Appendix 9-B

Denison Mines Corporation
Wheeler River Project

Terrestrial Environment
Wildlife and Vegetation Baseline Inventory

January 2020 Update

OMNIA
ECOLOGICAL SERVICES

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Wheeler River Project

Terrestrial Environment
Wildlife and Vegetation Baseline Inventory
-2019 DRAFT REPORT UPDATE-

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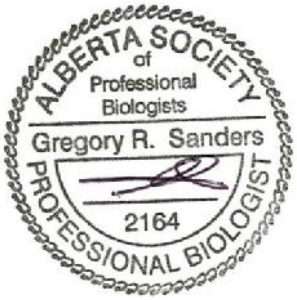

January 2020

OMNIA ECOLOGICAL SERVICES

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1.0 INTRODUCTION

1.1 Study Background and Objectives

Omnia Ecological Services (Omnia) was retained by Denison Mines Corporation (Denison) in September 2016 to collect terrestrial (wildlife and vegetation resources) baseline data in support of the proposed development of the Wheeler River Project. The terrestrial baseline data was originally collected to support future pre-feasibility studies, technical assessments, project layout and environmental effects assessments related to the development of the Gryphon and Phoenix uranium deposits and associated infrastructure. However, in 2019 the focus was narrowed to the Phoenix development only.

The objectives of the terrestrial baseline surveys were to:

- Characterize the existing terrestrial environment in the Project Area
- Inform pre-feasibility engineering design work
- Inform environmental effects and technical assessments
- Establish a framework to facilitate future environmental effects monitoring
- Support the development of project specific mitigation strategies

This report documents and summarizes baseline ecological land classification, baseline anthropogenic disturbance, wildlife elements including: avian, terrestrial, semi-aquatic furbearers and amphibians, and baseline chemistry of soil, vegetation, and small mammals obtained during field programs completed from 2016 to 2019. In addition, local Indigenous land user information has been collected to inform and supplemental baseline field surveys where possible.

1.2 Study Area

The Denison Wheeler River Project is located along the eastern edge of the Athabasca Basin in northern Saskatchewan and is located approximately 35 km north-northeast of the Key Lake mill and 35 km southwest of the McArthur River uranium mine. The terrestrial baseline surveys were stratified into two nested study areas, a Local Study Area (LSA) and a Regional Study Area (RSA). The original study areas were based on both the Gryphon and Phoenix developments; in 2019 both the LSA and RSA were adjusted to focus on the Phoenix development only. The LSA was 48 km^2 and sized to account for direct effects of the Phoenix project as well as a sensory buffer (1.7 km) for the proposed mine access road options and mine site(s) development. The RSA was 400 km^2 and was designed to capture potential cumulative effects of the project on a subregion (including species with large home ranges), and included areas with potential to be affected directly or indirectly as well as suitable reference areas. The RSA was also used to provide context to support future impacts assessments on valued ecosystems components (Figure 1.2-1).

1.3 Ecological Setting

Ecoregion

The LSA and RSA fall entirely within the Athabasca Plain Ecoregion. The Athabasca Plain Ecoregion occurs in the northeastern portion of the Boreal Shield Ecozone in Saskatchewan, extending south from Lake Athabasca to Cree Lake and as far west as the Alberta border (Acton *et al*. 1998).

Landforms and Soils

The extent and type of vegetation in this area is greatly influenced by landform type. Topography is more subdued (low relief) in this ecoregion than elsewhere in the Canadian Shield, due to flat-lying sandstone bedrock and almost continuous cover of sandy glacial deposits. Distinctive landscape features of this ecoregion include large areas of kame and kettle topography with sandy-till moraines and areas of active sand dunes. Numerous lakes occur, while rivers are generally small and uncommon. Glaciation has left a lasting imprint on this area which is reflected in thin soils and irregular relief. Surficial materials are mainly composed of an undulating to strongly rolling discontinuous drift plain. Eskers and drumlins are common terrain features. Sandy and gravelly Podzols, Brunisols, and Luvisols occur on till materials, while sand and sandy loam Brunisols have developed on glaciofluvial deposits. Organic soils, Cryosols, and Mesisols are characteristic of lowland depressions. Discontinuous permafrost may also be present in the area (Acton *et al*. 1998).

Regional Vegetation

Stands of jack pine with a ground cover of lichen occupy the dry sandy sites. Mixed stands of jack pine and black spruce occupy moist sites such as topographic lows. White spruce, aspen, and balsam poplar are rare but can occur. Open jack pine (*Pinus banksiana*) forests with a thin cover of lichen are common and dominate the uplands but black spruce (*Picea mariana*) forests can also occur. Blueberry (*Vaccinium myrtilloides*) is the most prevalent ground cover species in the uplands. Black spruce, and to a lesser extent tamarack, are the dominant forest types in poorly drained lowland situations including bog and fen areas. Labrador tea (*Rhododendron groenlandicum*) is the most common ground cover plant in low sites. Areas of birch (*Betula papyrifera*) and willow (*Salix spp.*) do occur but these are generally limited to riparian areas along streams and rivers. Fire is common across the region resulting in extensive areas which are at various stages of regeneration (Acton *et al*. 1998).

Regional Wildlife

Vertebrate wildlife species known, expected or with the potential to occur within the Denison Wheeler River project area are presented in Appendix 1. The list of species with potential to occur within the Denison Wheeler Project area was developed using information from previous studies in the area (Rio Tinto 2014, Cameco 2013), regional and provincial references (SKCDC 2019b, Smith 1996 and Banfield 1974), field data collected in support of this project and the author's experience. All species observed during field investigations were denoted in Appendix 1 and all

provincial and federal sensitive or at-risk species designations included (SKCDC 2019b, GOC 2019, SkMOE 2017.)

2.0 BASELINE FIELD INVESTIGATIONS

2.1 Anthropogenic, Fire and Predictive Ecosite Mapping

Anthropogenic, fire and predictive Ecosite mapping was created/compiled and refined for the Denison Wheeler River LSA and RSA.

The objectives of this mapping were to:

- Provide an Ecosite map (and supply by type) for characterizing the study areas and to support analysis of terrestrial wildlife-Ecosite affiliations
- Provide baseline anthropogenic disturbance mapping for the Wheeler River Project area
- Provide baseline vegetation cover/fire mapping to support project planning
- Provide baseline vegetation cover mapping for monitoring and/or assessment of impacts

2.1.1 Anthropogenic Mapping

Methods

To develop baseline anthropogenic mapping for the LSA and RSA a two-step procedure was used. First, the Environment and Climate Change Canada (ECCC) national level anthropogenic mapping was downloaded and clipped to the study area boundaries (ECCC 2015). Second, to improve the resolution and ensure completeness, all visually discernible anthropogenic features in the Denison Wheeler Project area were digitized at a scale 1:5,000. To support this process and enhance the final product, a combination of 2018 project specific ortho-photography, Landsat Imagery (2018) and Map Info Microsoft Bing Imagery (2018) were used to visually identify anthropogenic features. Industrial Clearings (polygons) were hand drawn based on imagery, and all linear features were digitized as lines and buffered to create polygons as per the widths detailed below:

- Cutline: 1.75 m
- Right-of-way (ROW): 2.5 m
- Trail: 4 m
- Rough Road: 5.5 m
- Road: 10 m
- Transmission ROW: 40 m
- McArthur-Key Haul Road: 40-60 m

The digitized features were layered according to the following priority (where the layers overlapped, the above layer stamped out the layer below):

1. Industrial Clearing
2. McArthur-Key Haul Road
3. Transmission ROW

4. Road
5. Rough road
6. Trail
7. Cutline
8. ROW

Results

The results of the anthropogenic mapping for the LSA and RSA are displayed in Figure 2.1-1. Using the refined anthropogenic map product (unbuffered), the total amount of anthropogenic disturbance was 2.0 km^2 (0.04%) in the LSA and 6.1 km^2 (0.02%) in the RSA (Table 2.1-1). Industrial Clearings, Roads, and Cutlines were the most common anthropogenic disturbance types in the LSA.

Per the ECCC (2015) mapping, the density of unbuffered linear feature disturbances is 1.04 km per km^2 in the LSA and 0.42 km per km^2 in the RSA (Table 2.1-2). A comparison of the refined anthropogenic mapping versus the unbuffered EC (2012) linear feature data set found the refined LSA map had a linear feature density 7.8 times higher than the ECCC (2015) data set. Comparatively, the refined RSA anthropogenic map had a linear feature density that was 9.5 times greater than ECCC (2015). As noted above, refined anthropogenic mapping indicated seven linear feature types in the Denison Wheeler Project area, while the ECCC (2015) data set detected three types (road, cutline and transmission line). This difference was as a result of the approach and scale (1:30,000) of the mapping completed by ECCC (2015).

The results of the updated and improved anthropogenic footprint including 500m buffer were compared to the buffered ECCC (2015) anthropogenic data set (Table 2.1-3). The refined anthropogenic map for the LSA resulted in total linear disturbance of 47.4 km^2 (99.1%), versus the ECCC (2015) dataset including 32.8 km^2 (69.1%) linear disturbance. For the RSA the refined anthropogenic footprint was 331.4 km^2 (82.8%) compared to 129.3 km^2 (32.3%) using the ECCC (2015) dataset.

2.1.2 Fire Mapping

Methods

Historical fire data (mapping) was obtained from the Saskatchewan Ministry of Environment (SkMOE), Wildfire Management Branch (Jones 2019). The fire data spans from 1945 to 2018 and is provided as a shapefile. The data was downloaded, clipped and overlaid onto the Denison Wheeler Project area. The mapped fire polygons include water bodies therefore; the hydrological layer developed by NRCAN (2017) was used to exclude water polygons. The resulting imagery was then queried to analyze fire history for the LSA and RSA. The data is presented as percent burned area as a function of the study areas and percent burn of the terrestrial study areas.

The coarse level of fire polygon mapping does not account for residual patches (unburned areas) within the larger fire polygon, typically this results in an over estimation of total hectares burned (Kansas et al. 2016). The interpreted Ecosite mapping (Section 2.1.3) delineates residual patches and therefore provides a more accurate delineation of burned areas within the LSA and RSA.

Results

A total of 7 fires have occurred in the Denison Wheeler Project CRSA since 1945. The age of these fires ranges from recent (2008) to 46 years (Table 2.1-4). The historical fires that have occurred within the RSA are displayed in Figure 2.1-2.
Fires in the LSA:

- Two fires occurred within the LSA during the last 40 years (Table 2.1-4, Figure 2.1-2).
- The two fires covered 19.4 km^2, which equates to 40.9% of the LSA (including water) and 45.0% of the terrestrial area only.

Fires in the RSA:

- Six fires have occurred in the RSA historically. Five of these fires have occurred within the last 40 years (Table 2.1-4, Figure 2.1-2).
- These five fires covered 223.4 km^2, which equates to 55.9% of the RSA (70.6% of the terrestrial area only).

2.1.3 Ecosite Mapping

2.1.3.1 Predictive Ecosite Map (PEM)

Methods

Predictive Ecosite Mapping (PEM) was obtained from the Saskatchewan Technical Branch to support the creation of an Ecosite map for the study area. To further refine and assess mapping accuracy, a ground truth component was included in the baseline field studies.
A total of 2,352 field sampling/ground truthing sites were used, where Ecosite delineation was completed. The sampling sites provided the supporting data for expanding, refining and accuracy assessment of the PEM for the LSA and RSA.
Field sampling/ground truthing sites included data from:

- Ungulate pellet group/browse availability survey: 1,596 locations
- Small mammal trapping program: 389 locations
- Vegetation/Ecosite characterization survey: 154 locations
- Songbird survey: 101 locations
- Linear feature regeneration assessment program: 46 locations
- Ground control points: 56 locations
- Soil/lichen program: 10 locations

Approximately half of the locations from the ungulate pellet group/browse availability survey (n=723) were used for the map accuracy assessment. The remaining locations were set aside to support Ecosite mapping in the event that the PEM was found to have insufficient accuracy. The ground control points were overlain onto the mapped Ecosites to assess accuracy of the predictive Ecosite map.

Results

Predictive Ecosite map accuracy was 28.4% or 205 of 723 correct ground control points. The main reason for this inaccuracy is that McLaughlan *et al*. (2010) did not describe forest types under 40 years of age in their Ecosite classification system. Since 70.6% of the RSA is mapped as having

burned within the last 40 years (see Section 2.1.2), the majority of the study area was covered by regenerating forests that are not described by the McLaughlan *et al*. (2010). The PEM was therefore not suitable on its own to map the Ecosites in the LSA and RSA.

2.1.3.2 Interpreted Ecosite Map

Methods

To create a refined Ecosite map to accurately outline the current Ecosites (including regenerating stages) in the LSA and RSA, a combination of the existing PEM and alternative sources including Landsat Imagery (2018), Bing and Google Earth Imagery (2017-2018) were utilized. Visual interpretation was guided by field data not used for the accuracy assessment. The resulting Ecosite map was completed at a 1:20,000 scale.

The regenerating land cover types less than 40 years old, which did not match any of the Ecosites described by McLaughlan *et al*. (2010), were categorized based on vegetation height and therefore broadly on stand age, following methods outlined by Skatter *et al*. (2017). The categories were grouped as low shrub (< 1m tall, approximately 5–20 years of age), tall shrub (1–5m tall, approximately 20–40 years of age), and treed (> 5 m tall, approximately 30–50 years of age). The categories were further divided into two vegetation types (bog and coniferous) based on moisture regime (upland versus lowland).

Results

The accuracy of the resulting Ecosite map, taking into consideration the newly created regenerating forest "Ecosite types" was 70.7%, and included 23 different land cover classifications (Figure 2.1-3). The most abundant land cover types in the RSA were RF2-C (regenerating coniferous forest) (26.2%), BS3 (jack pine / blueberry / lichen) (25.8%), and water bodies (20.9%). These three land cover types accounted for 72.9% of the RSA. The most abundant land cover types in the LSA were RF2-C (regenerating coniferous forest) (38.4%) and BS3 (jack pine / blueberry / lichen) (33.8%), accounting for 72.2% of the LSA (Table 2.1-5).

The Ecosite map outlined several areas of unburned residual patches that were mapped as burned in the fire map provided by SkMOE (Figure 2.1-2). Findings from other studies in the region have documented this as well. Kansas *et al*. (2016) studied the potential for residual fire patches to occur in the Saskatchewan Boreal Shield and documented that 25% of the area within mapped fire polygons was unburned (excluding water, which accounted for 8% of the area). Residual patches therefore can make up a considerable amount of the landscape within this region. Notwithstanding, refined project specific mapping demonstrates that that 43.4% of the LSA and 37.6% of the RSA has burned within the last 40 years.

2.2 Ecosite Characterization, Plant Structural Diversity, and Species Richness Assessment

The purpose of the detailed vegetation and wildlife habitat characterization field surveys was to describe and quantify the ecological and botanical conditions within recurring mapped Ecosite types and regeneration forests. By sub-sampling sites representative of each mapped Ecosite type and regeneration stage, information was obtained to describe, evaluate and map the relative ecological importance and integrity of landscapes in the study area. The data collected at sampling

sites also allowed for an evaluation of structural and compositional diversity and species richness components. Data on wildlife habitat included information regarding downed woody debris, standing dead tree (snag) frequency, diameter and decay class, and hiding cover (horizontal foliar diversity).

Structural diversity is a measure of the manner in which species are arranged vertically into categories within an ecosystem (Kimmins 1997). Vegetation structure is therefore based on size and physical features (e.g. trees, tall shrubs, forbs, etc.) rather than taxonomy. The structural complexity of an ecological community is positively correlated with the diversity of animal life (Meffe *et al.* 1997). This is especially true for vertebrate wildlife species that require unique and variable reproductive, forage, and cover opportunities or "niches" for survival and reproduction. Areas with high structural diversity also tend to provide greater amounts of hiding cover.

The number of species present and their relative abundance are measures of species diversity and richness (Kimmins 1997). A fundamental principle of conservation biology is to protect sites that support high levels of local "species richness" (the number of organisms present in an area) (Noss 1990; Council on Environmental Quality 1993). Ecosystems that support a high level of diversity of plant species tend to be structurally diverse and productive (Meffe *et al*. 1997) and these areas in turn support a wide variety and abundance of insect and animal forms.

2.2.1 Methods

Data Collection for Ecosites and Regeneration Forests

In order to describe and classify the vegetation cover types, data for five main vegetation components and four structural components were collected:

Vegetation components:

1) Woody plants
2) Graminoids
3) Forbs
4) Bryophytes
5) Lichens

Structural components:

1) Standing dead trees (Snags)
2) Course woody debris (CWD)
3) The percent cover of bare soil, rock, and open water
4) Foliar and horizontal hiding cover

Woody plants were segregated by tree and shrub layer. These were further divided into the following five sub-layers:

A) Trees were defined as *all* woody plants greater than 5 m tall. Within the tree layer, three sub-layers were recognized:

A1) Super canopy - included the tallest trees of the main canopy, which may be veterans of one or more fires, or the tallest trees of the same age class as the main canopy (usually a minor portion of the stand composition).

A2) Main tree canopy (co-dominant trees) - the main layer of tree cover, composed of trees whose crowns form the upper layer of foliage; typically the major portion of the stand composition.

A3) Sub-canopy trees - included trees greater than 5 m high that do not reach the main canopy. These may form a distinct secondary canopy and were often a mixture of trees of various heights younger than those in the main canopy, or they were suppressed trees of the same age.

To be defined as a multi-layer tree stand, tree layers had to differ by 2 m before being defined as a separate layer.

B) The shrub layer included all woody plants less than 5 m tall. Established tree species regeneration less than 5 m in height was considered part of the shrub layer. Two sub-layers were recognized:

B1) Tall shrub layer - included all woody plants 1-5 m tall, including shrubs and advanced tree regeneration and trees in poorly growing stands where the canopy was less than 5 m high.

B2) Low shrub layer - included all woody plants less than 1 m height. This layer included dwarfed or immature specimens of species normally considered in tall shrub or tree layers (Figure 2.2-1).

Graminoids (Gr) were defined as grasses and grass like species such as sedges and rushes. Forbs (Fo) were defined as herbaceous flowering plants that were not graminoids. Bryophytes (Br) include mosses and liverworts, whereas lichens (Li) were limited to terrestrial lichen species.

Snags were defined as standing dead trees greater than 10 cm diameter at breast height (DBH), and 2 meter in height. These were categorized into species and stages of decay based on criteria developed by Lee *et al.* (1995) (Figure 2.2-2). Course woody debris comprised any deadfall greater than 10 cm in diameter.

Each vegetation/wildlife habitat plot sampling site consisted of a main plot (30 m x 20 m); five 1 x 1 m sub-plots; and five 20 x 50 cm sub plots (Figure 2.2-3), see Skatter *et al.* 2014 and Charlebois *et al*. 2015 for details. A 30 m tape was laid out to establish the start and end points of the sample site. The main plots comprised a 10 m band on either side of the 30 m transect. The 1 x 1 m sub-plots were placed at 5 m intervals along the sampling transect, and the 20 x 50 cm sub-plots were placed within the 1 x 1 m sub-plots. UTM locations for the start and end points of the 30 m transect were recorded, and a photograph was taken of each sampling site.

Data for tree layers and the tall shrub layer, as well as snag info were collected in the main 30 m x 20 m plots. Each tree layer was assigned its own species composition, percentage canopy closure, median height, and DBH. Tree core samples were taken to determine the age of representative trees for each layer. The percentage canopy closure and median height of tall shrub species within the 30 x 20 m main plot were measured. The number and decay class (Lee *et al.* 1995) of CWD intercepts along the 30 m tape were recorded. In each of the 1 x 1 m sub-plots the percent covers of each low shrub, forb and graminoid species were recorded. In the 20 x 50 cm sub-plots percent covers of bryophyte and lichen species as well as bare soil, rocks and open water were estimated. Plant species that could not be identified in the field were collected, pressed, and provided to a plant taxonomist for identification. The level of hiding cover afforded by vegetation within each vegetation cover type was measured using methods developed by Nudds (1977). A canvas cloth with ten alternating 25 x 30 cm bands of white and red paint at heights of from ground level to 2.5 m was held up and viewed in four cardinal directions at a distance of 15 m from the plot centre (Figure 2.2-4). The percentage of each of the ten bands that was hidden by vegetation was estimated to the nearest 10%.

Data Presentation for Ecosites and Regeneration Stages

A detailed description of each of the Ecosite types sampled is provided in the form of a two-page fact sheet. The first fact sheet contains information about species composition and vegetation layers. The second sheet provides information about structural attributes and ratings as well as biodiversity information and Ecosite supply. An example of each of the two fact sheets is provided in Figure 2.2-5 and Figure 2.2-6. Instructions on how to read the fact sheets are provided below.

An identification banner at the top of each fact sheet provides the Ecosite code [1] and the Ecosite name followed by the number of sampling plots completed [2] (Figure 2.2-5). The codes and names follow McLaughlan *et al.* (2010). For habitats that did not match any of the Ecosites described in McLaughlan *et al.* (2010), a two letter and one number code was assigned. These were predominantly the post fire regenerating stages. These would in most cases be classified as BS3(jack pine/blueberry/lichen) or BS2 (lichen/felsenmeer- bedrock), however as McLaughlan *et al* (2010) do not describe forests younger than 40 years, there are a high portion of areas that would be excluded because there are large areas of young forest in the project area. By describing each regeneration stage, these younger forests and their attributes will be described in detail.

The name of the Ecosite conveys information about the ecology of the unit, as the species and soil conditions used to name the site are diagnostic of the Ecosite (McLaughlan *et al.* 2010). A sample photograph [3] taken from one of the plots for each Ecosite provides a pictorial representation of the site. A short text description [4] of the Ecosite is provided under the Ecosite Description heading. This description is usually taken directly from McLaughlan *et al.* 2010, with additional study area specific comments where applicable.

A bar graph [5] is used to depict the mean percent cover of each vegetation layer. The Species and Vegetation Layer Info section [6] provides the average, minimum, and maximum number of plant and lichen species per sample plot. Detailed botanical and structural information for each vegetation layer in the Ecosite is provided in two separate tables. The first table provides information (total number of species observed; average crown closure; mean tree height; mean

diameter at breast height (DBH); species composition; year of origin) for each tree layer (A1, A2, and A3).

The second table provides botanical and structural information for all remaining vegetation layers, including: total number of species observed; characteristic species; and, average percentage cover.

On the second fact sheet the Structural Attributes and Relative Rating table [7] provides information about snags (mean number per plot; mean snag diameter; mean snag height; and mean snag decay class); course woody debris (CWD) (mean frequency per plot; mean diameter; and mean decay class); and mean percent cover of litter, bare soil, bare rock and open water (Figure 2.2-6). A bar graph [8] is displayed to show the vertical distribution of hiding cover for the Ecosite. Each bar represents the average hiding cover for each 25 cm layer. The overall average hiding cover (for all vertical layers) per Ecosite is presented at the top of the graph.

Section [9] of the second fact sheet page provides information about structural diversity (value), species richness (average number of species per plot), and unique and rare species occurrences (total numbers observed per Ecosite). A rating for each of these values is provided in a separate column.

Section 10 (Ecosite Supply) shows the relative proportion of LSA and RSA occupied by the Ecosite. Section 11 (Ecological Interpretations) is taken primarily from McLaughlan *et al*. (2010). It provides a written description of how the site may respond to disturbances such as fire, harvesting, etc. It may also include a predicted successional trajectory of the Ecosite.

Plant Structural Diversity and Species Richness Assessments

A structural diversity index value was calculated for each sampled Ecosite using a Shannon-Wiener coefficient. This calculation took into account the number of vegetation layers present in each plot as well as the percent cover of each layer. Due to similarity in height, bryophytes and lichens were considered as one layer. A mean value for each Ecosite was calculated. The higher the number of cover and evenness of vegetation layers present, the higher the structural diversity value.

To estimate and rank the relative plant and lichen species diversity among the different Ecosite types in the Wheeler River LSA, two species richness measures were used. The two measures of diversity are based on plant and lichen species data collected during the field survey in the LSA. The first measure, total species richness of Ecosite types, was developed by dividing the total number of plant species found in sampling plots by the number of plots completed per Ecosite. A second diversity metric was a count of the number of plant species that were unique to each Ecosite type. It was assumed that unequal sample size did not affect the probability of finding unique species. Both types of measures were ranked-ordered by Ecosite and rated from Low to High.

2.2.2 Results

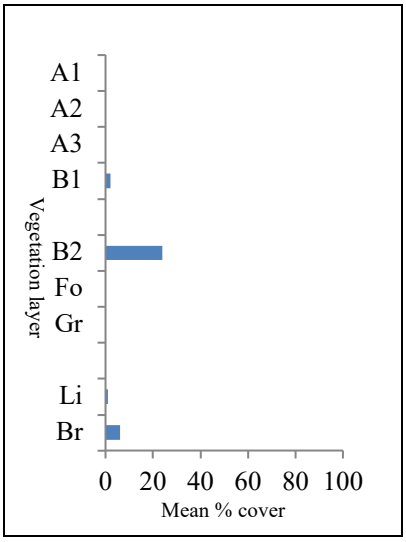
Vegetation and wildlife habitat characterization field surveys were completed between July 7 and July 16, 2017. Sample site locations were widely distributed throughout the study area (Figure 2.2-7), with a focus on the LSA. A total of 194 species and/or genus of spp. were recorded during the vegetation field survey. A list of all plant and lichen species is provided in Appendix 2.

A total of 78 vegetation/wildlife habitat sampling plots were completed in the Wheeler River Project area. From two to five sample plot sites were completed in each Ecosite. Based on species composition and structural attributes, a total of 20 distinct Ecosite types or regeneration forest types were identified:

Code	Type
RF3	Regenerating forest - low shrub dominated
RF2	Regenerating forest - tall shrub dominated
RF1	Regenerating forest - tree dominated
BS3	Jack pine/blueberry/lichen
BS4	Jack pine - black spruce/feathermoss
BS7	Black spruce/blueberry/lichen
BS9	Black spruce - jack pine/feathermoss
BS16	Black spruce/balsam poplar/river alder swamp
BS17	Black spruce treed bog
BS18	Labrador tea shrubby bog
BS19	Graminoid bog
BS20	Open bog
BS21	Tamarack treed fen
BS22	Leatherleaf shrubby poor fen
BS23	Willow shrubby rich fen
BS24	Graminoid fen
BS25	Open fen
BS26	Rush sandy shore
BS27	Sedge rocky shore
DL1	Disturbed lands - vegetated

Plot sampling was not completed for Waterbody (LK) and Disturbed lands – non vegetated (DL2), hence no Ecosite Fact Sheets were developed. Fact sheets for each of the remaining 20 Ecosite types are provided below.

RF3 Regenerating forest – low shrub dominated (n=4)



Ecosite Description

The RF3 regeneration stage is a pioneer stage following forest fires, and is therefore low shrub dominated. Blueberry and jack pine are the most common low shrub species, although cranberry is found in some plots. There are scattered tall shrubs as well, including black spruce and jack pine. The ground is characterized by a high percentage cover of bare soil and litter. Forbs, graminoids, mosses and lichens are virtually absent. The average age of this stage is 12 years in the study area.

Species and Vegetation Layer Info

Average number plant and lichen species per plot (min, max): 6 (3, 11)

Tree Layer Info:

Tree Layer	Total # Species	Crown Closure	Mean Height	Mean DBH	Species Composition	Year of Origin
A1 (n=0):						
A2 (n=0):						
A3 (n=0):						

Lower Vegetation Layer info:

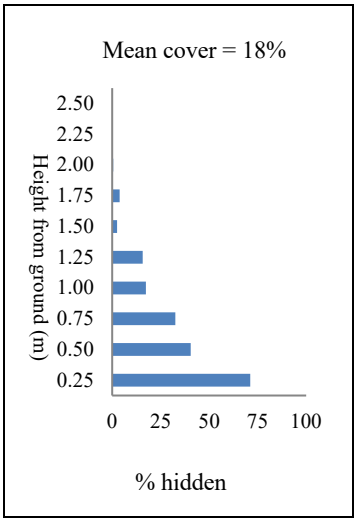
Vegetation Layer	Total # Species	Percentage Cover	Species Composition*
B1	2	2%	Pinuban10
B2	2	24%	Vaccmyr5 Pinuban5
Forb			
Graminoid			
Lichen	9	1%	Cladcor3 Cladmit2 Claddef1 Cladfim1 Cladsp.1 Parmamb1 Vulppin1
Bryophyte	1	6%	Polyjun10

*Only including species that constitute 10% or more by composition.

RF3 Regenerating forest – low shrub dominated (n=4)

Structural Attributes and Relative Rating

Structural Component	Attribute	Value	Rating
Snags	Mean # of snags/plot	0.8	Moderate
	Mean snag diameter (cm)	11.2	
	Mean snag height (m)	3.4	
	Mean snag decay Class	3.0	
Course Woody Debris	Mean frequency of CWD	0.5	Low
	Mean CWD diameter (cm)	10	
	Mean CWD decay class	3.0	
Mean Percent Ground Cover	Litter Cover	42.6	High
	Litter Depth (cm)	0.6	Low
	Bare Soil	49.8	High
	Bare Rock	0.0	Low
	Open Water	0.0	Low

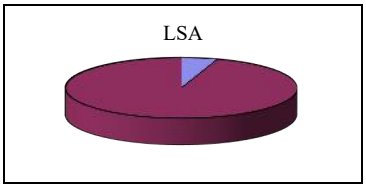


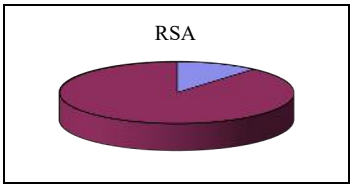
Structural Diversity, Species Richness, and Unique and Rare Species Occurrence Evaluation

Attribute	Value	Rating
Structural diversity	0.7	Low
Species richness	6	Low
Unique species	0	Low
Provincially listed species	0	Low
Unique species observed: None		
Provincially listed species observed: None		

Ecosite Supply

Areas occupied by the RF3 ecosite comprised 237.1 ha (5%) of the LSA and 4536.9 ha (11.3%) of the RSA.

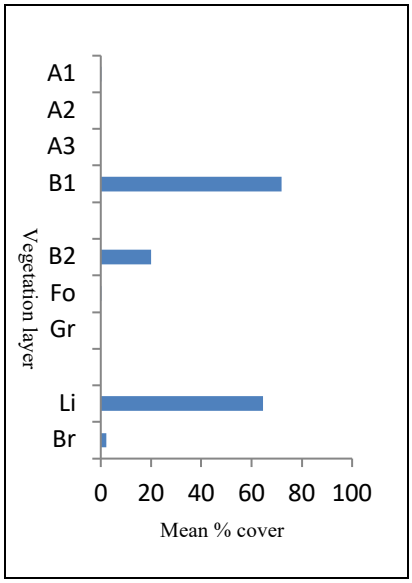




Ecological Interpretation

This is a commonly encountered ecosite in the study area. They are associated with the hills of eskers and drumlins as well as level plains. RF3 ecosites are poor in plant and lichen species diversity. The RF3 ecosite is a pioneer stage following forest fires, and will succeed towards RF2 in absence of fire.

RF2 Regenerating forest – tall shrub dominated (n=4)



Ecosite Description

This regeneration stage is usually dominated by a thick cover of tall jack pine shrubs. Some areas have residual patches of trees within. The low shrub layer is dominated by blueberry. The dominant ground cover is reindeer lichen. The average age of this phase is 36 years in the study area.

Species and Vegetation Layer Info

Average number plant and lichen species per plot (min, max): 15 (10, 21)

Tree Layer Info:

Tree Layer	Total # Species	Crown Closure	Mean Height	Mean DBH	Species Composition	Year of Origin
A1 (n=1):	1	<1%	6.0 m	5.0 cm	Pj10	1988
A2 (n=0):						
A3 (n=0):						

Lower Vegetation Layer info:

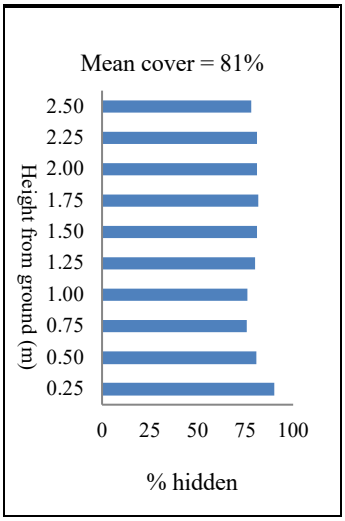
Vegetation Layer	Total # Species	Percentage Cover	Species Composition*
B1	3	72%	Pinuban10
B2	8	20%	Vaccmyr7 Ledugro1 Chamcal1
Forb	2	<1%	Corncan8 Lycoann2
Graminoid			
Lichen	16	65%	Cladmit9
Bryophyte	5	2%	Pleusch5 Polyjun4 Polypil1

*Only including species that constitute 10% or more by composition.

RF2 Regenerating forest – tall shrub dominated (n=4)

Structural Attributes and Relative Rating

Structural Component	Attribute	Value	Rating
Snags	Mean # of snags/plot	0.0	Low
	Mean snag diameter (cm)		
	Mean snag height (m)		
	Mean snag decay Class		
Course Woody Debris	Mean frequency of CWD	0.3	Low
	Mean CWD diameter (cm)	11.0	
	Mean CWD decay class	3.0	
Mean Percent Ground Cover	Litter Cover	33.0	High
	Litter Depth (cm)	1.1	Moderate
	Bare Soil	1.3	Low
	Bare Rock	0.0	Low
	Open Water	0.0	Low

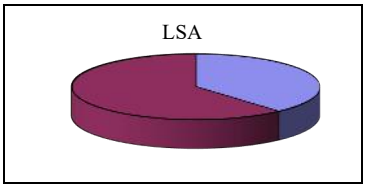


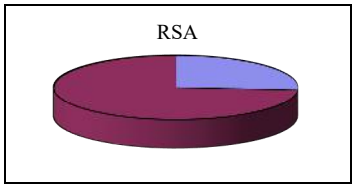
Structural Diversity, Species Richness, and Unique and Rare Species Occurrence Evaluation

Attribute	Value	Rating
Structural diversity	1.0	Low
Species richness	15	Moderate
Unique species	1	Low
Provincially listed species	0	Low
Unique species observed: Wooden soldiers (*Cladonia botrytes*)		
Provincially listed species observed: None		

Ecosite Supply

Areas occupied by the RF2 ecosite comprised 1822.5 ha (38.4%) of the LSA and 10480.5 ha (26.2%) of the RSA. It is the most common ecosite in the area.

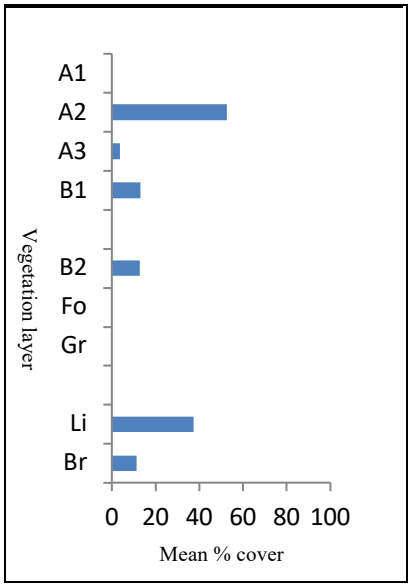




Ecological Interpretation

RF2 ecosites are relatively poor in vascular species diversity. However, lichen diversity is relatively high. They closely resemble the RF1 ecosite but are generally younger. As the case is for RF3, this is a commonly encountered ecosite on the Boreal Shield. They are associated with the hills of eskers and drumlins as well as level plains. The RF2 ecosite succeeds the RF3 ecosite, and will continue to succeed towards RF1 in absence of fire.

RF1 Regenerating forest – tree dominated (n=4)



Ecosite Description

RF1 rgeneration stage is usually jack pine dominated. Blueberry and bog cranberry shrubs can be found beneath the tree canopy, along with jack pine and the occasional black spruce and Labrador tea. Bryophytes are sporadically distributed and the dominant ground cover is reindeer lichen. This phase is on average 40 years old in the study area.

Species and Vegetation Layer Info

Average number plant and lichen species per plot (min, max): 16 (13, 18)

Tree Layer Info:

Tree Layer	Total # Species	Crown Closure	Mean Height	Mean DBH	Species Composition	Year of Origin
A1 (n=0):						
A2 (n=6):	2	53%	7.2 m	7.6 cm	Pj10	1980
A3 (n=1):	1	4%	5.8 m	5.7 cm	Pj10	1987

Lower Vegetation Layer info:

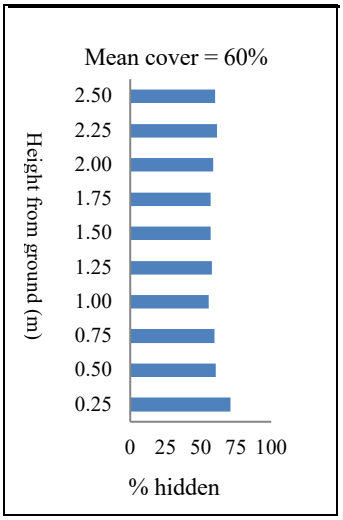
Vegetation Layer	Total # Species	Percentage Cover	Species Composition*
B1	3	13%	Pinuban6 Alnucri3 Picemar1
B2	3	13%	Vaccmyr8 Vaccvit1 Ledugro1
Forb			
Graminoid			
Lichen	20	37%	Cladmit9
Bryophyte	7	11%	Pleusch9

*Only including species that constitute 10% or more by composition.

RF1 Regenerating forest – tree dominated (n=4)

Structural Attributes and Relative Rating

Structural Component	Attribute	Value	Rating
Snags	Mean # of snags/plot	0.0	Low
	Mean snag diameter (cm)		
	Mean snag height (m)		
	Mean snag decay Class		
Course Woody Debris	Mean frequency of CWD	1.8	High
	Mean CWD diameter (cm)	11.5	
	Mean CWD decay class	5.7	
Mean Percent Ground Cover	Litter Cover	50.4	High
	Litter Depth (cm)	1.1	Moderate
	Bare Soil	0.0	Low
	Bare Rock	0.0	Low
	Open Water	0.0	Low



Structural Diversity, Species Richness, and Unique and Rare Species Occurrence Evaluation

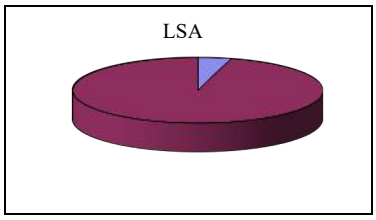
Attribute	Value	Rating
Structural diversity	1.3	Moderate
Species richness	16	Moderate
Unique species	0	Low
Provincially listed species	0	Low

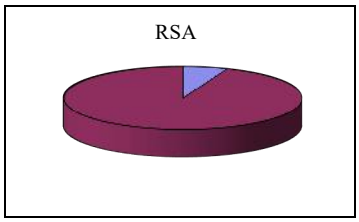
Unique species observed:
None

Provincially listed species observed:
None

Ecosite Supply

Areas occupied by RF1 comprised 199.3 ha (4.2%) of the LSA and 2401.8 ha (6.0%) of the RSA.

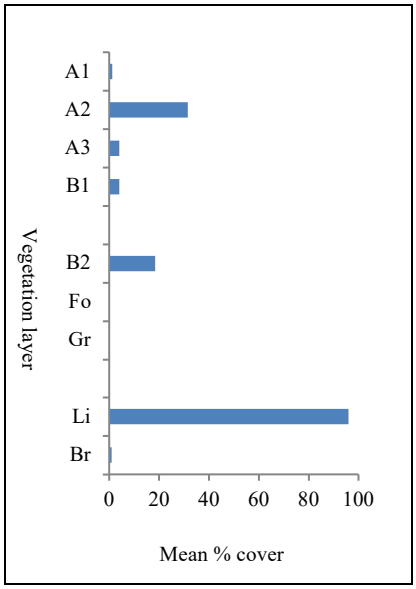




Ecological Interpretation

RF1 ecosites have a moderate structural diversity and high species richness. They closely resemble the RF2 ecosite but RF1 sites have a greater structural diversity and canopy closure. RF1 can be considered to be in a more advanced successional stage than RF2, and will (if wild fires are absent) succeed towards a BS3 or BS7 over time.

BS3 **Jack pine/blueberry/lichen: Moderately fresh sand** (n=4)



Ecosite Description

BS3 is dominated by jack pine in the overstory. The vascular plant understory is relatively sparse but includes Labrador tea, blueberry, and bog cranberry. Herbs are virtually absent. The forest floor is covered with reindeer lichen. Lichen species diversity is high. The age for this ecosite ranges from approximately 80 years old in the study area.

Species and Vegetation Layer Info

Average number plant and lichen species per plot (min, max): 17 (15, 19)

Tree Layer Info:

Tree Layer	Total # Species	Crown Closure	Mean Height	Mean DBH	Species Composition	Year of Origin
A1 (n=0):						
A2 (n=5):	1	27%	9.2 m	13.4 cm	Pj10	1938
A3 (n=6):	2	2%	7.2 m	9.0 cm	Pj9 Sb1	1962

Lower Vegetation Layer info:

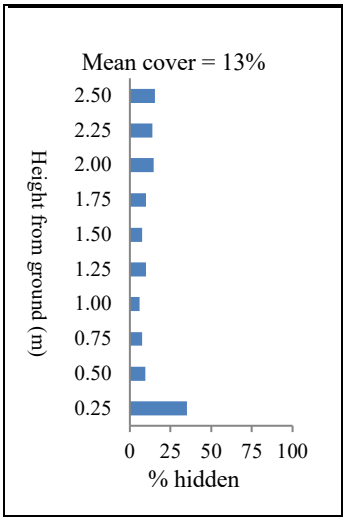
Vegetation Layer	Total # Species	Percentage Cover	Species Composition*
B1	2	4%	Pinuban10
B2	6	18%	Vaccmyr7 Vaccvit2 Ledugro1
Forb			
Graminoid			
Lichen	20	96%	Cladmit6 Cladunc2 Cladste1
Bryophyte	5	1%	Polypil6 Pholnut2 Polyjun1 Dicrpol1

*Only including species that constitute 10% or more by composition.

BS3 Jack pine/blueberry/lichen: Moderately fresh sand (n=4)

Structural Attributes and Relative Rating

Structural Component	Attribute	Value	Rating
Snags	Mean # of snags/plot	0.3	Low
	Mean snag diameter (cm)	10.1	
	Mean snag height (m)	0.9	
	Mean snag decay Class	5.0	
Course Woody Debris	Mean frequency of CWD	0.8	Moderate
	Mean CWD diameter (cm)	11.5	
	Mean CWD decay class	3.0	
Mean Percent Ground Cover	Litter Cover	25.5	Moderate
	Litter Depth (cm)	0.9	Moderate
	Bare Soil	1.8	Low
	Bare Rock	0.0	Low
	Open Water	0.0	Low



Structural Diversity, Species Richness, and Unique and Rare Species Occurrence Evaluation

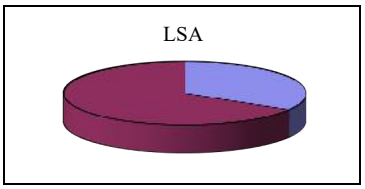
Attribute	Value	Rating
Structural diversity	1.0	Moderate
Species richness	17	Moderate
Unique species	3	Moderate
Provincially listed species	0	Low

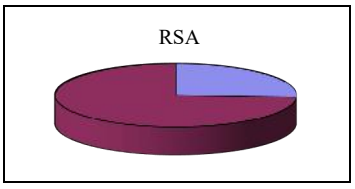
Unique species observed:
Pholia moss (*Pholia nutans*), Shingled Cladonia (*Cladonia scabriuscula*), Common bearberry (*Arctostaphylos uva-ursi*)

Provincially listed species observed:
None

Ecosite Supply

Areas occupied by Jack pine /blueberry /lichen forests comprised 1605.8 ha (33.8%) of the LSA and 10330.5 ha (25.8%) of the RSA.

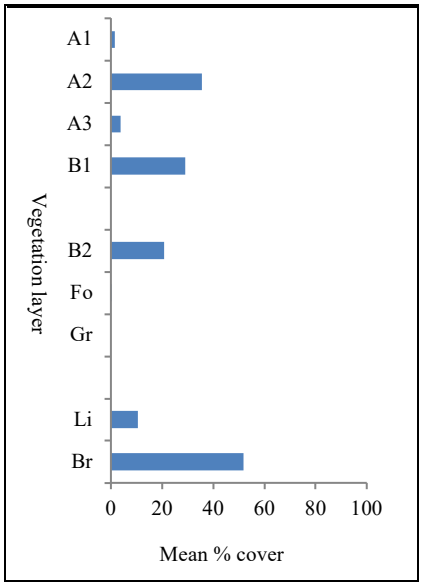




Ecological Interpretation

BS3 ecosites are relatively dry and occur in almost every topographic position and with every slope class. They are associated with the hills of eskers and drumlins as well as level plains. Following disturbance, these ecosites will usually return to being pine dominated, provided an adequate cone crop existed prior to disturbance. When compared to BS4 ecosites these ecosites tend to be drier, have less understory, and more open canopy. In the absence of disturbance, these ecosites may transition toward the BS7 ecosite condition.

BS4 Jack pine – black spruce/feathermoss: Moderately dry sand (n=4)



Ecosite Description

BS4 ecosite types are dominated by jack pine and black spruce in the overstory. Some of the sites encountered, however, may be pure jack pine. The understory of BS4 ecosite consists mainly of ericaceous shrubs, jack pine, green alder and black spruce. The forest floor is predominantly a mixture of litter as well as Schreber's moss and some reindeer lichen. The moisture regime of BS4 ecosites tends toward being relatively fresh and soils tend to be sandy loams and loamy sands. The age of this ecosite is approximately 55 years old.

Species and Vegetation Layer Info

Average number plant and lichen species per plot (min, max): 17 (14, 23)

Tree Layer Info:

Tree Layer	Total # Species	Crown Closure	Mean Height	Mean DBH	Species Composition	Year of Origin
A1 (n=3):	2	2%	9.9 m	11.0 cm	Sb8 Pj2	1955
A2 (n=6):	2	36%	8.6 m	10.4 cm	Pj9 Sb1	1962
A3 (n=3):	2	4%	6.5 m	7.3 cm	Pj10	1963

Lower Vegetation Layer info:

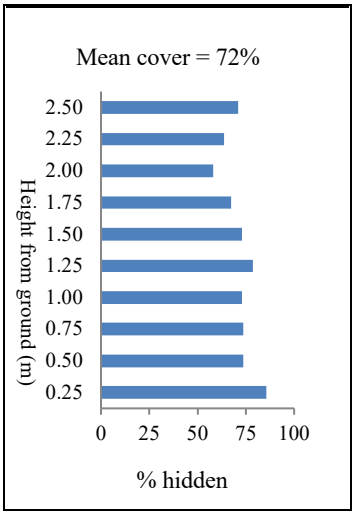
Vegetation Layer	Total # Species	Percentage Cover	Species Composition*
B1	4	29%	Pinuban8 Picemar1 Alnucri1
B2	5	20%	Ledugro5 Vaccmyr3 Vaccvit1
Forb	1	<1%	Lycoann10
Graminoid			
Lichen	14	11%	Cladmit6 Cladgra1 Peltneo1
Bryophyte	10	52%	Pleusch9

*Only including species that constitute 10% or more by composition.

BS4 Jack pine – black spruce/feathermoss: Moderately dry sand (n=4)

Structural Attributes and Relative Rating

Structural Component	Attribute	Value	Rating
Snags	Mean # of snags/plot	0.3	Low
	Mean snag diameter (cm)	15.1	
	Mean snag height (m)	5.5	
	Mean snag decay Class	2.0	
Course Woody Debris	Mean frequency of CWD	0.5	Low
	Mean CWD diameter (cm)	13.1	
	Mean CWD decay class	4.0	
Mean Percent Ground Cover	Litter Cover	40.4	High
	Litter Depth (cm)	2.2	Moderate
	Bare Soil	0.1	Low
	Bare Rock	0.0	Low
	Open Water	0.0	Low

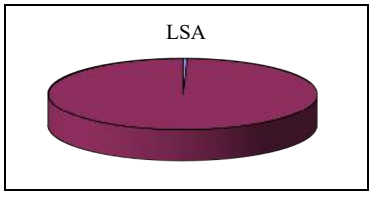


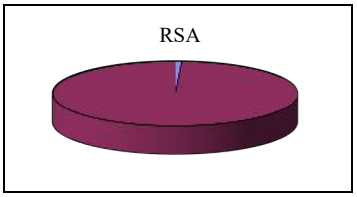
Structural Diversity, Species Richness, and Unique and Rare Species Occurrence Evaluation

Attribute	Value	Rating
Structural diversity	1.4	High
Species richness	17	Moderate
Unique species	1	Low
Provincially listed species	0	Low
Unique species observed: Carpet pelt (*Peltigera neopolydactyla*)		
Provincially listed species observed: None		

Ecosite Supply

Areas occupied by Jack pine-black spruce/feather moss comprised 22.8 ha (0.5%) of the LSA and 331.3 ha (0.8%) of the RSA.

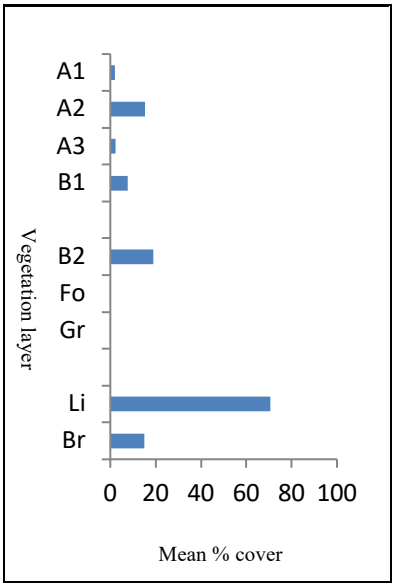




Ecological Interpretation

BS4 ecosites relatively are commonly encountered in the study area. While similar in overstory to BS3, they are moister, have a greater proportion of black spruce, are associated with a greater diversity of vascular plants, and have more of a closed canopy. Following fire, these sites will usually return to being pine and pine/spruce dominated. In the absence of disturbance these sites may transition toward the BS9 ecosite condition.

BS7 Black spruce/blueberry/lichen: Moderately dry sand (n=5)



Ecosite Description

BS7 is usually black spruce dominated and may be mixed with subdominant jack pine. A cover of ericaceous shrubs can be found beneath the tree canopy along with black spruce advanced. Forbs and graminoids are absent, and the dominant ground cover is reindeer lichen. These sandy sites are usually associated with upper and mid-slope topography on islands and peninsulas where wild fires are rare. The average age of this ecosite type is 90 years in the study area.

Species and Vegetation Layer Info

Average number plant and lichen species per plot (min, max): 20 (14, 25)

Tree Layer Info:

Tree Layer	Total # Species	Crown Closure	Mean Height	Mean DBH	Species Composition	Year of Origin
A1 (n=6):	2	2%	12.4 m	17.9 cm	Sb7 Pj3	1917
A2 (n=10):	2	15%	8.6 m	11.4 cm	Sb7 Pj3	1928
A3 (n=3):	1	2%	5.9 m	5.9 cm	Sb10	1974

Lower Vegetation Layer info:

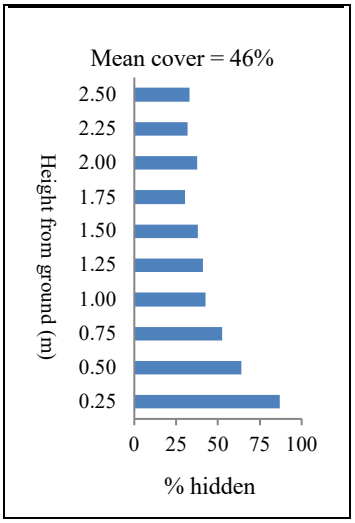
Vegetation Layer	Total # Species	Percentage Cover	Species Composition*
B1	6	8%	Picemar7 Pinuban2 Salibeb1 Alnucri1
B2	6	19%	Vaccmyr5 Ledugro3 Vaccvit2
Forb			
Graminoid			
Lichen	27	71%	Cladmit7 Cladste2 Cladran1
Bryophyte	8	15%	Pleusch8 Ptilcil1 Dicrpol1

*Only including species that constitute 10% or more by composition.

BS7 Black spruce/blueberry/lichen: Moderately dry sand (n=5)

Structural Attributes and Relative Rating

Structural Component	Attribute	Value	Rating
Snags	Mean # of snags/plot	0.6	Low
	Mean snag diameter (cm)	11.2	
	Mean snag height (m)	2.8	
	Mean snag decay Class	4.7	
Course Woody Debris	Mean frequency of CWD	2.4	High
	Mean CWD diameter (cm)	13.0	
	Mean CWD decay class	3.6	
Mean Percent Ground Cover	Litter Cover	10.7	Moderate
	Litter Depth (cm)	0.6	Low
	Bare Soil	0.0	Low
	Bare Rock	0.0	Low
	Open Water	0.0	Low



Structural Diversity, Species Richness, and Unique and Rare Species Occurrence Evaluation

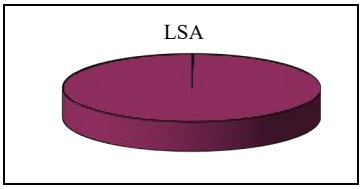
Attribute	Value	Rating
Structural diversity	1.1	Moderate
Species richness	20	High
Unique species	4	Moderate
Provincially listed species	0	Low

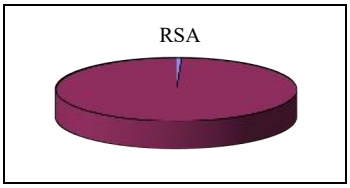
Unique species observed:
Greater sulphur-cup (Cladonia sulfurina), Common freckle pelt (Peltigera aphthosa), Dusty Gristle (Ramalina pollinaria), Blanket-leaf Willow (Salix silicicola)

Provincially listed species observed:
None

Ecosite Supply

Areas occupied by black spruce/ lichen forests comprised 9.6 ha (0.2%) of the LSA and 279.8 ha (0.7%) of the RSA.

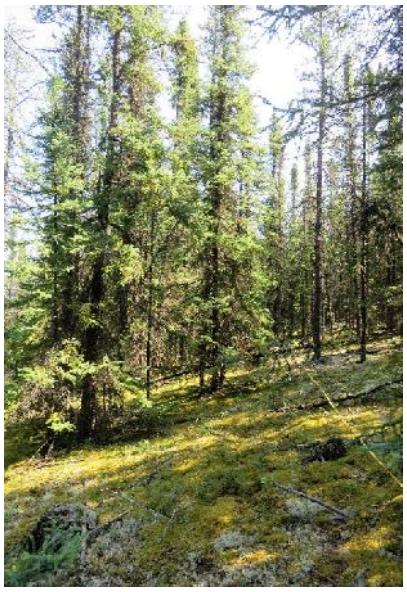


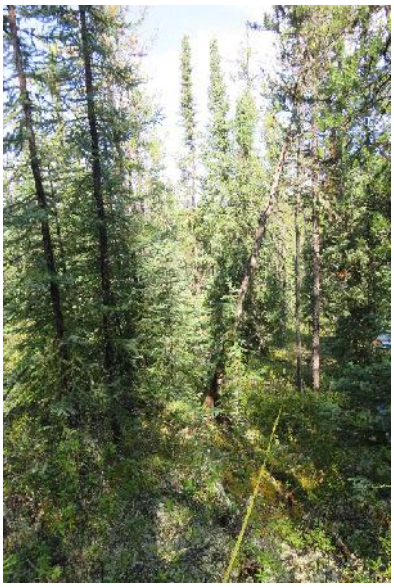


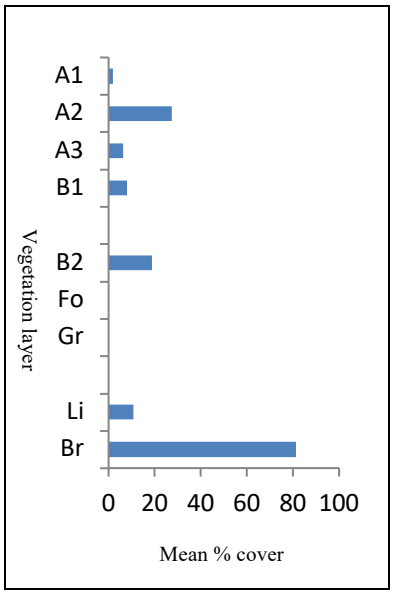
Ecological Interpretation

BS7 ecosites are relatively poor in vascular species diversity, but high in lichen species diversity. They closely resemble the BS3 ecosite but are spruce dominated and have slightly less canopy closure. Given the dry condition and lack of vascular species, these ecosites may return to their former condition following disturbance. BS7 can be considered to be in a climax condition. The low ground cover, relatively open canopy, and presence of black spruce in the understory are features that would tend to perpetuate the ecosite in the absence of disturbance.

BS9 Black spruce – jack pine/feathermoss: Moderately dry sand (n=4)







Ecosite Description

BS9 ecosite canopies are predominantly pure black spruce. These ecosites tend to have high stem density and closed canopy conditions. Ericaceous shrub cover is relatively high. One of the distinguishing features of this ecosite is the nearly continuous carpet of Schreber's moss. These sandy sites are usually associated with lower slope topography adjacent to lakes on islands and peninsulas where wild fires are rare. The average age of this ecosite in the study area is 70 years old.

Species and Vegetation Layer Info

Average number plant and lichen species per plot (min, max): 15 (10, 19)

Tree Layer Info:

Tree Layer	Total # Species	Crown Closure	Mean Height	Mean DBH	Species Composition	Year of Origin
A1 (n=2):	1	2%	10.3 m	14.2 cm	Sb10	1941
A2 (n=8):	2	28%	7.9 m	9.7 cm	Sb7 Pj3	1947
A3 (n=4):	2	6%	5.9 m	7.2 cm	Sb6 Pj4	1955

Lower Vegetation Layer info:

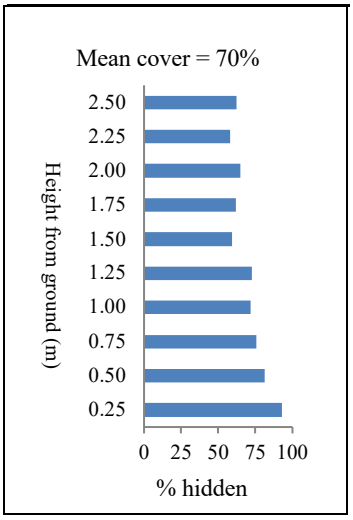
Vegetation Layer	Total # Species	Percentage Cover	Species Composition*
B1	4	8%	Picemar6 Pinuban3 Alnucri1
B2	6	19%	Ledugro6 Vaccvit2 Vaccmyr2
Forb			
Graminoid			
Lichen	13	11%	Cladmit7 Cladste1
Bryophyte	7	81%	Pleusch9

*Only including species that constitute 10% or more by composition.

BS9 **Black spruce – jack pine/feathermoss** (n=4)

Structural Attributes and Relative Rating

Structural Component	Attribute	Value	Rating
Snags	Mean # of snags/plot	1.0	Moderate
	Mean snag diameter (cm)	11.6	
	Mean snag height (m)	5.8	
	Mean snag decay Class	2.0	
Course Woody Debris	Mean frequency of CWD	0.3	Low
	Mean CWD diameter (cm)	10.0	
	Mean CWD decay class	5.0	
Mean Percent Ground Cover	Litter Cover	8.0	Low
	Litter Depth (cm)	0.9	Moderate
	Bare Soil	0.0	Low
	Bare Rock	0.0	Low
	Open Water	0.0	Low

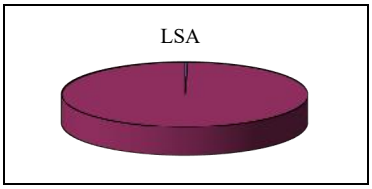


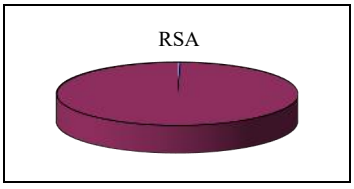
Structural Diversity, Species Richness, and Unique and Rare Species Occurrence Evaluation

Attribute	Value	Rating
Structural diversity	1.2	Moderate
Species richness	15	Moderate
Unique species	0	Low
Provincially listed species	0	Low
Unique species observed: None		
Provincially listed species observed: None		

Ecosite Supply

Areas occupied by black spruce-jack pine/feathermoss forests comprised 15.1 ha (0.3%) of the LSA and 147.8 ha (0.4%) of the RSA.

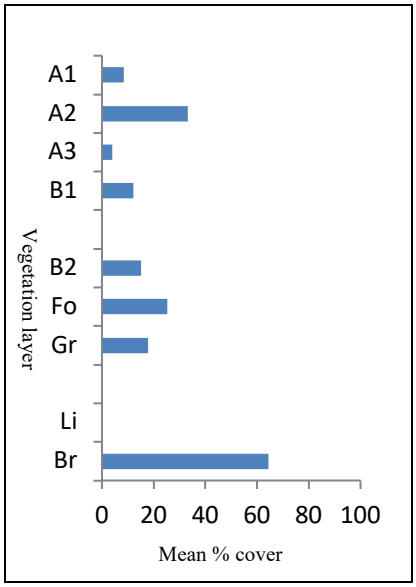




Ecological Interpretation

Although there is no herbaceous layer indicated for this ecosite, herbaceous diversity is relatively high. This is because the ecosite provides a range of microsite conditions that give refuge to a variety of herbaceous species that are not common enough to have a constancy value of > 40%. The lack of hardwood species and the occurrence of black spruce in the understory will likely lead to the perpetuation of this ecosite following fire or other disturbance.

BS16 Black spruce/balsam poplar/river alder swamp: Very moist mesic organic (n=3)



Ecosite Description

BS16 ecosites can, in the study area, occur with nearly pure birch overstories, both of which may have scattered black spruce present. Willows, birch and current species are common in the understory, as are a variety of herbaceous plants. In the ground layer feather moss is also frequently encountered. The average age of this ecosite is 55 years old.

Species and Vegetation Layer Info

Average number plant and lichen species per plot (min, max): 32 (28, 34)

Tree Layer Info:

Tree Layer	Total # Species	Crown Closure	Mean Height	Mean DBH	Species Composition	Year of Origin
A1 (n=4):	3	8%	10.9 m	13.7 cm	Sb4 Lt4 Bw2	1951
A2 (n=6):	3	33%	11.0 m	13.1 cm	Sb6 Bw3 Lt1	1962
A3 (n=3):	2	4%	9.1 m	13.3 cm	Sb8 Pb2	1957

Lower Vegetation Layer info:

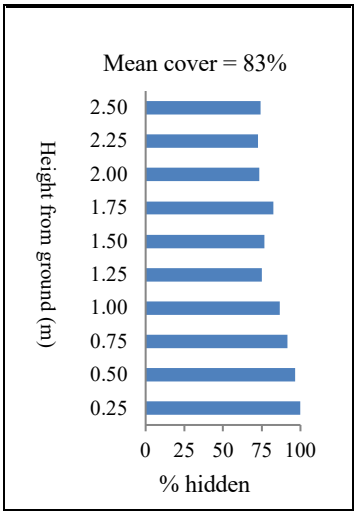
Vegetation Layer	Total # Species	Percentage Cover	Species Composition*
B1	8	12%	Betuocc3 Picemar3 Batupap2 Salidis1 Salisp.1
B2	15	15%	Myrigal5 Ribetri2 Rubuaca1 Rubuida1 Ledugro1
Forb	21	25%	Corncan3 Aralnud2 Violren2 Mentarv1 Potepal1
Graminoid	6	18%	Caredis6 Calacan3 Careutr1
Lichen Bryophyte	13	65%	Sphasqu2 Spharip2 Plagell2 Callgig1 Aulapal1 Ptilpul1

*Only including species that constitute 10% or more by composition.

BS16 Black spruce/balsam poplar/river alder swamp: Very moist mesic organic (n=3)

Structural Attributes and Relative Rating

Structural Component	Attribute	Value	Rating
Snags	Mean # of snags/plot	2.0	High
	Mean snag diameter (cm)	18.6	
	Mean snag height (m)	5.4	
	Mean snag decay Class	3.3	
Course Woody Debris	Mean frequency of CWD	2.3	High
	Mean CWD diameter (cm)	12.8	
	Mean CWD decay class	5.1	
Mean Percent Ground Cover	Litter Cover	33.7	High
	Litter Depth (cm)	6.8	High
	Bare Soil	0.0	Low
	Bare Rock	0.0	Low
	Open Water	0.0	Low



Structural Diversity, Species Richness, and Unique and Rare Species Occurrence Evaluation

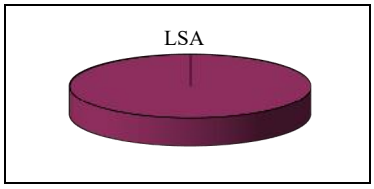
Attribute	Value	Rating
Structural diversity	1.8	High
Species richness	31	High
Unique species	15	High
Provincially listed species	0	Low

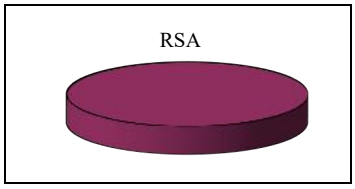
Unique species observed: Drepanocladus moss (*Drepanocladus aduncus*), Peat moss (*Sphagnum riparium*), Floating Hook Moss (*Warnstorfia fluitans*), Wild sarsaparilla (*Aralia nudicaulis*), Bulb-bearing water hemlock (*Cicuta bulbifera*), Water horsetail (*Equisetum fluviatile*), Threepetal bedstraw (*Galium trifidum*), Lapland buttercup (*Ranunculus lapponicus*), Running raspberry (*Rubus pubescens*), Starflower (*Trientalis borealis*), Hookspur violet (*Viola adunca*), Twinflower (*Linnea borealis*), Skunk currant (*Ribes glandulosum*), Wild red currant *(Ribes triste*), Raspberry *(Rubus idaeus*)

Provincially listed species observed: None

Ecosite Supply

No areas with the black spruce/balsam poplar/river alder swamp ecosite were located in the LSA, however 8.7 ha (<0.1%) were located in the RSA.

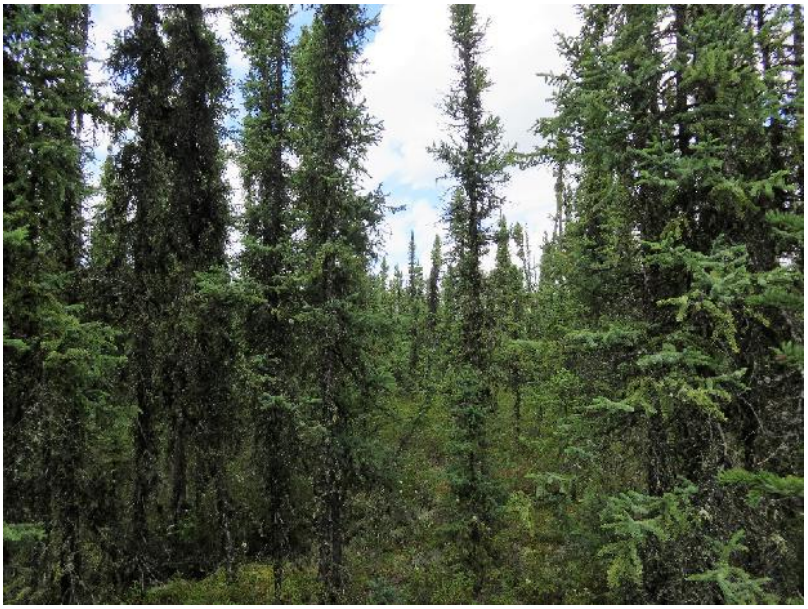


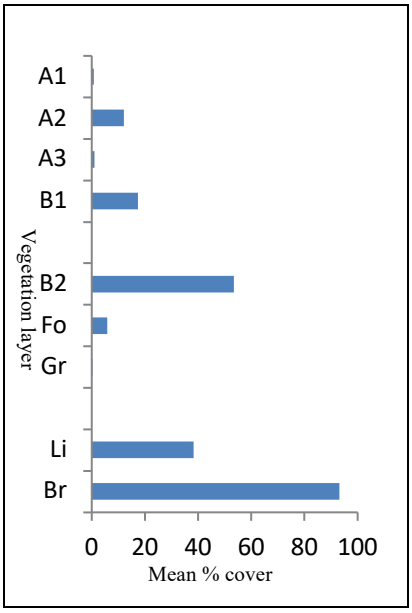


Ecological Interpretation

BS16 is uncommon in the study area. They are associated with transition positions on the landscape between wetlands and uplands, i.e. riparian areas. It is common for these sites to have abundant flowing water. Due to their position and adequate drainage, they are among the richest ecosites in the study area, both in terms of number of species, structural diversity, and number of unique species. They also have high amounts of litter and course woody debris contributing to increased number of micro habitats for numerous vertebrate and invertebrate species. SA16 is relatively stable and may return to their former composition following disturbance or stay in that condition in the absence of disturbance.

BS17 Black spruce treed bog: Very moist mesic organic (n=4)





Ecosite Description

BS17 ecosites have a somewhat open canopy of black spruce an average age of 90 years old. The understory is largely ericaceous shrub (mostly Labrador tea) and the ground cover is dominated by several peat moss species.

Species and Vegetation Layer Info

Average number plant and lichen species per plot (min, max): 20 (17, 23)

Tree Layer Info:

Tree Layer	Total # Species	Crown Closure	Mean Height	Mean DBH	Species Composition	Year of Origin
A1 (n=2):	1	<1%	9.2 m	11.8 cm	Sb10	1914
A2 (n=6):	1	12%	7.0 m	8.6 cm	Sb10	1926
A3 (n=1):	1	1	6.8 m	8.0 cm	Sb10	1903

Lower Vegetation Layer info:

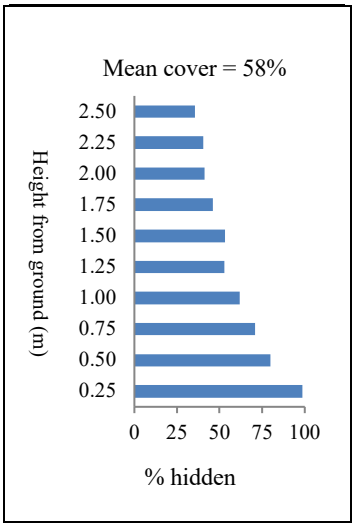
Vegetation Layer	Total # Species	Percentage Cover	Species Composition*
B1	1	18%	Picemar10
B2	13	54%	Ledugro5 Chamcal3 Ledupal1 Vaccvit1
Forb	4	6%	Rubucha9
Graminoid	1	<1%	Eriovag10
Lichen	9	38%	Cladmit9 Cladran1
Bryophyte	9	93%	Sphafus6 Sphaang2 Pleusch2

*Only including species that constitute 10% or more by composition.

