.3 Migration Pathways

The dBBMM analysis identified a moderate-high to high-use migration path that overlaps the Project Area (mine site), for both fall and spring migration. The analysis also identified a network of lesser used migration paths indicating that there may be a degree of variability in the paths used between years or individuals (i.e., some collared caribou migrate through and/or around the mine site along low-use pathways outside the primary pathway). Use of the primary path by caribou was confirmed by the remote camera program, that consistently detected higher numbers of caribou and caribou events in cameras that align with the pathway. The camera data also supported the dBBMM findings of a wider network of pathways used during spring migration (30 cameras detected caribou) compared to the fall (12 cameras detected caribou). Cameras with little or no detections during the fall were generally located in the low use areas identified in the dBBMM (Figure 2-6). During spring, cameras in the primary migration corridor (e.g., cameras 12, 13, 27 and 28) (Figure 2-7) continued to detect relatively high numbers of caribou; however, other cameras deployed in low use areas identified by the dBBMM also detected caribou in moderate numbers (e.g., cameras 4, 9, 20, 24, 29 and 30).

The dBBMM analysis also identified high-use migration stopover sites within the main migration path. The fall migration corridor had five stopover areas, with one relatively large stopover area at the east end of

Victoria Lake Reservoir, overlapping the Project Area. Cameras 12, 13, 16, 27 and 28 all occur within the large high-use stopover area. There were also several small areas, and one relatively large stopover area in spring, located south of Star Lake near the west end of Beothuk Lake (north of the Project Area). Camera 27, which detected high numbers of caribou during spring migration (e.g., 1,395 caribou in 2022) is located near the large spring high-use stopover area.

Findings also suggest that caribou migrate along a high-use path at the north end of Valentine Lake (approximately 8 m at the narrowest point), north of the Marathon pit and waste rock pile. The topography in this area, with a narrow land bridge between portions of Valentine Lake, seems to act as a natural narrow corridor that may limit the width of the caribou migration path. Caribou will select migration paths that provide adequate forage and resting habitat (Saher 2005), are less energetically demanding (e.g., less rugged, open terrain) (Saher and Schmigelow 2005), and have relatively low predation risk compared to other potential paths (Bergerud et al. 1990; Ferguson and Elkie 2004). Caribou are capable swimmers and swim between 1-10 km between Arctic islands within their range (Miller 1995), despite being an energetically inefficient mode of movement (LeBlond et al. 2016).

The Caribou Alternate Migration Pathway Analysis predicted that if caribou alter their primary migration path because of the Project, caribou could travel between 0 km and 13 km farther than the baseline LCP during frozen conditions, and 6 km to 30 km farther than the estimated baseline LCP during unfrozen conditions (spring and fall migration combined). Other than camera 28 (positioned both along alternate pathways and the primary migration path), cameras deployed along potential alternate pathways detected relatively few caribou (<60) over the sampling period. Cameras 18, 20 and 30 detected the most caribou across surveys. Cameras 18 and 20 are located northeast of the Project Area along the 0 km pathway predicted for spring migration, while camera 30 is located southwest of the Project Area along the 5 km pathway for spring migration. Camera 29, located approximately 3 km northwest of the Leprechaun pit in an area predicted to be a low-use route during fall migration and near (but not aligned with) the 5 km ZOI for spring migration, also detected a relatively high number of caribou.

The associated relative energetic costs of the alternative pathways range from 1.01 to 1.41 times greater than the baseline LCP. Baseline and alternate pathways traverse primarily open habitats (e.g., coniferous forest, low shrub, and wetland-shrub types), with proportions of open coniferous habitats decreasing with increasing ZOI distance (up to 13% less at the 15 km ZOI). While the decreased proportion of open habitats on the predicted alternate pathways suggest that those paths may have higher resistance values and be more energetically demanding during migration, the habitats on the alternate pathways are largely similar to the baseline pathway.

3.1.4 Survey Effort and Effects on Caribou Detections – Remote Camera Monitoring

Based on the remote camera data collected during 2019 and 2020 and direction from NLDFAA-WD, the number of cameras deployed increased from 11-12 cameras in 2019 and 2020, to 26 cameras in spring 2021, and to 31 cameras starting in fall 2021. The additional cameras were deployed to monitor caribou use within the migration corridor as well as potential alternate migration paths.

During fall 2019 and fall 2020, the mean number of caribou events per camera-day was 0.17 (±0.05 SE) and 0.18 (±0.06 SE), respectively, but during fall 2021 and 2022, when the number of cameras had more than doubled, total caribou detections were relatively lower and the mean number of events per camera-day decreased to 0.04 (±0.02 SE) and 0.05 (±0.02 SE), respectively. The majority of camera locations in fall 2019 and 2020 (75%) were within the primary migration corridor and supported relatively high numbers of caribou detections (e.g., >1,000 caribou detections at MAR1 in each year), whereas in fall 2021 and 2022 cameras were primarily deployed outside of the high and moderate-high use areas identified by the dBBMM (80%), along alternate modeled pathways (Figure 2-3). While two of the new cameras (27 and 28) were deployed in the primary migration pathway, the number of events per camera-day were low compared to spring migration (described below).

During spring sampling, the mean number of events per camera day was the same in 2020 and 2022 (0.26 ±0.05 SE and 0.26 ±0.06 SE, respectively), but lower in 2021 (0.15 ±0.03 SE). The high mean number of events per camera-day in spring 2020 is likely related to the high percentage of cameras in the primary migration pathway, while in spring 2021 there were only four of 26 cameras that aligned with the primary pathway. Thus, most of the survey effort in spring 2021 (80% of cameras) focused on low-use areas identified by the dBBMM. In spring 2022, two additional cameras were deployed in the primary pathway (cameras 27 and 28) that had a high number of events per camera-day (1.70 ±0.21 SE and 1.07 ±0.17 SE, respectively) that contributed to the relatively high mean number of events per camera-day in that year. The mean number of caribou events detected by cameras inside of the primary path were consistently higher than that by cameras outside of the primary path. This suggests that the moderate-low and low-use areas, including alternate pathways identified by the LCP analysis, receive relatively less use, despite the increased sample size compared to cameras in the high and moderate-high use areas.

3.2 CARIBOU CLASSIFICATION

During aerial surveys, the proportion of caribou calves (i.e., percent calves out of total animals classified) on the Buchans herd calving grounds was 30% in 2020, 23% in 2021 and 29% in 2022 (Appendix B). The proportion of calves on resident caribou calving grounds in the ZOI was 11% in 2020, 31% in 2021, and 17% in 2022. The number of calf:female pairs remained relatively stable throughout aerial surveys of the Buchans herd calving grounds, ranging from 422 in 2021 to 516 pairs in 2020. The number of calf:female pairs in the ZOI was similar in 2020 and 2021 (24 and 30 pairs, respectively) but only 11 pairs were detected in 2022. These numbers represent baseline information on Buchans herd caribou and resident caribou, based on surveys conducted during the early post-calving period within the boundaries delineated for the respective study areas.

As these surveys were undertaken immediately following calving, a relatively high proportion of calves would be expected compared other seasons such as migration (e.g., only <1% to 11% of caribou detected by the spring and fall remote camera programs were calves). Historic surveys completed during the fall and winter of 2007, 2011, 2016, and 2019 found 8–16% calves in the Buchans herd and 6–15% calves in the Grey River herd (Government of NL 2020a). In 2014, Weir et al. (2014) reported an average, stabilized calf recruitment of ~11% beginning in the 2000s for the Newfoundland caribou population (based on fall surveys), however, indicated that this number was insufficient for population increase. Note

that recent studies suggest that the calf survival rate of some caribou herds in central Newfoundland may be increasing to more sustainable levels (CBC 2022).

As expected, aerial surveys and remote cameras consistently detected more female caribou than males. Caribou distribution is segregated by sex at certain times of year (Jakimchuk et al. 1987) including during calving (Lent 1966; Cameron and Whitten 1979), which could explain the low proportion of males observed. Caribou detections in the Buchans herd calving grounds survey area generally found males to be more widely dispersed, while females and females with calves were primarily aggregated in one portion of survey area. Sexual segregation on calving grounds has also been observed in the George River herd in Labrador (Couturier et al. 1996) and in the Bluenose-East Herd in the Northwest Territories (Adamczewski et al. 2014).

3.3 BUCHANS HERD CALVING GROUNDS POPULATION SURVEY

The population estimate for the Buchans herd on the calving grounds in 2021 was 1,278 caribou (95% CI: 812 to 2,011) and in 2022 was 1,724 caribou (95% CI: 1,090 to 2,726). The population estimate from 2021 is within the 95% confidence interval for 2022, and the 2022 estimate is within the 95% confidence interval for 2021, meaning the two population estimates are not statistically different from each other between those two years. The best fit model estimated a mean group size of approximately 4.30 caribou in 2021 and 3.65 caribou in 2022. These estimates represent baseline information on the population of Buchans herd caribou on the calving grounds for the Approved Project (pre-construction), based on surveys during the early post-calving period within the 5,229.6 km^2 area delineated as the Buchans herd calving ground survey area.

As summarized in Table 11.5 of the Valentine Gold EIS, historical population estimates completed by NLDFFA – Wildlife Division for the Buchans herd were completed during other seasons (e.g., fall-winter or spring) and over different survey areas. The differences in seasonal distribution and group size composition likely contribute to differences in those population estimates (e.g., 4,112 and 4,474 caribou in 2007 and 2019, respectively) and those completed in 2021 and 2022. In addition, different survey methods and population models were used in previous studies compared to the current investigation, thus making it difficult to compare population estimates and trend over time. Ultimately, the historical surveys (2014 and 2019) are not directly comparable to 2021 and 2022 due to differences in survey methods, area, and season.

Other factors that may influence population estimates include the distribution of males and females during key periods. A lower proportion of male caribou were detected in the 2021 and 2022 post-calving surveys, suggesting a portion of the males were not within the survey area at the time of the survey. In Alaska, male and calving females occupy distinct areas during post-calving (Jakimchuk et al. 1987), and caribou in British Columbia show segregation following calving, with females selecting habitats with lower predation risk, possibly at the expense of forage availability (Bergerud et al. 1984). Sexual segregation on the calving grounds has also been observed in the George River herd in Labrador (Couturier et al. 1996) and in the Bluenose-East Herd in the Northwest Territories (Adamczewski et al. 2014). The difference between 2021 and 2022 estimates for the Buchans herd and the 2007 and 2019 fall-winter estimates are similar to reported estimates from the Middle Ridge, where the estimate from a survey in early June 2012

(2,905 caribou; 95% CI 1,893–4,459) (Fifield et al. 2012) was markedly lower than two winter surveys in 2006 and 2010 when more than 8,800 caribou were estimated (Dyke 2010 in Fifield et al. 2012). Another factor that could have contributed to the difference between the post-calving and winter estimates is that South Coast herds share a winter range (Weir et al. 2014). The previous winter survey may have included caribou from other herds as the Buchans herd intermixes with others on the winter range.

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APPENDIX A

ANNUAL REPORTS: REMOTE CAMERA SURVEYS

SUPPLIED AS A SEPARATE DOCUMENT

APPENDIX B

ANNUAL REPORTS: AERIAL CALVING GROUNDS SURVEYS

SUPPLIED AS A SEPARATE DOCUMENT

APPENDIX 10B

Valentine Gold Project: Caribou Protection and Environmental Effects Monitoring Plan (Preliminary)

MOZ-NFLD-001-MOZ-0000-000000-80-EMP-0014

Valentine Gold Project:

Caribou Protection and Environmental Effects Monitoring Plan (Preliminary)

Marathon Gold Corporation
36 Lombard Street, Suite 600
Toronto, ON M5C 2X3

January 2022

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Abbreviations

dBBMM	dynamic browning bridge movement modelling
CPEEMP	Caribou Protection and Environmental Effects Mitigation and Monitoring Plan
EA	environmental assessment
EIS	Environmental Impact Statement
GPS	Global Positioning System
Julian Date	day of the year ranging from 1 to 365 or 366
km	kilometre
LAA	Local Assessment Area
LCP	least cost path
m	metre
Marathon	Marathon Gold Corporation
NL	Newfoundland and Labrador
NLDFFA-Wildlife Division	NL Department of Fisheries, Forestry and Agriculture – Wildlife Division
NSD	net squared displacement
RAA	Regional Assessment Area
TMF	tailings management facility
ZOI	zone of influence

Glossary

Cumulative Effects	The environmental effects that are likely to result from a project in combination with other projects or activities that have been or will be carried out
Environmental Effect	Refers to changes to the environment or to health, social or economic conditions and the positive and negative consequences of these changes
Effects Pathways	Effect pathways describe how a project could result in the potential environmental effect (cause-and-effect relationship; the Project-effect pathway)
Mitigation Measures	Measures or actions taken to eliminate, reduce, control or offset the adverse effects of a project
Performance Indicator	A quality of an objective to be measured and reported
Performance Target	The desired value of a performance indicator
Residual Effects	The effects of a project that remain after the application of mitigation
Risk	Risk is the possibility of something (such as environmental effect) occurring. There are many definitions of risk and for the purpose of this CPEEMP, risk involves uncertainty about the effects of an activity with respect to caribou or the chance of adverse effects to caribou.
Risk Assessment	Risk assessment aims to assess the possibility of something occurring (likelihood) and affect or influence of that occurrence on something else (impact). For the purpose of this CPEEMP, this means to assess the possibility a Project effect will occur and the potential impact of that effect on caribou.
Significance	A measure of the degree to which an environmental effect may be adverse or beneficial
Thresholds	the point at which there is an abrupt change in an ecosystem quality, property or phenomenon, or where small changes in an environmental driver produce large responses in the ecosystem. In this context, the point at which alternate actions will be taken.

1.0 INTRODUCTION

Marathon Gold Corporation (Marathon) is planning to develop an open pit gold mine south of Valentine Lake, located in the Central Region of the Island of Newfoundland, approximately 60 kilometres (km) southwest of Millertown, Newfoundland and Labrador (NL) (Figure 1-1). The Valentine Gold Project (the Project) will consist primarily of open pits, waste rock piles, crushing and stockpiling areas, conventional milling and processing facilities (the mill), a tailings management facility, personnel accommodations, and supporting infrastructure including roads, on-site power lines, buildings, and water and effluent management facilities. The mine site is accessed by an existing public access road that extends south from Millertown approximately 88 km to Marathon's existing exploration camp. Marathon will upgrade and maintain the 76 km of access road from a turnoff located approximately 8 km southwest of Millertown to the mine site.

The Project is comprised of two mining areas, the Leprechaun and Marathon deposits. Standard surface mining techniques will be used to mine gold ore from two open pits. Ore material will initially be mined and processed at a nominal rate of 6,850 tonnes per day, increasing to 10,960 tonnes per day in Year 4. Ore will be processed through the mill, where it will be crushed, milled and put through floatation and cyanidation processes to recover the gold. High-grade and low-grade ore materials will be stockpiled for mixing and for processing later in the mine life. Tailings will be treated in the process plant area to remove cyanide from the effluent and subsequently deposited in an engineered tailings management facility (TMF), where effluent will be monitored for compliance with the *Metal and Diamond Mining Effluent Regulations*. Gold will be formed into doré bars, which will be shipped from site to market in secured trucks.

The construction of the Project is expected to take place over a period of approximately 20 to 24 months, followed by an estimated mine operation life of 13 years. The Project will operate 24 hours a day, seven days a week on a 12-hour shift basis. Upon cessation 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.

Other Project components and activities that are associated with the primary mining, milling and processing activities include site and haul road construction and maintenance, waste rock management, electrical power supply and distribution, process and potable water supply and distribution, site wide stormwater and effluent management including: monitoring; treatment and discharge; fuel storage and fueling stations; mine and plant workshops and services; administrative office; personnel accommodations and lunchrooms; and security (Figure 1-2). A power line connected from nearby NL Hydro's Star Lake Generating Station to the mine site will be required to supply power to the Project and will be permitted, constructed and operated by NL Hydro.

The Project Area overlaps woodland caribou range in central Newfoundland; the NL Department of Fisheries, Forestry and Agriculture (NLDFFA)-Wildlife Division identified the Buchans, Gaff Topsails, Grey River and La Poile herds as having the potential to interact with the Project Area, Local Assessment Area (LAA) and Regional Assessment Area (RAA) (Government of NL 2020). An assessment of Project effects on caribou was provided in Chapter 11 of the Environmental Impact Statement (EIS; Marathon 2020), supported by baseline studies that were appended to the EIS (i.e., Baseline Study Appendix 2: Caribou), and submitted amendments and responses to Information Requirements. The assessment considered Project effects on caribou including change in habitat, change in movement, and change in mortality (Chapter 11, EIS; Marathon 2020).

This Caribou Protection and Environmental Effects Monitoring Plan (CPEEMP) defines the mitigation measures aimed at reducing the risk of adverse effects on caribou and describes the follow-up and monitoring activities that will be undertaken to verify the environmental assessment (EA)/EIS effects predictions and mitigation effectiveness.

For the purpose of this CPEEMP, 'caribou' refers to the species (*Rangifer tarandus*), and to their daily, seasonal and annual life requisites (i.e., habitat for food, shelter, calving, and movement) necessary for caribou populations to be sustainable. Herd names are used in reference to specific caribou groups (i.e., Buchans, Grey River, Gaff Topsails, and La Poile).

The CPEEMP is considered a “live” document that will be updated regularly, based on conditions of authorization (EA release and permitting); collection of additional baseline data prior to construction; information from follow-up and monitoring activities as the Project advances; and ongoing review with regulators, scientific experts, Indigenous groups, and stakeholders. A revision log and distribution list are maintained in Appendix A.

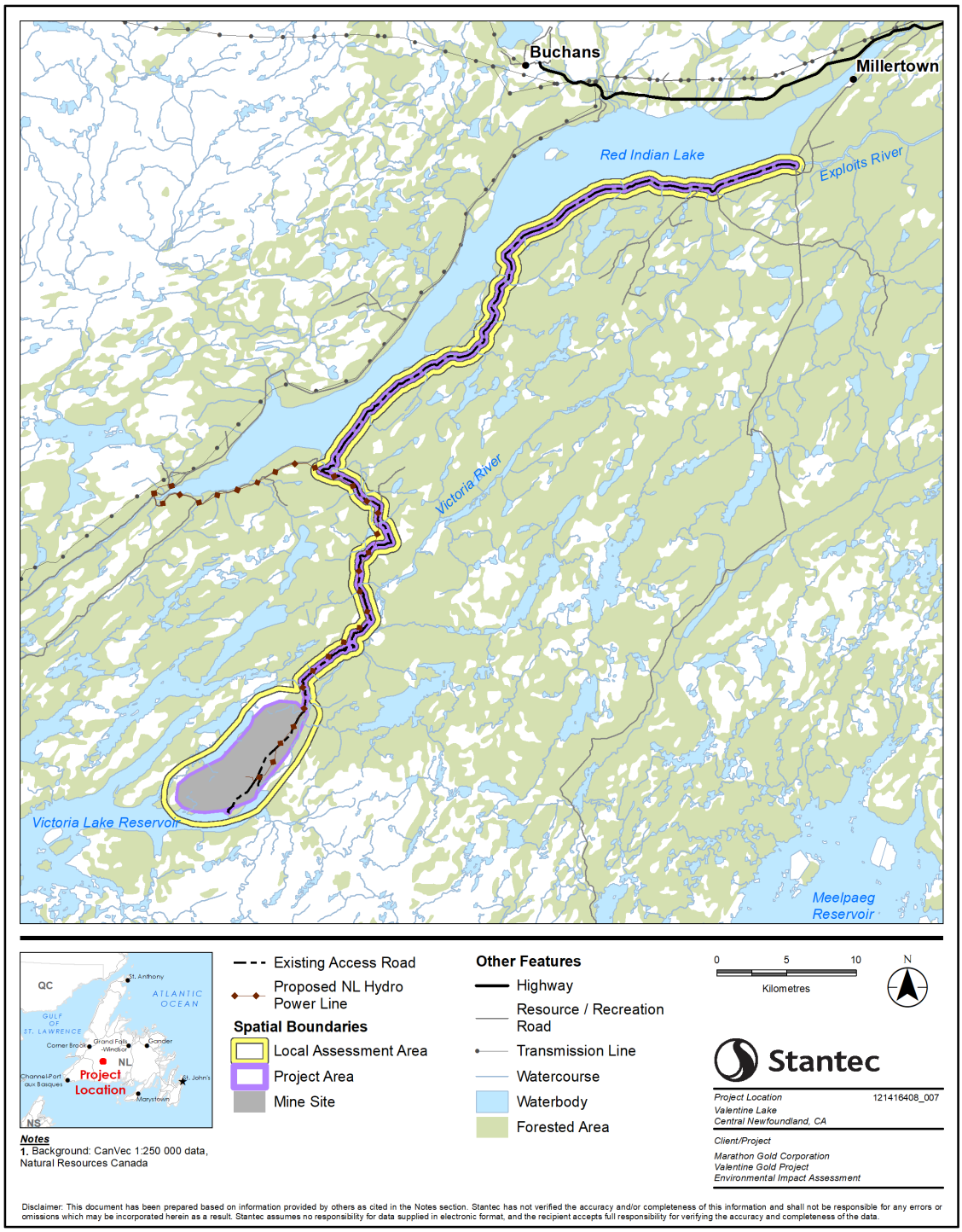


Figure 1-1 Project Area and Local Assessment Area

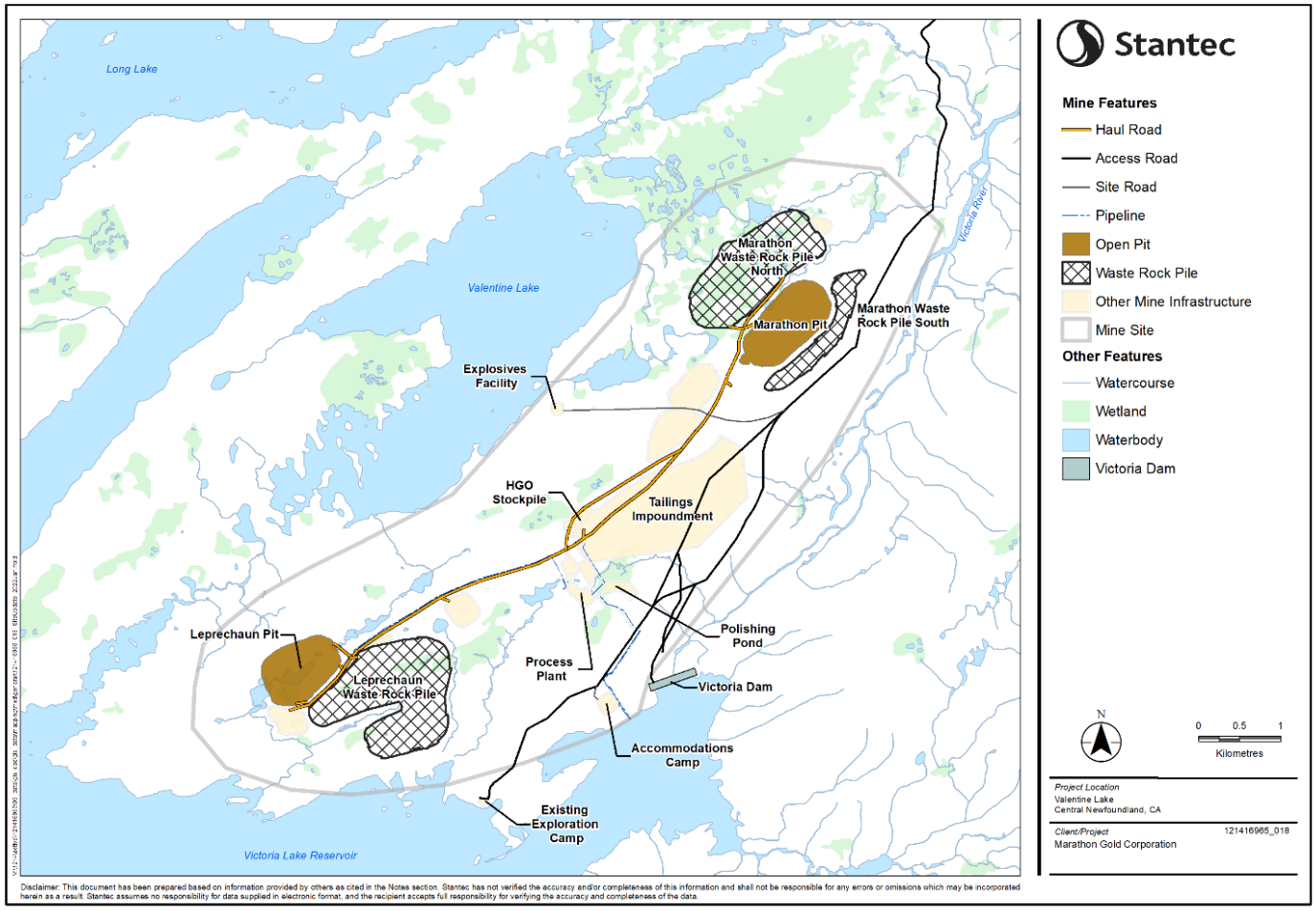


Figure 1-2 Revised Site Plan

2.0 PURPOSE

The purpose of the CPEEMP is to provide specific mitigation and monitoring protocols that will reduce the risk of Project effects on caribou directly, or through adaptive management. The goal of avoiding or reducing Project effects on caribou and their habitat will be achieved by linking the risk of the predicted Project effects directly to mitigation measures, monitoring mitigation effectiveness through performance indicators, reviewing monitoring results relative to performance targets with specific thresholds, and potentially refining mitigation or monitoring approaches through an adaptive management process. To achieve this goal, three objectives, which are linked to the primary potential Project effects on caribou, have been identified:

Objective 1: Avoid or reduce adverse effects on caribou habitat (direct and indirect)

- Reduce the area of caribou habitat affected directly (loss or alteration) and indirectly (due to sensory disturbance, dust)
- Progressively rehabilitate as much habitat each year as is practicable

Objective 2: Maintain current migration and timing by avoiding or reducing adverse effects on caribou movement

- Avoid or reduce adverse effects on caribou habitat (see Objective 1)
- Reduce Project effects related to sensory disturbance to caribou that may result in changes in timing and duration of migration
- Reduce obstacles and activities related to caribou migration to reduce potential avoidance of the mine site and access road

Objective 3: Reduce mortality risk

- Reduce risk of caribou-vehicle collisions
- Reduce risk of caribou injuries or mortalities related to site infrastructure (e.g., pits, ponds)
- Reduce the overall risk to caribou associated with Project effects, thereby reducing indirect mortality risk

This CPEEMP has been developed to comply with commitments in the EIS, the Caribou Supplemental Report, and response to Information Requirements and regulator comments, and to align with the Ministers' conditions of EA Release issued on [*dd/mm/2022*]. Specific conditions addressed in this CPEEMP include:

[*To be completed upon release from EA*]

The CPEEMP was also developed to comply with the *Canadian Environmental Assessment Act, 2012* and NL *Wild Life Act*, RSNL 1990, c W-8, and *Wild Life Regulations.*

3.0 SUPPORTING INFORMATION

Information and documents that support the development of this CPEEMP are identified in the sections below.

3.1 BACKGROUND INFORMATION

Background and supporting documents to this CPEEMP are listed below. This list will be updated as additional information becomes available through the EA process, continued baseline studies, detailed engineering, permitting, and future monitoring.

- Valentine Gold Project EIS (Marathon 2020): Chapter 11 (Caribou), Chapter 21 (Cumulative Effects) and associated, appended baseline studies
- Responses to Information Requirements and regulator comments, including the Caribou Alternate Migration Pathway Analysis and the Caribou Supplemental Information Report
- 2020 caribou survey field program as reported in *Fall 2020 Caribou Survey – Remote Cameras* (Stantec 2021a)
- 2021 post-calving aerial survey of the Buchans and resident caribou as reported in *2021 Post-Calving Aerial Survey* (Stantec 2021b)
- 2021 caribou survey field program as reported in *Spring 2021 Caribou Survey – Remote Cameras* (Stantec 2021c)

3.2 POTENTIAL PROJECT EFFECTS

This section provides a brief summary of predicted Project effects, effects pathways for caribou and caribou habitat. The spatial and temporal boundaries, and the general Project activities considered in the assessment and prediction of Project effects are also summarized for context, as the spatial and temporal boundaries are referenced in this document as they pertain to risk, mitigation measures, and monitoring.

The following spatial boundaries (Figure 3-1) were used to assess Project and cumulative effects:

- The **Project Area** encompasses the mine site, including Project infrastructure, and the access road plus a 20 metre (m) wide buffer on either side. The Project Area is the anticipated area of direct physical disturbance associated with the construction, operation and decommissioning, rehabilitation and closure of the Project.
- The **Local Assessment Area (LAA)** includes a 1 km buffer surrounding the mine site and a 500 m buffer surrounding the access road.
- The **Regional Assessment Area (RAA**) includes the combined population ranges of the Buchans, Gaff Topsails, Grey River and La Poile Herds (determined by caribou telemetry data obtained from the NLDFFA-Wildlife Division).

The following temporal boundaries were used to assess Project and cumulative effects:

- Construction Phase – 20 to 24 months, currently planned to commence in Q3 2022
- Operation Phase – Estimated 13-year operation life, with commissioning / start-up and mine / mill operation slated to start Q2 2024
- Decommissioning, Rehabilitation and Closure Phase – Closure rehabilitation will commence upon the cessation of mining and milling activities and is anticipated to take approximately 2 years to complete.
- Post-closure monitoring – Requirements for post-closure monitoring for the Project will vary as some components of the Project (e.g., the TMF and waste rock piles) will be available for closure rehabilitation 3 to 4 years prior to the completion of the operations phase. Closure rehabilitation for some components will not be completed until the end of the closure period. Post-closure monitoring is typically conducted for 6 to 8 years after closure is completed and the monitoring component associated with the CPEEMP will be determined through discussions with NLDFFA-Wildlife Division.

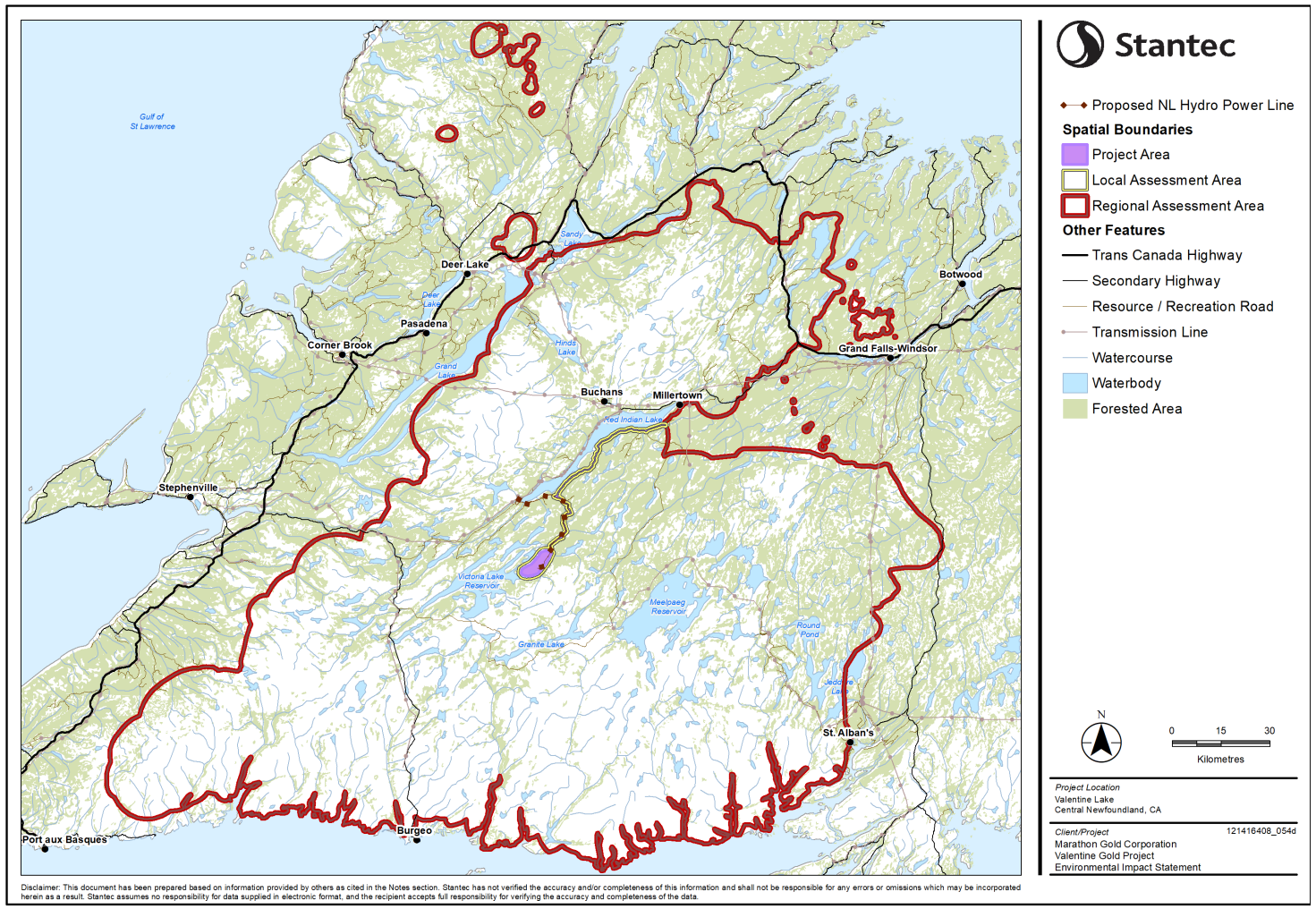


Figure 3-1 Caribou Regional Assessment Area

The general Project components and activities that may interact with caribou and caribou habitat during construction, operation, and decommissioning, rehabilitation and closure are:

- Access road upgrades
- Mine site preparation and earthworks
- Construction and installation of Project infrastructure and equipment
- Project-related transportation
- Open pit mining and associated topsoil, overburden and rock management, milling and processing, tailings management, and water management activities
- Maintenance activities (e.g., vehicles, snow clearing, road maintenance)
- Emissions, discharges and wastes (e.g., noise and air emissions, hazardous and non-hazardous wastes)

A summary of potential effects on caribou is presented in Table 3.1. These potential Project effects, and the potential consequences of these effects provide the basis for the risk assessment presented in Section 4.0.

Table 3.1 Potential Project Effects, Effect Pathways and Measurable Parameters

Potential Project Effect	Effect Pathway	Measurable Parameter(s)	Additional Context, Potential Consequences and Linkages Between Effects
Change in habitat	Direct and/or indirect loss or alteration of habitat arising from vegetation clearing and mine construction, and/or sensory disturbance (e.g., avoidance)	• Amount caribou habitat directly or indirectly lost or altered	Change in habitat, either directly (e.g., vegetation clearing) or indirectly (e.g., sensory disturbance), may also affect movement and mortality risk of caribou. Sensory disturbance in the vicinity of the mine site can result in altered migration paths for Buchans herd caribou with potential implications on energetic demand, body condition, pregnancy rates, and predation risk. Sensory disturbance can also result in reduced use or avoidance by Grey River herd caribou during calving.

Table 3.1 Potential Project Effects, Effect Pathways and Measurable Parameters

Potential Project Effect	Effect Pathway	Measurable Parameter(s)	Additional Context, Potential Consequences and Linkages Between Effects
Change in movement	Change in migration paths or patterns arising from habitat loss and/or sensory disturbance (e.g., avoidance)	• Amount of direct (Project component development) and indirect (sensory disturbance) alteration to the current migration paths/corridor • Proportion or relative amount of use of the preferred migration path within the Project Area	'Migration corridor' refers to a broader area used for migration at the population-level. The migration corridor is comprised of 'migration paths', which are used by caribou. A migration path may be used by one or more caribou. Project effects assessment includes potential changes in the functionality of the migratory pathway, with potential implications on the timing, movement rate, or use of stopover sites during caribou migration, and potential increased energetic demands, decreased body condition, decreased pregnancy rates, and increased predation risk. The risk of changes in movement and potential changes in calving success and recruitment includes potential adverse effects on the population (size and trend) of Buchans herd caribou.
Change in mortality risk	Direct change in mortality risk due to vegetation clearing and site preparation activities, vehicular collisions, and indirect change in mortality risk (e.g., increased predation)	• Changes in traffic volumes during the life of the Project • Interactions with Project infrastructure, vehicles and equipment	Direct sources of mortality include those attributable to vegetation clearing and site preparation activities, and vehicular collisions. Indirect sources of mortality are assessed qualitatively and include mortality risk factors such as displacement (due to habitat changes) to areas where predation risk is higher, and/or change in energetic demands and resulting effects on body condition (related to changes in habitat or movement).

4.0 RISK TO CARIBOU

The development of the Project will create risks to the Buchans herd which migrate through the Project Area twice annually, and to the Grey River herd whose calving grounds are located to the south of Victoria Lake Reservoir and approximately 2.5 km south of the Project Area. Risk to caribou include: migrating caribou (Buchans herd) and 'resident' caribou, which are identified as caribou that spend their time within approximately 17 km (based on the potential zone of influence [ZOI] of the Project); caribou from both the Buchans and Grey River herds; and a portion of the Grey River herd calving grounds.

Maintaining the functionality of migration paths by preserving connectivity between seasonal ranges is vital to sustaining viable populations of migratory ungulates (Monteith et al. 2018). The Marathon open pit and waste rock pile will be developed within the primary migration corridor for the Buchans herd. This development will create a permanent obstacle which migrating caribou will be forced to avoid. In addition to the physical obstacle, site activities and associated sensory disturbance will also affect caribou within proximity to the mine site, and direct interaction with Project features and activities such as access road or haul road traffic could result in injury or mortality.

Development and operation of the Project presents two 'levels' of risk to migrating caribou. The higher-level risk is the uncertainty associated with the reaction of caribou to Project effects (combination of physical obstacle and sensory disturbance). There are three potential responses for migrating Buchans caribou:

- Caribou may continue to migrate through the existing, preferred corridor, navigating around but close to the Marathon open pit and waste rock pile
- As a result of physical obstacles and sensory disturbance, caribou may avoid the Project and migrate along alternate paths that will be longer and result in greater energetic consumption
- As a result of physical obstacles and sensory disturbance, caribou may fail to migrate, subsequently remaining either north or south of the Project year-round

These potential responses by migrating caribou may occur at the individual, group, or population level. A mixed response by caribou to the Project is also possible, whereby individuals or groups may react differently to the Project (e.g., some caribou migrate through the site and other caribou migrate via alternate, longer pathways).

Assessing the likelihood that caribou will respond to the Project in one or multiple ways, and at what level of response (individuals, groups, population) is very difficult. While the literature suggests that caribou migration patterns are frequently affected by disturbance, a herd-wide failure to migrate has not been reported as a response to disturbance (e.g., Murphy and Curatolo 1987; Dyer et al. 2002; Vistnes et al. 2004; Mahoney and Schaefer 2002; Wilson et al. 2016). There is also evidence related to the creation of Star Lake reservoir, also in the primary migration corridor, that caribou did alter their path of travel during

construction and returned post construction. The creation of the reservoir altered the migratory route temporarily but did not stop the migratory behaviours of the herd (Mahoney and Schaefer 2002).

The risk assessment presented for migrating caribou in Tables 4.1 through 4.3 evaluates the specific risks to caribou assuming that each potential migration response may occur and assesses the corresponding risks related to that response. As a result, the risk assessment, which is subsequently used to inform and evaluate the mitigation requirements in Section 5.0, considers all risks to caribou regardless of their response to the Project during migration.

Tables 4.1 through 4.4 provide a description and assessment of risk for each migration scenario as well as for resident caribou. Whether caribou migration response occurs at the population level (e.g., all migrating caribou choose to migrate through the site) or there is a mixed response (e.g., some caribou migrate through the site while others fail to migrate), the overall risk to caribou is high likelihood and the potential impact is high. The mitigation measures and monitoring program presented in Sections 5.0 and 6.0, below, have been developed to reduce these risks to the extent possible and adaptive management will be used to further reduce risk associated with the uncertainty in how caribou will respond.

Figure 4-1 provides a visual representation of the Project effects pathways and potential consequences associated with each of the three migration responses/scenarios described above. Figure 4-2 is a graphical characterization of risk levels to caribou migrating through the site over a year, corresponding the risks described in Table 4.1.

Table 4.1 Description and Assessment of Risk for Migration Through the Sites

Migration Through the Site	There will be increased risk to caribou that continue to migrate via the existing primary migration corridor as a result of direct interaction with Project activities and components. The direct risks to caribou are temporal in nature in that migrating caribou will interact with the Project during the migration period only (see risks to resident caribou in Table 4.4), however, indirect risks associated with the increased stress resulting from caribou interacting with the Project may persist beyond the migration potentially impacting caribou health. Risk to caribou migrating through the site will increase as the Project moves through construction and into operation, peaking in Year 3/4 of operations as the Project component footprints are fully developed and site activities peak. Subsequently, the risk to caribou migrating through the site will begin to reduce as mining slows and ceases in Year 9/10 of operations and tailings are directed to the Leprechaun pit and will reduce further with full closure and rehabilitation of the Project commencing in Year 13. The closure phase activity levels (lower than construction) will result in reduced sensory disturbance leading into post-closure where Project-related sensory disturbance will be eliminated except for long-term post-closure monitoring, and only residual physical Project components will remain. Once fully developed during operations, the TMF, waste rock piles, and open pits will remain as permanent landscape changes. The tailings surface will be revegetated, as will the waste rock pile. The open pit will be flooded and incorporate ingress/egress areas in the event animals enter the water. Caribou migrating through the Project site post-closure will need to continue to circumnavigate these features. The risk assessment below applies to caribou that migrate through the site only, whether at the individual, group, or population level, and is not an assessment of the likelihood that caribou will migrate through the site.

			Construction		Operations		Closure		Post-Closure	
Project Effect Pathway	**Description**	**Potential Consequence**	**Likelihood**	**Potential Impact**	**Likelihood**	**Potential Impact**	**Likelihood**	**Potential Impact**	**Likelihood**	**Potential Impact**
Direct interaction with Project activities or infrastructure	If caribou migrate through the site, they will encounter Project activities and infrastructure that could result in direct interactions (e.g., vehicle collisions, traversing steep and/or rocky slopes) which in turn result in stress, injury or mortality.	Increased stress Increased risk of direct mortality	Moderate	Moderate to High	Moderate	Moderate to High	Low	Moderate to High	Low	Low
Direct habitat loss related to site clearing, indirect habitat loss due to sensory disturbance and dust	Migrating caribou spend limited time feeding; however, loss of forage and cover within the Project Area due to clearing and sensory disturbance may increase stress, thereby affecting overall health, particularly for pregnant females during spring migration.	Increased stress Increased risk of indirect mortality Increased risk of calf mortality	Low	Moderate	Low	Moderate	Low	Low	Low	Low
Migratory path altered by site infrastructure and activity (reduced permeability)	If caribou migrate through the site, they will encounter Project component development (primarily the open pit, waste rock pile, TMF) within their existing migration corridor which will require some degree of alteration to their path, which will continue to increase as the footprints of these components increase during construction and early operations phases. Alterations to their paths, even within the primary corridor will most likely increase energetic output and stress.	Increased stress Increased risk of indirect mortality Increased risk of calf mortality Increased risk of adult mortality	High	Moderate to High	High	Moderate to High	High	Moderate to High	High	Moderate to High
Sensory disturbance related to on-site activity	If caribou migrate through the site, they will be affected by sensory disturbances such as noise, olfactory, light and human activity which can increase levels of stress, potentially affecting overall health.	Increased stress Increased risk of indirect mortality	Moderate to High	Moderate to High	High	Moderate to High	Moderate	Moderate	Low	Low
Changes in seasonal migratory patterns	The potential effects (risks) described above may combine to influence the timing and speed of the migration and overall behaviours (e.g., stopovers) of the herd.	Increased stress Increased risk of indirect mortality Increased risk of calf mortality Increased risk of adult mortality	Moderate	Moderate	Moderate	Moderate	Low	Low to Moderate	Low	Low
Overall risk to caribou migrating through the site for each Project phase:			Moderate to High	High	Moderate to High	High	Moderate	Moderate	Low	Low

Notes:
Risk assessment (likelihood or potential impact) is non-cumulative over Project Phases
These risk assessments were considered and inform the mitigation measures presented in Section 5.0 of the CPEEMP

Table 4.2 Description and Assessment of Risk for Migration via Alternate Routes

Migrate via Alternate Routes	If caribou migrate via alternate routes, there will be an increase in migration route length and duration. It is unclear how far the alternate paths may deviate from the current corridor. As the distances increase, so do energetic requirements and the potential to interact with other risks more directly, such as predators or development activities associated with other projects. These alternate paths may also change intra-group dynamics and the timing of movements. If caribou migrate via alternate routes that remain in close proximity to the Project, it is expected they will choose to move to the northeast to avoid Project activities and features immediately southwest of the existing migratory corridor. In this case, the caribou are not expected to interact directly with Project components or activities, with the exception of crossing the existing access road and power line corridor. Caribou migrating in close proximity to the northeast of the Project may be influenced by sensory disturbances such as noise and light, however, noise and light levels reduce with distance from the Project. As described for the migration through the site scenario, sensory disturbance from Project activities will increase until they peak around Year 3/4 and then drop off later in Project operations, through closure and become nil post-closure. If caribou migrate via alternate routes that move further away from the Project, it is expected they may choose to travel to the northeast or southwest of the existing migratory corridor. In this case, the caribou are still not expected to interact directly with Project components or activities, except for crossing the access road and power line corridor northeast, or possibly approaching the Leprechaun pit area from the southwest. Caribou migrating at greater distance from the Project are not likely to be directly influenced by sensory disturbances such as noise and light, however, will be affected by increased energetic requirements, as described above. As Project activities begin to taper off towards the end of operations and into closure the reduction in activity may result in caribou that selected alternate migration routes returning to the initial migratory corridor. The risk assessment below applies to caribou that select alternate migration paths only, whether at the individual, group, or population level, and is not an assessment of the likelihood that caribou will select alternate paths.

Project Effect Pathway	Description	Potential Consequence	Construction		Operations		Closure		Post-Closure	
			Likelihood	Potential Impact	Likelihood	Potential Impact	Likelihood	Potential Impact	Likelihood	Potential Impact
Direct interaction with Project activities or infrastructure	If caribou use alternate paths, they will likely avoid the mine site entirely, however, if their alternate path move northeast they will cross the access road and power line, where interaction with Project-related traffic is possible which could result in stress, injury or mortality.	Increased stress Increased risk of direct mortality	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Low	Low
Habitat loss (function of corridor) related to using less optimal paths	The use of alternate paths may cause animals to travel less direct paths, potentially through more difficult terrain (i.e., thicker forests, steeper terrain, less cover, larger waterbodies). Caribou spend little to no time foraging while migrating. These longer more circuitous routes may result in more energetic output and with less cover and potentially more exposure to predators.	Increased stress Increased risk of indirect mortality (energetic output) Increased risk of calf mortality Increased risk of adult mortality Increased risk of predation	Moderate	High	Moderate to High	High	Moderate	Moderate	Low	Moderate
Sensory disturbances related to Project activity	The ZOI, the distance over which the combined sensory disturbances created by the Project may influence caribou behaviour, is unknown. As a result, the degree of avoidance, and thus the incremental travel distance, energetic effort and exposure to predators that caribou will experience using these alternate routes is difficult to estimate. These factors can increase levels of stress and energetic output potentially affecting overall health, and calf survival.	Increased stress Increased risk of indirect mortality Potential decrease in calf recruitment / survival	Moderate	High	High	High	Moderate	Moderate	Low	Low
Changes in seasonal migratory patterns	The use of alternate paths may influence the timing and overall behaviours of the migratory herd. These new paths may require a change in timing due to exposure to snow, available cover, ice-free waterbodies. These variables may result in new staging areas that may not have suitable forage for the herd.	Increased stress Increased risk of indirect mortality (energetic output) Increased risk of calf mortality Increased risk of adult mortality Increased risk of predation	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Low	Low
Overall risk to caribou migrating via alternate routes for each Project phase, noting that the overall risk is variable relative to distance from the Project Area:			Moderate	High	Moderate to High	High	Moderate	Moderate	Low	Low

Note:
Risk assessment (likelihood or potential impact) is non-cumulative over Project Phases; These risk assessments were considered and inform the mitigation measures presented in Section 5.0 of the CPEEMP

Table 4.3 Description and Assessment of Risk for Failure to Migrate

Failure to Migrate	The failure to migrate is considered an unlikely scenario and there is no published literature indicating that a migratory herd has stopped migrating due to a new Project occurring within or near it's migratory route[1]. Failure to migrate may occur at the individual or group level, however, it is unlikely to be detected unless it occurs at the herd level. If failure to migrate at the herd level were to occur, the caribou could remain north of the site or to the south eliminating the use of their other range (winter or summer/calving). The effects of a failure to migrate would be realized by the Buchans herd, as well as the herds that utilize the same range in which the Buchans herd remains. In the event of a failure to migrate, if the Buchans herd stays to the north on their calving/summer grounds, the Gaff Topsails herd will also be affected. If the Buchans herd stays to the south, the Grey River herd will also be affected. The ZOI, the distance over which the combined sensory disturbances created by the Project may influence caribou behaviour, is unknown. If caribou fail to migrate due to Project-related effects, it is anticipated that it will happen earlier in the life of the Project as the ZOI develops during construction and increases as sensory disturbance from Project activities increase until they peak around Year 3/4 of operations. The ZOI will begin to drop off later in Project operations, through closure and sensory disturbances become nil post-closure. It is expected that the likelihood of a failure to migrate occurring due to Project-related factors will diminish with reduced activity and sensory disturbance levels. The risk assessment below applies to caribou that fail to migrate, whether at the individual, group, or population level, only and is not an assessment of the likelihood that caribou will fail to migrate. As noted above, detection of individuals or groups that fail to migrate is not likely to be possible and may be happening naturally as Buchans herd caribou mix with other herds within the overlap of their existing ranges. As such, the risk assessment below also assumes the failure to migrate occurs at the population level.