BS17 Black spruce treed bog: Very moist mesic organic (n=4)

Structural Attributes and Relative Rating

Structural Component	Attribute	Value	Rating
Snags	Mean # of snags/plot	0.0	Low
	Mean snag diameter (cm)		
	Mean snag height (m)		
	Mean snag decay Class		
Course Woody Debris	Mean frequency of CWD	0.0	Low
	Mean CWD diameter (cm)		
	Mean CWD decay class		
Mean Percent Ground Cover	Litter Cover	14.0	Moderate
	Litter Depth (cm)	0.7	Low
	Bare Soil	0.0	Low
	Bare Rock	0.0	Low
	Open Water	0.0	Low

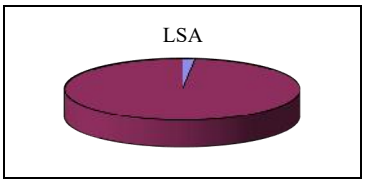


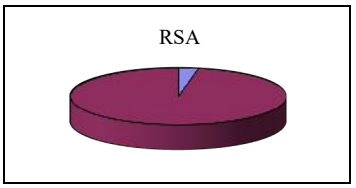
Structural Diversity, Species Richness, and Unique and Rare Species Occurrence Evaluation

Attribute	Value	Rating
Structural diversity	1.2	Moderate
Species richness	19	Moderate
Unique species	3	Moderate
Provincially listed species	0	Low
Unique species observed: Woodland horsetail (*Equisetum sylvaticum*), Split-peg lichen (*Cladonia cariosa*), Creeping-Snowberry (*Gaultheria hispidula*)		
Provincially listed species observed: None		

Ecosite Supply

Areas occupied by black spruce treed bog comprised 82.1 ha (1.7%) of the LSA and 1152.1 ha (2.9%) of the RSA.

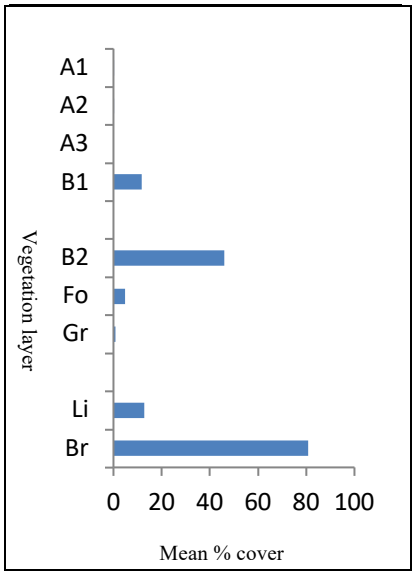




Ecological Interpretation

BS17 is common in the study area. The black spruce on these sites usually represents all ages as the *Sphagnum* moss on the site encourages vegetative reproduction by branch layering. Despite the wet conditions, black spruce can remain free from rot for long periods. In the absence of disturbance these sites will likely remain as a treed bog. Following disturbance these sites may more closely resemble BS18 or BS20.

BS18 Labrador tea shrubby bog: Moderately wet mesic organic (n=4)



Ecosite Description

BS18 is dominated by ericaceous shrubs, notably leatherleaf and Labrador tea. Occasionally black spruce trees may occur. Aside from the expected absence of trees, shrubby bogs tend to be very similar to treed bogs (BS17).

Species and Vegetation Layer Info

Average number plant and lichen species per plot (min, max): 19 (15, 26)

Tree Vegetation Layer Info:

Tree Layer	Total # Species	Crown Closure	Mean Height	Mean DBH	Species Composition	Year of Origin
A1 (n=1):	1	<1%	5.8 m	7.9 cm	Sb10	1903
A2 (n=2):	1	<1%	5.2 m	5.9 cm	Sb10	1974
A3 (n=1):						

Lower Layer info:

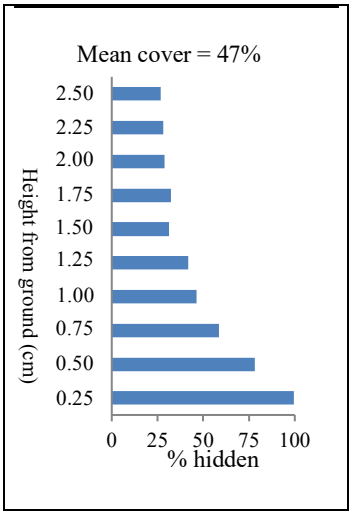
Vegetation Layer	Total # Species	Percentage Cover	Species Composition*
B1	3	12%	Picemar10
B2	10	46%	Chamcal4 Ledugro3 Ledupal2 Kalmpol1
Forb	6	5%	Rubucha7 Smiltri2
Graminoid	4	<1%	Eriovag5 Careaqu3 Careoli1 Carepau1
Lichen	11	13%	Cladmit6 Cladran3
Bryophyte	8	81%	Sphafus9

*Only including species that constitute 10% or more by composition.

BS18 Labrador tea shrubby bog: Moderately wet mesic organic (n=4)

Structural Attributes and Relative Rating

Structural Component	Attribute	Value	Rating
Snags	Mean # of snags/plot	0.0	Low
	Mean snag diameter (cm)		
	Mean snag height (m)		
	Mean snag decay Class		
Course Woody Debris	Mean frequency of CWD	0.0	Low
	Mean CWD diameter (cm)		
	Mean CWD decay class		
Mean Percent Ground Cover	Litter Cover	6.1	Low
	Litter Depth (cm)	0.6	Low
	Bare Soil	0.0	Low
	Bare Rock	0.0	Low
	Open Water	0.0	Low

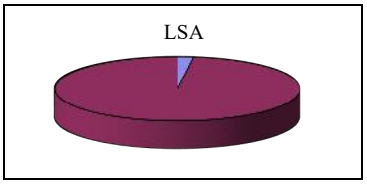


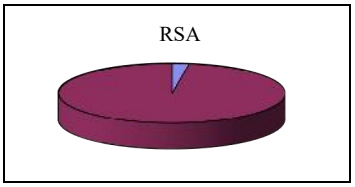
Structural Diversity, Species Richness, and Unique and Rare Species Occurrence Evaluation

Attribute	Value	Rating
Structural diversity	1.0	Moderate
Species richness	19	Moderate
Unique species	1	Low
Provincially listed species	0	Low
Unique species observed: Woodland horsetail (*Equisetum pretense*)		
Provincially listed species observed: None		

Ecosite Supply

Areas occupied by Labrador tea shrubby bog comprised 101.0 ha (2.1%) of the LSA and 963.4 ha (2.4%) of the RSA.

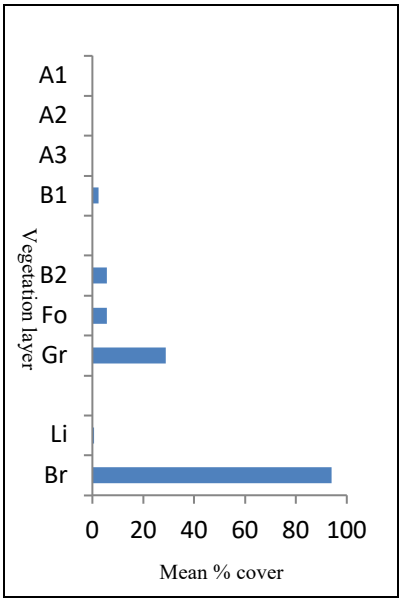




Ecological Interpretation

BS18 ecosites are commonly encountered in the study area. Like the other forms of bogs, most of the moisture they receive is the result of precipitation. Shrubby bogs, unlike treed bogs, are more likely to be found on level sites. Since the water table associated with shrubby bogs is usually below the site surface, they are also susceptible to disturbance from fire. Fires with a long enough duration or intensity may kill shrub species and the bog may transition into an open (BS20) or graminoid dominated (BS19) condition.

BS19 Graminoid bog: Very wet humic organic (n=4)



Ecosite Description

BS19 ecosites are dominated by sedges and other graminoids in association with peat moss species. They typically lack any substantial tree or shrub cover.

Species and Vegetation Layer Info

Average number plant and lichen species per plot (min, max): 15 (13, 17)

Tree Layer Info:

Tree Layer	Total # Species	Crown Closure	Mean Height	Mean DBH	Species Composition	Year of Origin
A1 (n=0):						
A2 (n=0):						
A3 (n=0):						

Lower Vegetation Layer info:

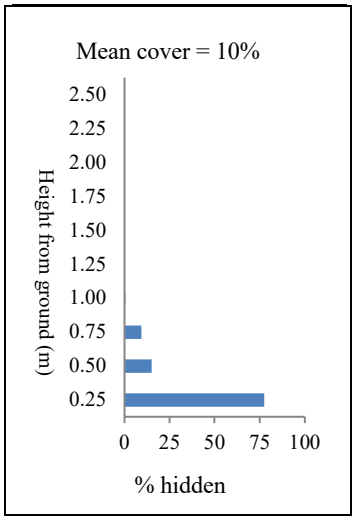
Vegetation Layer	Total # Species	Percentage Cover	Species Composition*
B1	2	2%	Picemar6 Larilar4
B2	6	6%	Andrpol5 Chamcal1 Kalmpol1 Oxycmic1
Forb	5	6%	Schepal6 Smiltri4
Graminoid	9	29%	Careoli3 Eriovag2 Careutr1 Careliv1 Caremag1 Juncbuf1
Lichen	1	<1%	Cladmit10
Bryophyte	7	94%	Sphafus5 Sphaang2 Sphagir1 Sphamaj1 Pleusch1

*Only including species that constitute 10% or more by composition.

BS19 Graminoid bog: Very wet humic organic (n=4)

Structural Attributes and Relative Rating

Structural Component	Attribute	Value	Rating
Snags	Mean # of snags/plot	0.0	Low
	Mean snag diameter (cm)		
	Mean snag height (m)		
	Mean snag decay Class		
Course Woody Debris	Mean frequency of CWD	0.0	Low
	Mean CWD diameter (cm)		
	Mean CWD decay class		
Mean Percent Ground Cover	Litter Cover	0.5	Low
	Litter Depth (cm)	0.3	Low
	Bare Soil	0.0	Low
	Bare Rock	0.0	Low
	Open Water	0.0	Low

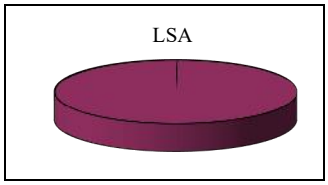


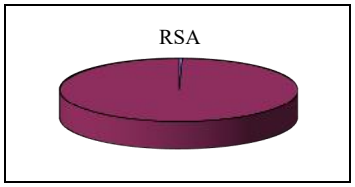
Structural Diversity, Species Richness, and Unique and Rare Species Occurrence Evaluation

Attribute	Value	Rating
Structural diversity	0.9	Low
Species richness	15	Moderate
Unique species	1	Low
Provincially listed species	1	Low
Unique species observed: Short-tail Rush (*Juncus brevicaudatus*)		
Provincially listed species observed: Angle-leaved sundew (*Drosera anglica*)		

Ecosite Supply

Areas occupied by a combination of BS19 and BS24 comprised 11.1 ha (0.2%) of the LSA and 171.2 ha (0.4%) of the RSA

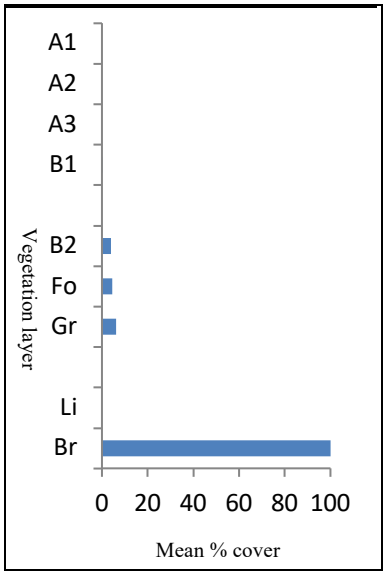




Ecological Interpretation

Graminoid bogs are infrequently encountered in the study area. While similar to graminoid fens (BS24) they lack fen species and standing water is not readily seen. Following disturbance by either fire or prolonged flooding, these sites will typically return to their former condition. However, they may revert to an open bog condition until the grasses become reestablished.

BS20 Open bog: Moderately wet fibric organic (n=4)



Ecosite Description

BS20 ecosites are dominated by peat moss species and have low cover values of shrubs and graminoids and forbs. Trees are completely lacking.

Species and Vegetation Layer Info

Average number plant and lichen species per plot (min, max): 12 (10, 15)

Tree Layer Info:

Tree Layer	Total # Species	Crown Closure	Mean Height	Mean DBH	Species Composition	Year of Origin
A1 (n=0):						
A2 (n=0):						
A3 (n=0):						

Lower Vegetation Layer info:

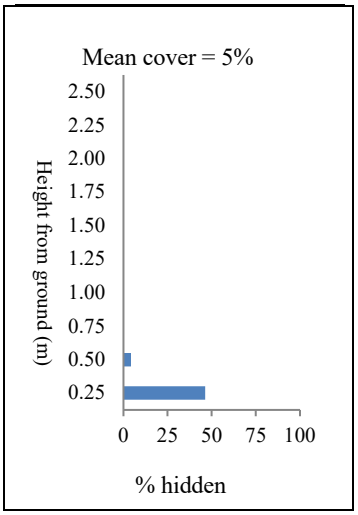
Vegetation Layer	Total # Species	Percentage Cover	Species Composition*
B1	1	<1%	Picemar10
B2	5	4%	Andrpol5 Chamcal3 Oxycmic2
Forb	5	4%	Schepal6 Drosrot2 Smiltri1
Graminoid	6	6%	Eriovag3 Juncbuf2 Eleoqui2 Carelim2 Caremag1
Lichen Bryophyte	3	100%	Sphafus5 Sphamaj4 Sphamag1

*Only including species that constitute 10% or more by composition.

BS20 Open bog: Moderately wet fibric organic (n=4)

Structural Attributes and Relative Rating

Structural Component	Attribute	Value	Rating
Snags	Mean # of snags/plot	0.0	Low
	Mean snag diameter (cm)		
	Mean snag height (m)		
	Mean snag decay Class		
Course Woody Debris	Mean frequency of CWD	0.0	Low
	Mean CWD diameter (cm)		
	Mean CWD decay class		
Mean Percent Ground Cover	Litter Cover	0.0	Low
	Litter Depth (cm)	0.0	Low
	Bare Soil	0.0	Low
	Bare Rock	0.0	Low
	Open Water	0.0	Low

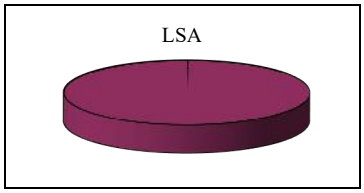


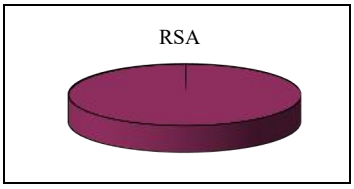
Structural Diversity, Species Richness, and Unique and Rare Species Occurrence Evaluation

Attribute	Value	Rating
Structural diversity	0.5	Low
Species richness	12	Moderate
Unique species	1	Low
Provincially listed species	1	Low
Unique species observed: Few-flowered Spikerush (*Eleocharis quinqueflora*)		
Provincially listed species observed: Angle-leaved sundew (*Drosera anglica*)		

Ecosite Supply

Areas occupied by BS20 comprised 4.8 ha (0.1%) of the LSA and 65.2 ha (0.2%) of the TSA.

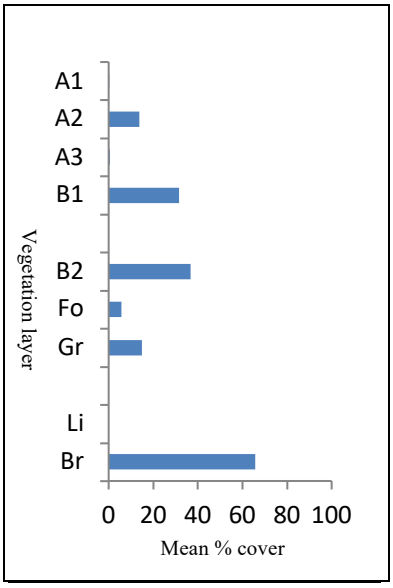




Ecological Interpretation

Open bogs are infrequently encountered in the study area. They tend to occur within treed or shrubby bogs (BS17 and BS18 respectively) which is why they more closely resemble those ecosites rather than graminoid bogs (BS19). Open bogs also tend to be wetter than their surrounding conditions. Over time, these ecosites could be expected to become a shrubby or treed bog.

BS21 Tamarack treed fen: Wet fibric organic (n=4)



Ecosite Description

BS21 ecosite has tamarack as the dominant tree species. Many of the shrub species encountered in fens are more commonly associated with moister conditions than that which would be found in bogs, such as gale and birch species. It is not uncommon for treed fens to have a water table at or near the surface. Treed fens are usually associated with an organic substrate but mineral soil substrates may also be encountered.

Species and Vegetation Layer Info

Average number plant and lichen species per plot (min, max): 19 (15, 21)

Tree Layer Info:

Tree Layer	Total # Species	Crown Closure	Mean Height	Mean DBH	Species Composition	Year of Origin
A1 (n=1):	1	<1%	9.9 m	15.9 cm	Lt10	1943
A2 (n=8):	2	14%	8.5 m	11.9 cm	Lt7 Sb3	1946
A3 (n=2):	2	<1%	8.3 m	9.3 cm	Lt5 Sb5	1970

Lower Vegetation Layer info:

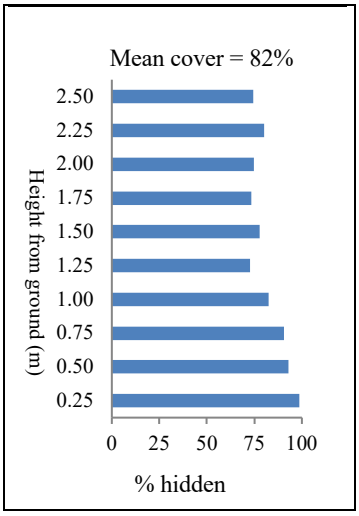
Vegetation Layer	Total # Species	Percentage Cover	Species Composition*
B1	7	32%	Betupum5 Picemar2 Larilar1 Betuocc1 Betugla1
B2	11	37%	Betupum5 Myrigal4
Forb	9	6%	Potepal4 Violpal3 Habeopt1 Mentarv1 Rubucha1
Graminoid	9	15%	Caredis4 Calacan3 Agrosca1 Careaqu1
Lichen Bryophyte	8	66%	Sphaang4 Sphasqu2 Tomenit2 Ptilpul1 Drepunc1

*Only including species that constitute 10% or more by composition.

BS21 Tamarack treed fen: Wet fibric organic (n=4)

Structural Attributes and Relative Rating

Structural Component	Attribute	Value	Rating
Snags	Mean # of snags/plot	0.3	Low
	Mean snag diameter (cm)	10.5	
	Mean snag height (m)	0.8	
	Mean snag decay Class	6.0	
Course Woody Debris	Mean frequency of CWD	0.0	Low
	Mean CWD diameter (cm)		
	Mean CWD decay class		
Mean Percent Ground Cover	Litter Cover	33.1	High
	Litter Depth (cm)	4.8	High
	Bare Soil	0.0	Low
	Bare Rock	0.0	Low
	Open Water	0.0	Low



Structural Diversity, Species Richness, and Unique and Rare Species Occurrence Evaluation

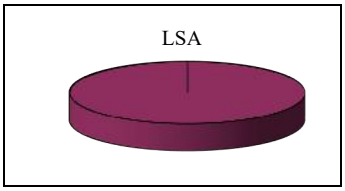
Attribute	Value	Rating
Structural diversity	1.6	High
Species richness	19	Moderate
Unique species	7	High
Provincially listed species	0	Low

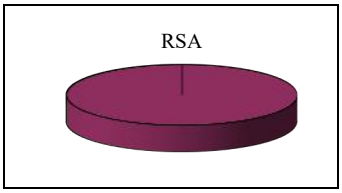
Unique species observed:
Calliergon moss (*Calliergon stramineum*), Brown moss (*Drepanocladus unciatus*), Threeleaf goldthread (*Coptis trifolia*), Blunt-leaved orchid (*Habenaria obtusata*), Northern reedgrass (*Calamagrostis inexpansa*), Sparseflower sedge (*Carex tenuiflora*), Autumn willow (*Salix serissima*)

Provincially listed species observed:
None

Ecosite Supply

Areas occupied by Tamarack treed fen comprised 14.7 ha (0.3%) of the LSA and 66.2 (0.2%) of the RSA.

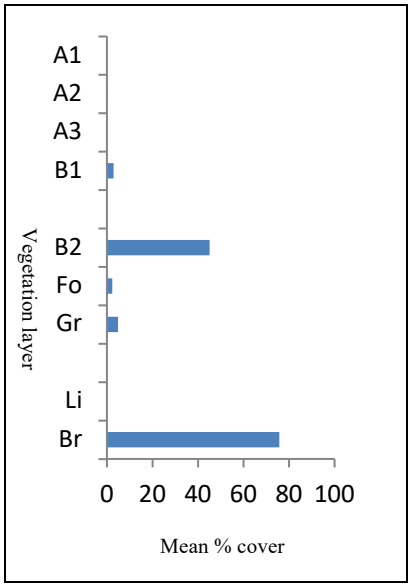




Ecological Interpretation

BS21 ecosites are a very uncommon wetland in the study area. They tend to occur in association with shrubby fens (BS22 and BS23) and resemble ribbons in the landscape along drainage ways. Following disturbance, these ecosites could be expected to become a shrubby fen (BS22). In the absence of disturbance these ecosites will likely remain in their current condition.

BS22 Leatherleaf shrubby poor fen: Very wet fibric organic (n=4)



Ecosite Description

In the study area, BS22 ecosite has tamarack, willow, and spruce as dominant tall shrub species. Ericaceous shrubs are common in the low shrub layer. Sedges are the dominant species in the herbaceous layer and *Sphagnum* mosses are very abundant. Shrubby poor fens frequently have a water table that is at or near the surface. The substrate for these ecosites is usually organic although a mineral substrate is also possible.

Species and Vegetation Layer Info

Average number plant and lichen species per plot (min, max): 15 (14, 15)

Tree Layer Info:

Tree Layer	Total # Species	Crown Closure	Mean Height	Mean DBH	Species Composition	Year of Origin
A1 (n=0):						
A2 (n=1):	1	<1%	5.8 m	8.4 cm	Sb10	1960
A3 (n=0):						

Lower Vegetation Layer info:

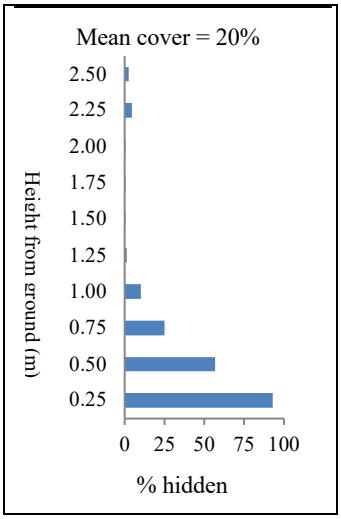
Vegetation Layer	Total # Species	Percentage Cover	Species Composition*
B1	4	3%	Picemar7 Salipla2 Larilar1
B2	12	45%	Chamcal7 Kalmpol1 Myrigal1
Forb	6	2%	Potepal6 Schepal3 Drosrot1
Graminoid	8	5%	Scircae2 Careutr2 Caremag2 Careaqu2 Carelim1
Lichen			
Bryophyte	7	76%	Sphaang4 Sphafus3 Sphagir2 Strastr1

*Only including species that constitute 10% or more by composition.

BS22 Leatherleaf shrubby poor fen: Very wet fibric organic (n=4)

Structural Attributes and Relative Rating

Structural Component	Attribute	Value	Rating
Snags	Mean # of snags/plot	0.0	Low
	Mean snag diameter (cm)		
	Mean snag height (m)		
	Mean snag decay Class		
Course Woody Debris	Mean frequency of CWD	0.0	Low
	Mean CWD diameter (cm)		
	Mean CWD decay class		
Mean Percent Ground Cover	Litter Cover	17.3	Moderate
	Litter Depth (cm)	1.8	Moderate
	Bare Soil	4.5	Moderate
	Bare Rock	0.0	Low
	Open Water	0.0	Low



Structural Diversity, Species Richness, and Unique and Rare Species Occurrence Evaluation

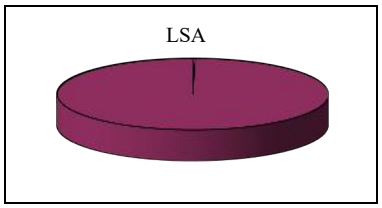
Attribute	Value	Rating
Structural diversity	1.0	Low
Species richness	15	Moderate
Unique species	1	Low
Provincially listed species	1	Low

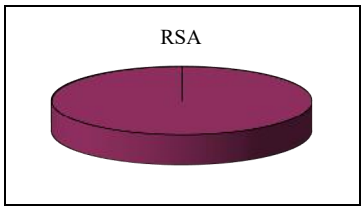
Unique species observed:
Filiform hypnum moss (*Hypnum cupressiforme var filiforme*)

Provincially listed species observed:
Angle-leaved sundew (*Drosera anglica*)

Ecosite Supply

Areas occupied by leatherleaf shrubby poor fen comprised 13.1 ha (0.3%) of the LSA and 28.4 ha (0.1%) of the RSA.

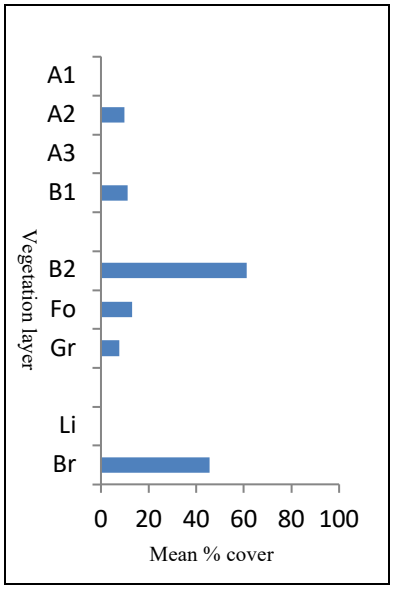




Ecological Interpretation

BS22 ecosites are common in the study area. Shrubby poor fens are sometimes associated with Tamarack treed fens (BS21). These sites tend to be wetter than shrubby bogs (BS18), and have a higher percentage of sedges.

BS23 Willow shrubby rich fen: Wet fibric organic (n=4)



Ecosite Description

BS23 has high cover values of willows. Other shrubs that could be found include birch species, tamarack and spruce. Grasses tend to be more common on the BS23 ecosite than sedges. Shrubby rich fens are more commonly associated with mineral soil substrate but will also occur on an organic substrate.

Species and Vegetation Layer Info

Average number plant and lichen species per plot (min, max): 19 (11, 27)

Tree Layer Info:

Tree Layer	Total # Species	Crown Closure	Mean Height	Mean DBH	Species Composition	Year of Origin
A1 (n=0):						
A2 (n=7):	3	10%	7.1 m	11.2 cm	Sb5 Pj4 Lt1	1957
A3 (n=0):						

Lower Vegetation Layer info:

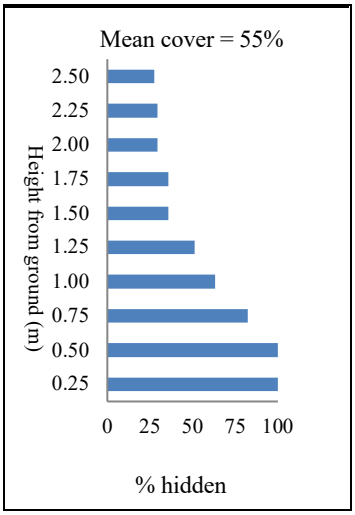
Vegetation Layer	Total # Species	Percentage Cover	Species Composition*
B1	10	11%	Betupum4 Picemar3 Pinuban1 Larilar1
B2	10	61%	Myrigal6 Saliped2
Forb	15	13%	Potepal4 Symppun2 Violren1 Rumeorb1 Mentarv1
Graminoid	5	8%	Calacan5 Careaqu3 Carecan1
Lichen			
Bryophyte	7	46%	Sphasqu4 Sphaang3 Strastr1 Rhizpse1 Plagell1

*Only including species that constitute 10% or more by composition.

BS23 Willow shrubby rich fen: Wet fibric organic (n=4)

Structural Attributes and Relative Rating

Structural Component	Attribute	Value	Rating
Snags	Mean # of snags/plot	1.5	High
	Mean snag diameter (cm)	12.2	
	Mean snag height (m)	5.7	
	Mean snag decay Class	4.0	
Course Woody Debris	Mean frequency of CWD	0.5	Low
	Mean CWD diameter (cm)	11.0	
	Mean CWD decay class	4.5	
Mean Percent Ground Cover	Litter Cover	45.0	High
	Litter Depth (cm)	5.9	High
	Bare Soil	0.0	Low
	Bare Rock	0.0	Low
	Open Water	0.0	Low



Structural Diversity, Species Richness, and Unique and Rare Species Occurrence Evaluation

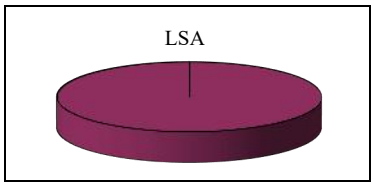
Attribute	Value	Rating
Structural diversity	1.5	High
Species richness	19	Moderate
Unique species	9	High
Provincially listed species	0	Low

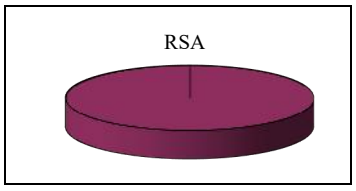
Unique species observed:
Common green bryum moss *(Bryum pseudotriquetrum*), Rhizomnium moss (*Rhizomnium pseudopunctatum*), Water-horehound (*Lycopus americanus*), Thufted loosestrife (*Lysimachia thyrsiflora*), Water dock (*Rumex orbiculatus*), Swamp Aster (*Symphyotrichum puniceum*), River alder (*Alnus rugosa*), Bristly black currant (*Ribes lacustre*), Gray willow (*Salix glauca*)

Provincially listed species observed:
None

Ecosite Supply

Areas occupied by willow shrubby rich fen comprised 3.2 ha (0.1%) of the LSA and 20.8 ha (0.1%) of the RSA.

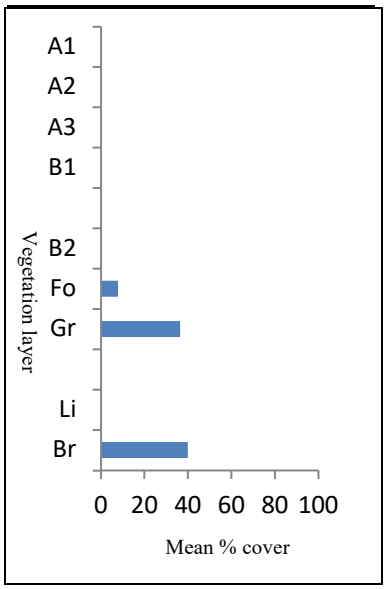




Ecological Interpretation

BS23 ecosites differ considerably from leatherleaf shrubby poor fens (BS22). Rich fen ecosites often occur adjacent to streams. They have a high occurrence of unique species. In the absence of disturbance these ecosites are self-sustaining. Following disturbance they will likely return to their former composition.

BS24 Graminoid fen: Very wet humic organic (n=4)



Ecosite Description

Graminoid fens often have various sedge species as well as marsh reed grass. They generally lack trees and shrubs. Sphagnum moss is the most common moss found in association with these sites. Graminoid fens usually have water at or near the surface. While graminoid fen ecosites are usually associated with organic soils, they may also occur with mineral substrates.

Species and Vegetation Layer Info

Average number plant and lichen species per plot (min, max): 8 (5, 10)

Tree Layer Info:

Tree Layer	Total # Species	Crown Closure	Mean Height	Mean DBH	Species Composition	Year of Origin
A1 (n=0):						
A2 (n=1):	1	<1%	6.4 m	11.5 cm	Sb10	1942
A3 (n=0):						

Lower Vegetation Layer info:

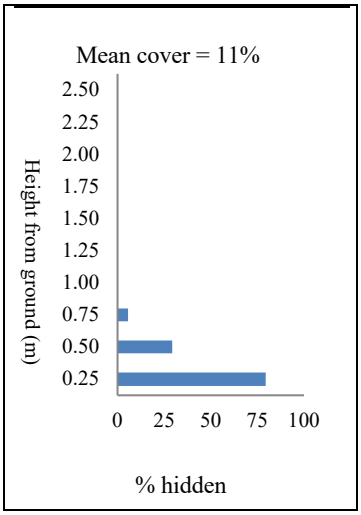
Vegetation Layer	Total # Species	Percentage Cover	Species Composition*
B1	2	<1%	Picemar5 Pinuban5
B2	4	<1%	Saliped6 Andrpol2 Kalmpol1 Oxycmic1
Forb	3	8%	Utriint7 Schepal2 Potepal1
Graminoid	8	37%	Careoli5 Careaqu2 Calacan1 Carelim1
Lichen Bryophyte	4	40%	Polycom6 Polystr2 Sphasqu2

*Only including species that constitute 10% or more by composition.

BS24 Graminoid fen: Very wet humic organic (n=4)

Structural Attributes and Relative Rating

Structural Component	Attribute	Value	Rating
Snags	Mean # of snags/plot	0.0	Low
	Mean snag diameter (cm)		
	Mean snag height (m)		
	Mean snag decay Class		
Course Woody Debris	Mean frequency of CWD	0.0	Low
	Mean CWD diameter (cm)		
	Mean CWD decay class		
Mean Percent Ground Cover	Litter Cover	9.5	Low
	Litter Depth (cm)	1.0	Moderate
	Bare Soil	0.0	Low
	Bare Rock	0.0	Low
	Open Water	50.0	High

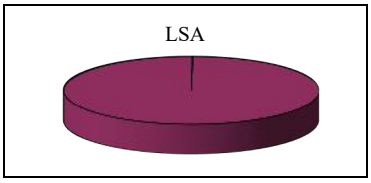


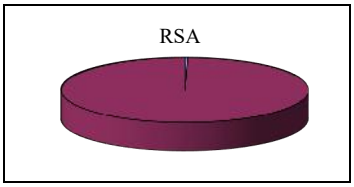
Structural Diversity, Species Richness, and Unique and Rare Species Occurrence Evaluation

Attribute	Value	Rating
Structural diversity	1.0	Low
Species richness	8	Low
Unique species	2	Low
Provincially listed species	0	Low
Unique species observed: Flatleaf bladderwort (*Utricularia intermedia*), Capitate sedge (*Carex capitate*)		
Provincially listed species observed: None		

Ecosite Supply

Areas occupied by a combination of BS24 and BS19 comprised 11.1 ha (0.2%) of the LSA and 171.2 ha (0.4%) of the RSA

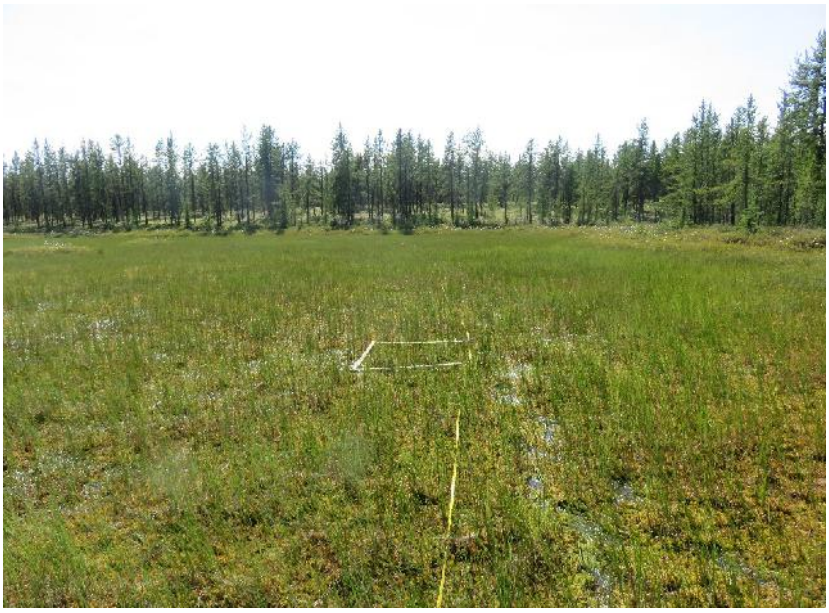


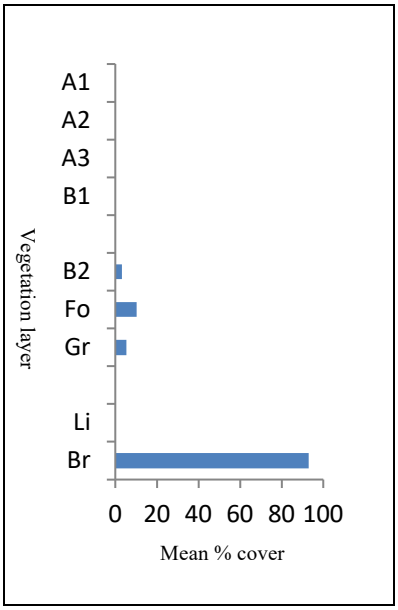


Ecological Interpretation

BS24 is occasionally found across the study area. They are often in close proximity to lake or creek shorelines. The high water table on these sites can provide the proper conditions for submergent plants. Following disturbance, such as ice action, these ecosites could be expected to return to graminoid fens.

BS25 Open fen: Wet mesic organic (n=2)





Ecosite Description

BS25 is conspicuous by the lack of any dominant form of vegetation with the exception of mosses. It is not uncommon for open fens to exhibit many of the vegetation species found in adjacent ecosites. The diversity of species and cover values are low. In terms of substrate, open fens can either have a mineral or organic substrate.

Species and Vegetation Layer Info

Average number plant and lichen species per plot (min, max): 10 (10, 10)

Tree Layer Info:

Tree Layer	Total # Species	Crown Closure	Mean Height	Mean DBH	Species Composition	Year of Origin
A1 (n=0):						
A2 (n=0):						
A3 (n=0):						

Lower Vegetation Layer info:

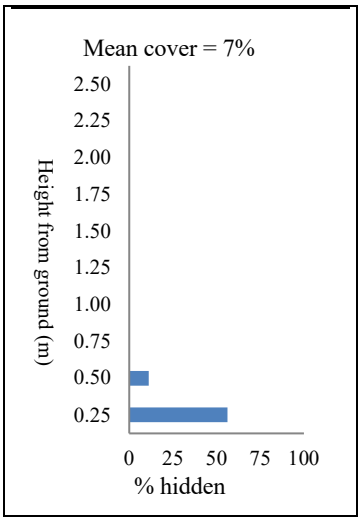
Vegetation Layer	Total # Species	Percentage Cover	Species Composition*
B1			
B2	3	3%	Andrpol7 Kalmpol3
Forb	4	10%	Schepal4 Menytri4 Drosrot1 Drosang1
Graminoid	5	5%	Carelim4 Eleonit3 Eleopal2 Caremag1
Lichen			
Bryophyte	3	93%	Sphasqu5 Sphang3 Sphacap2

*Only including species that constitute 10% or more by composition.

BS25 Open fen: Wet mesic organic (n=2)

Structural Attributes and Relative Rating

Structural Component	Attribute	Value	Rating
Snags	Mean # of snags/plot	0.0	Low
	Mean snag diameter (cm)		
	Mean snag height (m)		
	Mean snag decay Class		
Course Woody Debris	Mean frequency of CWD	0.0	Low
	Mean CWD diameter (cm)		
	Mean CWD decay class		
Mean Percent Ground Cover	Litter Cover	0.0	Low
	Litter Depth (cm)	0.0	Low
	Bare Soil	0.0	Low
	Bare Rock	0.0	Low
	Open Water	0.0	Low



Structural Diversity, Species Richness, and Unique and Rare Species Occurrence Evaluation

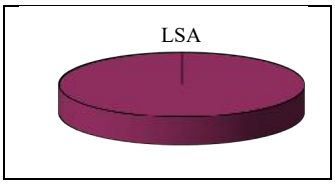
Attribute	Value	Rating
Structural diversity	0.6	Low
Species richness	10	Moderate
Unique species	2	Low
Provincially listed species	2	Moderate

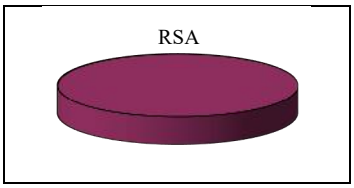
Unique species observed:
Peat moss (*Sphagnum capillifolium*), Neat Spike-rush (*Eleocharis nitida*)

Provincially listed species observed:
Angle-leaved sundew (*Drosera anglica*), Neat Spike-rush (*Eleocharis nitida*)

Ecosite Supply

Areas occupied by open fen comprised 2.1 ha (<0.1%) of the LSA and 5.7 ha (<0.1%) of the RSA.

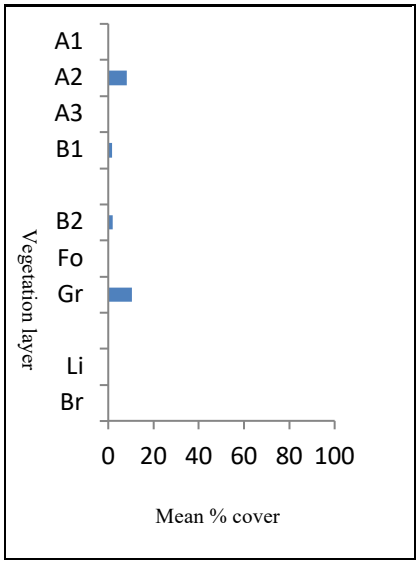




Ecological Interpretation

BS25 ecosites are uncommon across the study area. They exist as small pockets nested within other fen ecosites. Following disturbance these ecosites could be expected to return to open fens, but over time it is likely that they would become part of the adjacent fen ecosite.

BS26 Rush Sandy Shore: very moist sand (n=4)



Ecosite Description

BS26 ecosites are characterized by having a relatively low cover of rushes, grasses, and sedges and little else. The ground cover is mostly exposed soil; usually just sand.

Species and Vegetation Layer Info

Average number plant and lichen species per plot (min, max): 9 (5, 12)

Tree Layer Info:

Tree Layer	Total # Species	Crown Closure	Mean Height	Mean DBH	Species Composition	Year of Origin
A1 (n=1):	1	<1%	11.4 m	20.1 cm	Pj10	1902
A2 (n=3):	1	8	7.0 m	12.8 cm	Pj10	1934
A3 (n=0):						

Lower Vegetation Layer info:

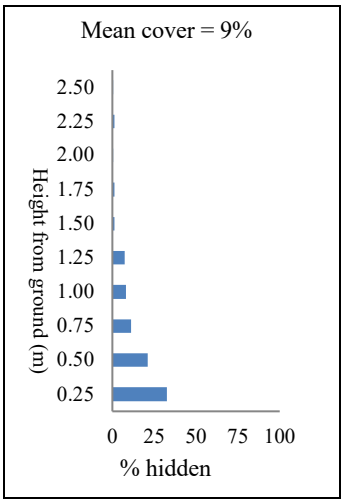
Vegetation Layer	Total # Species	Percentage Cover	Species Composition*
B1	5	2%	Pinuban5 Betupap2 Alnucri1 Picemar1 Salibeb1
B2	5	2%	Myrigal8 Chamcal1
Forb	3	<1%	Polyach4 Potenor3 Epilang2
Graminoid	10	11%	Careaqu5 Calastr3 Juncalp2
Lichen			
Bryophyte			

*Only including species that constitute 10% or more by composition.

BS26 Rush Sandy Shore: very moist sand (n=4)

Structural Attributes and Relative Rating

Structural Component	Attribute	Value	Rating
Snags	Mean # of snags/plot	0.8	Moderate
	Mean snag diameter (cm)	15.4	
	Mean snag height (m)	5.2	
	Mean snag decay Class	3.3	
Course Woody Debris	Mean frequency of CWD	0.0	Low
	Mean CWD diameter (cm)		
	Mean CWD decay class		
Mean Percent Ground Cover	Litter Cover	10.9	Moderate
	Litter Depth (cm)	0.4	Low
	Bare Soil	88.6	High
	Bare Rock	0.0	Low
	Open Water	0.0	Low



Structural Diversity, Species Richness, and Unique and Rare Species Occurrence Evaluation

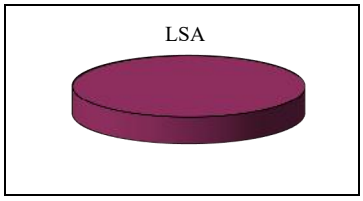
Attribute	Value	Rating
Structural diversity	1.2	Moderate
Species richness	9	Low
Unique species	4	Moderate
Provincially listed species	0	Low

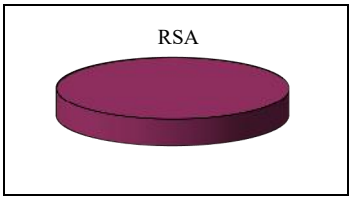
Unique species observed:
Striate Knotweed (*Polygonum achoreum*), Narrow-leaved reed grass (*Calamagrostis stricta ssp. Stricta*), Lens-fruited Sedge (*Carex lenticularis*), Red fescue (*Festuca rubra*)

Provincially listed species observed:
None

Ecosite Supply

Areas occupied by rush sandy shores comprised 0.9 ha (<0.1%) of the LSA and 15.0 ha (<0.1%) of the RSA.

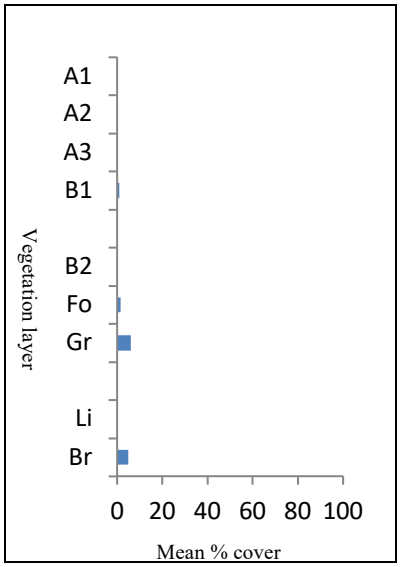




Ecological Interpretation

Rush sandy shores are almost always narrow linear features adjacent to lakes or ponds. This particular ecosite was defined based on data almost exclusively from the Athabasca Dunes ecodistrict.

BS27 Sedge Rocky Shore: very moist sand (n=4)



Ecosite Description

BS27 ecosites are sparsely vegetated sites that may have a variety of water tolerant species (e.g., tamarack, sweet gale, and sedges) present but in very low quantities. They are often predominantly rock on the surface and the water table is near the surface and usually visible.

Species and Vegetation Layer Info

Average number plant and lichen species per plot (min, max): 9 (6, 12)

Tree Layer Info:

Tree Layer	Total # Species	Crown Closure	Mean Height	Mean DBH	Species Composition	Year of Origin
A1 (n=1):	1	<1%	5.6 m	6.8 cm	Sb10	1971
A2 (n=0):						
A3 (n=0):						

Lower Vegetation Layer info:

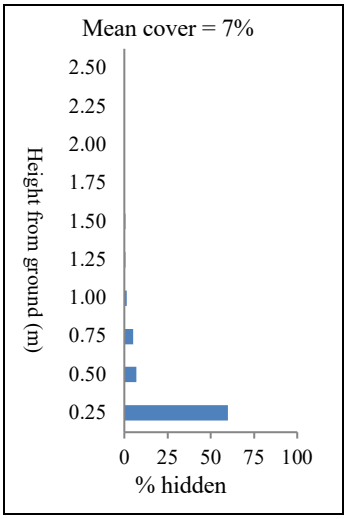
Vegetation Layer	Total # Species	Percentage Cover	Species Composition*
B1	3	1%	Picemar8 Larilar1 Pinuban1
B2	2	<1%	Myrigal6 Larilar4
Forb	7	1%	Caltpal3 Callver2 Drosrot2 Epilpal1 Ranupen1
Graminoid	12	6%	Careaqu4 Agrosca2 Careutr1 Juncdud1
Lichen Bryophyte	3	5%	Marsema7 Jungexs2 Tomenit1

*Only including species that constitute 10% or more by composition.

BS27 Sedge Rocky Shore: very moist sand (n=4)

Structural Attributes and Relative Rating

Structural Component	Attribute	Value	Rating
Snags	Mean # of snags/plot	0.0	Low
	Mean snag diameter (cm)		
	Mean snag height (m)		
	Mean snag decay Class		
Course Woody Debris	Mean frequency of CWD	0.0	Low
	Mean CWD diameter (cm)		
	Mean CWD decay class		
Mean Percent Ground Cover	Litter Cover	1.5	Low
	Litter Depth (cm)	0.1	Low
	Bare Soil	27.5	High
	Bare Rock	17.0	High
	Open Water	43.5	High



Structural Diversity, Species Richness, and Unique and Rare Species Occurrence Evaluation

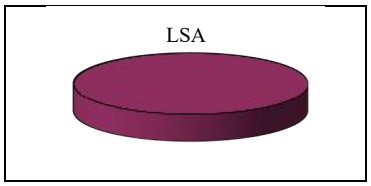
Attribute	Value	Rating
Structural diversity	1.2	Moderate
Species richness	9	Low
Unique species	7	High
Provincially listed species	0	Low

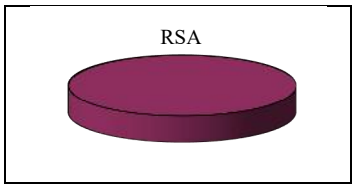
Unique species observed:
Jungermannia exsertifolia, Notched Rustwort (*Marsupella emarginata*), Vernal Water-starwort (*Callitriche verna*), Bristly Buttercup (*Ranunculus pensylvanicus*), Inland Sedge (*Carex interior*), Dudley's Rush (*Juncus dudleyi*), Nuttall's Salt-meadow Grass (*Puccinellia nuttalliana*)

Provincially listed species observed:
None

Ecosite Supply

Areas occupied by sedge rocky shores comprised 4.2 ha (<0.1%) of the LSA and 29.2 ha (<0.1%) of the RSA.

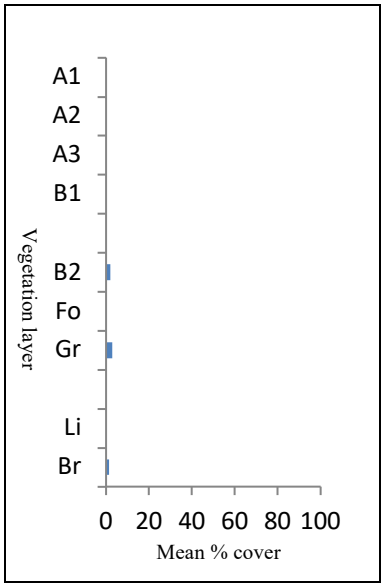




Ecological Interpretation

Whereas BS26 ecosites more closely reflect the condition of the Athabasca Dunes ecodistrict, this ecosite (BS27) applies to the rocky-sandy shore conditions in other areas of the Boreal Shield ecozone. Like BS26, this ecosite also occurs as a narrow feature adjacent to lakes and ponds.

DL1 Disturbed lands - vegetated (n=4)



Ecosite Description

DL1 ecosite type is characterized by previous removal of naturally occurring vegetation (and in some cases soil) and the absence of a tree layer. Some sites include an open shrub layer including by willows, green alder, and jack pine. Graminoids and forbs are also present, however, mainly consisting of planted or invasive species. A cover of mosses can also be found on the ground, but bare soil is a predominant feature in this ecosite type.

Species and Vegetation Layer Info

Average number plant and lichen species per plot (min, max): 4 (3, 5)

Tree Layer Info:

Tree Layer	Total # Species	Crown Closure	Mean Height	Mean DBH	Species Composition	Year of Origin
A1 (n=0):						
A2 (n=0):						
A3 (n=0):						

Lower Vegetation Layer info:

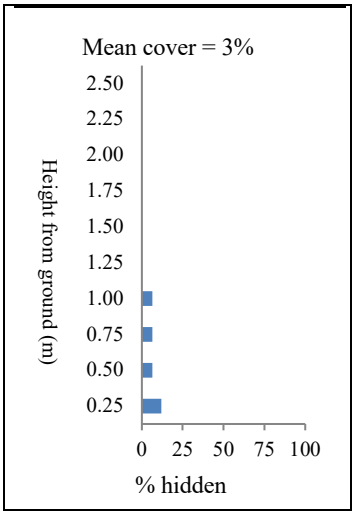
Vegetation Layer	Total # Species	Percentage Cover	Species Composition*
B1	1	<1%	Pinuban10
B2	4	2%	Vaccmyr8 Pinuban1 Vaccvit1
Forb	3	<1%	Epilang8 Chenalb1 Saxitri1
Graminoid	3	3%	Agrosca6 Carebre4
Lichen	1	<1%	Cladmit10
Bryophyte	1	1%	Polyjun10

*Only including species that constitute 10% or more by composition.

DL1 Disturbed lands - vegetated (n=4)

Structural Attributes and Relative Rating

Structural Component	Attribute	Value	Rating
Snags	Mean # of snags/plot	0.0	Low
	Mean snag diameter (cm)		
	Mean snag height (m)		
	Mean snag decay Class		
Course Woody Debris	Mean frequency of CWD	0.0	Low
	Mean CWD diameter (cm)		
	Mean CWD decay class		
Mean Percent Ground Cover	Litter Cover	7.2	Low
	Litter Depth (cm)	0.4	Low
	Bare Soil	89.4	High
	Bare Rock	0.0	Low
	Open Water	0.0	Low



Structural Diversity, Species Richness, and Unique and Rare Species Occurrence Evaluation

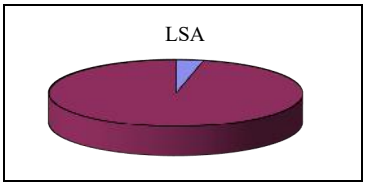
Attribute	Value	Rating
Structural diversity	1.2	Moderate
Species richness	4	Low
Unique species	3	Moderate
Provincially listed species	0	Low

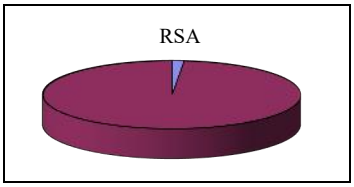
Unique species observed:
Lamb's-Quarters (*Chenopodium album*), Three-toothed saxifrage (*Saxifraga tricuspidata*), Fescue Sedge (*Carex brevior*)

Provincially listed species observed:
None

Ecosite Supply

Areas occupied by anthropogenic disturbance comprised 165.8 ha (3.5%) of the LSA and 596.4 ha (1.5%) of the RSA.





Ecological Interpretation

DL1 ecosites are poor in species diversity. They do have a moderate number of unique species, however, these species are generally actively seeded (such as red fescue) or invasive (such as narrow-leaved hawk's beard and dandelion). The ecosites are the result of previously cleared developed sites (e.g. road right-of-ways and airstrips) where some kind of natural revegetation has taken place, as well as areas where active reclamation has occurred.

2.3 Linear Feature Natural Regeneration Assessment

2.3.1 Background

Environment Canada (EC) (2012) assessed the capacities of caribou ranges to maintain self-sustaining local populations of boreal caribou across Canada. They utilized a methodology that linked calf recruitment to levels of disturbance within specific ranges. The objective was to identify range-specific disturbance based on management thresholds. For SK1, in 2018, ECCC indicated that to ensure sustainable caribou populations total buffered anthropogenic disturbance should not exceed five percent and that total disturbance (natural + buffered anthropogenic) should not exceed 40 percent. Currently, under this scheme, the Denison project area is considered to be completely disturbed when taking into account buffered anthropogenic disturbance in the LSA and is 82% disturbed in the RSA. Linear disturbances, in the form of exploration lines, temporary exploration trails and all season and seasonal roads were most common (see Section 2.1.2).

The increase in linear disturbances has the potential to increase the hunting opportunities and efficiencies of wolves (James *et al.* 2004; Dickie *et al.* 2017) and black bears (Latham *et al*. 2011a; Tigner *et al.* 2014, DeMars and Boutin 2017). Dickie *et al*. (2017) demonstrated that wolves move faster and farther on right-of-way's (ROW) (especially wider ROWs) than in interior forests. Latham *et al*. (2011b) observed that legacy seismic lines in Alberta were the most important movement corridors for wolves during the snow-free season, and Tigner *et al.* 2014 also found that black bears used linear features more frequently than undisturbed forest interior. This increased carnivore use of linear features could lead to higher levels of woodland caribou mortality.

Additive footprint, from the proposed Wheeler River Project, will result in an increase to baseline disturbance levels and prolong the natural recovery timeline of these and existing disturbances. The network of linear footprint, particularly where it occurs within or nearby effective caribou habitat, may present the best opportunity for compensatory reclamation activities. However, not all existing disturbances may be currently disturbed because natural succession has likely begun on many older features.

Visual or physical obstruction by vegetation is thought to be an important functional habitat attribute for wildlife, either as hiding cover, or as a factor affecting movement. Ungulate flight responses are likely governed by several factors and the amount of hiding cover is likely one important factor (Nudds 1977). This section presents two approaches for investigating *current* visual and physical obstruction as well as one approach for investigating *potential future* visual and physical obstruction on linear features. The approaches for current visual obstruction include measurements of hiding cover (percentage hidden) and vegetation regrowth (percent cover or stem count by vegetation layer). The approach for examining *potential future* visual obstruction involves investigating regeneration of ericaceous shrub and tree species composition. Ericaceous shrubs, such as blueberry, Labrador tea and leatherleaf (see McLaughlan *et al*. 2010) will generally not grow taller than 1 m and will not contribute considerably in terms of line blocking, physical or line of sight. Tree species (such as jack pine and black spruce) on the other hand will, given there are no fires or human traffic, grow tall enough to block line of sight. The abundance of tree species regeneration on a linear feature (although currently less than 1 m tall) would therefore be an

important predictor of future regrowth and visual obstruction potential on a linear feature. A paired sampling design was used to compare current conditions along existing disturbance features to adjacent reference sites.

2.3.2 Methods

Sample Site Selection

Field sampling was conducted between July 23 and 31, 2019, with full vegetation green-up. Sampling sites were stratified by lowland, upland sites and then by mature or regenerating forest classes. Sample sites were stratified randomly using a 1:20,000 anthropogenic feature and vegetation cover type map (see Section 2.1.1 and 2.1.2). In addition, due to the relatively homogenous vegetative characteristics of the study area, specific sites with higher levels of linear feature regeneration were intentionally selected to provide adequate representation. All sample sites chosen were to be accessible safely by ATV. Sampled disturbance types included handcut exploration lines (1-2 m wide), temporary trails (3-7 m wide) and roads (6-10 m wide).

Paired reference transects were run along the same bearing and parallel to linear feature transects in suitable interior (reference) habitat 30 m away. A total of 46 sites were sampled. The locations of transects are provided in Figure 2.3-1. Transect details are provided in Appendix 3.

Sample Site Layout and Sampling Design

Each sampling site consisted of a 30-m transect along which five 20 cm x 50 cm sub-plots, five 1 m x 1 m sub-plots and three 2 m x 5 m sub-plots were systematically distributed at 5 m intervals (Figure 2.3-2). A series of vegetative and structural attributes were estimated or measured. Visual estimates along a continuous scale to the nearest percent were made at each sub-plot as described in British Columbia Ministry of Forests (1998). The percent cover of bare soil, rock/stones, litter, mulch, terrestrial lichen, feather moss, and sphagnum moss were recorded in the 5, 20 cm x 50 cm sub-plots. The depth of litter and mulch were also recorded. In each of the 1 m x 1 m sub-plots, the 10 most abundant low shrubs (<1 m in height) were recorded and given a rank order from 1 (most abundant) to 10 (least abundant). Forbs, grasses and sedges/rushes were grouped together and recorded and ranked in the same manner. Total percent cover and median height of low shrubs, forbs, grasses, sedges/rushes and standing water was recorded for each sub-plot. Tall shrub saplings were surveyed in the 2 m x 5 m sub-plot. Saplings were divided into 2 groups: 1-<3-m and ≥3-5-m heights. Species and height was recorded for each sapling. Structural data included frequency of occurrence of coarse woody debris and hiding cover. Coarse woody debris was recorded along the length of the 30-m transect. The total number of intercepts, the diameter and the decay class (1-7) of all pieces >10 cm were measured or estimated (Lee et al. 1995).

Horizontal and vertical visual obstruction from vegetation was estimated in both east and west directions from the transect centre and along each disturbance and corresponding reference transects adapting methods by Nudds (1977). A red and white colour-coded cloth measuring 2.5 m in height was held upright 15 m from the observed at the transect centre (Figure 2.2-4). The observer viewed the cloth from both caribou and wolf eye levels (1.7 m and 1.2 m above ground

respectively, as per Kansas *et al.* 2015). An estimate of percent obstructed/hidden (by vegetation) was recorded for each of the ten 25 x 25 cm squares.

Analysis

Three types of analyses were completed to assess natural regeneration of disturbed linear features and paired reference transects, including:

1) Level of visual obstruction provided by vegetation on linear features.
2) Level of vegetation regrowth (percentage cover or stem counts).
3) Analysis of low shrub cover, focused on dominant species type (ericaceous shrub or tree) to determine the percentage of species that has the potential to reach caribou eye level and beyond (to predict whether a line is likely to be naturally revegetated over time).

For each of these three analyses, four classes of features were investigated, including features:

1) that have burned after creation (Appendix 4 - Photograph 2.3-1) versus those that have not burned since creation (Appendix 4 - Photograph 2.3-2).
2) in upland (Appendix 4 - Photograph 2.3-3) versus lowland (bogs and fens) (Appendix 4 - Photograph 2.3-4) areas.
3) in old (> 40 years since fire) (Appendix 4 - Photograph 2.3-3) versus young forest (< 40 years since fire) (Appendix 4 - Photograph 2.3-2).
4) with varying degree of human use, ranging from None (Appendix 4 - Photograph 2.3-5), Low (Appendix 4 - Photograph 2.3-6), Low/Moderate (Appendix 4 - Photograph 2.3-7), Moderate (Appendix 4 - Photograph 2.3-8), Moderate/High (Appendix 4 - Photograph 2.3-9), and High (Appendix 4 - Photograph 2.3-10). Level of use was based on observations in the field including flattened vegetation, percentage of bare soil, presence and extent of tire tracks, etc.

Seven different vegetation cover/stem density metrics (lichens, mosses, forbs, graminoids, shrubs < 1 m, shrubs 1-2 m, and shrubs 3-5 m) and two vegetation structure metrics (wolf hiding cover and caribou hiding cover) were analyzed. The average values for all vegetation layers as well as the average values for visual obstruction up to 2-m height from both caribou and wolf eye levels for the sampling by stratified sites were calculated in both the linear feature transects (treatment) and the paired and adjacent natural transects (reference).

For the low shrub layer, the 10 most abundant shrub species (<1 m in height) were recorded and given a rank order from 1 (most abundant) to 10 (least abundant) for each sub-plot. The ranks were converted to a numerical value (1 = 100, 2 = 90, 3 = 80, …, 10 = 10), and the values from each sub-plot were added to provide a total amount for each transect (thereby taking into consideration both ranking and occupancy for the sub-plots). This value was then normalized so each species received a value between 0 (not observed in any sub-plot) to 100 (overall highest ranking and most commonly recorded in sub-plots).

Using this information, two levels of analysis were undertaken. First, a comparison between disturbance and reference for each site type (e.g. Upland - Disturbed vs. Upland - Reference) were analysed. Second, a comparison of the level of natural regeneration between disturbed areas in

different site types (e.g. Upland - Disturbed vs. Lowland - Disturbed) was analysed. To investigate the variation between reference and disturbance transects (rather than the variation within each of these groups), the precision of the mean value was quantified by calculating standard error of the mean (SE).

For the first level analysis, paired t-tests were run to verify if differences in mean values between compared variables were statistically significant ($P<0.05$). For the second level analysis, two-sample t-tests, not assuming equal variance, were run to verify if differences in mean values between compared variables were statistically significant ($P<0.05$). All data was analyzed using Minitab v. 17.3.1 (Minitab Inc., State College, PA, USA).

Assumptions and limitations

Natural vegetation recovery, at any given site, will depend on a variety of factors. There is no information on when linear features were created, how they were created, how they were used and for how long they may have been used, among other factors. Therefore, this variable cannot be fully accounted for. The analyses therefore did not take age of disturbance into consideration. For each of the four sets of analyses, several additional assumptions and limitations were identified:

1) Burned before or after creation of linear disturbance
    - Since there is no information available on when linear features were created, the designation of burned before or after line creation was based on evidence observed during the field trip, such as presence of stumps and/or deadfall from tree felling (see Photograph 2.3-5 in Appendix 4).
    - Transects included in this analysis are all:
        i. No/Low human use (to investigate effect of fire only (not human use)).
        ii. Trail or Handcut (as roads had minimal natural recovery irrespective of fire age)
        iii. In young upland regenerating forest (to compare similar ages of fire)

2) Upland versus lowland comparisons include transects that:
    - Have No/Low human use (to investigate effect of moisture only (not human use)).
    - Are Trail or Handcut (as roads have minimal recovery irrespective of moisture regime).
    - Represent areas of between 30 to 100 years since fire, since there is most overlap for these ages).

3) Old versus Young comparisons include transects that:
    - Are upland areas only (very limited young lowland transects).
    - Have not burned since the line was cut.
    - Are divided into young (<40 years since fire) and old (>40 years since fire).
    - Have No/Low human use (to investigate effect of age only (not human use)).
    - Are Trail or Handcut (as roads had minimal recovery irrespective of fire age).

4) Levels of Human Use, transects that include:
    - All landcover types (uplands and lowlands)
    - All ages
    - All types of features

- All categories of human use

2.3.3 Results

The key findings and trends for each of the three analyses, *including Visual Obstruction, Vegetation Recovery and Ericaceous shrubs vs. Tree Species ar*e provided in Table 2.3.1. Detailed results for each analysis are provided below.

2.3.3.1 Visual Obstruction

Line cut before versus after fire

No significant differences in visual obstruction in any layers were observed between disturbed versus reference transects for areas that had burned after the line was cut (Figure 2.3-3A). This indicates that, for trails and hand cuts and in absence of continued human use, wildfires will, to some extent, "reset" the disturbance and initiate the natural recovery process such that vegetation conditions will be similar on and off disturbance. In situation where lines were cut after fires, wolf visual obstruction was significantly higher for reference transects from 0.25 to 1.25 m layers ($P<0.03$), and caribou visual obstruction was significantly higher for reference transects in the 0.25 to 0.75 m layers, indicating poor vegetation regrowth in areas cut after fire (Figure 2.3-3B).

Upland versus lowland

Lowlands generally had a slightly higher visual obstruction in the lower height layers compared with uplands. In lowlands, caribou visual obstruction was significantly different for all layers, except 0.25 and 0.5 m above ground ($P<0.05$), however in uplands these lower layers were also significantly different between reference and disturbance (Figure 2.3-4A). Wolf visual obstruction was similar for both lowlands and uplands as both displayed no significant differences in the 0.25 to 1 m layers (Figure 2.3-4B). Comparison of recovery for disturbed areas, for lowlands versus uplands, indicated that a higher visual obstruction in the lowest height layer occurred. Both wolf and caribou visual obstruction were significantly different in the 0.25 m layer but displayed no significant difference in any of the higher layers.

Young forest versus old forest

There was a greater difference between reference and disturbed areas for young forests than for old forest. Overall, hiding cover (all layers combined) was significantly different between disturbed and reference for both wolf ($P=0.001$) and caribou ($P<0.001$). Both wolf and caribou were also significantly different in every height layer ($P<0.05$) (Figure 2.3-5A). For old forests this difference was not as prominent, since the lower height layers showed no significant difference between disturbed and reference (Figure 2.3-5B). This difference, between old and young forests, was not a result of differences in recovery rates, however. Since older forests were generally more open and had lower visual obstruction overall, compared to younger forests, there was an inherently smaller difference between reference and disturbed areas in old forests. The recovery rates (based on visual obstruction) were similar for both young and old forest, and there were no

significant differences in any layers for either wolf (P=0.345) or caribou (P=0.466) (Figure 2.3-5C).

Level of human Use

Human use significantly affected vegetation regrowth (based on visual obstruction). There was no significant difference between no use and low use (Figures 2.3-6A and 2.3-6B), nor between moderate and high use (Figures 2.3-6C and 2.3-6D). There was however a significant difference between low use and moderate use for both caribou (P=0.015) and wolf (P=0.013), indicating that rather than a gradual change in vegetation recovery with increasing disturbance, there is a threshold of human use after which natural vegetation recovery drops drastically.

2.3.3.2 Vegetation Recovery

Line cut before versus after fire

Average cover of lichens, mosses and low shrubs were similar in reference and disturbed areas for areas burned before and after line creation. Tall shrubs (1-3 m) were observed in disturbed areas in young forests (12-15 years since fire) only if the area was burned after the line was created (Figure 2.3-7), emphasizing the importance of fires for initiating regrowth on disturbed linear features and the potential need for manual intervention should management objectives desire regrowth on these features (i.e. reduce the overall level of disturbance).

Upland versus lowland

Lowlands generally had higher moss and low shrub cover, and a lower lichen cover than uplands (Figure 2.3-8). This is likely due to site conditions (e.g. soil moisture) rather than as a result of disturbance since there were no significant differences between reference and disturbed areas for either the lowland or upland transects.

Young forest versus old forest

There was a significantly higher cover of lichen in old forests compared to young forests regardless of disturbance levels (Figure 2.3-9). However, there were no significant differences in natural regrowth of disturbed sites between old and young forests.

Level of human Use

As the case was for visual obstruction, human use significantly affected vegetation regrowth. There was no significant difference between reference and disturbance for the no use and low use areas. However, moderate and high use areas had minimal regrowth (Figure 2.3-10). This highlights the deleterious effects of continued human use of disturbance features on natural regrowth.

2.3.3.3 Ericaceous Shrub versus Tree Species Composition

Line cut before versus after fire

Features that had burned after the line was created showed a similar abundance of jack pine for both reference (56) and disturbed (60) areas (Table 2.3-2). Areas that were burned prior to line creation had a much lower abundance of jackpine in the disturbed areas (18) compared to reference (59). This supports the findings of visual obstruction and vegetation regrowth in that wildfires for trails and hand cuts and in absence of continued human use, reset the disturbance and initiate recovery, and that recovery post fire is similar on and off disturbance.

Upland versus lowland

Lowlands had a higher abundance of black spruce in disturbed areas (55) compared to reference areas (37), indicating these lines are on a trajectory towards natural recovery (Table 2.3-3). Upland areas had a very low abundance of tree species in both reference (jackpine: 4, black spruce: 4) and disturbed areas (jackpine: 6 and black spruce: 4), indicating there is minimal natural recovery in upland areas where no fire disturbance has occurred.