Project Effect Pathway	Description	Potential Consequence	Construction		Operations		Closure		Post-Closure	
			Likelihood	Impact	Likelihood	Impact	Likelihood	Impact	Likelihood	Impact
Consolidated home ranges, contraction of home ranges	Combining home ranges (Buchans with Gaff Topsails or Grey River) could result in the contraction of range and competition for forage. Higher densities could not only prove detrimental to forage availability but could change predator success and abundance.	Increased stress Increased risk of direct and indirect mortality Potential decrease in calf recruitment / survival Potential changes in population metrics such as adult males: adults Increased risk of predation	High	High	High	High	High	High	High	High
Increased competition for seasonal food sources	Should a failure to migrate occur, the home ranges of the Buchans herd and the adjacent herd will likely change, potentially increasing competition for available forage and cover.	Increased stress Increased risk of direct and indirect mortality Potential decrease in calf recruitment / survival	High	High	High	High	High	High	High	High
Overall risk to caribou as assessed for individuals, groups, or population failing to migrate for each Project phase:			High	High	High	High	High	High	High	High

[1] There is evidence related to the creation of Star Lake reservoir, also in the primary corridor, that caribou did alter their path of travel during construction and returned post construction. The creation of the reservoir altered the migratory route temporarily but did not stop the migratory behaviours of the herd (Mahoney and Schaefer 2002). Hydroelectric development and the disruption of migration in caribou. Biological Conservation. 107. 147-153.

Notes:
Risk assessment (likelihood or potential impact) is non-cumulative over Project Phases
These risk assessments were considered and inform the mitigation measures presented in Section 5.0 of the CPEEMP

Table 4.4 Description and Assessment of Risk for Resident Caribou

Resident caribou	Resident caribou, which are caribou that spend a portion of the year within proximity to the Project Area whether part of the Grey River or Buchans herds, may be affected by sensory disturbances within the ZOI, the distance over which the combined sensory disturbances created by the Project may influence caribou behaviour. The ZOI of the Project is unknown (based on available literature ranges from approximately 4 km to 15 km or more and is variable annually, seasonally, and due to other factors), and the response or degree of avoidance that resident caribou may exhibit is also unknown. Resident caribou will move around and may approach or move through the site at times and therefore may have direct interaction with the access road and/or the mine site. Risk to resident caribou due to sensory disturbance or direct interaction with the site will increase as the Project moves through construction and into operation, peaking in Year 3/4 of operations as the Project component footprints are fully developed and site activities peak. Subsequently, the risk to resident caribou will begin to reduce as mining slows and ceases in Year 9/10 of operations and tailings are directed to the Leprechaun pit and will reduce further with full closure and rehabilitation of the Project commencing in Year 13. The closure phase activity levels (lower than construction) will result in reduced sensory disturbance leading into post-closure where Project-related sensory disturbance will be eliminated with the exception of long-term post-closure monitoring, and only residual physical Project components will remain. The risk assessment below applies to resident caribou, whether at the individual, group, or population level, and is not an assessment of the likelihood that caribou will continue to reside for portions of the year within proximity to the Project Area, or if they will interact directly with the Project Area.

Project Effect Pathway	Description	Potential Consequence	Construction		Operations		Closure		Post-Closure	
			Likelihood	Impact	Likelihood	Impact	Likelihood	Impact	Likelihood	Impact
Direct interaction with Project activities or infrastructure	If resident caribou move close to or through the site, they may encounter Project activities and infrastructure that could result in direct interactions (e.g., vehicle collisions, traversing steep and/or rocky slopes) which in turn result in stress, injury or mortality.	Increased stress Increased risk of direct mortality	Moderate	Moderate to High	Moderate	Moderate to High	Low	Moderate to High	Low	Low
Direct habitat loss related to site clearing, indirect habitat loss due to sensory disturbance and dust	If resident caribou spend time in proximity to, or move through, the Project Area, loss of forage and cover within the Project Area due to clearing and sensory disturbance may increase stress, thereby affecting overall health.	Increased stress Increased risk of indirect mortality Increased risk of calf mortality	Moderate	Moderate	Moderate	Moderate	Low to Moderate	Low	Low	Low
Altered ranges	If resident caribou are influenced by the Project ZOI, it may cause an alteration of their seasonal range, resulting in higher caribou densities, increasing competition for forage and changes to predator success and abundance. This could increase levels of stress and competition potentially affecting overall health, and calf survival.	Increase risk of indirect mortality Decrease in calf recruitment / survival Increased predation risk	Moderate	Moderate	Moderate	Moderate to High	Low	Moderate	Low	Low
Overall risk to resident caribou as assessed for individuals, groups, or population for each Project phase, noting that the overall risk is variable relative to distance from the Project Area:			Moderate	Moderate to High	Moderate	Moderate to High	Low	Moderate	Low	Low

Notes:
Risk assessment (likelihood or potential impact) is non-cumulative over Project Phases
These risk assessments were considered and inform the mitigation measures presented in Section 5.0 of the CPEEMP

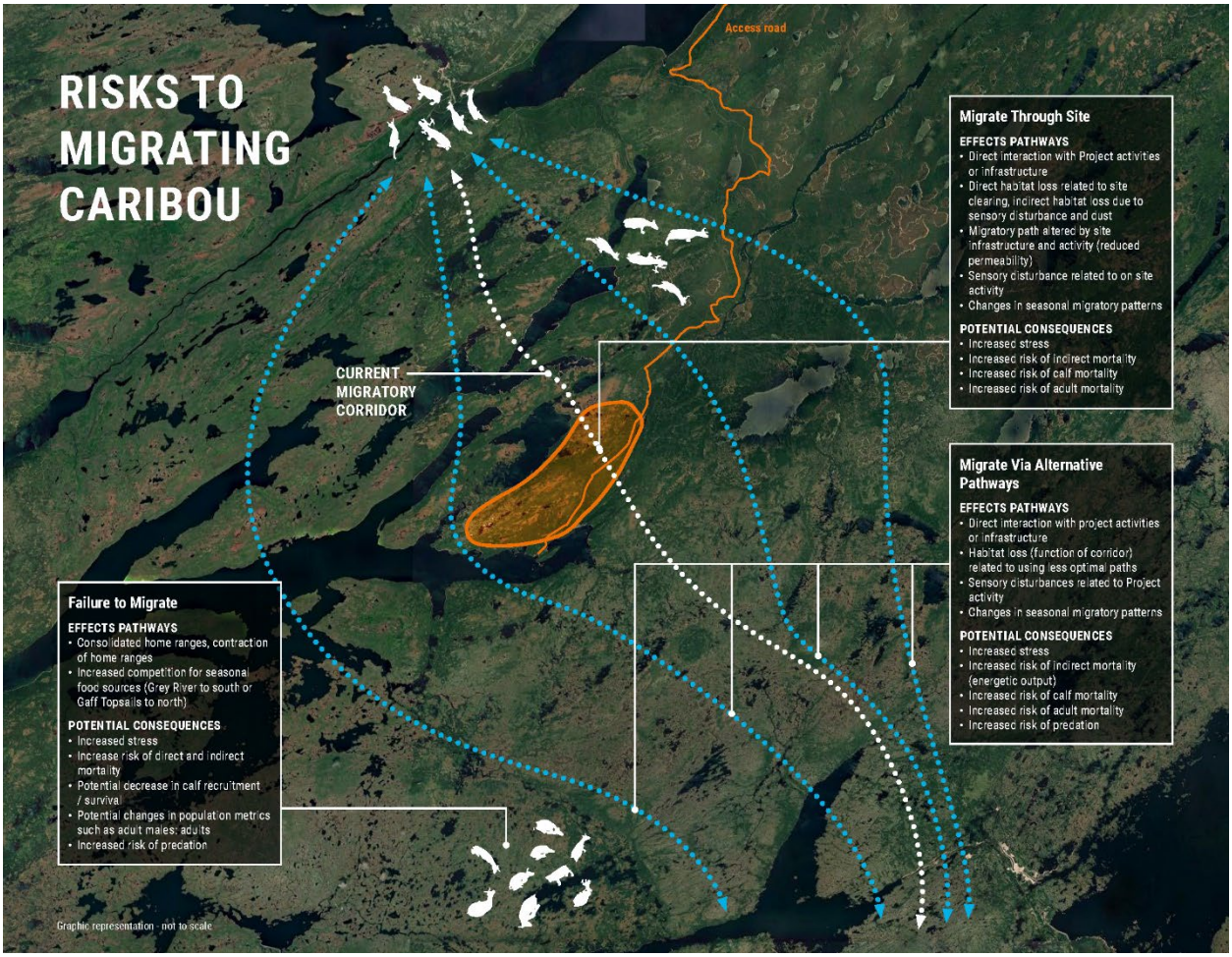


Figure 4-1 Risks to Caribou Associated with Changes to Migration

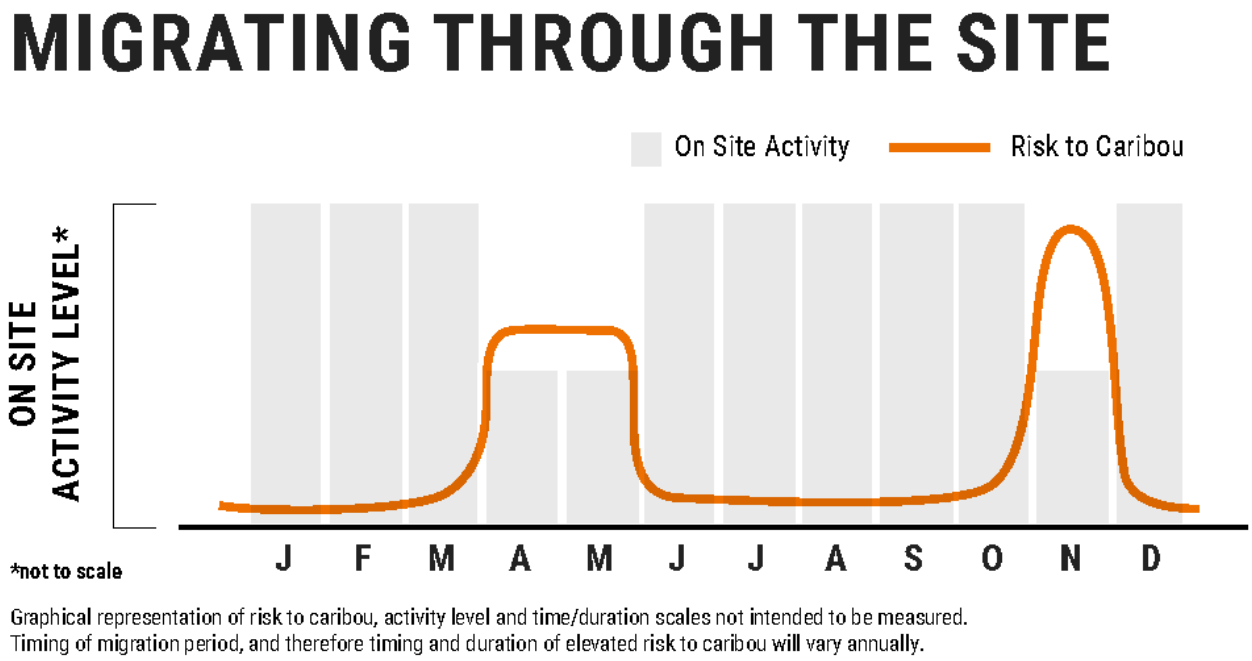


Figure 4-2 Time-Based Risk Levels for Caribou Migrating through Site

5.0 CARIBOU PROTECTION AND MITIGATION MEASURES

To avoid or reduce potential adverse Project effects on caribou, and to reduce the associated risks to caribou as described in Section 4.0, caribou protection and mitigation measures are proposed in correlation with general and specific monitoring programs.

5.1 CARIBOU PROTECTION LEVELS

To effectively address changes in caribou proximity to the Project and behavioural patterns throughout the year, four levels of caribou protection have been established. The protection levels are summarized in Table 5.1 and are shown graphically on a time scale in Figure 5-1.

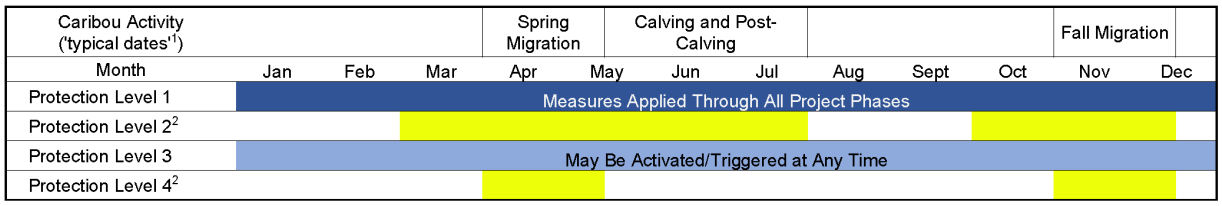
Table 5.1 Levels of Caribou Protection

Caribou Protection Levels[1]	
Protection Level	**Description**
Level 1: Normal Operation	• Always activated • Mitigation in Table 5.3 corresponding to Protection Level 1 always apply • Routine caribou monitoring (see Section 6.0)
Level 2: Site Notification	• Activated during sensitive seasons for caribou (i.e., approaching migration period, calving, post-calving periods) – Triggered three weeks prior to migration period typical[2] dates, minimum; or – If earlier, triggered when collared caribou are detected in the fall having left the Buchans Plateau and are congregating near Star Lake, and in spring when they have crossed between Granite Lake and the Meelpaeg Reservoir – In spring, will continue from spring migration through calving and post-calving period, to July 31 – In fall, will continue until two weeks post-migration (100% of collars southeast of Project Area) • Mitigation and monitoring: – Mitigation in Table 5.3 for Protection Level 2 apply, including but not limited to the following: o Informing/reminding personnel regarding their roles and responsibilities relating to caribou (Section 5.1) o Preparing for Marathon pit area activity suspension, reduced access road traffic, pre-migration inspection of site conditions – Increased level of caribou monitoring (see Section 6.0)

Table 5.1 Levels of Caribou Protection

Caribou Protection Levels[1]	
Protection Level	**Description**
Level 3: Site Alert	• Activated any time of year – Triggered when caribou are detected within 1 km of Project activities any time of year – Will continue until caribou have moved greater than 1 km from Project activities, based on monitoring and review by Environmental Team – May be triggered during the migration periods for individuals or very small groups of animals (<5) using a 3 km zone (see notes below for Protection Level 4) • Mitigation and monitoring: – Mitigation in Table 5.3 corresponding to Protection Level 3 apply – Specifically, Environmental Team will determine if specific Project activities will be reduced or suspended[3]. NLDFFA-Wildlife Division will be immediately contacted notify/consult – Increased level of caribou monitoring (see Section 6.0), specific to caribou within specified zone
Level 4: Reduction or Suspension of Project Activities	• Activated during the spring migration, based on Protection Level 2, migration-specific monitoring: – Triggered when one or more collared caribou cross a 'virtual fence' 10 km southeast of the mine site; or – If earlier, triggered when migrating groups of caribou (> 5 caribou) approach within 3 km (visual, drone, or remote camera observation) – Down-grade to Level 2 when all collared caribou are greater than 3 km north of the site – If individuals or very small groups of migrating caribou (<5 caribou) are observed within 3 km of Project activities, Protection Level 3 will apply using a 3 km zone • Activated during the fall migration, based on Protection Level 2, migration-specific monitoring: – Triggered when one or more collared caribou cross the Lloyds River (roughly 15 km north of the site); or if earlier – Triggered when migrating groups of caribou (>5 caribou) approach within 3 km (visual, drone, or remote camera observation) – Down-grade to Level 2 when all collared caribou are greater than 3 km north of the site – If individuals or very small groups of migrating caribou (<5 caribou) are observed within 3 km of Project activities, Protection Level 3 will apply using a 3 km zone • Mitigation and monitoring: – Level 4 mitigation from Table 5.3 apply, including suspended activity in TMF and Marathon pit areas, reduced access road traffic and possibility of additional Project activity reduction or suspension may be implemented where migrating caribou are observed in close proximity to site features and activity (beyond the Marathon pit and TMF areas) – Continued increased level of caribou monitoring (see Section 6.0)

Notes:
[1] Applies to the construction, operation, and decommissioning phases of the Project.
[2] Current 'normal' windows are April 1 through May 19 (spring migration) and November 1 through December 15 (fall migration) (Emera Newfoundland and Labrador 2013).
[3] Where resident caribou persist to remain near the mine site or Project activities, further measures may be required to deter the animal(s) or protect the animal(s). NLDFFA-Wildlife Division will be consulted if this situation occurs.



Notes: [1] General dates for caribou migration (Emera Newfoundland and Labrador 2013), and may vary annually based on weather and other factors that will be addressed through monitoring

[2] Activation/triggers and duration for Protection Levels 2, 3, and 4 are shown approximately only, actual activation dates and durations will vary based on information gained from the caribou monitoring program.

Figure 5-1 Caribou Activity Timescale

Protection Level 1 mitigation measures and monitoring, which are in place at all times, are focused on reducing risk to resident caribou, with increased mitigation and monitoring activated (Protection Level 3) when caribou move within 1 km of Project activities.

Protection Level 2 increases mitigation measures and monitoring ahead of the Buchans herd's migration periods and during the calving and post-calving period for both the Buchans and Grey River herds. Protection Level 4, which reduces Project activities prior to caribou approaching the site, is activated when the Buchans herd triggers specified thresholds associated with each of the migration periods. Geographical and timing triggers for Protection Levels 2 through 4 are shown graphically on Figure 5-2.

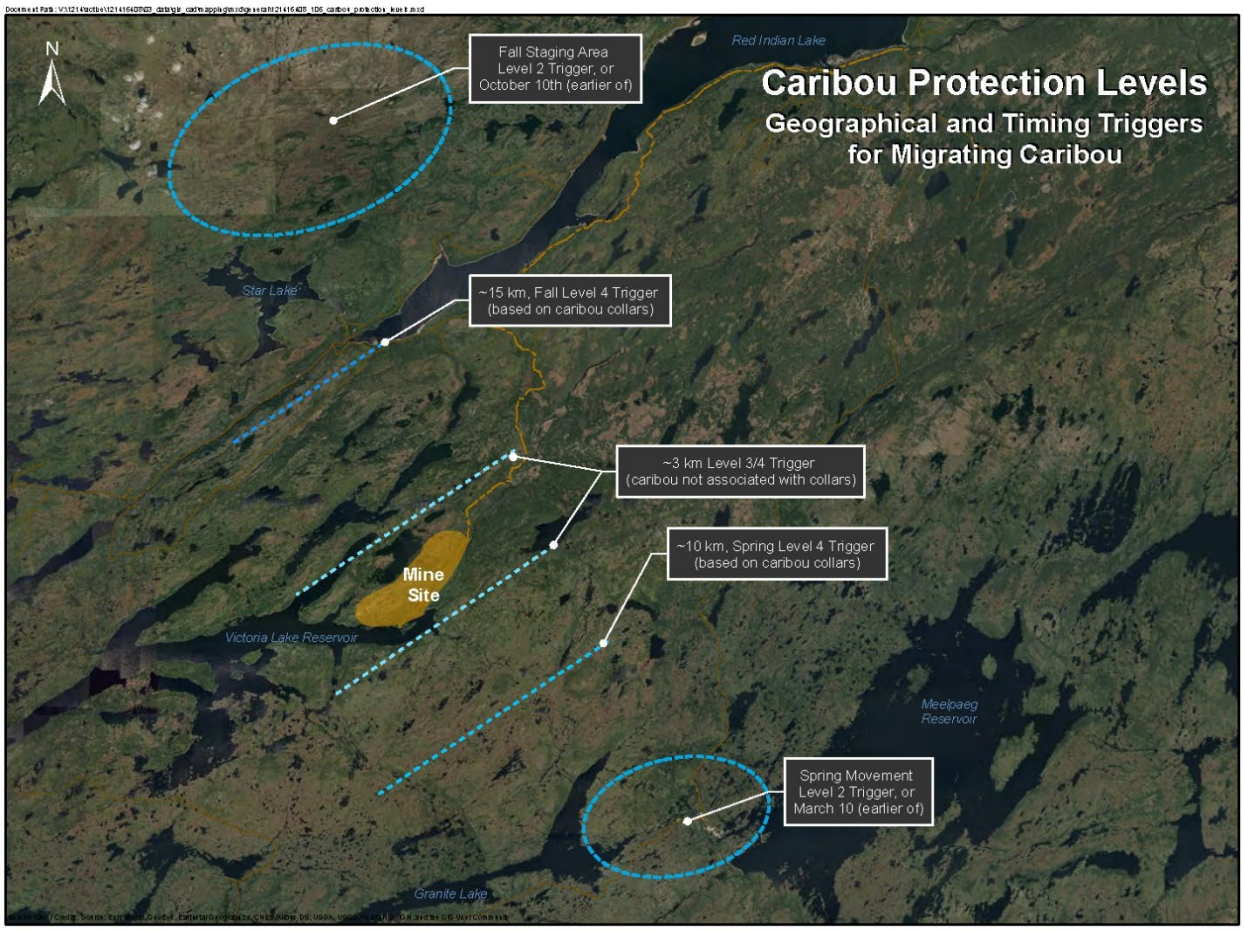


Figure 5-2 Caribou Protection Levels

Protection Level 2 is activated by one of two conditions for each migration period. In the spring, Level 2 will be activated by the earlier of:

1. March 10 (3 weeks prior to published migration period); or
2. Collar monitoring shows caribou moving north of Granite and Meelpaeg Lakes.

In the fall, Protection Level 2 will be activated by the earlier of:

1. October 10 (3 weeks prior to published migration period; or
2. Collar monitoring shows caribou congregating northeast of Star Lake.

Protection Level 3 for migrating caribou is intended to apply to individuals or small groups (<5) of caribou that may migrate ahead of, or behind the primary migration. In this case, mitigation measures and monitoring would already be at Protection Level 2, and identification of individual or very small groups of

migrating caribou within a 3 km threshold of the site would result in the quick reduction or suspension of activities based on the location and movement of the caribou and would likely be of short duration unless there are multiple individuals or small groups migrating separately.

Protection Level 4 requires different activation triggers for each migration period due to the differences in the behaviour of caribou in spring and fall. Data used in the interpretation of migration timing, duration, and group size is presented in Appendix B.

During the spring migration, caribou move slowly relative to the fall migration, in smaller groups (average less than five caribou) and are more spread-out geographically as they approach the site. The existing data for the spring migration also indicates less certainty in the timing and location of caribou movements during migration. In the fall, caribou move very quickly, in larger groups (average approximately ten caribou), within a well-defined corridor, and most of the herd pass through the migration corridor thresholds outlined below in less than a week

Establishing triggers and thresholds to activate the protection levels for the fall migration is relatively straight forward based on their behaviours:

- Pre-migration staging in the area north/northeast of Star Lake requires activation of Protection Level 2 if not already activated based on timing (October 10).
- Collared animals crossing the Lloyd's River provide an approximate 15 km trigger to activate Protection Level 4 as these caribou will travel to the site in two to three days. Smaller groups of caribou may migrate ahead of the primary migration, noting that in the fall of 2021, two collars passed through the migration corridor approximately three weeks ahead of the primary migration.
- The narrow crossing area at the northeast end of Valentine Lake approximately 3 km northwest of the site is a relatively open area where caribou that may not be moving in proximity to a collared caribou can be observed visually, using drones, and/or remote cameras.

Establishing triggers and thresholds to activate protection levels for the spring migration is more challenging due to the slower and more geographically spread-out movement, and even increased vegetation and generally visibility southeast of the Project Area:

- Caribou have crossed between Granite Lake and the Meelpaeg Reservoir requires activation of Protection Level 2 if not already activated based on timing (March 10).
- Collared animals crossing a 'virtual fence' 10 km southeast of the Project Area will activate Protection Level 4.
- The ridgeline south of the Victoria River valley, and approximately 3 km southeast of the site includes bogs and partially open areas where caribou can generally be observed visually, using drones, and/or remote cameras.

Marathon will employ additional monitoring resources for the spring 2022 migration (prior to construction) to collect additional data and to determine the best monitoring approach and location specific to the spring migration in consultation with NLDFFA-Wildlife Division.

Monitoring levels associated with each caribou protection level are described as follows, with additional information on specific monitoring equipment and approach provided in Section 6.0:

- Routine monitoring under Protection Level 1 will include review of caribou sightings by employees and contractors, environmental personnel monitoring for caribou during other site-wide environmental data collection, regular checks of remote camera images and collar data.
- When Protection Level 2 is activated, employees and contractors will be notified and asked to actively look for caribou. Environmental personnel will visit look-out locations daily (or more frequently if required) to monitor for caribou activity. If Protection Level 2 is activated based on the date trigger, collar data monitoring will be completed throughout each day, and once caribou are staging near the Protection Level 4 activation thresholds, a caribou monitoring team will commence monitoring at and within the 3 km thresholds using visual vantage points, drones, and remote cameras. The frequency and duration of caribou monitoring will depend on the proximity of caribou per collaring data and/or visual observation, increasing as the primary migration approaches (and decreasing once the migration has passed)
- When Protection Level 3 is activated, monitoring by Environmental personnel and/or the caribou monitoring team will be specific to the caribou within proximity to the mine site (1 km or 3 km depending on the timing).
- When Protection Level 4 is activated all monitoring activities (visual, cameras, collars). Specific environmental and/or caribou monitoring team members will collect demographic data where possible, and monitor caribou behaviour associated with Project components and activities.

As detail around visual monitoring locations, camera locations, assigned monitoring personnel, and specific methodology for monitoring is developed, this CPEEMP will be updated to include that information.

5.2 MITIGATION

The mitigation hierarchy, which has been applied elsewhere for caribou (e.g., Alberta; British Columbia) is: 1) Avoid; 2) Reduce; 3) Restore; and 4) Offset. Consistent with standard practice, Marathon is focused on avoiding and reducing the risk of potential Project effects on caribou to the extent feasible. Restoration and offsetting are generally not considered feasible in relation to impacts on caribou for this Project.

Based on the assessment of risks to caribou presented in Section 4.0, Marathon has employed a similarly systematic approach to the assessment of potential mitigation measures to reduce the risks associated with all Project phases, potential Project effect pathways, and the range of caribou responses and levels of response to the Project. The Mitigation Evaluation Matrix presented in Table 5.2 has been used with the results of the risk assessment to develop the mitigation measures presented in Tables 5.3 through 5.5.

Additional mitigation may be determined or established through ongoing consultation with regulators, Indigenous groups and stakeholders, through additional baseline studies, detailed engineering, or

monitoring. Additional mitigation identified could be new or an adaptation of an existing mitigation and would subsequently be added to the appropriate table. Where a Tier 1 mitigation is adapted to a Tier 2 mitigation based on monitoring results (adaptive management process), the Tier 1 mitigation table will be updated to show the Tier 1 mitigation is no longer being used, and direct the reader to the appropriate mitigation in the Tier 2 table.

Mitigation and associated monitoring actions will be regularly reviewed (annually at a minimum) and updated or revised as required in consultation with NLDFFA-Wildlife Division.

Table 5.2 Mitigation Evaluation Matrix - Migration

Mitigation Evaluation Matrix - Migration										
	Response	Migration Through Site			Migration Route Offset (1 to 5 km)		Migration Route Offset (5 to 15 km)		Failure to Migrate	
	Level of Response	Individuals	Groups	Population	Groups	Population	Groups	Population	Groups	Population
Mitigation Level	Tier 1	?	?	?	?	?	?	?	?	?
	Tier 2 (Adaptive Management Level 1)	?	?	?	?	?	?	?	?	?
	Tier 3 (Adaptive Management Level 2)	?	?	?	?	?	?	?	?	?

Use of Matrix:

- Used to systematically assess potential mitigation based on caribou response and level of response to the Project
- Each response and level of response is evaluated, and appropriate mitigation considered based on a tiered approach as follows:
  - Tier 1 - Mitigation to be implemented initially, not tied to monitoring and/or adaptive management
  - Tier 2 - Refinement of Tier 1 mitigations or additional mitigation to be implemented based on monitoring (adaptive management Level 1), if applicable
  - Tier 3 - Refinement of Tier 2 mitigation or additional mitigation to be implemented based on monitoring (adaptive management Level 2), if applicable

  Note: Example of a refinement of a lower tier mitigation could be a change in the applicable threshold applied (e.g., distance)
- Mitigation associated with each response and level of response are considered for all potential effects pathways for each primary Project effect (change in habitat, movement, or mortality)
- In the event of a mixed response by caribou to the Project (e.g., some caribou migrate through the site, while others migrate at an offset distance), mitigation developed for each response and level of response (that aren't already implemented) can be implemented or adapted as required
- Matrix is used to evaluate all of the above variables for each phase of the Project - Construction, Operations, Closure, and Post-Closure

The ongoing planning and design phases of the Project have focused on avoiding and reducing the risk of Project effects to caribou since the EA for the Project commenced. The following site design changes have occurred (since filing the EIS), as shown in corresponding Figures 5-3, 5-4, and 5-5:

- As shown by the changes between the EA Registration/Project Description (Marathon 2019) site plan (Figure 5-3) and the site plan subsequently submitted with the Valentine Gold Project EIS (Marathon 2020) (Figure 5-4), the following scope and design changes were implemented:
  - The Victory deposit (pit) and waste rock pile was removed from the Project scope, avoiding additional Project activities and infrastructure that could further affect migrating caribou.
  - The heap leach pad and process were removed from the Project scope, reducing Project footprint.
  - Due to the interaction of a potential TMF dam failure with the Victoria Dam, the TMF required relocation. The siting study considered 14 new potential sites, a number of which were not carried forward due to their impacts on caribou migration. While the updated TMF location created a higher potential effect on caribou than previous, the siting considered key factors (including caribou, potential impacts on the Victoria Dam and fish habitat) and the revised location was selected.
  - The process plant was moved to the west of the revised TMF location, reducing potential sensory disturbance along the primary migration corridor/paths.
  - Based on consultation with NL Hydro and NLDFFA-Wildlife Division, the proposed transmission line route was aligned with the existing access road through the migration corridor and to the northeast, which avoids creating a new linear feature and reduces direct effects on habitat.

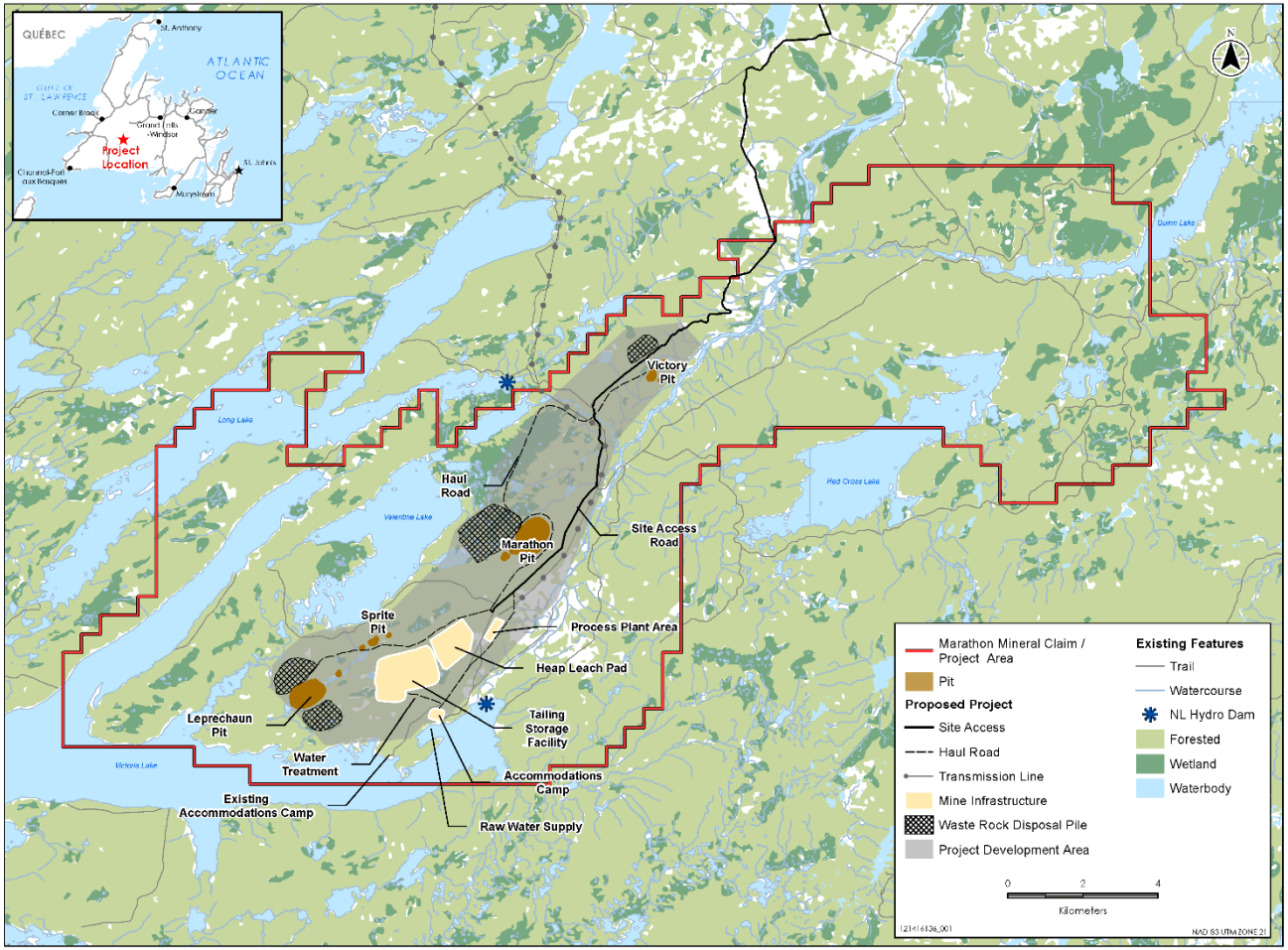


Figure 5-3 Site Plan from the EA Registration

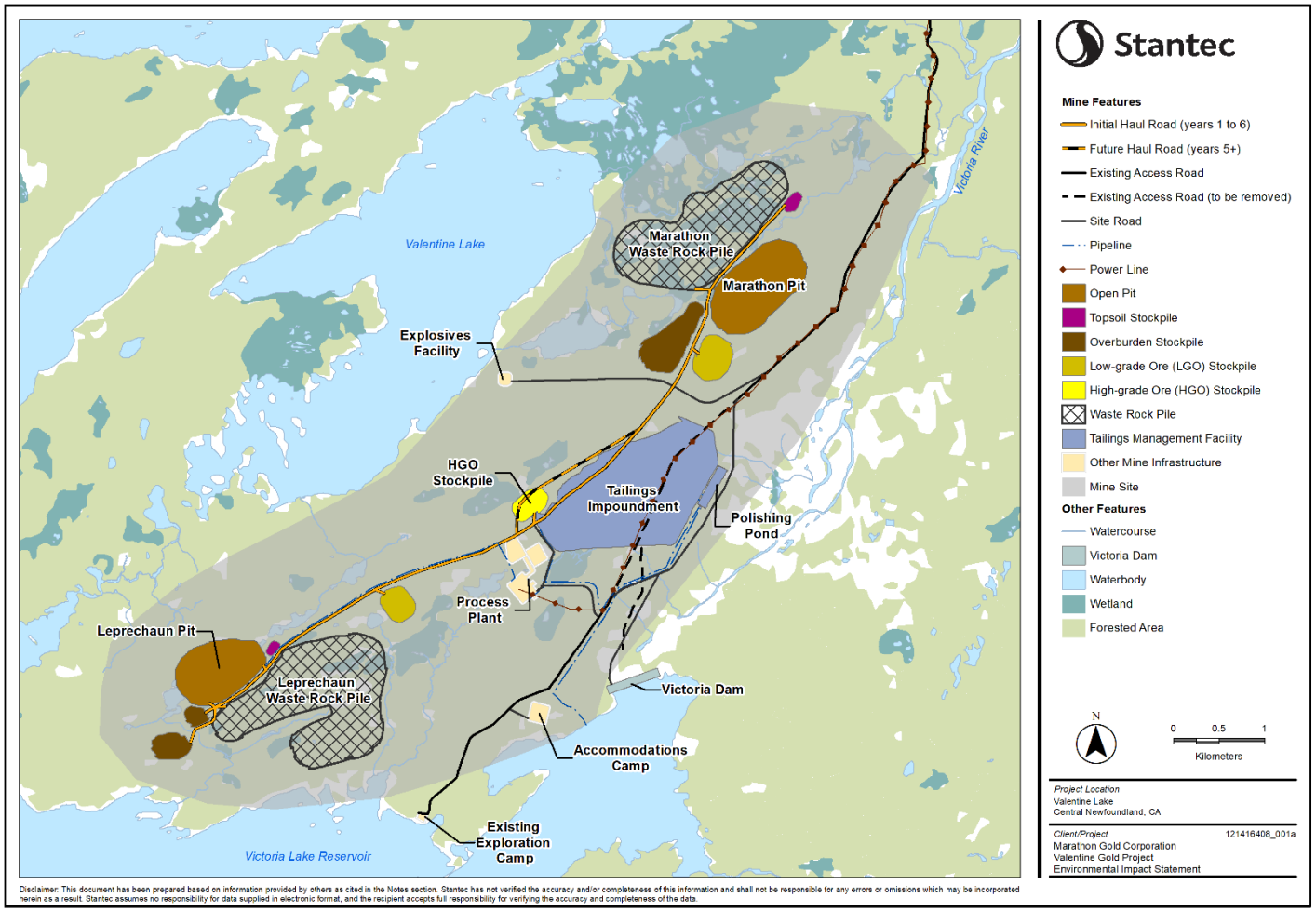


Figure 5-4 Site Plan from the EIS issued September 30, 2020

- As shown by the changes between the EIS site plan (Marathon 2020) (Figure 5-4) and the latest site plan (Figure 5-5), the following design changes have been implemented:
  - The water treatment plant and polishing pond have been relocated closer to the plant. The activities and sensory disturbance associated with these features are now further to the west of the primary migration corridor.
  - Ongoing consultation with the NLDFFA-Wildlife Division regarding the options to accommodate caribou that may choose to migrate through the Project Area to the west of the Marathon open pit and waste rock pile, thereby improving permeability of the migratory corridor during all phases of the Project, has resulted in proposed changes to the Marathon waste rock pile and overburden and low-grade ore stockpiles. The layout of the waste rock pile has been revised to narrow the dimension of the pile perpendicular to the migration corridor and to provide a barrier to caribou on approach to each side of the pit. To further improve permeability, the low-grade ore stockpile has been relocated to the west, and the overburden stockpile has been shifted west to open a corridor between the stockpiles and the open pit and waste rock pile through which caribou can travel. Marathon will continue to review this design through detailed engineering to maximize the width of this corridor. The haul road and ditching design in this corridor will also consider caribou movement. As the overburden and low-grade ore stockpiles will be removed and the areas rehabilitated during closure, the post-closure corridor will be further widened.
  - Through further engineering analysis, the transmission line has been reduced from a double pole design to a single pole design, which reduces the overall clearing requirements (width of the right of way).
  - Based on further consultation with NL Hydro and NLDFFA-Wildlife Division, the proposed transmission line route was aligned with the existing access road all the way to Star Lake Terminal which avoids creating a new linear feature and further reduces direct effects on habitat, and is further away from potential alternate caribou migration routes that caribou may use following commencement of construction and subsequent operation of the Valentine Gold Project.

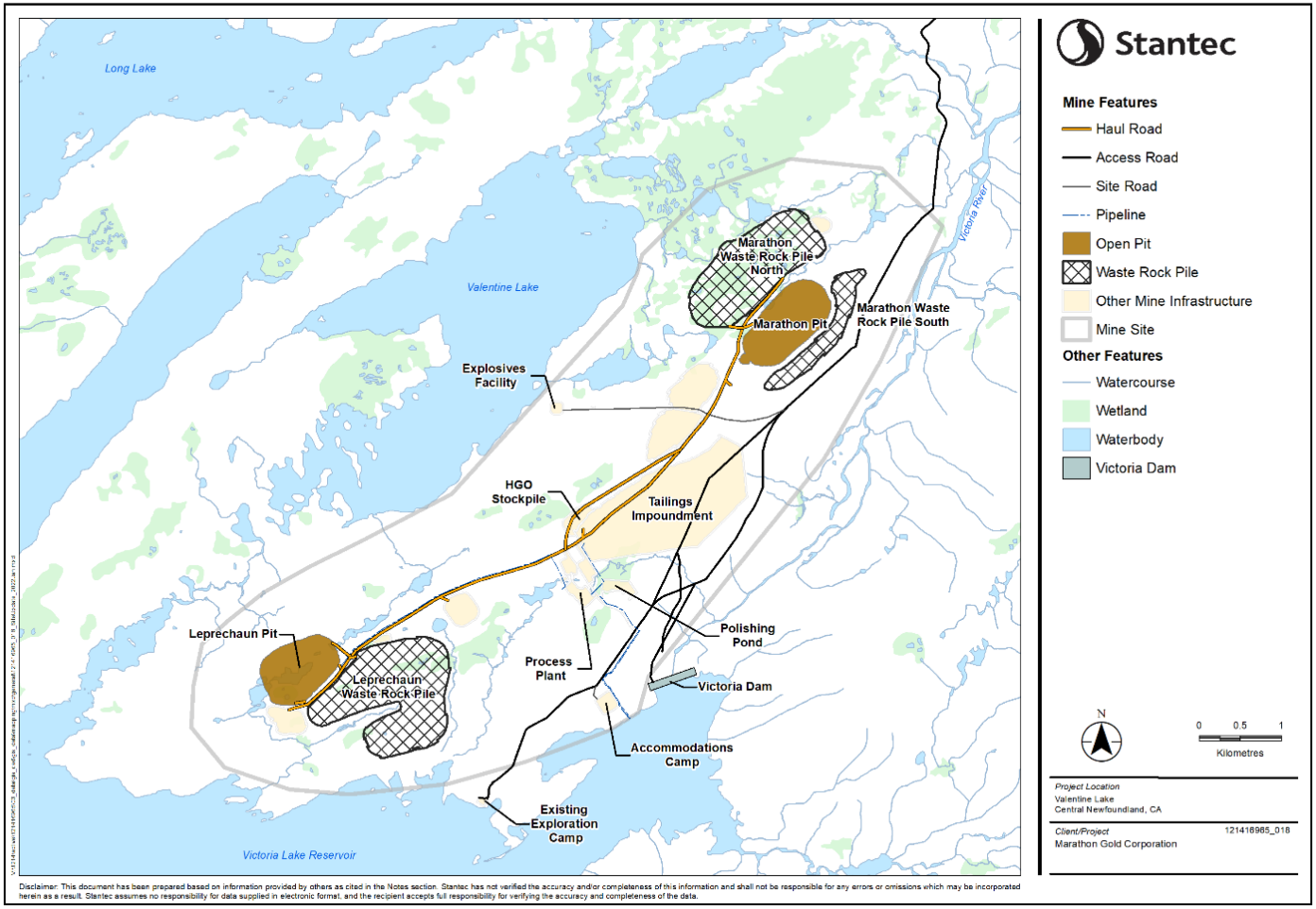


Figure 5-5 Revised Site Plan

While design and scope changes have considered risks to caribou, and have predominantly been positive in this respect, risks associated with Project components and activities remain and the mitigation measures presented in the following tables are designed to reduce risks to caribou.

Table 5.3 presents the Tier 1 mitigation list, which are mitigation measures that will be implemented for the Project. These mitigation have been previously presented in the Valentine Gold Project EIS submitted, with several revised or updated mitigation measures presented.

Table 5.4 presents the Tier 2 mitigation list, which presents potential mitigation refinements or adaptations that may be implemented if monitoring determines this requirement. Tier 2 mitigation measures are considered the first adaptive management level of mitigation.

Table 5.5 presents the Tier 3 mitigation list, which presents potential mitigation refinements or adaptations that may be implemented if monitoring determines this requirement. Tier 3 mitigation measures are considered the second adaptive management level of mitigation.

Tables 5.3 to 5.5 also present the direct monitoring approach or action used to evaluate the effectiveness of each mitigation, the potential monitoring outcomes, and response or next steps associated with each outcome.

Table 5.2 Tier 1 Mitigation Measures

Tier 1 Mitigation - To Be Implemented at Corresponding Project Phase																					
	Project Phase							Implementation Period and Protection Level				Response and Level Addressed									
Mitigation ID	Construction	Operation	Decommissioning	Post-closure	Potential Project Effects	Mitigation Objective	Mitigation Measure	Immediate Implement-action and/or Ongoing Measure	Migration Period Specific	Protection Level	Individuals	Groups	Population	Resident caribou	Migration Through Site	Alternate Migration Route (1 to 5 km)	Alternate Migration Route (5 km or greater)	Failure to Migrate	Monitoring Approach or Action (Specific to Mitigation)	Monitoring Outcomes and Thresholds	Response or Next Steps
CM001	✓	✓	✓	-	Change in Habitat	Maintain forage and cover, reduce sensory disturbance	Project footprint and disturbed areas will be limited to the extent practicable.	✓	-	1	✓	✓	✓	✓	✓	✓	✓	-	Monitor clearing and land disturbance during construction and operations for compliance with design features and planned clearing limits	Clearing or disturbance is consistent with design features and planned clearing limits	None
																				Clearing or disturbance occurring beyond design or planned clearing limits	Correct in consultation with Engineering and Construction teams
																				Requirement for clearing or disturbance beyond design identified during construction	Tier 2 Mitigation - see table
CM002	✓	✓	-	-	Change in Habitat	Maintain forage and cover, reduce sensory disturbance	Vegetation will be maintained around high activity areas to the extent practicable, to serve as a buffer to reduce sensory disturbance.	✓	-	1	✓	✓	✓	✓	✓	✓	✓	-	Monitor clearing during construction and operations for compliance with design features and planned clearing limits	Clearing is consistent with design features and planned clearing limits	None
																				Clearing occurring beyond design or planned clearing limits	Correct in consultation with Engineering and Construction teams
CM003	✓	✓	✓	✓	Change in Habitat	Maintain forage and cover	Where crossing of wetlands (with equipment and/or vehicles) is unavoidable, protective layers such as matting or biodegradable geotextile 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.	✓	-	1	✓	✓	✓	✓	✓	-	-	-	Environmental personnel will monitor/inspect activities that may require travel over wetlands during all Project phases	Crossing of wetlands completed using appropriate protective measures	None
																				Crossing of wetlands not completed using appropriate protection measures	Take corrective action in terms of completing the work, rehabilitate disturbed areas

Table 5.2 Tier 1 Mitigation Measures

Tier 1 Mitigation - To Be Implemented at Corresponding Project Phase																					
	Project Phase				Potential Project Effects	Mitigation Objective	Mitigation Measure	Implementation Period and Protection Level				Response and Level Addressed									
Mitigation ID	Construction	Operation	Decommissioning	Post-closure				Immediate Implement-action and/or Ongoing Measure	Migration Period Specific	Protection Level	Individuals	Groups	Population	Resident caribou	Migration Through Site	Alternate Migration Route (1 to 5 km)	Alternate Migration Route (5 km or greater)	Failure to Migrate	Monitoring Approach or Action (Specific to Mitigation)	Monitoring Outcomes and Thresholds	Response or Next Steps
CM004	✓	✓	-	-	Change in Habitat	Maintain forage and cover, reduce sensory disturbance	Transplant/plant larger trees where appropriate/advantageous to improve vegetation cover and reduce sensory disturbance	✓		1	✓	✓	✓	✓	✓	✓	-	-	Monitoring approach not applicable. Noise monitoring may result in this mitigation being implemented for adaptive management	n/a	n/a
CM005	✓	✓	✓	✓	Change in Habitat	Reduction of sensory disturbance	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. Vehicles and heavy equipment will be regularly inspected and maintained in good working order and will be equipped with appropriate mufflers to reduce noise	✓	-	1	✓	✓	✓	✓	✓	✓	✓	-	Noise monitoring of equipment directly or indirectly (general noise monitoring), audit of equipment/vehicle inspection records	Equipment noise levels within operating range specified by the manufacturer for each equipment unit; inspections/maintenance program being followed; general noise levels within acceptable level	None
																				Equipment noise levels above operating range specified by the manufacturer for each equipment unit, or inspections/maintenance program not being followed; general noise levels within acceptable level	Implement corrective actions - inspections, maintenance
																				Equipment noise levels above operating range specified by the manufacturer for each equipment unit, or inspections/maintenance program not being followed; general noise levels above acceptable level	Tier 2 Mitigation - see table

Table 5.2 Tier 1 Mitigation Measures

Tier 1 Mitigation - To Be Implemented at Corresponding Project Phase																					
	Project Phase				Potential Project Effects	Mitigation Objective	Mitigation Measure	Implementation Period and Protection Level				Response and Level Addressed									
Mitigation ID	Construction	Operation	Decommissioning	Post-closure				Immediate Implement-action and/or Ongoing Measure	Migration Period Specific	Protection Level	Individuals	Groups	Population	Resident caribou	Migration Through Site	Alternate Migration Route (1 to 5 km)	Alternate Migration Route (5 km or greater)	Failure to Migrate	Monitoring Approach or Action (Specific to Mitigation)	Monitoring Outcomes and Thresholds	Response or Next Steps
CM006	✓	✓	✓	-	Change in Habitat	Reduction of sensory disturbance; reduction of direct mortality risk; maintain migratory corridor permeability	The transportation of workers and materials to and from the site via the access road will be managed through a Traffic Management Plan to reduce traffic frequency (reducing noise, dust, mortality risk)	✓	-	1	✓	✓	✓	✓	✓	✓	✓	✓	-	Monitor traffic volumes, efficacy (loaded both directions), timing (daylight driving)	Traffic monitoring determines that Project traffic is efficient (e.g., no half-loads) and operating in accordance with protocols within the Traffic Management Plan	None
																					Traffic monitoring determines that Project traffic is not efficient and/or not operating in accordance with protocols within the Traffic Management Plan	Implement corrective actions - trucks loaded both directions, daytime driving only, other
CM007	✓	✓	✓	-	Change in Habitat	Maintain forage and cover; reduce sensory disturbance; maintain migratory corridor permeability	Vehicles (including off-highway vehicles) used by Marathon personnel will be restricted to roads, trails, and corridors to the extent practicable	✓	-	1	✓	✓	✓	✓	✓	-	-	-	Monitoring via inspection by environmental personnel	Vehicles using roads, trails and corridors only	None
																					Vehicles traveling in areas other than road, trails and corridors (e.g., across wetlands)	Implement corrective actions - additional signage, employee/contractor education, rehabilitation of impacts
CM008	✓	✓	✓	✓	Change in Mortality	Reduction of direct mortality risk; reduction of sensory disturbance	Caribou will have the right-of-way except where deemed unsafe to Project personnel. If wildlife is observed on a road, speed will be reduced and vehicle stopped, if necessary, to allow wildlife to pass and leave road. Specific protocols are provided in Section 5.2.2 of this document.	✓	-	1	✓	✓	✓	✓	✓	✓	✓	-	Visual monitoring on site and along access road for conformance with protocols, review of employee caribou observation reports	Conformance with protocols	None
																					Conformance with protocols	Implement corrective actions - employee/contractor discipline, further employee/contractor education, utilize data from observation reports and/or near-miss incidents to refine protocols