Young forest versus old forest

When looking at old (>40 years old) versus young (< 40 years old) upland areas, the abundance of tree species was similar in disturbed and reference areas for both age types (Table 2.3-4). However, the abundance of tree species was much higher for young upland forest than for old upland forests. This indicates old forests are likely not recovering naturally and would need active reclamation to instigate vegetation regrowth.

Level of human Use

Areas with no human use and low human use had similar abundance of tree species, whereas both moderate and high use areas had very low abundance of tree species (Table 2.3-5). Again, this highlights the deleterious effects of continued human use of disturbance features on natural regrowth.

2.3.4 Key Take-aways

- Wildfires (in absence of continued human use), can reset the disturbance for trails and hand cuts, and instigate a post fire recovery that is similar on and off disturbance features. No reclamation efforts will be needed in these areas.

- Natural vegetation recovery of tree/shrub height and abundance on disturbed features is relatively high in lowland habitats. Reclamation efforts are likely not needed in these areas.

- Human use is an important factor affecting vegetation regrowth. Reduced access to trails would be an important factor affecting reclamation success. Restricting access could also enhance natural recovery in some areas.

- Results indicate that natural vegetation recovery, on disturbances, is lower (tree/shrub height and abundance) in mature upland habitats. For caribou management, these are areas where reclamation efforts should be prioritized.

- Based on the above results, the reclamation efforts that likely would create the greatest contribution to overall habitat improvement would target trails and handcuts in mature upland habitat. Management strategies should include visual and physical obstruction, reduced line of sight and restricted access (human use).

2.4 Rare Vascular Plant Surveys

The rare vascular plant survey was completed with the primary objectives of:

- Documenting rare vascular plant occurrence(s) within the proposed Denison Wheeler Project footprint
- Providing a scientifically defensible baseline for potential follow-up/monitoring requirements
- Describe rare plant-Ecosite affiliations

2.4.1 Methods

Sampling Protocol

The rare plant survey was completed according to the Government of Saskatchewan (2017) Rare Vascular Plant Survey Protocol. Using available Saskatchewan Ecosite mapping, the survey transects were laid out randomly in all of the available Ecosites within the disturbance footprint for the proposed Denison Wheeler River project. Given that the landscape consists of boreal conifer forests, the most appropriate sampling unit was determined to be 100 m transects and the number of transects in each Ecosite was determined using the following formula as per the Government of Saskatchewan (2017) Rare Vascular Plant Survey Protocol:

$$y = (0.8\ x/z) + (40/z)$$

Where:

y is the number of 100 m transects
z is the total transect width in meters
x is the area of each habitat in hectares

The transects were randomly laid out in a geographic information system (GIS) prior to the field work (Figure 2.4-1) and the resulting transects were then loaded onto handheld GPS units. When possible a minimum of 10 transects per Ecosite were placed, however in some cases given the orientation and shape of the Ecosite polygons on the landscape this was not always possible. Using random transects laid out in each Ecosite, rather than a meandering search approach, transect based searches of high probability rare plant habitat reduce bias and allow for a replicate of the transects if desired. This approach also allows for calculation of search effort (Henderson 2009).

The stratification of transects by Ecosite type is displayed Table 2.4-1.

Field Work

Two rare vascular plant surveys were completed in the proposed Denison Wheeler River Project footprint. The first survey was designed to survey a subset of the 74 random transects. The purpose of this survey was to assess the accuracy of the predictive Ecosite mapping and provide replicate survey locations in the areas of the footprint most likely to remain static as the proposed footprint was, and still is, preliminary in nature. The rare plant surveys were completed by two surveyors travelling on foot along each predetermined 100 m transect using handheld GPS units and

recording all vascular plant species encountered within 2 m on each side of the 100 m transect as per the guidelines. All plant species observed were recorded and details of the Ecosite affiliation, population, and distribution of all rare vascular plants recorded. In addition to the prescribed transects, rare Ecosite searches were completed when encountered. Two observers walked a meandering path through the rare Ecosite to survey its entirety.

Where possible, plant identification was completed in the field. Plants that were not immediately identifiable were collected for later determination using additional references.

In Saskatchewan, rare plant species are those with S1, S2, or S3 conservation ranks as per the most recent SKCDC vascular plant database (SKCDC 2019a) (Table 2.4-2).

Post Field Work

The identification of all plants or plant photographs were verified using additional references (Leighton 2012, Harms and Leighton 2011, Kershaw *et al*. 2001, Moss 1994) and online databases including the BC E-flora database (Klinkenberg 2011). Some plant specimens that had very small distinguishing characteristics (e.g. grasses, sedges, and other aquatic plants) were identified using a dissecting microscope.

2.4.2 Results

During the first survey, a total of 20 100 m transects and two rare Ecosite searches were completed. The survey was completed between July 9 and 12, 2017. The total transect area searched was 8,000 m^2 (20 x 100 m length x 4 m wide). The additional rare Ecosite searches resulted in 2,000 m^2 (500 m x 4 m) searched in BS19 (graminoid bog) and 4,400 m^2 (1,100 m x 4 m) searched in BS18 (Labrador tea shrubby bog) (Figure 2.4-1).

A second rare vascular plant survey was completed between July 28 and August 2, 2017. A total of 74 transects, including 20 replicates from the first survey, were completed for a total survey area of 29,600 m^2 (74 transects x 100 m length x 4 m wide) (Figure 2.4-1). The field surveys found fewer Ecosites than the predictive Ecosite mapping indicated. As a result, more transects were completed than the Government of Saskatchewan (2017) rare plant survey protocol required. Table 2.4-3 outlines the number of transects completed per Ecosite as identified during the field survey.

Plant Inventory

In total there were 66 vascular plant species and eight identifiable non-vascular species recorded in all 74 transects across both surveys (Appendix 5 and 6). The first survey (July 9-12) identified 44 vascular plant species. The second survey (July 28-Aug 4) identified 65 vascular plants. The relatively low number of vascular species reflects the low plant species richness associated with primarily upland immature jack pine stands in the boreal Athabasca Plain ecoregion in northern Saskatchewan.

There were no invasive non-native plant species recorded along any of the transects.

Rare Plants

There were two rare plant species observed (Table 2.4-4), with one species observed at nine locations along eight different transects (Figure 2.4-1). A GPS polygon or waypoint of the rare plant population was recorded and photos of the plants and the plant community were taken of each species observed as well as a full description of the habitat. All rare plant observations were recorded in the recently updated Saskatchewan load form under the plant tab and submitted to the SKCDC. The two rare species included:

- Alaskan clubmoss (*Diphasiastrum sitchense*)

Description
Alaskan clubmoss is a low-growing evergreen forb with ground-trailing horizontal stems that are often half buried in the lichen and duff on the forest floor (Harms and Leighton 2011). The cones are sessile and borne terminally on some branches; upright shoots are mostly less than 15cm; leaves are 5-ranked; stems are 3-4 mm wide (Figure 2.4-2). Alaskan clubmoss is ranked S2 in Saskatchewan.
Population and Habitat
There were nine patches of Alaskan clubmoss recorded on eight transects with population estimates ranging between 15 to 940 clumps covering 6 to 1,611 m^2 (Figures 2.4-1, 2.4-2, 2.4-3; Table 2.4-4). This species was associated with open transitional zones between upland jack pine (*Pinus banksiana*) and forested bogs (Figure 2.4-4). One population was also found in the transition between mature and immature jack pine stands at the base of a slope. Alaskan clubmoss was found growing in association with blueberry (*Vaccinium myrtilloides*), common Labrador tea (*Rhododendron groenlandicum*), leatherleaf (*Chamaedaphne calyculata*), and pale laurel (*Kalmia polifolia*).

- Three-seeded sedge (*Carex trisperma*)

Description
Three-seeded sedge was observed during both surveys. Three-seeded sedge is a loosely cespitose sedge species 10-60 cm high, with leaves 0.5-1.5 mm wide (Leighton 2012). This species has 2-4 spikes in the inflorescence all alike with female flowers above male flowers, spikes 4-6 mm long and 3-4 mm wide; perigynia 1-5 per spike, 2.5-3.7 mm long, ovate to elliptic tapering to the 0.5 mm beak, glabrous, finely veined and punticulate; lowest spike is remote (1-4 cm below the upper spikes); lowest spike bract reaching the spike above or often overtopping the inflorescence (Figure 2.4-5). Three-seeded sedge is ranked S3 in Saskatchewan.
Population and Habitat
There was one patch of three-seeded sedge observed in a wet depression in the riparian area of a creek. This patch had an estimated 100 plants of this species and was found growing in association with two-seeded sedge (*Carex disperma*), common Labrador tea (*Rhododendron groenlandicum*), and bluejoint (*Calamagrostis canadensis*) (Figures 2.4-1, 2.4-5, 2.4-6; Table 2.4-4).

2.4.3 2019 Rare Plant Survey Requirement Assessment

As detailed in Section 2.4.1, rare plant surveys were completed in 2017 according to the Saskatchewan Government protocol 20.0 Rare Prarie Plants (2015). However, after the surveys were completed the Wheeler River project footprint was altered (access corridor and proposed mine footprint). In some places, substantial adjustments were made, but in many other locations the shift was small. Overall, the proposed development, and associated footprint, remained in the same local vicinity and the adjusted access corridor and project footprint were in very close proximity to the previous alignment.

However, per the Rare Vascular Plant protocol, extensive new sampling would be required. Our preliminary assessment of the 2017 sampling was that the scale, intensity and spatial distribution of the sampling was adequate to inform an Environmental Impact Statement (EIS) under the condition that site specific rare plant pre-disturbance surveys would accompany a project approval. To confirm this, Omnia consulted with the Saskatchewan Government (S. Vingemazer) to confirm the status of the existing survey data and potential requirements for new surveys. After consultation, it was agreed upon that the surveys already completed were adequate to satisfy the requirements of an EIS but additional surveys would be required for locations where new proposed footprint overlapped with Ecosites that were not sampled during the 2017 surveys. In addition, Denison committed to completed pre-disturbance rare plant surveys, where required, once the project footprint had been finalized and prior to construction.

Map overlays were completed, and results indicated that the new alignment/footprint overlapped two Ecosites not surveyed in 2017 including:

- BS7- Black spruce-blueberry-lichen (0.3 Ha)
- BS9- Black spruce-jack pine/feathermoss (1.5 Ha)

Following the guidance provided by S. Vingemazer (pers. comm), in the spring of 2019, a reconnaissance field trip was completed to assess mapping accuracy and evaluate the need for additional rare plant surveys. Prior to the field trip, the centroids of each candidate polygon were derived from the GIS and uploaded to a hand-held GPS.

A total of 26 candidate BS7 and/or BS9 polygons were visited to ground truth predictive Ecosite mapping and assess the need for additional rare plant surveys (Figure 2.4-7). Only one site was mapped accurately as a BS9, an approximately 40 x 15 m polygon (Figure 2.4-8). Table 2.4-5 details the findings of the ground truthing survey.

A rare plant survey was not completed on the black spruce-jack pine/feathermoss (BS9) polygon. Due to the small size of the polygon it is likely the final footprint can be adjusted to avoid rare plant impact to this Ecosite. In addition, Denison has committed to completing pre-disturbance rare plant surveys on the finalized footprint, should the finalized design include disturbance to the black spruce-jack pine/feathermoss (BS9) Ecosite.

2.5 Vegetation and Soil Collection and Chemistry Analysis

The vegetation and soil sampling program consisted of three components: (1) the collection of blueberry stems, leaves, and fruit (currents years' growth), (2) the collection of terrestrial lichen, and (3) the collection of soil samples. The primary objectives of this survey were to:

- Determine baseline conditions of physical properties, inorganic ions, metals and radionuclides in vegetation (blueberry and lichen) and soil samples
- Establish baseline sampling to support future monitoring, mitigation, and impact assessment

2.5.1 Methods

Vegetation and soil samples were collected from pre-established Radon permanent sample plots (PSP). The sampling consisted of three components: the collection of terrestrial lichen, current year's growth of blueberry (leaf, stem and berry), and a soil sample. The terrestrial lichen was collected by hand and all debris (leaves, needles and dirt) was removed from the sample. Latex gloves were worn during the collection to prevent contamination of the samples and a new pair of gloves was utilized at each site. A total wet volume of 500 g was collected and placed in a plastic bag to be frozen until chemical analysis. The blueberry vegetation was collected by using Teflon coated scissors to remove leaves, stems and berries from the current year's growth. Scissors were cleaned with distilled water between sample sites to prevent contamination. Latex gloves were worn during any handling of the samples and replaced after each sample site (pers. comm. D. Chorney 2017). A total wet volume of 500 g was collected, placed in a plastic bag and frozen until laboratory analysis.

Soil samples were collected using a small spade shovel. The shovel was cleaned with distilled water between sample sites to prevent contamination. The organic "duff" layer was removed from the sample and mineral soil was collected to a depth of five centimeters. Latex gloves were worn while removing the duff layer to prevent contamination and gloves were replaced after each sample site. A total wet volume of 100 g of soil was collected, placed in a plastic bag and frozen until laboratory analysis.

The samples were collected as close to the pre-established PSP locations as possible. Sample collection ranged from 25 to 200 m total distance from the Radon sample site to fulfil the weight requirements.

All samples were shipped frozen or dried to the Saskatchewan Research Council (SRC) for chemical analysis. The vegetation and soil samples were analyzed for both metal and radionuclide parameters.

The metals parameters that were analyzed included:

- Aluminum
- Antimony
- Arsenic
- Barium
- Beryllium
- Boron
- Cadmium
- Chromium
- Cobalt
- Copper
- Iron
- Lead
- Manganese
- Molybdenum
- Nickel
- Selenium
- Silver
- Strontium
- Thallium
- Tin
- Titanium
- Uranium
- Vanadium

The radionuclide parameters that were analyzed included:

- Lead-210
- Polonium-210
- Radium-226
- Thorium-230

The metal parameters were analyzed by inductively coupled plasma - mass spectronomy and radionuclides were analyzed by extraction and beta counting (Pb-210) or alpha spectroscopy (Po-210, Ra-226, Th-230) (pers. comm. D. Chorney 2017).

2.5.2 Results

Vegetation (lichen and blueberry) and soil samples were collected from 10 sample sites between August 2 and 7, 2017 (Figure 2.5-1). The results of the lichen chemical analysis are presented in Table 2.5-1, blueberry chemical analysis results are presented in Table 2.5-2, and the soil chemical analysis results are presented in Table 2.5-3.

Lichen radionuclide levels were relatively consistent across all sample sites. However, several metal parameters were elevated in sample site RSV10, including: aluminum, beryllium, boron, cadmium, chromium, cobalt, iron, lead, nickel, titanium, uranium, and zinc compared to other sample sites.

Blueberry radionuclide levels were also relatively consistent across sample sites. However, similar to lichen samples, higher levels of some elements including Lead-210 and Polonium-210 were observed in sample site RSV10 and higher levels of Thorium-230 in sample site RSV4. Metal parameters were variable but relatively consistent, aside from elevated levels of aluminium, chromium, iron, lead, titanium, and vanadium in RSV6.

Radionuclide levels in soil were also variable but relatively consistent. Sample site RSV9 showed higher levels of Lead-210 and Polonium-210 compared to other sample sites. Metal parameters

were relatively consistent with only sample site RSV 9 showing elevated levels of calcium, copper, lead, and manganese compared to other sample sites.

Although the primary objective of this survey was to provide a characterization of background and baseline levels for the Wheeler site, a comparison of soil and vegetation chemistry to Rio Tinto's Roughrider Project, completed in northern Saskatchewan is presented in Table 2.5-4 (Rio Tinto 2014). Soil and vegetation chemistry was similar between the two project areas. Soil metal parameter concentrations were generally higher in the Roughrider project area and radionuclide parameters higher in the Wheeler River project area. Lichen and blueberry metal parameters where generally higher in the Wheeler River project area. Radionuclide parameters for lichen were higher in the Wheeler river project area while blueberry radionuclide parameter concentrations were lower in the Wheeler River project area.

2.6 Winter Track Count Survey

The three primary objectives of the winter tracking survey were to:

- Determine the presence/not-absence of winter-active animals
- Determine the relative abundance of winter-active animals
- Enhance the project specific area understanding of species-Ecosite affiliations
- Provide a scientifically defensible baseline for potential follow-up/monitoring requirements

2.6.1 Methods

Two types of winter track count surveys were utilized. The first was driving/walking roads/anthropogenic areas within the LSA and recording all intersections of animal trails along the existing and proposed road alignments. The second method utilized triangle shaped transects. Triangle transects measured 7.5 km in length (2.5 km per side) and were located using a stratified random approach across the LSA and RSA. In addition to the triangle transects, a series of opportunistic riparian transects were also sampled to ensure representation of this less common wildlife habitat type.

Data was collected at 50 m intervals (termed a 'sub-transect') along each transect. Methodology was developed with guidance from the Saskatchewan Ministry of Environment (2014a) Species Detection Survey Protocol: Snow Track Surveys and the tracking triangle approach was adopted from long-term monitoring techniques originating in Finland (Linden *et al.* 1996) and adopted by the Alberta Biodiversity Monitoring Program (Shank and Farr 1999). Hand-held global positioning systems (GPS) were used for navigation and orientation purposes and to measure transect and sub-transect lengths. The road/anthropogenic transect routes were recorded using the track-log function in a hand held GPS, recording points every ten seconds.

The number of fresh animal trails crossing the transect path since the last snowfall event were recorded by species. Animal tracks were identified to species by print, stride and straddle. Multiple-pass hare and red squirrel trails were enumerated as five animals. Fresh bed sites (since last snowfall event) and ungulate foraging events (current winter browse associated with fresh

trails) were recorded within a 3 m band on either side of the transect path. Detailed information on anthropogenic features (i.e., cut lines, roads etc.) was also recorded; including occurrence, human use and wildlife use at the end of each 50 m sub-transect. Wildlife tracking data was collected a minimum of 24 hours after a snowfall event and continued until the track record was obliterated by wind, snow melt, or new snowfall. Tracking data and snow depth measurements were completed at the end of each 50 m sub-transect. A Universal Transverse Mercator (UTM) coordinate marking the start and end of each 50 m sub-transect was recorded.

The number of kilometer-days (length of transect multiplied by the days since last snowfall) was calculated for each transect and sub-transect. The number of animal trails per km-day by species was calculated by project area, Ecosite type, and transect.

2.6.2 Results

A total of 11 triangle transects (82 km), five riparian transects (2.7 km) and three road/anthropogenic transects (18 km) were completed between January 25 and February 3, 2017. Nine of 11 triangle transects (67 km), the five riparian transects and portions of the road/anthropogenic transects (11.5 km) were replicated between February 1 – 3 and March 2 – 12, 2018. (Figure 2.6-1). Sampling intensity was 440 km-days in 2017 and 179 km-days in 2018 for the entire project area. The trails of thirteen different species/species group were detected during winter tracking surveys across 15 Ecosites (Table 2.6-1 and Table 2.6-2). Listed below in descending order are species and corresponding mean trail densities for the entire project area:

- Snowshoe hare (*Lepus americanus*) – 7.48 trails per km-day
- Red squirrel (*Tamiasciurus hudsonicus*) – 1.52
- Grouse (*Phasianidea spp.*) or Ptarmigan (*Lagopus spp.*) – 0.60
- Marten (*Martes americana*) – 0.34
- Microtine rodent species – 0.23
- Ermine (*Mustela erminea*) – 0.12
- Canada Lynx (*Lynx canadensis*) – 0.11
- Mink (*Mustela vison*) – 0.07
- Woodland caribou (*Rangifer tarundus*) – 0.05
- Fisher (*Pekania pennanti*) – 0.01
- Otter (*Lontra canadensis*) – 0.01
- Red fox (*Vulpes vulpes*) – 0.01
- Moose (*Alces alces*) – 0.01

Ungulates

Two species of ungulates trails were observed during winter tracking surveys (moose and woodland caribou). Moose trails were observed on transects 5, 11 and the road/anthropogenic. Transect 11 had the highest mean density of moose trails at 0.09 trails per km-day. Transect 11 also had the highest trails per km day in 2017 (0.17), while transect 5 had the highest density (0.11) in 2018. Woodland caribou trails were observed on transects 2, 9, and 11 and were only detected during 2017 surveys. The highest trail densities observed in 2017 were on transect 11 (0.69) and transect 2 (0.67). Transect 11 had the highest mean trail density at 0.34 trails per km day. No

woodland caribou trails were observed along road/anthropogenic or creek transects (Figure 2.6-1 and Table 2.6-1).

Moose trails were observed in four Ecosites: BS17 (black spruce treed bog), BS18 (Labrador tea shrubby bog), road/anthropogenic (polygonal and linear disturbance) and RF2 (regenerating forest – tall shrub dominated). Trail densities were highest at 0.02 trails per km day in RF2 (regenerating forest – tall shrub dominated) during 2017 surveys and 0.41 in BS17 (black spruce treed bog) during 2018 surveys. The mean density was also highest in BS17 (black spruce treed bog) at 0.20 trails per km day. (Table 2.6-2).

Woodland caribou trails were detected in six Ecosites during the 2017 surveys: BS3 (jack pine/blueberry/lichen), BS7 (black spruce/blueberry/lichen), BS9 (black spruce-jack pine/feathermoss), BS17 (black spruce treed bog), RF2 (regenerating forest – tall shrub dominated) and on Water/Lake Ice. Trail density was highest in BS9 (black spruce - jack pine/feathermoss) at 1.43 per km day, followed by BS7 (black spruce/blueberry/lichen) (0.65) and BS17 (black spruce treed bog) (0.64). The highest mean density of trails occurred in the BS9 (black spruce - jack pine/feathermoss) Ecosite at 0.71 trails per km day (Table 2.6-2). No fresh trails were detected during 2018 surveys.

Woodland caribou feeding activity (fresh and old) was recorded at five different locations on transects 2 and 9 during 2017 surveys. Four were ground feeding craters and one was arboreal feeding. All observations were within the BS3 (jack pine/blueberry/lichen) Ecosite. The 2018 surveys detected 13 old ground feeding craters/crater complexes along transects 2, 9 and 12. Eight observations occurred in the BS3 (jack pine/blueberry/lichen) Ecosite and five observation in the RF2 (regenerating forest – tall shrub dominated) Ecosite.

Carnivores

The trails of seven species of carnivores were detected during winter tracking surveys including: marten, ermine mink, fisher, red fox, lynx and otter. Carnivore trails were observed in 74% (14/19) Ecosites (Figure 2.6-1 and Tables 2.6-1 and 2.6-2).

Marten trails were observed on all three transects types (triangle, creek, and road/anthropogenic). Transects 9 (1.51 trails/km-day), 2 (0.66), and 12 (0.59) had the highest trail densities during the 2017 surveys and transects 9 (1.64), 11 (1.62), and 12 (0.58) had the highest trail densities during the 2018 surveys. The highest mean density of marten trails was observed on transect 9 (1.57).

Marten trails were detected in 58% (11/19) of Ecosites across both sampling years. Marten trails were most often observed in the BS3 (0.83 trails/km-day) (jack pine/blueberry/lichen), BS4 (0.61) (jack pine – black spruce/feathermoss), and BS16 (0.58) (black spruce/balsam poplar/river alder swamp) Ecosites during 2017 surveys. The 2018 surveys detected marten trails most commonly in the BS4 (1.06) (jack pine – black spruce/feathermoss), BS7 (0.76) (black spruce/blueberry/feathermoss) and RF2 (0.68) (regenerating forest – tall shrub dominated) Ecosites. The highest mean density of marten trails was observed in Ecosite BS4 (0.83) (jack pine – black spruce/feathermoss)

Ermine trails were recorded on all three transect types. Trails were widespread during the 2017 surveys with detections on 65% (11/17) transects, while 2018 surveys detected ermine trails on 20% (3/15) transects. Creek 4 (1.69 trails/km-day), creek 3 (1.11), and transect 8 (0.69) had the highest trail densities during 2017 surveys. Creek 4 also had the highest trail density during 2018 surveys (2.35) and the highest mean trail density (2.02).

Ermine trails were detected in 58% (11/19) of Ecosites across both sampling years. Ecosites BS21 (1.61 trails/km-day) (tamarack treed fen), BS17 (1.01) (black spruce treed bog), and BS23 (0.61) (willow shrubby fen) had the highest trail densities in 2017. The 2018 survey detected ermine trails most frequently in the BS16 (6.47) (black spruce/balsam poplar/river alder swamp) Ecosite. The highest mean trail density was detected in Ecosite BS16 (3.23) (black spruce/balsam poplar/river alder swamp).

Mink trails were observed along all three transect types. Creek 3 (1.11 trails/km-day), creek 4 (0.48), and transect 12 (0.07) had the highest densities of trails in 2017 and transect 11 (0.90), transect 9 (0.72) and transect 12 (0.12) in 2018. Creek 3 had the highest mean mink trail density at 0.56 trails per km-day.

Mink trails were detected in 11 of 19 Ecosites (65%) but showed a marked preference for BS17 (black spruce treed bog), BS21 (tamarack treed fen) and BS18 (Labrador tea shrubby bog), with mean trail densities of 0.80, 0.61 and 0.43 trails per km-day respectively.

Fisher trails were only observed during 2017 surveys; along the road/anthropogenic transect and one triangle transect. Fisher mean trail densities were 0.09 on the road/anthropogenic transects and 0.02 on triangle transect 2. Fisher trails were detected in the anthropogenic (0.08 trails/km-day), RF1 (0.03) (regenerating forest – tree dominated) and BS3 (0.01) (jack pine/blueberry/lichen) Ecosites.

Lynx trails were detected on all transect types. The highest trail densities were observed on transects 4 (0.69 trails/km-day), transect 1 (0.49), and transect 6 (0.42) during 2017 surveys and creek 3 (2.51), transect 10 (0.62), and transect 7 (0.11) in 2018. The highest mean density was detected on creek 4 (1.25).

Lynx trails were detected in 37% (7/19) of the Ecosites surveyed across both sampling years. Ecosites BS18 (0.39 trails/km-day) (Labrador tea shrubby bog), RF2 (0.30) (regenerating forest – tall shrub dominated), and RF1 (0.26) (regenerating forest – tree dominated) hosted the highest density of lynx trails in 2017. The 2018 surveys detected lynx trails most frequently in Ecosites BS23 (2.51) (willow shrubby rich fen), RF3 (0.31) (regenerating forest – low shrub dominated) and RF2 (0.22) (regenerating forest – tall shrub dominated). The highest mean trail density across both sampling years was observed in BS23 (1.25) (willow shrubby rich fen). A single lynx bed site was recorded along transects 6 in the RF2 (regenerating forest – tall shrub dominated) Ecosite in 2017.

Otter trails were only observed in 2017; along triangle and creek transects. The highest trail densities were detected on Creek 4 (0.24), transect 11 (0.17), and transect 12 (0.10) during 2017 surveys and creek 4 yielded the highest mean density (0.12). Otter trails were detected in 32%

(6/19) of the Ecosites sampled. Ecosites BS18 (0.13) (Labrador tea shrubby bog), and BS17 (0.09) (black spruce treed bog) and Water/Lake ice (0.05) had the highest trail densities.

Red fox trails were detected on triangle and road/anthropogenic transects. Red fox trails were detected on transect 11 (0.34 trails/km-day) and along the road/anthropogenic transects (0.02) in 2017 and transect 12 (0.06) along the road/anthropogenic transect (0.05) in 2018. The highest mean trail density was observed on transect 11 (0.17).

Red fox trails were detected in 21% (4/19) of the Ecosites across both sampling years. Ecosites RF3 (regenerating forest – low shrub), Anthropogenic (polygonal and linear disturbance) and RF2 (regenerating forest – tall shrub dominated) had trail densities of 0.13 trails per km-day, 0.02 and 0.01 in 2017. The 2018 survey detected red fox trails in the anthropogenic (polygonal and linear disturbances) and Water/Lake ice Ecosites both at densities of 0.04 trails per km-day. The mean trail density was highest in the RF3 (regenerating forest – low shrub dominated) Ecosite at 0.06 trails per km-day.

Small Mammal Prey and Game Birds

The trails of four different species or species groups of small mammals and game birds were observed during winter tracking surveys including: snowshoe hare, red squirrel, grouse/ptarmigan, and microtine rodents (Figure 2.6-1 and Tables 2.6-1 and 2.6-2).

Snowshoe hare trails were the most commonly observed trails in the Project area. Snowshoe hare trails were observed along all three transects types with the highest densities of trails per km-day on transect 1 (24.89), transect 6 (18.03), and transect 7 (15.68) in 2017 and transect 10 (28.72), transect 6 (27.04), and transect 7 (10.51) in 2018. The highest mean snowshoe hare trail density was detected along transect 6 (22.53).

Snowshoe hare trails were observed in 63% (12/19) of the Ecosites surveyed across both sampling years. Snow shoe hare trails were most commonly observed in RF2 (20.60 trails/km-day) (regenerating forest – tall shrub dominated), RF1 (20.00) (regenerating forest – tree dominated), and BS4 (19.67) (jack pine - black spruce/feathermoss) in 2017 and RF2 (24.29) (regenerating forest – tall shrub dominated), RF1 (10.28) (regenerating forest – tree dominated), and BS7 (2.28) (black spruce/blueberry/lichen) in 2018. The Ecosite with the highest mean trail density observed was RF2 (22.45) (regenerating forest – tall shrub dominated).

Red squirrel trails were also detected along all three transect types. Creek 3 (5.2), transect 4 (4.57), and transect 6 (3.93) hosted the highest trail densities in 2017, while 2018 surveys detected the highest red squirrel trail densities along transect 10 (6.38), creek 4 (4.72), and transect 7 (2.71). The highest mean trail density was observed along transect 10 (3.78).

Red squirrel trails were widespread and observed in 79% (15/19) of the Ecosites across both sampling years. The highest red squirrel trail densities were detected in B21 (4.83 trails/ km-day) (tamarack treed fen), BS23 (4.27) (willow shrubby rich fen), and BS9 (3.83) (black spruce – jack pine/feathermoss) in 2017 and BS16 (6.47) (black spruce/balsam poplar/river alder swamp), BS24

(3.96) (graminoid fen), and BS7 (2.78) (black spruce/blueberry/lichen). Ecosite BS16 (3.82) (black spruce/balsam poplar/river alder swamp) had the highest mean red squirrel trail density.

Grouse/ptarmigan trails were observed along all three transects types. The highest trail densities were detected along creek 5 (3.27), transect 8 (1.41), and transect 1 (1.1) in 2017 and creek 3 (35.95), creek 4 (18.87), and transect 11 (0.72) in 2018. The highest mean trail density was observed along creek 3 (17.97).

The trails of grouse/ptarmigan were recorded in 13 of 19 (68%) of Ecosites sampled. The highest trail densities were detected in the BS24 (10.53 trails/km-day) (graminoid fen), BS19 (5.69) (graminoid bog) and BS18 (2.48) (Labrador tea shrubby bog) during 2017 surveys. The 2018 surveys detected the highest trail densities in the BS23 (35.95) (willow shrubby rich fen), BS16 (3.23) (black spruce/balsam poplar/river alder swamp), and BS17 (3.04) (black spruce treed bog) Ecosites. The highest mean trail density was observed in Ecosite BS23 (17.97) (willow shrubby rich fen).

The trails of microtine rodents were observed along all three transect types. The highest density of microtine rodent trails was observed along transect 9 (1.92), creek 3 (1.11), and the road/anthropogenic transects (0.84) in 2017; and transect 7 (0.65), transect 9 (0.51), and transect 11 (0.27) in 2018. Transect 9 had the highest mean trail density (1.22).

Microtine rodent trails were observed in 63% (12/19) of Ecosites across both sampling years. Microtine rodent trail densities were highest in BS19 (1.90 trail/km-day) (graminoid bog), BS23 (1.22) (willow shrubby rich fen), and Anthropogenic (0.67) (polygonal and linear disturbances) in 2017. The 2018 surveys detected the highest microtine rodent trail densities in Ecosites: BS9 (0.56) (black spruce – jack pine/feathermoss), BS3 (0.21) (jack pine/blueberry/lichen), and RF2 (0.15) (regenerating forest – tall shrub dominated). The highest mean trail density was observed in the BS19 (0.95) (graminoid bog) Ecosite.

2.7 Spring Ungulate Pellet Group/Browse Availability Survey

Pellet group/browse availability transects replicated the terrestrial portion of the established winter tracking triangle transects and creek transects throughout the LSA and RSA. In addition, pellet group/browse availability transects were completed along the proposed access corridor and existing Phoenix anthropogenic disturbance. The objectives of this survey were to:

- Collect data on the presence/not-absence of ungulates (moose and woodland caribou) and carnivores in the project area and by transect and Ecosite
- Collect data on the relative abundance of ungulates (moose and woodland caribou) and carnivores in the project area and by transect and Ecosite
- Collect data on browse availability and use of woody forage species for moose
- Describe the frequency of occurrence and abundance of terrestrial and arboreal lichen for woodland caribou
- Collect data on the presence/not-absence and relative abundance of game birds (grouse/ptarmigan species)

- Develop a scientifically defensible baseline to support impact assessment and to allow for potential future follow up/monitoring requirements

2.7.1 Methods

A handheld GPS and satellite imagery was used by the observer(s) to navigate the pre-established transects (i.e. same transects used for winter track counts). Observers searched for ungulate pellet groups and carnivore scats one meter on either side of the transect line. Each transect was broken into 50 m sub-transects. A UTM coordinate for the start and end point of each 50 m sub-transect was recorded. Winter (non-growing season) pellet groups were recorded separately from summer (growing season) pellet groups based on shape and texture. Pellet groups observed that were deposited before the previous winter were also recorded but were labelled as "Old".

At the end of each 50 m sub-transect a detailed browse availability/use plot was completed using a 5.6 m radius (100 m2) plot. The percent cover class of each woody shrub species available within the plot was recorded. Cover classes included: nil (0%); very low (0 to 5%); low (5 to 25%); moderate (25 to 50%); and high (>50%) (Daubenmire 1959). An estimate of the percent of available twigs browsed was also completed using the same classes. The browse use classes measured forage use of woody plants by all ungulates and did not make a distinction as to the actual ungulate species using these plants. Terrestrial lichen cover was estimated using a representative 1 m x 1 m plot nested within the larger 5.6 m radius plot. Arboreal lichen cover was estimated using five relative abundance cover classes as per the methods of Armleder *et al*. (1992).

Pellet group/browse survey transects were overlain onto Ecosite mapping within a geographic information system (GIS). Each sub-transect was assigned an Ecosite type using field notes and GIS query data. A count was made of the number of pellets or scats per total sub-transect sampling area (50 m x 2 m or 100 m2) for all segments. The resultant measure of ungulate use was the number of pellet groups/ha per animal species and Ecosite type. Frequency of occurrence (constancy) and mean percent canopy coverage (midpoints of canopy closure classes) of each available woody browse species was calculated for sub-transects by vegetation cover type. These two values were multiplied to provide an availability index value for each browse species and vegetation type. The frequency of use and mean percent browsing (midpoints of vegetation cover classes) of woody browse species was calculated for each species and vegetation cover type. These two values were multiplied to determine a browse use index value for each woody browse species and Ecosite type.

2.7.2 Results

A total of 11 triangle transects, five riparian transects, one proposed access route transect and one existing anthropogenic route transect were surveyed between June 9 and 20, 2017. The triangle, riparian, and access route transects were replicated between June 7 and 14. 2018. The total search effort was 16 hectares in each year (Figure 2.7-1). All transects, with the exception of the proposed access transect, were replicates of the winter track count program. The pellets or scats of eight species or species groups pellet groups were detected during the survey (Table 2.7-1). Listed below, in descending order, are the mean pellet group densities in the project area for each species detected:

- Grouse/ptarmigan – 17.28 pellet groups/ha
- Woodland caribou – 1.48 (combined summer/winter)
- Moose – 0.97 (combined summer/winter)
- Black bear – 0.19
- Wolf – 0.06
- Red Fox – 0.06
- Mink – 0.03
- Marten – 0.03

Pellet Group Densities

Ungulates

Two species of ungulates pellet groups were observed during the survey including moose and woodland caribou.

Moose winter pellet groups were observed on eight different transects and summer pellet groups on four transects. Winter pellet groups were detected most frequently along creek 3 (19.2 pellet groups/ha), transect 11 (3.9/ha), and transect 8 (2.4/ha) in 2017 and along creek 3 (9.4/ha), transect 1 (2.0/ha), and the access transect (1.0/ha) in 2018. Summer pellet groups were observed on creek 4 (12.5/ha) and transect 10 (1/ha) in 2017. In 2018 summer pellet groups were detected along transect 4 (3.8/ha) and transect 6 (0.8/ha). The highest mean pellet group density for winter pellets was observed along creek 3 (14.3/ha), while the highest mean summer pellet group density was detected along creek 4 (6.3/ha). No moose pellet groups were observed along the existing anthropogenic disturbance transects (Figure 2.7-1 and Table 2.7-1).

Moose occurred widely but demonstrated a habitat focused distribution. Moose winter pellet groups were detected in four Ecosites/vegetation cover types and summer pellet groups were detected in three Ecosites/vegetation cover types across both sampling years. Ecosites/vegetation cover types with winter pellet groups in 2017 included: BS7 (3.5 pellet groups/ha) (black spruce/blueberry/lichen), RF2 (1.9/ha) (regenerating forest – tall shrub dominated), RF3 (1.2/ha) (regenerating forest - low shrub dominated) and RF1 (1.2/ha) (regenerating forest – tree dominated). Ecosites/vegetation cover types with winter pellet groups in 2018 included: RF2 (1.3/ha) (regenerating forest – tall shrub dominated) and RF1 (0.3/ha) (regenerating forest – tree dominated). The highest mean winter pellet group density was detected in the BS7 (1.8/ha) (black spruce/blueberry/lichen) Ecosite. Summer pellet groups were detected in Ecosites/vegetation cover types BS16 (24.6/ha) (black spruce/balsam poplar/river alder swamp) and RF2 (0.2/ha) (regenerating forest – tall shrub dominated) in 2017. The 2018 survey detected summer pellet groups in the RF2 (1.1/ha) (regenerating forest – tall shrub dominated) and RF1 (0.3/ha) (regenerating forest – tree dominated) Ecosites/vegetation cover types. The highest mean summer pellet group density was detected in Ecosite BS16 (12.3/ha) (black spruce/balsam poplar/river alder swamp) (Table 2.7-2).

Woodland caribou pellet groups were observed on five transects. Winter pellet groups were detected at a density of 1.3 pellets per hectare on transect 9 and 0.7 pellets per hectare on transect

5 during the 2017 surveys. Summer pellets were only detected on transect 9 (0.7 / ha) in 2017. The 2018 surveys detected the highest densities of winter pellet groups on transects creek 5 (13.4/ha), transect 2 (9.9 / ha) and transect 12 (9.7 / ha). No woodland caribou summer pellet groups were detected during the 2018 surveys. The highest mean density of winter woodland caribou pellet groups was observed along creek 5 (6.7/ha), while the highest mean density of summer pellet groups was detected on transect 9 (0.3/ha). No woodland caribou pellet groups were observed along the proposed access or existing anthropogenic transects (Figure 2.7-1 and Table 2.7-1).

Woodland caribou pellet groups were detected in 25% (5/20) Ecosites/vegetation cover types. Winter pellet groups were only detected in BS3 (jack pine/blueberry/lichen) Ecosite/vegetation cover type at a frequency of 0.7 pellet groups per hectare during the 2017 survey. The 2018 survey detected winter pellet groups most frequently in the BS7 (61.7/ha) (black spruce/blueberry/lichen), BS3 (6.3/ha) (jack pine/blueberry/lichen), and BS17 (1.6/ha) (black spruce treed bog). The highest mean density of winter pellet groups was detected in the BS7 (30.8/ha) (black spruce/blueberry/lichen). Summer pellet groups were detected in the BS18 (Labrador tea shrubby bog) Ecosite/vegetation cover type at a frequency of 3.0 pellet groups per hectare during the 2017 survey and no summer pellet groups were detected in 2018 (Table 2.7-2).

Carnivores

Five species of carnivore scat were detected during pellet group surveys including black bear, fox, wolf, mink, and marten. Black bear scat was detected on 28% (5/18) of transects. The highest mean black bear scat density was observed on creek 3 (4.7 scat/ha). Fox scat was detected on transect 6 and transect 1, with a mean density of 0.4/ha and 0.4/ha respectively. Wolf scat was detected along creek 5 and transect 9, with mean densities of 3.3/ha and 0.3/ha. Mink scat was detected on transect 9 with a mean density of 0.3/ha. Marten scat was detected on transect 11 (0.5/ha). No carnivore scat was detected along the proposed access or existing anthropogenic transects (Figure 2.7-1 and Table 2.7-1).

Carnivore scat was detected in five Ecosites/vegetation cover types. Black bear scat was detected in five Ecosites/vegetation types, with the highest mean scat densities observed in BS9 (4.5/ha) (black spruce – jack pine/feathermoss) and BS17 (0.8/ha) (black spruce treed bog). Wolf scat was detected in Ecosites/vegetation cover types BS17 (0.8/ha) (black spruce treed bog) and BS3 (0.1/ha) (jack pine/blueberry/lichen). Fox scat was detected in RF2 (0.2/ha) (regenerating forest – tall shrub dominated). Mink scat was detected in BS17 (0.8/ha) (black spruce treed bog), and marten scat was detected in BS3 (0.1/ha) (jack pine/blueberry/lichen) (Table 2.7-2).

Upland Game Birds

Grouse/ptarmigan pellet groups were observed frequently in the project area with detections along 12 transects. Transect 6 (32.3 pellet groups/ha), proposed access transect (29.1/ha), and transect 9 (25.1/ha) had the highest mean densities of grouse/ptarmigan pellet groups. No pellet groups were observed along the creek or anthropogenic transects (Figure 2.7-1 and Table 2.7-1).

Grouse/ptarmigan pellet groups were detected in 12 Ecosites/vegetation cover types with the highest densities observed in the BS19 (68.8/ha) (graminoid bog), BS7 (30.8/ha) (black spruce/blueberry/lichen), and BS9 (28.8/ha) (black spruce – jack pine/feathermoss) (Table 2.7-2).

Woody Browse and Lichen Availability

Terrestrial Lichen

Terrestrial lichen was observed in all Ecosite/vegetation cover types sampled except for BS23 (willow shrubby rich fen), and recent burn. Frequency of occurrence was very high (greater than 98%) in Ecosites/vegetation cover types BS3 (jack pine/blueberry/lichen), BS4 (jack pine – black spruce/feathermoss), BS7 (black spruce/blueberry/lichen), BS9 (black spruce – jack pine/feathermoss), BS21 (tamarack treed fen), RF1 (regenerating forest – tree dominated), and RF2 (regenerating forest – tall shrub dominated). Terrestrial lichen importance values (frequency of occurrence X mean percent cover) was highest in Ecosites/vegetation cover types BS3 (jack pine/blueberry/lichen), BS7 (black spruce/blueberry/lichen), and RF2 (regenerating forest – tall shrub dominated). Terrestrial lichen was very abundant. The project area had a 96% terrestrial lichen frequency of occurrence and a mean cover of 52% (Appendix 7).

Arboreal Lichen

Arboreal lichen occurred in 80% (16/20) of Ecosites/vegetation cover types surveyed. Arboreal lichen occurred most frequently in BS3 (jack pine/blueberry/lichen), BS7 (black spruce/blueberry/lichen), BS16 (black spruce/balsam poplar/river alder swamp), BS21 (tamarack treed fen), and BS23 (willow shrubby rich fen). However, it should be noted that the sampling intensity in BS16 (black spruce/balsam poplar/river alder swamp), BS21 (tamarack treed fen), and BS23 (willow shrubby rich fen) was low so these results should be interpreted with caution. Arboreal lichen was present at 55% of the project area sample sites but lichen loads were light (Class 1 recorded at 61% of the sites and Class 2 at 37%) (Appendix 7).

Woody Browse

The availability and use of nine species or species groups of woody browse recorded in the Denison Wheeler River project area are detailed in Appendix 8. The most commonly encountered species were alder spp. (17% of segments), willow spp. (4%), and sweet gale (3%). Alder was observed in 45% (9/20) of the Ecosites/vegetation cover types sampled, willow in 80% (16/20), and sweet gale in 65% (13/20). Alder, willow, and sweet gale were also the only woody species browsed. Willow had the highest overall frequency of browse at 2%, while both alder and sweet gale were browsed less than 1%. Browse was observed in the BS3 (jack pine/blueberry/lichen, BS16 (black spruce/balsam poplar/river alder swamp), BS22 (leatherleaf shrubby poor fen), RF3 (regenerating forest - low shrub dominated) and RF2 (regenerating forest – tall shrub dominated) Ecosites/vegetation cover types.

2.8 Small Mammal Trapping Survey and Tissue Analysis

Mice, voles, and shrews are a primary prey for a number of mammalian carnivore species including fisher, marten, and ermine (Pattie and Fisher 1999). Avian raptors such as owls and hawks also rely on small mammals as prey. Small mammals are often also used as bio-indicators. In support of the project, the objectives of this survey were to:

- Determine the species composition and relative abundance of voles, mice and shrews
- Determine Ecosite-small mammal habitat associations for the study area
- Collect micro-habitat information at trap sites to assist in the future development of optimum reclamation targets geared towards small mammal species
- Collect small mammal specimens for baseline/background metal and radionuclide tissue analysis

2.8.1 Methods

Trapping/Inventory

Sampling was stratified by Ecosite but completed in areas with potential to be impacted by the proposed project footprint (Gryphon and Phoenix deposits) and in suitable reference areas. Small mammal trap lines consisted of 15 trap stations spaced 10 m apart. Each trap station consisted of two Victor snap traps spaced 3 meters apart. In addition, three pit-fall traps were deployed along the transect for the capture of shrews, which are not always readily captured using snap-traps. The pit-fall traps were equally spaced along the trap-line. Traps and pit-falls were left in place for three consecutive trap nights. Snap traps and pit-fall traps were baited with a mixture of peanut butter and oats. Trap lines were checked once a day and all captures were recorded. Captured animals were collected using zip-lock bags and were marked with the date of capture, species, trap line, and trap station. Specimens were frozen and stored for future tissue analysis.

Habitat Characterization

Vegetation cover and structure plots (5 m x 2 m) were established at each trapping station to quantify habitat attributes present along each trap line and at each trap station. The objective was to quantify and describe the micro-habitat characteristics of each Ecosite/vegetation cover type. Micro-habitat associations can then be used to help guide future reclamation prescriptions to accommodate small mammal species. At each trap site, measurements/estimates of the following variables were completed:

- Percent cover of graminoids
- Percent cover of forbs
- Percent cover of shrubs (<2.5m)
- Percent cover of shrubs (2.5-5m)
- Percent cover of trees (>5m)
- Tree diameter at breast height (DBH)
- Tree species composition
- Percent cover of surface litter

- Surface litter depth (cm)
- Graminoid height (cm)
- Forb height (cm)
- Low shrub height (cm)
- Tall shrub height (m)
- Percent cover of bare soil
- Percent cover of deadfall (0-10 cm)
- Percent cover of deadfall (10-25 cm)
- Percent cover of deadfall (>25 cm)
- Percent cover of rock
- Percent cover of standing water
- Percent cover of sphagnum
- Percent cover of feather moss
- Percent cover of lichen

Data for all variables were pooled and summarized by Ecosite/vegetation cover type.

Baseline Tissue Analysis – Metals and Radionuclides

All specimens captured during the small mammal trapping program were collected and frozen for future metal and radionuclide analysis by the Saskatchewan Research Council (SRC) lab. In conjunction with Denison, subsets of the specimens were selected for analysis. Red-backed voles were selected as the species to be analyzed as a result of abundance, spatial location of specimen and because of the suitability of this species for follow-up programs. Samples collected from each of the two future impact sites were combined to provide baseline metal and radionuclide levels in each of the three study areas. The reference area was further sub-divided into three sub-samples.

The metals parameters being analyzed were:

- Aluminum
- Antimony
- Arsenic
- Barium
- Beryllium
- Boron
- Cadmium
- Chromium
- Cobalt
- Copper
- Iron
- Lead
- Manganese
- Molybdenum
- Nickel
- Selenium
- Silver
- Strontium
- Thallium
- Tin
- Titanium
- Uranium
- Vanadium

The radionuclide parameters that were analyzed included:

- Lead-210

- Polonium-210
- Radium-226
- Thorium-230

The metal parameters were analyzed by inductively coupled plasma – mass spectronomy and radionuclides were analyzed by extraction and beta counting (Pb-210) or alpha spectroscopy (Po-210, Ra-226, Th-230).

2.8.2 Results

The small mammal trapping program was completed between September 24 and October 2, 2016. A total of 26 trap lines sampled in 17 different Ecosites/vegetation cover types, resulting in a total trapping effort of 2,562 trap nights (Table 2.8-1 and Table 2.8-2). The small mammal trap lines were stratified by three general areas: Gryphon deposit, Phoenix deposit, and reference (Figure 2.8-1).

Trapping/Inventory and Habitat Characterization

A total of 197 individual small mammals of three species were captured. Red-backed voles (*Clethrionomys gapperi*) were most abundant with 140 captures (5.8/100 trap nights), followed by meadow voles (*Microtis pennsylvanicus*) (40 or 1.6/100 trap nights), and dusky shrews (*Sorex monticolus*) (9 or 0.4/100 trap nights). The overall capture rate was 7.7 captures per 100 trap nights.

Incidental capture of six gray jays also occurred. Captures were either live released or disposed of.

Red-backed Vole

Red-backed voles were captured along 24 of 26 trap lines (92%) and in 15 of 17 Ecosites/vegetation cover types (88%). The most productive Ecosites/vegetation cover types included black spruce treed bog (BS17), willow shrubby rich fen (BS23), and jack pine – black spruce/feathermoss (BS4), with capture rates of 12.0, 12.0, and 10.0 red-backed voles per 100 trap nights respectively (Table 2.8-1 and Table 2.8-2).

The three Ecosites/vegetation cover types yielding the highest capture rates also had some of the highest percentages of low shrub cover and coarse woody debris as determined during the micro site habitat assessment (Table 2.8-3). Coarse woody debris and shrub cover are two major components of red-backed vole habitat (Carey and Johnson 1995, Sullivan *et al.* 2011) and should be incorporated into future reclamation.

Meadow Vole

Meadow voles were captured along 10 of 26 trap lines (38%) and in 10 of 17 Ecosites/vegetation cover types (59%) sampled. The most productive Ecosites/vegetation cover types included graminoid bog (BS19), tamarack treed fen (BS21), willow shrubby fen (BS23), and open bog (BS20), with capture rates of 12.0, 6.0, 4.0, and 4.0 per 100 trap nights respectively (Table 2.8-1 and Table 2.8-2).

The relative abundance of meadow voles was highest in four Ecosites/vegetation cover types including: BS19 (graminoid bog), BS21 (tamarack treed fen), BS23 (willow shrubby rich fen), and BS20 (open bog). These Ecosites/vegetation cover types had high a percentage of low ground cover as a result of abundant low shrub and/or graminoid species. In addition, these four habitats have high moisture regimes as evidenced by the presence of open water and/or sphagnum moss (Table 2.8-3). Peles and Barrett (1996) found that standing vegetation and litter abundance are key components in habitat selection for meadow voles, while Dehn *et al.* (2017) found that by adjusting cover to a higher density, meadow voles were more active, foraged more, and produced more offspring. The results of the current study support the findings of Peles and Barrett (1996) and Dehn *et al.* (2017) and suggest that providing a well-developed shrub layer with substantial litter cover (often achieved through the presence of graminoids) would be a useful strategy for reclamation.

Dusky Shrew

Dusky shrews were captured along 6 of 26 trap line (23%) and in 3 of 17 Ecosites/vegetation cover types (18%) sampled. The three Ecosites/vegetation cover types with captures were Labrador tea shrubby bog (BS18), black spruce treed bog (BS17), and jack pine – black spruce/feathermoss (BS4). Capture rates were 2/100 trap nights in BS18 (Labrador tea shrubby bog), 1.5/100 trap nights in BS17 (black spruce treed bog), and 0.7/100 trap nights in BS4 (jack pine – black spruce/feathermoss) (Table 2.8-1 and Table 2.8-2).

The Ecosites/vegetation cover types where dusky shrews were captured all had some combination of high shrub cover, litter cover, coarse woody debris and/or moss. BS17 (black spruce treed bog) and BS18 (Labrador tea shrubby bog) had high shrub cover and sphagnum moss values, while BS4 (jack pine – black spruce/feathermoss) had high shrub cover, litter cover and coarse woody debris cover values (Table 2.8-3). Whitaker Jr. (1963) found that moss is an important component in shrew habitat, while Wrigley *et al*. (1979) found hydric habitats dominated by either shrubs or graminoid/sedge were most suitable for shrews. To provide adequate reclamation for a variety of shrew species it is important to ensure the presence of interspersed wet habitats, such as fens and riparian areas. Creating habitats with a combination of graminoid cover, shrub cover, and moss will provide essential habitat for a variety of shrew species.

Baseline Tissue Analysis – Metals and Radionuclides

A total of 124 red-backed vole specimens were submitted for metals and radionuclide analysis. The phoenix deposit site sample consisted of transects 11-15 and 29 red-backed voles were composited for testing. The gryphon deposit site consisted of transects 1-3, 9-10 and 18 red-backed voles were composited for testing. In consultation with Denison, the reference areas were broken into three sub-sets for analysis based on their locations within the study area. Reference 1 consisted of transects 4-8 and composited 20 red-backed voles. Reference 2 and 3 consisted of transects 17-21 and were divided nearly equally to provide two composite samples (i.e. 28 and 29) for the two respective reference areas. Results of the metals and radionuclide analysis are presented in Table 2.8-4. Samples collected at the phoenix deposit indicated elevated levels of aluminum, titanium, uranium and Radium-226 in comparison to other sites.

2.9 Amphibian Nocturnal Call and Visual Search Surveys

The primary objective of these surveys was to establish the presence/not-absence and relative abundance of amphibian species within the Pheonix project area. Four species have the potential to occur including: Canadian toad (*Bufo hemiophrys*), northern leopard frog (*Rana pipens*), wood frog (*Lithobates sylvaticus*), and boreal chorus frog (*Pseudacris maculata*). Canadian toad and northern leopard frog are identified as sensitive species in Saskatchewan and as such have setback distances dependent on the level and type of disturbance. Canadian toad has setbacks ranging from 0 to 90 meters, while northern leopard frogs setbacks range from 10 to 500 meters (SkMOE 2017). Northern leopard frog is also listed as *Special Concern* by COSEWIC with a SARA Schedule 1 status (GOC 2017).

2.9.1 Methods

Nocturnal survey sites for amphibians were established within the project area at approximately 800 m intervals along linear features, where safe night time access was possible. The Saskatchewan Ministry of Environments species detection protocol for amphibian auditory surveys (2014b) was used to establish methodology for the amphibian nocturnal call surveys. Sites were surveyed beginning thirty minutes after sunset and ending at approximately 1 am. Surveying was not carried out at temperatures below 6° C as amphibian calling declines markedly below this temperature, or with winds higher than a Beaufort level 3.

At each survey site a one minute "quiet down" was honoured to allow amphibians disturbed by vehicular noise to resume calling, followed by a three minute listening period. Calls were identified to species and a qualitative assessment made as to the number present – one or two, several (3 to 5), and many (>5). Weather conditions – temperature, wind speed (Beaufort scale), and percentage cloud cover – were recorded at the start of each night's survey. The survey site locations were recorded using a hand-held GPS unit.

The visual search surveys were completed in areas of potential amphibian breeding habitat. The Saskatchewan Ministry of Environments species detection protocol for amphibian visual surveys (2014c) was used to establish methodology for the amphibian visual search surveys. The visual survey was completed by two observers slowing walking the perimeter of a waterbody and recording any observations of amphibian eggs, larvae, young or adults. The survey was completed during daylight hours and in sunny conditions. The survey route was recorded using the tracklog function on a hand-held GPS unit.

2.9.2 Results

Amphibian auditory surveys were completed between June 16 and 20, 2017 and June 6 and 9, 2018. A total of 61 sites were surveyed, 32 in the LSA and 29 in the RSA during the 2017 survey. The 2018 survey replicated 26 previously completed survey sites, 19 in the LSA and 7 in the RSA (Figure 2.9-1). The 2017 survey detected one species, wood frogs, at one location within the LSA. The detection rate of wood frogs was 2% (1/61 plots) for the entire project area and no detections occurred within the LSA (Table 2.9-1). The 2018 auditory survey detected boreal chorus frogs

only. The detection rate was 19% (5/26 plots) for the project area and 21% for the LSA (4/19 plots) (Table 2.9-2). The difference in detection rates and species observation is likely a result of seasonal differences between years. The spring of 2018 was substantially wetter than the previous year due to heavy snow pack in the previous winter.

Visual search surveys were completed between June 7 and 14, 2018. A total of 4.6 km of shoreline was searched. Two wood frogs were detected during the visual search, resulting in a detection rate of 0.43 observations per km surveyed (Figure 2.9-1). No formal visual search surveys were completed during the 2017 surveys; however boreal chorus frogs were detected incidentally during other field surveys.

A comparison to regional results showed that wood frogs have been observed in five of six studies. Boreal chorus frogs have been observed in four of six studies and northern leopard frogs in one study. Boreal chorus frogs and wood frogs were detected less frequently in the Denison Wheeler River project area than other regional studies; however Cameco's Millennium project (very close proximity) also reported similarly low detection rates (Table 2.9-3).

2.10 Breeding Songbird Point Count Call Survey

Breeding songbird point count surveys were undertaken within the Pheonix project area to:

- Document the diversity of breeding songbirds within the project area
- Describing the relative abundance and diversity of breeding songbirds by Ecosite/vegetation cover types
- Determine the presence/not-absence of known or potential avian species at risk

2.10.1 Methods

The breeding songbird point count call survey methodology was developed with guidance from the Saskatchewan Ministry of Environments species detection survey protocol for forest bird surveys (SkMOE 2014d). Point counts were established within representative habitat types (Ecosites/vegetation cover types) in the project area and spaced at least 250 m apart. Point counts were predominantly located at minimum 100 m from any anthropogenic features. However due to the scarcity and spatial juxtaposition of some habitat types, point counts occasionally fell within 100 m. All point count locations were recorded using a hand held GPS unit.

Point counts were completed between sunrise and the following four hours. Each point count consisted of a one minute quiet down period followed by a 10 minute listening/observation period. The 10-minute count was broken down into a zero-to-three minute time period and a three-to 10 minute time period. All birds observed visually or aurally within the 100 m radius plot were recorded to species. Each bird observed/heard was recorded as an indicated pair (i.e. representing a mating pair). Species detected outside the survey plot were also recorded and included as incidentals. Descriptive weather data (temperature, sky condition, wind – Beaufort wind scale was recorded at the beginning of each point count. Surveys were not completed when temperatures fell below zero degrees Celsius, during precipitation or when winds reached Beaufort level 3.

Analysis of breeding songbird data included species richness and diversity, species presence, relative abundance (by species and habitat), habitat use, and detection of species at risk. The Shannon-Wiener Diversity Index (H) was used to quantify diversity for a given area or habitat. Species evenness (E) was calculated using (H) and the natural logarithm of (S). Evenness refers to how close in numbers each species in an environment are. Evenness values will range from 0-1, where variation in species richness decreases as values approach 1(complete evenness). These calculations are detailed below:

$$H = -\text{sum}\ (Pi\ln[Pi])$$
$$E = H/\ln\ (S)$$

where:

S = total number species in a habitat;
Pi = proportion of S made up of the ith species; and,
E= equability of species distribution.

2.10.2 Results

Breeding songbird point count surveys were completed within the Pheonix project area between June 7 and 17, 2017. A total of 101 survey points were completed across 21 Ecosites/vegetation cover types (Figure 2.10-1 and Table 2.10-1). A total of 319 indicated pairs, representing a mean detection rate of 3.2 pairs per survey point, and a Shannon-Wiener diversity index of 2.9 with an evenness value of 0.8, were observed in the project area (Table 2.10-2). Thirty-six unique species were detected during the survey (Table 2.10-3). The ten most commonly detected species in descending order were:

- Ruby-crowned Kinglet (51)
- Dark-eyed Junco (40)
- Gray Jay (34)
- Yellow-rumped Warbler (31)
- Swainson's Thrush (18)
- Hermit Thrush (18)
- Lincoln Sparrow (15)
- Chipping Sparrow (15)
- Fox Sparrow (15)
- American Robin (13)

Avian Species by Ecosite/Vegetation Cover Type

Species richness was highest in the regeneration – tree dominated (RF1 - 13 species), leatherleaf shrubby poor fen (BS22 – 12), black spruce treed bog (BS17 – 11), tamarack treed fen (BS21 – 11), and regeneration – tall shrub dominated (RF2 – 11) Ecosites/vegetation cover types. The lowest species richness was observed in open fen (BS25 – 1), graminoid bog (BS19 – 2), and graminoid fen (BS24 – 3) (Table 2.10-2).

The highest mean number of breeding songbird pairs was detected in the jack pine – white birch/feathermoss (BS5 – 7 pairs), jack pine – black spruce/feathermoss (BS4 – 5.2), and black spruce/blueberry/lichen (BS7 – 4.6) Ecosites/vegetation cove types. The lowest mean number of pairs were detected in the open fen (BS25 – 0.5), graminoid fen (BS24 – 0.8), and graminoid bog (BS19 – 1) (Table 2.10-2).

The Ecosites/vegetation cover types with the highest Shannon-Wiener diversity index were leatherleaf shrubby poor fen (BS22 – 2.4), regeneration – tree dominated (RF1 – 2.3), Labrador tea shrubby bog (BS18 – 2.2), and tamarack treed fen (BS21 – 2.2). The lowest Shannon-Wiener index was recorded in the open fen (BS25 – 0), graminoid bog (BS19 – 0.7), and graminoid fen (BS24 – 1) Ecosites/vegetation cover types (Table 2.10-2).

Ecosites/vegetation cover types with the highest evenness value included: graminoid bog (BS19), willow shrubby rich fen (BS23), open bog (BS20), sedge rocky shore (BS27), Labrador tea shrubby bog (BS18), rush sandy shore (BS26), and leatherleaf shrubby poor fen (BS22) with a value of one. The Ecosite/vegetation with the lowest evenness value was black spruce/blueberry/lichen with a value of 0.8. All remaining Ecosites/vegetation cover types had a value of 0.9 (Table 2.10-2).

A total of 34 avian species were observed incidentally during the breeding songbird survey and are listed in Appendix 1.

2.11 Semi-aquatic Furbearer Shoreline Survey

Semi-aquatic furbearing mammals (muskrat, mink, beaver and otter) are important species for fur trapping and traditional lifestyles. In addition, muskrats for example, have a widespread distribution, are generally abundant, are adaptable, and are a good indicator of aquatic ecosystem health (Westworth Associates 2002). Semi-aquatic furbearer shoreline surveys were completed to:

- Provide quantitative data on the occurrence and relative abundance of semi-aquatic furbearing mammals
- Provide spatial data on the distribution of semi-aquatic furbearer sign within the Wheeler River Project area

2.11.1 Methods

Semi-aquatic furbearer shoreline surveys were completed along the shorelines of select creeks, lakes, and ponds. Two observers paddled the shorelines of pre-selected sites and detailed notes were recorded to document the location and type of semi-aquatic mammal sign including:

- Territorial scent stations
- Foraging platforms and/or sign of foraging
- Resting platforms
- Scat
- Houses/lodges, dams or runs

The perimeters of select water bodies were paddled and the survey routes were mapped using the track-log function in a hand held GPS unit. The locations of all observations, including incidental sightings were recorded (UTM). The track-log route path data was recorded at five second intervals. All observations were summarized by species and water body. The resultant measure was the number of observations per km of shoreline.

2.11.2 Results

A total of 23 water bodies were surveyed (17 lakes/ponds and portions of 6 creeks) between September 29 and October 3, 2016 (Figure 2.11-1). The total distance of shoreline surveyed was 96 km, with approximately 42 km in the LSA and 65 km in the RSA. Signs of three target species, muskrat (*Ondatra zibethicus*), beaver (*Castor canadensis*), and river otter (*Lontra canadensis*) were observed during the survey.

Muskrat sign was noted in both the LSA and RSA. Muskrat sign was lumped into three types of observations including: burrows/houses, feeding/scent, and scat. A total of 70% (16/23) of water bodies had muskrat sign of some kind. Scat was the most commonly observed muskrat sign averaging 0.92 observations per km for the entire survey, while densities in the LSA and RSA were 1.8/km and 0.5/km respectively. Creek 6 (4.3/km), creek 5 (3.8), and lake 11 (3.6/km) had the highest scat densities. Feeding and scent sign was observed along the shores of 48% (11/23) of water bodies surveyed and consisted of sedge clippings, tuber/roots, and various emergent and submergent aquatic vegetation chewing/harvesting and scent platforms. Feeding/scent sign was observed at a rate of 1.0/km in the LSA and 0.3/km in the RSA. Lake 11 (7.3/km), creek 5 (3.8/km), and lake 9 (3.6) had the highest feeding/scent sign observation rates. Muskrat houses or runs were only observed in the LSA (0.2/km) on Lake 11 at a rate of 5.5/km (Table 2.11-1).

Beaver sign was also categorized into three types of observations including: runs/scent/feeding, active houses, and old/inactive houses. Beaver sign was observed in the LSA and RSA. Run/scent/feeding sign was observed at a rate of 0.3/km in the LSA and 0.1/km in the RSA. Run/scent/feeding sign was observed along the shores of 22% (5/23) of the water bodies surveyed, with the highest concentrations at lake 10 (3.0/km) and lake 7 (2.8/km), while lake 2 had the next highest density at 0.3/km. Old and inactive beaver houses, classed as such by their dilapidated, overgrown appearance and lack of fresh sign or feed beds, were observed in both the LSA and RSA at rates of 0.1/km and 0.1/km respectively. A total of 26% (6/23) of the lakes surveyed had old/inactive beaver houses present. Lake 14 (1.1/km), lake 7 (0.5/km), and creek 4 (0.3/km) had the highest densities. In addition, old run/scent/feeding sign was noted in the LSA and RSA. Forty three percent (10/23) of water bodies paddled had old run/scent/feeding sign (Table 2.11-1).

River otter sign was broken into two types including: scent/feeding and scat. River otter sign was recorded in the RSA only. Scent/feeding sign was detected at a rate of 0.03/km with observations on lake 6 (0.04/km) and lake 9 (0.4/km). Scat was observed on creek 2 (3.0/km) and creek 4 (0.8/km) for an overall density of 0.09/km in the RSA (Table 2.11-1).

2.12 Aerial Waterfowl and Raptor Stick Nest Survey

The aerial waterfowl and raptor stick nest survey was completed for the proposed Wheeler River project to:

- Document the presence/ not-absence, diversity, and abundance of breeding waterfowl
- Documenting the occurrence of active, inactive and old raptor nests (e.g. bald eagle, osprey and red-tailed hawk)
- Document the occurrence of species at risk

2.12.1 Methods

Lakes, streams and wetland areas were surveyed by helicopter at the maximum altitude that allowed identification of birds. A total of three observers completed the survey, with two observers documenting waterfowl observations and one observer documenting stick nest observations. Surveys were completed under appropriate environmental conditions that would not deter waterfowl from being exposed on open water (low wind speed and no precipitation). Weather conditions were recorded at the beginning of each survey and monitored throughout. All birds observed were identified to species, when possible, and total observations by lake/river/wetland complex were recorded. Survey sections varied in area searched (combined area of water bodies) from 2.2 ha to 450 ha as well as in the number of water bodies per section. Therefore, the abundance (number of birds observed) and species richness (number of species observed) in each survey section was divided by area searched to allow comparison between sections. For each survey section, factors such as average size of water bodies, density of water bodies, as well as mapped Ecosite within 100 m buffer of each water body was considered when attempting to identify important attributes for waterfowl within the Wheeler River Project area.

Raptor nest locations were recorded using a hand held GPS unit and nests were classified as active, inactive or old. Notes pertaining to species and clutch size/number of eggs were recorded for all active nests.

2.12.2 Results

A total of 33 survey sections containing 353 water bodies were surveyed on June 15 and 16, 2017 (Figure 2.12-1). The survey recorded 20 confirmed unique species and six species groups, for a total of 681 individual waterfowl/raptor(s) (Table 2.12-1). The ten most commonly observed species were:

- Ring-necked Duck (107)
- Common Merganser (93)
- Common Loon (75)
- Mallard (70)
- Unknown White-headed Gull (67)
- Bald Eagle (47)
- Canada Goose (37)
- Lesser Scaup (30)

- Yellowlegs Spp. (24)
- Bufflehead (23)

Thirty of the 33 survey sections observed waterfowl or raptors utilizing them. The survey sections with the highest species diversity were section 15 (11 species), section 31 (10 species) and sections 1, 18, and 21 (9 species). The highest individual abundance was observed in section 15 (67 individuals), section 31 (49 individuals), section 7 (47 individuals), and section 20 (40 individuals) (Table 2.12-2). However, based on area searched, the survey sections with the highest species diversity per hectare were survey section 7 (2.7 species/ha), survey section 13 (0.3 species/ha) and survey sections 3, 11, 27, 28 and 30 (0.2 species/ha). The highest individual abundance (density of birds per ha) was observed in survey section 7 (20.8 birds/ha), sections 28 and 30 (0.8 birds/ha), section 27 (0.6 birds/ha), and sections 11 and 13 (0.5 birds/ha) (Figure 2.12-1, Table 2.12-3).

Likely factors contributing to a high density of birds and species richness appear to be related to the size of the water body. All survey sections with the highest bird densities and species richness had sizes of 5 ha or less (Table 2.12-3). The overall density and species diversity, in relation to average size of water body, is displayed in Figure 2.12-2.

Connectivity between and proximity to neighbouring water bodies may also be important. As an example, no birds were observed in section 24 although this section was comprised of small water bodies. The water bodies in this section, were however, all isolated from each other (Figure 2.12-1). Section 7 was the only section comprised by a creek. The creek was predominantly narrow, and therefore did not cover a large area overall, however it provided a variety of micro habitats (ponds, low flowing water, as well as rapids) which may have contributed to the observation of high diversity and density which was not observed elsewhere within the study area.

Adjacent Ecosite type did not appear to affect density or diversity as three of the highest ranked sections were bordered by bogs and fens, whereas the other three were bordered by upland coniferous forest types (Table 2.12-3).

A total of 24 active (currently occupied), inactive (not currently occupied), and old (dilapidated) nests were observed in the project area (Figure 2.12-1). Eleven nests were active including four bald eagle nests (*Haliaeetus leucocephalus*), four osprey (*Pandion haliaetus*) nests, one raven (*Corvus corax*) nest, one herring gull (*Larus argentatus*) nest, one common loon nest, and one mew gull (*Larus canus*) colony of 12-15 nests (Table 2.12-4).

2.13 Regional Ungulate Aerial Surveys

No ungulate aerial surveys were completed as part of this baseline investigation. However several ungulate aerial surveys have been completed in several portions of the Boreal Shield of Saskatchewan (Woodland Caribou Management Unit : SK1) since 2008. Eight aerial surveys were completed for existing or potential mining projects in the Wheeler River Project area by other industrial operators in the area. These included five surveys for Cameco's Key Lake Mine, two surveys for Cameco's proposed Millennium project, and one survey for Cameco's McArthur River Mine. The Millennium Project site is located approximately 13 km from the Wheeler River Project

area and the Key Lake and McArthur River Mines are approximately 35 km away. McLoughlin *et al.* (2016) provided a brief summary of the methods and results of these surveys.

It should be noted that an aerial survey was planned for the Wheeler River Project area; however SkMOE disscussions advised against the survey and would not grant a permit to complete the work.

2.13.1 Methods

Detailed methodology was not available for all the surveys. However, generalized methodology was provided in McLoughlin *et al.* (2016). Surveys were completed using helicopters and a viewing window of 200 m was used. Surveys were completed in December, February and March. The extent of survey area ranged from 320 to 2,285 km^2 and coverage ranged from 40 to 100% of the blocks surveyed.

2.13.2 Results

The mean woodland caribou density for all 16 surveys was 0.04 observations per km^2 but ranged from 0 to 0.13/km^2. Moose density was 0.05 observations per km^2 but ranged from 0.01 to 0.12/km^2. The mean density of woodland caribou detected during aerial surveys completed for projects in the vicinity of the Wheeler River Project area (Key Lake, Millennium, and McArthur River) was 0.04 observations per km^2. The mean density of moose detections for projects in the vicinity of the Wheeler River Project area was also 0.04 per km^2.

The densities of woodland caribou in surveys completed near the Wheeler River Project were consistent with the average of all surveys. The Millennium site, which is located close enough to the Wheeler River Project to assume that the 2,285km^2 aerial survey overlaps the Wheeler River Project area had low woodland caribou densities at 0.005 detections per km^2. Moose detections during the Millennium surveys were consistent with the average of all surveys at 0.04 per km^2.

Detailed results of ungulate aerial surveys, as derived from McLoughlin *et al.* (2016), can be found in Table 2.13-1.

2.14 Acoustic Bat Surveys

Acoustic bat surveys were completed to determine the presence/non-absence, diversity and relative abundance of bat species in the Wheeler River Project area. Acoustic surveys measure bat passes and feeding buzzes.

2.14.1 Methods

Surveys commenced one half hour after sunset and ended one half hour before sunrise. Survey stations were established 500 m apart along linear features where safe night travel was possible. Surveys were only completed during appropriate weather conditions, with weather attributes (temperature, sky condition and wind (Beaufort scale)) recorded throughout the survey.

Each survey site consisted of a five-minute listening period using a Wildlife Acoustics Echo Meter Touch 2 Pro. The detector was held with the microphone at a 45 degree angle and slowly rotated 360 degrees for the duration of the sampling period. If a bat was detected the detector was held stationary for 15 seconds to avoid duplicate counts.

Total detector hours were calculated for the Project area and by ecosite/vegetation cover type. Ecosite/vegetation cover type for each survey point was established by utilizing the dominate ecosite/vegetation cover type within a 50 m radius of the survey point.

Acoustic Bat Call Analysis

Data was analyzed using Wildlife Acoustics Kaleidoscope software. Echolocation call characteristics were used to identify bat species. Call characteristics used to establish species included:

- minimum frequency
- maximum frequency
- call duration
- call slope
- call shape

Call characteristics were compared to reference calls in literature and call libraries (WDNR 2016, WNDD 2016, Keinath 2011, Adams 2003). In addition, reference calls within Omnia's call library were used where possible.

2.14.2 Results

Passive acoustic bat surveys were complete in the Project area between July 22 and 23, 2019. Sixty-one acoustic bat survey locations were surveyed for a total of 305 minutes (Figure 2.14-1). Two bat species or species groups were detected during the survey, little brown myotis (*Myotis lucifugus*) and little brown myotis/northern myotis (*Myotis septentrionalis*). Bat species or species group were detected in 30% (18/61) of survey locations at a rate of 3.5 echolocation observations per hour. Feeding buzzes were detected in 3% (2/61) of survey locations at a rate of 0.4 feeding buzzes per hour. Detailed results by survey location and species/species group can be found in Table 2.14-1.

A total of five mapped ecosites were sampled during the passive bat acoustic surveys. The most commonly sampled ecosites/vegetation cover types were BS3 (jack pine/blueberry/lichen) (2.17 hrs), RF2 (regenerating forest – tall shrub dominated) (2.17hrs) and Anthropogenic (polygonal and linear disturbance) (0.42 hrs). Little brown myotis passes and feeding buzzes were most commonly detected in the BS9 (black spruce – jack pine/feathermoss) ecosite at 72 passes/hr and 60 feeding buzzes/ hr respectively. It should be noted the sample size in this ecosite was limited. The BS3 ecosite detected little brown myotis passes (5.5/hr) and feeding buzzes (0.9/hr) second most frequently. Little brown myotis/northern myotis passes were most frequently detected in the BS3

(3.7/hr) and Anthropogenic (2.4) ecosites. No feeding buzzes were detected for the little brown myotis/northern myotis group (Table 12.14-2).

2.15 Covert Camera Survey

Covert camera surveys are an effective and non-invasive way to gather wildlife observation data. They collect data remotely and continuously for a range of species and can be deployed in the field for months at a time; with minimal maintenance. The primary objectives of this survey were to:

- Determine the presence/non-absence and spatial distribution of wildlife species within the project study area
- Identify the relative use of linear features (roads, trails, and hand-cut lines) by wildlife and humans in the study area

2.15.1 Methods

A total of 20 Reconyx HyperFire 2 Professional Covert IR cameras were deployed within the Wheeler River Project area. Camera locations were determined using a combination of a stratified random and targeted approach. The stratified random approach allowed for coverage across the Project area, while a targeted approach allowed for the inclusion of rare attributes and camera placement to minimize theft.

The cameras were located on three linear feature types including road, trail/rough road and hand-cut line. Cusack *et al*. (2015) found that camera placement (random versus game trail based) was unlikely to affect community level inferences, given adequate sampling effort. Road sites were selected with the intention of further division into two sub-classes including an all-season road and a seasonal road. The feature types were defined as:

- Road – A maintained or seasonally accessible road supporting truck traffic or larger.
- Trail / Rough road – A cleared disturbance over 2 m in width.
- Hand-cut Line – A cleared disturbance under 2 m in width.

The study area was divided into four geographic units to ensure spatial distribution of the covert cameras across the study area. Cameras were stratified across mature and regenerating forest types as well as various levels of linear feature natural regeneration. Linear features were randomly selected within the geographic units to be ground trothed for camera locations ensuring distribution across ecosites/age classes and various linear feature regeneration levels. In addition, camera locations were purposely selected to minimize the potential for theft. Seven cameras were located on each of: trail / rough road and hand-cut line and six cameras were placed along roads. The six road cameras were established with the intention of further sub-division into all-season and seasonal roads based on winter maintenance (i.e. plowed vs. un-plowed in winter).
Cameras were mounted on stable trees, 1.5 m above the ground to capture a variety of species and pointed towards the targeted linear feature. All cameras faced north, or as close as feasible, to optimize lighting and avoid sun glare (Dunne 2007). Each camera was tested at its field location to ensure proper function. Camera settings included: high sensitivity trigger and motion sensors, three photographs per activation, one second photograph intervals and no quiet period between activations.

Camera photographs were examined to determine the number of individuals of each species captured. Each animal photographed was considered as an individual, since most species present in the study area are not distinguishable by pelage. Multiple photographs of the same individual (i.e. standing in front of camera, milling back and forth) were considered one observation event. Anthropogenic presence was also of interest so photographs containing humans/human use (vehicles, heavy equipment, recreational use, etc.) were also examined. The number of captures was divided by the number of camera deployment days to provide a relative abundance of species and human use.

2.15.2 Results

The 20 covert cameras were deployed between June 5 and 6, 2019 (Figure 2.15-1). Results were available from all 20 camera locations, totaling 2,929 camera days. The study recorded 11.9 wildlife captures per 100 camera days across all species in the Project area. Trails/rough roads and roads had the highest frequency of wildlife detection at 15.4 and 9.7 captures per 100 camera days. Snowshoe hare (2.2/100 camera days), woodland caribou (1.6) and black bears (1.2) were the most commonly photographed species. Table 2.15-1 and Table 2.15-2 detail the wildlife capture results by camera, species and feature type.

Human use in the study area was also quantified along linear features. The study recorded 201.4 human use events per 100 camera days across the Project area. Roads accounted for 99% (200.1/100 camera days) of human use observed in the Project area. Passenger vehicles (trucks, cars and vans) were the most commonly detected human use at 132.9 detections per 100 camera days. Table 2.15-3 and Table 2.15-4 detail human use captures by camera, vehicle group and feature type.

It is important to note that detections collected using covert cameras represent the minimum detection rate as cameras can malfunction or be misaligned due to tampering from animals or humans.

A sample of covert camera wildlife photograph captures can be viewed in Appendix 9. The covert camera survey is currently ongoing and a second data collection will occur in 2020.

3.0 SPECIES AT RISK AND SENSITIVE SPECIES

A total of 13 sensitive or federally/provincially listed species at risk were observed within the Denison Wheeler River Project area (Table 3-1). Sensitive species were defined as a species having a ranking of S3 or lower by the Saskatchewan Conservation Data Centre (SKCDC) or a species with a disturbance setback outlined in the Saskatchewan Ministry of Environment Activity Restriction Guidelines for Sensitive Species (2017). A total of nine species observed have seasonal setback distances based on the activity restrictions guidelines (Table 3-1).

Figure 3-1 displays the spatial distribution of sensitive and species at risk observations in the project area. These include olive-sided flycatcher and common nighthawk, which were observed frequently within the LSA and along areas of proposed disturbance/footprint. Species such as woodland caribou were only observed in the RSA, with observations concentrated in the northeast and southeast portions of the RSA.

Figure 3-2 displays the spatial distribution of sensitive and species at risk requiring setbacks under the Saskatchewan Activity Restriction Guidelines for Sensitive Species (2017). Specific setback distances and seasonal applicability are detailed in Table 3-1. Species and features such as olive-sided flycatcher, bald eagle nests and common nighthawk nests were all detected near the proposed footprint and will need to be considered in project planning.

4.0 REGIONAL FUR HARVEST DATA

4.1 Methods

Fur harvest return information for the 1985-86 to 2017-18 (33 years) was obtained from Lois Koback, Fur and Problem Wildlife Support with the Ministry of Environment Fish, Wildlife and Lands Branch. Data was obtained and summarized for all species for Fur Conservation Area (FCA) N-18 (Cree Lake) (Table 4.1-1), which incorporated the entire Wheeler River Project area. A summary of the total and average (plus minimum and maximum) annual number of furbearers harvested for FCA N-18 per year is provided.

4.2 Results

In FCA N-18, from the period 1985-86 to 2017-18, fur returns for 14 different species/species groups were reported. These included, in descending order of total captures, marten (4, 167), mink (2,761), muskrat (702), red squirrel (255), fox spp. (241), beaver (227), otter (192), fisher (149), weasel spp. (72), lynx (64) coyote (14), black bear (8), wolf (5) and wolverine (5) (Table 4.1-1). The three species with the highest average capture rates over the 33 year period were marten (138.9), mink (95.2), and muskrat (63.8).
Caution must be used when interpreting this data. Capture rates can vary widely and may reflect trapper effort and fur prices as much as animal abundance.

5.0 INDIGENOUS AND LOCAL KNOWLEDGE

5.1 Regional Indigenous Land Use

The Wheeler River Project area is located within the English River First Nation (ERFN) traditional territories. The ERFN has identified an estimated caribou range, cabins, traditional trails, winter trails, reserve lands and burial sites in the Wheeler River Project area and the surrounding region. Appendix 10, Figures 10-1 and 10-2 detail the EFRN traditional territories boundary traditional land uses in context with the Wheeler River Project Area.
Consultation was completed with the Kineepik Metis Local located in the Northern Village of Pinehouse, Saskatchewan in 2018 to complete a Use-and-Occupancy Map. The purpose of this Use-and Occupancy mapping was to provide a baseline inventory of harvesting and fixed cultural sites that residents have used during their lifetimes. In 2018 55 individuals were interviewed to supplement an existing 2011 survey completed outside the Wheeler River Project area. The 2018 consultation focused on the Key Lake Road corridor intersecting the Wheeler River Project Area. The resulting Use-and Occupancy Map is provided in Appendix 10 Figure 10-3.

5.2 Local Indigenous Assistants

During baseline field surveys for terrestrial mammal, avian and plant species, Omnia engaged local ERFN field assistants on many of the baseline surveys. Table 5.2-1 details local indigenous assistants and the level of involvement.

5.3 Local Indigenous Land User

Omnia, in conjunction with Denison, hosted a local indigenous land user (Mr. John) at the Wheeler River Project site to conduct an in-person interview on October 29, 2019. Mr. John has multiple cabins in the Wheeler River Project area and actively traps, hunts and commercial fishes in the Project area.
Mr. John discussed several topics with Omnia and Denison personnel including:

- Cabin locations
- Outfitting
- Trapping
- Commercial Fishing
- Country Food
- The Wheeler River Aquatic Baseline
- The Wheeler River Terrestrial Baseline
- Land Use and Lake Names
- Climate Change
- The Wheeler River Project Options and General Discussion

Several of Mr. John's comments pertaining to wildlife in the Wheeler River Project Area aligned with the findings of the terrestrial baseline. Specifically, Mr. John indicated that he observed woodland caribou more frequently than moose, Omnia also observed this (Table 2.6-1 and 2.7-1).

In addition, the locations Mr. John indicated observing woodland caribou and moose agreed with Omnia's findings (Table 2.6-1 and 2.7-1).
Mr. John indicated that Marten are much more commonly observed than fisher and are captured 90% of the time versus fisher while trapping. Omnia also found marten trails to be detected much more frequently than fisher trails (Table 2.6-1).
In addition, his comments have been incorporated to provide comparison and local indigenous land user knowledge, where relevant, throughout the wildlife baseline summary.

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7.0 TABLES

Table 2.1-1. Refined Mapping of Anthropogenic Disturbance (Unbuffered) in the Denison Wheeler River Project LSA and RSA.

Disturbance Feature	LSA		RSA	
	km^2	%	km^2	%
Cutline	0.49	0.010	2.01	0.005
Road	0.54	0.011	1.03	0.003
Rough Road	0.27	0.006	0.82	0.002
Right-of-way	-	-	0.10	0.000
Transmission Right-of-way	0.07	0.001	0.45	0.001
Trail	0.13	0.003	0.75	0.002
Industrial Clearing	0.53	0.011	0.92	0.002
Total	**2.03**	**0.043**	**6.08**	**0.015**

Table 2.1-2. Linear Feature Density in the Denison Wheeler River Project Area.

Linear Feature	LSA (km/km^2)		RSA (km/km^2)	
	ECCC (2015)	Refined Mapping	ECCC (2015)	Refined Mapping
Cutline	0.01	5.98	0.03	2.91
McArthur-Key Haul Road	1.03	0.08	0.36	0.06
Road		0.28		0.06
Rough Road		1.07		0.38
ROW				0.10
Trail		0.67		0.47
Transmission ROW		0.04	0.03	0.03
Total	**1.04**	**8.11**	**0.42**	**4.01**

Table 2.1-3. Comparison of Updated and Improved Anthropogenic Footprint with the ECCC (2015) Footprint. Both Datasets Include a 500 m Buffer.

Study Area		Anthropogenic (500 m buffer included)		Total Area (km^2)
		ECCC (2015)	Refined Mapping	
LSA	km^2	32.80	47.45	47.50
	%	69.1	99.9	
RSA	km^2	129.31	331.07	400.01
	%	32.3	82.8	

Table 2.1-4. Overview of Historical Fires from 1945 to 2018 in the LSA and RSA for the Wheeler River Project Area.

Forest Age (Years)	Fire Years	LSA (km^2)	LSA (%)	RSA (km^2)	RSA (%)
0-10	none	0	0	0	0
11-20	2004, 2007, 2008	3.47	7.3	59.28	14.8
21-30	1990, 1998	0	0	0.54	0.1
31-40	1981	15.96	33.6	163.56	40.9
41-70	1973	2.53	5.3	33.8	8.5
70+	none	0	0	0	0

Table 2.1-5. Ecosites in the Denison Wheeler River Project Area.

Ecosite Code	Ecosite Name/Description	LSA (Ha)	RSA (Ha)	LSA (%)	RSA (%)
RF3-C	Regenerating coniferous forest - low shrub <1 m tall (5-20 years)	237.1	4536.9	5.0	11.3
RF3-B	Regenerating bog - low shrub <1 m tall (5-20 years)	0.0	20.2	0.0	0.1
RF2-C	Regenerating coniferous forest - tall shrub 1-5 m tall (20-40 years)	1822.5	10480.5	38.4	26.2
RF2-B	Regenerating bog - tall shrub 1-5 m tall (20-40 years)	0.0	2.0	0.0	0.0
RF1-C	Regenerating coniferous forest - treed >5 m tall (30-50 years)	199.3	2401.8	4.2	6.0
BS3	Jack pine/ blueberry/ lichen	1605.8	10330.5	33.8	25.8
BS4	Jack pine- black spruce/ feathermoss	22.8	331.3	0.5	0.8
BS7	Black spruce/ blueberry/ lichen	9.6	279.8	0.2	0.7
BS9	Black spruce- jack pine/ feathermoss	15.1	147.8	0.3	0.4
BS14	White birch/ lingonberry- Labrador tea	0.3	1.8	0.0	0.0
BS16	Black spruce/ balsam poplar/ river alder swamp	0.0	8.7	0.0	0.0
BS17	Black spruce treed bog	82.1	1152.1	1.7	2.9
BS18	Labrador tea shrubby bog	101.0	963.4	2.1	2.4
BS19/24	Graminoid bog/ graminoid fen	11.1	171.2	0.2	0.4
BS20	Open bog	4.8	65.2	0.1	0.2
BS21	Tamarack treed fen	14.7	66.2	0.3	0.2
BS22	Leatherleaf shrubby poor fen	13.1	28.4	0.3	0.1
BS23	Willow shrubby rich fen	3.2	20.8	0.1	0.1
BS25	Open fen	2.1	5.7	0.0	0.0
BS26	Rush sandy shore	0.9	15.0	0.0	0.0
BS27	Sedge rocky shore	4.2	29.2	0.1	0.1
AN	Anthropogenic	165.8	596.4	3.5	1.5
Waterbody	Waterbody	434.3	8345.8	9.1	20.9
Total		**4749.8**	**40000.8**	**100.0**	**100.0**

Table 2.3-1. Key Findings and Trends for Each Analysis, Including *Visual Obstruction*, *Vegetation Recovery* and *Ericaceous* shrubs vs. Tree Species Occurrence.

Variable	Main findings/trends for disturbed areas
Visual Obstruction	
Line cut before vs. after fire	Significantly higher visual obstruction in areas burned after vs. before line creation.
Upland vs. Lowland	Significantly higher visual obstruction in lowlands vs. uplands for the 0.25 m layer.
Young forest vs. Old Forest	No difference in visual obstruction in disturbed areas between old and young forest.
Level of Human Use	Significantly higher visual obstruction in areas with No/Low vs. Moderate/High human use.
Vegetation Recovery	
Line cut before vs. after fire	Significantly higher stem counts of Shrubs (1-3m) in areas burned after vs. before line creation.
Upland vs. Lowland	Significantly higher low shrub and moss cover, and lower lichen cover in lowlands vs. uplands.
Young forest vs. Old Forest	Significantly higher lichen cover in old vs. young forest.
Level of Human Use	Significantly higher vegetation recovery in areas with No/Low vs. Moderate/High human use.
Ericaceous Shrub vs. Tree Species	
Line cut before vs. after fire	Higher tree species occurrence in areas burned after vs. before line creation.
Upland vs. Lowland	Higher tree species occurrence in in lowlands vs. uplands.
Young forest vs. Old Forest	Higher tree species occurrence in young vs. old forest.
Level of Human Use	Higher tree species occurrence in areas with No/Low vs. Moderate/High human use.

Table 2.3-2. Species Ranking and Compositional Information for Shrub Species (< 1m tall) in Areas Burned Before and After Line was Cut - Reference Versus Disturbed.

Rank	Area burned after line was created 12-15 years since fire (n=3)		Area burned before line was created 12-15 years since fire (n=3)		Area burned before line was created 20-30 years since fire (n=2)	
	Reference	Disturbed	Reference	Disturbed	Reference	Disturbed
1	Vaccmyr (100)	Pinuban (60)	Vaccmyr (64)	Vaccmyr (68)	Vaccmyr (99)	Vaccmyr (97)
2	Pinuban (56)	Vaccmyr (54)	Pinuban (59)	Vaccvit (40)	Vaccvit (59)	Vaccvit (73)
3	Ledugro (25)	Chamcal (31)	Vaccvit (5)	Pinuban (18)	Pinuban (47)	Ledugro (58)
4	Chamcal (23)	Ledugro (31)			Ledugro (27)	Pinuban (30)
5	Andrpol (9)	Andrpol (17)				Picemar (8)
6	Picemar (9)					
7	Vaccvit (4)					

Coniferous tree species

Ericaceous shrub species

Notes:

Values in brackets show abundance of each species.
This is not a percentage cover value, but a normalized relative abundance of each species compared to other species (values: 0-100).

Table 2.3-3. Species Ranking and Compositional Information for Shrub Species (< 1m tall) in Lowland and Upland Areas - Reference Versus Disturbed.

Rank	Lowland (Bog/Fen) (n=8)	
	Reference	Disturbed
1	Ledugro (96)	Ledugro (95)
2	Chamcal (86)	Chamcal (79)
3	Andrpol (68)	Andrpol (75)
4	Vaccvit (40)	Picemar (55)
5	Oxycmic (40)	Oxycmic (52)
6	Picemar (37)	Vaccvit (27)
7	Vaccmyr (6)	Vaccmyr (21)
8		Empenig (7)
9		Pinuban (2)
10		

Upland (n=12)	
Reference	Disturbed
Vaccmyr (97)	Vaccmyr (100)
Vaccvit (59)	Vaccvit (55)
Ledugro (26)	Ledugro (30)
Chamcal (6)	Arctuva (6)
Arctuva (5)	Pinuban (6)
Pinuban (4)	Alnucri (5)
Andrpol (4)	Chamcal (5)
Picemar (4)	Picemar (4)
Betupum (2)	Andrpol (2)
Alnucri (2)	Empenig (2)

Coniferous tree species

Ericaceous shrub species

Deciduous low shrub species

Notes:

Values in brackets show abundance of each species.
This is not a percentage cover value, but a normalized relative abundance of each species compared to other species (values: 0-100).

Table 2.3-4. Species Ranking and Compositional Information for Shrub Species (< 1m tall) in Old (> 40 years) Upland Forest and Young (< 40 years) Upland Forest - Reference Versus Disturbed.

Rank	Old upland forest (n=8)	
	Reference	Disturbed
1	Vaccmyr (100)	Vaccmyr (97)
2	Vaccvit (57)	Vaccvit (61)
3	Ledugro (8)	Ledugro (20)
4	Arctuva (7)	Arctuva (5)
5	Picemar (5)	Empenig (3)
6	Pinuban (5)	Picemar (3)
7		
8		
9		

Young upland forest (n=12)	
Reference	Disturbed
Vaccmyr (91)	Vaccmyr (84)
Pinuban (40)	Vaccvit (38)
Vaccvit (34)	Ledugro (34)
Ledugro (32)	Pinuban (32)
Chamcal (12)	Chamcal (13)
Andrpol (6)	Andrpol (7)
Picemar (2)	Alnucri (5)
Betupum (2)	Picemar (4)
Alnucri (2)	Arctuva (3)

Coniferous tree species

Ericaceous shrub species

Deciduous low shrub species

Notes:

Values in brackets show abundance of each species.

This is not a percentage cover value, but a normalized relative abundance of each species compared to other species (values: 0-100).

Table 2.3-5. Species Ranking and Composition Information for Shrub Species (< 1m tall) by Level of Human Use - Reference Versus Disturbed.

Rank	No human use (n=22)		Low human use (n=12)		Moderate human use (n=4)		High human use (n=8)	
	Reference	Disturbance	Reference	Disturbance	Reference	Disturbance	Reference	Disturbance
1	Vaccmyr (65)	Vaccmyr (61)	Ledugro (64)	Vaccmyr (69)	Vaccmyr (100)	Vaccmyr (36)	Vaccmyr (78)	Picemar (5)
2	Vaccvit (34)	Ledugro (40)	Vaccmyr (61)	Ledugro (50)	Vaccvit (72)	Vaccvit (15)	Vaccvit (62)	
3	Ledugro (34)	Vaccvit (39)	Vaccvit (55)	Vaccvit (36)	Arctuva (9)	Empenig (10)	Ledugro (49)	
4	Chamcal (30)	Chamcal (27)	Chamcal (35)	Chamcal (34)	Alnucri (5)		Pinuban (12)	
5	Andrpol (22)	Andrpol (20)	Andrpol (28)	Andrpol (32)	Picemar (5)		Picemar (7)	
6	Pinuban (18)	Pinuban (18)	Picemar (20)	Picemar (22)	Ledugro (4)		Betupum (5)	
7	Oxycmic (11)	Oxycmic (13)	Oxycmic (12)	Oxycmic (14)			Arctuva (4)	
8	Picemar (8)	Picemar (13)	Pinuban (10)	Empenig (5)			Andrpol (4)	
9	Arctuva (3)	Arctuva (3)	Alnucri (3)	Arctuva (3)			Oxycmic (4)	
10	Betupum (1)	Alnucri (3)		Alnucri (3)			Chamcal (2)	

Coniferous tree species

Ericaceous shrub species

Deciduous low shrub species

Notes:

Values in brackets show abundance of each species.
This is not a percentage cover value, but a normalized relative abundance of each species compared to other species (values: 0-100).

Table 2.4-1 Rare Vascular Plant Survey Stratification Using Predictive Ecosite Mapping in the Denison Wheeler River Project Area – 2017.

Ecosites	Area of Ecosite (ha)	# of Predicted Transects
BS7 – Black spruce/blueberry/lichen	0.56	10
BS9 – Black spruce-jack pine/feathermoss	2.50	10
BS17 – Black spruce treed bog	3.09	10
BS3 – Jack pine/blueberry/lichen	47.47	17
BS4 – Jack pine-black spruce/feathermoss	11.88	11
BS5 – Jack pine-white birch/feathermoss	0.29	7
Waterbody	1.25	9
Total	**67.48**	**74**

Table 2.4-2. Conservation Rank Definitions - Saskatchewan Conservation Data Centre Database - 2019.

S1	Critically Imperiled/ Extremely rare	At very high risk of extinction or extirpation due to extreme rarity, very steep declines, high threat level, or other factors.
S2	Imperiled/Very rare	At high risk of extinction or extirpation due to a very restricted range, very few populations, steep declines, threats or other factors.
S3	Vulnerable/Rare to uncommon	At moderate risk of extinction or extirpation due to a restricted range, relatively few populations, recent and widespread declines, threats, or other factors.
S4	Apparently Secure	Uncommon but not rare; some cause for long-term concern due to declines or other factors.
S5	Secure/Common	Demonstrably secure under present conditions; widespread and abundant; low threat level.

Table 2.4-3. Rare Plant Survey Transects Completed per Ecosite in Denison Wheeler River Project Area – 2017.

Ecosites	# of Transects Surveyed
BS3 – Jack pine/blueberry/lichen	27
BS4 – Jack pine – black spruce/feathermoss	32
BS17 – Black spruce treed bog	4
BS18 – Labrador tea shrubby bog	4
BS19 – Graminoid bog	4
BS24 – Graminoid fen	3
Total	**74**

Table 2.4-4. Rare Plant Observations in the Denison Wheeler River Project Area – 2017.

Species	Centroid of Population		Count or Estimate	Area of Population (m2)	Habitat Description
	Easting (NAD 83)	Northing (NAD 83)			
Alaskan clubmoss	4754853	6377011	58	144	Open PJ-lichen stand
Alaskan clubmoss	475178	6376885	17	10	Open PJ-lichen stand
Alaskan clubmoss	475329	6376923	15	32	Open PJ-lichen stand at bottom of slope
Alaskan clubmoss	475460	6376439	80 (E)	203	Open area at transition from treed bog to upland pine/lichen stand
Alaskan clubmoss	475452	6376386	940 (E)	1611	Transition zone between shrubby bog and open immature PJ-lichen stand
Alaskan clubmoss	475727	6375972	100 (E)	246	Transition between creek riparian area and upland PJ-lichen stand
Alaskan clubmoss	475762	6375940	25 (E)	58	Transition between creek riparian area and upland pine/lichen stand
Alaskan clubmoss	475549	6375788	400 (E)*	444	Transition between mature PJ stand and immature Pj stand
Alaskan clubmoss	475532	6375840	400 (E)*	392	Immature PJ stand
Three-seeded sedge	475722	6375989	100 (E)	6	Wet depression beside permanent creek

E=Estimate
*Population intersects two transects

Table 2.4-5. Rare Plant Ecosite Ground Truthing in the Denison Wheeler Project Area – 2019.

Site	UTM-NAD 83		Confirmed Ecosite*
	Easting	Northing	
1	475405	6376230	RF2
2	475428	6376212	RF2
3	475452	6376131	RF2
4	475259	6377292	RF2
5	475544	6377292	RF2/Anthropogenic
6	475469	6377202	RF2
7	475358	6377130	RF1
8	475469	6377022	RF1
9	475529	6377022	RF1
10	**475585**	**6377022**	**BS9**
11	479338	6376542	RF2
12	479228	6376387	RF2
13	475349	6377434	RF2
14	475409	6377406	RF2
15	475621	6375672	RF2
16	475633	6375625	RF2
17	477449	6374772	RF2
18	475447	6377178	RF2/Anthropogenic
19	475559	6376992	RF2
20	475319	6377412	RF2
21	475602	6375732	RF2
22	475349	6377307	RF2
23	475584	6375792	RF2
24	475604	6376915	RF2
25	475409	6377100	RF1
26	474980	6376485	RF2/RF1

* Ecosite definitions and characteristics are provided in Section

Table 2.5-1. Summary of Metals and Radionuclides in Lichen Collected in the Denison Wheeler River Project Area – 2017.

Parameter	Units	RSV1	RSV2	RSV3	RSV4	RSV5	RSV6	RSV7	RSV8	RSV9	RSV10	Mean	Stand Dev
Physical Properties													
Moisture	%	60.09	66.31	11.31	13.31	6.55	4.96	5.87	6.93	7.3	7.35	**19.00**	22.27
Metals and Trace Elements													
Aluminum	ug/g	440	410	620	470	440	670	760	620	540	1700	**667**	361.14
Antimony	ug/g	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	**<0.1**	-
Arsenic	ug/g	0.11	0.1	0.12	0.13	0.09	0.16	0.18	0.18	0.1	0.24	**0.14**	0.045
Barium	ug/g	12	16	25	16	18	21	16	14	9.8	14	**16.18**	4.15
Beryllium	ug/g	0.01	0.01	0.02	0.01	0.01	0.02	0.02	0.02	0.02	0.06	**0.02**	0.01
Boron	ug/g	1	1	2	1	1	2	1	<1	2	3	**1.45**	-
Cadmium	ug/g	0.07	0.06	0.09	0.07	0.08	0.1	0.08	0.1	0.08	0.12	**0.09**	0.02
Chromium	ug/g	1	1.1	1.5	1.3	1	3.2	2.2	3.5	1.2	6.8	**2.28**	1.74
Cobalt	ug/g	0.08	0.08	0.1	0.08	0.09	0.23	0.17	0.32	0.14	0.39	**0.17**	0.11
Copper	ug/g	1.6	1.5	1.8	1.5	1.5	1.7	1.6	1.3	1.6	2	**1.61**	0.18
Iron	ug/g	220	190	280	230	180	350	390	370	260	840	**331**	183.65
Lead	ug/g	0.82	0.52	0.8	0.6	0.51	1	1.8	1.3	0.41	1.4	**0.92**	0.43
Manganese	ug/g	95	83	112	102	148	107	78	194	137	191	**124.7**	39.60
Molybdenum	ug/g	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	**<0.1**	-
Nickel	ug/g	0.67	0.94	0.94	0.9	0.58	1.6	1.1	1.7	0.7	3.3	**1.243**	0.77
Selenium	ug/g	0.11	0.09	0.2	0.1	0.12	0.14	0.12	0.12	0.05	0.14	**0.119**	0.04
Silver	ug/g	0.02	0.01	0.02	0.01	0.01	0.01	0.02	0.01	<0.01	0.03	**0.015**	-
Strontium	ug/g	4.2	6.3	10	5	6.2	8.3	5	4.6	4.6	7.1	**6.13**	1.78
Thallium	ug/g	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	**<0.05**	-
Tin	ug/g	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.06	<0.05	0.07	**0.03**	-
Titanium	ug/g	10	11	18	14	9.7	23	21	17	12	45	**18.1**	9.99
Uranium	ug/g	0.06	0.06	0.07	0.06	0.06	0.11	0.12	0.14	0.19	0.8	**0.17**	0.22
Vanadium	ug/g	0.6	0.5	0.8	0.6	0.5	1	1.1	1	0.7	2.2	**0.9**	0.48
Zinc	ug/g	13	11	14	14	14	16	14	21	20	26	**16.3**	4.36
Radionuclides													
Lead-210	Bq/g	0.55	0.51	0.52	0.55	0.4	0.51	0.63	0.61	0.31	0.63	**0.52**	0.10
Polonium-210	Bq/g	0.36	0.36	0.32	0.36	0.23	0.37	0.45	0.42	0.2	0.46	**0.35**	0.08
Radium-226	Bq/g	0.0033	0.0027	0.0021	0.003	0.0025	0.0024	0.0026	0.003	0.007	0.01	**0.004**	0.002
Thorium-230	Bq/g	0.0005	<0.0006	0.0007	0.002	0.0008	0.002	0.002	0.001	0.003	0.007	**0.0019**	-

Values below detection limits were set to half the value for calculating the mean.

Table 2.5-2. Summary of Metals and Radionuclides in Blueberry Collected in the Denison Wheeler River Project Area – 2017.

Parameter	Units	RSV1	RSV2	RSV3	RSV4	RSV5	RSV6	RSV7	RSV8	RSV9	RSV10	Mean	Stand Dev
Physical Properties													
Moisture	%	45.99	65.02	44.27	51.01	48.16	47.08	59.16	47.76	39.16	36.71	48.43	8.04
Metals and Trace Elements													
Aluminum	ug/g	43	63	73	120	50	370	28	45	69	86	94.7	94.99
Antimony	ug/g	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-
Arsenic	ug/g	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	-
Barium	ug/g	56	61	58	76	54	54	48	46	58	75	58.6	9.48
Beryllium	ug/g	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-
Boron	ug/g	7	8	17	22	12	12	7	13	9	10	11.7	4.52
Cadmium	ug/g	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-
Chromium	ug/g	<0.5	<0.5	<0.5	0.7	<0.5	4.5	<0.5	<0.5	<0.5	0.6	0.76	-
Cobalt	ug/g	0.11	0.03	0.24	0.04	0.02	0.08	0.03	0.04	0.07	0.03	0.07	0.06
Copper	ug/g	4.7	5.6	4.9	3.9	4.1	4.9	4.1	4.1	4	4.8	4.51	0.52
Iron	ug/g	30	37	55	69	28	190	24	26	40	43	54.2	47.2
Lead	ug/g	0.04	0.06	0.02	0.04	0.02	0.15	0.01	0.01	0.02	0.04	0.04	0.04
Manganese	ug/g	1050	1190	1820	1790	1570	1590	710	1210	940	2340	1421	465
Molybdenum	ug/g	<0.1	<0.1	<0.1	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-
Nickel	ug/g	1.2	1.4	1.6	1.1	1	2.6	0.67	1.3	0.82	3	1.469	0.72
Selenium	ug/g	<0.05	0.05	0.1	<0.05	<0.05	0.05	<0.05	<0.05	<0.05	<0.05	0.05	-
Silver	ug/g	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-
Strontium	ug/g	5.8	22	9.4	6.4	6.8	6.1	4.2	8.2	12	8.3	8.92	4.82
Thallium	ug/g	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	-
Tin	ug/g	<0.05	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	-
Titanium	ug/g	0.77	1.2	0.9	3.6	0.67	17	0.53	0.52	0.97	1.3	2.75	4.83
Uranium	ug/g	<0.01	<0.01	<0.01	<0.01	<0.01	0.03	<0.01	<0.01	0.02	0.02	0.01	-
Vanadium	ug/g	<0.1	<0.1	<0.1	<0.1	<0.1	0.4	<0.1	<0.1	<0.1	<0.1	<0.1	-
Zinc	ug/g	10	16	13	13	12	16	9.9	14	12	15	13.09	2.09
Radionuclides													
Lead-210	Bq/g	0.014	0.017	0.022	0.01	0.016	0.012	0.013	0.007	0.025	0.037	0.017	0.008
Polonium-210	Bq/g	0.004	0.005	0.008	0.003	0.006	0.002	0.005	0.004	0.008	0.017	0.006	0.004
Radium-226	Bq/g	0.0026	0.003	0.005	<0.0003	<0.0002	0.003	<0.0002	0.0019	0.0037	0.0033	0.0023	-
Thorium-230	Bq/g	<0.0004	<0.0005	<0.001	0.0009	<0.0004	<0.001	<0.0004	<0.0004	<0.0004	<0.0004	0.000335	-

Values below detection limits were set to half the value for calculating the mean.

Table 2.5-3. Summary of Metals and Radionuclides in Soil Collected in the Denison Wheeler River Project Area – 2017.

Parameter	Units	RSV1	RSV2	RSV3	RSV4	RSV5	RSV6	RSV7	RSV8	RSV9	RSV10	Mean	Stand Dev
Metals and Trace Elements													
Aluminum	ug/g	4300	4900	4300	4600	3300	4800	4050	1980	1990	1580	3580	1212
Antimony	ug/g	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	-
Arsenic	ug/g	0.8	0.8	0.8	1	0.5	0.8	0.6	0.4	0.4	0.4	0.7	0.21
Barium	ug/g	48	58	30	62	67	39	66	36	84	30	52	17.3
Beryllium	ug/g	0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	<0.1	<0.1	<0.1	0.07	-
Boron	ug/g	3	2	3	4	3	5	2	1	2	<1	2.55	-
Cadmium	ug/g	0.3	0.2	0.2	0.3	0.4	0.6	0.3	0.6	0.4	0.6	0.4	0.15
Calcium	ug/g	750	600	530	700	490	530	790	350	2400	320	746	571
Chromium	ug/g	6.4	5.2	5.9	7	3.7	5	4.7	1.1	1.5	0.8	4.1	2.15
Cobalt	ug/g	0.5	0.3	0.3	0.4	0.2	0.2	0.3	<0.2	0.2	<0.2	0.26	-
Copper	ug/g	1.7	2.5	0.8	1.7	1.5	0.7	2.4	0.8	4.6	0.8	1.8	1.14
Iron	ug/g	4940	2680	3610	4390	1870	2240	2880	640	850	520	2462	1466
Lead	ug/g	4.4	3.2	2.6	2.7	2.7	2.7	3.4	1.6	6.4	1.8	3.2	1.32
Magnesium	ug/g	500	360	430	500	260	430	340	140	240	90	329	136
Manganese	ug/g	64	38	39	48	48	36	42	24	120	31	49	26
Molybdenum	ug/g	0.2	0.1	0.1	0.1	0.2	0.1	0.1	<0.1	0.1	<0.1	0.1	0.04
Nickel	ug/g	1.1	1.4	1	1.4	1.2	0.9	1.4	0.5	1.2	0.5	1.1	0.32
Selenium	ug/g	<0.1	0.2	<0.1	0.1	<0.1	<0.1	0.1	<0.1	0.1	<0.1	0.08	-
Silver	ug/g	0.3	0.2	0.1	0.2	0.3	0.6	0.1	0.5	0.2	0.4	0.3	0.16
Sodium	ug/g	440	240	290	300	390	640	290	400	160	290	344	125
Strontium	ug/g	16	19	16	21	18	20	19	18	18	18	18	1.49
Thallium	ug/g	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	-
Tin	ug/g	0.5	0.4	0.5	0.5	0.2	0.4	0.4	<0.1	0.1	<0.1	0.31	-
Titanium	ug/g	550	370	450	490	230	400	340	90	90	74	308	168
Uranium	ug/g	0.6	0.4	0.6	0.6	0.4	0.6	0.4	0.2	0.2	0.2	0.4	0.17
Vanadium	ug/g	11	7.6	9.2	11	4.3	6.7	7.4	1.4	2.2	1.2	6.2	3.55
Zinc	ug/g	5.8	8.3	2.5	3.8	8.6	4.4	5.9	2.3	19	4	6.5	4.65
Nutrients													
Phosphorus	ug/g	130	250	150	150	80	160	140	30	300	40	143	80
Potassium	ug/g	1100	770	930	760	1400	1500	980	990	880	820	1013	241
Radionuclides													
Lead-210	Bq/g	0.16	0.05	0.11	<0.04	0.11	<0.04	0.09	<0.04	0.19	<0.04	0.079	-
Polonium-210	Bq/g	0.14	0.07	0.04	0.05	0.07	0.04	0.07	0.03	0.21	0.06	0.078	0.053
Radium-226	Bq/g	0.02	0.02	0.02	0.02	<0.01	0.02	0.02	<0.01	<0.01	<0.01	0.02	0
Thorium-230	Bq/g	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-

Values below detection limits were set to half the value for calculating the mean.

Table 2.5-4. Comparison of Denison Wheeler River Project Vegetation and Soil Chemistry to the Roughrider Project[1].

Parameter	Units	Wheeler River Soil	Roughrider Soil	Wheeler River Lichen	Roughrider Lichen	Wheeler River Blueberry	Roughrider Blueberry
Metals and Trace Elements							
Aluminum	ug/g	3580	5500	667	213	94.7	64.5
Antimony	ug/g	<0.2	0.3	<0.1	0.1	<0.1	<0.1
Arsenic	ug/g	0.65	0.95	0.14	0.14	<0.05	<0.05
Barium	ug/g	52	19	16.2	4.7	58.6	79.5
Beryllium	ug/g	0.07	0.1	0.02	<0.01	<0.01	<0.01
Boron	ug/g	2.55	<1	1.45	<1	11.7	9
Cadmium	ug/g	0.39	<0.01	0.085	0.05	<0.01	0.01
Calcium	ug/g	-	-	-	-	-	-
Chromium	ug/g	4.13	7	2.28	<0.5	0.76	<0.5
Cobalt	ug/g	0.26	0.45	0.168	0.04	0.07	0.03
Copper	ug/g	1.75	1.5	1.61	0.64	4.51	4.85
Iron	ug/g	2462	5717	331	114	54.2	33.5
Lead	ug/g	3.15	1	0.916	0.32	0.04	0.04
Magnesium	ug/g	-	-	-	-	-	-
Manganese	ug/g	49	38	124.7	33	1421	1086
Molybdenum	ug/g	0.11	0.15	<0.1	<0.1	<0.1	0.1
Nickel	ug/g	1.06	1.65	1.24	0.29	1.47	1.37
Selenium	ug/g	0.08	0.1	0.12	0.07	0.05	<0.05
Silver	ug/g	0.29	<0.1	0.01	0.01	<0.01	<0.01
Sodium	ug/g	344	165	-	-	-	-
Strontium	ug/g	18.3	24	6.13	1.8	8.92	13
Thallium	ug/g	<0.2	<0.2	<0.05	<0.05	<0.05	<0.05
Tin	ug/g	0.31	0.55	0.03	<0.05	<0.05	<0.05
Titanium	ug/g	308	579	18	6.8	2.7	1.2
Uranium	ug/g	0.42	0.55	0.17	0.11	0.01	0.01
Vanadium	ug/g	6.2	12.5	0.9	0.3	<0.1	<0.1
Zinc	ug/g	6.46	4.75	16.3	9.2	13.1	16.5
Nutrients							
Phosphorus	ug/g	143	150.5	-	-	-	-
Potassium	ug/g	1013	520	-	-	-	-
Radionuclides							
Lead-210	Bq/g	0.08	<0.04	0.52	0.38	0.017	0.064
Polonium-210	Bq/g	0.08	0.01	0.35	0.3	0.006	0.014
Radium-226	Bq/g	0.02	0.03	0.004	0.002	0.002	0.013
Thorium-230	Bq/g	<0.02	0.02	0.002	0.001	0.0003	0.001

1 Source Rio Tinto Canada Uranium Corporation (2014)

Table 2.6-1. Number of Trails per km day by Transect in the Denison Wheeler River Project Area - 2017 & 2018.

Transect	Length (Km)		Km-days		Microtines		Red Squirrel		Snowshoe Hare		Grouse/ Ptarm.		Ermine		Mink	
	2017	2018	2017	2018	2017	2018	2017	2018	2017	2018	2017	2018	2017	2018	2017	2018
1	7.6	-	52.63	-	0.04	-	2.94	-	24.89	-	1.10	-	0.27	-	0	-
2	7.5	7.7	44.20	22.07	0.18	0	0.63	0.09	0.29	0	0.09	0.32	0	0	0.05	0
4	7.7	-	30.23	-	0.10	-	4.57	-	15.22	-	0.93	-	0.13	-	0.00	-
5	6.6	7.0	32.08	26.85	0.00	0	0.41	0.56	0	0	0.56	0.15	0	0	0	0
6	7.5	7.5	21.63	19.94	0.53	0	3.93	0.30	18.03	27.03	1.94	0.30	0.28	0	0	0
7	7.5	7.5	38.08	9.23	0.08	0.65	2.15	2.71	15.68	10.51	0.18	0.22	0.26	0.22	0.03	0
8	7.4	7.5	43.17	18.46	0.39	0.22	3.08	1.73	9.66	4.12	1.41	0.60	0.65	0.16	0	0.05
9	7.5	7.5	19.26	9.75	1.92	0.51	0.26	0.62	0	0	0.36	0.41	0.10	0	0	0.72
10	7.6	7.5	21.99	16.15	0.05	0.19	1.18	6.38	14.42	28.73	0.32	0.06	0.27	0	0	0
11	7.5	7.4	11.62	11.10	0.95	0.27	0.34	1.89	0.17	0.36	0.43	0.72	0	0	0	0.90
12	7.5	7.5	28.79	17.17	0.03	0.06	1.60	0.58	0	0.52	0.07	0.23	0	0	0.07	0.12
Creek 1	0.5	0.5	2.56	0.97	0.00	0	0.78	0	0	0	0	0	0	0	0	0
Creek 2	0.6	0.5	2.76	1.24	0.36	0	0.36	0	1.09	0	0	0	0.36	0	0	0
Creek 3	0.5	0.5	2.69	1.20	1.11	0	5.20	1.67	4.46	0	0	35.83	1.11	0	1.11	0
Creek 4	0.6	0.5	4.15	0.85	0.00	0	1.21	4.71	1.69	0	0.48	18.82	1.69	2.35	0.48	0
Creek 5	0.5	0.7	2.45	2.73	0.00	0	0	0	0	0	3.27	0	0	0	0	0
Road/ anthro	18.4	11.5	81.61	21.44	0.65	-	0.53	-	1.68	-	0.23	-	0.05	-	0.01	0
Total	**103.0**	**81.4**	**439.9**	**179.14**	**0.33**	**0.12**	**1.77**	**1.26**	**8.33**	**6.64**	**0.61**	**0.59**	**0.19**	**0.04**	**0.03**	**0.11**
Mean	**92.2**		**309.52**		**0.23**		**1.52**		**7.48**		**0.60**		**0.12**		**0.07**	

Notes:

"- " = not completed

Table 2.6-1 Cont. Number of Trails per km day by Transect in the Denison Wheeler River Project Area - 2017 & 2018.

Transect	Length (Km)		Km-days		Marten		Fisher		Red Fox		Lynx		Otter		Moose		Woodland Caribou	
	2017	2018	2017	2018	2017	2018	2017	2018	2017	2018	2017	2018	2017	2018	2017	2018	2017	2018
1	7.6	-	52.63	-	0.02	-	0.00	-	0	-	0.49	-	0.02	-	0	-	0	-
2	7.5	7.7	44.20	22.07	0.66	0.09	0.05	0	0	0	0	0	0	0	0	0	0.43	0
4	7.7	-	30.23	-	0	-	0	-	0	-	0.69	-	0	-	0	-	0	-
5	6.6	7.0	32.08	26.85	0.53	0.22	0	0	0	0	0	0	0.03	0	0	0.11	0	0
6	7.5	7.5	21.63	19.94	0	0	0	0	0	0	0.42	0	0	0	0	0	0	0
7	7.5	7.5	38.08	9.23	0.32	0.11	0	0	0	0	0.05	0.11	0.05	0	0	0	0	0
8	7.4	7.5	43.17	18.46	0.09	0.38	0	0	0	0	0	0	0	0	0	0	0	0
9	7.5	7.5	19.26	9.75	1.51	1.64	0	0	0	0	0	0	0	0	0	0	0.67	0
10	7.6	7.5	21.99	16.15	0	0.43	0	0	0	0	0	0.62	0	0	0	0	0	0
11	7.5	7.4	11.62	11.1	0.34	1.62	0	0	0.34	0	0	0.09	0.17	0	0.17	0	0.69	0
12	7.5	7.5	28.79	17.17	0.59	0.58	0	0	0	0.06	0	0	0.10	0	0	0	0	0
Creek 1	0.5	0.5	2.56	0.97	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Creek 2	0.6	0.5	2.76	1.24	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Creek 3	0.5	0.5	2.69	1.2	0	0	0	0	0	0	0	2.50	0	0	0	0	0	0
Creek 4	0.6	0.5	4.15	0.85	0.24	0	0	0	0	0	0	0	0.24	0	0	0	0	0
Creek 5	0.5	0.7	2.45	2.73	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Road/ anthro	18.4	11.5	81.61	21.44	0.21	0.05	0.09	0	0.01	0.05	0	0.05	0	0	0	0.05	0	0
Total	**103.0**	**81.3**	**439.89**	**179.14**	**0.30**	**0.38**	**0.02**	**0**	**0.01**	**0.01**	**0.13**	**0.09**	**0.02**	**0**	**0.005**	**0.02**	**0.09**	**0**
Mean	**92.1**		**309.52**		**0.34**		**0.01**		**0.01**		**0.11**		**0.01**		**0.01**		**0.05**	

Notes:

"- " = not completed

Table 2.6-2. Number of Trails per km day by Ecosite in the Denison Wheeler River Project Area - 2017 & 2018.

Ecosite	Length (Km)		Km-days		Microtines		Red Squirrel		Snowshoe Hare		Grouse/ Ptarm.		Ermine		Mink	
	2017	2018	2017	2018	2017	2018	2017	2018	2017	2018	2017	2018	2017	2018	2017	2018
BS3	23.32	22.50	97.55	56.53	0.44	0.21	2.66	1.59	1.29	0.57	0.37	0.25	0.06	0	0.02	0.04
BS4	0.78	0.60	3.30	0.95	0.61	0	3.33	0	19.67	0	0	0	0	0	0.30	0
BS7	1.34	1.52	6.19	3.95	0.32	0	2.59	2.78	0.97	2.28	0	0	0	0	0	0
BS9	1.02	0.83	4.20	1.78	0.24	0.56	3.81	0	4.05	0.56	0	1.12	0.24	0	0.24	0
BS16	0.24	0.20	1.71	0.31	0	0	1.17	6.47	0	0	0.58	3.23	0	6.47	0	0
BS17	2.50	2.42	10.87	4.93	0.28	0	0.55	0.41	1.20	0.81	1.10	3.04	1.01	0	0.18	1.42
BS18	1.91	1.91	7.65	4.62	0	0	0	0.43	3.79	0.43	2.48	0	0	0	0	0.87
BS19	0.14	0.05	0.53	0.12	1.90	0	0	0	0	0	5.69	0	0	0	0	0
BS21	0.25	0.26	1.24	0.60	0	0	4.83	0	2.42	0	0	0	1.61	0	0.81	0
BS22	0.38	0.29	1.82	0.56	0	0	0	0	0	0	0	0	0	0	0	0
BS23	0.33	0.49	1.64	1.20	1.22	0	4.27	1.67	3.66	0	0	35.95	0.61	0	1.22	0
BS24	0.10	0.10	0.57	0.25	0	0	0	3.96	0	0	10.53	0	0	0	0	0
BS25	0.10	0.10	0.49	0.37	0	0	0	0	0	0	0	0	0	0	0	0
BS26	0.05	0.00	0.21	0.00	0	0	0	0	0	0	0	0	0	0	0	0
RF1	8.26	5.62	37.90	13.42	0.26	0.07	2.24	0.75	20.00	10.28	1.35	0.60	0.32	0.15	0	0.07
RF2	28.84	20.07	120.03	41.28	0.16	0.15	2.50	2.37	20.60	24.29	0.99	0.51	0.32	0.07	0.01	0.07
RF3	3.77	2.32	15.95	3.23	0.19	0	1.32	1.55	1.32	0.00	0.06	0.00	0.56	0	0	0
Water/Lake Ice	10.66	10.17	44.37	22.61	0.05	0.09	0.09	0	0	0	0.02	0.09	0.02	0	0	0.13
Anthropogenic	19.02	11.92	83.68	22.43	0.67	-	0.56	-	1.78	-	0.23	-	0.05	-	0.01	0
Total	**102.99**	**81.37**	**439.89**	**179.14**	**0.33**	**0.12**	**1.77**	**1.26**	**8.33**	**6.64**	**0.61**	**0.59**	**0.19**	**0.04**	**0.03**	**0.11**
Mean	**92.18**		**309.52**		**0.23**		**1.52**		**7.48**		**0.60**		**0.12**		**0.07**	

Table 2.6-2 Cont. Number of Trails per km day by Ecosite in the Denison Wheeler River Project Area - 2017 & 2018.

Ecosite	Length (Km)		Km-days		Marten		Fisher		Red Fox		Lynx		Otter		Moose		Woodland Caribou	
	2017	2018	2017	2018	2017	2018	2017	2018	2017	2018	2017	2018	2017	2018	2017	2018	2017	2018
BS3	23.32	22.50	97.55	56.53	0.83	0.55	0.01	0	0	0	0.09	0	0.02	0	0	0	0.11	0
BS4	0.78	0.60	3.30	0.95	0.61	1.06	0	0	0	0	0	0	0	0	0	0	0	0
BS7	1.34	1.52	6.19	3.95	0.16	0.76	0	0	0	0	0	0	0	0	0	0	0.65	0
BS9	1.02	0.83	4.20	1.78	0.24	0	0	0	0	0	0	0	0	0	0	0	1.43	0
BS16	0.24	0.20	1.71	0.31	0.58	0	0	0	0	0	0	0	0	0	0	0	0	0
BS17	2.50	2.42	10.87	4.93	0.37	0.20	0	0	0	0	0	0	0.09	0	0	0.41	0.64	0
BS18	1.91	1.91	7.65	4.62	0.26	0	0	0	0	0	0.39	0	0.13	0	0	0.22	0	0
BS19	0.14	0.05	0.53	0.12	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BS21	0.25	0.26	1.24	0.60	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BS22	0.38	0.29	1.82	0.56	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BS23	0.33	0.49	1.64	1.20	0	0	0	0	0	0	0	2.51	0	0	0	0	0	0
BS24	0.10	0.10	0.57	0.25	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BS25	0.10	0.10	0.49	0.37	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BS26	0.05	0.00	0.21	0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
RF1	8.26	5.62	37.90	13.42	0.26	0.07	0.03	0	0	0	0.26	0.15	0.03	0	0	0	0	0
RF2	28.84	20.07	120.03	41.28	0.08	0.68	0	0	0.01	0	0.30	0.22	0.02	0	0.02	0	0.07	0
RF3	3.77	2.32	15.95	3.23	0	0	0	0	0.13	0	0	0.31	0	0	0	0	0	0
Water/Lake Ice	10.66	10.17	44.37	22.61	0.05	0.04	0	0	0	0.04	0	0	0.05	0	0	0	0.09	0
Anthropogenic	19.02	11.92	83.68	22.43	0.20	0.09	0.08	0	0.02	0.04	0	0.04	0	0	0	0.04	0.00	0
Total	**102.99**	**81.33**	**439.89**	**179.14**	**0.30**	**0.38**	**0.02**	**0**	**0.01**	**0.01**	**0.13**	**0.09**	**0.02**	**0**	**0**	**0.02**	**0.09**	**0**
Mean	**92.16**		**309.52**		**0.34**		**0.01**		**0.01**		**0.11**		**0.01**		**0.01**		**0.05**	

Table 2.7-1. Pellet Groups per Hectare by transect in the Denison Wheeler River Project Area - 2017 & 2018.

Transect	Area (ha)		Species											
			Winter Moose		Summer Moose		Old Moose		Winter Caribou		Summer Caribou		Old Caribou	
	2017	2018.00	2017	2018	2017	2018	2017	2018	2017	2018	2017	2018	2017	2018
1	1.51	1.50	1.99	2.00	0	0	1.99	0	0	0	0	0	0	0
2	1.34	1.41	0	0	0	0	0	0	0	9.94	0	0	0	2.13
4	1.33	1.33	0.75	0	0	3.75	9.02	1.50	0	0	0	0	0	0
5	1.42	1.41	0	0	0	0	0	0	0.70	8.54	0	0	0	0
6	1.51	1.20	0.66	0	0	0.84	0.66	2.51	0	0	0	0	0	0
7	1.34	1.35	0	0	0	0	1.49	3.70	0	0	0	0	0	0
8	1.23	1.20	2.44	0.83	0	0	7.32	5.82	0	0	0	0	0	0
9	1.52	1.51	0	0	0	0	0	0	1.32	3.30	0.66	0	0	0.66
10	1.05	0.92	1.90	0	0.95	0	1.90	0	0	0	0	0	0	0
11	1.04	1.04	3.85	0.96	0	0	0.96	1.92	0	0	0	0	0	0
12	1.01	1.03	0	0	0	0	2.97	2.92	0	9.73	0	0	0	0
Creek 1	0.11	0.10	0	0	0	0	9.52	0	0	0	0	0	0	0
Creek 2	0.11	0.10	0	0	0	0	0	0	0	0	0	0	0	0
Creek 3	0.10	0.11	19.23	9.39	0	0	0	0	0	0	0	0	0	0
Creek 4	0.08	0.12	0	0	12.50	0	0	0	0	0	0	0	0	0
Creek 5	0.11	0.15	0	0	0	0	0	0	0	13.38	0	0	0	0
Access	1.05	1.03	0	0.98	0	0	0	1.95	0	0	0	0	0	0
Anthro	0.22	-	0	-	0	-	0	-	0	-	0	-	0	-
Total	**16.08**	**15.81**	**1.00**	**0.44**	**0.12**	**0.38**	**2.11**	**1.52**	**0.19**	**2.72**	**0.06**	**0.00**	**0.00**	**0.25**
Mean	**15.94**		**0.72**		**0.25**		**1.82**		**1.45**		**0.03**		**0.13**	

Notes:

"-" = not completed

Table 2.7-1 Cont. Pellet Groups per Hectare by transect in the Denison Wheeler River Project Area - 2017 & 2018.

Transect	Area (ha)		Species											
			Grouse/ Ptarm		Fox		Mink		Marten		Bear		Wolf	
	2017	2018	2017	2018	2017	2018	2017	2018	2017	2018	2017	2018	2017	2018
1	1.51	1.50	23.84	16.01	0.66	0	0	0	0	0	0	0	0	0
2	1.34	1.41	11.21	37.63	0	0	0	0	0	0	0	0	0	0
4	1.33	1.33	12.78	18.76	0	0	0	0	0	0	0	0	0	0
5	1.42	1.41	9.86	36.28	0	0	0	0	0	0	0	0	0	0
6	1.51	1.20	10.60	55.16	0	0.84	0	0	0	0	0.66	0	0	0
7	1.34	1.35	2.99	2.96	0	0	0	0	0	0	0	1.48	0	0
8	1.23	1.20	4.07	15.81	0	0	0	0	0	0	0	0	0	0
9	1.52	1.51	5.26	44.92	0	0	0.66	0	0	0	0	0	0	0.66
10	1.05	0.92	5.71	6.49	0	0	0	0	0	0	0	0	0	0
11	1.04	1.04	3.85	3.83	0	0	0	0	0.96	0	0	0	0	0
12	1.01	1.03	12.87	30.15	0	0	0	0	0	0	0.99	0	0	0
Creek 1	0.11	0.10	0	0	0	0	0	0	0	0	0	0	0	0
Creek 2	0.11	0.10	0	0	0	0	0	0	0	0	0	0	0	0
Creek 3	0.10	0.11	0	0	0	0	0	0	0	0	0	9.39	0	0
Creek 4	0.08	0.12	0	0	0	0	0	0	0	0	0	0	0	0
Creek 5	0.11	0.15	0	0	0	0	0	0	0	0	0	6.69	0	6.69
Access	1.05	1.03	15.24	42.93	0	0	0	0	0	0	0	0	0	0
Anthro	0.22	-	0	-	0	-	0	-	0	-	0	-	0	-
Total	**16.08**	**15.81**	**9.58**	**24.99**	**0.06**	**0.06**	**0.06**	**0.00**	**0.06**	**0.00**	**0.12**	**0.25**	**0.00**	**0.13**
Mean	**15.94**		**17.28**		**0.06**		**0.03**		**0.03**		**0.19**		**0.06**	

Notes:

"-" = not completed

Table 2.7-2. Pellet Groups per Hectare by Ecosite/Vegetation Cover Type in the Denison Wheeler River Project Area - 2017 & 2018.

Ecosite/Veg Cover Type	Area (ha)		Species											
			Winter Moose		Summer Moose		Old Moose		Winter Caribou		Summer Caribou		Old Caribou	
	2017	2018	2017	2018	2017	2018	2017	2018	2017	2018	2017	2018	2017	2018
BS3	4.61	4.92	0	0	0	0	0	0.20	0.65	6.30	0	0	0	0.61
BS4	0.21	0.12	0	0	0	0	0	0	0	0	0	0	0	0
BS7	0.29	0.16	3.50	0	0	0	0	0	0	61.68	0	0	0	6.17
BS9	0.11	0.26	0	0	0	0	8.94	0	0	0	0	0	0	0
BS16	0.04	0.08	0	0	24.58	0	0	0	0	0	0	0	0	0
BS17	0.58	0.61	0	0	0	0	0	0	0	1.63	0	0	0	0
BS18	0.33	0.31	0	0	0	0	0	0	0	0	3.00	0	0	0
BS19	0.00	0.02	0	0	0	0	0	0	0	0	0	0	0	0
BS21	0.04	0.03	0	0	0	0	24.39	0	0	0	0	0	0	0
BS22	0.09	0.08	0	0	0	0	0	0	0	0	0	0	0	0
BS23	0.01	0.00	0	0	0	0	0	0	0	0	0	0	0	0
BS24	0.05	0.02	0	0	0	0	19.68	47.43	0	0	0	0	0	0
BS25	0.04	0.00	0	0	0	0	0	0	0	0	0	0	0	0
BS26	0.05	0.03	0	0	0	0	0	0	0	0	0	0	0	0
BS27	0.05	0.04	0	0	0	0	0	0	0	0	0	0	0	0
RF1	2.55	3.98	1.17	0.25	0	0.25	1.96	1.26	0	0.25	0	0	0	0
RF2	5.93	4.51	1.85	1.33	0.17	1.11	4.21	3.77	0	0	0	0	0	0
RF3	0.82	0.49	1.21	0	0	0	1.21	0	0	0	0	0	0	0
Recent Burn	0.03	0.03	0	0	0	0	0	0	0	0	0	0	0	0
Anthropogenic	0.22	0.11	0	0	0	0	0	0	0	0	0	0	0	0
Total	**16.08**	**15.81**	**1.00**	**0.44**	**0.12**	**0.38**	**2.11**	**1.52**	**0.19**	**2.72**	**0.06**	**0.00**	**0.00**	**0.25**
Mean	**15.94**		**0.72**		**0.25**		**1.82**		**1.45**		**0.03**		**0.13**	

Table 2.7-2 Cont. Pellet Groups per Hectare by Ecosite/Vegetation Cover Type in the Denison Wheeler River Project Area - 2017 & 2018.

Ecosite/Veg Cover Type	Area (ha)		Species											
			Grouse/ Ptarm		Fox		Mink		Marten		Bear		Wolf	
	2017	2018	2017	2018	2017	2018	2017	2018	2017	2018	2017	2018	2017	2018
BS3	4.61	4.92	8.68	36.98	0	0	0	0	0.22	0	0	0	0	0.20
BS4	0.21	0.12	13.97	25.29	0	0	0	0	0	0	0	0	0	0
BS7	0.29	0.16	0	61.68	0	0	0	0	0	0	0	0	0	0
BS9	0.11	0.26	26.82	30.82	0	0	0	0	0	0	8.94	0	0	0
BS16	0.04	0.08	0	0	0	0	0	0	0	0	0	0	0	0
BS17	0.58	0.61	0	1.63	0	0	1.72	0	0	0	0	1.63	0	1.63
BS18	0.33	0.31	0	0	0	0	0	0	0	0	0	0	0	0
BS19	0.00	0.02	0	137.60	0	0	0	0	0	0	0	0	0	0
BS21	0.04	0.03	0	0	0	0	0	0	0	0	0	0	0	0
BS22	0.09	0.08	0	0	0	0	0	0	0	0	0	0	0	0
BS23	0.01	0.00	0	0	0	0	0	0	0	0	0	0	0	0
BS24	0.05	0.02	19.68	47.43	0	0	0	0	0	0	0	0	0	0
BS25	0.04	0.00	0	0	0	0	0	0	0	0	0	0	0	0
BS26	0.05	0.03	0	31.08	0	0	0	0	0	0	0	0	0	0
BS27	0.05	0.04	0	0	0	0	0	0	0	0	0	0	0	0
RF1	2.55	3.98	11.36	23.11	0	0	0	0	0	0	0.39	0.25	0	0
RF2	5.93	4.51	12.98	20.19	0.17	0.22	0	0	0	0	0	0.44	0	0
RF3	0.82	0.49	1.21	0	0	0	0	0	0	0	0	0	0	0
Recent Burn	0.03	0.03	0	0	0	0	0	0	0	0	0	0	0	0
Anthropogenic	0.22	0.11	0	28.46	0	0	0	0	0	0	0	0	0	0
Total	**16.08**	**15.81**	**9.58**	**24.99**	**0.06**	**0.06**	**0.06**	**0.00**	**0.06**	**0.00**	**0.12**	**0.25**	**0.00**	**0.13**
Mean	**15.94**		**17.29**		**0.06**		**0.03**		**0.03**		**0.19**		**0.06**	

Table 2.8-1. Small Mammal Captures per Transect in the Wheeler River Project Area – 2016.

Transect	Total Trapping Effort (# of trap nights)	Trapping Success (# of individuals caught per 100 trap nights)		
		Red-Backed Vole	Meadow Vole	Dusky Shrew
1	99	2.02	0.40	0.00
2	99	2.02	12.12	0.00
3	99	7.07	2.02	1.01
4	99	1.01	0.00	0.00
5	99	0.00	0.00	0.00
6	99	12.12	4.04	0.00
7	96	0.00	1.04	0.00
8	99	7.07	0.00	2.02
9	99	2.02	2.02	3.03
10	99	3.03	0.00	0.00
11	99	6.06	0.00	0.00
12	99	2.02	1.01	0.00
13	99	18.18	0.00	1.01
14	99	2.02	0.00	0.00
15	99	1.01	0.00	0.00
16	99	6.06	0.00	0.00
17	99	9.09	0.00	0.00
18	99	15.15	0.00	1.01
19	99	17.17	1.01	1.01
20	99	4.04	8.08	0.00
21	99	12.12	4.04	0.00
22	99	5.05	0.00	0.00
23	99	2.02	1.01	0.00
24	99	2.02	0.00	0.00
25	99	8.08	0.00	0.00
26	90	3.33	0.00	0.00
Project Area	**2,562**	**5.78**	**1.56**	**0.35**

Table 2.8-2. Small Mammal Captures by Ecosite in the Wheeler River Project Area – 2016.

Ecosite Code	Ecosite Name	Total Trapping Effort (# of trap nights)	Trapping Success (# of individuals caught per 100 trap nights)		
			Red-Backed Vole	Meadow Vole	Dusky Shrew
BS3	Jack pine / blueberry / lichen: Moderately fresh sand	99	0	0	0
BS4	Jack pine - black spruce/ feathrmoss: Moderately dry	297	10.44	0.67	0.67
BS5	Jack pine - white birch/feathermoss: Moderately dry sand	99	6.06	0	0
BS7	Black spruce / blueberry / lichen: Moderately dry sand	288	2.08	0	0
BS9	Black spruce - jack pine / feathermoss: Moderately fresh sandy loam	99	9.09	0	0
BS17	Black spruce treed bog: Very moist mesic organic	198	12.12	0.51	1.52
BS18	Labrador tea shrubby bog: Moderately wet mesic organic	198	8.59	1.01	2.02
BS19	Graminoid bog: Very wet humic organic	99	2.02	12.12	0
BS20	Open bog: Moderately wet fibric organic	99	2.02	4.04	0
BS21	Tamarack treed fen: Wet fibric organic	198	8.08	6.06	0
BS23	Willow shrubby rich fen: Wet fibric organic	99	12.12	4.04	0
BS24	Graminoid fen: Very wet humic organic	96	0	1.04	0
BS26	Rush sandy shore: Very moist sand	99	8.08	0	0
BS27	Sedge rocky shore: Very moist sand	99	2.02	1.01	0
RF1	Regeneration - Tree Dominated	99	2.02	0	0
RF2	Regeneration - Tall Shrub Dominated	297	3.03	0	0
AN	Anthropogenic/disturbed	99	2.02	1.01	0

Table 2.8-3. Small Mammal Micro-Habitat Assessment in the Wheeler River Project Area – 2016.