Table 5.2 Tier 1 Mitigation Measures

Tier 1 Mitigation - To Be Implemented at Corresponding Project Phase																					
	Project Phase				Potential Project Effects	Mitigation Objective	Mitigation Measure	Implementation Period and Protection Level				Response and Level Addressed									
Mitigation ID	Construction	Operation	Decommissioning	Post-closure				Immediate Implement-action and/or Ongoing Measure	Migration Period Specific	Protection Level	Individuals	Groups	Population	Resident caribou	Migration Through Site	Alternate Migration Route (1 to 5 km)	Alternate Migration Route (5 km or greater)	Failure to Migrate	Monitoring Approach or Action (Specific to Mitigation)	Monitoring Outcomes and Thresholds	Response or Next Steps
CM009	✓	✓	✓	✓	Change in Mortality	Reduction of direct mortality risk; reduction of sensory disturbance	Project vehicles will be required to comply with posted (or specified) speed limits and all traffic signage along the access road, site roads and haul roads	✓	-	1	✓	✓	✓	✓	✓	✓	✓	-	Visual and radar monitoring along roadways for compliance with rules. Haul trucks are equipped with telemetry equipment that is recorded and can be monitored remotely	Compliance with speed limits, signage and other traffic rules/protocols	None
																				Non-compliance with speed limits, signage and other traffic rules/protocols	Implement corrective actions - employee/contractor discipline, further employee/contractor education, utilize data from observation reports and/or near-miss incidents to refine protocols
CM010	✓	✓	✓	✓	Change in Mortality	Reduce direct mortality risk; reduce sensory disturbance	Project vehicles along the access road, site roads and haul roads may be required to comply with reduced speed limits and additional traffic control measures when specific management level are implemented. May include speed restrictions and/or additional traffic controls for specific areas of the site (site and haul roads), or along the access road.	-	-	2 and 3	✓	✓	✓	✓	✓	✓	✓	✓	Visual and radar monitoring along roadways for compliance with rules. Haul trucks are equipped with telemetry equipment that is recorded and can be monitored remotely	Compliance with speed limits, signage and other traffic rules/protocols	None
																				Non-compliance with speed limits, signage and other traffic rules/protocols	Implement corrective actions - employee/contractor discipline, further employee/contractor education, utilize data from observation reports and/or near-miss incidents to refine protocols

Table 5.2 Tier 1 Mitigation Measures

Tier 1 Mitigation - To Be Implemented at Corresponding Project Phase																					
	Project Phase				Potential Project Effects	Mitigation Objective	Mitigation Measure	Implementation Period and Protection Level				Response and Level Addressed									
Mitigation ID	Construction	Operation	Decommissioning	Post-closure				Immediate Implement-action and/or Ongoing Measure	Migration Period Specific	Protection Level	Individuals	Groups	Population	Resident caribou	Migration Through Site	Alternate Migration Route (1 to 5 km)	Alternate Migration Route (5 km or greater)	Failure to Migrate	Monitoring Approach or Action (Specific to Mitigation)	Monitoring Outcomes and Thresholds	Response or Next Steps
CM011	✓	✓	✓	✓	Change in Mortality; Change in Movement	Reduce direct mortality risk; reduce sensory disturbance; maintain migratory corridor permeability	Project vehicles along the access road, site roads and haul roads will be required to comply with reduced speed limits and additional traffic control measures during the fall and spring migration periods. This is in addition to the suspension of activities in the Marathon pit area.Includes speed limit reductions for site roads, section(s) of the access road within the migration corridor with appropriate buffers, night driving will be prohibited along the access road except for emergencies, convoys will be utilized to the extent possible, increased traffic control signage within the migration corridor and at known crossing locations	-	✓	4	✓	✓	✓	✓	✓	✓	✓	✓	Visual and radar monitoring along roadways for compliance with rules. Haul trucks are equipped with telemetry equipment that is recorded and can be monitored remotely	Compliance with speed limits, signage and other traffic rules/protocols	None
																					Non-compliance with speed limits, signage and other traffic rules/protocols	Implement corrective actions - employee/contractor discipline, further employee/contractor education, utilize data from observation reports and/or near-miss incidents to refine protocols

Table 5.2 Tier 1 Mitigation Measures

Tier 1 Mitigation - To Be Implemented at Corresponding Project Phase																						
	Project Phase				Potential Project Effects	Mitigation Objective	Mitigation Measure	Implementation Period and Protection Level				Response and Level Addressed										
Mitigation ID	Construction	Operation	Decommissioning	Post-closure				Immediate Implement-action and/or Ongoing Measure	Migration Period Specific	Protection Level	Individuals	Groups	Population	Resident caribou	Migration Through Site	Alternate Migration Route (1 to 5 km)	Alternate Migration Route (5 km or greater)	Failure to Migrate	Monitoring Approach or Action (Specific to Mitigation)	Monitoring Outcomes and Thresholds	Response or Next Steps
CM012	✓	✓	✓	-	Change in Mortality; Change in Movement	Reduce direct mortality risk; reduce sensory disturbance; maintain migratory corridor permeability	Project-related traffic on the access road will be further reduced during migration periods – via the Traffic Management Plan and logistics/warehouse management systems, protocols will be developed to maximize supply and warehousing levels prior to the migration periods, as well as manage contractor-related work and rotation changes to the degree practicable (also considering worker health and safety) to reduce traffic levels during the migration period. Logistics prior to, during, and post-migration periods will be integrated with the migration-period caribou monitoring and the associated thresholds for increased caribou protection levels.	-	✓	4	✓	✓	✓	-	✓	✓	✓	✓	Monitoring of traffic volumes (counts) and for conformance with associated traffic protocols. Reduction target will be 60% traffic volume relative to average traffic levels, noting that accurate estimates of traffic volumes may be difficult to determine due to contracting schedules. Marathon will continuously review logistics during construction, operations, and closure, and target the maximum reduction in traffic levels practicable during migration periods.	Reduction of traffic volumes to 60% or less than average traffic levels; traffic protocols being followed	None
																					Reduction of traffic volumes to 60% or less than average traffic levels not achieved; traffic protocols not being followed	Implement review of traffic reduction measures, taking additional actions where possible; further employee/contractor education
																					Reduction of traffic volumes to 60% or less than average traffic levels not achievable due to length of migration period (e.g., spring period longer) or inability to store sufficient supplies	Tier 2 Mitigation - see table

Table 5.2 Tier 1 Mitigation Measures

Tier 1 Mitigation - To Be Implemented at Corresponding Project Phase																					
	Project Phase				Potential Project Effects	Mitigation Objective	Mitigation Measure	Implementation Period and Protection Level				Response and Level Addressed									
Mitigation ID	Construction	Operation	Decommissioning	Post-closure				Immediate Implement-action and/or Ongoing Measure	Migration Period Specific	Protection Level	Individuals	Groups	Population	Resident caribou	Migration Through Site	Alternate Migration Route (1 to 5 km)	Alternate Migration Route (5 km or greater)	Failure to Migrate	Monitoring Approach or Action (Specific to Mitigation)	Monitoring Outcomes and Thresholds	Response or Next Steps
CM013	✓	✓	✓	✓	Change in Habitat	Reduce sensory disturbance	Project-related air traffic (helicopters) will maintain a minimum altitude of 500 m to the extent feasible at all times of the year. Where caribou are observed along the flight path, the path will be altered by 1 km to avoid passing directly overhead of caribou where safe or possible to do so. Air traffic is expected to be limited and low altitude flying is only expected to be required adjacent to a site landing area. Protocols will be reviewed with the helicopter contractor prior to flights.	✓	-	1	✓	✓	✓	✓	-	-	-	-	Monitor air traffic protocols via Project-related pilot and/or passenger reports	Air traffic protocols followed	None
																					Air traffic protocols not followed	Implement corrective actions with helicopter contractor - pilot training, change contractors if repeated issues
CM014	✓	✓	✓	✓	Change in Habitat	Reduce sensory disturbance	Air traffic (helicopters) will be limited or suspended during caribou migration and calving periods except when used for caribou studies. If air travel is required during the migration period, air traffic will avoid traveling within 5 km of the primary migratory corridor, except on approach/departure from the site. Protocols will be reviewed with the helicopter contractor prior to flights.	-	✓	4	✓	✓	✓	✓	✓	✓	✓	✓	Monitor air traffic protocols via Project-related pilot and/or passenger reports	Air traffic protocols followed	None
																					Air traffic protocols not followed	Implement corrective actions with helicopter contractor - pilot training, change contractors if repeated issues

Table 5.2 Tier 1 Mitigation Measures

Tier 1 Mitigation - To Be Implemented at Corresponding Project Phase																					
	Project Phase				Potential Project Effects	Mitigation Objective	Mitigation Measure	Implementation Period and Protection Level				Response and Level Addressed									
Mitigation ID	Construction	Operation	Decommissioning	Post-closure				Immediate Implement-action and/or Ongoing Measure	Migration Period Specific	Protection Level	Individuals	Groups	Population	Resident caribou	Migration Through Site	Alternate Migration Route (1 to 5 km)	Alternate Migration Route (5 km or greater)	Failure to Migrate	Monitoring Approach or Action (Specific to Mitigation)	Monitoring Outcomes and Thresholds	Response or Next Steps
CM015	✓	✓	✓	✓	Change in Mortality	Reduce direct mortality, reduce sensory disturbance, reduce direct and indirect effect on resource users	Hunting will be strictly prohibited on the mine site. Workers will not be permitted to hunt while staying at the accommodations camp and will not be permitted to bring firearms to site.	✓	-	1	✓	✓	✓	-	✓	✓	✓	-	Site security, environmental and transportation personnel will observe and report infractions.	Workers complying with rules	None
																				Workers not complying with rules	Workers caught breaking rules will be subject to discipline, up to and including dismissal in accordance with Marathon's policies.
CM016	✓	✓	✓	✓	Change in Habitat, Change in Movement, Change in Mortality	Reduce direct mortality, reduce sensory disturbance, maintain forage and cover, maintain migration corridor permeability, reduce direct and indirect effects on resource users	Educate employees and contractors regarding caribou protection and monitoring. A specific component of the employee and contractor induction and ongoing training programs will be focused on the CPEEMP and the roles and responsibilities under the Plan as further described in Section 5.2.1 of this document. Contract documentation for applicable contracts will include the CPEEMP. Notices and 'reminder' documentation will be issued prior to migration periods and if management levels are increased.	✓	-	All	✓	✓	✓	✓	-	✓	✓	✓	✓	Tracking and auditing employee and contractor records regarding induction and update training (also a requirement under the Project Environmental and Social Management System). Audits of contract documentation.	Tracking and audits show compliance with induction, training, and documentation requirements for employees and contractors	None
																				Tracking and audits show non-compliance with induction, training, and documentation requirements for employees and contractors	Implement corrective actions (also per the ESMS) to ensure compliance with induction, training, and documentation requirements

Table 5.2 Tier 1 Mitigation Measures

Tier 1 Mitigation - To Be Implemented at Corresponding Project Phase																					
	Project Phase				Potential Project Effects	Mitigation Objective	Mitigation Measure	Implementation Period and Protection Level				Response and Level Addressed									
Mitigation ID	Construction	Operation	Decommissioning	Post-closure				Immediate Implement-action and/or Ongoing Measure	Migration Period Specific	Protection Level	Individuals	Groups	Population	Resident caribou	Migration Through Site	Alternate Migration Route (1 to 5 km)	Alternate Migration Route (5 km or greater)	Failure to Migrate	Monitoring Approach or Action (Specific to Mitigation)	Monitoring Outcomes and Thresholds	Response or Next Steps
CM017	✓	✓	✓	✓	Change in Movement	Maintain migratory corridor permeability	Breaks in snowbanks associated with snow clearing along roadways will be created at ~200 m intervals, to the extent practicable, through the migratory corridor to provide caribou with crossing opportunities. Where feasible, breaks will be aligned on opposite sides of the road and with existing wildlife trails (where these occur). Snowbanks will typically be < 1 m tall to facilitate caribou crossing roadways during spring and fall migration. To be applied for all roads east of the plant site, and on the access road from site to the Roebucks turn-off.	✓	-	1	✓	✓	✓	-	✓	✓	✓	-	Observation of caribou use of breaks and reaction to road crossing (visual - caribou or tracks, collar, camera). Inspection of snow clearing along identified roadway sections	Snow clearing protocols followed	None
																					Snow clearing protocols not being followed	Implement corrective actions with snow clearing contractor - operator education, replace operator or contractor if repeated non-compliance
																					No indication/evidence of road crossing issues (redirection, avoidance, etc.)	None
																					Indication/evidence of issues for caribou crossing road due to snowbanks	Increase frequency of breaks and/or lower bank height
CM018	✓	✓	✓	✓	Change in Movement	Maintain migratory corridor permeability	Water management ditches will be designed, constructed and maintained to allow wildlife crossing opportunities	✓	-	1	✓	✓	✓	-	✓		-	-	Monitor via on-site monitoring and collar data to determine if caribou hesitant or encounter issues crossing water management ditches	Caribou observed (directly and/or through hoof print/trail evidence) crossing water management ditches without issue	None
																					Caribou avoiding crossing water management ditches	Tier 2 Mitigation - see table

Table 5.2 Tier 1 Mitigation Measures

Tier 1 Mitigation - To Be Implemented at Corresponding Project Phase																						
	Project Phase				Potential Project Effects	Mitigation Objective	Mitigation Measure	Implementation Period and Protection Level				Response and Level Addressed										
Mitigation ID	Construction	Operation	Decommissioning	Post-closure				Immediate Implement-action and/or Ongoing Measure	Migration Period Specific	Protection Level	Individuals	Groups	Population	Resident caribou	Migration Through Site	Alternate Migration Route (1 to 5 km)	Alternate Migration Route (5 km or greater)	Failure to Migrate	Monitoring Approach or Action (Specific to Mitigation)	Monitoring Outcomes and Thresholds	Response or Next Steps
CM019	✓	✓	-	-	Change in Habitat	Reduce sensory disturbance	Visual and/or drone surveys for caribou will be undertaken prior to blasting for construction and operations. For construction blasting (civil works) and during pit development, which includes near-surface blasting, the search zone will be 1 km from the blast. After the pit perimeter is developed and blasting is more than 50 m below the pit crest (whereby noise and vibrations will be reduced for receptors) the clearance zone will be a 500 m buffer from the final pit perimeter. Blasting will be delayed if caribou are observed within these zones.	✓	-	1	✓	✓	✓	✓	✓	✓	-	-	Regular reviews of collar data, visual and/or drone surveys will be utilized to determine if caribou are within the specified zone prior to blasting. Noise and ground vibration will be monitored via stations established at the site. If caribou are detected outside the specified zone but within a 3 km radius of the blast, visual monitoring of the caribou will be conducted to determine if they animal(s) have an adverse reaction to the blast event.	Caribou identified within the specified zone	Blasting operations suspended until caribou clear the zone
																				No caribou identified within the specified blast zone and no caribou within a 3 km radius	None, blasting operations permitted
																				No caribou identified within the specified blast zone; caribou within a 3 km radius but no adverse reaction to blast event	None, blasting operations permitted
																				No caribou identified within the specified blast zone; caribou within a 3 km radius show adverse reaction to blast event	Tier 2 Mitigation - see table

Table 5.2 Tier 1 Mitigation Measures

Tier 1 Mitigation - To Be Implemented at Corresponding Project Phase																						
	Project Phase				Potential Project Effects	Mitigation Objective	Mitigation Measure	Implementation Period and Protection Level				Response and Level Addressed										
Mitigation ID	Construction	Operation	Decommissioning	Post-closure				Immediate Implement-action and/or Ongoing Measure	Migration Period Specific	Protection Level	Individuals	Groups	Population	Resident caribou	Migration Through Site	Alternate Migration Route (1 to 5 km)	Alternate Migration Route (5 km or greater)	Failure to Migrate	Monitoring Approach or Action (Specific to Mitigation)	Monitoring Outcomes and Thresholds	Response or Next Steps
CM020	✓	✓	-	-	Change in Habitat; Change in Movement	Maintain migratory corridor permeability, reduce sensory disturbance	Construction and production blasting in the Marathon pit area and TMF area will be suspended during the spring and fall migration periods.	-	✓	4	✓	✓	✓	✓	✓	✓	-	-	Monitoring associated with triggering this mitigation is conducted as part of the collar monitoring program - assessing caribou movements as the migration period approaches to trigger the suspension of blasting activities in the Marathon pit and TMF area. See Table 5.1 regarding caribou Protection Levels and triggers, and Section 6.0 regarding monitoring. Monitoring the outcome of this mitigation is tied to the overall monitoring of caribou response to the Project during migration. See Section 6.0 for further details.	See Section 6.0 of this document regarding potential monitoring outcomes (caribou response)	See Section 6.0 of this document regarding potential monitoring outcomes (caribou response) - as this mitigation relates to the suspension of activities during the migration, the response or next steps will likely be associated with other Project activities and not this specific mitigation.

Table 5.2 Tier 1 Mitigation Measures

Tier 1 Mitigation - To Be Implemented at Corresponding Project Phase																						
	Project Phase				Potential Project Effects	Mitigation Objective	Mitigation Measure	Implementation Period and Protection Level				Response and Level Addressed										
Mitigation ID	Construction	Operation	Decommissioning	Post-closure				Immediate Implement-action and/or Ongoing Measure	Migration Period Specific	Protection Level	Individuals	Groups	Population	Resident caribou	Migration Through Site	Alternate Migration Route (1 to 5 km)	Alternate Migration Route (5 km or greater)	Failure to Migrate	Monitoring Approach or Action (Specific to Mitigation)	Monitoring Outcomes and Thresholds	Response or Next Steps
CM021	✓	-	-	-	Change in Habitat; Change in Movement	Maintain migratory corridor permeability, reduce sensory disturbance	Construction blasting in the Plant and Leprechaun pit area is expected to be limited. During the construction phase of the Project, scheduling of construction-related (civil) blasting will be scheduled outside of the migratory periods to the extent practical. If necessary during the construction period, blast design will be reduced to minimize noise and vibration, noting that current predictive modeling indicates noise levels will be less than 40 dBA and vibration levels (peak particle velocity) less and 5 mm/s, within the primary caribou migration corridor approximately 2 to 8 km from the potential blast areas.	-	✓	4	✓	✓	✓	✓	✓	✓	-	-	Visual and/or drone monitoring will be conducted to determine if there is an adverse reaction from caribou migrating through Project Area.	No adverse reaction of caribou to blasting event	None
																					Startle or other adverse reaction of migrating caribou to blasting event	Suspend construction blasting operations until migratory period complete, corresponding in reduction of caribou Protection Level from 4 to 2.

Table 5.2 Tier 1 Mitigation Measures

Tier 1 Mitigation - To Be Implemented at Corresponding Project Phase																						
	Project Phase				Potential Project Effects	Mitigation Objective	Mitigation Measure	Implementation Period and Protection Level				Response and Level Addressed										
Mitigation ID	Construction	Operation	Decommissioning	Post-closure				Immediate Implement-action and/or Ongoing Measure	Migration Period Specific	Protection Level	Individuals	Groups	Population	Resident caribou	Migration Through Site	Alternate Migration Route (1 to 5 km)	Alternate Migration Route (5 km or greater)	Failure to Migrate	Monitoring Approach or Action (Specific to Mitigation)	Monitoring Outcomes and Thresholds	Response or Next Steps
CM022	✓	✓	-	-	Change in Habitat	Reduce sensory disturbance	Production blasting in Leprechaun pit during construction and operations phases is planned to continue during the migration period as current predictive modeling indicates noise levels will be less than 40 dBA and vibration levels (peak particle velocity) less and 5 mm/s, within the primary caribou migration corridor, located approximately 5 to 8 km from the pit. Visual and/or drone surveys for caribou will be undertaken prior to blasting and during the migration period, the search zone will be 2 km from the pit. Blasting will be delayed if caribou are observed within 1 km, and if groups of 10 caribou or more are observed within 2 km.	-	✓	4	✓	✓	✓	✓	✓	✓	✓	✓	-	Visual and/or drone surveys will be utilized to determine if caribou are within the specified zone prior to blasting. Noise and ground vibration will be monitored via stations established at the site. If caribou are detected outside the specified zone but within a 3 km radius of the blast (corresponding to Protection Level 2), visual monitoring of the caribou will be conducted to determine if they animal(s) have an adverse reaction to the blast event.	Caribou identified within the specified zone	Blasting operations suspended until caribou clear the zone
																					No caribou identified within the specified blast zone and no caribou within a 3 km radius	None, blasting operations permitted
																					No caribou identified within the specified blast zone; caribou within a 3 km radius	Blasting operations permitted, visual monitoring of caribou reaction to blast event
																					No caribou identified within the specified blast zone; caribou within a 3 km radius show adverse reaction to blast event	Tier 2 Mitigation - see table

Table 5.2 Tier 1 Mitigation Measures

Tier 1 Mitigation - To Be Implemented at Corresponding Project Phase																				
	Project Phase				Potential Project Effects	Mitigation Objective	Mitigation Measure	Implementation Period and Protection Level				Response and Level Addressed									
Mitigation ID	Construction	Operation	Decommissioning	Post-closure				Immediate Implement-action and/or Ongoing Measure	Migration Period Specific	Protection Level	Individuals	Groups	Population	Resident caribou	Migration Through Site	Alternate Migration Route (1 to 5 km)	Alternate Migration Route (5 km or greater)	Failure to Migrate	Monitoring Approach or Action (Specific to Mitigation)	Monitoring Outcomes and Thresholds	Response or Next Steps
CM023	✓	✓	✓	-	Change in Habitat	Reduce indirect habitat loss, reduce sensory disturbance, maintain migratory corridor permeability	Activities in the Marathon pit area, including the Marathon waste rock pile, overburden and topsoil stockpiles, and low grade ore stockpile, that result in sensory disturbance to caribou (e.g., blasting, loading, hauling) will be suspended while caribou are migrating.	-	✓	4	✓	✓	✓	-	✓	✓	-	-	Monitoring of caribou response to the Project during migration via collars, cameras, visual monitoring.	Caribou continue to migrate through the primary corridor and around the Marathon pit and associated components	None
																				Caribou exhibit avoidance of the Project and associated components and choose alternate migration routes	Tier 2 Mitigation - see table
CM024	✓	✓	✓	-	Change in Habitat	Maintain forage and cover	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.	✓	-	1	✓	✓	✓	✓	✓	✓	-	-	Inspection of the TMF with respect to exposed, dry surfaces; overall dust monitoring via dust monitoring stations erected at the site.	Exposed, dry surfaces not evident, no visual dusting during wind events, no dust monitoring exceedances	None
																				Larger areas of exposed, dry tailings and/or visual dusting during wind events, no dust monitoring exceedances	Review and revise the tailings deposition plan to further minimize exposed, dry surfaces
																				Larger areas of exposed, dry tailings and/or visual dusting during wind events; dust monitoring exceedances	Tier 2 Mitigation - see table
CM025	✓	✓	-	-	Change in Habitat	Reduce indirect habitat loss	Emission control technologies (stacks, filters, scrubbers) will be designed/installed to reduce air contaminant emissions (dust) from process equipment and buildings	✓	-	1	✓	✓	✓	✓	✓	✓	-	-	Project dust monitoring - see Section 5.2.3 regarding monitoring thresholds	Dust within defined thresholds	None
																				Dust above defined thresholds	Tier 2 Mitigation - see table

Table 5.2 Tier 1 Mitigation Measures

Tier 1 Mitigation - To Be Implemented at Corresponding Project Phase																						
	Project Phase				Potential Project Effects	Mitigation Objective	Mitigation Measure	Implementation Period and Protection Level				Response and Level Addressed							Monitoring Approach or Action (Specific to Mitigation)	Monitoring Outcomes and Thresholds	Response or Next Steps
Mitigation ID	Construction	Operation	Decommissioning	Post-closure				Immediate Implement-action and/or Ongoing Measure	Migration Period Specific	Protection Level	Individuals	Groups	Population	Resident caribou	Migration Through Site	Alternate Migration Route (1 to 5 km)	Alternate Migration Route (5 km or greater)	Failure to Migrate			
CM026	-	✓	-	-	Change in Habitat	Reduce indirect habitat loss, reduce disturbed habitat	Waste rock piles will be progressively rehabilitated (including revegetation) to reduce dust emissions. Progressive rehabilitation is a regulatory requirement under the *Mines Act*.	✓	-	1	✓	✓	✓	✓	✓	✓	-	-	Monitor progressive rehabilitation effectiveness	Progressive rehabilitation is successful and therefore dust suppression is achieved	None
																				Progressive rehabilitation is not successful and therefore adequate dust suppression is not achieved	Implement corrective actions regarding progressive rehabilitation of the waste rock pile per Project Rehabilitation and Closure Plan
CM027	✓	✓	-	-	Change in Habitat	Reduce indirect habitat loss	Surfaces of topsoil and overburden stockpiles that will not be disturbed for extended periods will be stabilized by means of vegetating, covering, or utilizing surface binders.	✓	-	1	✓	✓	✓	✓	✓	✓	-	-	Project dust monitoring - see Section 5.2.3 regarding dust monitoring thresholds	Dust levels within defined thresholds	None
																				Dust levels above defined thresholds	Tier 2 Mitigation - see table
CM028	✓	✓	✓	-	Change in Habitat	Reduce indirect habitat loss	Dust suppression will be applied to roads and open-ground areas on an as-needed basis during dry and/or high wind conditions. Dust suppression will normally be water (contact water) but may also include surface binders for high traffic areas based on regulatory approval.	✓	-	1	✓	✓	✓	✓	✓	✓	✓	-	Project dust monitoring - see Section 5.2.3 regarding dust monitoring thresholds	Dust levels within defined thresholds	None
																				Dust levels above defined thresholds	Tier 2 Mitigation - see table