Habitat Attribute	Transect ID / Ecosite																
	23	25	7	21	6/20	1	2	9/18	8/19	17	4/24/ 26	16	3/13	5/11	10/15/ 22	14	12
	BS27	BS26	BS24	BS23	BS21	BS20	BS19	BS18	BS17	BS9	BS7	BS5	BS4	BS3	Pj Tall Shrub Regen	Pj Treed Regen	Disturbed
Mean % trees (>5m)	0.00	1.33	-	-	17.33	-	-	1.50	9.17	33.67	26.00	16.33	19.90	19.00	1.82	16.33	1.00
Mean Tree dbh (cm)	-	12.53	-	-	11.04	-	-	7.72	8.44	11.01	10.01	5.33	11.03	9.72	5.87	6.18	11.35
Mean tree height (m)	-	8.33	-	-	9.43	-	-	6.72	8.02	10.27	9.39	7.25	9.31	9.21	6.00	6.42	9.50
Mean % shrubs (<2.5m)	0.80	17.33	5.47	82.33	1.67	21.00	0.13	73.83	57.83	16.13	20.97	54.00	46.73	32.00	35.33	16.67	5.20
Mean % shrubs (2.5-5m)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.67	13.02	5.47	3.11	40.60	5.67	2.83	14.56	25.67	0.00
Mean Low shrub height (cm)	41.80	44.47	26.25	122.00	77.67	28.43	30.00	37.93	77.67	52.40	32.29	96.40	40.40	35.50	134.18	22.67	19.90
Mean Tall shrub height (m)	-	-	-	-	3.44	-	-	3.50	3.50	3.78	3.19	3.77	3.48	3.42	3.55	3.93	-
Mean % Forbes	0.63	0.00	0.07	2.20	4.72	0.07	0.50	2.13	4.72	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mean Forb Height (cm)	4.40	-	5.00	12.53	11.50	2.00	5.30	4.04	11.50	-	-	-	-	-	-	-	-
Mean % Graminoids	75.00	8.50	25.00	4.73	7.62	46.40	46.33	1.32	7.62	0.00	0.00	0.00	0.02	0.00	0.00	0.00	2.73
Mean Graminoid Depth (cm)	51.73	46.00	46.00	45.71	53.76	41.80	44.33	26.54	53.76	-	-	-	54.00	-	-	-	46.79
Mean % litter	6.70	3.03	0.00	0.00	0.92	0.43	0.50	0.55	0.92	1.30	0.88	25.33	7.05	4.30	4.77	3.90	5.97
Mean Litter depth (cm)	3.15	1.27	-	-	1.07	0.96	1.00	0.98	1.07	1.09	1.03	2.80	1.57	1.23	1.43	1.80	4.90
Mean % Bare soil	0.00	69.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.44	0.00	72.13
Mean % Deadfall (0-10 cm)	0.00	0.23	0.00	0.00	1.18	0.00	0.00	0.07	1.18	1.57	1.46	2.80	4.18	0.65	2.87	0.10	0.00
Mean % Deadfall (10-25 cm)	0.00	0.13	0.00	0.00	0.00	0.00	0.00	0.07	0.00	0.00	0.38	0.00	0.47	0.22	0.01	0.00	0.00
Mean % Deadfall (>25cm)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Overall % Deadfall	0.00	0.37	0.00	0.00	1.15	0.00	0.00	0.13	1.18	1.57	1.92	2.80	4.65	0.87	2.88	0.10	0.00
Mean % Rock	10.33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.57	8.03	3.23	0.33	0.69	0.33	2.20
Mean % Water	6.03	5.67	51.13	10.00	5.97	3.67	24.70	0.35	5.97	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mean % Sphagnum	0.00	0.00	43.93	89.67	44.97	88.33	0.37	66.97	44.97	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mean % Feathermoss	0.00	0.00	0.00	0.00	46.00	0.00	0.00	2.48	46.00	51.70	44.78	3.37	17.45	19.02	0.42	0.00	0.00
Mean % Terrestrial Lichen	0.00	0.00	0.00	0.00	0.02	0.00	0.00	16.02	0.02	31.77	47.83	7.87	26.45	68.13	75.29	79.33	1.67

Table 2.8-4. Summary of Red-backed Voles Metals and Radionuclide Analysis in the Wheeler River Project Area – 2016.

Parameter	Units	Gryphon	Phoenix	Reference 1	Reference 2	Reference 3
Physical Properties						
Moisture	%	73.06	73.23	72.46	72.65	72.95
Metals and Trace Elements						
Aluminum	ug/g	7.8	34	5.1	5.7	7.8
Antimony	ug/g	<0.02	<0.02	<0.02	<0.02	<0.02
Arsenic	ug/g	0.01	0.02	<0.01	<0.01	0.01
Barium	ug/g	22.8	22.3	10.1	42.2	24.6
Beryllium	ug/g	<0.002	<0.002	<0.002	<0.002	<0.002
Boron	ug/g	0.3	0.3	0.3	0.3	0.4
Cadmium	ug/g	0.018	0.021	0.036	0.058	0.034
Chromium	ug/g	<0.1	<0.1	<0.1	<0.1	<0.1
Cobalt	ug/g	0.049	0.055	0.048	0.047	0.054
Copper	ug/g	2.8	2.6	2.5	2.7	2.4
Iron	ug/g	68	71	59	62	62
Lead	ug/g	0.027	0.035	0.027	0.038	0.039
Manganese	ug/g	6.8	9.4	7.7	8	7.6
Molybdenum	ug/g	0.02	0.05	0.04	0.04	0.04
Nickel	ug/g	0.09	0.09	0.1	0.08	0.12
Selenium	ug/g	0.44	0.66	0.43	0.16	0.29
Silver	ug/g	<0.002	<0.002	<0.002	<0.002	<0.002
Strontium	ug/g	0.82	1.7	1.4	2.4	2.2
Thallium	ug/g	<0.01	<0.01	<0.01	<0.01	<0.01
Tin	ug/g	<0.01	<0.01	<0.01	<0.01	<0.01
Titanium	ug/g	0.41	1.6	0.35	0.39	0.36
Uranium	ug/g	0.01	0.031	0.007	0.01	0.007
Vanadium	ug/g	<0.02	0.02	<0.02	<0.02	<0.02
Radionuclides						
Lead-210	Bq/g	0.011	0.006	0.009	0.008	0.011
Polonium-210	Bq/g	0.018	0.015	0.018	0.017	0.013
Radium-226	Bq/g	0.0017	0.0037	0.0014	0.002	0.0015
Thorium-230	Bq/g	<0.0003	<0.0003	<0.0004	<0.0003	<0.0003

Table 2.9-1. Amphibian Point Count Survey Results in the Wheeler River Project Area – 2017.

Date	Start Time	Site	Study Area	Easting NAD 83	Northing NAD 83	Weather Conditions			Amphibian Species
						Sky Code[a]	Temp (C)	Beaufort Wind[b]	Wood Frog
17/06/2017	22:30	1	RSA	471524	6379813	2	11	1	0
17/06/2017	22:37	2	RSA	472331	6379837	2	11	1	0
17/06/2017	22:46	3	RSA	472993	6379306	2	11	1	0
17/06/2017	22:54	4	RSA	473814	6379286	5	11	1	0
17/06/2017	23:01	5	RSA	474130	6378541	5	11	1	0
17/06/2017	23:08	6	RSA	474855	6378136	2	11	1	0
17/06/2017	23:15	7	RSA	475632	6377884	2	11	1	0
17/06/2017	23:22	8	RSA	475648	6377073	2	11	1	0
17/06/2017	23:30	9	LSA	475400	6376296	2	11	1	0
17/06/2017	23:39	10	RSA	474603	6376421	5	11	1	0
17/06/2017	23:53	11	LSA	475204	6375512	5	11	1	0
18/06/2017	0:00	12	LSA	474770	6374837	5	11	1	0
18/06/2017	0:07	13	RSA	474031	6374498	5	11	1	0
18/06/2017	0:18	14	LSA	475593	6374778	2	11	1	0
18/06/2017	0:25	15	LSA	474886	6374024	2	11	1	0
18/06/2017	0:32	16	RSA	474557	6373284	2	11	1	0
18/06/2017	0:39	17	LSA	474946	6372581	2	11	0	0
18/06/2017	0:46	18	LSA	475775	6372547	5	11	0	0
18/06/2017	0:52	19	LSA	476321	6373164	5	11	0	0
18/06/2017	1:00	20	LSA	477124	6373356	5	9	1	0
18/06/2017	22:31	21	LSA	475916	6371760	2	16	0	0
18/06/2017	22:37	22	LSA	476517	6371209	2	16	0	0
18/06/2017	22:43	23	LSA	477329	6371090	2	16	0	0
18/06/2017	22:49	24	LSA	478039	6371489	2	16	0	0
18/06/2017	22:57	25	LSA	477177	6370280	2	16	0	0
18/06/2017	23:02	26	LSA	476791	6369516	2	16	0	0
18/06/2017	23:10	27	LSA	478579	6370874	2	16	1	0
18/06/2017	23:16	28	LSA	478977	6371571	2	16	0	0
18/06/2017	23:23	29	LSA	479374	6370704	2	16	0	0
18/06/2017	23:30	30	LSA	480236	6370707	2	16	0	0

Notes:

[a]**Sky codes**: 0 = Few clouds; 1 = Partly Cloudy; 2 = Cloudy or Overcast; 4 = Fog or Smoke; 5 = Drizzle or light rain

[b]**Beaufort wind** 0 = Calm, smoke rises vertically; 1 =Light air, smoke drifts, weather vane inactive;

2 = Light breeze, leaves rustle, can feel wind on face; 3 = Gentle breeze, leaves and twigs move around, small flags extend;
4 = Moderate breeze, moves thin branches, raise loose papers (do not conduct survey)

[c]**Amphibian Calling Index:** 1, 2 or 3, Several = 3-5 or Many = > 5

Table 2.9-1 Cont. Amphibian Point Count Survey Results in the Wheeler River Project Area – 2017.

Date	Start Time	Site	Study Area	Easting NAD 83	Northing NAD 83	Weather Conditions			Amphibian Species
						Sky Code[a]	Temp (C)	Beaufort Wind[b]	Wood Frog
18/06/2017	23:40	31	LSA	478718	6370106	2	16	0	0
18/06/2017	23:47	32	LSA	478182	6369438	2	16	0	0
18/06/2017	23:52	33	RSA	477607	6368751	2	16	0	0
18/06/2017	23:54	34	RSA	477172	6368721	2	16	0	0
19/06/2017	0:05	35	RSA	476727	6367388	2	16	0	0
19/06/2017	0:10	36	RSA	476278	6366692	2	16	0	0
19/06/2017	0:20	37	LSA	479791	6371475	5	16	0	0
19/06/2017	0:26	38	RSA	480500	6371882	5	16	0	0
19/06/2017	0:32	39	RSA	481064	6372482	5	16	0	0
19/06/2017	0:38	40	RSA	481615	6373103	5	16	0	0
19/06/2017	0:45	41	RSA	482125	6373731	5	16	0	0
19/06/2017	0:53	42	RSA	482553	6374410	5	11	0	0
19/06/2017	22:34	43	RSA	477975	6381272	1	9	0	0
19/06/2017	22:40	44	RSA	477728	6380499	1	9	0	0
19/06/2017	22:47	45	RSA	477010	6380131	1	9	0	0
19/06/2017	22:54	46	RSA	476237	6379858	1	9	0	0
19/06/2017	23:02	47	RSA	475936	6379096	1	9	0	0
19/06/2017	23:09	48	RSA	476095	6378240	1	9	0	0
19/06/2017	23:17	49	RSA	476609	6377630	1	9	0	2
19/06/2017	23:25	50	LSA	477268	6377187	1	9	0	0
19/06/2017	23:33	51	LSA	477800	6376556	1	9	0	0
19/06/2017	23:39	52	LSA	477869	6375786	0	9	0	0
19/06/2017	23:45	53	LSA	478656	6375909	0	9	0	0
19/06/2017	23:51	54	LSA	479147	6376580	0	9	0	0
19/06/2017	23:57	55	LSA	479474	6377304	0	9	0	0
20/06/2017	0:08	56	LSA	477056	6375835	0	9	0	0
20/06/2017	0:15	57	LSA	476604	6375181	0	9	0	0
20/06/2017	0:23	58	LSA	477037	6374493	0	9	0	0
20/06/2017	0:30	59	LSA	477856	6374614	0	9	0	0
20/06/2017	0:46	60	RSA	474141	6372503	0	9	0	0
20/06/2017	0:52	61	RSA	473567	6371944	0	6	0	0

Notes:

[a]**Sky codes**: 0 = Few clouds; 1 = Partly Cloudy; 2 = Cloudy or Overcast; 4 = Fog or Smoke; 5 = Drizzle or light rain

[b]**Beaufort wind** 0 = Calm, smoke rises vertically; 1 =Light air, smoke drifts, weather vane inactive;

2 = Light breeze, leaves rustle, can feel wind on face; 3 = Gentle breeze, leaves and twigs move around, small flags extend;
4 = Moderate breeze, moves thin branches, raise loose papers (do not conduct survey)

[c]**Amphibian Calling Index:** 1, 2 or 3, Several = 3-5 or Many = > 5

Table 2.9-2. Amphibian Point Count Survey Results in the Wheeler River Project Area – 2018.

Date	Start Time	Site	Study Area	Easting NAD 83	Northing NAD 83	Weather Conditions			Amphibian Species
						Sky Code[a]	Temp (C)	Beaufort Wind[b]	Boreal Chorus Frog
08/06/2018	22:24	5	RSA	474130	6378541	0	20	0	
08/06/2018	22:31	6	RSA	474855	6378136	0	20	0	
08/06/2018	22:39	7	RSA	475632	6377884	0	20	0	
08/06/2018	22:47	8	RSA	475648	6377073	0	20	0	
08/06/2018	22:55	9	LSA	475400	6376296	0	15	0	
08/06/2018	23:05	10	RSA	474603	6376421	0	19	0	
08/06/2018	23:18	11	LSA	475204	6375512	0	17	0	
08/06/2018	23:25	12	LSA	474770	6374837	0	17	0	
08/06/2018	23:33	13	RSA	474031	6374498	0	15	0	
08/06/2018	23:44	14	LSA	475593	6374778	0	16	0	3
08/06/2018	23:51	15	LSA	474886	6374024	0	15	0	1
08/06/2018	23:58	16	RSA	474557	6373284	0	17	0	Many
09/06/2018	00:05	17	LSA	474946	6372581	0	14	0	
09/06/2018	00:14	21	LSA	475916	6371760	0	13	0	
09/06/2018	00:21	22	LSA	476517	6371209	0	12	0	1
09/06/2018	00:27	23	LSA	477329	6371090	0	14	0	
09/06/2018	00:34	24	LSA	478039	6371489	0	14	1	
09/06/2018	00:43	27	LSA	478579	6370874	0	10	1	
06/06/2018	22:22	52	LSA	477869	6375786	0	9	0	
06/06/2018	22:31	56	LSA	477056	6375835	0	8	0	
06/06/2018	22:42	57	LSA	476604	6375181	0	8	0	
06/06/2018	22:53	58	LSA	477037	6374493	0	6	0	
06/06/2018	23:03	59	LSA	477856	6374614	0	7	0	1
06/06/2018	23:14	20	LSA	477124	6373356	0	8	0	
06/06/2018	23:33	19	LSA	476321	6373164	0	6	0	
06/06/2018	23:41	18	LSA	475775	6372547	0	4	0	

Notes:

[a]**Sky codes**: 0 = Few clouds; 1 = Partly Cloudy; 2 = Cloudy or Overcast; 4 = Fog or Smoke; 5 = Drizzle or light rain

[b]**Beaufort wind** 0 = Calm, smoke rises vertically; 1 =Light air, smoke drifts, weather vane inactive;

2 = Light breeze, leaves rustle, can feel wind on face; 3 = Gentle breeze, leaves and twigs move around, small flags extend;
4 = Moderate breeze, moves thin branches, raise loose papers (do not conduct survey)

[c]**Amphibian Calling Index:** 1, 2 or 3, Several = 3-5 or Many = > 5

Table 2.9-3. Comparison of Wheeler River Project Area Amphibian Nocturnal Call Survey Results to Other Studies in Northern Saskatchewan.

Survey Area	Survey Dates	# of Survey Sites	% of Plots With Boreal Chorus Frogs	% of Plots with Wood Frogs	% of Plots with Canadian Toads	% of Plots with Northern Leopard Frogs
Denison-Wheeler River 2018	June 6-9, 2018	26	19	0	0	0
Denison-Wheeler River 2017	June 16-20, 2017	61	0	2	0	0
Sask Power/Black Lake First Nation- Tazi Twe Hydroelectric Project	May 28, June 2, June 13, 2012	28	50	32	0	0
Rio Tinto - Roughrider	June 6-8, 2012	17	53	6	0	0
SRC-Gunnar Mine*	August, 2009	N/A	Observed (3)	Observed (66)	Not Observed	Observed (6)
Cameco - Millennium	June 13-26, 2007	Unknown	0	Observed**	0	0

*Visual Survey
**Number of observations not quantified
Source: Rio Tinto (2014), Golder (2013), SRC (2013), and Cameco (2009)

Table 2.10-1. Mean Breeding Song Bird Pairs Detected per Vegetation Cover Type in the Wheeler River Project Area - 2017.

Species	N	Ecosite and Sample Size																			
		BS3	BS4	BS5	BS7	BS9	BS16	BS17	BS18	BS19	BS20	BS21	BS22	BS23	BS24	BS25	BS26	BS27	RF1	RF2	RF3	AN
	101	7	5	1	7	7	5	7	5	2	3	4	4	2	5	2	3	5	7	7	7	6
	Mean pairs																					
Alder Flycatcher	0.02								0.2			0.3										
American Robin	0.13	0.3	0.2			0.1		0.3				0.3			0.2		0.3	0.2	0.1	0.1	0.1	
Barn Swallow	0.04																					0.7
Belted Kingfisher	0.02																				0.3	
Blue-headed vireo	0.01																		0.1			
Boreal Chickadee	0.03							0.1			0.7											
Bufflehead	0.01																	0.2				
Cedar Waxwing	0.01																		0.1			
Chipping Sparrow	0.15	0.1	0.6	1.0	0.1	0.1		0.3					0.5	0.5					0.1		0.3	
Common Loon	0.02																	0.4				
Common Merganser	0.03																1.0					
Common Raven	0.01													0.5								
Dark-eyed Junco	0.40	0.3	0.2	3.0	0.3	0.4	0.4	0.2	0.4		0.3	1.3	0.3	0.5	0.4				0.1	0.7	0.7	
Fox Sparrow	0.15		0.2	2.0	0.3				0.2										0.4	0.7	0.1	
Gray Jay	0.34	0.3	0.4	1.0	1.4	0.3	0.2	0.6	0.2				0.5				0.3		0.1	0.6	0.3	0.2
Greater Yellowlegs	0.03		0.2										0.3					0.2				

Table 2.10-1 Cont. Mean Breeding Song Bird Pairs Detected per Vegetation Cover Type in the Wheeler River Project Area - 2017.

Species	N	Ecosite and Sample Size																			
		BS3	BS4	BS5	BS7	BS9	BS16	BS17	BS18	BS19	BS20	BS21	BS22	BS23	BS24	BS25	BS26	BS27	RF1	RF2	RF3	AN
	101	7	5	1	7	7	5	7	5	2	3	4	4	2	5	2	3	5	7	7	7	6
	Mean pairs																					
Herring Gull	0.01																	0.2				
Hermit Thrush	0.18	0.3			0.1	0.1		0.1					0.3						0.6	1.0	0.1	
Killdeer	0.02																0.3					0.2
Lincoln Sparrow	0.15					0.1	0.4	0.1	0.2	0.5	0.3	0.8	0.8				0.3				0.1	
Mew Gull	0.01																0.3					
Olive-sided Flycatcher	0.08							0.3				0.3	0.5	0.5	0.2					0.1		
Palm Warbler	0.09								0.2		0.3	0.3	0.8	1.0	0.2							
Ring-billed Gull	0.01																0.3					
Ruby-crowned Kinglet	0.50	0.7	1.4		1.3	0.9	0.6	1.0	0.2			0.3	0.3	0.5					1.0	0.4		
Solitary Sandpiper	0.04													0.5			0.3	0.4				
Spruce Grouse	0.01		0.2																			
Swamp Sparrow	0.05								0.2		0.3	0.3	0.3			0.5						
Swainson's Thrush	0.18	0.1	0.8		0.1	0.4		0.1	0.2	0.5	0.3	0.3							0.4	0.1		
Tennessee Warbler	0.01						0.2															
Tree Swallow	0.01																					0.2
Wilson's Warbler	0.04					0.1													0.3	0.1		

Table 2.10-1 Cont. Mean Breeding Song Bird Pairs Detected per Vegetation Cover Type in the Wheeler River Project Area - 2017.

Species	N	Ecosite and Sample Size																			
		BS3	BS4	BS5	BS7	BS9	BS16	BS17	BS18	BS19	BS20	BS21	BS22	BS23	BS24	BS25	BS26	BS27	RF1	RF2	RF3	AN
	101	7	5	1	7	7	5	7	5	2	3	4	4	2	5	2	3	5	7	7	7	6
	Mean pairs																					
Winter Wren	0.01						0.2															
White-throated Sparrow	0.05						0.2					0.3									0.4	
Yellow-bellied Flycatcher	0.02																		0.1	0.1		
Yellow-rumped Warbler	0.31	0.1	1.0		0.9	0.4	0.6	0.1	0.6			0.3	0.3	0.5			0.3		0.3	0.1	0.3	

Table 2.10-2. Songbird Diversity Indices by Ecosite in the Wheeler River Project Area - 2017.

Ecosite	N	Diversity Indices				Decreasing Richness		Decreasing Pairs		Decreasing S-W		Decreasing Evenness	
		Species Richness	Mean # of Pairs	Shannon-Wiener Diversity	Evenness	Ecosite	Species Richness	Ecosite	Mean # of Pairs	Ecosite	Shannon-Wiener Diversity	Ecosite	Evenness
BS3	**7**	8	2.3	1.9	0.9	Project Area	36	BS5	7.0	Project Area	2.9	BS19	1.0
BS4	**5**	10	5.2	2.0	0.9	RF1	13	BS4	5.2	BS22	2.4	BS23	1.0
BS5	**1**	4	7.0	1.3	0.9	BS22	12	BS7	4.6	RF1	2.3	BS20	1.0
BS7	**7**	8	4.6	1.7	0.8	BS17	11	BS21	4.5	BS18	2.2	BS27	1.0
BS9	**7**	10	3.1	2.1	0.9	BS21	11	BS22	4.5	BS21	2.2	BS18	1.0
BS16	**5**	8	2.8	2.0	0.9	RF2	11	RF2	4.3	BS17	2.1	BS26	1.0
BS17	**7**	11	3.7	2.1	0.9	BS4	10	BS23	4.0	RF2	2.1	BS22	1.0
BS18	**5**	10	2.6	2.2	1.0	BS9	10	RF1	4.0	BS26	2.1	BS3	0.9
BS19	**2**	2	1.0	0.7	1.0	BS18	10	BS17	3.7	BS9	2.1	BS16	0.9
BS20	**3**	7	2.7	1.9	1.0	BS26	9	BS26	3.7	RF3	2.1	BS24	0.9
BS21	**4**	11	4.5	2.2	0.9	RF3	9	Study Area	3.2	BS4	2.0	RF3	0.9
BS22	**4**	12	4.5	2.4	1.0	BS3	8	BS9	3.1	BS16	2.0	BS5	0.9
BS23	**2**	7	4.0	1.9	1.0	BS7	8	BS16	2.8	BS23	1.9	BS21	0.9
BS24	**5**	3	0.8	1.0	0.9	BS16	8	RF3	2.7	BS20	1.9	BS9	0.9
BS25	**2**	1	0.5	0.0	NA	BS20	7	BS20	2.7	BS3	1.9	RF1	0.9
BS26	**3**	9	3.7	2.1	1.0	BS23	7	BS18	2.6	BS27	1.7	BS17	0.9
BS27	**5**	6	1.6	1.7	1.0	BS27	6	BS3	2.3	BS7	1.7	RF2	0.9
RF1	**7**	13	4.0	2.3	0.9	AN	5	BS27	1.6	AN	1.4	BS4	0.9
RF2	**7**	11	4.3	2.1	0.9	BS5	4	AN	1.3	BS5	1.3	AN	0.9
RF3	**7**	9	2.7	2.1	0.9	BS24	3	BS19	1.0	BS24	1.0	BS7	0.8
AN	**6**	5	1.3	1.4	0.9	BS19	2	BS24	0.8	BS19	0.7	Project Area	0.8
Project Area	**101**	36	3.2	2.9	0.8	BS25	1	BS25	0.5	BS25	0.0	BS25	NA

Table 2.10-3. Breeding Songbird Observations in Descending order of Abundance in the Wheeler River Project Area – 2017.

Common Name	Scientific Name	Number of Pairs
Ruby-crowned Kinglet	*Regulus calendula*	51
Dark-eyed Junco	*Junco hyemalis*	40
Gray Jay	*Perisoreus canadensis*	34
Yellow-rumped Warbler	*Dendroica coronata*	31
Hermit Thrush	*Catharus guttatus*	18
Swainson's Thrush	*Catharus ustulatus*	18
Chipping Sparrow	*Spizella passerina*	15
Fox Sparrow	*Passerella iliaca*	15
Lincoln Sparrow	*Melospiza lincolnii*	15
American Robin	*Turdus migratorius*	13
Palm Warbler	*Setophaga palmarum*	9
Olive-sided Flycatcher	*Contopus cooperi*	8
Swamp Sparrow	*Melospiza georgiana*	5
White-throated Sparrow	*Zonotrichia albicollis*	5
Barn Swallow	*Hirundo rustica*	4
Solitary Sandpiper	*Tringa solitaria*	4
Wilson's Warbler	*Wilsonia pusilla*	4
Boreal Chickadee	*Poecile hudsonicus*	3
Common Merganser	*Mergus merganser*	3
Greater Yellowlegs	*Tringa melanoleuca*	3
Alder Flycatcher	*Empidonax alnorum*	2
Belted Kingfisher	*Megaceryle alcyon*	2
Common Loon	*Gavia immer*	2
Killdeer	*Charadrius vociferus*	2
Yellow-bellied Fylcatcher	*Empidonax flaviventris*	2
Bufflehead	*Bucephala albeola*	1
Cedar Waxwing	*Bombycilla cedrorum*	1
Common Raven	*Corvus corax*	1
Blue-headed vireo	*Vireo solitarius*	1
Herring Gull	*Larus smithsonianus*	1
Mew Gull	*larus canus*	1
Ring-billed Gull	*Larus delawarensis*	1
Spruce Grouse	*Falcipennis canadensis*	1
Tennessee Warbler	*Leiothlypis peregrina*	1
Tree Swallow	*Tachycineta bicolor*	1
Winter Wren	*Troglodytes hiemalis*	1

Table 2.11-1. Semi-Aquatic Furbearer Shoreline Survey Observations in the Wheeler River Project Area – 2016.

Water Body ID	Shoreline (km)	Observations per km								
		Muskrat			Beaver				Otter	
		Burrow/ House/ Run	Scent platform /Feed Sign	Scat	Run/ Scent/ Feed Sign	Old Run/ Scent/ Feed Sign	Active House	Inactive/ Old House	Scent/ Feed Sign	Scat
Lake 1	5.3	0	0	0	0	0	0	0	0	0
Lake 2	8.9	0	0	0.45	0.34	0.22	0	0	0	0
Lake 3	3.9	0	0.26	0.26	0	0.26	0	0	0	0
Lake 4	5.7	0	1.93	2.98	0	0	0	0	0	0
Lake 5	2.1	0	0.95	1.90	0	0	0	0	0	0
Lake 6	26.1	0	0.08	0.46	0.08	0.38	0	0.04	0.04	0
Lake 7	3.9	0	0.26	2.05	2.82	0.77	0	0.51	0	0
Lake 8	11.5	0	0.52	0.35	0	1.22	0	0.09	0	0
Lake 9	2.8	0	3.57	3.57	0	0	0	0	0.36	0
Lake 10	4.7	0	0	0.21	0	2.98	0	0	0	0
Lake 11	1.1	5.45	7.27	3.64	0	0	0	0	0	0
Lake 12	1.3	0	0	0	0	2.31	0	0	0	0
Lake 13	1.4	0	0	0	0	1.43	0	0	0	0
Lake 14	0.9	0	0	1.14	0	0	0	1.14	0	0
Lake 15	1.3	0	0	0	0	0	0	0	0	0
Lake 16	3.8	0	0	0	0	10.00	0	0	0	0
Lake 17	1.4	0	0	0	0	0	0	0	0	0
Creek 1	0.9	0	0	3.33	0	0	0	0	0	0
Creek 2	0.7	0	0	3.03	0	0	0	0	0	3.03
Creek 3	0.7	0	0	0	0	0	0	0	0	0
Creek 4	3.9	0	0.77	0.26	0.26	1.54	0	0.26	0	0.77
Creek 5	2.1	0	3.81	3.81	0	1.43	0	0	0	0
Creek 6	2.1	0	0.48	4.29	0	0	0	0	0	0
LSA	**31.9**	**0.19**	**0.97**	**1.79**	**0.34**	**0.41**	**0**	**0.06**	**0**	**0**
RSA	**64.5**	**0.00**	**0.34**	**0.50**	**0.09**	**1.29**	**0**	**0.06**	**0.03**	**0.09**
Total	**96.4**	**0.06**	**0.55**	**0.92**	**0.18**	**1.00**	**0**	**0.06**	**0.02**	**0.06**

Table 2.12-1. Aerial Waterfowl Survey Observations in Descending order of Abundance in the Wheeler River Project Area – 2017.

Common Name	Scientific Name	Number of Pairs
Ring-necked Duck	*Aythya collaris*	107
Common Merganser	*Mergus merganser*	93
Common Loon	*Gavia immer*	75
Mallard	*Anas platyrhynchos*	70
Unknown White-Headed Gull	*Larus spp.*	67
Bald Eagle	*Haliaeetus leucocephalus*	47
Canada Goose	*Branta canadensis*	37
Lesser scaup	*Aythya affinis*	30
Yellowlegs Spp.	*Tringa spp.*	24
Bufflehead	*Bucephala albeola*	23
Unknown Dabbler	*Anas spp.*	17
Mew Gull	*Larus canus*	15
Unknown Diver	*Aythya, Bucephala, or Mergus spp.*	13
Surf scoter	*Melanitta perspicillata*	10
Bonaparte's gull	*Larus philadelphia*	10
Sandpiper Spp.	*Actitus or Tringa spp.*	10
Osprey	*Pandion haliaetus*	8
Common Goldeneye	*Bucephala clangula*	6
Common Raven	*Corvus corax*	6
Herring gull	*Larus argentatus*	5
Red-tailed hawk	*Buteo jamaicensis*	2
White-winged Scoter	*Melanitta deglandi*	1
Ring-billed Gull	*Larus delawarensis*	1
Common Tern	*Sterna hirundo*	1
Unknown Gull	*Larus spp.*	1
Northern Harrier	*Circus cyaneus*	1
Unknown Hawk	*Accipter, Buteo or Circus spp.*	1

Table 2.12-2. Aerial Waterfowl and Stick Nest Survey Results in the Wheeler River Project Area - 2017.

Species	Survey Section ID																																
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	Total
Canada goose	4				17		2	2				2															2	2	2		4			37
Mallard	1	2			2	1	16	2		1	1	2				2	5	3		4	4	2				5	3	9			3	2		70
Common merganser	2	4		16	3		24						5			2	11	2	14							3		7						93
Ring-necked duck			1			4	2	2			3		2		20			2	2	12	15						12		9	17	4			107
Lesser scaup															12			10					2				1	3		2				30
Bufflehead			1	1				1						6				2		2								3	1		6			23
Common Goldeneye														6																				6
Surf scoter										2							3				2				2					1				10
White-winged Scoter																					1													1
Common loon	3			3	5	3		2		1		7	1	3	1		3	5	2	8	4	3	1		2	5			3	1	5	4		75
Herring gull												1							1		1									2				5
Mew Gull	2												1		12																			15
Bonaparte's gull															4					3										3				10
Ring-billed Gull										1																								1
Common Tern																				1														1
Unknown white-headed Gull	9	1				1				1		2		10			1	2	2	10		1	2			1	3	1	3	5	11	1		67
Unknown Dabbler				1											10															6			17
Unknown Diver							1			2											2				1	2			1		4			13
Unknown Gull																											1							1
Bald Eagle	2	2		2	4		2	1		6		2	1		3	2	5	3	7							1		3				1		47
Red-tailed hawk															1												1							2
Northern Harrier												1																						1
Osprey	1														1			2			2											2		8
Common Raven															2																	4		6
Unknown Hawk															1																			1
Yellowlegs Spp.											3		2	4			2				2	1					2	1	1	3	3			24
Sandpiper Spp.	1															2						1			1	4			1					10
Total	**25**	**9**	**2**	**23**	**31**	**9**	**47**	**10**	**0**	**14**	**7**	**17**	**12**	**29**	**67**	**8**	**30**	**31**	**28**	**40**	**33**	**8**	**5**	**0**	**6**	**21**	**25**	**29**	**21**	**31**	**49**	**14**	**0**	**681**

Table 2.12-3. Information on Water Bodies Within Survey Sections for the Aerial Waterfowl Surveys in the Wheeler River Project Area - 2017.

Survey Section ID	# Water Bodies	Total Area Searched (ha)	Average Water Body Size (ha)	Density (# birds /ha)	Species diversity (# species /ha)	Ecosite Distribution Within a 100 m Buffer Adjacent to Water Body (Percentage by Composition)		
						Coniferous Upland	Deciduous Upland	Bogs and Fens
1	10	95	9	0.3	0.1	94.2	0.3	5.4
2	2	171	85	0.1	0.0	91.5	1.7	6.8
3	8	10	1	0.2	0.2	80.3	0.0	19.7
4	3	68	23	0.3	0.1	68.7	0.6	30.7
5	10	347	35	0.1	0.0	32.0	0.0	68.0
6	7	47	7	0.2	0.1	54.9	2.2	43.0
7	2	2	1	20.8	2.7	1.5	0.0	98.5
8	5	170	34	0.1	0.0	69.3	2.6	28.1
9	5	45	9	0.0	0.0	11.8	1.5	86.7
10	2	326	163	0.0	0.0	99.5	0.2	0.3
11	8	13	2	0.5	0.2	46.6	0.0	53.4
12	14	252	18	0.1	0.0	66.1	1.2	32.7
13	12	22	2	0.5	0.3	39.8	1.6	58.6
14	15	160	11	0.2	0.0	99.0	0.1	0.9
15	10	307	31	0.2	0.0	62.0	4.8	33.2
16	1	219	219	0.0	0.0	53.4	13.1	33.5
17	8	171	21	0.2	0.0	86.3	1.7	12.0
18	18	228	13	0.1	0.0	56.1	4.3	39.6
19	2	473	236	0.1	0.0	64.5	0.9	34.6
20	10	237	24	0.2	0.0	97.7	0.3	2.0
21	11	108	10	0.3	0.1	95.5	0.4	4.1
22	10	139	14	0.1	0.0	91.8	6.0	2.2
23	3	91	30	0.1	0.0	93.2	4.8	2.0
24	4	2	1	0.0	0.0	98.4	0.3	1.3
25	3	172	57	0.0	0.0	92.8	1.3	5.9
26	7	194	28	0.1	0.0	95.0	0.5	4.5
27	10	42	4	0.6	0.2	96.4	0.2	3.3
28	10	35	3	0.8	0.2	86.7	1.5	11.8
29	7	65	9	0.3	0.1	96.7	0.7	2.6
30	7	36	5	0.8	0.2	91.2	0.4	8.5
31	11	173	16	0.3	0.1	97.6	0.6	1.8
32	11	142	13	0.1	0.0	94.0	3.5	2.5
33	2	67	34	0.0	0.0	88.0	3.0	9.0

Table 2.12-4. Nest Sites Observed During Aerial Waterfowl Surveys in the Wheeler River Project Area - 2017.

Nest Description	Location (NAD 83)
Active bald eagle nest (male & female adults in nest)	13 V 474274 6374049
Active bald eagle nest (2 adults in nest)	13 V 479947 6374456
Active bald eagle nest (2 chicks)	13 V 479746 6372025
Active osprey nest (1 adult in nest)	13 V 473270 6362347
Active osprey nest (2 adults in nest)	13 V 481637 6376574
Active osprey nest (2 adults by nest; 3-4 eggs)	13 V 470727 6375318
Active osprey nest (2 adults in nest)	13 V 467131 6378408
Active raven nest (1 adult in nest)	13 V 480451 6371997
Active raven nest (4 birds in nest)	13 V 467080 6378261
Active mew gull colony of nests (12-15)	13 V 473788 6366773
Active herring gull nest (1 adult; 2 chicks)	13 V 470261 6374778
Active common loon nest (1 adult; 2 eggs)	13 V 468790 6371207
Inactive stick nest	13 V 476448 6370902
Inactive stick nest	13 V 477881 6374083
Inactive stick nest	13 V 478079 6373723
Inactive stick nest	13 V 477759 6373453
Inactive stick nest	13 V 479692 6369142
Inactive stick nest	13 V 472180 6376933
Inactive stick nest	13 V 479052 6379747
Inactive stick nest	13 V 468570 6369528
Inactive stick nest	13 V 467152 6378011
Old stick nest	13 V 473588 6366034
Old stick nest	13 V 469765 6378861
Old stick nest	13 V 473096 6382905
Old stick nest	13 V 468402 6379791

Table 2.13-1. Regional Ungulate Aerial Surveys in the SK1 (Boreal Shield) Region of Saskatchewan[a].

tudy	Survey Timing	Sample Area (km^2)	Survey Intensity (%)	Search Intensity	Species/km^2		Woodland Caribou Population Structure		
					Moose	Caribou	Bulls:Cow	Calf:Cow	Calves as a % of Total Population
Millennium TRSA	March 2014	2,285	40	1.7	0.040	0.005	1.600	0.000	0
Millennium LSA	March 2014	397	100	1.7	0.050	0.000	-	-	-
Key Lake 2014 (Unpublished)	March 3-12 2014	1616	40	1.7	0.030	0.030	-	-	-
Key Lake 2013 (Unpublished)	March 13-16 2013	1616	40	1.7	0.030	0.060	0.750	0.250	18
Key Lake 2012 (Unpublished)	March 15-17 2012	1616	40	1.5	0.05	0.09	0.310	0.130	9
Key Lake 2011 (Unpublished)	Dec 13-17 2011	1616	40	2	0.04	0.06	0.714	0.330	12
914	Mar 2011	554	-	-	-	0.000	-	-	-
McArthur River 2011 (HAB-TECH 2012)	Feb 7-9 2011	400	100	1.8	0.05	0.04	0.270	0.270	18
914	Feb 2011	554	-	-	-	0.004	-	-	-
914	Dec 2010	410	-	-	-	0.027	-	-	-
Cigar Lake 2011 (HAB-TECH 2011)	March 7-9 2010	320	100	1.4	0.01	0	-	-	-
Four Bear 2010 (HAB-TECH 2010a)	March 5-6 2010	350	100	1.5	0.08	0	-	-	-
Key Lake 2010 (HAB-TECH 2010b)	Feb 23-24 2009	384	100	1.7	0.02	0.05	0.250	0.000	0
Virgin River 2009 (HAB-TECH 2009b)	March 21-24 2009	376	100	1.8	0.050	0.130	0.320	0.400	20
Courtenany Lake, U of S 2015	Mar 17-18 2015	380	100	1.7	0.024	0.0950	0.357	0.180	11.1
Tamarack 2009 (HAB-TECH 2009a)	Feb 27-29 2008	324	100	1.9	0.12	0	-	-	-

[a]Source: McLoughlin *et al.* (2016).

Table 12.14-1. Acoustic Bat Survey Results in the Wheeler River Project Area – 2019.

Plot #	Date	Location (NAD83)		Passes Per Species/Species Group			
		Easting	Northing	Little Brown Myotis		Little Brown / Northen Myotis	
				Pass	Buzz	Pass	Buzz
1	22-Jul-19	479807	6377682	-	-	-	-
2	22-Jul-19	479456	6377297	-	-	-	-
3	22-Jul-19	479277	6376813	-	-	-	-
4	22-Jul-19	478937	6376395	-	-	-	-
5	22-Jul-19	478657	6375955	-	-	-	-
6	22-Jul-19	478146	6375790	-	-	-	-
7	22-Jul-19	477867	6376241	-	-	1	-
8	22-Jul-19	477681	6376716	-	-	5	-
9	22-Jul-19	477325	6377111	-	-	-	-
10	22-Jul-19	476877	6377352	-	-	-	-
11	22-Jul-19	476512	6377721	1	-	-	-
12	22-Jul-19	476133	6378105	-	-	-	-
13	22-Jul-19	476012	6378612	-	-	-	-
14	22-Jul-19	475650	6377895	-	-	-	-
15	22-Jul-19	475127	6377913	-	-	-	-
16	22-Jul-19	474710	6378266	-	-	-	-
17	22-Jul-19	475487	6377356	-	-	-	-
18	22-Jul-19	475709	6376883	-	-	-	-
19	22-Jul-19	475230	6376681	1	-	-	-
20	22-Jul-19	474701	6376688	-	-	-	-
21	22-Jul-19	475291	6376147	-	-	-	-
22	22-Jul-19	475295	6375628	-	-	-	-
23	22-Jul-19	474923	6375237	5	2	-	-
24	22-Jul-19	475322	6374945	-	-	-	-
25	22-Jul-19	475816	6374813	-	-	-	-
26	22-Jul-19	475183	6374448	1	-	-	-
27	22-Jul-19	474881	6373999	1	-	-	-
28	22-Jul-19	474693	6373544	-	-	-	-
29	22-Jul-19	474572	6372970	4	-	-	-
30	22-Jul-19	474948	6372584	-	-	-	-
31	23-Jul-19	480431	6370701	-	-	-	-
32	23-Jul-19	479907	6370702	-	-	-	-
33	23-Jul-19	479384	6370704	-	-	-	-
34	23-Jul-19	478997	6371050	1	-	-	-
35	23-Jul-19	479478	6371305	-	-	-	-
36	23-Jul-19	480100	6371675	1	-	-	-
37	23-Jul-19	478872	6370475	-	-	-	-

Table 12.14-1 Cont. Acoustic Bat Survey Results in the Wheeler River Project Area – 2019.

Plot #	Date	Location (NAD83)		Passes Per Species/Species Group			
		Easting	Northing	Little Brown Myotis		Little Brown / Northen Myotis	
				Pass	Buzz	Pass	Buzz
38	23-Jul-19	478666	6369939	-	-	-	-
39	23-Jul-19	478506	6370899	-	-	-	-
40	23-Jul-19	478013	6370955	-	-	-	-
41	23-Jul-19	477596	6370629	1	-	-	-
42	23-Jul-19	478036	6371460	1	-	-	-
43	23-Jul-19	478232	6371933	-	-	1	-
44	23-Jul-19	477503	6371078	-	-	-	-
45	23-Jul-19	477025	6371210	-	-	-	-
46	23-Jul-19	476521	6371222	-	-	1	-
47	23-Jul-19	476146	6371600	-	-	1	-
48	23-Jul-19	475733	6371873	-	-	-	-
49	23-Jul-19	475475	6372267	-	-	-	-
50	23-Jul-19	475802	6372680	-	-	-	-
51	23-Jul-19	476177	6373063	-	-	-	-
52	23-Jul-19	476503	6373489	-	-	-	-
53	23-Jul-19	477006	6373433	-	-	1	-
54	23-Jul-19	476844	6373875	-	-	-	-
55	23-Jul-19	477258	6374303	-	-	-	-
56	23-Jul-19	477698	6374559	1	-	-	-
57	23-Jul-19	477611	6375071	-	-	-	-
58	23-Jul-19	476892	6374678	-	-	-	-
59	23-Jul-19	476422	6374849	-	-	-	-
60	23-Jul-19	476719	6375267	6	5	-	-
61	23-Jul-19	476983	6375682	-	-	-	-
Total Passes or Buzzes Per Hour				**4.72**	**1.38**	**1.97**	**0**

Table 12.14-2. Acoustic Bat Survey Results by Ecosite in the Wheeler River Project Area – 2019.

Ecosite	Survey Hours	Species					
		Little Brown Myotis		Little Brown / Northern Myotis		Total	
		Pass/hr	Buzz/hr	Pass/hr	Buzz/hr	Pass/hr	Buzz/hr
BS3	2.17	5.5	0.9	3.7	0	**9.2**	**0.9**
BS9	0.08	72.0	60.0	0	0	**72.0**	**60.0**
RF1	0.25	0	0	0	0	**0**	**0**
RF2	2.17	2.3	0	0.5	0	**2.8**	**0**
Anthropogenic	0.42	2.4	0	2.4	0	**4.8**	**0**
Total	**5.08**	**4.72**	**1.38**	**1.97**	**0**	**7.48**	**1.38**

Table 2.15-1. Covert Camera Wildlife Capture Results in the Denison Wheeler River Project Area – 2019.

Camera ID	Associated Feature	Zone	Easting	Northing	Camera Days	Species Observations Per 100 Camera Days							
						Bear[1]	Bear Young	Caribou[1]	Caribou Young	Moose[1]	Moose Young	Wolf	Lynx
Camera 1	Trail	13 V	472440	6374145	147	-	-	-	-	-	-	0.68	0.68
Camera 2	Road	13 V	476630	6375211	146	2.05	-	-	-	-	-	2.74	-
Camera 3	Road - Winter plowed	13 V	475267	6372271	146	-	-	-	-	-	-	1.37	-
Camera 4	Handcut	13 V	473576	6374512	147	-	-	-	-	-	-	0.68	-
Camera 5	Road - Winter plowed	13 V	478753	6371007	145	0.69	-	2.07	-	-	-	-	-
Camera 6	Handcut	13 V	477352	6371130	146	-	-	-	-	-	-	-	-
Camera 7	Trail	13 V	478023	6381000	147	3.40	-	-	-	1.36	-	2.72	5.44
Camera 8	Trail	13 V	480952	6373587	147	2.04	-	-	-	-	-	-	-
Camera 9	Trail	13 V	468131	6378008	146	4.79	-	-	-	0.68	0.68	0.68	-
Camera 10	Handcut	13 V	474833	6378212	146	-	-	-	-	2.05	0.68	-	-
Camera 11	Handcut	13 V	472229	6373052	147	-	-	-	-	-	-	-	0.68
Camera 12	Handcut	13 V	482865	6374381	146	-	-	2.05	-	-	-	-	-
Camera 13	Road - Winter plowed	13 V	473289	6371751	147	1.36	0.68	-	-	-	-	5.44	2.04
Camera 14	Road - Winter plowed	13 V	476813	6371337	145	-	-	-	-	-	-	0.69	-
Camera 15	Road	13 V	480404	6378289	147	2.72	-	-	-	-	-	2.04	-
Camera 16	Handcut	13 V	481041	6370934	147	2.04	-	14.29	5.44	-	-	-	-
Camera 17	Trail	13 V	472576	6378989	146	1.37	-	-	-	0.68	-	-	0.68
Camera 18	Trail	13 V	474518	6378349	147	1.36	-	-	-	-	-	1.36	1.36
Camera 19	Handcut	13 V	475568	6375889	147	1.36	-	-	-	-	-	0.68	-
Camera 20	Trail	13 V	480387	6369930	147	0.68	-	13.61	5.44	-	-	-	-
Total					**2929**	**1.19**	**0.03**	**1.60**	**0.55**	**0.24**	**0.07**	**0.96**	**0.55**

* Age not specified- adult or unknown age

Table 2.15-1 Cont. Covert Camera Wildlife Capture Results in the Denison Wheeler River Project Area – 2019.

Camera ID	Associated Feature	Zone	Easting	Northing	Species Observations Per 100 Camera Days								
					Camera Days	Fox	Marten	Hare	Squirrel	Porcupine	Sandhill Crane	Other Birds[2]	Unknown Mammal
Camera 1	Trail	13 V	472440	6374145	147	-	-	13.61	4.76	1.36	-	2.04	2.72
Camera 2	Road	13 V	476630	6375211	146	-	-	-	4.79	-	-	0.68	-
Camera 3	Road - Winter plowed	13 V	475267	6372271	146	2.74	-	-	-	-	-	0.68	0.68
Camera 4	Handcut	13 V	473576	6374512	147	-	-	1.36	-	-	-	-	-
Camera 5	Road - Winter plowed	13 V	478753	6371007	145	-	-	-	-	-	-	-	-
Camera 6	Handcut	13 V	477352	6371130	146	-	-	-	-	-	-	-	-
Camera 7	Trail	13 V	478023	6381000	147	0.68	-	0.68	0.68	3.40	-	-	-
Camera 8	Trail	13 V	480952	6373587	147	-	-	-	-	-	-	-	-
Camera 9	Trail	13 V	468131	6378008	146	-	-	-	-	-	-	-	0.68
Camera 10	Handcut	13 V	474833	6378212	146	-	-	2.05	0.68	-	-	-	-
Camera 11	Handcut	13 V	472229	6373052	147	-	0.68	3.40	-	-	-	0.68	0.68
Camera 12	Handcut	13 V	482865	6374381	146	-	-	-	-	-	-	-	-
Camera 13	Road - Winter plowed	13 V	473289	6371751	147	1.36	-	14.97	-	1.36	-	7.48	8.16
Camera 14	Road - Winter plowed	13 V	476813	6371337	145	1.38	-	-	-	-	-	-	-
Camera 15	Road	13 V	480404	6378289	147	-	2.04	-	2.04	0.68	1.36	2.04	0.68
Camera 16	Handcut	13 V	481041	6370934	147	0.68	-	-	-	-	-	-	0.68
Camera 17	Trail	13 V	472576	6378989	146	-	-	1.37	-	-	-	-	2.05
Camera 18	Trail	13 V	474518	6378349	147	-	-	-	5.44	-	-	6.12	-
Camera 19	Handcut	13 V	475568	6375889	147	0.68	-	5.44	-	6.12	-	-	-
Camera 20	Trail	13 V	480387	6369930	147	2.04	-	-	-	8.16	-	0.68	1.36
Total					**2929**	**0.48**	**0.14**	**2.15**	**0.92**	**1.06**	**0.07**	**1.02**	**0.89**

[1] Age not specified- adult or unknown age

[2] Other bird species include: Canada Jay, Hairy Woodpecker, Grouse spp. and unknown

Table 2.15-2. Covert Camera Wildlife Capture Results by Feature Type in the Denison Wheeler River Project Area – 2019.

Associated Feature	Total Camera Days	Species observations per 100 camera days															
		Bear[1]	Bear Young	Caribou[1]	Caribou Young	Moose[1]	Moose Young	Wolf	Lynx	Fox	Marten	Hare	Squirrel	Porcupine	Sandhill Crane	Other Birds[2]	Unknown Mammal
Road	876	1.14	0.11	0.34	-	-	-	2.05	0.34	0.91	0.34	2.51	1.14	0.34	0.23	1.83	1.60
Hand-cut	1026	0.49	-	2.34	0.78	0.29	0.10	0.19	0.10	0.19	0.10	1.75	0.10	0.88	-	0.10	0.19
Trail	1027	1.95	-	1.95	0.78	0.39	0.10	0.78	1.17	0.39	-	2.24	1.56	1.85	-	1.27	0.97
Total	**2929**	**1.19**	**0.03**	**1.60**	**0.55**	**0.24**	**0.07**	**0.96**	**0.55**	**0.48**	**0.14**	**2.15**	**0.92**	**1.06**	**0.07**	**1.09**	**0.89**

[1] Age not specified- adult or unknown age

[2] Other bird species include: Canada Jay, Hairy Woodpecker, Grouse spp. and unknown

Table 2.15-3. Covert Camera Anthropogenic Capture Results in the Denison Wheeler River Project Area – 2019.

Camera ID	Associated Feature	Zone	Easting	Northing	Camera Days	Captures per 100 Camera Days				
						Heavy Equipment	Trucks, Cars, Vans	ATVs / Snowmobiles / UTV's	Human (non-motorized)	Unknown Vehicle
Camera 1	Trail	13 V	472440	6374145	147	-	-	-	-	-
Camera 2	Road	13 V	476630	6375211	146	-	6.16	73.29	-	6.85
Camera 3	Road - Winter plowed	13 V	475267	6372271	146	192.47	1880.82	440.41	2.05	191.78
Camera 4	Handcut	13 V	473576	6374512	147	-	-	-	-	-
Camera 5	Road - Winter plowed	13 V	478753	6371007	145	106.21	344.14	80.69	-	11.03
Camera 6	Handcut	13 V	477352	6371130	146	-	-	-	-	-
Camera 7	Trail	13 V	478023	6381000	147	-	-	4.08	-	-
Camera 8	Trail	13 V	480952	6373587	147	-	-	-	-	-
Camera 9	Trail	13 V	468131	6378008	146	-	-	-	-	-
Camera 10	Handcut	13 V	474833	6378212	146	-	-	-	-	-
Camera 11	Handcut	13 V	472229	6373052	147	-	-	-	-	-
Camera 12	Handcut	13 V	482865	6374381	146	-	-	-	-	-
Camera 13	Road - Winter plowed	13 V	473289	6371751	147	2.72	31.29	76.19	-	0.68
Camera 14	Road - Winter plowed	13 V	476813	6371337	145	114.48	323.45	109.66	0.69	7.59
Camera 15	Road	13 V	480404	6378289	147	-	0.68	17.69	-	1.36
Camera 16	Handcut	13 V	481041	6370934	147	-	-	-	-	-
Camera 17	Trail	13 V	472576	6378989	146	-	-	-	-	-
Camera 18	Trail	13 V	474518	6378349	147	-	-	18.37	-	-
Camera 19	Handcut	13 V	475568	6375889	147	-	-	-	-	-
Camera 20	Trail	13 V	480387	6369930	147	-	-	2.72	-	-
Total					**2929**	**20.66**	**128.71**	**41.00**	**0.14**	**10.93**

Table 2.15-4. Covert Camera Anthropogenic Capture Results by Feature Type in the Denison Wheeler River Project Area – 2019.

Associated Feature	Total Camera Days	Captures per 100 Camera Days				
		Heavy Equipment	Trucks, Cars, Vans	ATVs / Snowmobiles / UTV's	Human (non-motorized)	Unknown Vehicle
Road	876	69.06	430.37	132.88	0.46	36.53
Hand-cut	1026	-	-	-	-	-
Trail	1027	-	-	3.60	-	-
Total	**2929**	**20.66**	**128.71**	**41.00**	**0.14**	**10.93**

Table 3-1. Vertebrate Sensitive and Species at Risk Observations in the Wheeler River Project Area – 2017-2019.

Common Name	Scientific Name	Obs. Source	Obs. Type	Obs. Per Type	Total Obs.	SKCDC Status	COSEWIC Status	SARA Status	SARGSS	Setback Distance (high disturbance)
Common Loon	*Gavia immer*	Field Survey	Auditory and/or Visual	85	114	S5B, SUN, S5M	Not at Risk		Breeding Bird: May 15-July 15	200m
		Incidental	Auditory and/or Visual	28						
		Field Survey	Nest	1						
Woodland Caribou	*Rangifer tarandus caribou*	Field Survey	Track	72	200	S3	Threatened	Threatened		
		Field Survey	Visual (camera)	63						
		Field Survey	Pellet	47						
		Incidental	Track/Browse	5						
		Field Survey	Crater	13						
Bald Eagle	*Haliaeetus leucocephalus*	Field Survey	Visual	47	54	S5B, S5N, S4M	Not at Risk		Nest Site: Mar. 15-July 15	1,000m
		Incidental	Visual	3						
		Field Survey	Nest	4						
Common Nighthawk	*Chordeiles minor*	Incidental	Auditory and/or Visual	76	83	S4B, S4M	Special Concern	Threatened	Breeding Bird: May 1-Aug. 31	200m
		Incidental	Nest	2						
		SCDC	Visual	5						
Little Brown Myotis	*Myotis lucifugus*	Field Survey	Ultrasonic Detection	24	24	S4B, S4N	Endangered	Endangered	Roost/forgaing site: year	500m
Little Brown Myotis / Northern Myotis	*Myotis lucifugus / Myotis septentionalis*	Field Survey	Ultrasonic Detection	10	10	S4B, S4N / S3	Endangered	Endangered	Roost/forgaing site: year round	500m
Mew Gull	*Larus canus*	Field Survey	Auditory and/or Visual	16	29	S4B, S4M			Nesting Colony: May 1-July 15	400m
		Field Survey	Nest	13						

Table 3-1 Cont. Vertebrate Sensitive and Species at Risk Observations in the Wheeler River Project Area – 2017-2019.

Common Name	Scientific Name	Obs. Source	Obs. Type	Obs. Per Type	Total Obs.	SKCDC Status	COSEWIC Status	SARA Status	SARGSS	Setback Distance (high disturbance)
Osprey	*Pandion haliaetus*	Field Survey	Visual	8	12	S2B, S2M			Nest Site: May 1-Aug.	1,000m
Olive-sided Flycatcher	*Contopus cooperi*	Field Survey	Auditory and/or Visual	8	14	S4B, S4M	Threatened	Threatened	Breeding Bird May 1-Aug. 31	300m
		Incidental	Auditory and/or Visual	6						
River Otter	*Lontra canadensis*	Field Survey	Track	10	11	S3				
		Incidental	Visual	1						
Bonaparte's Gull	*Chroicocephalus philadelphia*	Field Survey	Visual	10	11	S4B, S4M			Nesting Colony May 1-July 15	400m
		Incidental	Visual	1						
Herring Gull	*Larus argentatus*	Field Survey	Auditory and/or Visual	6	7	S5B, S5M			Nesting Colony May 1-July 15	400m
		Field Survey	Nest	1						
Barn Swallow	*Hirundo rustica*	Field Survey	Auditory and/or Visual	4	4	S5B, S5M	Threatened			
Horned Grebe	*Podiceps auritus*	Incidental	Visual	1	1	S5B, S5M	Special Concern	Special Concern		
Common Tern	*Sterna hirundo*	Field Survey	Visual	1	1	S5B, S5M	Not at Risk		Nesting Colony May 1-July 15	400m

SKCDC Rankings:
2 = Imperiled/Very rare
3 = Vulnerable/Rare to uncommon
4 = Apparently Secure
5 = Secure/Common
M = for a migratory species, rank applies to the transient (migrant) population
B = for a migratory species, applies to the breeding population in the province
N= for a migratory species, applies to the non-breeding population in the province
U= status is uncertain in Saskatchewan because of limited or conflicting information (unrankable)
SARGSS: Saskatchewan Activity Restriction Guidelines for Sensitive Species

Table 4.1-1. Trapping Capture Rates per Year by Species in FCA N-18 (Cree Lake).

Year	N-18 Cree Lake																	
	1985-86	1986-87	1987-88	1988-89	1989-90	1990-91	1991-92	1992-93	1993-94	1994-95	1995-96	1996-97	1997-98	1998-99	1999-00	2000-01	2001-02	2002-03
Beaver	67	58	43	3	6	0	1	3	7	9	5	9	3	0	1	0	12	0
Coyote	3	3	0	0	0	0	0	0	0	0	0	2	3	0	0	0	2	0
Fisher	17	6	3	4	7	9	9	20	5	19	3	20	0	0	0	0	5	9
Red Fox	37	20	13	8	0	0	2	4	0	17	3	13	0	0	3	3	6	8
Cross Fox	16	10	6	6	0	0	3	3	0	2	5	3	0	0	0	2	3	0
Silver Fox	7	0	2	0	0	0	0	0	0	1	0	1	0	0	0	0	1	0
Total Fox	60	30	21	14	0	0	5	7	0	20	8	17	0	0	3	5	10	8
Lynx	23	24	1	0	1	1	0	3	2	2	0	3	0	0	0	0	1	0
Marten	125	69	177	63	82	72	81	49	22	107	154	258	94	106	54	153	191	170
Mink	306	233	458	120	137	69	109	51	19	87	94	180	43	76	53	43	152	55
Muskrat	9	274	79	3	51	0	0	0	8	0	81	7	0	0	0	0	143	22
Otter	37	25	31	6	7	2	2	8	0	9	12	7	1	0	1	6	14	9
Squirrel	84	46	81	0	7	0	0	0	0	4	0	0	0	0	0	0	2	0
Weasel	28	6	12	0	5	0	0	0	0	11	0	9	0	0	0	0	0	0
Wolf	1	1	2	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
Black Bear	0	2	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	1
Wolverine	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	**760**	**777**	**908**	**214**	**303**	**158**	**207**	**141**	**63**	**268**	**357**	**513**	**144**	**182**	**112**	**207**	**532**	**274**

* for captures > 0

Table 4.1-1 Cont. Trapping Capture Rates per Year by Species in FCA N-18 (Cree Lake).

Year	N-18 Cree Lake															Total	Mean (Min, Max)*
	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18		
Beaver	-	0	0	-	-	0	0	0	0	0	0	0	0	0	0	**227**	**16.2 (1, 67)**
Coyote	-	0	1	-	-	0	0	0	0	0	0	0	0	0	0	**14**	**2.33 (1, 3)**
Fisher	-	3	7	-	-	1	0	1	0	1	0	0	0	0	0	**149**	**7.84 (1, 20)**
Red Fox	-	0	1	-	-	1	0	2	3	4	3	1	3	0	1	**156**	**7.09 (1, 37)**
Cross Fox	-	0	2	-	-	0	2	1	2	5	1	0	0	0	0	**72**	**4.24 (1, 16)**
Silver Fox	-	0	0	-	-	0	0	0	1	0	0	0	0	0	0	**13**	**2.17 (1, 7)**
Total Fox	-	0	3	-	-	1	2	3	6	9	4	1	3	0	1	**241**	**10.48 (1, 60)**
Lynx	-	0	1	-	-	0	0	1	0	0	1	0	0	0	0	**64**	**4.92 (1, 24)**
Marten	-	81	187	-	-	116	77	175	306	317	366	57	114	114	230	**4167**	**138.90 (22, 366)**
Mink	-	83	104	-	-	54	13	69	22	54	43	18	7	0	9	**2761**	**95.21 (7, 454)**
Muskrat	-	0	25	-	-	0	0	0	0	0	0	0	0	0	0	**702**	**63.82 (3, 274)**
Otter	-	3	6	-	-	0	0	0	5	0	0	1	0	0	0	**192**	**9.60 (1, 37)**
Squirrel	-	0	0	-	-	0	0	31	0	0	0	0	0	0	0	**255**	**36.43 (2, 84)**
Weasel	-	0	0	-	-	0	0	1	0	0	0	0	0	0	0	**72**	**10.29 (1, 28)**
Wolf	-	0	0	-	-	0	0	0	0	0	0	0	0	0	0	**5**	**1.25 (1, 2)**
Black Bear	-	0	0	-	-	0	0	0	0	0	0	0	0	0	0	**8**	**2.67 (1, 5)**
Wolverine	-	0	2	-	-	0	0	1	1	0	0	0	0	0	0	**5**	**1.25 (1, 2)**
Total	-	**170**	**336**	**-**	**-**	**172**	**92**	**282**	**340**	**381**	**414**	**77**	**124**	**114**	**240**	**8862**	**571.74 (63, 908)**

* for captures > 0

Table 5.2-1. Local Assistants – Denison Wheeler River Project 2016-2019.

Local Assistant	Residence	Date	Task
Nathan Dawatsara	Patuanak, SK	Sep-Oct 2016	Assisted completing shoreline surveys
Adam Paul	Patuanak, SK	Jan-Feb 2017	Assisted completing winter tracking surveys
William Paul	Patuanak, SK	June 2017	Assisted completing Ungulate browse availability and pellet group surveys. Assisted completing Amphibian nocturnal call surveys
William Paul	Patuanak, SK	August 2017	Assisted with vegetation and soil collection for chemistry analysis
William Paul	Patuanak, SK	February 2018	Assisted completing winter tracking surveys
William Paul	Patuanak, SK	June 2018	Assisted completing Ungulate browse availability and pellet group surveys. Assisted completing Amphibian nocturnal call surveys

8.0 FIGURES

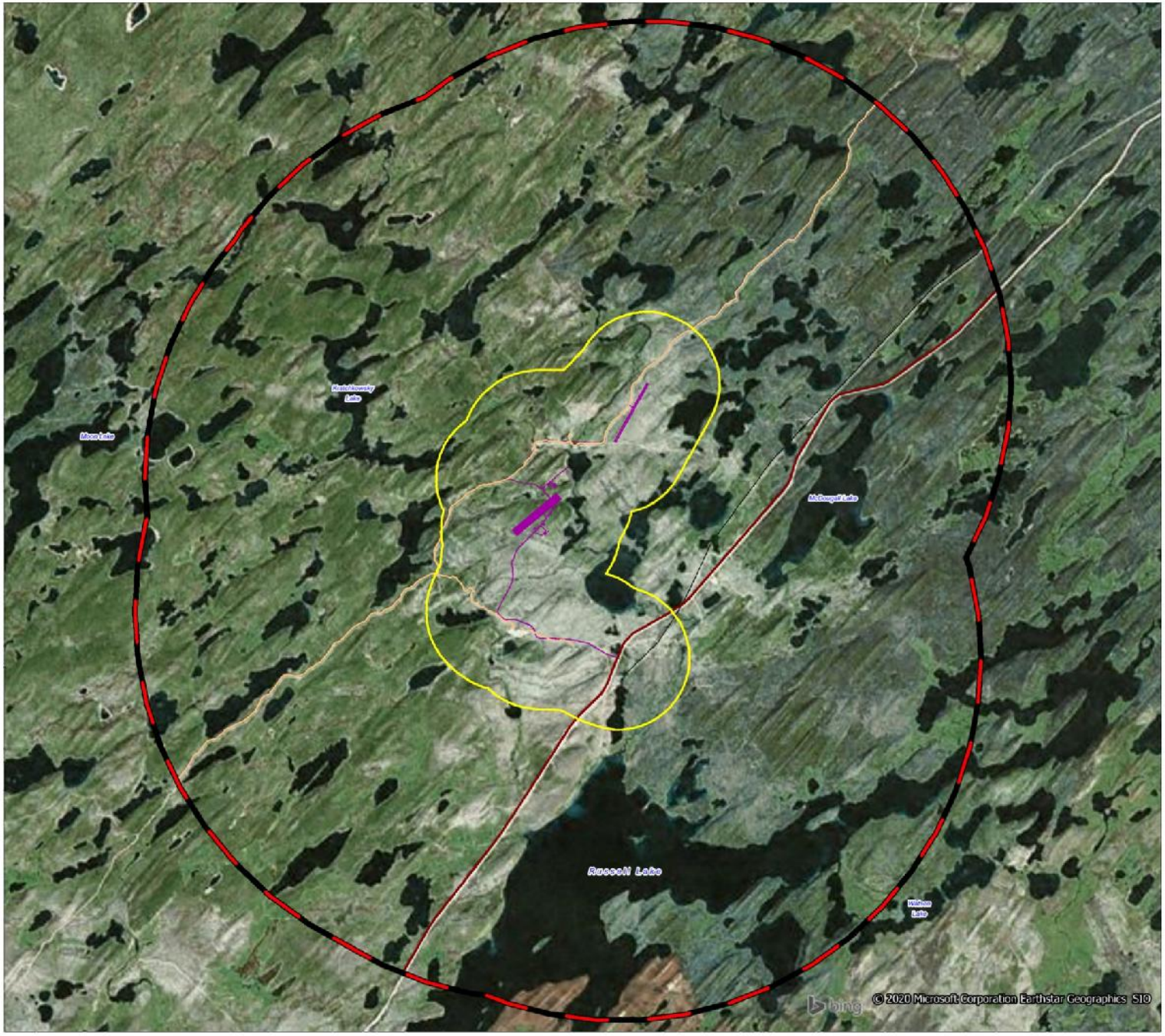

Figure 1.2-1 Terrestrial Baseline Project Area
- Denison Wheeler River Project

Legend

- Road
- McArthur-Key Haul Road
- Transmission ROW
- Planned Development Footprint
- Local Study Area (LSA)
- Regional Study Area (RSA)

0 5 10

kilometers
Scale = 1 : 90,000

OMNIA ECOLOGICAL SERVICES

Produced by Rich Ashton, Dec. 2019
Ref# O-F721a_11-17

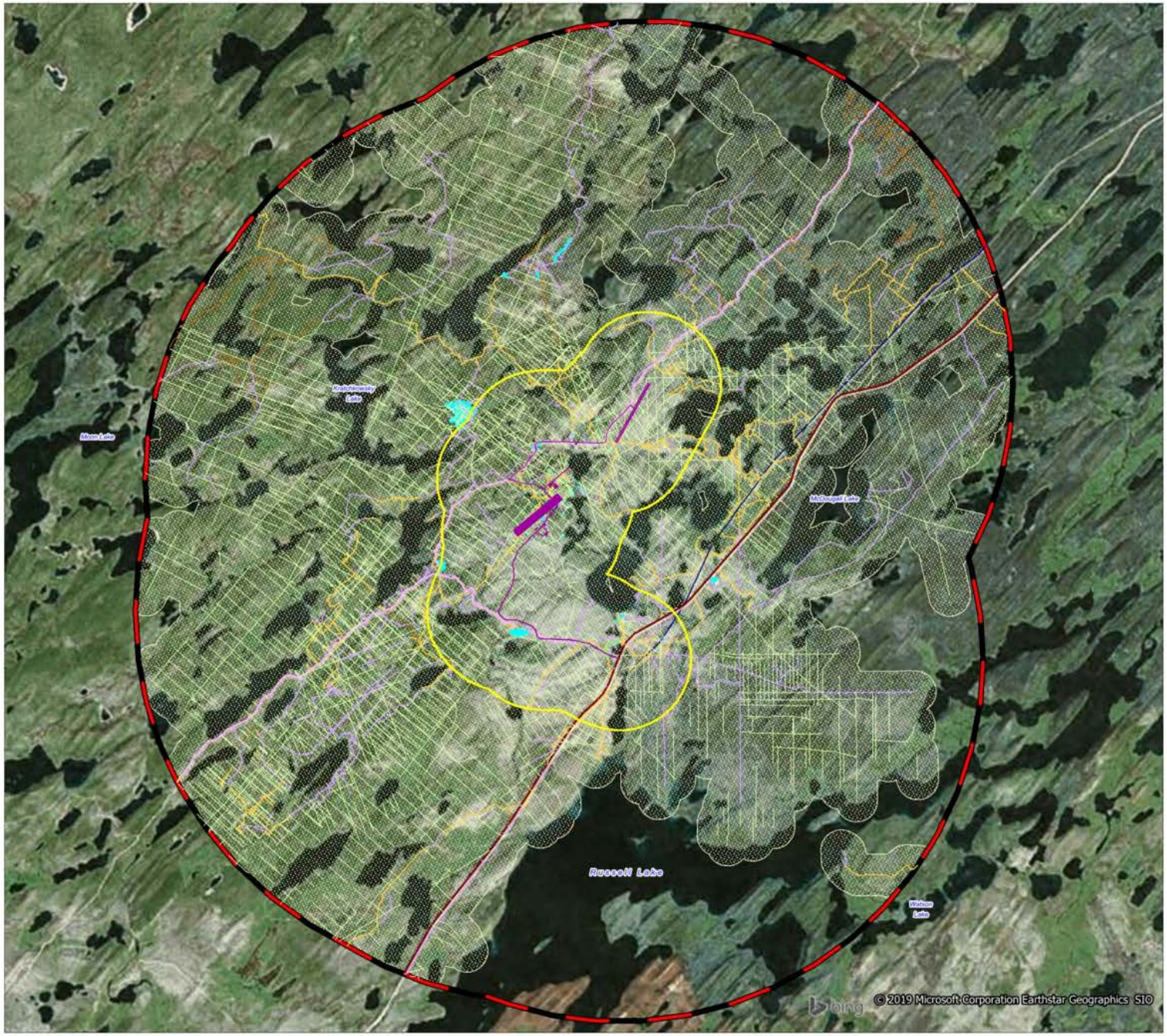

Figure 2.1-1 Anthropogenic Disturbance Mapping
- Denison Wheeler River Project

Legend

Linear Disturbance Type
- McArthur-Key Haul Road
- Road
- Rough Road
- Trail
- ROW
- Cutline
- Transmission ROW

Clearing
500m CRS Buffer

Planned Development Footprint
Local Study Area (LSA)
Regional Study Area (RSA)

N
W E
S

0 5 10
kilometers
Scale = 1 : 90,000

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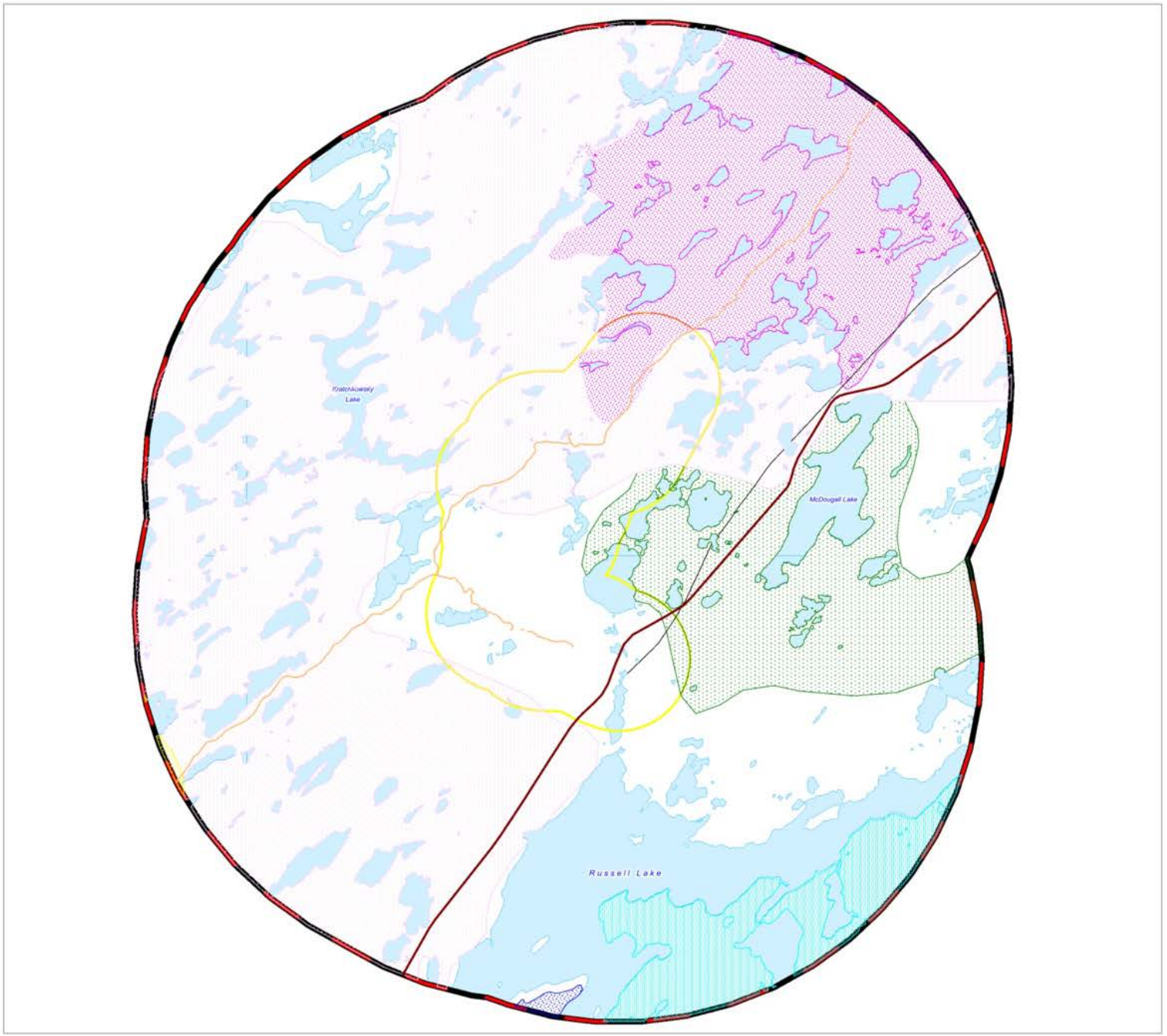

Figure 2.1-2 Historical Fire Mapping
- Denison Wheeler River

Legend

Historical Wild Fires
- 1,973
- 1,981
- 1,998
- 2,004
- 2,007
- 2,008

Main Linear Features
- McArthur-Key Haul Road
- Road
- Transmission ROW
- Waterbody
- Local Study Area (LSA)
- Regional Study Area (RSA)

N
W E
S

0 5 10

kilometers
Scale = 1 : 90,000

OMNIA
ECOLOGICAL SERVICES

Produced by Rich Ashton, Dec. 2019
Ref# O-F721a_11-17

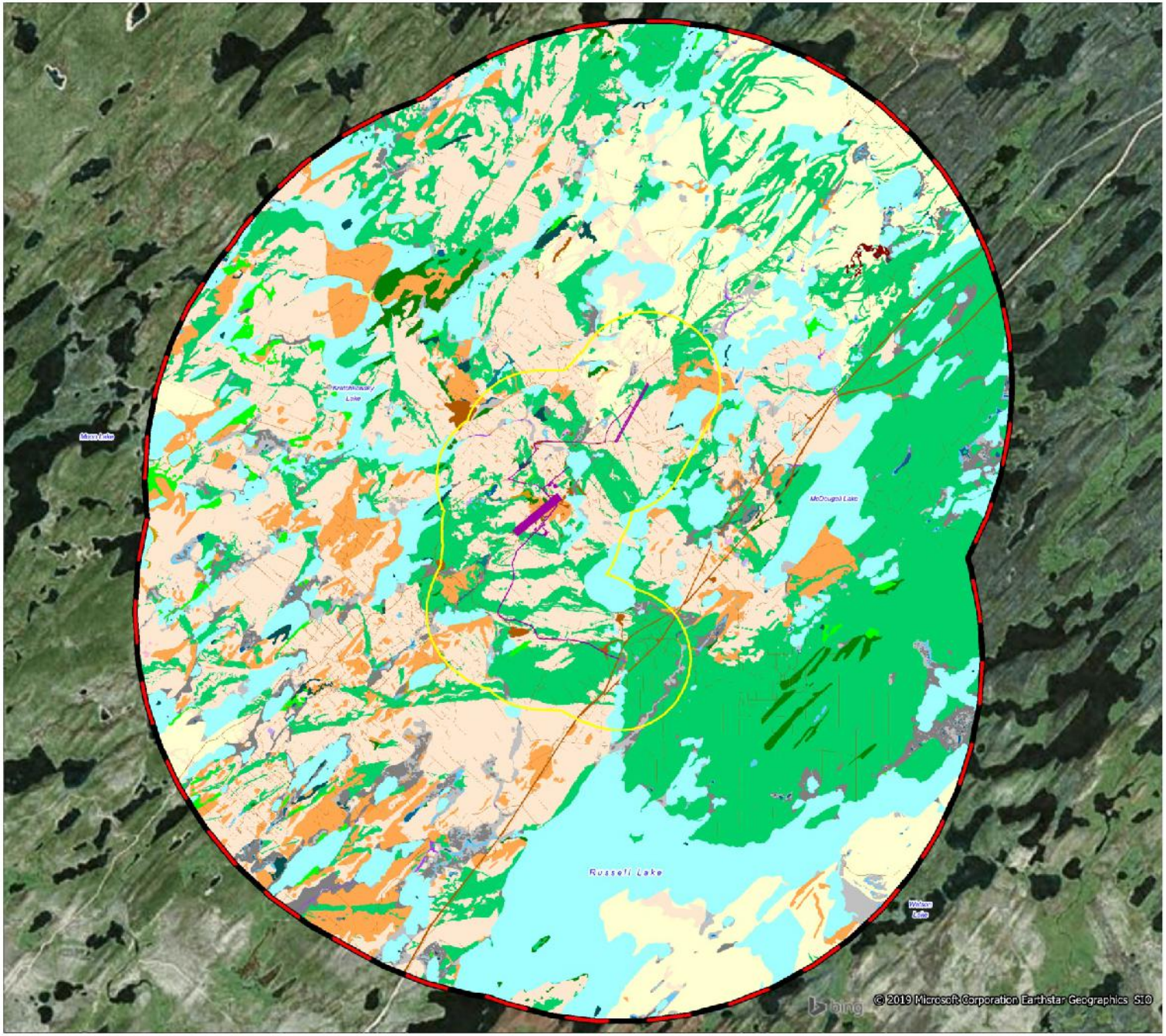

Figure 2.1-3 Interpreted Ecosite Mapping - Denison Wheeler River Project

Legend

Ecosite Type

- RF1 - Regenerating Forest > 5m tall
- RF2 - Regenerating Forest - 1-5m tall
- RF3 - Regenerating Forest <1m tall
- RF2 - Regenerating Bog - 1-5m tall
- RF1 - Regenerating Bog > 5m tall
- BS3 - Jack pine - blueberry / lichen
- BS4 - Jack pine - black spruce / feathern
- BS7 - Black spruce - blueberry / lichen
- BS9 - Black spruce - jack pine / feathern
- BS14 - White birch / lingonberry - labrad
- BS16 - Black spruce/ balsam poplar / riv
- BS17 - Black spruce treed bog
- BS18 - Labrador tea shrubby bog
- BS19 - Graminoid bog
- BS20 - Open bog
- BS19/BS24 - Graminoid bog / Graminoic
- BS21 - Tamarack treed fen
- BS22 - Leatherleaf shrubby poor fen
- BS23 - Willow shrubby rich fen
- BS24 - Graminoid fen
- BS25 - Open fen
- BS26 - Rush sandy shore
- BS27 - Sedge rocky shore
- AN - Anthropogenic
- Waterbody

- Planned Development Footprint
- Local Study Area (LSA)
- Regional Study Area (RSA)

N W E S

0 5 10

kilometers
Scale = 1 : 90,000

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Figure 2.2-1 Tree and shrub vegetation layer criteria for the Denison Wheeler Project area: A1: Super canopy; A2: Main tree canopy; A2 Sub-canopy; B1: Tall shrubs, and B2: Low shrubs

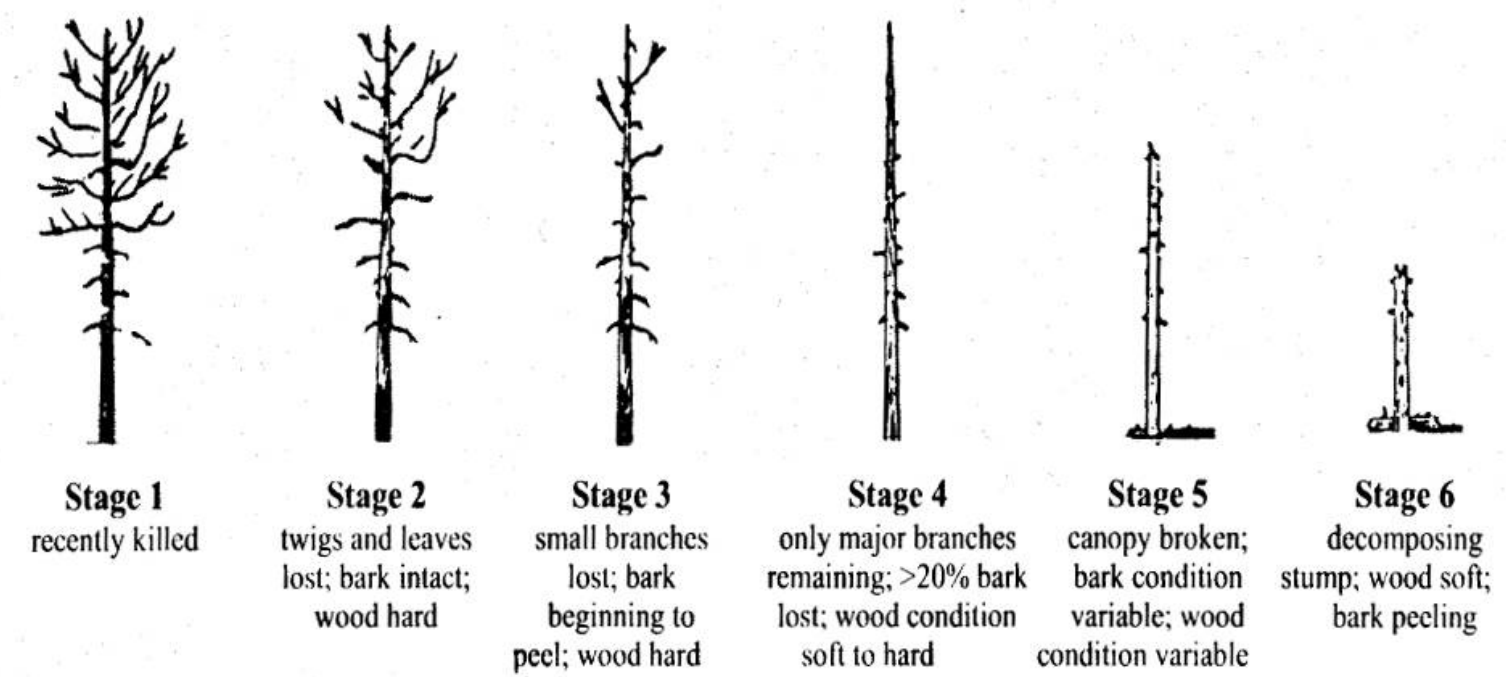


Figure 2.2-2. Decay classification system for snags in the Denison Wheeler Project area (Lee *et al.* 1995).

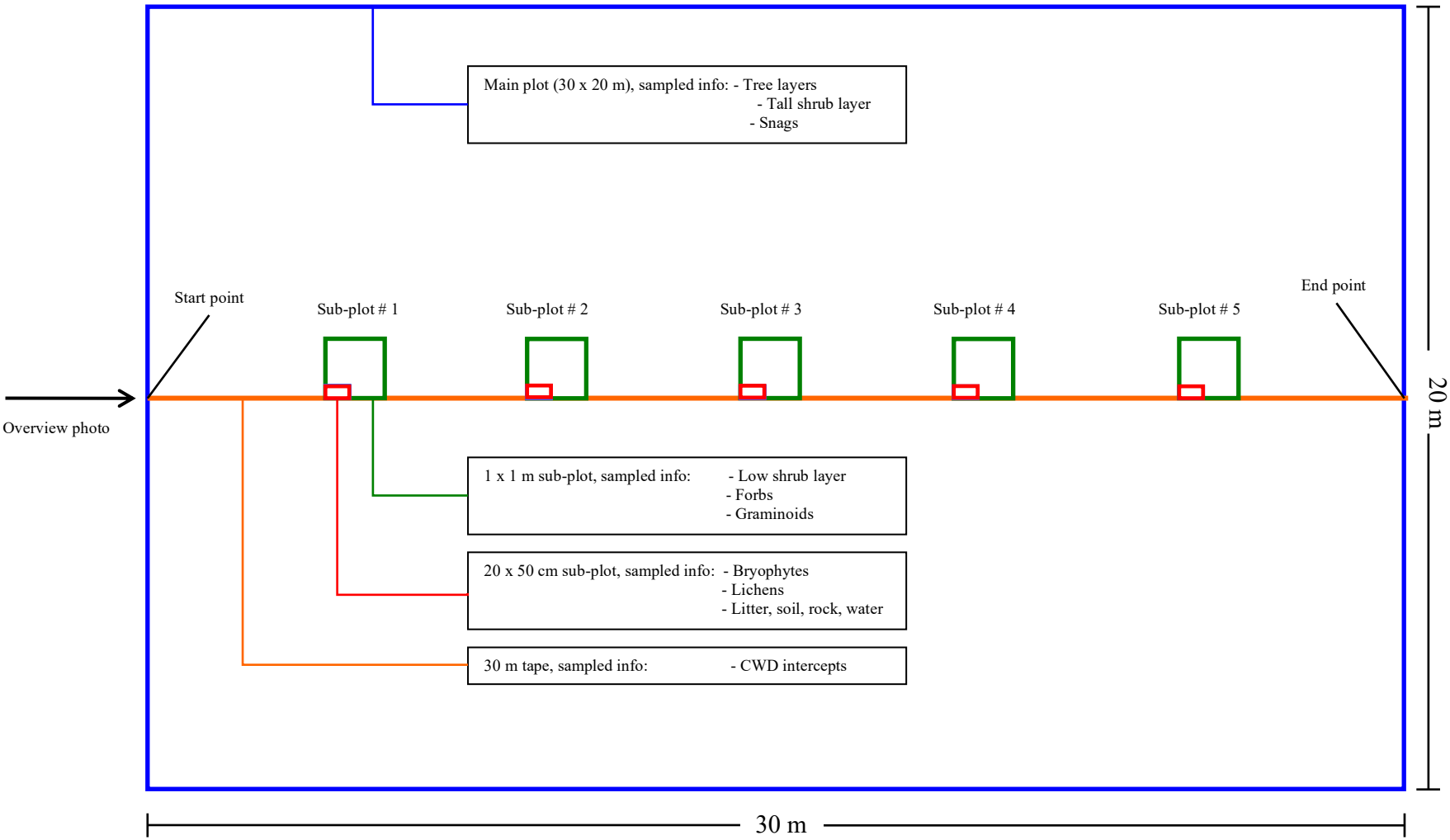
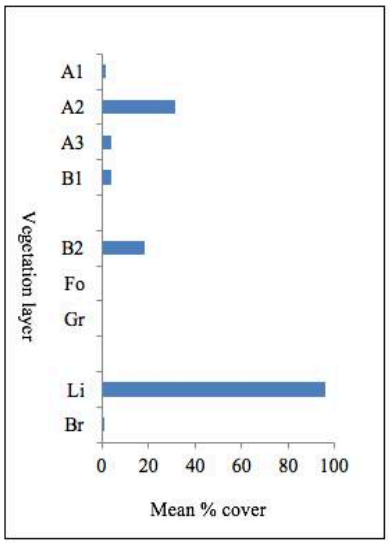


Figure 2.2-3. Layout of the vegetation sampling site.

Figure 2.2-4. Display of the hiding cover cloth.

1 → **BS3** **Jack pine/blueberry/lichen: Moderately fresh sand** (n=4) ← 2

3 →



4 →

Ecosite Description

BS3 is dominated by jack pine in the overstory. The vascular plant understory is relatively sparse but includes Labrador tea, blueberry, and bog cranberry. Herbs are virtually absent. The forest floor is covered with reindeer lichen. Lichen species diversity is high. The age for this ecosite ranges from approximately 80 years old in the study area.

← 5

---

6 →

Species and Vegetation Layer Info

Average number plant and lichen species per plot (min, max): 17 (15, 19)

Tree Layer Info:

Tree Layer	Total # Species	Crown Closure	Mean Height	Mean DBH	Species Composition	Year of Origin
A1 (n=0):						
A2 (n=5):	1	27%	9.2 m	13.4 cm	Pj10	1938
A3 (n=6):	2	2%	7.2 m	9.0 cm	Pj9 Sb1	1962

Lower Vegetation Layer info:

Vegetation Layer	Total # Species	Percentage Cover	Species Composition*
B1	2	4%	Pinuban10
B2	6	18%	Vaccmyr7 Vaccvit2 Ledugro1
Forb			
Graminoid			
Lichen	20	96%	Cladmit6 Cladunc2 Cladste1
Bryophyte	5	1%	Polypil6 Pholnut2 Polyjun1 Dicrpol1

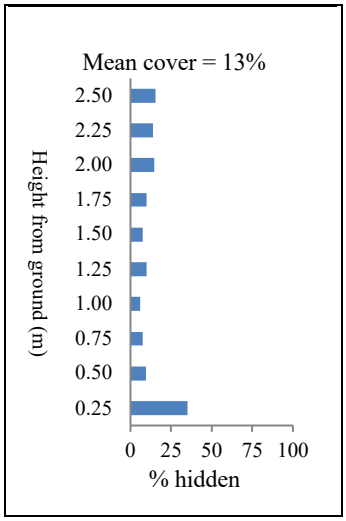
*Only including species that constitute 10% or more by composition.

Figure 2.2-5. Page 1 of the Ecosite fact sheets.

7 → **BS3** **Jack pine/blueberry/lichen: Moderately fresh sand** (n=4)

Structural Attributes and Relative Rating

Structural Component	Attribute	Value	Rating
Snags	Mean # of snags/plot	0.3	Low
	Mean snag diameter (cm)	10.1	
	Mean snag height (m)	0.9	
	Mean snag decay Class	5.0	
Course Woody Debris	Mean frequency of CWD	0.8	Moderate
	Mean CWD diameter (cm)	11.5	
	Mean CWD decay class	3.0	
Mean Percent Ground Cover	Litter Cover	25.5	Moderate
	Litter Depth (cm)	0.9	Moderate
	Bare Soil	1.8	Low
	Bare Rock	0.0	Low
	Open Water	0.0	Low



← 8

9 → ***Structural Diversity, Species Richness, and Unique and Rare Species Occurrence Evaluation***

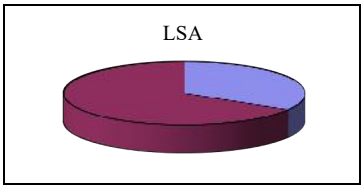
Attribute	Value	Rating
Structural diversity	1.0	Moderate
Species richness	17	Moderate
Unique species	3	Moderate
Provincially listed species	0	Low

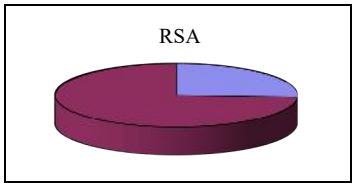
Unique species observed:
Pholia moss (*Pholia nutans*), Shingled Cladonia (*Cladonia scabriuscula*), Common bearberry (*Arctostaphylos uva-ursi*)

Provincially listed species observed:
None

10 → ***Ecosite Supply***

Areas occupied by Jack pine /blueberry /lichen forests comprised 1605.8 ha (33.8%) of the LSA and 10330.5 ha (25.8%) of the RSA.





11 → ***Ecological Interpretation***

BS3 ecosites are relatively dry and occur in almost every topographic position and with every slope class. They are associated with the hills of eskers and drumlins as well as level plains. Following disturbance, these ecosites will usually return to being pine dominated, provided an adequate cone crop existed prior to disturbance. When compared to BS4 ecosites these ecosites tend to be drier, have less understory, and more open canopy. In the absence of disturbance, these ecosites may transition toward the BS7 ecosite condition.

Figure 2.2-6. Page 2 of the Ecosite fact sheets.

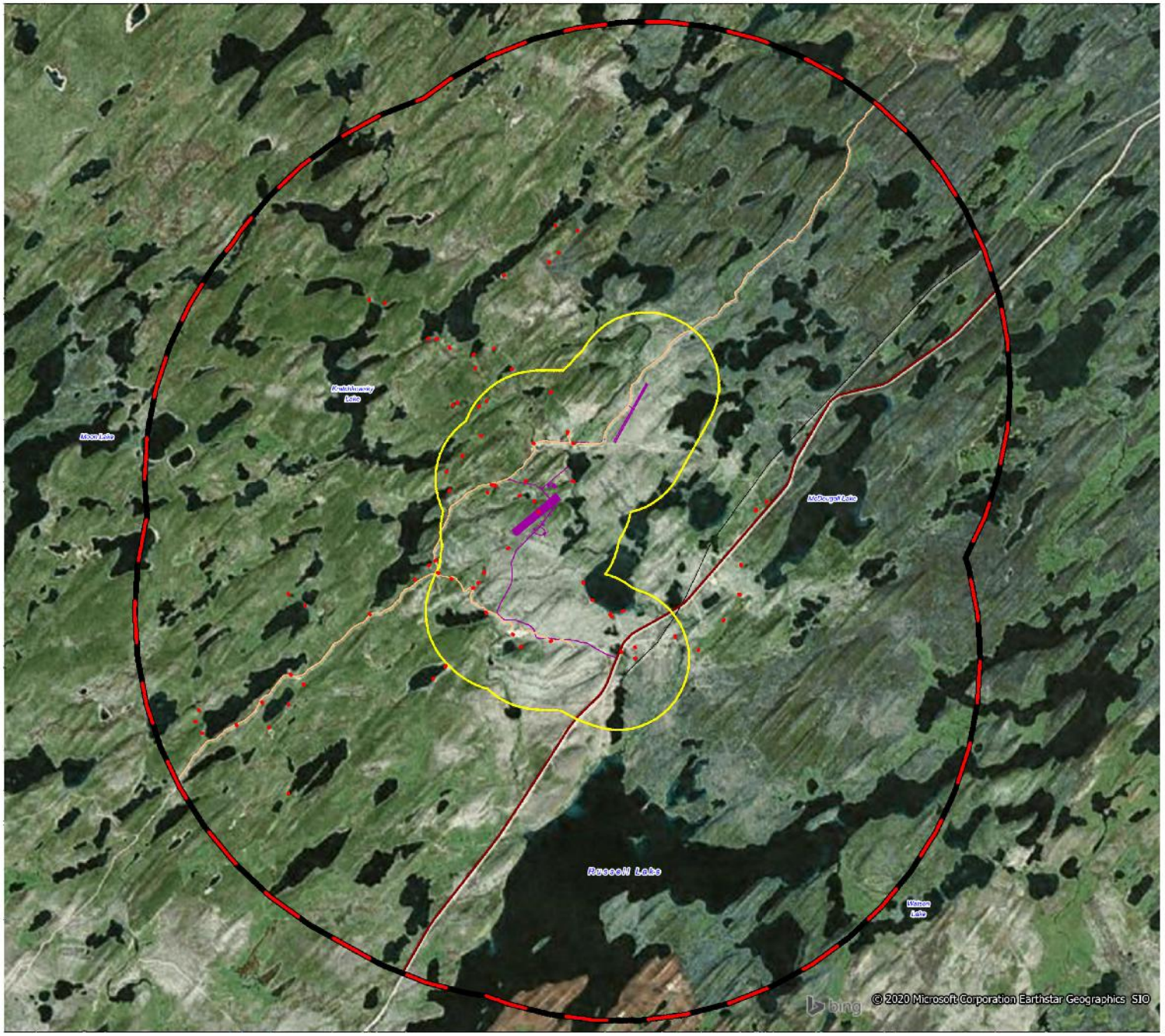


Figure 2.2-7 Vegetation Survey Plot Locations - Denison Wheeler River Project

Legend

- Veg Survey Plot
- Road
- McArthur-Key Haul Road
- Transmission ROW
- Planned Development Footprint
- Local Study Area (LSA)
- Regional Study Area (RSA)

N
W E
S

0 5 10

kilometers
Scale = 1 : 90,000

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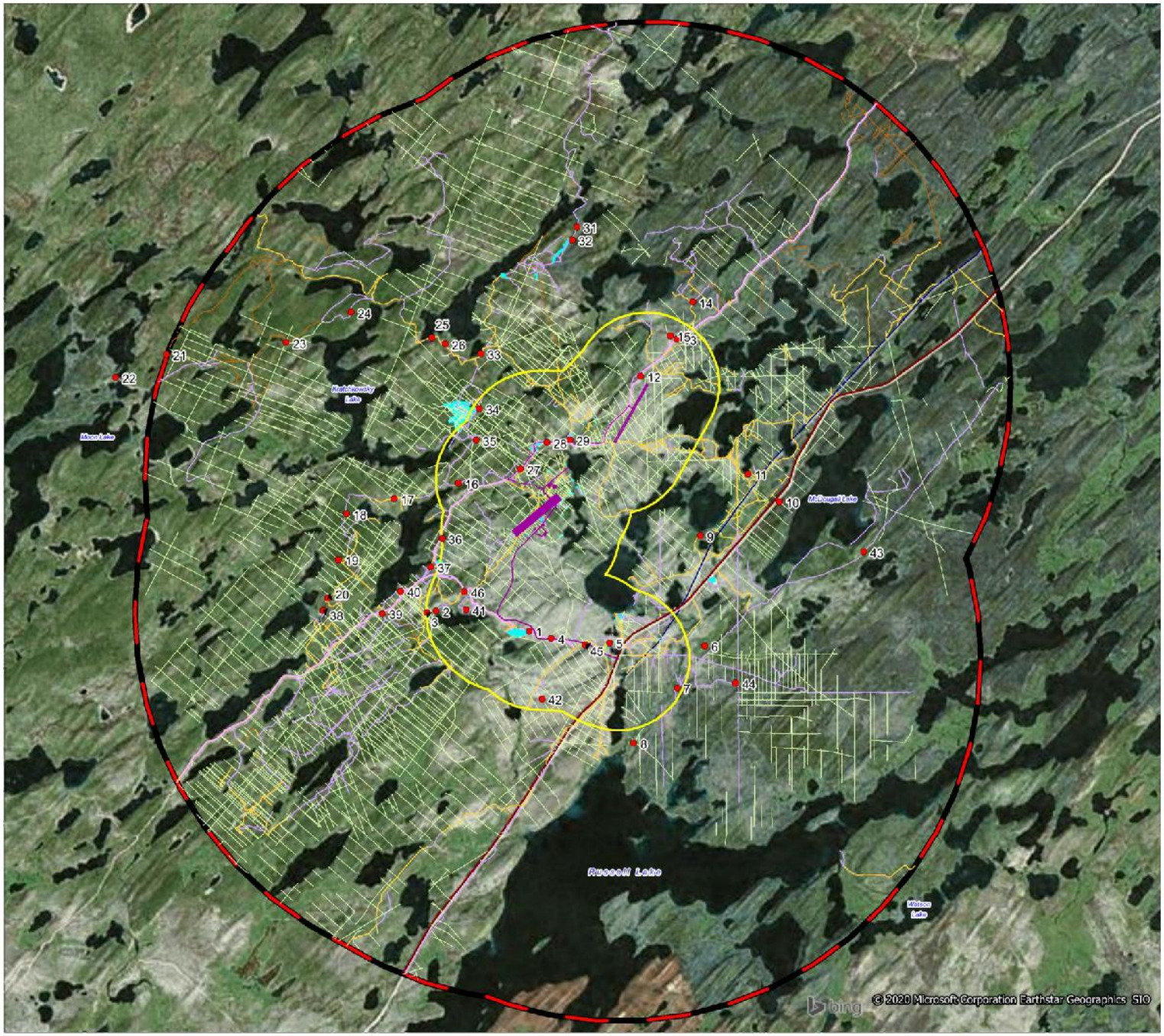

Figure 2.3-1 Linear Feature Natural Regeneration Assessment Transect Locations - Denison Wheeler River Project

Legend

- Regeneration Assessment Location

Linear Disturbance Type
- McArthur-Key Haul Road
- Road
- Rough Road
- Trail
- ROW
- Cutline
- Transmission ROW

- Clearing
- 500m CRS Buffer

- Planned Development Footprint
- Local Study Area (LSA)
- Regional Study Area (RSA)

N W E S

0 5 10

kilometers
Scale = 1 : 90,000

OMNIA ECOLOGICAL SERVICES

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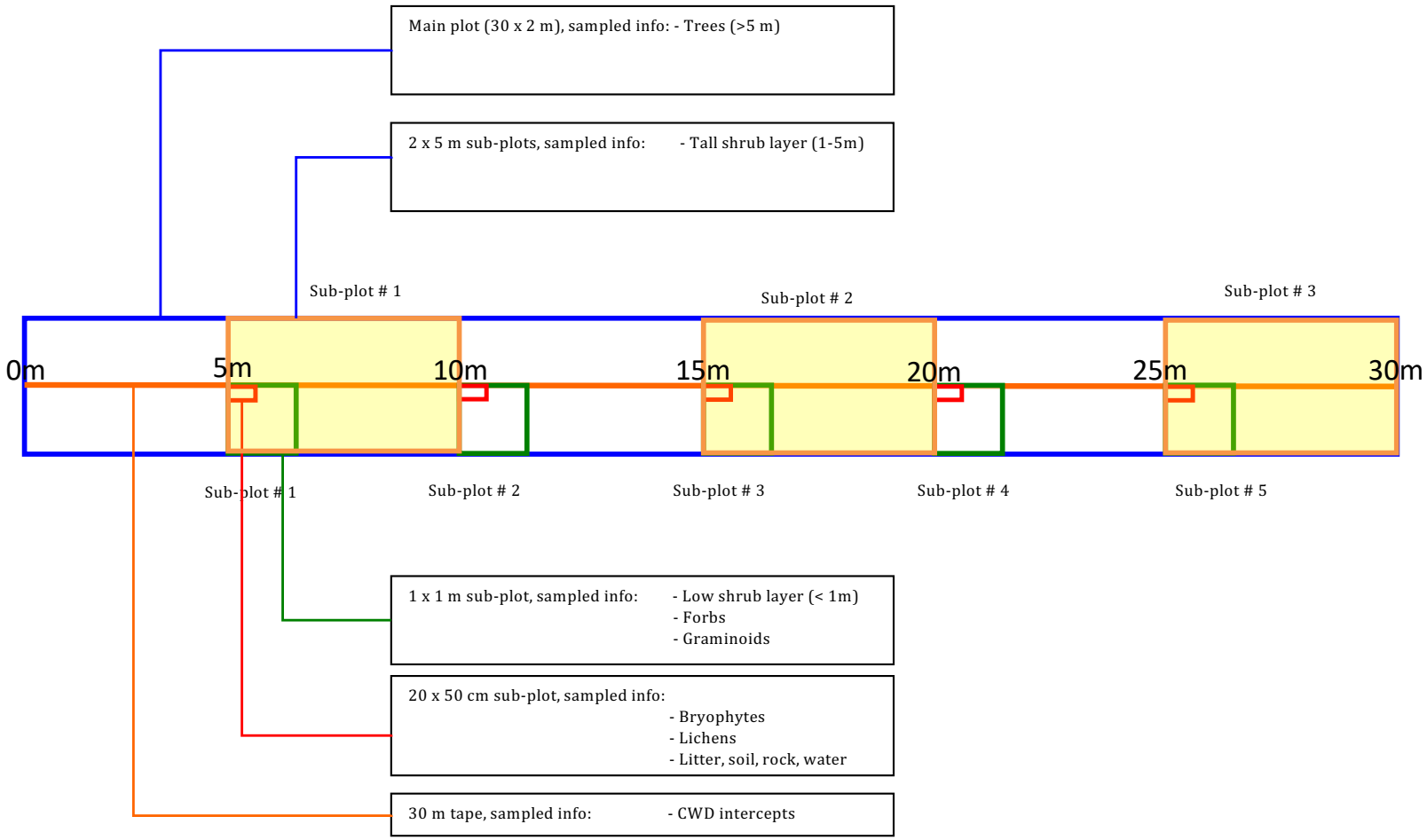

Figure 2.3-2 Ground sampling plot layout – Linear feature natural regeneration assessment.

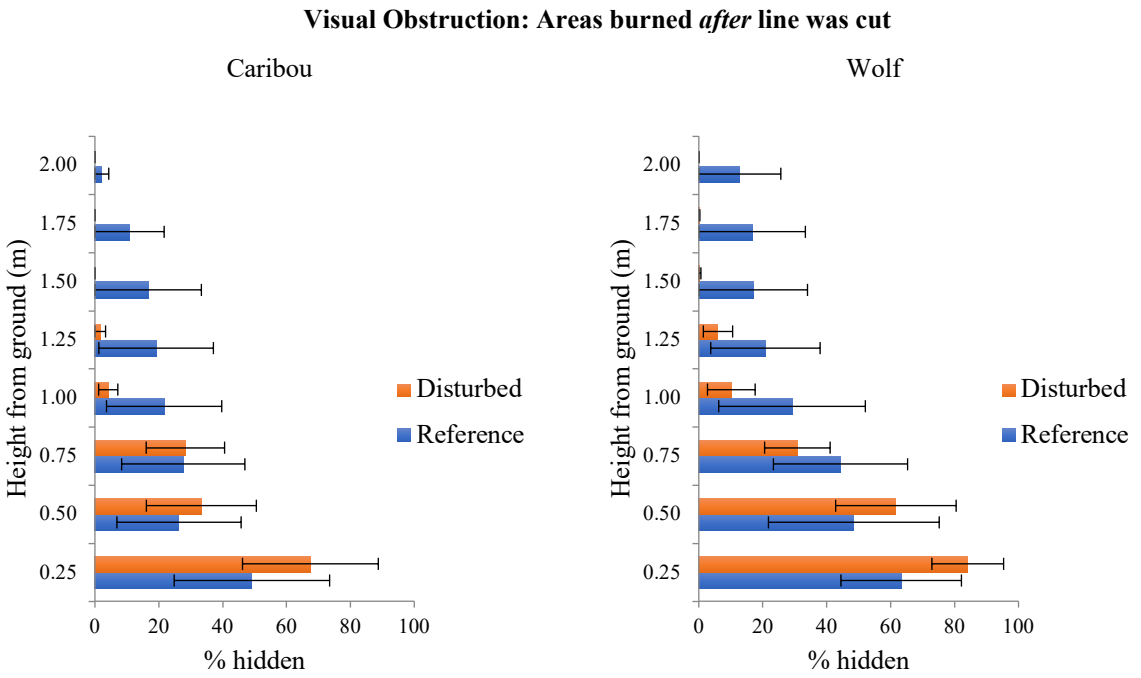

Figure 2.3-3A Visual obstruction in areas burned *after* line was cut for disturbance versus reference from caribou and wolf perspectives. The error bars are standard errors around the means. Fire occurred 12 to 15 years ago. No significant differences in hiding cover were found in any height layers for caribou or wolf (P>0.05) in Disturbance versus Control.

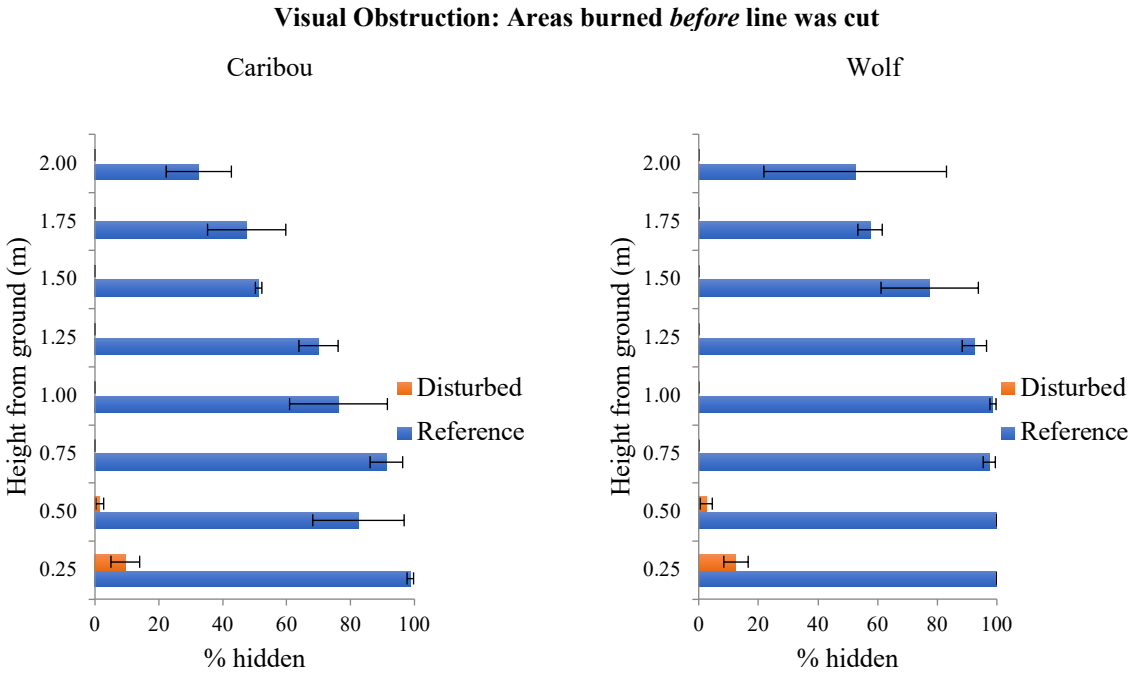

Figure 2.3-3B Visual obstruction in areas burned *before* line was cut for disturbance versus reference from caribou and wolf perspectives. The error bars are standard errors around the means. Fire occurred 12 to 15 years ago. Wolf visual obstruction was significantly higher for control plots in from 0.25 to 1.25 m layers (P<0.03). Caribou visual obstruction was significantly higher for control plots in the 0.25, 0.75, and 0.50 m layers.

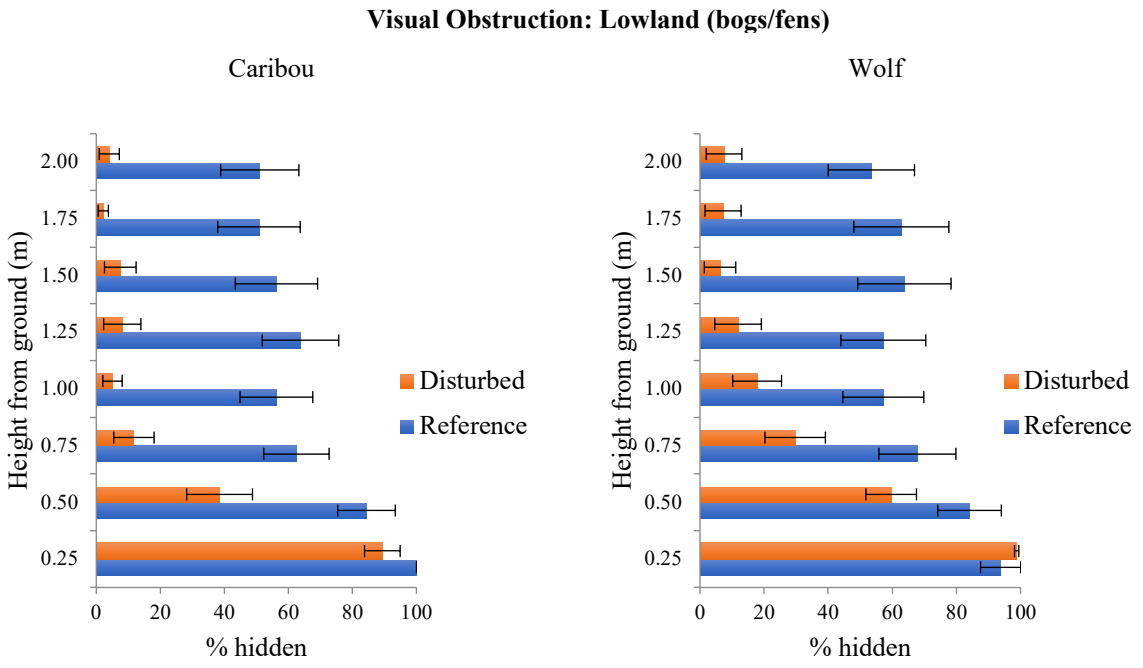

Figure 2.3-4A Visual obstruction in lowland (bogs/fens) for disturbance versus reference from caribou and wolf perspectives. The error bars are standard errors around the means. Caribou visual obstruction was significantly different for all layers, except 0.25 and 0.5 m above ground ($P<0.05$). Wolf visual obstruction was significantly different for all layers, except for 0.25 to 1 m above ground ($P<0.05$)

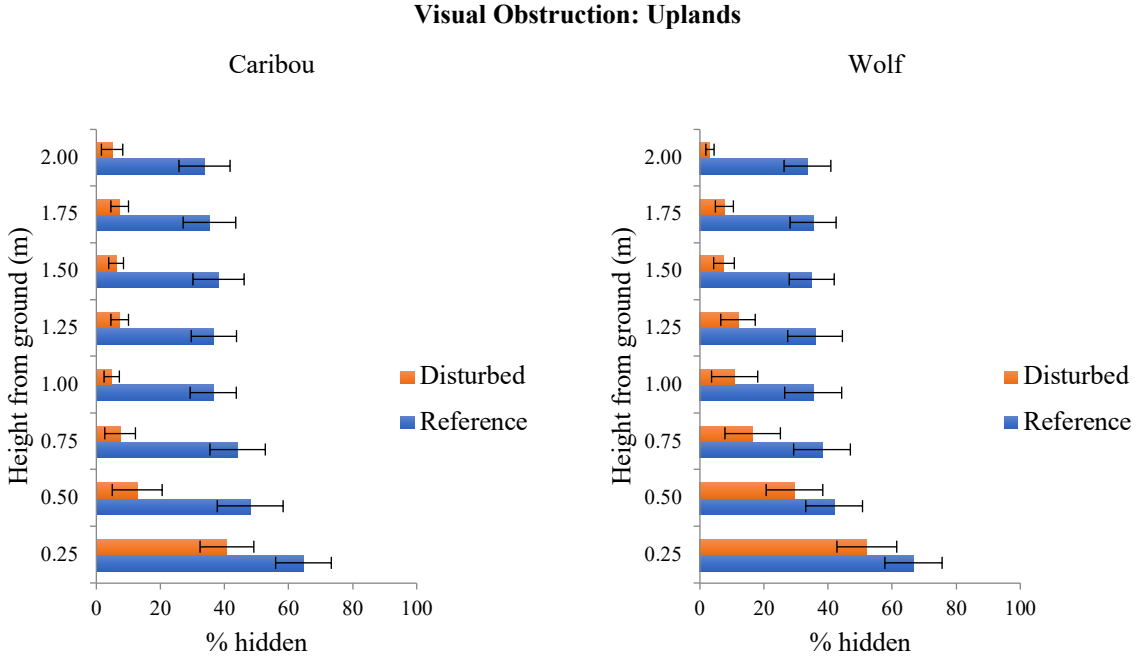

Figure 2.3-4B Visual obstruction in upland for disturbance versus reference from caribou and wolf perspectives. The error bars are standard errors around the means. Caribou visual obstruction was significantly different for all layers ($P<0.05$). Wolf visual obstruction was significantly different for all layers, except for 0.25 to 1 m above ground ($P<0.05$)

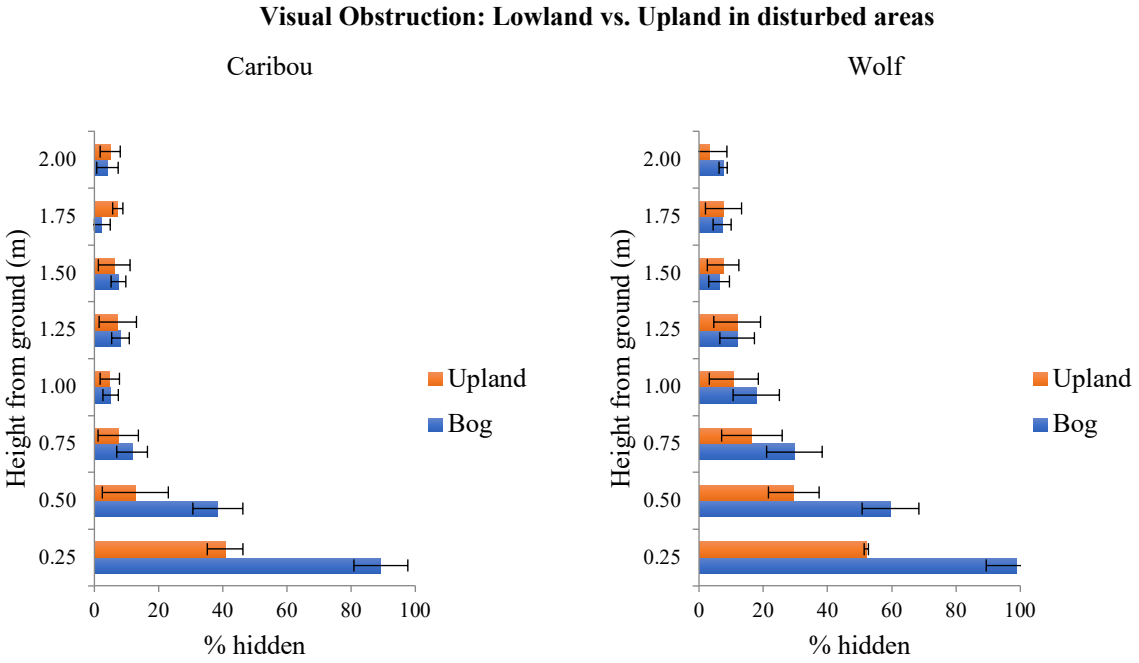

Figure 2.3-4C Visual obstruction in disturbed areas between lowland (bogs-fens) and upland from caribou and wolf perspectives. The error bars are standard errors around the means. Both wolf and caribou visual obstruction were significantly different in the 0.25 m layer, but displayed no significant difference in any of the higher layers.

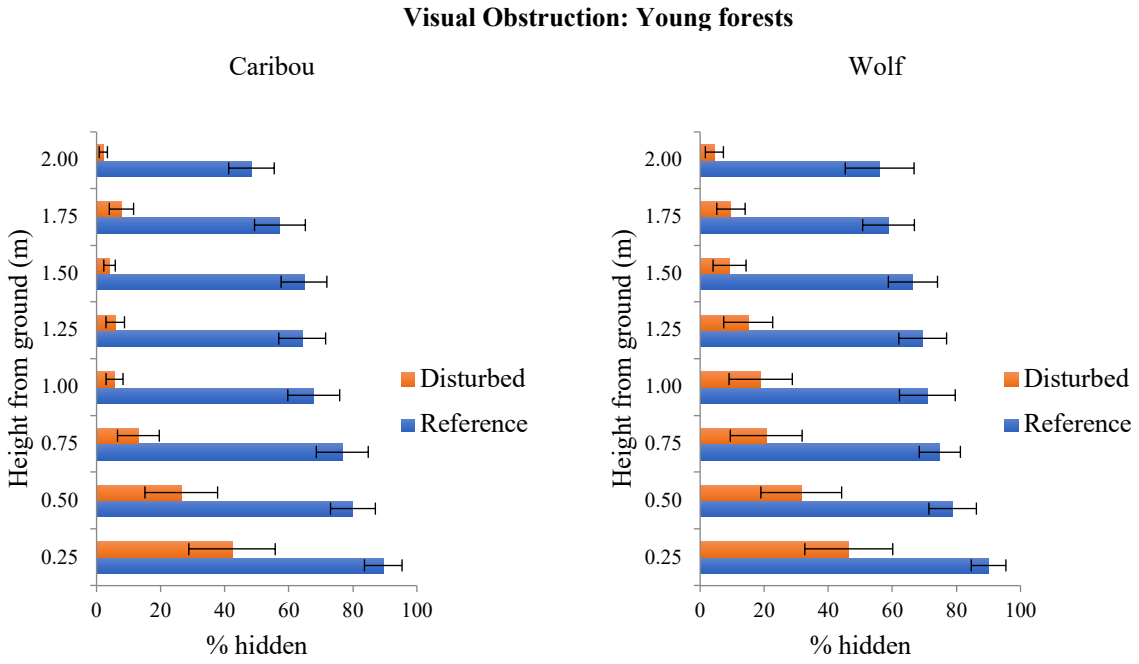

Figure 2.3-5A Visual obstruction in areas young forest (< 40 years old) for disturbance versus reference from caribou and wolf perspectives. The error bars are standard errors around the means. Overall hiding cover (all layers combined) significantly different between disturbance and control for both wolf (P=0.001) and caribou (P<0.001). Both wolf and caribou are also significantly different in every height layer (P<0.05).

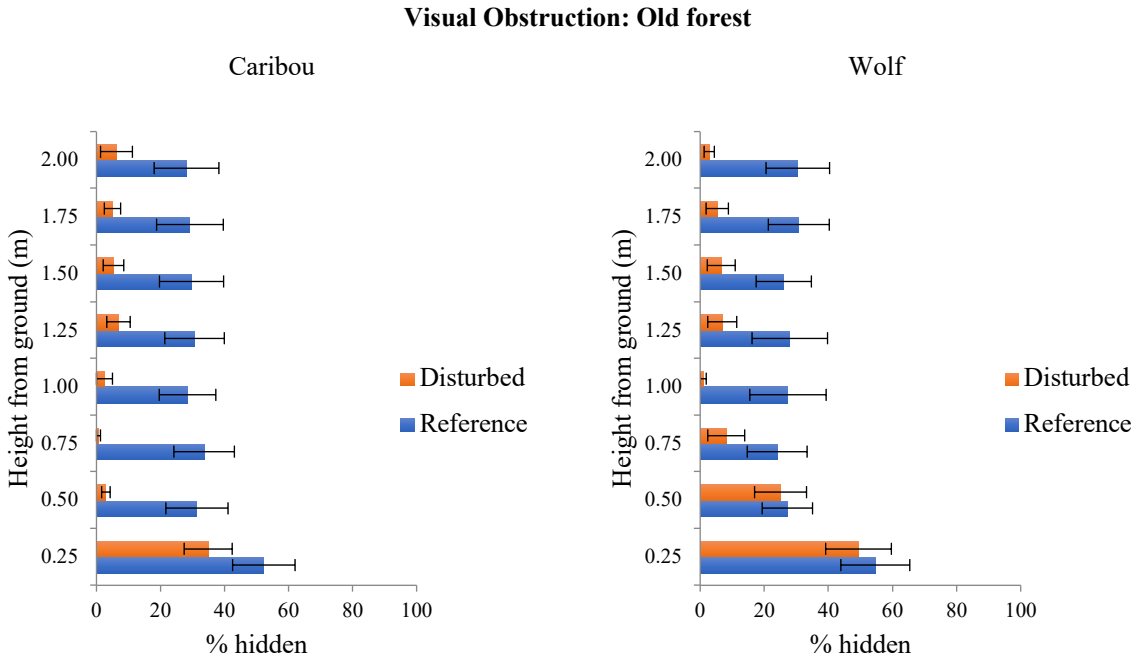

Figure 2.3-5B Visual obstruction in areas old forest (> 40 years old) for disturbance versus reference from caribou and wolf perspectives. The error bars are standard errors around the means. Overall hiding cover (all layers combined) significantly different between disturbance and control for both wolf (P=0.020) and caribou (P=0.016). Caribou had significant differences between control and disturbed for all layers except 0.25, 1.75 and 2 m (P>0.05), whereas wolf only had significant differences in the 1.75 and 2 m layers.

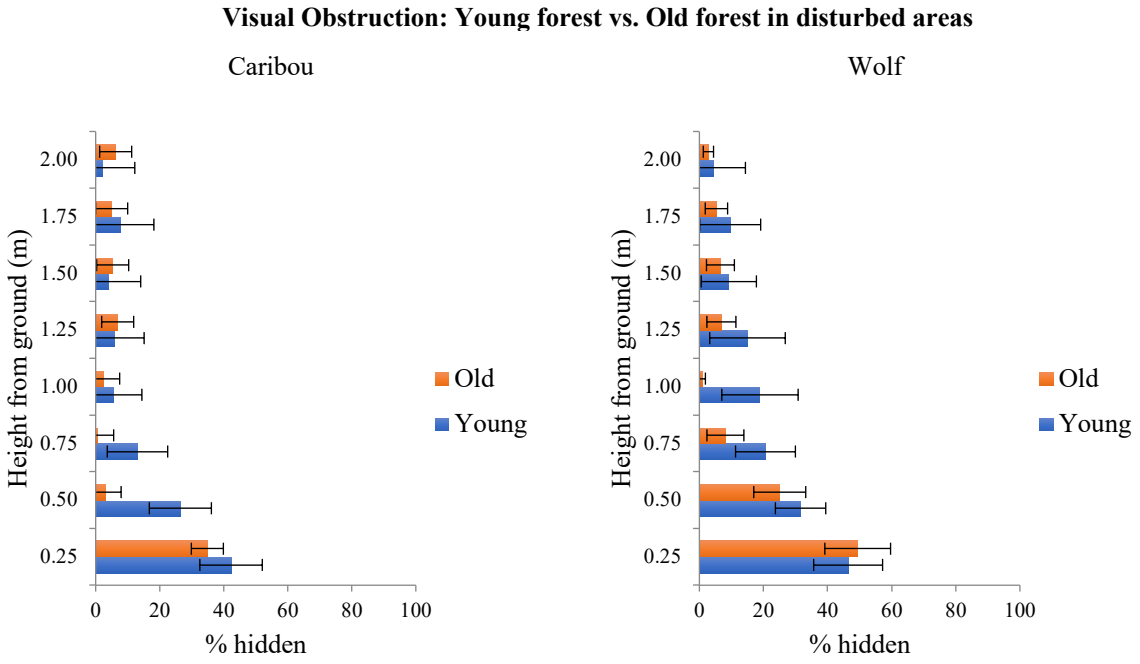

Figure 2.3-5C Visual obstruction in disturbed areas within old versus young forest from caribou and wolf perspectives. The error bars are standard errors around the means. There were no significant differences in any layers for either wolf (P=0.345) or caribou (P=0.466).

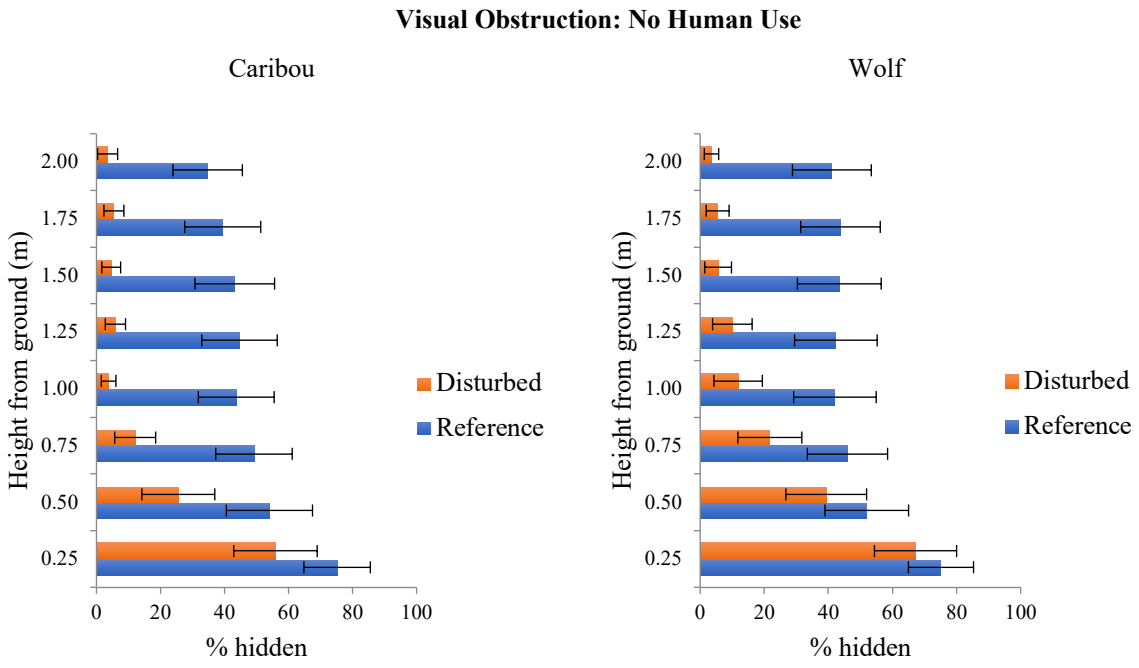

Figure 2.3-6A Visual obstruction in areas with no human use for disturbance versus reference from caribou and wolf perspectives. The error bars are standard errors around the means.

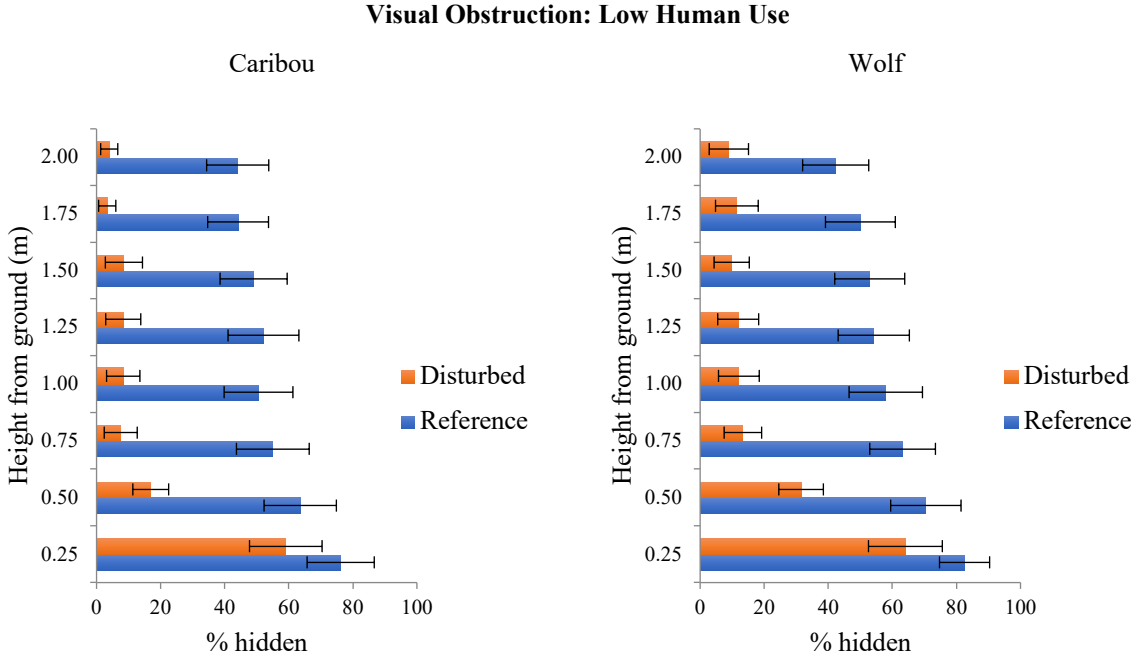

Figure 2.3-6B Visual obstruction in areas with low human use for disturbance versus reference from caribou and wolf perspectives. The error bars are standard errors around the means.

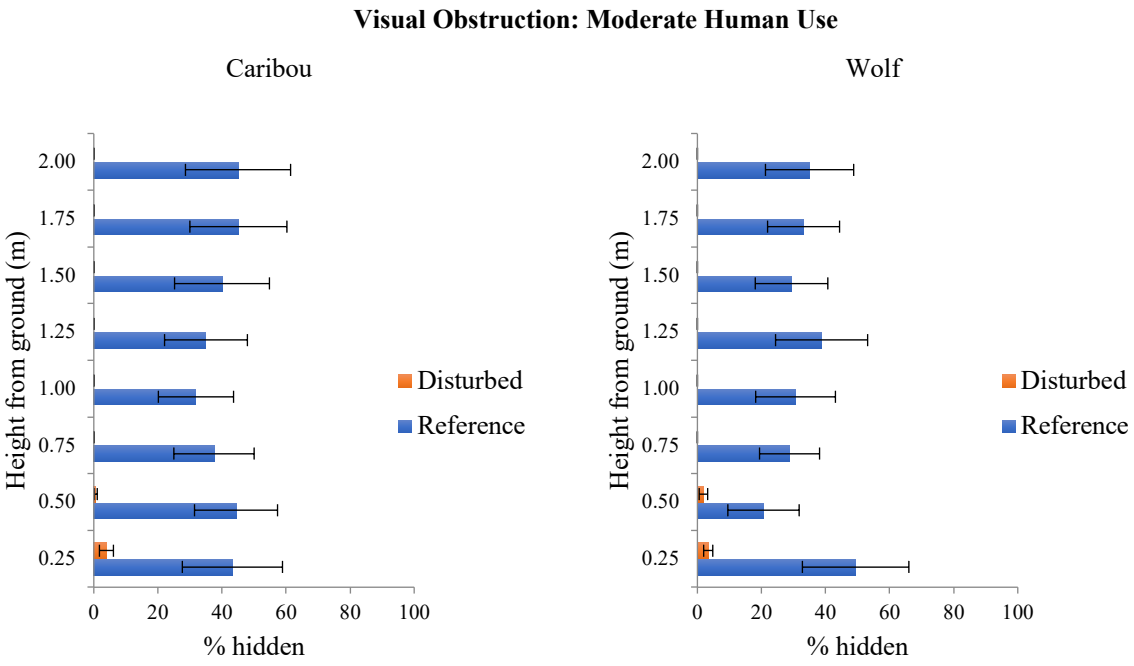

Figure 2.3-6C Visual obstruction in areas with moderate human use for disturbance versus reference from caribou and wolf perspectives. The error bars are standard errors around the means.

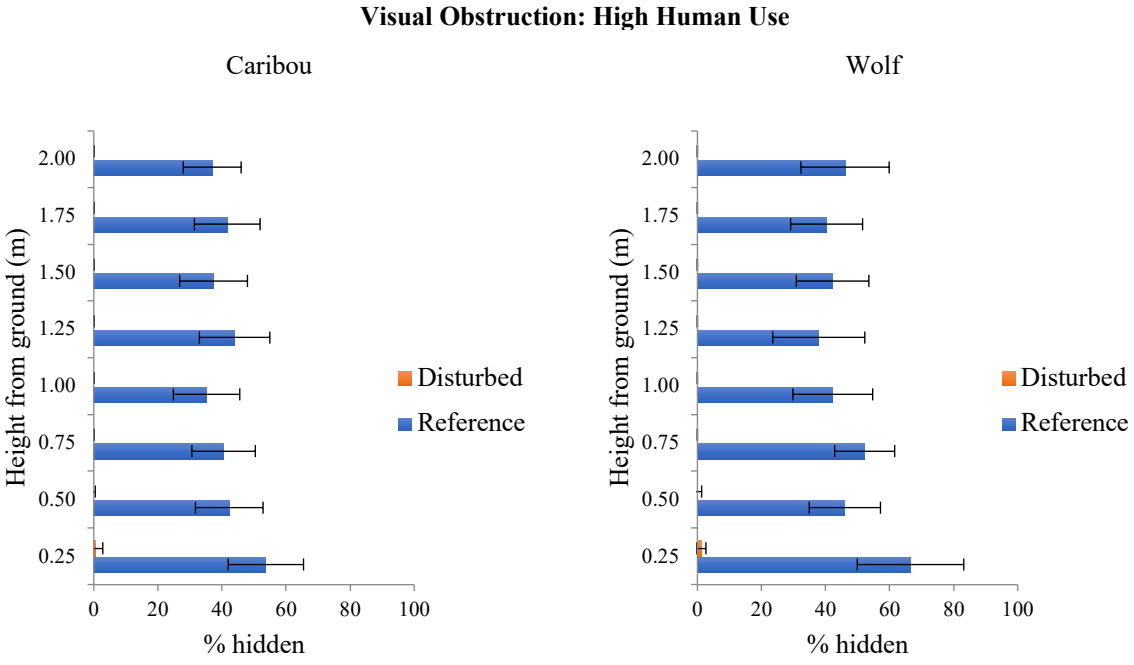

Figure 2.3-6D Visual obstruction in areas with high human use for disturbance versus reference from caribou and wolf perspectives. The error bars are standard errors around the means.

Vegetation Recovery: Areas burned before vs. after line was cut

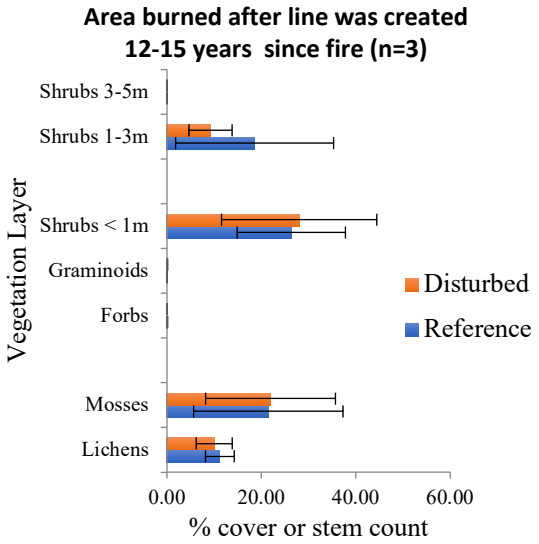

Figure 2.3-7A Average cover/stem count for disturbed versus reference in each vegetation layer for areas burned after line was created. The error bars are standard errors around the means.

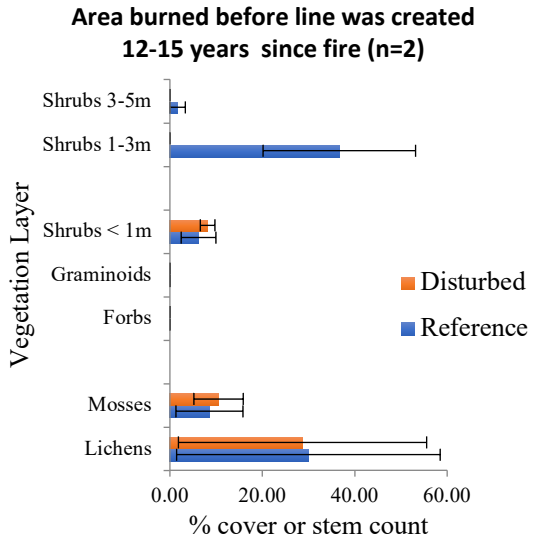

Figure 2.3-7B Average cover/stem count for disturbed versus reference in each vegetation layer for areas burned before line was created. The error bars are standard errors around the means.

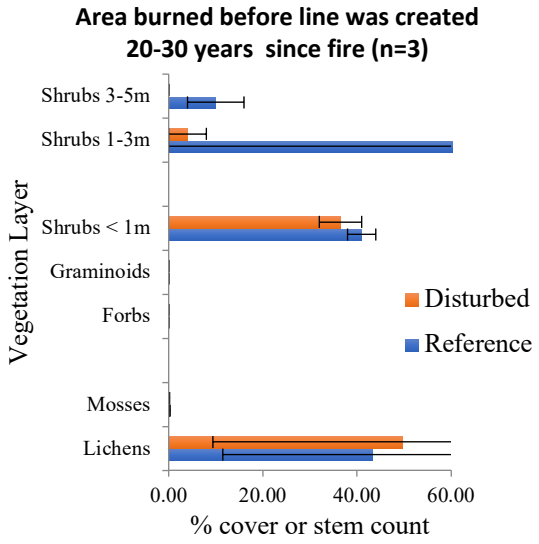

Figure 2.3-7C Average cover/stem count for disturbed versus reference in each vegetation layer for areas burned before line was created. The error bars are standard errors around the means.