Table 5.2 Tier 1 Mitigation Measures

Tier 1 Mitigation - To Be Implemented at Corresponding Project Phase																					
	Project Phase				Potential Project Effects	Mitigation Objective	Mitigation Measure	Implementation Period and Protection Level				Response and Level Addressed									
Mitigation ID	Construction	Operation	Decommissioning	Post-closure				Immediate Implement-action and/or Ongoing Measure	Migration Period Specific	Protection Level	Individuals	Groups	Population	Resident caribou	Migration Through Site	Alternate Migration Route (1 to 5 km)	Alternate Migration Route (5 km or greater)	Failure to Migrate	Monitoring Approach or Action (Specific to Mitigation)	Monitoring Outcomes and Thresholds	Response or Next Steps
CM029	-	✓	-	-	Change in Habitat	Reduce indirect habitat loss, reduce sensory disturbance	Conveyor belts at the mill will be enclosed to reduce dust generation and noise	✓	-	1	✓	✓	✓	✓	✓	✓	-	-	Project dust and noise monitoring - see Section 5.2.3 regarding dust and noise monitoring thresholds	Dust and noise within defined thresholds	None
																				Dust and/or noise above defined thresholds	Tier 2 Mitigation - see table
CM030	✓	✓	-	-	Change in Habitat	Reduce indirect habitat loss	When loading stockpiles, drop heights will be reduced to be as close to the pile as possible.	✓	-	1	✓	✓	✓	✓	✓	✓	-	-	Visual inspection of stockpiling activities; Project dust monitoring	Drop heights are within best and safe operating practice for the equipment type	None
																				Drop heights are above best and safe operating practice for the equipment type and creating excessive dust	Implement corrective actions with equipment operators

Table 5.2 Tier 1 Mitigation Measures

Tier 1 Mitigation - To Be Implemented at Corresponding Project Phase																					
	Project Phase				Potential Project Effects	Mitigation Objective	Mitigation Measure	Implementation Period and Protection Level				Response and Level Addressed									
Mitigation ID	Construction	Operation	Decommissioning	Post-closure				Immediate Implement-action and/or Ongoing Measure	Migration Period Specific	Protection Level	Individuals	Groups	Population	Resident caribou	Migration Through Site	Alternate Migration Route (1 to 5 km)	Alternate Migration Route (5 km or greater)	Failure to Migrate	Monitoring Approach or Action (Specific to Mitigation)	Monitoring Outcomes and Thresholds	Response or Next Steps
CM031	✓	✓	✓	-	Change in Habitat	Reduce indirect habitat loss, reduce sensory disturbance	Temporary and permanent lighting will be minimized to that required for safe construction and operation activities, and incorporate the following mitigation: - exterior lights will be shielded from above where possible - mobile and permanent lighting will be located such that unavoidable light spill from the working area is not directed to receptors outside the Project Area, to the extent practical - use of mobile flood lighting units will be minimized and will be turned off when not required - full cut off luminaires will be used where practical to reduce glare, light trespass, and sky glow from Project lighting	✓	-	1	✓	✓	✓	✓	✓	✓	-	-	Project light monitoring - see Section 5.2.3 regarding light monitoring thresholds	Light levels within defined thresholds	None
																				Light levels above defined thresholds	Tier 2 Mitigation - see table

Table 5.2 Tier 1 Mitigation Measures

Tier 1 Mitigation - To Be Implemented at Corresponding Project Phase																							
	Project Phase				Potential Project Effects	Mitigation Objective	Mitigation Measure	Implementation Period and Protection Level				Response and Level Addressed											
Mitigation ID	Construction	Operation	Decommissioning	Post-closure				Immediate Implement-action and/or Ongoing Measure	Migration Period Specific	Protection Level	Individuals	Groups	Population	Resident caribou	Migration Through Site	Alternate Migration Route (1 to 5 km)	Alternate Migration Route (5 km or greater)	Failure to Migrate	Monitoring Approach or Action (Specific to Mitigation)	Monitoring Outcomes and Thresholds	Response or Next Steps
CM032	✓	✓	-	-	Change in Habitat, Change in Movement	Reduce direct and indirect habitat loss, maintain migration corridor permeability	Planning for closure during Project design and Project development stages – Project features are designed and developed such that progressive and final rehabilitation activities do not require major re-work or significant alteration of the adjacent land and environment. With respect to caribou, this includes the design of the Marathon waste rock pile as it relates to minimizing footprint relative to the baseline migration corridor and providing a diversion around the open pit. The diversion around the pit also largely addresses the *Mines Act* requirements to install barricades around the high wall(s) of an open pit for safety.	✓	-	1	✓	✓	✓	✓	✓	-	-	-	Mitigation implemented - monitoring will included in the assessment (visual, collaring, drone, cameras) of caribou movement through the site. As the waste rock pile footprint will not be fully developed until approximately Year 2 of operations (4 years from start of construction), opportunities to monitor caribou movement through this area and make further adjustment to the design are possible.	Caribou movement in proximity to the Marathon open pit and adjacent waste rock pile area will be monitored and the results of the change in movement to adjust to the open pit may indicate further changes to the waste rock pile design could further reduce effects to caribou migrating through the Marathon pit area.	No further action may be required, however further adjustment to the waste rock pile design may be required.

Table 5.2 Tier 1 Mitigation Measures

Tier 1 Mitigation - To Be Implemented at Corresponding Project Phase																						
	Project Phase				Potential Project Effects	Mitigation Objective	Mitigation Measure	Implementation Period and Protection Level				Response and Level Addressed										
Mitigation ID	Construction	Operation	Decommissioning	Post-closure				Immediate Implement-action and/or Ongoing Measure	Migration Period Specific	Protection Level	Individuals	Groups	Population	Resident caribou	Migration Through Site	Alternate Migration Route (1 to 5 km)	Alternate Migration Route (5 km or greater)	Failure to Migrate	Monitoring Approach or Action (Specific to Mitigation)	Monitoring Outcomes and Thresholds	Response or Next Steps
CM033	✓	✓	-	-	Change in Habitat	Reduce direct and indirect habitat loss	Planning for closure during Project development and operations - revegetation design and testing is required to determine suitable and sustainable vegetation growth in the post-closure phase. As the closure design of the Project will relate to the post-closure use of the Project Area by caribou, Marathon will consult with NLDFFA - Wildlife Division as well as Indigenous groups and stakeholders with respect to revegetation planning and design and trials that will be conducted during the operations phase of the Project.	✓	-	1	✓	✓	✓	✓	✓	✓	✓	✓	n/a - implementation and monitoring via the Rehabilitation and Closure Plan requirement under the *Mines Act*.	n/a	n/a
CM034	-	-	✓	-	Change in Habitat, Change in Mortality	Reduce direct mortality risk	During closure, the open pits will be flooded. Ingress/egress area(s) will be created for people/animals at pit lake surface interfaces for mine closure (requirement of NLDIET-Mines Branch).	✓	-	1	✓	✓	✓	✓	✓	-	-	-	n/a - implementation and monitoring via the Rehabilitation and Closure Plan requirement under the *Mines Act*.	n/a	n/a

Table 5.2 Tier 1 Mitigation Measures

Tier 1 Mitigation - To Be Implemented at Corresponding Project Phase																						
	Project Phase				Potential Project Effects	Mitigation Objective	Mitigation Measure	Implementation Period and Protection Level				Response and Level Addressed										
Mitigation ID	Construction	Operation	Decommissioning	Post-closure				Immediate Implement-action and/or Ongoing Measure	Migration Period Specific	Protection Level	Individuals	Groups	Population	Resident caribou	Migration Through Site	Alternate Migration Route (1 to 5 km)	Alternate Migration Route (5 km or greater)	Failure to Migrate	Monitoring Approach or Action (Specific to Mitigation)	Monitoring Outcomes and Thresholds	Response or Next Steps
CM035	-	-	✓	-	Change in Habitat, Change in Movement	Reduce direct and indirect habitat loss, maintain migration corridor permeability	Project rehabilitation and closure will be planned to return the Project Area to as close to natural conditions as possible, including:- Removal and rehabilitation of the low grade ore stockpiles, overburden and topsoil stockpiles, haul roads, and water management features.- Removal of all site equipment and buildings (crusher, plant, accommodations, etc.) and rehabilitation of the associated disturbed areas.- Removal of all associated infrastructure (power lines, culverts, roads, etc.) and rehabilitation of the associated disturbed areas.- Reinstatement of pre-development topography and drainage courses to the extent possible.- Revegetation of all disturbed areas.Note that Marathon is required under the *Mines Act* to post Financial Assurance for the costs associated with the Rehabilitation and Closure Plan to ensure funds are available to complete this work in the event of a default by Marathon at any point over the life of the Project.	✓	-	1	✓	✓	✓	✓	✓	✓	✓	✓	n/a - implementation and monitoring via the Rehabilitation and Closure Plan requirement under the *Mines Act*.	n/a	n/a

Table 5.2 Tier 1 Mitigation Measures

Tier 1 Mitigation - To Be Implemented at Corresponding Project Phase																						
	Project Phase				Potential Project Effects	Mitigation Objective	Mitigation Measure	Implementation Period and Protection Level				Response and Level Addressed										
Mitigation ID	Construction	Operation	Decommissioning	Post-closure				Immediate Implement-action and/or Ongoing Measure	Migration Period Specific	Protection Level	Individuals	Groups	Population	Resident caribou	Migration Through Site	Alternate Migration Route (1 to 5 km)	Alternate Migration Route (5 km or greater)	Failure to Migrate	Monitoring Approach or Action (Specific to Mitigation)	Monitoring Outcomes and Thresholds	Response or Next Steps
CM036	-	-	✓	✓	Change in Habitat, Change in Movement	Reduce direct and indirect habitat loss, maintain migration corridor permeability	Decommissioning and rehabilitation of site roads during closure will be conducted to the extent possible, noting that some site roads will need to be maintained for post-closure site inspections and monitoring purposes. It is expected the roads left in place will be reduced in width and may be gated to reduce public access for the post-closure monitoring period.	✓	-	1	✓	✓	✓	✓	✓	✓	✓	✓	n/a - implementation and monitoring via the Rehabilitation and Closure Plan requirement under the *Mines Act*.	n/a	n/a
CM037	✓	✓	-	-	Change in Movement, Change in Mortality	Maintain migration corridor permeability, reduce direct mortality risk	Site inspection prior to the spring and fall migration periods to assess specific hazards that might present specific risk to caribou movement (as the site is changing over time, more rapidly during construction and closure phases). Project features (e.g., open pits, TMF, water management features) and areas/features under development or closure will be monitored during migratory periods and temporary fencing/barricades may be installed as needed to reduce risks to caribou.	-	✓	2	✓	✓	✓	✓	✓	-	-	-	n/a - mitigation is an inspection and monitoring activity itself	No specific risks or hazards are identified	None
																				Specific risks or hazards are identified prior to the migration period	Implement corrective or protective measures where possible.
																				Risks or hazards are identified based on monitoring of migrating caribou	Potential risks or hazards currently considered are addressed in Tier 1 and Tier 2 mitigations and these mitigation may be used to address identified issues, or additional mitigation may need to be developed for specific hazards or caribou responses -

Table 5.2 Tier 1 Mitigation Measures

Tier 1 Mitigation - To Be Implemented at Corresponding Project Phase																						
	Project Phase				Potential Project Effects	Mitigation Objective	Mitigation Measure	Implementation Period and Protection Level				Response and Level Addressed										
Mitigation ID	Construction	Operation	Decommissioning	Post-closure				Immediate Implement-action and/or Ongoing Measure	Migration Period Specific	Protection Level	Individuals	Groups	Population	Resident caribou	Migration Through Site	Alternate Migration Route (1 to 5 km)	Alternate Migration Route (5 km or greater)	Failure to Migrate	Monitoring Approach or Action (Specific to Mitigation)	Monitoring Outcomes and Thresholds	Response or Next Steps
																						see Tier 2 Mitigation table
CM038	✓	✓	✓	-	Change in Mortality	Reduce direct mortality risk	Outside of the migration periods, the on-site environmental team will be immediately notified when caribou are observed within 1 km of Project activities. The on-site environmental team will investigate and assess to determine if specific Project activities may be reduced or suspended, or if additional measures are required to minimize interaction and/or risk to caribou.	✓	-	3	✓	✓	✓	✓	-	-	-	-	The need for employees and contractors to monitor for and report caribou sightings will be highlighted as part of the induction and ongoing environmental training programs. Environmental inspections and audits of employee reports will be conducted. Monitoring of measures specific to protection of caribou in this case will require monitoring specific to the measures selected, most of which are expected to be addressed in the Tier 1 or Tier 2 mitigation tables.	Caribou sightings reported immediately, and report form completed	None
																				Caribou sightings not reported immediately and/or report forms not completed	Implement corrective actions - further employee/contractor training

Table 5.3 Tier 2 Mitigation Measures

Tier 2 Mitigation - To Be Implemented based on Monitoring (Adaptive Management to Tier 1 Mitigation)

Mitigation ID	Project Phase				Potential Project Effects	Tier 1 Mitigation Measure	Tier 2 Mitigation Measure	Tier 2 Implementation Period or Threshold				Tier 2 Monitoring		
	Construction	Operation	Decommissioning	Post-closure				Ongoing Measure	Migration period	Defined Threshold		Monitoring Approach or Action	Monitoring Outcomes	Response or Next Steps
										Applies	Threshold			
CM001	✓	✓	✓	-	Change in Habitat	Project footprint and disturbed areas will be limited to the extent practicable.	Rehabilitate and revegetate areas where cleared or disturbed areas are required short-term (also known as progressive rehabilitation)	-	-	✓	Area Identified	Monitor area of rehabilitation/revegetation	Rehabilitation/ revegetation successful, area restored	None
													Rehabilitation/ revegetation unsuccessful	Assess reason why unsuccessful and repeat or adapt rehabilitation/ revegetation actions
CM005	✓	✓	-	-	Change in Habitat	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. Vehicles and heavy equipment will be regularly inspected and maintained in good working order and will be equipped with appropriate mufflers to reduce noise	If noise level monitoring indicates that noise levels are above the levels predicted in the EIS or the thresholds described in Section 5.2.3 of the CPEEMP, a detailed noise assessment will be conducted to assess the key noise sources and determine options to reduce noise levels	-	-	✓	Based on Monitoring	Project-level monitoring of noise levels	Noise levels are within EIS prediction levels and appropriate thresholds	None
													Noise levels are above EIS prediction levels and appropriate thresholds	Implement further measures associated with the detailed noise assessment

Table 5.3 Tier 2 Mitigation Measures

Tier 2 Mitigation - To Be Implemented based on Monitoring (Adaptive Management to Tier 1 Mitigation)

	Project Phase							Tier 2 Implementation Period or Threshold				Tier 2 Monitoring		
Mitigation ID	Construction	Operation	Decommissioning	Post-closure	Potential Project Effects	Tier 1 Mitigation Measure	Tier 2 Mitigation Measure	Ongoing Measure	Migration period	Defined Threshold		Monitoring Approach or Action	Monitoring Outcomes	Response or Next Steps
										Applies	Threshold			
CM0012	✓	✓	✓	-	Change in Mortality; Change in Movement	Project-related traffic on the access road will be further reduced during migration periods – via the Traffic Management Plan and logistics/warehouse management systems, protocols will be developed to maximize supply and warehousing levels prior to the migration periods, as well as manage contractor-related work and rotation changes to the degree practicable (also considering worker health and safety) to reduce traffic levels during the migration period. Logistics prior to, during, and post-migration periods will be integrated with the migration-period caribou monitoring and the associated thresholds for increased caribou protection levels.	Review and implement additional strategies to reduce traffic volumes. Examples may include but not limited to additional warehouse and supplies storage on site, increase fuel storage capacity, directly manage traffic flow on the access road during migration periods (large convoys permitted when caribou are not close to the road).	-	✓	✓	Traffic Reduction Targets not met	Monitoring of traffic volumes (counts) and for conformance with associated traffic protocols.	Reduction of traffic volumes to 60% or less than average traffic levels	None
													Reduction of traffic volumes to 60% or less than average traffic levels not achieved	Implement further review of traffic reduction measures, taking additional actions where possible
CM0018	✓	✓	-	-	Change in Movement	Water management ditches will be designed, constructed and maintained to allow wildlife crossing opportunities	Install culverts and ground cover along water management ditches every 50 to 100 m to facilitate caribou crossings	-	-	✓	Based on Monitoring	Monitor via on-site monitoring and collar data to determine if caribou crossing over culverted ditches	Caribou observed (directly and/or through tracks/trail evidence) crossing culvert and non-culvert crossings without issue	None
													Caribou only crossing culvert locations (avoiding ditch crossing entirely)	Increase culvert crossings (frequency/length) in moderate to high use areas

Table 5.3 Tier 2 Mitigation Measures

Tier 2 Mitigation - To Be Implemented based on Monitoring (Adaptive Management to Tier 1 Mitigation)

	Project Phase							Tier 2 Implementation Period or Threshold				Tier 2 Monitoring		
Mitigation ID	Construction	Operation	Decommissioning	Post-closure	Potential Project Effects	Tier 1 Mitigation Measure	Tier 2 Mitigation Measure	Ongoing Measure	Migration period	Defined Threshold		Monitoring Approach or Action	Monitoring Outcomes	Response or Next Steps
										Applies	Threshold			
CM0019, CM0022	✓	✓	-	-	Change in Habitat	Visual and/or drone surveys for caribou will be undertaken prior to blasting for construction and operations. For construction blasting (civil works) and during pit development, which includes near-surface blasting, the search zone will be 1 km from the blast. After the pit perimeter is developed and blasting is more than 50 m below the pit crest (whereby noise and vibrations will be reduced for receptors) the clearance zone will be a 500 m buffer from the final pit perimeter. Blasting will be delayed if caribou are observed within these zones.	If caribou are detected outside the specified zone but within a 3 km radius of the blast, and visual monitoring of the caribou determines they have an adverse reaction to the blast event, further on-site monitoring and associated studies will be completed to assess a potential change in the thresholds for caribou proximity to a blast.	-	-	✓	Based on Monitoring	Regular reviews of collar data, visual and/or drone surveys will be utilized to determine if caribou are within the specified zone (increased based on Tier 2 - limit not determined) prior to blasting. Noise and ground vibration will be monitored via stations established at the site. If caribou are detected outside the specified zone but within a 3 km radius of the blast, visual monitoring of the caribou will be conducted to determine if they animal(s) have an adverse reaction to the blast event.	Caribou identified within the specified zone	Blasting operations suspended until caribou clear the zone
													No caribou identified within the specified blast zone and no caribou within a 3 km radius	None, blasting operations permitted
													No caribou identified within the specified blast zone; caribou within a 3 km radius but no adverse reaction to blast event	None, blasting operations permitted
													No caribou identified within the specified blast zone; caribou within a 3 km radius show adverse reaction to blast event	Increase blast clearance zone and continue monitoring

Table 5.3 Tier 2 Mitigation Measures

Tier 2 Mitigation - To Be Implemented based on Monitoring (Adaptive Management to Tier 1 Mitigation)

	Project Phase							Tier 2 Implementation Period or Threshold				Tier 2 Monitoring		
Mitigation ID	Construction	Operation	Decommissioning	Post-closure	Potential Project Effects	Tier 1 Mitigation Measure	Tier 2 Mitigation Measure	Ongoing Measure	Migration period	Defined Threshold		Monitoring Approach or Action	Monitoring Outcomes	Response or Next Steps
										Applies	Threshold			
CM0023	✓	✓	✓	-	Change in Movement	Activities in the Marathon pit area, including the Marathon waste rock pile, overburden and topsoil stockpiles, and low grade ore stockpile, that result in sensory disturbance to caribou (e.g., blasting, loading, hauling) will be suspended while caribou are migrating.	If caribou exhibit avoidance of the Project and associated components and choose alternate migration routes, further Project activity suspension will be implemented based on consultation with NLDFFA-Wildlife Division. As Project activities and the build-up of components (TMF, pit, waste rock pile) will increase over the first 4 to 5 years (2 years of construction plus early operations phase), the potential degree of disturbance to caribou or avoidance of the Project by caribou may be gradual over time. The monitoring program outlined in Section 6 of the CPEEMP will be critical to understanding the potential changes in caribou migration and behaviour and will be used to determine the degree of further Project activity suspension during the migration period, if required.	-	-	✓	Based on Monitoring	The full monitoring program described in Section 6 of the CPEEMP will be used to inform and monitor changes implemented to the Project activity suspension mitigation	Caribou return to migrating through or close to the baseline primary migration corridor	None
													Caribou exhibit continued or further avoidance of the Project and associated components and choose alternate migration routes	Tier 3 Mitigation - see table

Table 5.3 Tier 2 Mitigation Measures

Tier 2 Mitigation - To Be Implemented based on Monitoring (Adaptive Management to Tier 1 Mitigation)

	Project Phase							Tier 2 Implementation Period or Threshold				Tier 2 Monitoring		
Mitigation ID	Construction	Operation	Decommissioning	Post-closure	Potential Project Effects	Tier 1 Mitigation Measure	Tier 2 Mitigation Measure	Ongoing Measure	Migration period	Defined Threshold		Monitoring Approach or Action	Monitoring Outcomes	Response or Next Steps
										Applies	Threshold			
CM0024	✓	✓	✓	-	Change in Habitat	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.	Where standard mitigation for dust control at the TMF are determined to be insufficient through monitoring, additional measures will be applied to control dust based on an assessment of the source (area of the TMF) and cause (drying, mounding, insufficient deposition changes). Additional measures may include, but not be limited to, surface binders or temporary covers (synthetic, rock materials, or vegetation).	-	-	✓	Based on Monitoring	Inspection of the TMF with respect to exposed, dry surfaces; overall dust monitoring via dust monitoring stations erected at the site.	Exposed, dry surfaces not evident, no visual dusting during wind events, no dust monitoring exceedances	None
													Visual dusting during wind events, dust monitoring exceedances	Implement further measures associated with binders or covers
CM0025, CM0027, CM0028, CM0029	✓	✓	✓	-	Change in Habitat	Mitigation associated with dust control for: - process equipment and buildings - waste rock piles - topsoil and overburden stockpiles - roads and open-ground areas	If dust level monitoring indicates that dust levels are above the levels predicted in the EIS or the thresholds described in Section 5.2.3 of the CPEEMP, a detailed dust assessment will be conducted to assess the key source(s) and determine options to reduce levels	-	-	✓	Based on Monitoring	Project dust monitoring - see Section 5.2.3 regarding monitoring thresholds	Dust within defined thresholds	None
													Dust above defined thresholds	Implement further measures associated with dust control

Table 5.3 Tier 2 Mitigation Measures

Tier 2 Mitigation - To Be Implemented based on Monitoring (Adaptive Management to Tier 1 Mitigation)

	Project Phase							Tier 2 Implementation Period or Threshold				Tier 2 Monitoring		
Mitigation ID	Construction	Operation	Decommissioning	Post-closure	Potential Project Effects	Tier 1 Mitigation Measure	Tier 2 Mitigation Measure	Ongoing Measure	Migration period	Defined Threshold		Monitoring Approach or Action	Monitoring Outcomes	Response or Next Steps
										Applies	Threshold			
CM0031	✓	✓	✓	-	Change in Habitat	Temporary and permanent lighting will be minimized to that required for safe construction and operation activities, and incorporate the following mitigation: - exterior lights will be shielded from above where possible - mobile and permanent lighting will be located such that unavoidable light spill from the working area is not directed to receptors outside the Project Area, to the extent practical - use of mobile flood lighting units will be minimized and will be turned off when not required - full cut off luminaires will be used where practical to reduce glare, light trespass, and sky glow from Project lighting	If light level monitoring indicates that light levels are above the levels predicted in the EIS or the thresholds described in Section 5.2.3 of the CPEEMP, a detailed light assessment will be conducted to assess the key sources and determine options to reduce light levels	-	-	✓	Based on Monitoring	Project light monitoring - see Section 5.2.3 regarding light monitoring thresholds	Light levels within defined thresholds	None
													Light levels above defined thresholds	Implement further measures associated with light control

Table 5.3 Tier 2 Mitigation Measures

Tier 2 Mitigation - To Be Implemented based on Monitoring (Adaptive Management to Tier 1 Mitigation)

	Project Phase							Tier 2 Implementation Period or Threshold				Tier 2 Monitoring		
Mitigation ID	Construction	Operation	Decommissioning	Post-closure	Potential Project Effects	Tier 1 Mitigation Measure	Tier 2 Mitigation Measure	Ongoing Measure	Migration period	Defined Threshold		Monitoring Approach or Action	Monitoring Outcomes	Response or Next Steps
										Applies	Threshold			
CM0037	✓	✓	✓	-	Change in Mortality	Site inspection prior to the spring and fall migration periods to assess specific hazards that might present specific risk to caribou movement (as the site is changing over time, more rapidly during construction and closure phases). Project features (e.g., open pits, TMF, water management features) and areas/features under development or closure will be monitored during migratory periods and temporary fencing/barricades may be installed as needed to reduce risks to caribou.	Potential risks or hazards currently considered are addressed in Tier 1 and Tier 2 mitigations and these mitigation may be used to address identified issues, or additional mitigation may need to be developed for specific hazards or caribou responses. Additional mitigation may include temporary or permanent fencing, barriers or berms for exclusion from specific areas, or possibly to direct caribou away or towards a particular area of the Project, or aversive conditioning. Any options considered will be reviewed with NLDFFA-Wildlife Division prior to implementation	-	-	✓	Based on Monitoring	Camera and visual monitoring of the implemented options	Specific risks or hazards are addressed and no longer pose a risk to caribou	None
													Risks or hazards are not addressed based on monitoring of migrating caribou	Implement additional corrective or protective measures, if possible.