Vegetation Recovery: Lowland (bogs/fens) vs. Upland

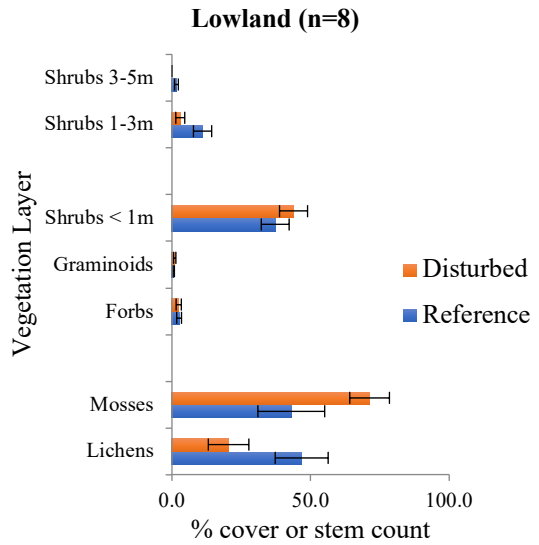

Figure 2.3-8A Average cover/stem count for disturbed versus reference in each vegetation layer for lowland (bogs/fens). The error bars are standard errors around the means.

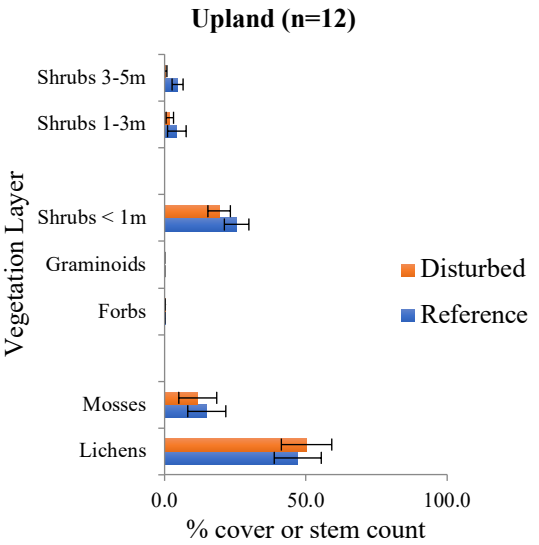

Figure 2.3-8B Average cover/stem count for disturbed versus reference in each vegetation layer for upland. The error bars are standard errors around the means.

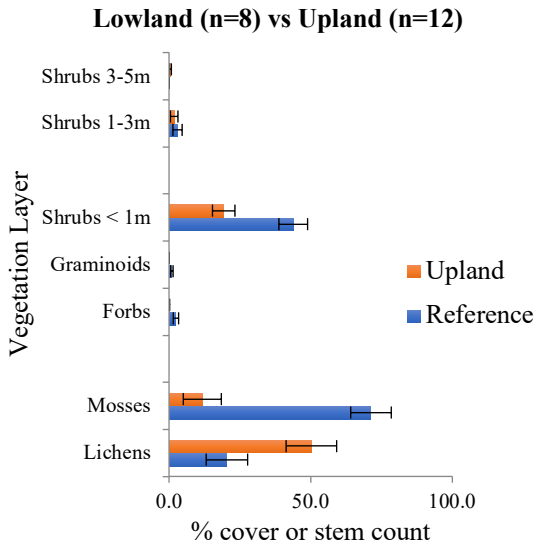

Figure 2.3-8C Average cover/stem count in disturbed areas between lowland (bogs-fens) and upland vs. reference. The error bars are standard errors around the means.

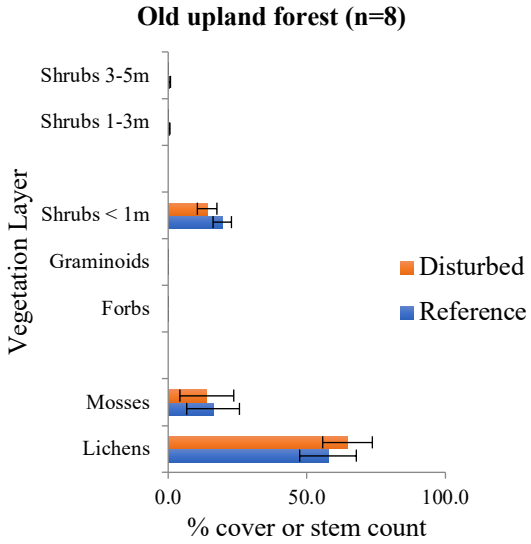

Figure 2.3-9A Average cover/stem count for disturbed versus reference in each vegetation layer for old upland forest. The error bars are standard errors around the means.

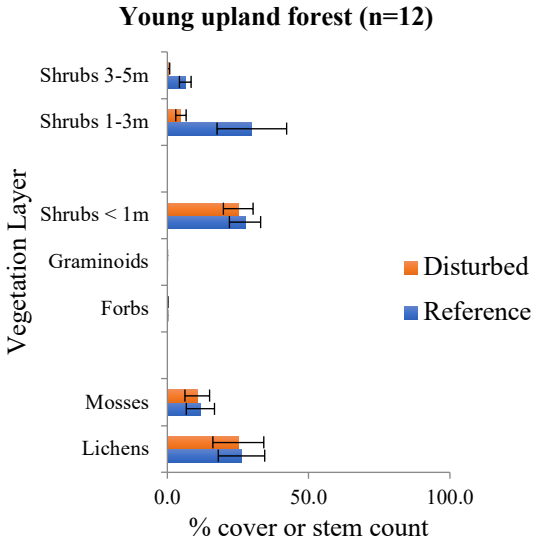

Figure 2.3-9B Average cover/stem count for disturbed versus reference in each vegetation layer for young upland forest. The error bars are standard errors around the means.

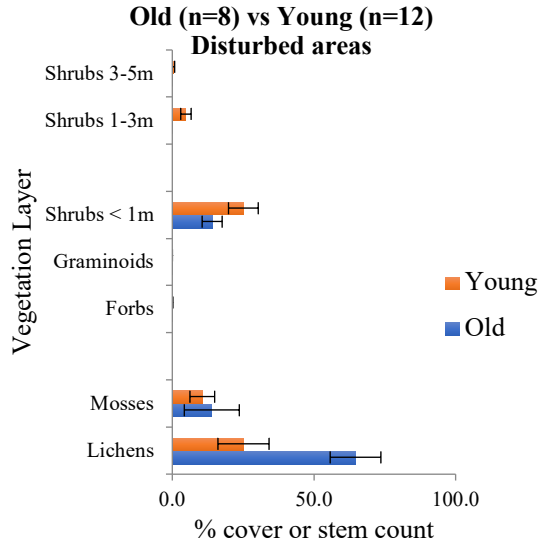

Figure 2.3-9C Average cover/stem count for disturbed areas in each vegetation layer for old versus young forest. The error bars are standard errors around the means.

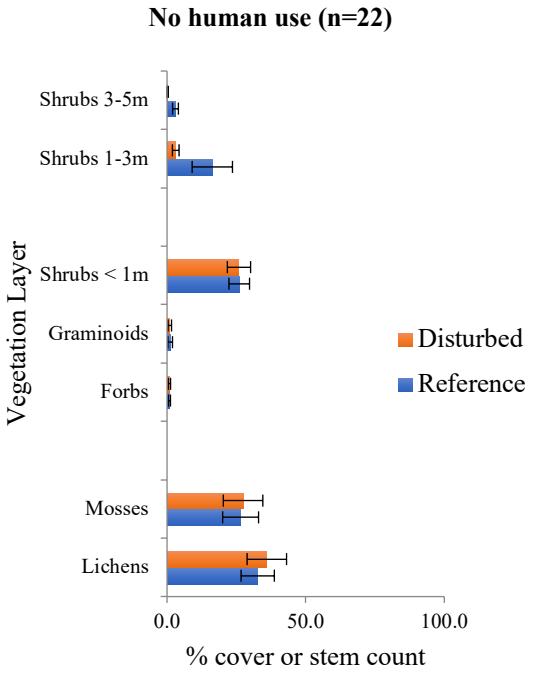

Figure 2.3-10A Average cover/stem count for disturbed versus reference in each vegetation layer for areas with no human use. The error bars are standard errors around the means.

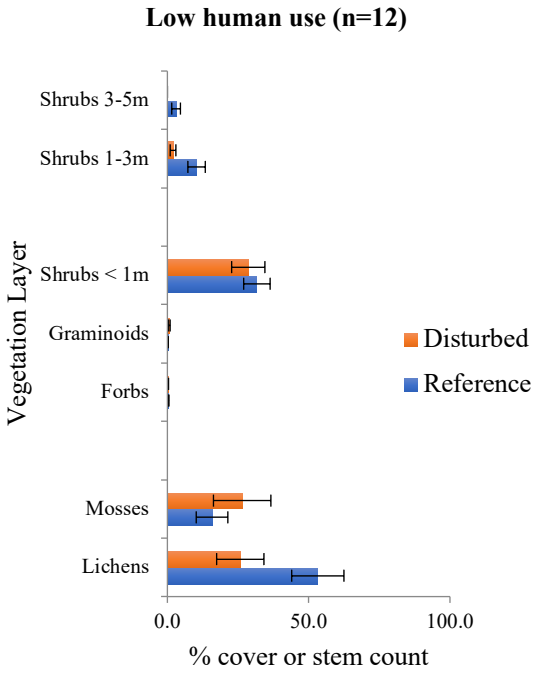

Figure 2.3-10B Average cover/stem count for disturbed versus reference in each vegetation layer for areas with low human use. The error bars are standard errors around the means.

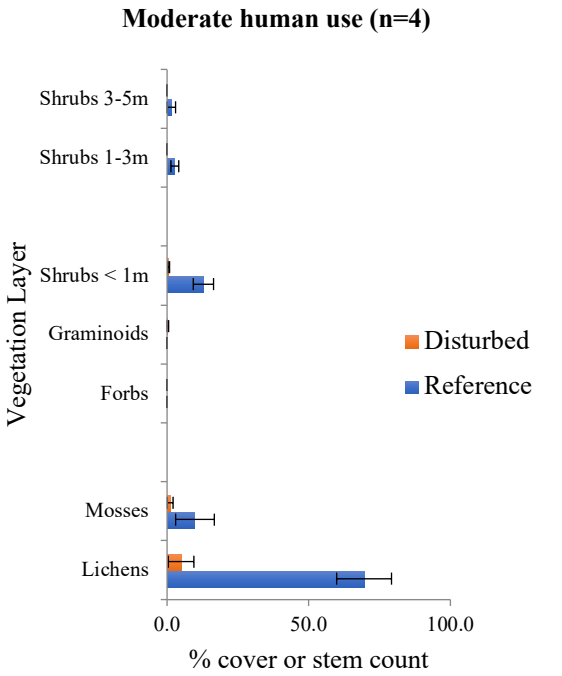

Figure 2.3-10C Average cover/stem count for disturbed versus reference in each vegetation layer for areas with moderate human use. The error bars are standard errors around the means.

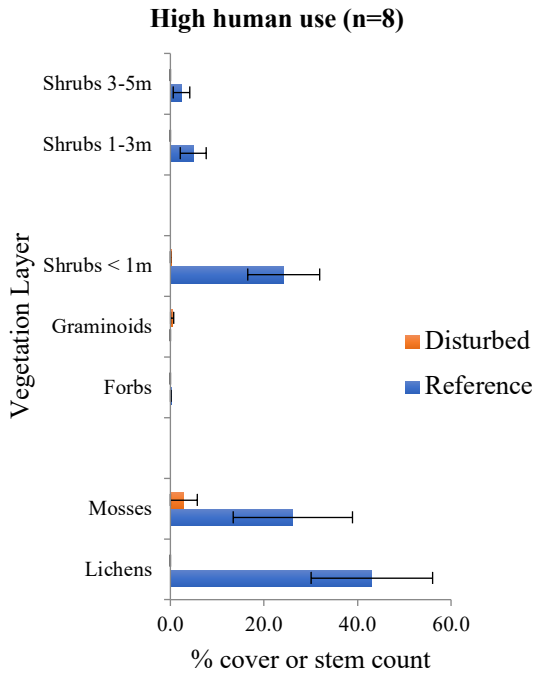

Figure 2.3-10D Average cover/stem count for disturbed versus reference in each vegetation layer for areas with high human use. The error bars are standard errors around the means.

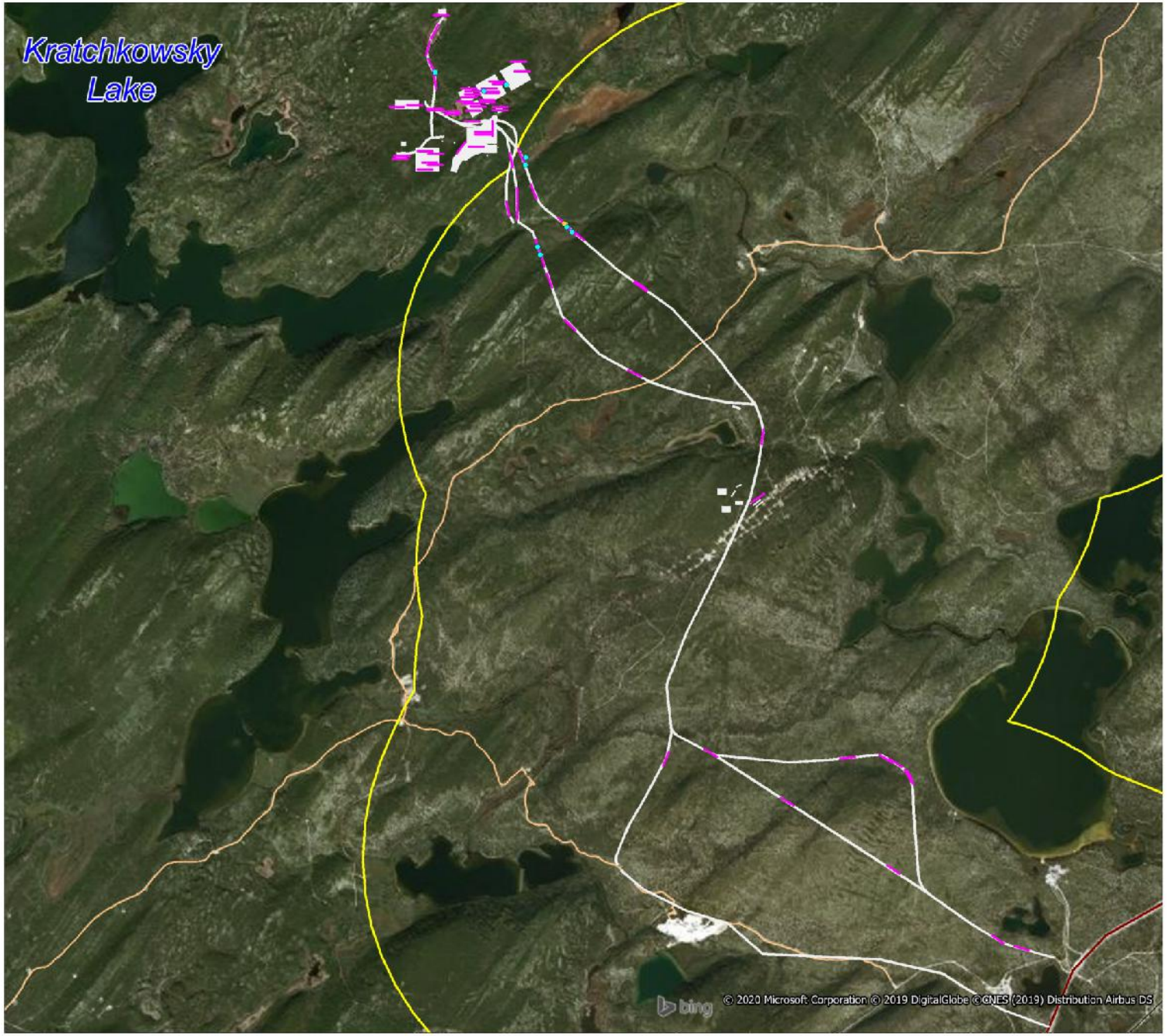

Figure 2.4-1 Rare Plant Survey Locations and Observations - Denison Wheeler River Project

Legend

Rare Plants Observed
- Diphasiastrum sitchense
- Carex trisperma

- Rare Plant Transect
- Road
- McArthur-Key Haul Road
- Transmission ROW
- 2017 Planned Development Footprint
- Local Study Area (LSA)

0 1 2

kilometers
Scale = 1 : 25,000

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Figure 2.4-2. Alaskan clubmoss partially buried in litter and lichen on the forest floor.

Figure 2.4-3. Alaskan clubmoss with horizontal stems.

Figure 2.4-4. Open immature jack pine stand with Alaskan clubmoss in the forb layer.

Figure 2.4-5. Close-up picture of three-seeded sedge flower and fruit structures.

Figure 2.4-6. Wet riparian depression with three-seeded sedge.

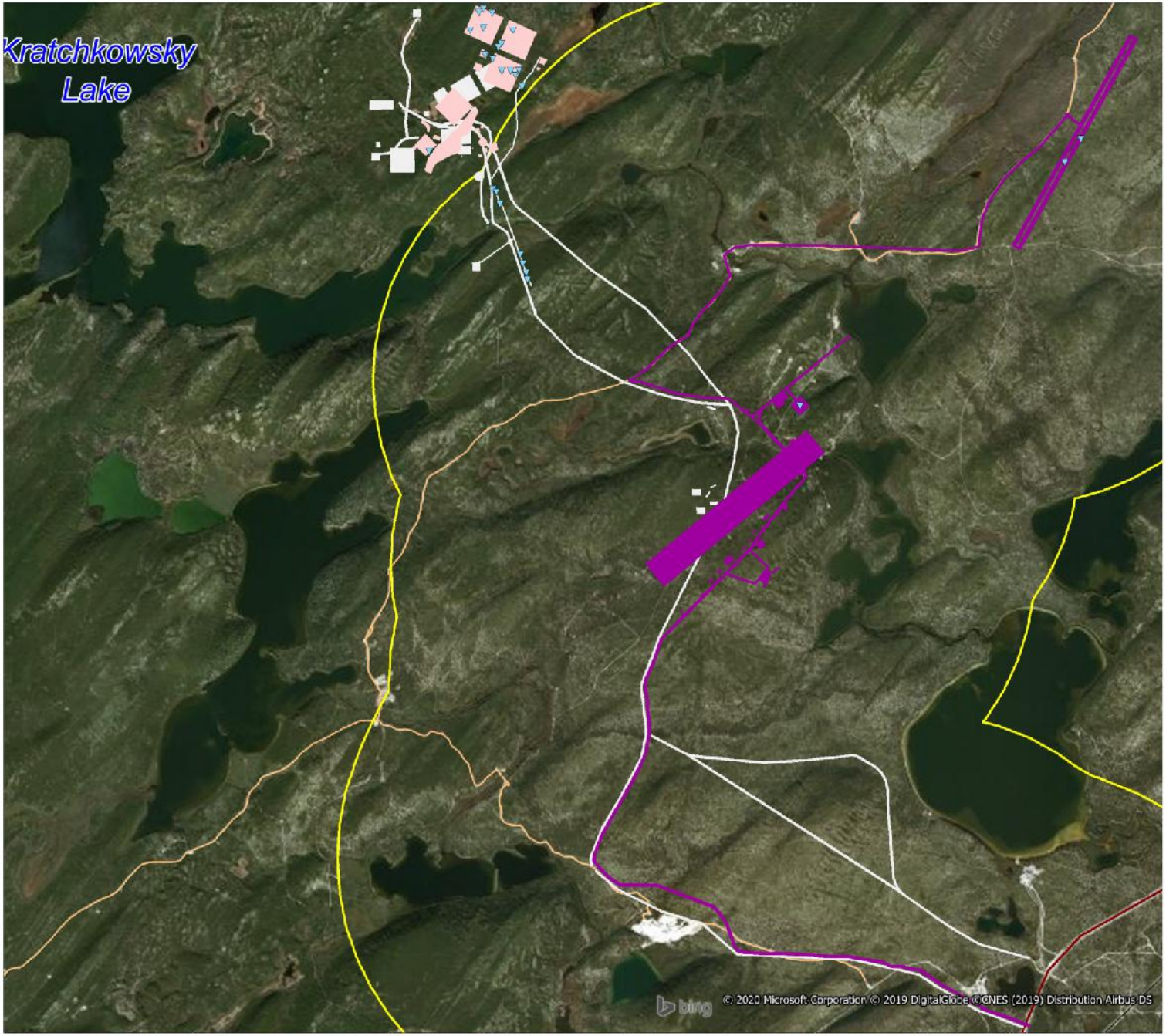

Figure 2.4-7 Rare Plant Survey Requirement Assessment - Denison Wheeler River Project

Legend

- Ground Verification Site
- Road
- McArthur-Key Haul Road
- Transmission ROW
- 2017 Planned Development Footprint
- 2018 Gryphon Planned Development Footprint
- 2019 Planned Development Footprint
- Local Study Area (LSA)

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0 1 2

kilometers
Scale = 1 : 25,000

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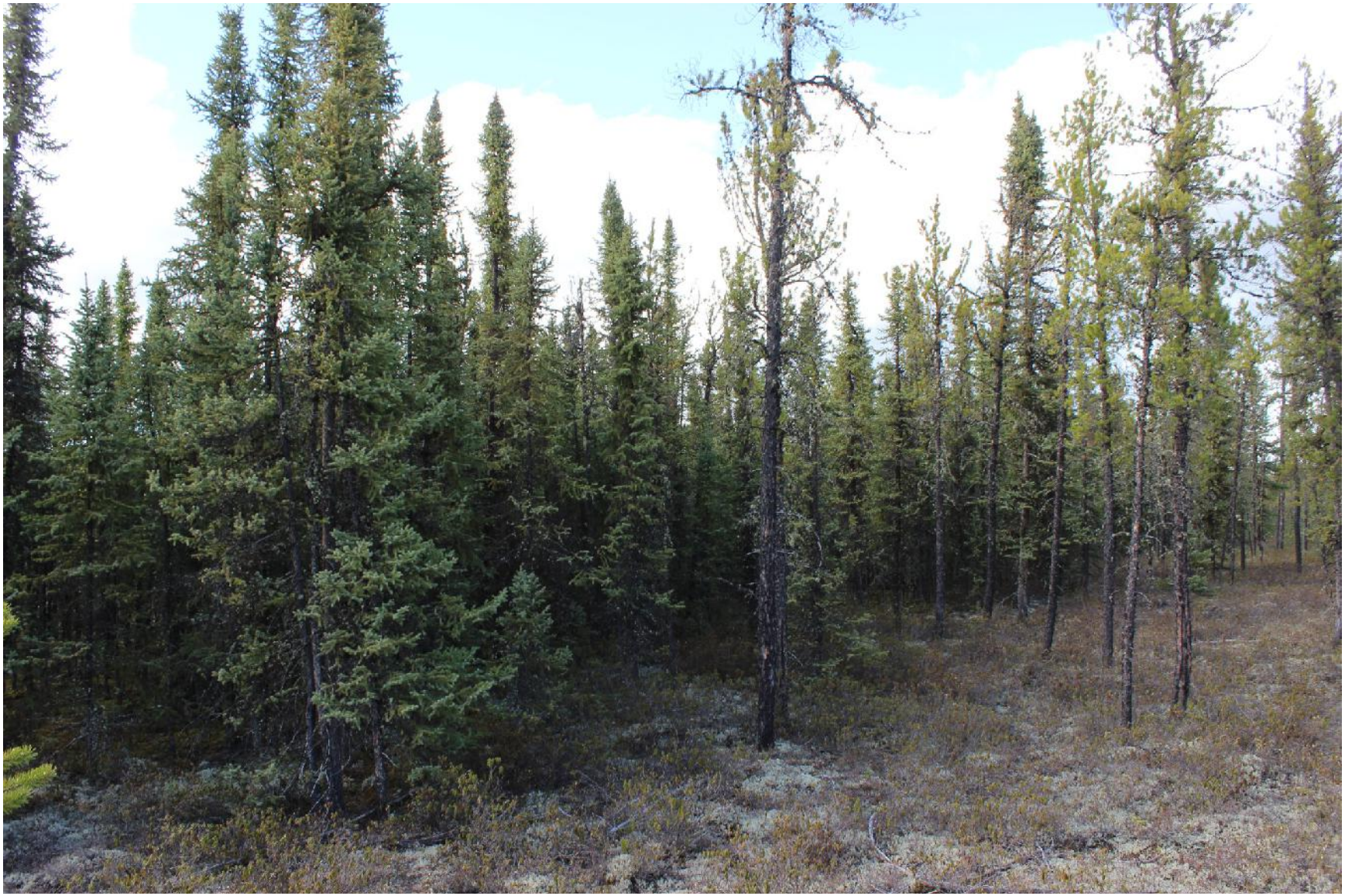

Figure 2.4-8. Black Spruce – Jackpine/Feathermoss (BS9) Polygon – Denison Wheeler River Project.

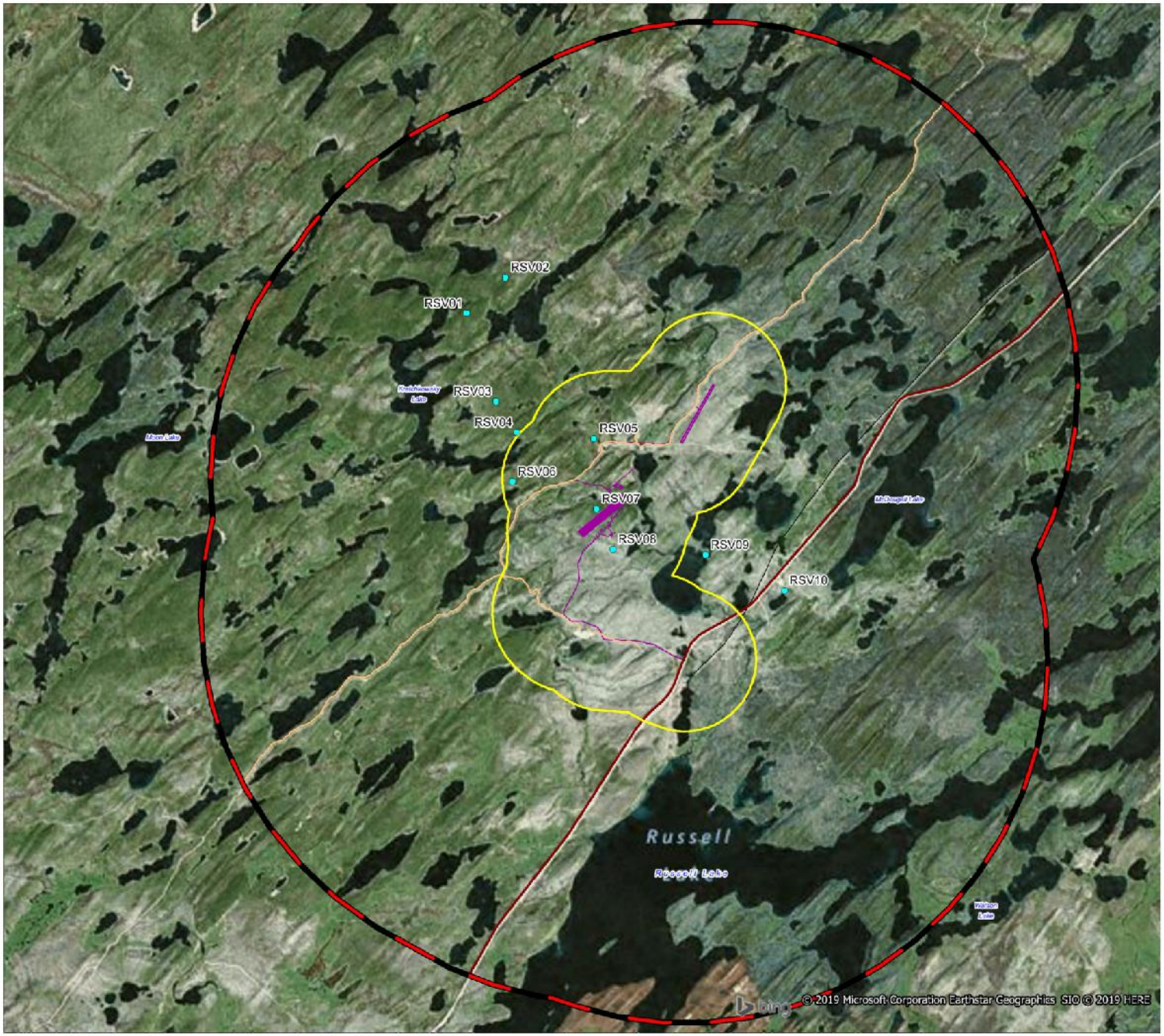

Figure 2.5-1 Vegetation and Soil Sampling Plot Locations - Denison Wheeler River Project

Legend

- Veg / Soil Sampling Plot
- Road
- McArthur-Key Haul Road
- Transmission ROW
- Planned Development Footprint
- Local Study Area (LSA)
- Regional Study Area (RSA)

N
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0 5 10

kilometers
Scale = 1 : 90,000

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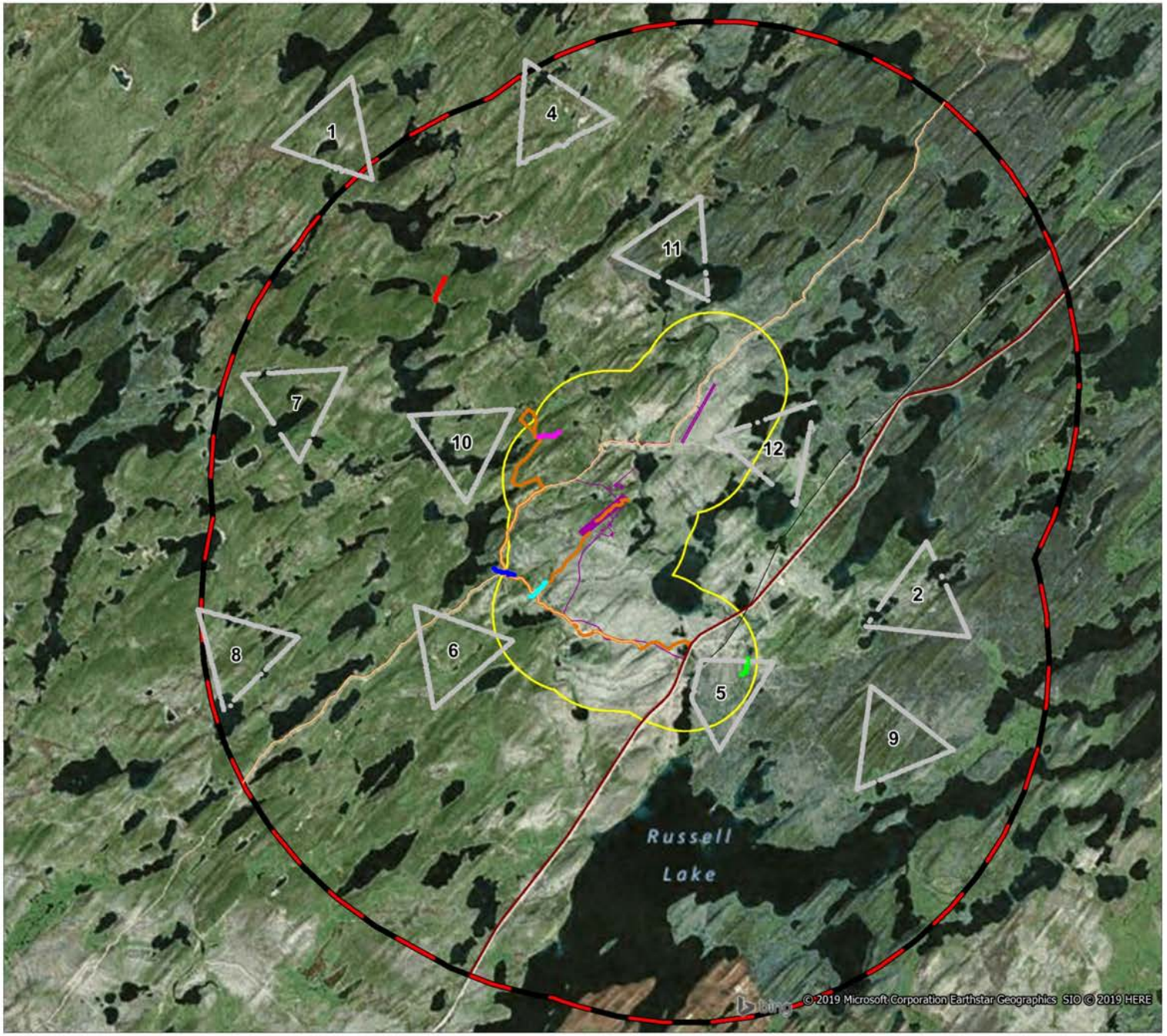

Figure 2.6-1 Winter Tracking Survey Transects - Denison Wheeler River Project

Legend

Winter Tracking Transect

- Triangle
- Creek 1
- Creek 2
- Creek 3
- Creek 4
- Creek 5
- Road / Anthropogenic
- Road
- McArthur-Key Haul Road
- Transmission ROW
- Planned Development Footprint
- Local Study Area (LSA)
- Regional Study Area (RSA)

N W E S

0 5 10

kilometers

Scale = 1 : 90,000

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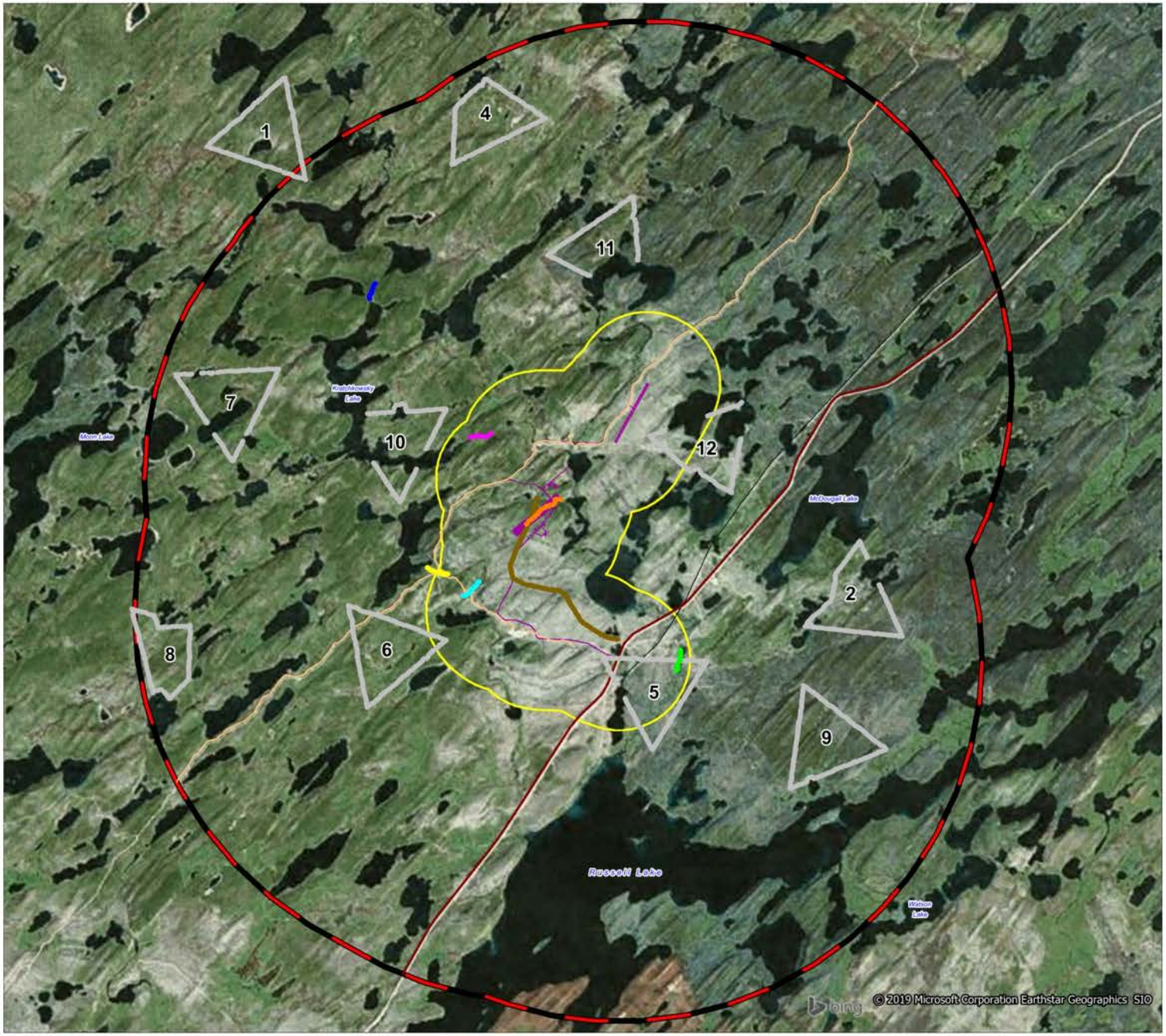

Figure 2.7-1 Ungulate Pellet Group/Browse Availability Transects - Denison Wheeler River Project

Legend

Pellet Group/browse Transect
- Proposed Access
- Creek 1
- Creek 2
- Creek 3
- Creek 4
- Creek 5
- Road / Anthropogenic
- Triangle

Road
McArthur-Key Haul Road
Transmission ROW
Planned Development Footprint
Local Study Area (LSA)
Regional Study Area (RSA)

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kilometers
Scale = 1 : 90,000

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Ref# O-F721a_11-17

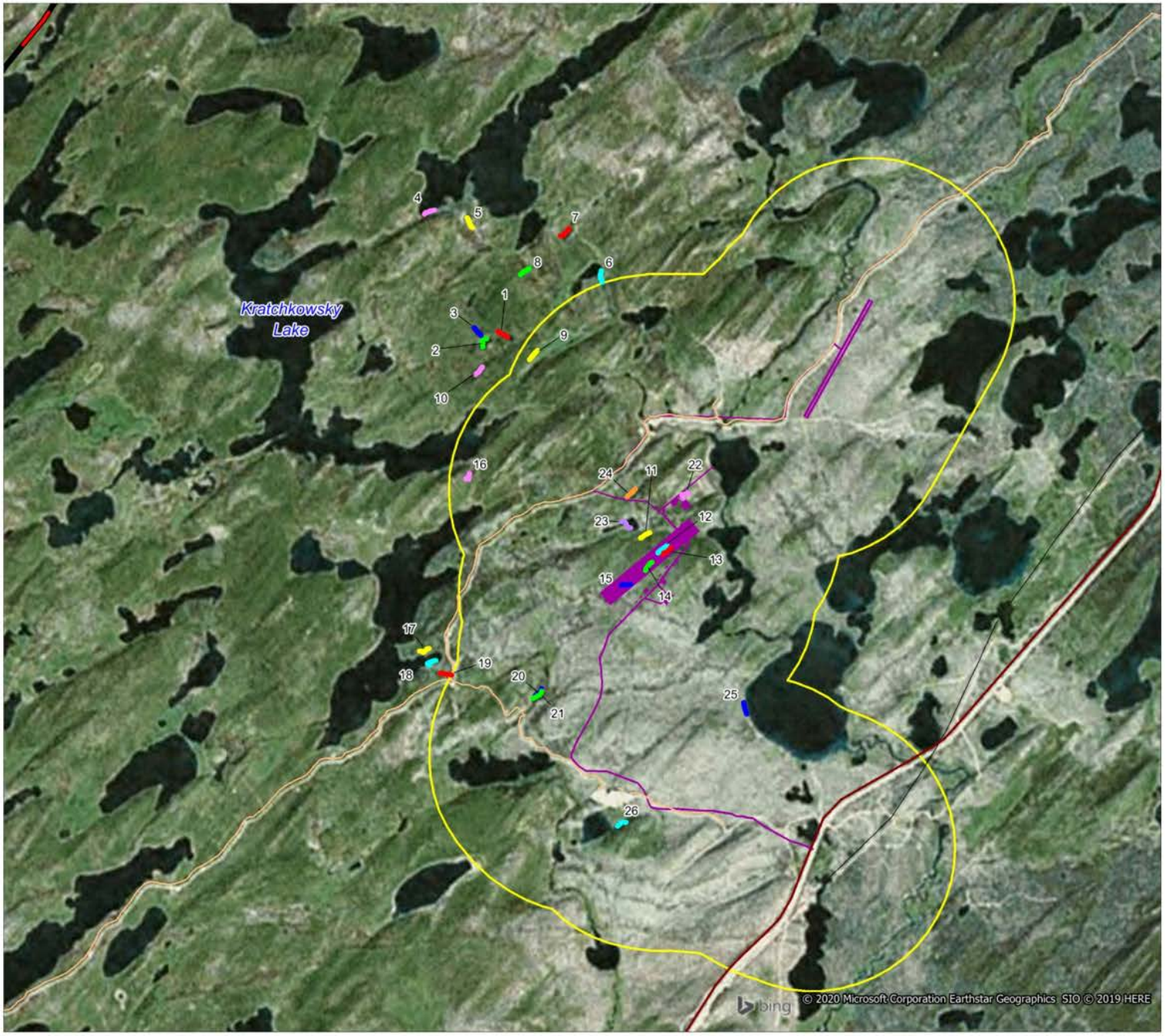

Figure 2.8-1 Small Mammal Trapping Transects - Denison Wheeler River Project

Legend

- Small Mammal Transect
- Road
- McArthur-Key Haul Road
- Transmission ROW
- Planned Development Footprint
- Local Study Area (LSA)
- Regional Study Area (RSA)

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0 2.5 5

kilometers
Scale = 1 : 45,000

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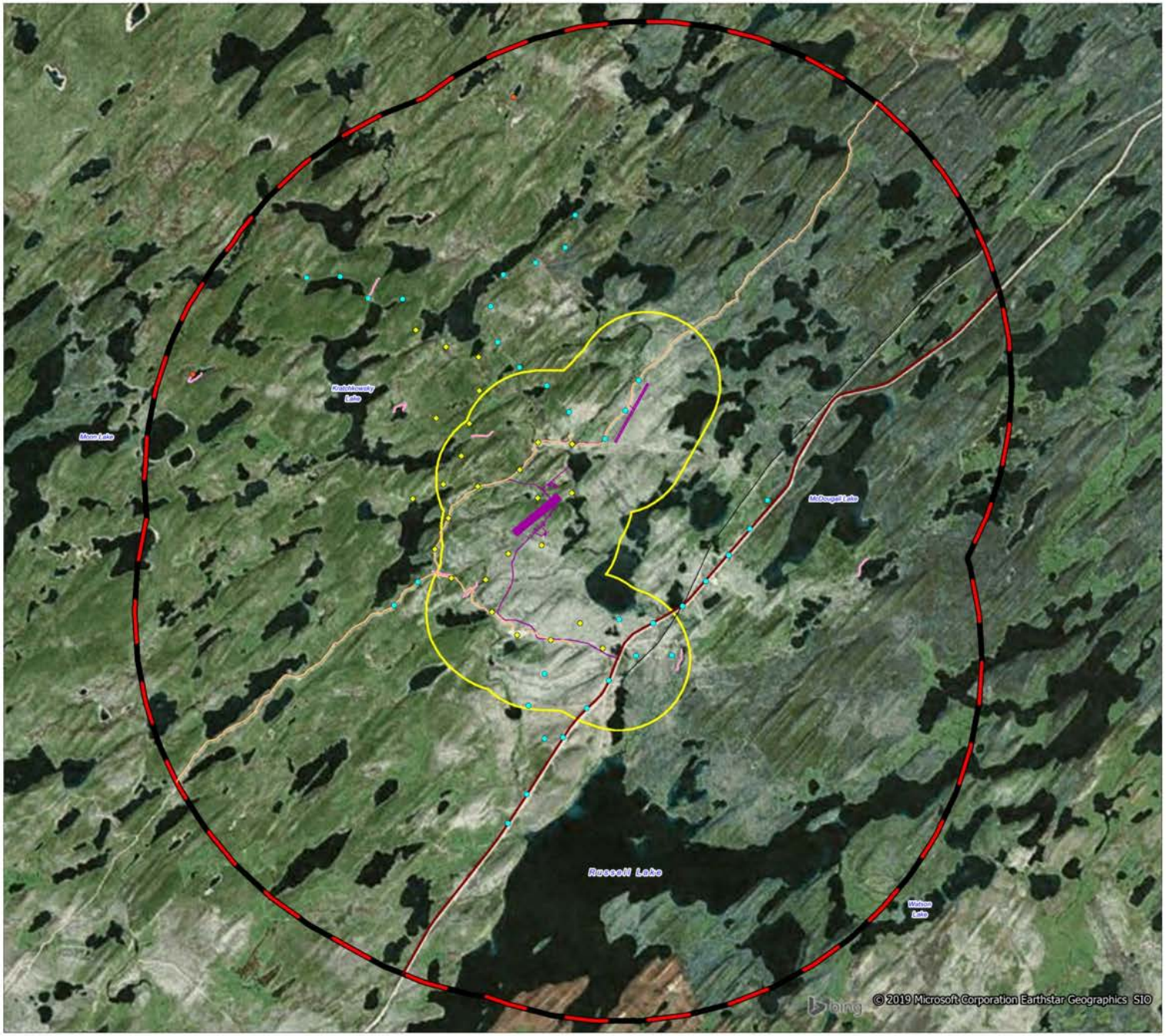

Figure 2.9-1 Amphibian Nocturnal Call Survey Plots and Visual Survey Routes - Denison Wheeler River Project

Legend

Pellet Group/browse Transect
Nocturnal Call Survey Plot (2017, 2018)
Nocturnal Call Survey Plot (2017)
Wood Frog Visual Location
Amphibian Visual Surveys 2018
Road
McArthur-Key Haul Road
Transmission ROW
Planned Development Footprint
Local Study Area (LSA)
Regional Study Area (RSA)

N
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kilometers
Scale = 1 : 90,000

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Produced by Rich Ashton, Dec. 2019
Ref# O-F721a_11-17

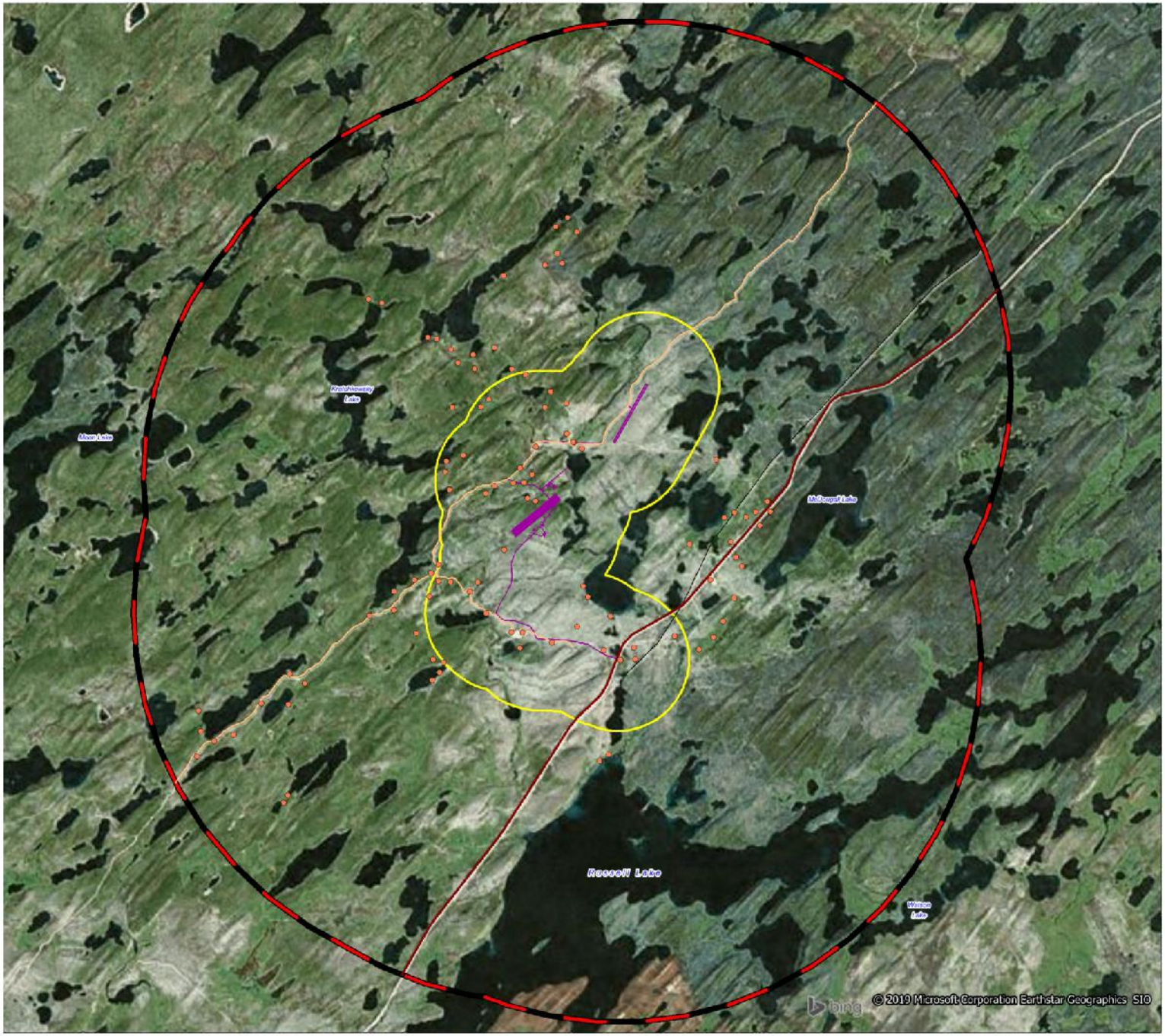

Figure 2.10-1 Breeding Songbird Point Count Survey Plots - Denison Wheeler River Project

Legend

- Veg / Soil Sampling Plot
- Road
- McArthur-Key Haul Road
- Transmission ROW
- Planned Development Footprint
- Local Study Area (LSA)
- Regional Study Area (RSA)

N
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0 5 10

kilometers
Scale = 1 : 90,000

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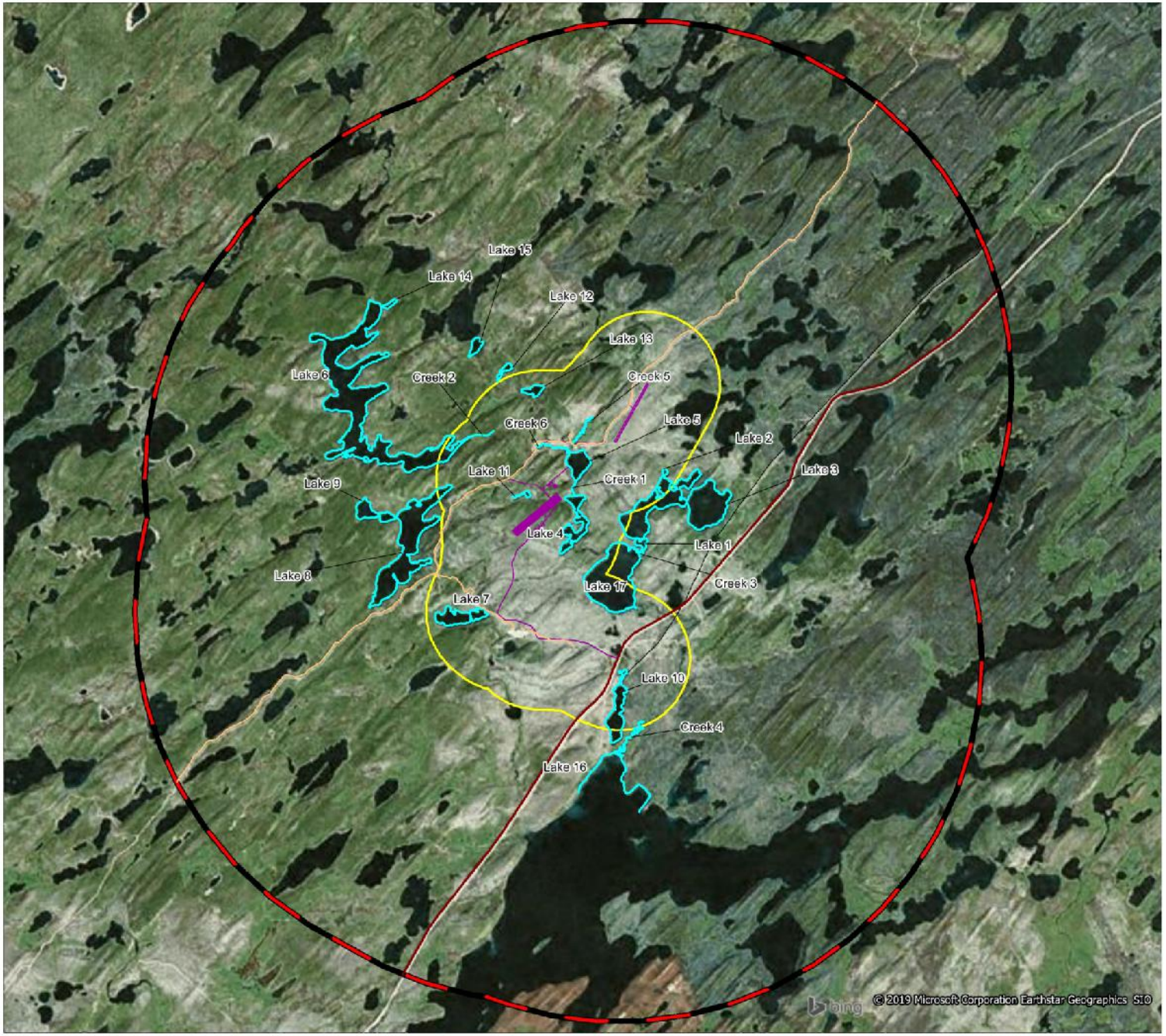

Figure 2.11-1 Semi-aquatic Furbearer Shoreline Survey Locations - Denison Wheeler River Project

Legend

- Shoreline Survey Route
- Road
- McArthur-Key Haul Road
- Transmission ROW
- Planned Development Footprint
- Local Study Area (LSA)
- Regional Study Area (RSA)

N
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kilometers
Scale = 1 : 90,000

OMNIA ECOLOGICAL SERVICES

Produced by Rich Ashton, Dec. 2019
Ref# O-F721a_11-17

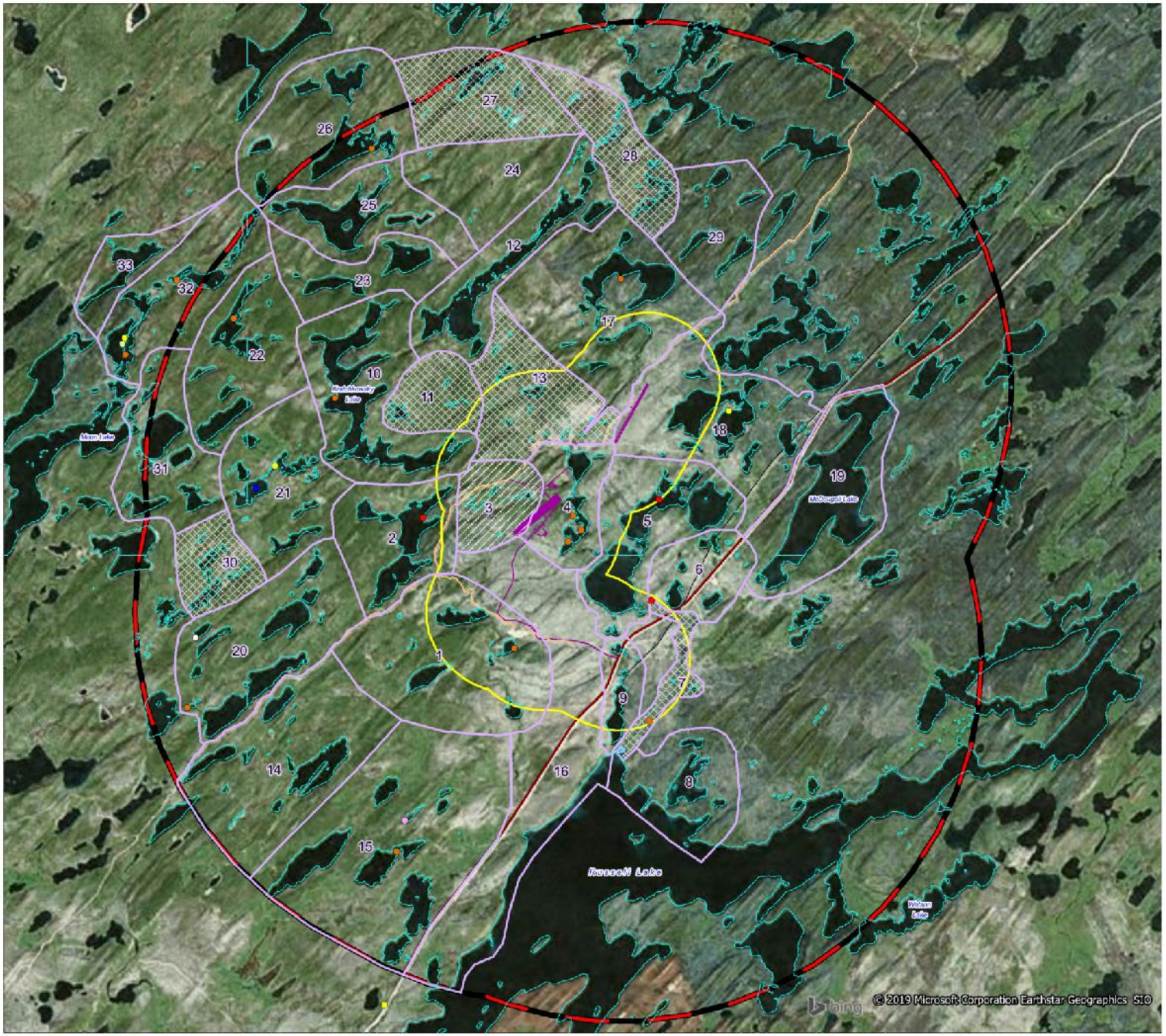

Figure 2.12-1 Aerial Waterfowl Sections and Stick Nest Locations - Denison Wheeler River Project

Legend

Nest Type

- Active Bald Eagle Nest
- Active Common Loon Nest
- Active Herring Gull Nest
- Active Mew Gull Colony of Nests (12-15)
- Active Osprey Nest
- Active Raven Nest
- Inactive/Old Stick Nest

- Waterfowl Survey Section
- High Waterfowl Species Diversity (# species/ha)
- High Waterfowl Abundance (# birds/ha)
- Road
- McArthur-Key Haul Road
- Transmission ROW
- Planned Development Footprint
- Local Study Area (LSA)
- Regional Study Area (RSA)

N W E S

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kilometers
Scale = 1 : 90,000

OMNIA ECOLOGICAL SERVICES

Produced by Rich Ashton, Dec. 2019
Ref# O-F721a_11-17

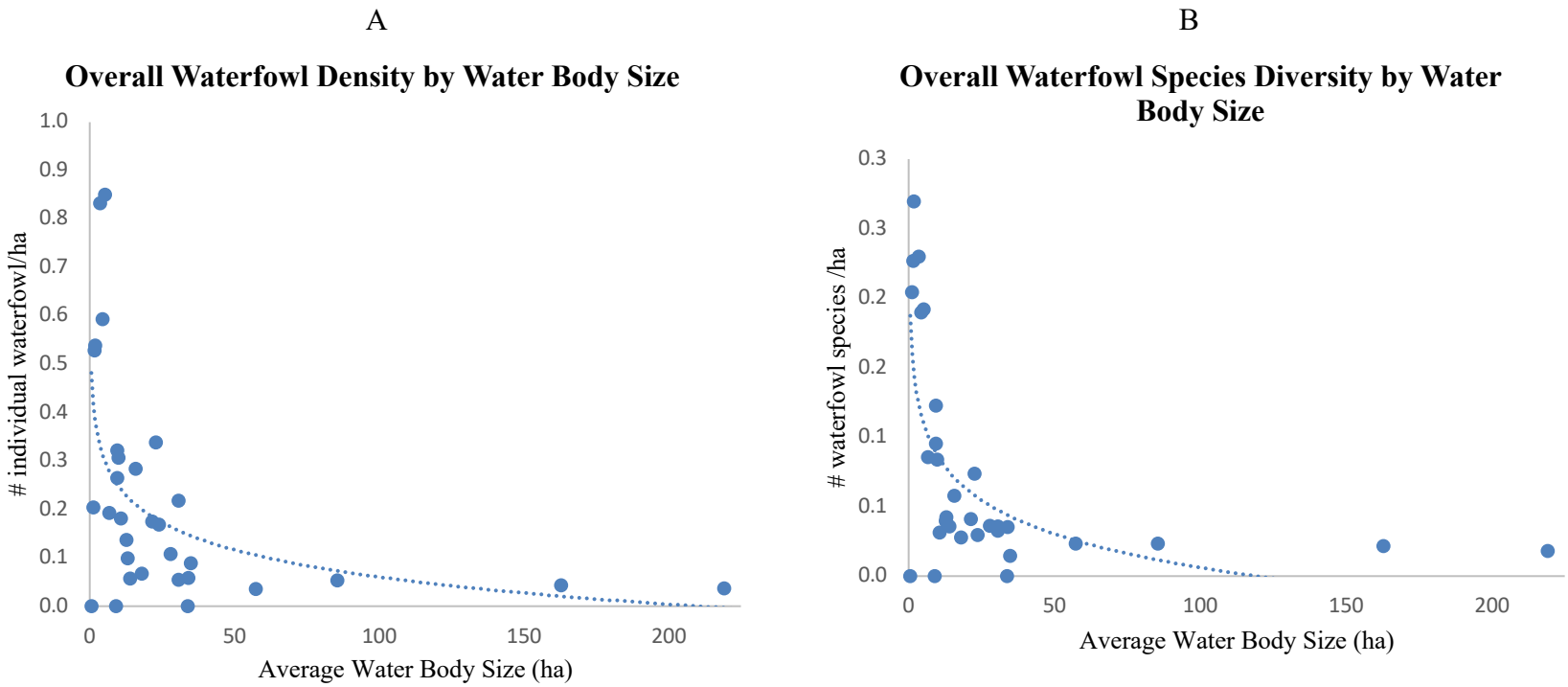

Figure 2.12-2 Relationship between average size of water body and (A) number of individual birds observed per hectare and (B) number of waterfowl species observed per hectare. Ponds and lakes included only.