Table 5.4 Tier 3 Mitigation Measures

Tier 3 Mitigation - To Be Implemented based on Monitoring (Adaptive Management to Tier 2 Mitigation)

	Project Phase								Tier 3 Implementation Period or Threshold				Tier 3 Monitoring		
Mitigation ID	Construction	Operation	Decommissioning	Post-closure	Potential Project Effects	Tier 1 Mitigation Measure	Tier 2 Mitigation Measure	Tier 3 Mitigation Measure	Ongoing Measure	Migration period	Defined Threshold		Monitoring Approach or Action	Monitoring Outcomes	Response or Next Steps
											Applies	Threshold			
CM0023	✓	✓	✓	-	Change in Movement	Activities in the Marathon pit area, including the Marathon waste rock pile, overburden and topsoil stockpiles, and low grade ore stockpile, that result in sensory disturbance to caribou (e.g., blasting, loading, hauling) will be suspended while caribou are migrating.	If caribou continue to exhibit avoidance of the Project and associated components and choose alternate migration routes, another level Project activity suspension may be implemented based on consultation with NLDFFA-Wildlife Division. As Project activities and the build-up of components (TMF, pit, waste rock pile) will increase over the first 4 to 5 years (2 years of construction plus early operations phase), the potential degree of disturbance to caribou or avoidance of the Project by caribou may be gradual over time. The monitoring program outlined in Section 8.0 of the CPEEMP will be critical to understanding the potential changes in caribou migration and behaviour and will be used to determine the degree of further Project activity suspension during the migration period, if required.	If caribou continue to exhibit avoidance of the Project and associated components and choose alternate migration routes, additional levels Project activity suspension may be implemented based on consultation with NLDFFA-Wildlife Division. The monitoring program outlined in Section 6.0 of the CPEEMP will continue to be critical to understanding the potential changes in caribou migration and behaviour and will be used to determine the degree of further Project activity suspension during the migration period, if required.	-	-	✓	Based on Monitoring	The full monitoring program described in Section 6.0 of the CPEEMP will be used to inform and monitor changes implemented to the Project activity suspension mitigation	Caribou return to migrating through or very close to the baseline primary migration corridor	None
														Caribou exhibit continued or further avoidance of the Project and associated components and choose alternate migration routes	Implement further activity suspension and/or reduce sensory disturbance further
n/a	✓	✓	✓	✓	Change in Movement, Change in Mortality	n/a	n/a	Where effects monitoring (see Section 6.0) indicates potential or realized trends or changes in caribou movement or mortality, additional mitigation that would be under the control of the NLDFFA-Wildlife Division may be considered (e.g., a predator control program).	-	-	✓	Based on Monitoring	The monitoring approach for the specific mitigation (e.g., predator control) would be developed for that specific mitigation.	Monitoring outcomes would be determined based on the specific mitigation and monitoring program.	The response or next steps associated with the monitoring outcomes would be determined based on the specific mitigation and monitoring program.

5.2.1 Employee and Contractor Training and Orientation

Marathon will confirm that all Project personnel understand the potential environmental effects of the Project on caribou related to their specific work activities, as well as their roles and responsibilities in reducing potential effects, including protocols for on-site observations, mitigation measures, and legal requirements. Environmental orientation and ongoing awareness training orientation for Marathon employees and contractors will include a review of:

- Environmental management requirements, including the procedures outlined in this CPEEMP and the Construction Environmental Protection Plan and any revisions to these documents
- Environmental considerations
- Non-compliance and corrective actions
- Environmental contingency measures
- Incident reporting requirements
- Work subject to regulatory permit requirements
- Construction site rules and regulations
- Wildlife awareness training

Employees and contractors will receive orientation during the on-boarding process. Employees and contractors will be required to sign a form indicating they have reviewed and understand their role and responsibilities regarding this CPEEMP and the Construction Environmental Protection Plan.

Observations of wildlife sightings, including caribou, will be reported by all staff and contractors on-site and monitored by the on-site environmental manager. All observations of caribou (e.g., location, date, number of animals, caribou behaviour) will be recorded in a log book developed for the Project and will be included in semi-annual and annual monitoring reports (Section 8.1).

5.2.2 Caribou Encounters on Roads

The following protocols are to be followed by all drivers in any type of vehicle travelling on the access road, at any time of the year. Note that during the migration periods in spring and fall, speed limits will be reduced within the migration corridor – notifications will be provided to all employees and contractors and signage will be posted along the road indicating reduced speed limits and known crossing locations.

- Respect speed limits and watch the road for wildlife and other vehicles at all times

- Caribou (as well as other wildlife) will always be given the right of way on all Project roads.
- If a caribou is encountered on the road STOP as far back as possible, greater than 50 m is preferred:
  - Turn off the engine
  - Turn on the emergency flashers to warn other vehicles approaching from either direction
  - Radio or call site security to notify and request a notification be sent to other drivers, noting the location of the caribou

  - Wait until the caribou have crossed and moved away from the road before proceeding – proceed at a reduced speed (20 km/hr) until at least 100 m past the last location the caribou were visible on the road

While not a lot of open areas exist along the access road, the following protocols are to be followed where such conditions are encountered, and on mine site roads where open areas are more frequent:

- If a caribou is observed within 100 m of the road (250 m for haul trucks), slow down to 20 km/hr:
  - If the caribou are resting, feeding, or moving away from the road, proceed with caution and at reduced speed until at least 100 m past the location
  - If the caribou are moving towards the road STOP as far back as possible and turn off the engine
    - Turn on the emergency flashers to warn other vehicles approaching from either direction
    - Radio or call site security to notify and request a notification be sent to other drivers, noting the location of the caribou
    - Wait until the caribou have crossed and moved away from the road by 50 m (where visible) before proceeding – proceed at a reduced speed (20 km/hr) until at least 100 m past the last location the caribou were visible on the road
- If a caribou is observed greater than 100 m from the road (greater than 250 m for haul trucks):
  - If the caribou are resting, feeding, or moving away from the road, proceed as usual
  - If the caribou are moving towards the road:
    - Proceed with caution at reduced speed (20 km/hr)
    - Turn on the emergency flashers to warn other vehicles approaching from either direction
    - Radio or call site security to notify and request a notification be sent to other drivers, noting the location of the caribou

5.2.3 Sensory and Air Quality Thresholds

Noise emissions from the Project will be monitored regularly using sound recording equipment set up at distance intervals from Project activities selected based on topography and vegetation cover to confirm the noise level predictions in the EIS. Monitoring will specifically target noise levels relative to the primary caribou migration corridor and noise levels at greater distances from Project activities (5 to 10 km or greater) to measure noise levels that may affect both migrating and resident caribou. There are no provincial or federal noise thresholds for caribou, however, 40 dBA is typically used as a threshold for disturbance of caribou.

There are no provincial or federal light emission thresholds for caribou, and while there is literature on the effects of light on wildlife there is little or nothing on targets or thresholds. The International Commission on Illumination guidelines for sparsely populated rural areas could be considered as a possible target/threshold for light emissions for caribou at 0.1 lux, which is roughly equivalent to light levels during a full moon and can be measured by most light meters. Marathon will develop a light monitoring program that considers potential effects on caribou in consultation with NLDFFA-Wildlife Division.

Provincial and federal air quality standards (including dust) are provided in the EIS, Table 5.1. There are no wildlife-specific dust thresholds. Marathon will be required to complete an ambient air quality monitoring program, including the installation of real time air quality monitors as required by the Newfoundland and Labrador Department of Environment and Climate Change. Passive dustfall collectors, and monitoring of dust on vegetation can be used to monitor dust levels and associated contaminant levels for comparison with the Canadian Council of Ministers of the Environment guidelines where they exist (limited).

6.0 FOLLOW-UP MONITORING

Marathon is committed to long-term follow-up monitoring of mitigation effectiveness and Project effects on caribou. The follow-up monitoring described in this section complements the mitigation measures described above in Section 5.0. The follow-up monitoring plan presented herein includes monitoring approaches and actions which are expected to require refinement based on the collection of additional baseline data prior to construction, collection of follow-up and monitoring results as the Project advances, and ongoing review with the NLDFFA-Wildlife Division, scientific experts, Indigenous groups and stakeholders.

The CPEEMP has been developed in accordance with the "follow-up and compliance monitoring" requirements under Canadian Environmental Assessment Agency's Operational Policy Statement (Follow-up Programs under the *Canadian Environment Assessment Act*, 2012) and includes two types of monitoring:

- Effects (condition) monitoring will monitor the effects of the Project on caribou and will build on information gathered during baseline studies. Changes in performance indicators will be monitored at an appropriate scale (e.g., within the Project Area, LAA, and RAA, hereafter the study area) to measure Project-related effects on caribou (e.g., their distribution) and contribute to ongoing evaluation of the overall condition of caribou within the study area. Effects monitoring will also evaluate the effectiveness of mitigation designed to reduce predicted changes in caribou habitat, movement, and mortality risk and will include documenting the presence of caribou on-site, and other incidents (e.g., injury, mortality) that require a management response (e.g., incident investigation) or and adaptive management action (e.g., Tier 2 mitigation measure). Collectively this information will be used to monitor the accuracy of EIS predictions.
- Conformance monitoring will determine compliance with regulatory requirements and other environmental commitments made in the EIS, Information Requirement responses, and conditions of EA release and reported in the Environmental and Social Management System.

Evaluating the outcomes of the effects monitoring and compliance monitoring will identify the potential need for adaptive management measures to further mitigate Project effects.

6.1 KEY MONITORING QUESTIONS

Responses by caribou to disturbance are variable and can include a shift in individual home ranges to avoid overlap with the disturbed area (e.g., MacNearney et al. 2016), selection of previously unused habitat (Sawyer et al. 2006), seasonal avoidance (e.g., Boulanger et al. 2012), alteration of behaviors and group sizes in the vicinity of the disturbance (e.g., Weir et al. 2007), and a change in the timing and direction of migration (e.g., Mahoney and Schaefer 2002). As the viability of caribou populations across the country decreases with increasing habitat disturbance, the Amended Recovery Strategy for the

Woodland Caribou (*Rangifer tarandus caribou*), Boreal population, in Canada (ECCC 2020) suggests limiting the quantity of disturbed habitat within their ranges. Additionally, maintaining the functionality of migration paths by preserving connectivity between seasonal ranges is vital to sustaining viable populations of migratory ungulates (Monteith et al. 2018). Due to the overlap with a primary migration corridor, the Project is likely to cause changes to caribou habitat, movement, and mortality risk, which ultimately could affect caribou recruitment and/or survival. A summary of environmental effects on caribou and the associated risks are presented in Sections 3.0 and 4.0 of this document. The mitigation presented in Section 5.0, above, are intended to avoid or reduce potential adverse effects on caribou.

The follow-up effects monitoring program presented below is designed in consideration of predicted Project effects and associated risks to caribou. The following questions provide the foundation for the effects-based monitoring program.

Question 1: Has the Project affected movement patterns of the Buchans herd?

- Q1a. Has the Project caused a change in the timing and / or duration of migration of the Buchans herd occur through the Project Area?
- Q1b. Has the Project caused a change in the number or ratio (e.g., calf: cow) of Buchans herd caribou moving through the Project Area?
- Q1c. Have migrating Buchans caribou used alternate migration routes as a result of the Project development and operation?

Question 2: Have the seasonal distributions of the Buchans and Grey River herds changed?

- Q2a. Have the seasonal ranges changed compared to baseline (e.g., size, location)?
- Q2b. Have the calving ranges changed compared to baseline (e.g., size, area)?

Question 3: Have the Buchans and Grey River populations changed?

- Q3a. Were there changes in demographic (e.g., calf:female ratio; adult male:adult female ratio; group composition on the calving grounds)?
- Q3b. Were there changes in the population estimate for the Buchans herd on the calving grounds?

Question 4: How have caribou directly interacted with the Project over time?

- Q4a. Are there changes in the observations of caribou at the mine site (e.g., number, timing, frequency, locations)?
- Q4b. Are there changes in the observations of caribou on the Project access road (e.g., number, timing, frequency, locations)?
- Q4c. Are there changes in the Project-related caribou injuries or mortalities in the Project (e.g., number, timing, locations)?

6.2 EFFECTS MONITORING

The goal of the effects monitoring is to determine whether the proposed mitigation measures are effective, and the EIS predictions are correct. The monitoring plan establishes means to track changes in performance indicators to quantify Project effects on caribou and caribou habitat over space and time relative to the Project. Table 6.1 presents the performance indicators that will be used to measure caribou response level to predicted targets. Conservative targets are proposed to initiate action prior to exceedance of biologically meaningful thresholds.

Table 6.1 Performance Indicators that will be used to Measure Caribou Response Level to Predicted Targets

Residual Effect	Performance Indicator	Target	Threshold
Change in caribou movement (Buchans herd)	• Timing and duration of migration	• Change in timing and duration of migration within natural variations	• Trending towards considerable change in timing and duration of migration
	• Amount of time spent at stop-overs	• Change in amount of time spent at stop-overs is within natural variations	• Trending towards considerable change in amount of time spent at stop-overs
	• Number of caribou or composition of caribou groups moving through Project Area	• No change in number of caribou or composition of caribou groups moving through Project Area	• Trending towards a decreasing number of migrating caribou or group composition as compared to baseline • Evidence that animals attempting to migrate do not migrate
Change in caribou movement (Buchans herd)	• Use of alternate pathways	• Alternate pathways are used	• Animals using alternate pathways show evidence of “stress” that may have population consequence
Change in caribou mortality risk (interactions with mine-infrastructure)	• Number of caribou-vehicle collisions in the Project Area	• Zero caribou-vehicle collisions in the Project Area	• Any caribou mortality related to vehicle traffic or, equipment in the Project Area
Change in caribou mortality risk (interactions with mine-infrastructure)	• Number of caribou injuries or mortalities in and around site infrastructure (e.g., pits, ponds)	• Zero caribou injuries or mortalities in and around site infrastructure	• Any caribou injury or mortality related to infrastructure in the Project Area

Table 6.1 Performance Indicators that will be used to Measure Caribou Response Level to Predicted Targets

Residual Effect	Performance Indicator	Target	Threshold
Change in caribou mortality risk (landscape scale Project effects)	• Population demographics trends are not negatively influenced by the Project	• Calf:cow ratios remain at sustainable levels consistent with baseline conditions	• Trending towards a reduced calf:cow ratio
		• Adult males / 100 caribou remain at sustainable levels consistent with baseline conditions	• Trending towards a changing adult males / 100 caribou ratio
		• Calf survival rate remain at sustainable levels consistent with baseline conditions	• Trending towards a decline in calf survival rate
		• Population size remain at sustainable levels consistent with baseline conditions	• Trending towards a reduced overall population size

6.2.1 Spatial and Temporal Scales

The spatial scale of the CPEEMP will be the baseline distribution of the Buchans and Grey River herds based on 95% kernel density estimates from collared caribou. The kernels for the Buchans and Grey River herds will be based on ARGOS and GPS telemetry locations from available baseline until immediately before Project construction beings (2005-2022 for the Buchans herd and 2004-2022 for the Grey River herd). For each herd, seasonal ranges will be estimated using the dates in Table 6.2. The separate seasonal ranges will be used to determine changes and will be combined to estimate the overall baseline distribution. The temporal scale of the monitoring program is the construction phase (approximately 2 years), operation phase (approximately 13 years), closure and rehabilitation (approximately 2 years) and post-closure (2-6 years pending monitoring results).

Table 6.2 General Seasons for Island Caribou in NL

Season	Seasonal Dates
Winter	December 16 – March 31
Spring Migration / Pre-calving	April 1 – May 19
Calving	May 20 – June 10
Post-Calving Migration / Dispersal	June 11 – June 30
Post-Calving Rearing	July 1 – August 31
Fall Rut	September 1 – October 31
Fall Migration / Dispersal	November 1 – December 15
Source: Emera Newfoundland and Labrador (2013)	

6.2.2 Data Collection

Data collected during the monitoring program will be used to confirm effects predictions, which will be derived primarily from GPS telemetry collars deployed on Buchans and Grey River caribou, remote cameras around the Project Area, and aerial surveys of the Buchans calving grounds and calving grounds for resident caribou near the mine site. Prior to and during the migratory periods (caribou protection levels 2 and 4), review of caribou movement data (collars and cameras) will increase substantively, and on-site teams will be deployed to observe, record and inform when caribou approaching the site. Additionally, drones will be used to confirm animals in proximity of the Project Area during sensitive seasons and prior to blasting throughout the year. On-site personnel (Environment Manager) will gather information from any sightings, near-miss or incident reports, such as the number of caribou observed on site and potential Project interactions, for inclusion in the monitoring plan. At regular intervals during the monitoring program, new spatial information will be brought into the analysis (e.g., new imagery or vegetation layers, additional or new information on other landscape activities in the RAA).

The primary sources of data are described below.

GPS Collared Caribou

A review of other studies that have used GPS collars indicates that the reliability of results improves with the number of collared individuals (Börger et al. 2006). Peer-reviewed research programs that used the same analyses as will be used for collar data analysis as described in this CPEEMP (i.e., dynamic Browning Bridge Movement Modelling, Net Squared Displacement and kernel analysis) included from 8 to 54 telemetry collars in their analyses (Anderson et al. 2005; Sawyer et al. 2013; Byrne et al. 2014; Latham et al. 2014; Walter et al. 2015; Bastille-Rousseau et al. 2016; Hamilton et al. 2017; Monteith et al. 2018; Robb et al. 2019; Dewey and Schwabedissen 2020). Additionally, 20 to 30 collars have been shown to be effective for monitoring adult female survival rates and cow:calf ratios while also providing sufficient statistical power to detect population trends over at least a five-year period (Rettie 2017 in GNWT-INF 2020). Based on a literature review and professional judgment, at least 20 active collars on the Grey River herd, and 40 collars on the Buchans herd would be needed to provide a robust statistical analysis. As the collar program needs to consider the possibility of collar malfunction (Tomkiewicz et al. 2010) and mortality of collared caribou, additional collars for relatively rapid replacement of 'lost' collars, would be needed.

Thus far, Marathon purchased 60 GPS collars (Lotek Iridium 420w) to support the long-term monitoring program. These collar deployments, as well as future collar deployments, will be managed by NLDFFA-Wildlife Division.

Remote Cameras

Marathon deployed 12 remote cameras in fall 2019, spring 2020, and fall 2020, near the Project Area to collect information on caribou group size and composition, and to estimate the timing of spring and fall migration through the mine site. Marathon augmented this program in spring 2021 by adding fourteen additional cameras, and in fall 2021 by adding an additional five cameras. The intent of the augmented program was to further refine the timing and location of migration relative to the Project Area, while also obtaining information on other wildlife trails through or near the Project Area, including potential trails identified by least cost path (LCP) analysis (Attachment A in Caribou Supplemental Information Report [Appendix G to the EIS Amendment]). Remote camera deployment was guided by likely travel paths identified from light detection and ranging data; the migration path analysis (i.e., dynamic Brownian Bridge Movement Models (dBBMM) analysis) completed for the EIS; potential alternative paths identified by the LCP analysis; and comments from the Wildlife Division. Further information on deployment locations and the selection criteria for location selection is available in the remote camera reports (BSA.2 2-A, 2-B [Stantec 2021a]).

Much of the guidance on appropriate sample sizes for remote camera programs is based on faunal inventories, occupancy studies, and population estimates where camera placement may be random or deployed in an array (e.g., Rovero and Zimmermann 2016). Peer-reviewed studies recommended that a

sample size from 25 to 30 remote cameras is suitable for determining species richness, occupancy, and density and is considered sufficient to provide reliable estimates of changes in caribou movement through the LAA (Gillespie et al. 2015; Kays et al. 2020). The goal of the remote camera monitoring program has been primarily to gather information on caribou access points to the Project Area, refine the timing of caribou migration through the mine site, gather information on alternate paths and provide information on group size and group dynamics. Currently, there are 31 remote cameras deployed in the Project study area, which is within the range recommended in the literature.

As the thresholds that will trigger migration-specific mitigation measures have been developed (see Table 5.3), the camera deployment to monitor caribou proximity going forward will be evaluated further.

Aerial Surveys

The goal of post-calving aerial surveys is to provide an estimate of the size of the Buchans herd population on the calving grounds, and to determine caribou demographics (e.g., group size and composition) for resident Grey River caribou and for the Buchans herd on the calving grounds. A demographics survey was completed in June 2020 and June 2021, and a population estimate was completed for caribou on the Buchans herd calving grounds in June 2021. Transects were established in the post-calving survey area and surveyed by helicopter. Caribou were observed and classified from the transect lines using distance-sampling methods to estimate population size (Stantec 2021b). Future aerial surveys, which will use the same methods, will provide comparative information from the construction and operation phases.

On-Site Observations

Observations of wildlife sightings, including caribou, will be monitored by the on-site environmental manager. Programs and protocols will be developed to monitor on-site caribou observations and will include the following:

- Observations on-site (year round) – development of a log for personnel to record wildlife observations (e.g., location, date, caribou behaviour); will be compiled by the on-site Environmental Team
- Completing pre-migration surveys of all mine site areas looking for specific hazards that may exist at a given point in time as the site changes over time (construction and closure phases particularly).
- Caribou on-site observation team during migratory periods - this could include strategic vantage points of the primary corridor or select locations within the corridor proximate to primary paths
- Drones will be used to monitor caribou activity near the Project during sensitive seasons and pre-blast activities
- TMF monitoring – monitoring of TMF (with increased frequency during migratory periods) to assess caribou activity in the area and associated hazards to caribou

- Incident reporting – development of a protocol to record information about wildlife incident (e.g., nature of the incident, time, location, personnel involved) which may lead to a root cause analysis and response (e.g., corrective action)
- Education and training – Project personnel be educated and trained on the draft CPEEMP, protocols for on-site observations, mitigation measures, and legal requirements (Section 5.2 CPEEMP)

This information will be collected by the on-site environmental manager and incorporated in during the reporting cycles.

6.2.3 Methods

The key monitoring questions have been defined for the draft CPEEMP (Section 6.1). The following sections describe the approach that will used to address the key questions.

Throughout this monitoring program a series of data sources and modelling approaches will be used to better understand and predict movement patterns, seasonal patterns and overall population changes. Marathon will be approaching these models from an information theoretic framework. This will allow for the development of a candidate set of biologically defensible *a priori* models (Burnham and Anderson 2002) that consider both spatial and temporal covariates that have been reported to influence habitat selection and movement patterns of caribou (e.g., distance to roads, snow cover, ice-out date, NVDI, topography, Julian dates, proximity to disturbance and disturbance type), where appropriate. A candidate model set will be developed in consultation with NLDFFA-Wildlife Division and Akaike's information criterion will be used to evaluate competing models and find the best approximating model.

6.2.3.1 Movement Patterns (Buchans Caribou Herd)

Due to the overlap between the Project and the migration path used by the Buchans herd, the residual effect on change in movement for the Buchans herd is predicted to be high in magnitude and is considered likely to occur, as presented in section 4.0 of the CPEEMP. With implementation of mitigation measures, and given the uncertainties described in section 11.6 in the EIS, the residual adverse effect of change in movement for the Buchans herd is conservatively predicted to be significant. This determination is the key component of the first key effects monitoring question: Has the Project affected movement patterns of the Buchans herd?

Q1a - Has there been a change in the timing and / or duration of migration?

The timing and duration of seasonal migrations will be estimated using net squared displacement (NSD) (Bunnefeld et al. 2011, Sawyer et al. 2016) with adjustments to calculate mean squared displacement as described in Singh et al. (2016). Specifically, NSD measures the square of the straight-line distance between an animal's starting point and each subsequent location. NSD is a model-driven method that attempts to distinguish between migration movement and other movement types or strategies (e.g., resident, disperser) (Bunnefeld et al. 2011).

The start and end dates of annual spring and fall migrations will be identified to compare potential shifts in timing and/or duration of migration during construction and operation relative to baseline (pre-construction), while also considering natural factors like weather. Potential shifts in timing or duration or migration during construction and operations will be evaluated using the variation observed in the baseline data (e.g., start or end dates of migrations are outside 95% confidence interval or ± 2 standard deviations of baseline Julian dates).

Information about the timing and duration of seasonal migrations will also be obtained from the remote cameras. Remote camera photos will be reviewed using the program Timelapse v.2.2.3.9, which is an image analysis software program that extracts photograph metadata and facilitates the management of photo results (Greenberg 2021). Photos will be analyzed based on independent events identified from individual photo series. An event will be defined as beginning when an animal or group of animals (i.e., one or more animals) enter the frame and ending when the animal or group has exited the frame for more than two minutes (Stantec 2015; Rowcliffe et al. 2008). Collared caribou detected in the photos will be counted and group composition metrics calculated (i.e., group sizes, sex ratios, and age classes).

Using the camera data, the start of the peak movement period will be defined as the first Julian day the proportion of caribou detections exceeds 5% of the total detections for each migration and will end when the cumulative total exceeds 80% of caribou events. The mean Julian day will be calculated for each migration period (i.e., spring and fall), and the migration periods recorded during construction and operation phases will be compared.

The duration of migration will also be determined by calculating movement rates (km/day or m/h) during spring and fall migration. Movement rates will be calculated using GPS collared data to monitor potential changes in movement behaviour during construction and operation relative to baseline. Movement rates will also be compared to determine if GPS collared caribou increase or decrease their movement rate relative to the mine site and ZOI as well as approaching and crossing the access road. Because fix interval can affect movement rates, GPS collared caribou that have similar fix intervals will used in the analysis.

Q1b - Has there been a change in the number of caribou moving through the Project Area?

GPS collar data will be used to identify the number of caribou, and their paths, moving through the Project Area. The remote camera data will also provide information on the number and group composition of caribou moving through the area. Remote cameras have been deployed around the perimeter of the Project Area to collect information on caribou entry and exit locations to the mine site. The mean number of caribou events and number of caribou detected at the locations around the Project Area perimeter will be used to compare potential changes in relative abundance (e.g., number of detections/100 camera days) during construction and operations relative to baseline estimates.

Differences in relative abundance between baseline and Project phases will be compared using a repeated measures ANOVA with Project phase as a factor if statistical assumptions (e.g., normality) can be met. Otherwise, a non-parametric test for repeated measures (e.g., Freidman test) will be used. Differences will be considered statistically significant if $p < 0.05$, although a biologically meaningful change will be evaluated on the basis of effect size.

Information on the number of caribou observed in the mine site or on the access road will be collected by on-site personnel and compared between Project phases.

Q1c - Are migrating caribou using alternate pathways?

Spring and fall caribou migration paths during construction and operation will be estimated using a dBBMM (Kranstauber et al. 2012) to compare potential changes in seasonal migration paths to baseline paths. The dBBMM provides a probabilistic estimate of animal occurrence at each grid cell within the migration path by considering the distance and time between successive locations as well as location error and uncertainty of the movement path between locations (Horne et al. 2007; Kranstauber et al. 2012). The seasonal migration paths during the construction and operation phases will be compared to baseline paths. The analysis will follow similar methods described by Sawyer et al. (2013) and Blum et al. (2015), focusing on the following components:

- identify potential changes in the location or size of the seasonal migration corridors.
- determine whether migration paths overlap the LCP options as previously identified.
- determine if there are new alternate or priority migration paths.
- identify potential changes in the number and /or size of seasonal stop-overs.

The utilization distributions estimated from the dBBMMs for the construction and operation phases will be compared to baseline, possibly by determining the amount of overlap in the seasonal ranges between phases (e.g., Fieberg and Kochanny 2005). Baseline will be established from available data up to the last migratory period prior to the initiation of construction.

The remote camera deployment locations were selected to overlap likely wildlife trails, areas identified by the baseline dBBMM, and LCP options identified by the Caribou Alternate Migration Pathway Analysis. The mean number of caribou events and number of caribou detected will be used to compare potential changes in relative abundance during construction and operations relative to baseline estimates. Differences in relative abundance (e.g., number of detections/100 camera days) between baseline and Project phases will be compared using a repeated measures ANOVA with Project phase as a factor if statistical assumptions (e.g., normality) are satisfied. Alternatively, a non-parametric test for repeated measures (e.g., Freidman test) will be used. For each analysis, differences will be considered statistically significant if $p < 0.05$, although a biologically meaningful change will be evaluated on the basis of magnitude of the effect.

6.2.3.2 Seasonal Distribution (Buchans and Grey River Caribou)

As described in the EIS (11.2.2.1), the assessed caribou herds undergo seasonal movements between ranges and intermix on winter ranges with other herds. The Buchans herd moves between ranges and migrates from central Newfoundland during spring to wintering areas on the south coast, where they interact primarily with the Grey River herd. Although not considered migratory, the Grey River herd have a seasonal range relatively near the Project. Changes in these seasonal ranges could indicate Project and is therefore the basis of the second primary question in the effects monitoring program: Have the seasonal distributions of the Buchans and Grey River herds changed?

Q2a - Have the seasonal ranges changed compared to baseline (e.g., size, area)?

Kernel or range density estimates will be used to describe the location, area, and seasonal range use of collared caribou (see section 11.2.1.3 of the EIS). Using the GPS collar data, caribou seasonal utilization distributions will be determined using the kernel density estimation method in ArcGIS™ v.10.7.1 (ESRI 2017) using Kernel Density in the Spatial Analyst Tools in ArcGIS™. Two contour intervals (isopleths) will be calculated for each seasonal range: a 50% contour area that represents the "core area" where caribou live, and a 95% contour area that representations the estimated seasonal home range boundary. Smoothed cross-validation will be used as the smoothing parameter for the calculation. The seasonal ranges during construction and operation will be compared to baseline, (Marathon has committed to updating the baseline conditions with all available information pr-construction), possibly by determining the amount of overlap in the seasonal ranges between phases (e.g., Fieberg and Kochanny 2005).

Q2b - Have the calving ranges changed compared to baseline (e.g., size, area)?

Kernel density estimates will be used to describe the calving range for the Buchans and Grey River caribou herd using a similar analysis as described above. The calving range during construction and operation will be compared to baseline calving ranges by comparing the degree of overlap (e.g., Fieberg and Kochanny 2005).

6.2.3.3 Population Change

As presented in the EIS section 11.2.2.1, although recent surveys indicate that population estimates of some herds in the south coast sub-population may be stabilizing (Government of NL 2019a), research also indicates that caribou populations on the Island of Newfoundland continue to be limited by poor calf survival (Government of NL 2015) and, subsequently, poor recruitment rates. For the herds that most directly interact with the Project, population studies have been on-going and will continue. These efforts are the foundation of the third key effects monitoring question: Have the Buchans and Grey River populations changed?

Q3a - Are there changes in the demographic parameters (e.g., calf:female ratio, adult male:adult female ratio) and group composition on the calving grounds?

Caribou will be counted and classified annually during the June aerial survey of the calving grounds. The demographics observed during the construction and operation phases will be compared to baseline conditions (June 2020 and 2021). Potentially meaningful changes, biologically or statistically, will be analyzed using appropriate tests (e.g., ANOVA; t-test; z-test).

Q3b - Are there changes in the population estimate for the Buchans herd on the calving grounds?

Population estimates will be completed yearly on the Buchans herd calving grounds. The population trends during the construction and operation phases will be compared to the baseline conditions (June 2020 and 2021). Potentially meaningful changes, biologically or statistically, will be analyzed using appropriate tests (e.g., ANOVA; t-test; z-test), although more complex population models may be needed to understand drivers of population change if they occur.

6.2.3.4 Caribou Interaction with the Project

Marathon has employed a systematic approach to the assessment of potential mitigation measures that consider all Project phases, the potential effect pathways, and the range of caribou responses and levels of response to the Project features and activities as presented in Section 5.0. The mitigation measures are intended to reduce potential risk to caribou. The fourth effects monitoring question is focused on the interactions of caribou with the Project: How have caribou directly interacted with the Project over time?

Q4a - Are there changes in the observations of caribou within the mine site (e.g., number, timing, frequency, locations)?

As described in Section 4.2.5.1, information about the number of caribou interacting with the mine site will be determined from observation data collected by on-site personnel, the GPS collar data, and remote camera data. The number, timing, frequency, and location of caribou interactions in the construction and operation phases will be tracked. Annual differences in the observations of caribou in the mine site between during Project phases will be evaluated using a parametric test if statistical assumptions (e.g., normality) can be met. Otherwise, a non-parametric test will be used. Differences in caribou observations may also be described qualitatively.

Q4b - Are there changes in the observations of caribou on the Project access road (e.g., number, timing, frequency, locations)?

Data collected by on-site personnel, the GPS collar data, and remote camera data pertaining to caribou use of the access road during the construction and operation phases will be summarized annually. The occurrences, trends and changes over time of observations of caribou on the access road will be recorded and evaluated using a parametric test if statistical assumptions (e.g., normality) can be met.

Otherwise, a non-parametric test will be used. Differences in caribou observations may also be described qualitatively.

Q4c - Are there changes in Project-related caribou injuries or mortalities in the Project Area (e.g., number, timing, locations)?

Observational data on Project-related caribou injuries or mortality will be recorded and investigated to determine any trends.

If there are either 'near miss' occurrences or injuries/fatalities of caribou related to Project activities (access road or site), an incident response will be triggered to determine the root cause of the occurrence. The mitigation measures in place to reduce the likelihood of this type of occurrence have associated monitoring protocols and thresholds for adaptive management actions, see Table 5.2.

7.0 ADAPTIVE MANAGEMENT

Marathon will use an adaptive management framework that allows for adjusting mitigation measures and management actions in response to monitoring results. The adaptive management framework establishes a process to evaluate monitoring outcomes relative to desired goals for specific mitigation measures as well as broader Project effects.

While construction activities related to site development will result in full footprint development in some areas of the site, the largest Project components (e.g., the open pits, waste rock piles, overburden and ore stockpiles, TMF) will be only partially developed during construction and will not be fully developed until several years into operations. It is anticipated that follow-up and monitoring activities completed during the construction and early development period will provide valuable information on potential change in caribou movement and interactions with respect to the Project and the effectiveness of proposed mitigation measures. This information will then be used to determine if adjustments to mitigation measures, or the adoption of new mitigation measures, is required.

The premise of adaptive management is to use a cycle of planning, implementation, monitoring, and analysis / learning to systematically determine whether mitigation measures are effective relative to the goals and objectives, while allowing for adjustments to mitigation when monitoring results indicate that the goals and objectives are not being achieved. Marathon is committed to working with the NLDFFA-Wildlife Division, scientific experts, Indigenous groups and stakeholders to implement mitigation measures, undertake follow-up and monitoring activities, and adapt mitigation measures as applicable to avoid or reduce Project-related effects on caribou migration and population.

Marathon's conceptual adaptive management framework is presented in the mitigation tables located in Section 5.0 where proposed mitigation measures to be implemented are presented in Table 5.3 with the associated monitoring, monitoring outcomes (assessment) and next steps. Where adaptive management

may be required to address goals or objectives that are not achieved, the refined or new mitigation are presented in Table 5.4.

The adaptive management framework includes the basic elements of Plan, Act, Monitor, Assess, and Revise, which function together under a feedback system. This framework is inherently linked to each mitigation measure, and broadly to each monitoring objective and question. The basic elements are illustrated in Figure 6-1 and summarized as follows:

- Plan: states the goal and is supported by targets and performance indicators
- Act: the 'doing' of specific actions, such as implementing one or more mitigation measure
- Monitor: seeks to collect data/information on the performance indicators and to report on those measures in respect of the targets
- Assess: allows for evaluation of the effectiveness of a mitigation measure in terms of meeting the target. Typically, measures that meet or exceed the target will result in no change to the Plan, whereas measures that do not meet the target will be reviewed in detail to identify the root cause of the deficiency and to identify adjustments or corrective measures to meet the target. The Assess element can include consultation and engagement regarding monitoring results and proposed corrective actions
- Revise: the process of implementing changes, as necessary, that were identified in the Assess element. The Revise element circles back to the Monitor and Assess elements as part of understanding whether the corrective actions are effective at achieving the stated goal.

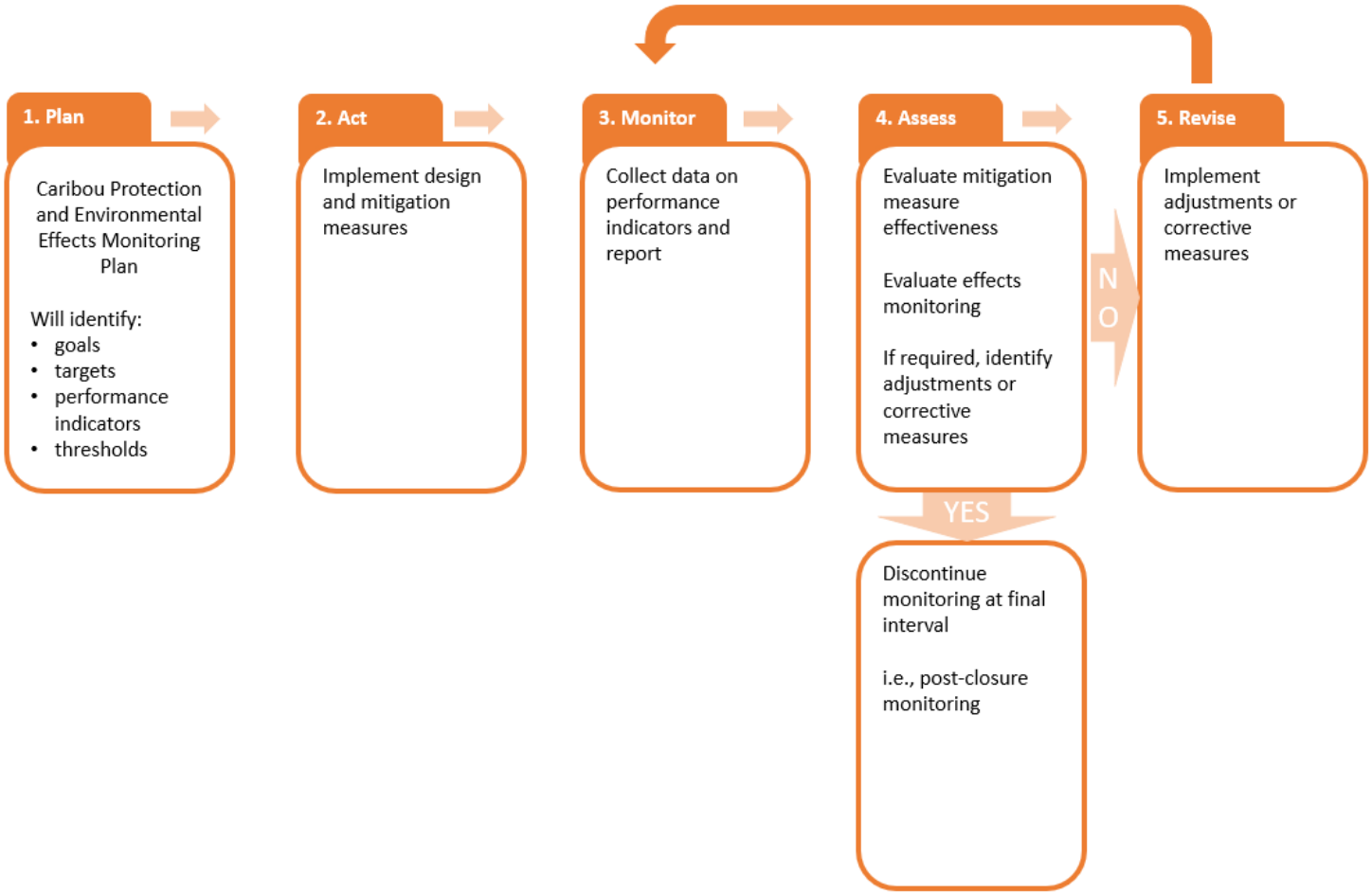


Figure 7-1 Adaptive Management Framework for the CPEEMP

8.0 MONITORING REPORTS

The specific schedule and format for monitoring reports will be reviewed in consultation with the NLDFFA-Wildlife Division and the reports will be made available to NLDFFA-Wildlife Division, Indigenous groups and stakeholders. The reports will contribute to adaptive management strategies to address potential Project effects on caribou habitat, movement, and mortality risk.

Field reports from camera surveys, aerial surveys, direct (visual) monitoring and on-site observations will be presented semi-annually, following completion of the field activities. These reports will include field data and preliminary analyses, as applicable, and will flag any potential issues or concerns. The field programs will be consolidated in an annual report that will include:

- A summary of remote camera and collar data results from the migration (spring or fall)
- Group composition and distribution (Grey River and Buchans caribou), and the population estimate (Buchans caribou) results from the aerial survey of the calving grounds (part of spring report)
- A summary of caribou observations from on-site personnel and monitoring
- Recommendations for changes in approaches for mitigation measures, if required

As noted, the collar data will be assessed following each migratory season, to identify any indications of changes in migratory patterns and timing. Given that the models utilize substantial datasets over greater time periods, comprehensive model runs will occur at two-year intervals and will present results from the GPS collar data [i.e., change in movement patterns (e.g., dBBMM, NSD); and change in seasonal distribution (kernel analysis)]. The associated, comprehensive report will also present comparisons between the most recent two-year period and the earlier monitoring periods for the purpose of identifying potential trends. The reports will contribute to adaptive management strategies to address the effectiveness of mitigation to reduce potential Project effects and risk to caribou.

Annual reports will also be prepared that will present the results of the on-going Project monitoring programs (e.g., noise, dust, lighting, traffic levels, effluent). This will be used to monitor compliance with regulatory requirements and other environmental commitments made in the EIS, IR responses, and conditions of EA release. Information from these programs will also inform the caribou-specific reports. The reporting schedule may be modified as the Project progresses and based on monitoring requirements identified by regulators (related to air quality and water) or through continued consultation with NLDFFA-Wildlife Division.

8.1 MONITORING AND REPORTING ACTIVITIES

To gather the required data to answer the key questions posed through the monitoring program described in Section 6.0, the primary means of data acquisition, the associated scope, tasks and frequencies are presented in Table 8.1.

Table 8.1 Monitoring Program Requirements and Schedule

Analysis/Program	Scope	Project Phase Breakdown and Schedule
Analysis requiring Telemetry Data		
Collaring – Grey River and Buchans Herds	Minimum 60 active collars divided between Buchan (n=40) and Grey River (n-20) herds	**Baseline Phase** • Collar purchase and deployment • Update baseline conditions **Construction Phase** • Replace malfunctioning and offline collars as soon as reasonable possible to maintain the present number of active collars. • Every 3-4 years – collar replacement/refurbishment • Download and process collar data (frequency will depend on the time of the year), report twice annually **Operational Phase** • Replace malfunctioning and offline collars as soon as reasonable possible to keep total number of active collars at 60. • Every 3-4 years – collar replacement/refurbishment **Download and process collar data, report twice annually Closure and Rehabilitation Phase** • Replace malfunctioning and offline collars as soon as reasonable possible to keep total number of active collars at 60. • Download and process collar data (frequency will depend on the time of the year), report twice annually **Post-closure Phase** • Replace malfunctioning and offline collars as soon as reasonable possible to keep total number of active collars at 60. • Every 3-4 years – collar replacement/refurbishment • Download and process collar data (frequency will depend on the time of the year), report twice annually • Continue monitoring and collar maintenance for at least three complete annual migrations.

Table 8.1 Monitoring Program Requirements and Schedule

Analysis/Program	Scope	Project Phase Breakdown and Schedule
Assess Change in Movement	Regular monitoring of collar function and caribou locations (e.g., bi-weekly during non-sensitive periods, daily during sensitive periods). Qualitative – description of broad presence across the landscape and updates on collar status. Quantitative - statistical movement analysis for each Project phase and statistical comparison among phases Approach: Identify changes in patterns of migration, including timing, duration, location, changes in behavior etc. Browning bridge movement modelling	**Baseline** • Baseline will be updated with all available information prior to start of construction • **Construction Phase** • Movement analysis for construction, approximately 2 years (ideally two of each migratory periods) • Seasonal summary of movements • Reports detailing movements and comparing to baseline **Operational Phase** • Seasonal summary of movements • Reports detailing movements and comparing to baseline and construction Biennial movement analysis for early operation period **Closure - Rehabilitation Phase** • Seasonal summary of movements • Reports detailing movements annually post-operations **Post-closure Phase** • Continue monitoring and collar maintenance for at least three complete annual migrations • Annual reports for at least three complete annual migrations

Table 8.1 Monitoring Program Requirements and Schedule

Analysis/Program	Scope	Project Phase Breakdown and Schedule
Assess impacts on calving caribou	Quantitative – determine seasonal ranges and compare over time Approach: Monitor and identify changes in use of traditional calving areas using kernels to compare calving locations Quantitative – statistical movement analysis (e.g., DeMars Model – kernel analysis) and comparison over time Possible Approach: Compare calving timing	**Baseline** • Baseline will be updated with all available information prior to start of construction (ranges and timing of calving) **Construction Phase** • Seasonal range and calf timing analysis for construction, approximately 2 years (ideally two of each season) • One analysis and report detailing any changes in seasonal use areas and determination of calf-timing **Operational Phase** • Biennial analysis and report for operation period **Closure - Rehabilitation Phase** • Annual summary of seasonal ranges **Post-closure Phase** • Annual reports for at least three complete annual migrations
Original research to refine timing and duration of spring and fall migration periods, and the calving and post calving periods (guidelines pg.48)	Quantitative - statistical analysis Possible Approach: Identify seasonal timing and duration for each season using Net Squared Displacement (NSD).	**Baseline** • Baseline will be updated with all available information prior to start of construction **Construction Phase** • Seasonal timing, individual and herd for construction 20-24 months (ideally two of each season) • One report detailing any changes in seasonal use areas and determination of calf-timing • Operational Phase Biennial analysis and report of seasonal use ranges **Closure - Rehabilitation Phase** • One report detailing seasonal use areas and calf timing two years post-operations **Post-closure Phase** • Annual analysis and reports for at least three complete annual migrations

Table 8.1 Monitoring Program Requirements and Schedule

Analysis/Program	Scope	Project Phase Breakdown and Schedule
Programs Requiring Aerial Surveys		
Post-Calving Surveys – Resident and Buchans	Monitor changes in birth and recruitment, and relate these to population trends Results from calving surveys within 'Zone of Influence' Qualitative – comparison of rates over time (e.g., yearly or from construction to operation phases) Buchans Aerial survey of 'complete Buchans range' Population estimate and cow/calf ratio	**Baseline** • Baseline will be updated with all available information prior to start of construction **Construction Phase** • Annual overflights • Annual reports detailing population estimates and ratios, analysis of changes over time and relative to baseline **Operational Phase** • Annual overflights • Annual reports detailing population estimates and ratios, analysis of changes over time and relative to baseline and construction **Closure and Rehabilitation – Phase** • Annual overflights (two years) • Annual reports detailing population estimates and ratios, analysis of changes over time **Post-closure Phase** • Annual overflights for at least three calving seasons • Annual reports detailing population estimates and ratios, analysis of changes over time

Table 8.1 Monitoring Program Requirements and Schedule

Analysis/Program	Scope	Project Phase Breakdown and Schedule
Program Requiring Remote Cameras		
Migratory group sizes and composition	To collect information on caribou group size and composition, and to supplement collar information on the timing of spring and fall migration through the mine site Results may require adjustment to locations of camera set-ups	**Baseline** • Baseline will be updated with all available information prior to start of construction **Construction Phase** • Annual reporting detailing group size, composition movements and timing **Operational Phase** • Annual reporting detailing group size, composition movements and timing **Closure and Rehabilitation Phase** • Annual reporting detailing group size, composition movements and timing **Post-closure Phase** • Annual reporting detailing group size, composition movements and timing comparing for at least three complete migratory seasons

9.0 ADDITIONAL INFORMATION

Marathon is committed to the mitigation and monitoring program described above and working with NLDFFA-Wildlife Division, Indigenous groups, and stakeholders to protect caribou through the avoidance and reduction of potentially adverse Project-related effects. Marathon understands that there is a need to provide operational and financial support to assist the NLDFFA-Wildlife Division monitor and assess information related to the Valentine Gold Project.

Marathon is committed to:

- Adhering to the mitigation and monitoring program as described in the CPEEMP
- Working directly with NLDFFA-Wildlife Division, Indigenous groups, and stakeholders to implement the plan and respond to results in a timely and transparent manner
- Working as a partner to deliver the commitments made in this and other documents that may stipulate Project conditions of approval.

While addressed above, Marathon reaffirms the commitment to review and update this CPEEMP in collaboration with NLDFFA-Wildlife Division based on the data collected via monitoring.

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APPENDIX A

Revision Log and Distribution List

CONTROLLED COPY DISTRIBUTION LIST

Marathon	Individual or Location

REVISION HISTORY LOG

Version	Date Issued	Revision Notes

REVISION REQUEST FORM

SECTION TO BE REVISED:

NATURE OF REVISION:

RATIONALE FOR REVISION:
(i.e., environment/worker safety, etc.)

SUBMITTED BY:

Please submit request to the Marathon Gold Corporation Environmental Manager, Environmental Superintendent or Environmental Coordinator.

APPENDIX B

Camera and Collar Timing Data