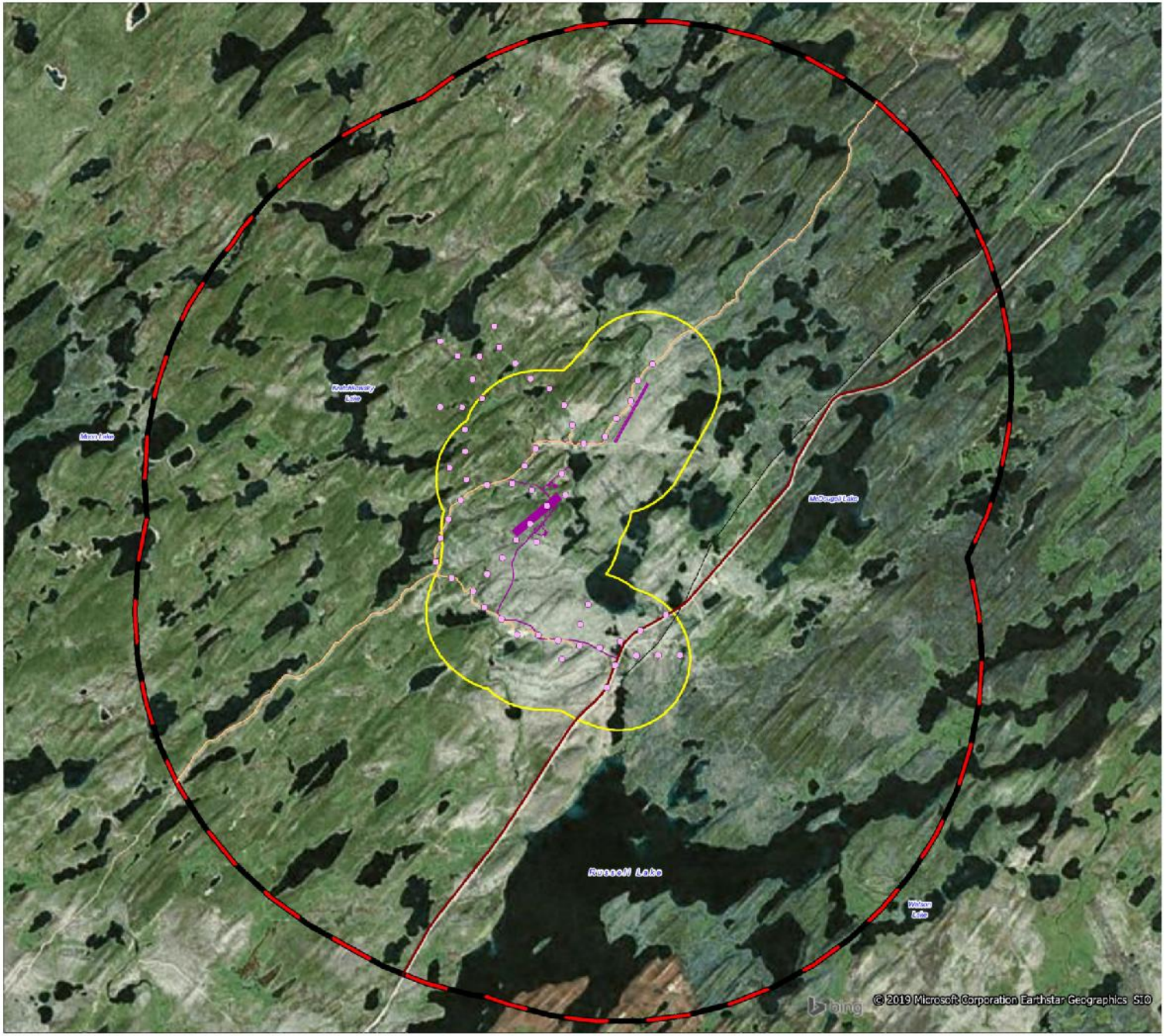

Figure 2.14-1 Acoustic Bat Surveys
- Denison Wheeler River Project

Legend

- Bat Survey Location
- Road
- McArthur-Key Haul Road
- Transmission ROW
- Planned Development Footprint
- Local Study Area (LSA)
- Regional Study Area (RSA)

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kilometers
Scale = 1 : 90,000

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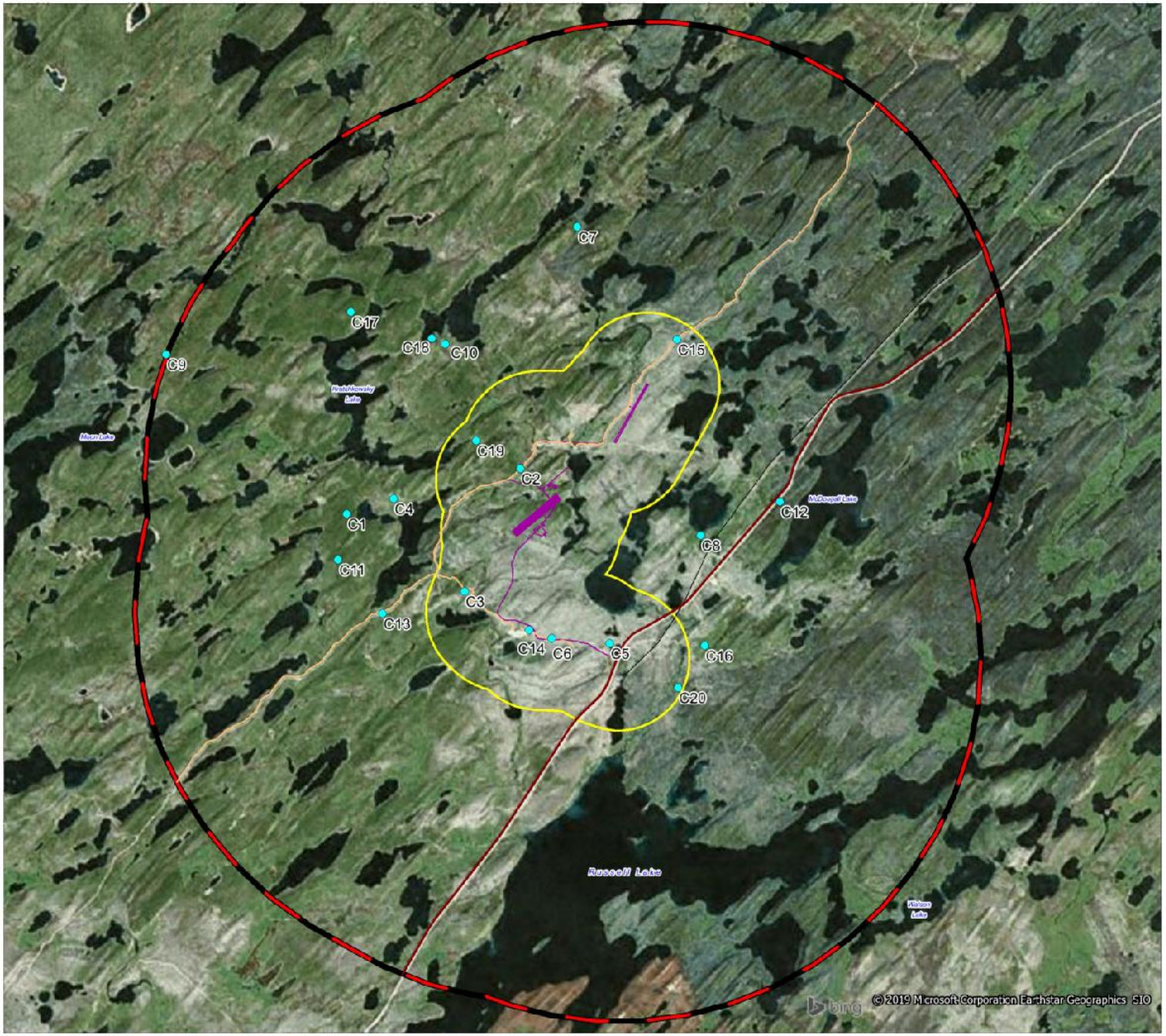

Figure 2.15-1 Covert Camera Surveys - Denison Wheeler River Project

Legend

- Covert Camera Location
- Road
- McArthur-Key Haul Road
- Transmission ROW
- Planned Development Footprint
- Local Study Area (LSA)
- Regional Study Area (RSA)

0 5 10

kilometers

Scale = 1 : 90,000

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Ref# O-F721a_11-17

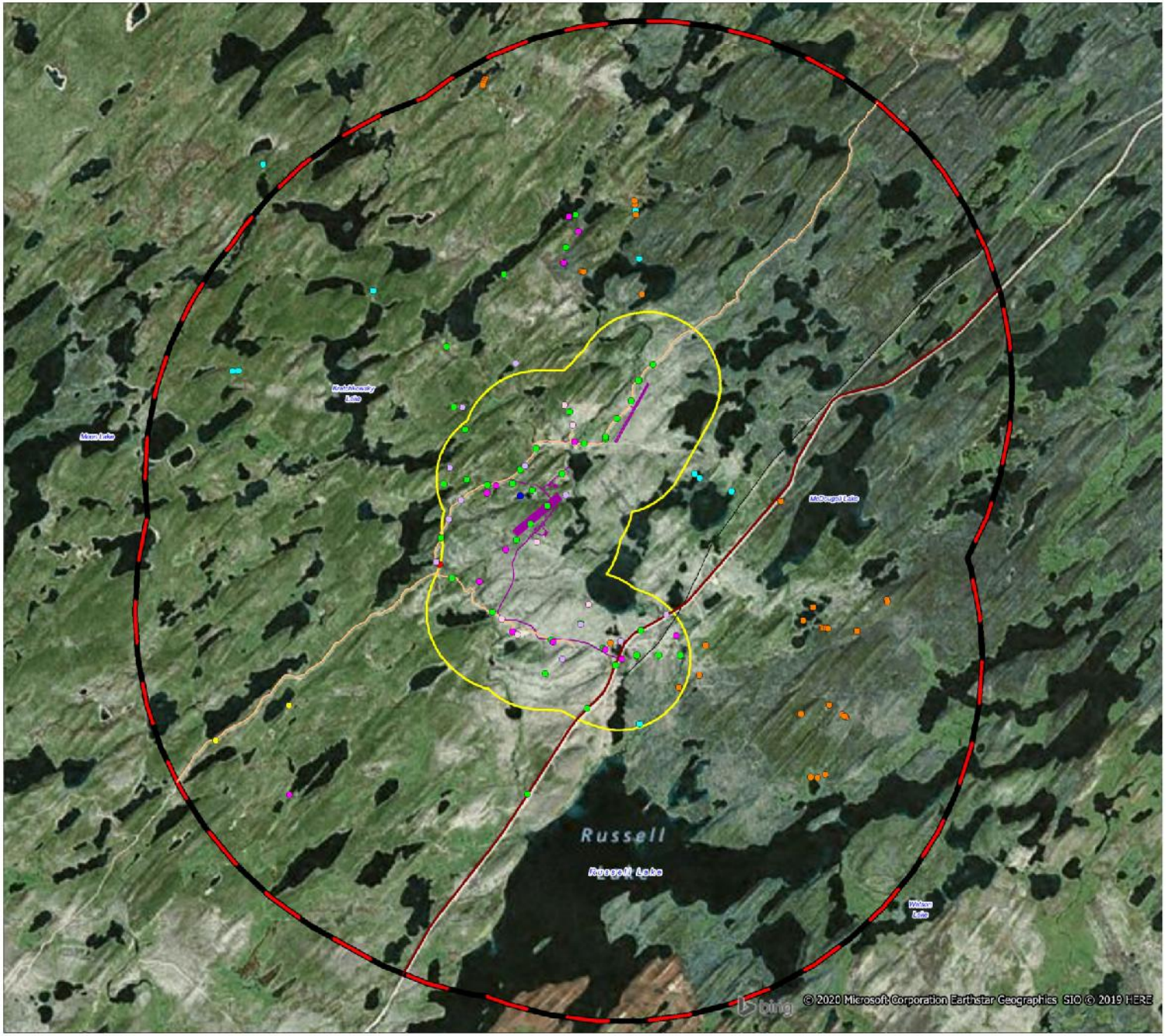

Figure 3-1 Sensitive and Species at Risk Observations - Denison Wheeler River Project

Legend

Species Observed

- Barn Swallow
- Common Nighthawk
- Horned Grebe
- Little Brown Myotis
- Myotis Spp.
- Olive-sided Flycatcher
- Osprey
- River Otter
- Woodland Caribou

- Road
- McArthur-Key Haul Road
- Transmission ROW
- Planned Development Footprint
- Local Study Area (LSA)
- Regional Study Area (RSA)

N
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kilometers
Scale = 1 : 90,000

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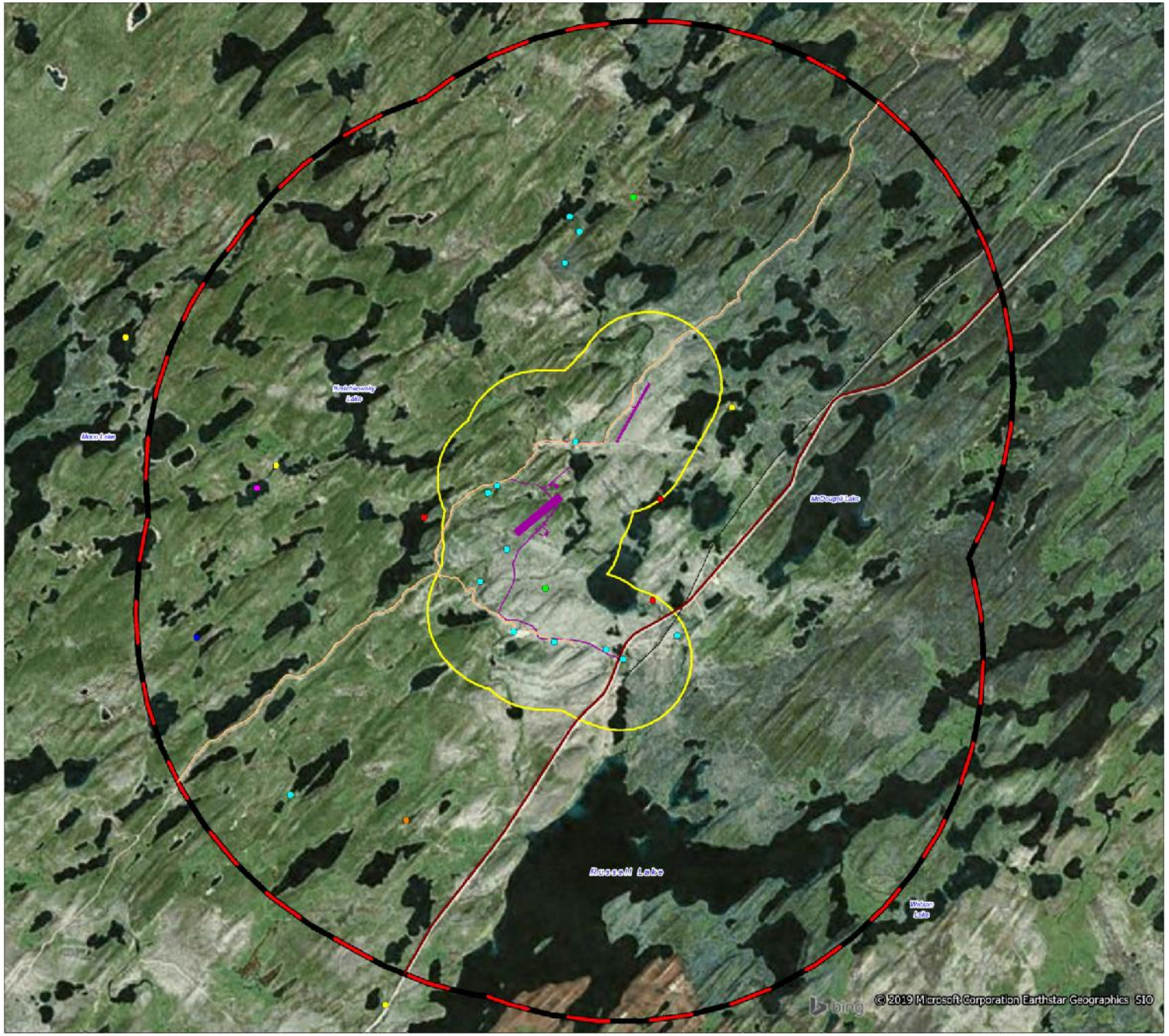

Figure 3-2 Sensitive Species Observations Requiring Setbacks - Denison Wheeler River Project

Legend

Species Observed

- Bald Eagle Nest
- Common Loon Nest
- Common Nighthawk Nest
- Herring Gull Nest
- Mew Gull Colony
- Olive-sided Flycatcher
- Osprey Nest

- Road
- McArthur-Key Haul Road
- Transmission ROW
- Planned Development Footprint
- Local Study Area (LSA)
- Regional Study Area (RSA)

N
W E
S

0 5 10

kilometers
Scale = 1 : 90,000

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9.0 APPENDICES

Appendix 1. List of Vertebrates Known or With Potential to Occur in the Denison Wheeler River project area – 2019.

Common Name	Scientific Name	At Risk Designation			Detected/Program[2]
		SKCDC[1]	COSEWIC	SARA	
BIRDS					
Greater White-fronted Goose	*Anser albifrons*				
Snow Goose	*Chen caerulescens*				
Canada Goose	*Branta canadensis*				Aerial Waterfowl, Incidental
Tundra Swan	*Cygnus columbianus*				
American Wigeon	*Anas americana*				Incidental
Mallard	*Anas platyrhynchos*				Aerial Waterfowl
Gadwall	*Anas strepera*				
Canvasback	*Aythya valisineria*				
Ruddy Duck	*Oxyura jamaicensis*				
Blue-winged Teal	*Anas discors*				
Northern Shoveler	*Anas clypeata*				
Northern Pintail	*Anas acuta*				
Green-winged Teal	*Anas crecca*				
Redhead	*Aythya american*				
Ring-necked Duck	*Aythya collaris*				Aerial Waterfowl, Incidental
Greater Scaup	*Aythya marila*				
Lesser Scaup	*Aythya affinis*				Aerial Waterfowl
Surf Scoter	*Melanitta perspicillata*				Aerial Waterfowl, Incidental
White-winged Scoter	*Melanitta fusca*				Aerial Waterfowl
Long-tailed Duck	*Clangula hyemalis*				
Bufflehead	*Bucephala albeola*				Songbird, Aerial Waterfowl, Incidental
Common Goldeneye	*Bucephala clangula*				Aerial Waterfowl
Hooded Merganser	*Lophodytes cullatus*				
Common Merganser	*Mergus merganser*				Songbird, Aerial Waterfowl, Incidental
Red-breasted Merganser	*Mergus serrator*				
Ruffed Grouse	*Bonasa umbellus*				

Appendix 1 cont.

Common Name	Scientific Name	At Risk Designation			Detected/Program[2]
		SKCDC[1]	COSEWIC	SARA	
Spruce Grouse	*Falcipennis canadensis*				Songbird, Incidental
Willow Ptarmigan	*Lagopus lagopus*				Winter Tracking
Sharp-tailed Grouse	*Tympanuchus phasianellus*				
Red-throated Loon	*Gavia stellata*	S1B, S1M			
Pacific Loon	*Gavia pacifica*	S3M			
Common Loon	*Gavia immer*		Not at Risk		Songbird, Aerial Waterfowl, bats Incidental
Red-necked Grebe	*Podiceps grisegena*		Not at Risk		
Horned Grebe	*Podiceps auritus*	S5B, S5M	Special Concern	Special Concern	Incidental
Eared Grebe	*Podiceps nigricollis*				
Pied-billed Grebe	*Podilymbus podiceps*				
American Bittern	*Botaurus lentigenosis*				
American White Pelican	*Pelecanus erythrorhynchos*		Not at Risk		
Double-crested Cormorant	*Phalacrocorax auritus*		Not at Risk		
Osprey	*Pandion haliaetus*	S2B, S2M			Aerial Waterfowl, Incidental
Bald Eagle	*Haliaeetus leucocephalus*		Not at Risk		Aerial Waterfowl, Incidental
Northern Harrier	*Circus cyaneus*		Not at Risk		Aerial Waterfowl, Incidental
Golden Eagle	*Aquila chrysaetos*	S3B,S3N,S4M	Not at Risk		
Sharp-shinned Hawk	*Accipiter striatus*		Not at Risk		
Cooper's Hawk	*Accipiter cooperii*		Not at Risk		
Northern Goshawk	*Accipiter gentilis*		Not at Risk		
Broad-winged Hawk	*Buteo platypterus*				
Swainson's Hawk	*Buteo swainsoni*				
Red-tailed Hawk	*Buteo jamaicensis*		Not at Risk		Aerial Waterfowl Incidental
Rough-legged Hawk	*Buteo lagopus*		Not at Risk		
American Kestrel	*Falco sparverius*				
Merlin	*Falco columbarius*		Not at Risk		
Gyrfalcon	*Falco rusticolus*		Not at Risk		
Peregrine Falcon	*Falco peregrinus*	S1B,SNRM	Special Concern	Special Concern	

Appendix 1 cont.

Common Name	Scientific Name	At Risk Designation			Detected/Program[2]
		SKCDC[1]	COSEWIC	SARA	
Sora	*Porzan carolina*				
Virginia Rail	*Rallus limicola*				
Yellow Rail	*Coturnicops noveboracensis*	S3B, S3M	Special Concern	Special Concern	
American Coot	*Fulica americana*		Not at Risk		
Great Blue Heron	*Ardea herodias*				
Sandhill Crane	*Grus canadensis*				Covert Camera
Whooping Crane	*Grus americana*	SXB, S1M	Endangered	Endangered	
Black-bellied Plover	*Pluvialis squatarola*				
American Golden-Plover	*Pluvialis dominica*				
Piping Plover	*Charadrius melodus*	S3B	Endangered	Endangered	
Semipalmated Plover	*Charadrius sempalmatus*				
Killdeer	*Charadrius vociferus*				Songbird
Spotted Sandpiper	*Actitis macularia*				
Solitary Sandpiper	*Tringa solitaria*				Songbird
Willet	*Tringa semipalmata*				
Greater Yellowlegs	*Tringa melanoleuca*				Songbird, Incidental
Lesser Yellowlegs	*Tringa flavipes*				Incidental
Hudsonian Godwit	*Limosa haemastica*	S4M	Threatened		
Marbled Godwit	*Limosa fedoa*				
Ruddy Turnstone	*Arenaria interpres*				
Red Knot	*Calidris canutus*	S2M	Endangered	Endangered	
Sanderling	*Calidris alba*				
Semipalmated Sandpiper	*Calidris pusilla*				
Least Sandpiper	*Calidris minutilla*				
White-rumped Sandpiper	*Calidris fuscicollis*				
Baird's Sandpiper	*Calidris bairdii*				
Pectoral Sandpiper	*Calidris melanotos*				
Dunlin	*Calidris alpina*				
Stilt Sandpiper	*Calidris himantopus*				

Appendix 1 cont.

Common Name	Scientific Name	At Risk Designation			Detected/Program[2]
		SKCDC[1]	COSEWIC	SARA	
Buff-breasted	*Calidris subruficollis*	S4M	Special Concern	Special Concern	
Short-billed	*Limnodromus griseus*				
Long-billed	*Limnodramus scolopaceus*				
Wilson's Snipe	*Gallinago delicata*				
Wilson's Phalarope	*Phalaropus tricolor*				
Red-necked Phalarope	*Phalaropus lobatus*	S4B, S3M	Special Concern		
Parasitic Jaeger	*Stercorarius parasiticus*				
Franklin's Gull	*Leucophaeus pipixcan*				
Bonaparte's Gull	*Chroicocephalus*				Aerial Waterfowl, Incidental
Mew Gull	*Larus canus*				Songbird, Aerial Waterfowl, Incidental
Ring-billed Gull	*Larus delawarensis*				Songbird, Aerial Waterfowl
California Gull	*Larus californicus*				
Herring Gull	*Larus argentatus*				Songbird, Aerial Waterfowl, Incidental
Glaucus Gull	*Larus hyperboreus*	S2N, S2M			
Forster's Tern	*Sterna forsteri*				
Caspian Tern	*Hydroprogne caspia*	S2B, S2M	Not at Risk		
Black Tern	*Chlidonias niger*		Not at Risk		
Common Tern	*Sterna hirundo*		Not at Risk		Aerial Waterfowl
Arctic Tern	*Sterna paradisaea*	S3B, S3M			
Great Horned Owl	*Bubo virginianus*				
Snowy Owl	*Bubo scandiacus*		Not at Risk		
Northern Hawk Owl	*Surnia ulula*	S3B, S5N	Not at Risk		
Short-eared Owl	*Asio flammeus*	S3B, S2N, S3M	Special Concern	Special Concern	
Long-eared Owl	*Asio otus*				
Barred Owl	*Strix varia*	S3			
Great Gray Owl	*Strix nebulosa*	S3	Not at Risk		
Northern Saw-whet	*Aegolius acadicus*				
Boreal Owl	*Aegolius funereus*	S3	Not at Risk		
Common Nighthawk	*Chordeiles minor*	S4B, S4M	Special Concern	Threatened	Bats, Incidental

Appendix 1 cont.

Common Name	Scientific Name	At Risk Designation			Detected/Program[2]
		SKCDC[1]	COSEWIC	SARA	
Ruby-throated Hummingbird	*Archilochus colubris*				
Belted Kingfisher	*Megaceryle alcyon*				Songbird, Incidental
Yellow-bellied Sapsucker	*Sphyrapicus varius*				
Downy Woodpecker	*Picoides pubescens*				
Hairy Woodpecker	*Picoides villosus*				Covert Camera
Three-toed Woodpecker	*Picoides tridactylus*				
Black-backed Woodpecker	*Picoides arcticus*				
Northern Flicker	*Colaptes auratus*				
Pileated Woodpecker	*Dryocopus pileatus*	S3			
Olive-sided Flycatcher	*Contopus cooperi*	S4B, S4M	Special Concern	Threatened	Songbird, Incidental
Western Wood-Pewee	*Contopus sordidulus*				
Yellow-bellied Flycatcher	*Empidonax*				Songbird, Incidental
Alder Flycatcher	*Empidonax alnorum*				Songbird
Least Flycatcher	*Empidonax minimus*				
Eastern Phoebe	*Sayornis phoebe*				
Eastern Kingbird	*Tyrannus tyrannus*				
Northern Shrike	*Lanius excubitor*	S1B, S4N, S4M			
Blue-headed Vireo	*Vireo solitarius*				Songbird
Warbling Vireo	*Vireo gilvus*				
Philadelphia Vireo	*Vireo philadelphicus*				
Red-eyed Vireo	*Vireo olivaceus*				
Blue Jay	*Cynocitta cristata*				
Gray Jay	*Perisoreus canadensis*				Small Mammal Trapping, Songbird, Covert Camera, Incidental
American Crow	*Corvus*				
Common Raven	*Corvus corax*				Songbird, Aerial Waterfowl, Incidental
Black-billed Magpie	*Pica hudsonia*				
Horned Lark	*Eremophila alpestris*				
Tree Swallow	*Tachycineta bicolor*				Songbird
Bank Swallow	*Riparia riparia*	S4B, S5M	Threatened		
Cliff Swallow	*Petrochelidon*				

Appendix 1 cont.

Common Name	Scientific Name	At Risk Designation			Detected/Program[2]
		SKCDC[1]	COSEWIC	SARA	
Barn Swallow	*Hirundo rustica*	S5B, S5M	Threatened		Songbird
Purple Martin	*Progne subis*				
Black-capped Chickadee	*Poecile atricapillus*				
Boreal Chickadee	*Poecile hudsonicus*				Songbird, Incidental
Red-breasted Nuthatch	*Sitta canadensis*				
White-breasted Nuthatch	*Sitta carolinensis*				
Brown Creeper	*Certhia americana*				
Winter Wren	*Troglodytes troglodytes*				Songbird
Sedge Wren	*Cistothorus platensis*		Not at Risk		
House Wren	*Troglodytes aedon*				
Ruby-crowned Kinglet	*Regulus calendula*				Songbird, Incidental
Golden-crowned Kinglet	*Regulus satrapa*				
Mountain Bluebird	*Sialia currocoides*				
Veery	*Catharus fuscescens*				
Gray-cheeked Thrush	*Catharus minimus*				
Swainson's Thrush	*Catharus ustulatus*				Songbird, Incidental
Hermit Thrush	*Catharus guttatus*				Songbird, Bats, Incidental
American Robin	*Turdus migratorius*				Songbird, Incidental
Gray Catbird	*Dumetella carolinensis*				
European Starling	*Sturnus vulgaris*				
American Pipit	*Anthus rubescens*				
Bohemian Waxwing	*Bombycilla garrulus*				
Cedar Waxwing	*Bombycilla garrulus*				Songbird
Tennessee Warbler	*Oreothlypis peregrina*				Songbird
Orange-crowned Warbler	*Oreothlypis celata*				
Yellow Warbler	*Setophaga petechia*				
Magnolia Warbler	*Setophaga magnolia*				
Chestnut-sided Warbler	*Setophaga pensylvanica*				
Black-and-white Warbler	*Mniotilta varia*				
Black-throated Green Warbler	*Setophaga virens*				

Appendix 1 cont.

Common Name	Scientific Name	At Risk Designation			Detected/Program[2]
		SKCDC[1]	COSEWIC	SARA	
Canada Warbler	*Cardellina canadensis*	S4B, S3M	Threatened	Threatened	
Cape May Warbler	*Setophaga tigrina*				
Yellow-rumped Warbler	*Setophaga coronata*				Songbird, Incidental
Palm Warbler	*Setophaga palmarum*				Songbird
Bay-breasted Warbler	*Setophaga castanea*				
Blackpoll Warbler	*Setophaga striata*				
Connecticut Warbler	*Oporornis agilis*	S2B, S2M			
Mourning Warbler	*Geothlypis philadelphia*				
Nashville Warbler	*Oreothlypis ruficapilla*				
Ovenbird	*Seiurus aurocapillus*				
Northern Waterthrush	*Parkesia noveboracensis*				
Common Yellowthroat	*Geothlypis trichas*				
Wilson's Warbler	*Cardellina pusilla*				Songbird
American Redstart	*Setophaga ruticilla*				
Western Tanager	*Piranga ludoviciana*				
American Tree Sparrow	*Spizella arborea*				
Chipping Sparrow	*Spizella passerina*				Songbird, Incidental
Clay-colored Sparrow	*Spizella pallida*				
Vesper Sparrow	*Pooecetes gramineus*				
Savannah Sparrow	*Passerculus sandwichensis*				Incidental
Le Conte's Sparrow	*Ammodramus leconteii*				
Fox Sparrow	*Passerella iliaca*				Songbird, Incidental
Song Sparrow	*Melospiza melodia*				
Lincoln's Sparrow	*Melospiza lincolnii*				Songbird, Incidental
Swamp Sparrow	*Melospiza georgiana*				Songbird
White-throated Sparrow	*Zonotrichia albicollis*				Songbird, Incidental
Harris' Sparrow	*Zonotrichia querula*	SUB, S5M	Special Concern		
White-crowned Sparrow	*Zonotrichia leucophrys*				
Dark-eyed Junco	*Junco hyemalis*				Songbird, Incidental
Lapland Longspur	*Calcarius lapponicus*				

Appendix 1 cont.

Common Name	Scientific Name	At Risk Designation			Detected/Program[2]
		SKCDC[1]	COSEWIC	SARA	
Smith's Longspur	*Calcarius pictus*				
Snow Bunting	*Plectrophenax nivalis*				
Red-winged Blackbird	*Agelaius phoeniceus*				
Yellow-headed Blackbird	*Xanthocephalus xanthocephalus*				
Rusty Blackbird	*Euphagus carolinus*	S3B,SUN,S3M	Special Concern	Special Concern	
Common Grackle	*Quiscalus quiscula*				
Brewer's Blackbird	*Euphagus cyanocephalus*				
Brown-headed Cowbird	*Molothrus ater*				
Pine Grosbeak	*Pinicola enucleator*	S2B, S4N			
Rose-breasted Grosbeak	*Pheucticus ludovicianus*				
Purple Finch	*Haemorhous purpureus*				
Red Crossbill	*Loxia curvirostra*				Incidental
White-winged Crossbill	*Loxia leucoptera*				
Common Redpoll	*Acanthis flammea*				
Hoary Redpoll	*Acanthis hornemanni*				
Pine Siskin	*Spinus pinus*				Incidental
House Sparrow	*Passer domesticus*				
Mammals					
Masked Shrew	*Sorex cinereus*				
Dusky Shrew	*Sorex monticolus*				Small Mammal Trapping
Common Water Shrew	*Sorex palustris*				
Arctic Shrew	*Sorex arcticus*				
Pygmy Shrew	*Sorex hoyi*				
Little Brown Bat	*Myotis lucifugus*	S4B, S4N	Endangered	Endangered	Bats
Northern Myotis	*Myotis septentrionalis*	S3	Endangered	Endangered	Bats
Silver-haired Bat	*Lasionycteris noctivagans*				
Big Brown Bat	*Eptesicus fuscus*				
Eastern Red Bat	*Lasiuris borealis*				
Hoary Bat	*Lasiuris cinereus*				

Appendix 1 cont.

Common Name	Scientific Name	At Risk Designation			Detected/Program[2]
		SKCDC[1]	COSEWIC	SARA	
Snowshoe Hare	*Lepus americanus*				Winter Tracking, Covert Camera
Least Chipmunk	*Tamias minimus*				
Woodchuck	*Marmota monax*				
Red Squirrel	*Tamiasciurus hudsonicus*				Winter Tracking, Covert Camera Incidental
Northern Flying Squirrel	*Glaucomys sabrinus*				
North American Beaver	*Castor canadensis*				Incidental
Deer Mouse	*Peromyscus maniculatus*				
Southern Red-backed Vole	*Myodes gapperi*				Small Mammal Trapping
Western Heather Vole	*Phenacomys intermedias*				
Meadow Vole	*Microtus pennsylvanicus*				Small Mammal Trapping
Yellow-cheecked Vole	*Microtus xanthognathus*				
Muskrat	*Ondatra zibethicus*				Bats, Incidental
Northern Bog Lemming	*Synaptomys borealis*				
Meadow Jumping Mouse	*Zapus hudsonius*				
North American Porcupine	*Erethizon dorsatum*				Bats, Covert Camera, Incidental
Coyote	*Canis latrans*				
Grey Wolf	*Canis lupus occidentalis*		Not at Risk		Covert Camera
Red Fox	*Vulpes vulpes*				Winter Tracking, Covert Camera
Black Bear	*Ursus americanus*		Not at Risk		Covert Camera, Incidental
American Marten	*Martes americana*				Winter Tracking, Covert Camera, Pellet
Fisher	*Pekania pennanti*				Winter Tracking
Short-tailed Weasel	*Mustela erminea*				Winter Tracking
Least Weasel	*Mustela nivalis*				
American Mink	*Neovison vison*				Winter Tracking, Pellet
Wolverine	*Gulo gulo*	S2	Special Concern	Special Concern	
Striped Skunk	*Mephitis mephitis*				
River Otter	*Lontra canadensis*	S3			Winter Tracking, Incidental
Canada Lynx	*Lynx canadensis*		Not at Risk		Winter Tracking, Covert Camera
Moose	*Alces americanus*				Winter Tracking, Covert Camera, Incidental

Appendix 1 cont.

Common Name	Scientific Name	At Risk Designation			Detected/Program[2]
		SKCDC[1]	COSEWIC	SARA	
Woodland Caribou	*Rangifer tarandus caribou*	S3	Threatened	Threatened	Winter Tracking, Pellet, Covert Camera, Incidental
Amphibians					
Canadian Toad	*Anaxyrus hemiophrys*		Not at Risk		
Boreal Chorus Frog	*Pseudacris triseriata*		Not at Risk		Incidental
Wood Frog	*Lithobates sylvaticus*				Amphibian, Bats, Incidental
Northern Leopard Frog	*Lithobates pipiens*	S3	Special Concern	Special Concern	
Red-sided Garter Snake	*Thamnophis sirtalis*				

1 SKCDC rankings presents for species ranked S3 or lower (breeding population for avian species)
2 Species detections included visual/auditory observations, scat/pellet groups, winter tracking trails and general sign

SKCDC Ranking:
B: for a migratory species, applies to the breeding population in the province
N: for a migratory species, applies to the non-breeding population in the province
M: for a migratory species, rank applies to the transient (migrant) population
U: status is uncertain in Saskatchewan because of limited or conflicting information (unrankable)
X: believed to be extinct or extirpated from the province
NR: rank is not yet assigned or species has not yet been assessed (not ranked)
1: Critically Imperiled/ Extremely rare
2: Imperiled/Very rare
3: Vulnerable/Rare to uncommon
4: Apparently Secure
5: Secure/Common
Saskatchewan Conservation Data Centre (SK CDC) go to:
http://www.biodiversity.sk.ca
Committee on the Status of Endangered Wildlife in Canada (COSEWIC) and its recommendations for listing, go to:
http://www.cosewic.gc.ca
Species at Risk Act (SARA) and its registry of protected species go to: http://www.sararegistry.gc.ca

Appendix 2. Species Observations during Plant Structural Diversity, Species Richness Assessment and Ecosite Characterization Survey.

Scientific Name	Common name	SKCDC Rank
Trees		
Abies balsamea	Balsam fir	
Picea mariana	Black spruce	
Pinus banksiana	Jackpine	
Shrubs		
Alnus viridis ssp. crispa	Green alder	
Alnus incana ssp. rugosa	Speckled alder	
Amelanchier alnifolia	Saskatoon	
Andromeda polifolia	Bog rosemary	
Arctostaphylos uva-ursi	Common bearberry	
Betula glandulosa	Dwarf Birch	
Betula occidentalis	River Birch	
Betula papyrifera	Paper birch	
Betula pumila	Swamp Birch	
Chamaedaphne calycaluta	Leatherleaf	
Empetrum nigrum	Crowberry	
Gaultheria hispidula	Creeping-Snowberry	
Kalmia polifolia	Pale Laurel	
Larix laricina	Tamarack	
Rhododendron groenlandicum	Common Labrador tea	
Rhododendron tomentosum	Labrador tea	S3
Linnea borealis	Twinflower	
Myrica gale	Sweet gale	
Vaccinium oxycoccos	Small cranberry	
Ribes glandulosum	Skunk currant	
Ribes lacustre	Bristly black currant	
Ribes triste	Swamp red currant	
Rubus idaeus	Raspberry	
Rubus arcticus ssp. acaulis	Nagoon Berry	
Salix bebbiana	Long-beaked Willow	
Salix discolor	Pussy willow	
Salix famelica	Yellow willow	
Salix maccalliana	Velvet-fruited Willow	
Salix myrtillifolia	Myrtle-leaf Willow	
Salix pedicellaris	Bog willow	
Salix planifolia	Diamondleaf willow	
Salix sp.	Unknown willow	

Appendix 2 cont.

Scientific Name	Common name	SKCDC Rank
Shrubs cont'd		
Salix glauca var. villosa	Gray-leaf Willow	S2
Salix serissima	Autumn willow	
Salix silicicola	Blanket-leaf Willow	S2
Salix pentandra	Bay Willow	
Vaccinium myrtilloides	Blueberry	
Vaccinium uliginosum	Bog Whortleberry	
Vaccinium vitis-idaea ssp. minus	Mountain Cranberry	
Graminoids		
Agrostis scabra	Hair Grass	
Calamagrostis canadensis	Blue-joint Reedgrass	
Calamagrostis stricta	Northern reedgrass	
Carex aquatilis	Water sedge	
Carex brunnescens	Short sedge	
Carex canescens	Hoary sedge	
Carex capitata	Capitate sedge	S3
Carex disperma	Two-seeded sedge	
Carex lasiocarpa var. americana	Slender sedge	
Carex limosa	Mud sedge	
Carex oligosperma	Fewseed sedge	
Carex pauciflora	Fewflower sedge	
Carex sp.	Sedge	
Carex tenuiflora	Thin-flowered Sedge	
Carex utriculata	Northwest territory sedge	
Carex magellanica ssp. irrigua	Boreal bog sedge	
Carex lenticularis	Lens-fruited Sedge	
Carex brevior	Fescue Sedge	
Carex interior	Inland Sedge	
Carex livida	Livid sedge	
Eleocharis palustris	Creeping Spike-rush	
Eleocharis nitida	Neat Spike-rush	S3
Eleocharis quinqueflora	Few-flowered Spikerush	
Eriophorum vaginatum var. spissum	Sheathed cottongrass	
Festuca rubra	Red fescue	
Juncus balticus	Baltic rush	
Juncus filiformis	Thread rush	
Juncus alpinoarticulatus	Northern Green Rush	
Juncus bufonius	Toad rush	
Juncus brevicaudatus	Short-tail Rush	
Juncus dudleyi	Dudley's Rush	

Appendix 2 cont.

Scientific Name	Common name	SKCDC Rank
Graminoids cont'd		
Potamogenton sp.	-	
Puccinellia nuttalliana	Nuttall's Salt-meadow Grass	
Trichophorum cespitosum	Tufted Bulrush	
Forbs		
Aralia nudicaulis	Wild sarsaparilla	
Calla palustris	Water Calla	
Callitriche palustris	Vernal Water-starwort	
Caltha palustris	Yellow Marsh-marigold	
Chenopodium album	Lamb's-Quarters	
Cicuta bulbifera	water hemlock	
Coptis trifolia	Threeleaf goldthread	
Cornus canadensis	Bunchberry	
Drosera anglica	English Sundew	S3
Drosera rotundifolia	Round-leaved sundew	
Dryopteris carthusiana	Spinulose woodfern	
Chamerion angustifolium ssp. angustifolium	Fireweed	
Epilobium palustre	Marsh willowherb	
Equisetum arvense	Common horsetail	
Equisetum fluviatile	Swamp Horsetail	
Equisetum sylvaticum	Woodland horsetail	
Equisetum pratense	Meadow Horsetail	
Galium trifidum	Small Bedstraw	
Platanthera obtusata	Small Northern Bog-orchid	
Lycopodium annotinum	Stiff clubmoss	
Lycopus americanus	Water-horehound	
Lysimachia thyrsiflora	Thufted loosestrife	
Mentha arvensis	Wild mint	
Menyanthes trifoliata	Bog Buckbean	
Mitella nuda	Bishop's-cap	
Polygonum achoreum	Striate Knotweed	
Potentilla norvegica	Rough cinquefoil	
Comarum palustris	Swamp cinquefoil	
Pyro sp.	Unknown Pyrola	
Ranunculus lapponicus	Lapland buttercup	
Ranunculus pensylvanicus	Bristly Buttercup	
Rubus chamaemorus	Cloudberry	
Rubus pubescens	Dewberry	
Rumex britannica	Water dock	
Saxifraga tricuspidata	Three-toothed saxifrage	

Appendix 2 cont.

Scientific Name	Common name	SKCDC Rank
Forbs cont'd		
Scheuchzeria palustris	Scheuchzeria	
Sium suave	Water parsnip	
Smilacina trifolia	Three-leaved Salomon's seal	
Symphyotrichum puniceum	Swamp Aster	
Trientalis borealis	Maystar	
Utricularia intermedia	Flatleaf bladderwort	
Viola adunca	Early Blue Violet	
Viola palustris	Marsh violet	
Viola renifolia	Kidney-leaved white violet	
Mosses		
Aulacomnium palustre	Ribbed Bog Moss	
Bryum pseudotriquetrum	Tall Clustered Thread Moss	
Calliergon giganteum	Giant Water Feather Moss	
Calliergon stramineum	Calliergon moss	
Dicranum bonjeanii	Bonjean's Broom Moss	
Dicranum polysetum	Electric Eels	
Dicranum scoparium	Broom fork moss	
Dicranum undulatum	Wavy Dicranum	
Drepanocladus aduncus	Drepanocladus moss	
Drepanocladus unciatus	Brown moss	
Hylocomium splendens	Stair-step moss	
Hypnum cupressiforme	Cypress Pigtail Moss	
Jungermannia exsertifolia	-	
Lophozia sp.	-	
Marsupella emarginata	Notched Rustwort	
Leiomylia anomala	Anomalous flapwort	S3
Pohlia nutans	Copper Wire Moss	
Plagiomnium ellipticum	Marsh Magnificent Moss	
Pleurozium schreberi	Big Red Stem Feathermoss	
Polytrichum commune	Common hair-cap	
Polytrichum juniperinum	Juniper hair-cap	
Polytrichum piliferum	Awned Hair-cap	
Polytrichum strictum	Bog Hair Cap	
Ptilidium ciliare	Ciliate Fringewort	
Ptilidium pulcherrimum	Tree Fringewort	S3
Ptilium crista castrensis	Knight's plume moss	
Rhizomnium pseudopunctatum	Felt Round Moss	
Sphagnum angustifolium	Poor Fen Peat Moss	
Sphagnum capillifolium	Acute-leaved Peat Moss	

Appendix 2 cont.

Scientific Name	Common name	SKCDC Rank
Mosses cont'd		
Sphagnum fuscum	Rusty Peat Moss	
Sphagnum girgensohnii	Girgensohn's Peat Moss	
Sphagnum magellanicum	Midway Peat Moss	
Sphagnum riparium	Shore-growing Peat Moss	
Sphagnum squarrosum	Squarrose Peat Moss	
Sphagnum majus	Greater peat moss	
Straminergon stramineum	Straw-coloured Water Moss	
Tomenthypnum nitens	Golden moss	
Warnstorfia fluitans	Floating Hook Moss	
Lichens		
Cetraria islandica	True Iceland lichen	S3
Cladina mitis	Green reindeer lichen	
Cladina rangiferina	Gray reindeer lichen	
Cladina stellaris	Star-tipped reindeer lichen	
Cladonia borealis	Boreal pixie-cup	S3
Cladonia botrytes	Wooden soldiers	
Cladonia cariosa	Split-peg lichen	
Cladonia cenotea	Powdered funnel lichen	S3
Cladonia chlorophaea	Mealy pixie-cup	
Cladonia coniocraea	Common powderhorn	
Cladonia cornuta	Bighorn cladonia	
Cladonia crispata	Organ-pipe lichen	S3
Cladonia cristatella	British soldiers	S3
Cladonia deformis	Lesser sulphur-cup	
Cladonia fimbriata	Trumpet lichen	
Cladonia gracilis spp. Turbinata	Smooth cladonia	
Cladonia multiformis	Sieve lichen	
Cladonia phyllophora	Felt cladonia	
Cladonia pleurota	Red-fruited pixie-cup	S2
Cladonia pyxidata	Pebbled pixie-cup	
Cladonia sp.	Cladonia lichen	
Cladonia sulphurina	Greater sulphur-cup	S2
Cladonia uncialis	Thorn cladonia	
Cladonia verruculosa	Western wand lichen	
Cladonia scabriuscula	Mealy forked cladonia	S1
Cetraria nivalis	Crinkled snow lichen	S3
Hypogymnia physodes	Monk's-hood lichen	
Icmadophila ericetorum	Candy lichen	

Appendix 2 cont.

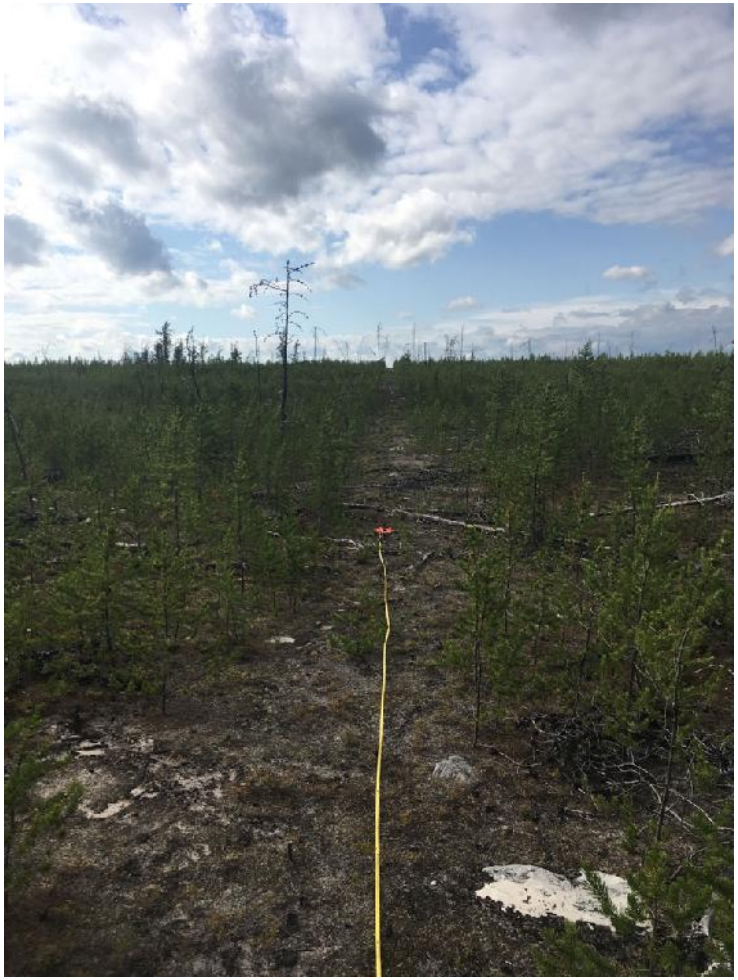
Scientific Name	Common name	SKCDC Rank
Lichens cont'd		
Parmeliopsis ambigua	Green starburst lichen	S3
Parmeliopsis hyperopta	Gray starburst lichen	S3
Peltigera aphthosa	Common freckle pelt	S2
Peltigera neopolydactyla	Carpet pelt	
Ramalina pollinaria	Chalky ramalina	S2
Stereocaulon tomentosum	Wolly foam lichen	
Vulpicida pinastri	Powdered sunshine lichen	
Xanthoria fallax	Hooded sunburst lichen	S3

Appendix 3. Transect Details for the Linear Feature Natural Regeneration Assessment.

Transect #	Easting	Northing	Feature Type	Ecosite	Landcover Type	Age Group	Age (years since fire)	Line cut pre or post fire?	Human Use Class
1	476813	6371313	Road	BS3	Upland	Old	71-80	N/A	5
2	474575	6371809	Trail	BS17	Bog	Old	91-100	N/A	1
3	474352	6371768	Handcut	BS18	Bog	Old	71-80	N/A	0
4	477351	6371131	Handcut	RF2	Upland	Young	11-20	Post-fire	0
5	478751	6371016	Road	RF2	Upland	Young	21-30	N/A	5
6	481040	6370932	Handcut	BS17	Bog	Old	91-100	N/A	0
7	480369	6369926	Trail	BS3	Upland	Old	101-110	N/A	3
8	479322	6368607	Trail	BS18	Bog	Young	31-40	N/A	1
9	480949	6373577	Trail	BS3	Upland	Old	61-70	N/A	2
10	482855	6374386	Handcut	BS9	Upland	Old	61-70	N/A	0
11	482103	6375061	Trail	RF1	Upland	Young	31-40	N/A	3
12	479532	6377411	Handcut	RF3	Upland	Young	1-10	Pre-fire	0
13	480400	6378296	Road	BS3	Upland	Old	81-90	N/A	4
14	480794	6379189	Trail	RF2	Upland	Young	1-10	Post-fire	1
15	480251	6378384	Handcut	RF2	Upland	Young	11-20	Post-fire	0
16	475133	6374874	Road	BS17	Bog	Young	31-40	N/A	5
17	473581	6374509	Handcut	RF2	Upland	Young	21-30	Post-fire	0
18	472435	6374145	Trail	RF1	Upland	Young	31-40	N/A	1
19	472233	6373055	Handcut	RF1	Upland	Young	21-30	Post-fire	0
20	471974	6372137	Trail	BS18	Bog	Young	31-40	N/A	1
21	468131	6378012	Trail	RF1	Upland	Young	31-40	N/A	0
22	466904	6377467	Trail	RF3	Upland	Young	1-10	Pre-fire	0
23	471009	6378277	Handcut	BS17	Bog	Old	45-50	N/A	0
24	472575	6378990	Trail	RF1	Upland	Young	31-40	N/A	2
25	474521	6378364	Trail	BS7	Upland	Old	101-110	N/A	4
26	474836	6378215	Handcut	BS3	Upland	Old	51-60	N/A	0
27	476629	6375201	Road	BS9	Upland	Old	71-80	N/A	5
28	477269	6375835	Handcut	RF2	Upland	Young	31-40	N/A	0
29	477820	6375891	Trail	BS3	Upland	Old	51-60	N/A	5
30	477781	6396059	Handcut	BS25	Bog	N/A	N/A	N/A	0
31	478019	6381001	Trail	BS3	Upland	Old	51-60	N/A	5
32	477902	6380689	Handcut	RF2	Upland	Young	1-10	Pre-fire	0
33	475695	6377977	Handcut	BS3	Upland	Old	61-70	N/A	0
34	475645	6376661	Handcut	BS17	Bog	Old	81-90	N/A	0
35	475568	6375893	Handcut	RF2	Upland	Young	31-40	N/A	0
36	474731	6373546	Handcut	BS3	Upland	Old	51-60	N/A	0
37	474454	6372864	Trail	BS17	Bog	Old	51-60	N/A	1
38	471861	6371833	Handcut	BS18	Bog	N/A	N/A	N/A	0
39	473285	6371756	Road	BS9	Upland	Old	61-70	N/A	5
40	473727	6372285	Trail	BS18	Bog	Young	31-40	N/A	2
41	475298	6371828	Handcut	BS3	Upland	Old	61-70	N/A	0
42	477114	6369678	Handcut	BS3	Upland	Old	81-90	N/A	0
43	484881	6373173	Trail	BS3	Upland	Old	51-60	N/A	1
44	481781	6370035	Trail	BS3	Upland	Old	61-70	N/A	2
45	478174	6370968	Handcut	BS3	Upland	Old	71-80	N/A	1
46	475261	6372261	Road	BS3	Upland	Old	61-70	N/A	5

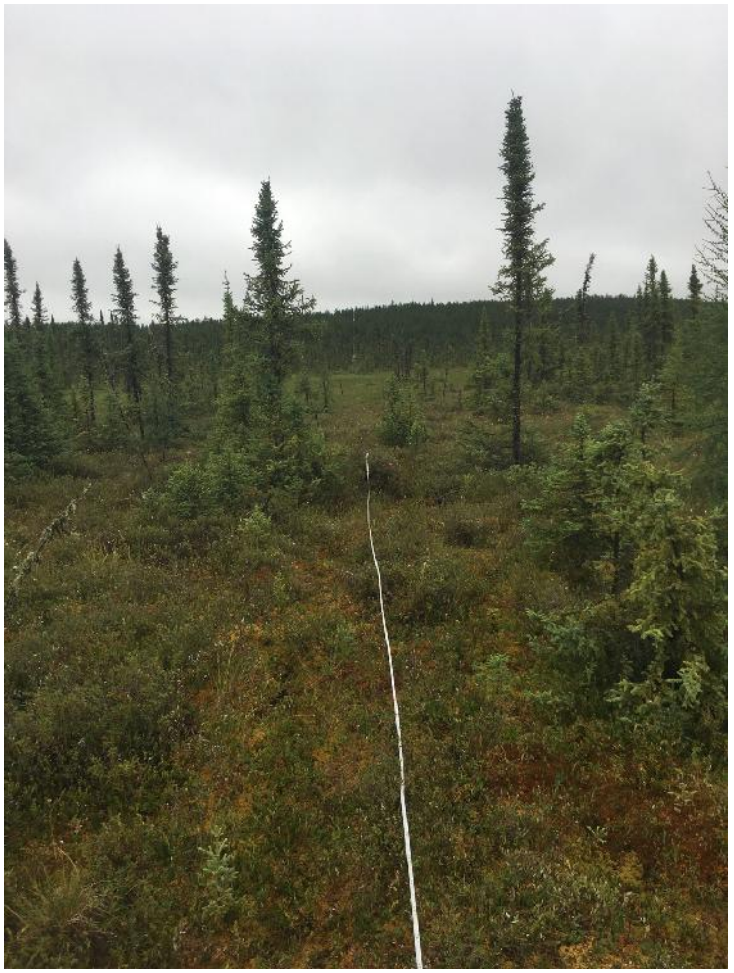
Appendix 4. Example photos from the Linear Feature Natural Regeneration Assessment.

Photograph 2.3-1 Area burned after line creation.



Photograph 2.3-2 Area burned before line creation.

Photograph 2.3-3 Mature upland.



Photograph 2.3-4 Lowland (bog).

Photograph 2.3-5 No human use (0)

Photograph 2.3-6 Low human use (1)

Photograph 2.3-7 Low/Moderate human use (2)

Photograph 2.3-8 Moderate human use (3)

Photograph 2.3-9 Moderate/High human use (4)

Photograph 2.3-10 High human use (5)

Appendix 5. Species Observations during Rare Vascular Plant Survey, July 9 – July 12 2017.

Scientific Name	Common Name	SKCDC
Trees		
Picea mariana	black spruce	
Pinus banksiana	jack pine	
Shrubs		
Alnus viridis ssp. crispa	green Alder	
Arctostaphylos uvi ursi	bearberry	
Betula glandulosa	bog birch	
Chamaedaphne calyculata	leatherleaf	
Myrica gale	sweet gale	
Kalmia polifolia	pale laurel	
Linnaea borealis ssp. americana	twinflower	
Rhododendron groenlandicum	common Labrador Tea	
Salix bebbiana	Bebb's willow	
Salix petiolaris	basket willow	
Vaccinium myrtilloides	blueberry	
Vaccinium oxycoccos	small cranberry	
Vaccinium vitis-idaea	lingonberry	
Grasses		
Agrostis scabra	rough hair grass	
Calamagrostis canadensis	bluejoint	
Deschampsia caespitosa	tufted hair grass	
Sedges, and rushes		
Carex aquatilis	water sedge	
Carex brunnescens ssp. sphaerostachya	brownish sedge	
Carex disperma	two-seeded sedge	
Carex limosa	mud sedge	
Carex oligosperma	few-seeded sedge	
Carex trisperma	**three-fruited sedge**	**S3**
Juncus balticus	baltic rush	
Forbs		
Galium triflorum	sweet-scented bedstraw	
Andromeda polifolia var. polifolia	Bog-rosemary	
Comarum palustre	marsh Cinquefoil	
Coptis trifolia	Goldthread	
Cornus canadensis	bunchberry	
Drosera roundifolia	round-leaved sundew	

Appendix 5 cont.

Scientific Name	Common Name	SKCDC
Forbs		
Equisetum arvense	common horsetail	
Equisetum scirpoides	dwarf scouring rush	
Equisetum sylvaticum	woodland horsetail	
Eriophorum brachyantherum var. brachyantherum	close-sheathed cotton-grass	
Lycopodium annotinum	stiff club-moss	
Maianthemum canadense	two-leaved Solomon's-seal	
Melampyrum lineare var. lineare	American cow-wheat	
Menyanthes trifoliata	bog buckbean	
Rubus chamaemorus	Cloudberry	
Scheuchzeria palustris	American scheuchzeria	
Viola nephrophylla	northern bog violet	
Viola palustris	marsh violet	
Mosses and lichens		
Cladina mitis	green reindeer lichen	
Cladina rangiferina	gray reindeer lichen	
Cladina stellaris	star-tipped reindeer lichen	
Peltigera neopolydactyla	carpet pelt	
Plerozium schreberi	big red stem feathermoss	
Polytrichum juniperinum	juniper hair-cap moss	
Ptilium crista-castrensis	knight's plume	
Sphagnum sp.	peat moss	

Appendix 6. Species Observations during Rare Vascular Plant Survey, July 28 – August 4 2017.

Scientific Name	Common Name	SKCDC Rank
Trees		
Picea mariana	black spruce	
Pinus banksiana	jack pine	
Shrubs		
Alnus viridis ssp. crispa	green Alder	
Arctostaphylos uvi ursi	bearberry	
Betula glandulosa	bog birch	
Chamaedaphne calyculata	leatherleaf	
Myrica gale	sweet gale	
Kalmia polifolia	pale laurel	
Linnaea borealis ssp. americana	twinflower	
Rhododendron groenlandicum	common Labrador Tea	
Salix bebbiana	Bebb's willow	
Salix petiolaris	basket willow	
Salix pyrifolia	balsam willow	
Salix scouleriana	Scouler's willow	
Vaccinium myrtilloides	blueberry	
Vaccinium oxycoccos	small cranberry	
Vaccinium vitis-idaea ssp. minus	mountain Cranberry	
Grasses		
Agrostis scabra	rough hair grass	
Calamagrostis canadensis	bluejoint	
Deschampsia caespitosa	tufted hair grass	
Glyceria grandis	American manna grass	
Sedges, and rushes		
Carex aquatilis	water sedge	
Carex backii	Back's sedge	
Carex brunnescens ssp. sphaerostachya	brownish sedge	
Carex canescens ssp. canescens	hoary sedge	
Carex disperma	two-seeded sedge	
Carex limosa	mud sedge	
Carex oligosperma	few-seeded sedge	
Carex trisperma	**three-fruited sedge**	**S3**
Carex utriculata	small bottle sedge	
Juncus balticus	baltic rush	
Juncus filiformis	thread rush	

Appendix 6 cont.

Scientific Name	Common Name	SKCDC Rank
Forbs		
Galium triflorum	sweet-scented bedstraw	
Andromeda polifolia var. polifolia	Bog-rosemary	
Apocynum androsaemifolium	spreading dogbane	
Campanula rotundifolia	harebell	
Chamerion angustifolium ssp. angustifolium	narrow-leaf Fireweed	
Cicuta maculata	water hemlock	
Comarum palustre	marsh Cinquefoil	
Coptis trifolia	Goldthread	
Cornus canadensis	bunchberry	
Diphasiastrum sitchense	**Alaskan clubmoss**	**S2**
Drosera roundifolia	round-leaved sundew	
Dryopteris carthusiana	spinulose wood-fern	
Equisetum arvense	common horsetail	
Equisetum fluviatile	swamp horsetail	
Equisetum scirpoides	dwarf scouring rush	
Equisetum sylvaticum	woodland horsetail	
Eriophorum brachyantherum var. brachyantherum	close-sheathed cotton-grass	
Eriophorum chamissonis	russet cotton-grass	
Lycopodium annotinum	stiff club-moss	
Lycopodium dendroideum	ground-pine	
Maianthemum canadense	two-leaved Solomon's-seal	
Melampyrum lineare var. lineare	American cow-wheat	
Menyanthes trifoliata	bog buckbean	
Nuphar variegata	yellow cowlily	
Rubus chamaemorus	Cloudberry	
Scheuchzeria palustris	American scheuchzeria	
Sibbaldiopsis tridentata	three-toothed Cinquefoil	
Stuckenia pectinata	Sago Pondweed	
Viola nephrophylla	northern bog violet	
Viola palustris	marsh violet	

Appendix 6 cont.

Scientific Name	Common Name	SKCDC Rank
Mosses and lichens		
Cladina mitis	green reindeer lichen	
Cladina rangiferina	gray reindeer lichen	
Cladina stellaris	star-tipped reindeer lichen	
Peltigera neopolydactyla	carpet pelt	
Plerozium schreberi	big red stem feathermoss	
Polytrichum juniperinum	juniper hair-cap moss	
Ptilium crista-castrensis	knight's plume	
Sphagnum sp.	peat moss	

Appendix 7. Terrestrial and Arboreal Lichen Occurrence by Ecosite Type in the Wheeler River Project Area, 2017/2018.

Ecosite Type	Total Sampling Area (ha)	n	Arboreal Lichen							Terrestrial Lichen		
			% Frequency Occurrence	Frequency by Cover Class					Mean Cover Class	% Frequency Occurrence	Mean % Cover	Importance Value
				1	2	3	4	5				
BS03	9.53	935	96.68	41.04	57.08	1.88	0.00	0.00	1.61	99.36	65.22	6480.26
BS04	0.33	34	88.24	53.33	46.67	0.00	0.00	0.00	1.48	100.00	16.91	1691.00
BS07	0.45	44	97.73	55.81	41.86	2.33	0.00	0.00	1.48	100.00	61.95	6195.00
BS09	0.37	37	89.19	57.58	42.42	0.00	0.00	0.00	1.44	100.00	27.32	2732.00
BS16	0.13	10	100.00	10.00	10.00	50.00	30.00	0.00	3.00	20.00	0.17	3.40
BS17	1.20	115	85.22	60.20	37.76	1.02	1.02	0.00	1.43	95.65	34.83	3331.49
BS18	0.64	63	37.50	70.83	12.50	16.67	0.00	0.00	1.46	89.06	24.92	2219.38
BS19	0.02	2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	50.00	0.50	25.00
BS21	0.07	7	100.00	85.71	14.29	0.00	0.00	0.00	1.14	71.43	5.71	407.87
BS22	0.17	15	46.67	14.29	42.86	42.86	0.00	0.00	2.29	53.33	4.38	233.59
BS23	0.01	1	100.00	0.00	0.00	0.00	100.00	0.00	4.00	0.00	0.00	0.00
BS24	0.07	7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	85.71	4.50	385.70
BS25	0.04	3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	33.33	2.00	66.66
BS26	0.09	8	25.00	100.00	0.00	0.00	0.00	0.00	1.00	62.50	4.50	281.25
BS27	0.09	7	28.57	100.00	0.00	0.00	0.00	0.00	1.00	71.43	8.14	581.44
RF03	1.32	131	8.40	90.91	9.09	0.00	0.00	0.00	1.09	74.05	2.51	185.64
RF02	10.44	1042	20.92	95.87	4.13	0.00	0.00	0.00	1.04	98.46	56.74	5586.62
RF01	6.53	646	53.41	93.33	6.09	0.58	0.00	0.00	1.07	98.76	47.26	4667.47
Anthropogenic	0.06	32	21.88	100	0.00	0.00	0.00	0.00	1.00	43.75	8.10	354.38
Recent Burn	0.33	5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	**31.88**	**3144**	**55.41**	**61.19**	**36.62**	**1.89**	**0.29**	**0.00**	**1.41**	**96.00**	**52.10**	**5001.60**

Appendix 8. Woody Browse Availability and Use Summary by Ecosite in the Denison Wheeler River Project Area, 2017/2018.

Ecosite	n	Jack Pine (*Pinus banksiana*)						Black Spruce (*Picea mariana*)				
		Frequency %	Mean PC[1]	Importance Value	% Browsed [1]	Importance Value		Frequency %	Mean PC[1]	Importance Value	% Browsed [1]	Importance Value
BS03	935	53.80	6.27	337.38	0.00	0.00		32.09	6.49	208.24	0.00	0.00
BS04	34	8.82	42.50	374.85	0.00	0.00		52.94	9.92	525.16	0.00	0.00
BS07	44	20.45	3.94	80.57	0.00	0.00		95.45	8.76	836.14	0.00	0.00
BS09	37	24.32	7.83	190.43	0.00	0.00		97.30	11.92	1159.82	0.00	0.00
BS16	10	20.00	2.50	50.00	0.00	0.00		60.00	8.33	499.80	0.00	0.00
BS17	115	33.91	8.67	294.00	0.00	0.00		88.70	14.67	1301.23	0.00	0.00
BS18	63	48.44	7.23	350.22	0.00	0.00		81.25	12.60	1023.75	0.00	0.00
BS19	2	100.00	2.50	250.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00
BS21	7	14.29	2.50	35.73	0.00	0.00		71.43	5.10	364.29	0.00	0.00
BS22	15	0.00	0.00	0.00	0.00	0.00		53.33	5.69	303.45	0.00	0.00
BS23	1	100.00	2.50	250.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00
BS24	7	42.86	2.50	107.15	0.00	0.00		28.57	2.50	71.43	0.00	0.00
BS25	3	66.67	2.50	166.68	0.00	0.00		100.00	2.50	250.00	0.00	0.00
BS26	8	37.50	2.50	93.75	0.00	0.00		62.50	2.50	156.25	0.00	0.00
BS27	7	14.29	37.50	535.88	0.00	0.00		100.00	6.07	607.00	0.00	0.00
RF03	131	99.24	46.23	4587.87	0.00	0.00		17.56	5.15	90.43	0.00	0.00
RF02	1042	97.89	58.75	5751.04	0.00	0.00		50.29	13.54	680.93	0.00	0.00
RF01	647	91.96	11.15	1025.35	0.00	0.00		70.79	12.88	911.78	0.00	0.00
Anthropogenic	32	65.63	4.33	284.18	0.00	0.00		9.38	2.50	23.45	0.00	0.00
Recent Burn	5	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00
Total	**3145**	**75.12**	**32.29**	**2425.62**	**0.00**	**0.00**		**50.68**	**11.53**	**584.34**	**0.00**	**0.00**

[1] = Calculated using percent cover/browse only where species/browse is present

Appendix 8 cont.

Ecosite	n	Alder Spp. (*Alnus spp.*)						Willow Spp. (*Salix spp.*)				
		Frequency %	Mean PC[1]	Importance Value	% Browsed[1]	Importance Value		Frequency %	Mean PC[1]	Importance Value	% Browsed[1]	Importance Value
BS03	935	8.66	8.65	74.94	0.00	0.00		1.93	2.50	4.83	4.17	8.05
BS04	34	35.29	20.67	729.44	0.00	0.00		8.82	2.50	22.05	0.00	0.00
BS07	44	27.27	10.67	290.97	0.00	0.00		6.82	2.50	17.05	0.00	0.00
BS09	37	35.14	6.46	227.00	0.00	0.00		2.70	15.50	41.85	0.00	0.00
BS16	10	0.00	0.00	0.00	0.00	0.00		80.00	16.06	1284.80	11.31	904.80
BS17	115	0.00	0.00	0.00	0.00	0.00		4.35	10.00	43.50	0.00	0.00
BS18	63	0.00	0.00	0.00	0.00	0.00		7.81	2.50	19.53	0.00	0.00
BS19	2	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00
BS21	7	0.00	0.00	0.00	0.00	0.00		57.14	8.88	507.40	0.00	0.00
BS22	15	0.00	0.00	0.00	0.00	0.00		13.33	9.00	119.97	7.75	103.31
BS23	1	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00
BS24	7	0.00	0.00	0.00	0.00	0.00		14.29	2.50	35.73	0.00	0.00
BS25	3	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00
BS26	8	0.00	0.00	0.00	0.00	0.00		75.00	4.58	343.50	0.00	0.00
BS27	7	14.29	2.50	35.73	0.00	0.00		28.57	2.50	71.43	0.00	0.00
RF03	131	24.43	15.39	375.98	0.47	11.48		9.16	4.58	41.95	0.00	0.00
RF02	1042	17.27	11.99	207.07	0.00	0.00		3.26	3.99	13.01	3.75	12.23
RF01	647	28.90	16.75	484.08	0.00	0.00		3.86	4.40	16.98	0.00	0.00
Anthropogenic	32	6.25	2.50	15.63	0.00	0.00		21.88	2.50	54.70	0.00	0.00
Recent Burn	5	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00
Total	**3145**	**16.53**	**13.37**	**221.01**	**0.03**	**0.50**		**4.32**	**4.95**	**21.38**	**2.27**	**9.81**

[1] = *Calculated using percent cover/browse only where species/browse is present*

Appendix 8 cont.

Ecosite	n	Tamarack (*Larix laricina*)						Trembeling Aspen (*Populus tremuloides*)				
		Frequency %	Mean PC[1]	Importance Value	% Browsed[1]	Importance Value		Frequency %	Mean PC[1]	Importance Value	% Browsed[1]	Importance Value
BS03	935	0.00	0.00	0.00	0.00	0.00		0.21	2.50	0.53	0.00	0.00
BS04	34	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00
BS07	44	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00
BS09	37	0.00	0.00	0.00	0.00	0.00		2.70	2.50	6.75	0.00	0.00
BS16	10	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00
BS17	115	10.43	2.50	26.08	0.00	0.00		0.00	0.00	0.00	0.00	0.00
BS18	63	7.81	2.50	19.53	0.00	0.00		0.00	0.00	0.00	0.00	0.00
BS19	2	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00
BS21	7	71.43	2.50	178.58	0.00	0.00		0.00	0.00	0.00	0.00	0.00
BS22	15	26.67	2.50	66.68	0.00	0.00		0.00	0.00	0.00	0.00	0.00
BS23	1	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00
BS24	7	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00
BS25	3	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00
BS26	8	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00
BS27	7	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00
RF03	131	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00
RF02	1042	0.00	0.00	0.00	0.00	0.00		0.10	2.50	0.25	0.00	0.00
RF01	647	0.00	0.00	0.00	0.00	0.00		0.15	2.50	0.38	0.00	0.00
Anthropogenic	32	0.00	0.00	0.00	0.00	0.00		15.63	2.50	39.08	0.00	0.00
Recent Burn	5	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00
Total	**3145**	**0.83**	**2.50**	**2.08**	**0.00**	**0.00**		**0.32**	**2.50**	**0.80**	**0.00**	**0.00**

[1] = *Calculated using percent cover/browse only where species/browse is present*

Appendix 8 cont.

Ecosite	n	Paper Birch (*Betula papyrifera*)						Birch Spp. (*Betula spp.*)				
		Frequency %	Mean PC[1]	Importance Value	% Browsed[1]	Importance Value		Frequency %	Mean PC[1]	Importance Value	% Browsed[1]	Importance Value
BS03	935	0.00	0.00	0.00	0.00	0.00		0.21	2.50	0.53	0.00	0.00
BS04	34	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00
BS07	44	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00
BS09	37	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00
BS16	10	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00
BS17	115	10.43	7.54	78.64	0.00	0.00		0.00	0.00	0.00	0.00	0.00
BS18	63	0.00	0.00	0.00	0.00	0.00		17.19	9.14	157.12	0.00	0.00
BS19	2	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00
BS21	7	0.00	0.00	0.00	0.00	0.00		100.00	21.93	2193.00	0.00	0.00
BS22	15	6.67	2.50	16.68	0.00	0.00		33.33	39.00	1299.87	0.00	0.00
BS23	1	0.00	0.00	0.00	0.00	0.00		100.00	37.50	3750.00	0.00	0.00
BS24	7	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00
BS25	3	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00
BS26	8	25.00	2.50	62.50	0.00	0.00		25.00	2.50	62.50	0.00	0.00
BS27	7	0.00	0.00	0.00	0.00	0.00		28.57	2.50	71.43	0.00	0.00
RF03	131	0.00	0.00	0.00	0.00	0.00		0.76	37.50	28.50	0.00	0.00
RF02	1042	0.00	0.00	0.00	0.00	0.00		2.02	4.93	9.96	0.00	0.00
RF01	647	0.46	2.50	1.15	0.00	0.00		1.70	10.36	17.61	0.00	0.00
Anthropogenic	32	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00
Recent Burn	5	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00
Total	**3145**	**0.19**	**2.50**	**0.48**	**0.00**	**0.00**		**2.38**	**11.29**	**26.87**	**0.00**	**0.00**

[1] = *Calculated using percent cover/browse only where species/browse is present*

Appendix 8 cont.

Ecosite	n	Currant Spp. (*Ribes spp.*)						Saskatoon (*Amelanchier alnifolia*)				
		Frequency %	Mean PC[1]	Importance Value	% Browsed[1]	Importance Value		Frequency %	Mean PC[1]	Importance Value	% Browsed[1]	Importance Value
BS03	935	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00
BS04	34	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00
BS07	44	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00
BS09	37	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00
BS16	10	0.00	0.00	0.00	0.00	0.00		10.00	2.50	25.00	0.00	0.00
BS17	115	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00
BS18	63	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00
BS19	2	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00
BS21	7	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00
BS22	15	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00
BS23	1	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00
BS24	7	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00
BS25	3	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00
BS26	8	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00
BS27	7	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00
RF03	131	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00
RF02	1042	0.10	2.50	0.25	0.00	0.00		0.19	2.50	0.48	0.00	0.00
RF01	647	0.00	0.00	0.00	0.00	0.00		0.15	15.00	2.25	0.00	0.00
Anthropogenic	32	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00
Recent Burn	5	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00
Total	**3145**	**0.03**	**2.50**	**0.08**	**0.00**	**0.00**		**0.13**	**5.63**	**0.73**	**0.00**	**0.00**

[1] = *Calculated using percent cover/browse only where species/browse is present*

Appendix 8 cont.

Ecosite	n	Sweet Gale (*Myrica gale*)						Cherry Spp. (*Prunus spp.*)				
		Frequency %	Mean PC[1]	Importance Value	% Browsed[1]	Importance Value		Frequency %	Mean PC[1]	Importance Value	% Browsed[1]	Importance Value
BS03	935	1.07	7.60	8.13	0.00	0.00		0.00	0.00	0.00	0.00	0.00
BS04	34	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00
BS07	44	4.55	2.50	11.38	0.00	0.00		0.00	0.00	0.00	0.00	0.00
BS09	37	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00
BS16	10	70.00	31.07	2174.90	11.31	791.70		0.00	0.00	0.00	0.00	0.00
BS17	115	16.52	9.50	156.94	0.00	0.00		0.00	0.00	0.00	0.00	0.00
BS18	63	17.19	11.18	192.18	0.00	0.00		0.00	0.00	0.00	0.00	0.00
BS19	2	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00
BS21	7	14.29	2.50	35.73	0.00	0.00		0.00	0.00	0.00	0.00	0.00
BS22	15	40.00	15.25	610.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00
BS23	1	100.00	75.00	7500.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00
BS24	7	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00
BS25	3	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00
BS26	8	62.50	10.00	625.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00
BS27	7	14.29	2.50	35.73	0.00	0.00		0.00	0.00	0.00	0.00	0.00
RF03	131	1.53	8.75	13.39	0.00	0.00		0.00	0.00	0.00	0.00	0.00
RF02	1042	1.63	6.29	10.25	0.00	0.00		0.00	0.00	0.00	0.00	0.00
RF01	647	2.01	11.73	23.58	0.00	0.00		0.15	2.50	0.38	0.00	0.00
Anthropogenic	32	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00
Recent Burn	5	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00
Total	**3145**	**3.02**	**11.58**	**34.97**	**0.05**	**0.00**		**0.03**	**2.50**	**0.08**	**0.00**	**0.00**

[1] = *Calculated using percent cover/browse only where species/browse is present*

Appendix 9. Wildlife Covert Camera Photo Captures in the Denison Wheeler River Project Area.

Camera 15 (Road) - Grey Wolf (*Canis lupus*)

Camera 9 (Trail) - Grey Wolf (*Canis lupus*)

Camera 12 (Handcut) - Woodland Caribou (*Rangifer tarandus caribou*)

Camera 16 (Handcut) - Woodland Caribou (*Rangifer tarandus caribou*)

Camera 20 (Trail) - Woodland Caribou (*Rangifer tarandus caribou*)

Camera 10 (Handcut)- Moose (*Alces alces*)

Camera 9 (Trail) - Moose (*Alces alces*)

Camera 15 (Road) - Black Bear (*Ursus americanus*)

Camera 17 (Trail) - Black Bear (*Ursus americanus*)

Camera 19 (Trail) - Lynx (*Lynx canadensis*)

Camera 7 (Trail) - Lynx (*Lynx canadensis*)

Camera 19 (Handcut) - Red Fox (*Vulpes vulpes)*

Camera 3- (Road) Red Fox (*Vulpes vulpes)*

Appendix 10. Local and Indigenous Knowledge.

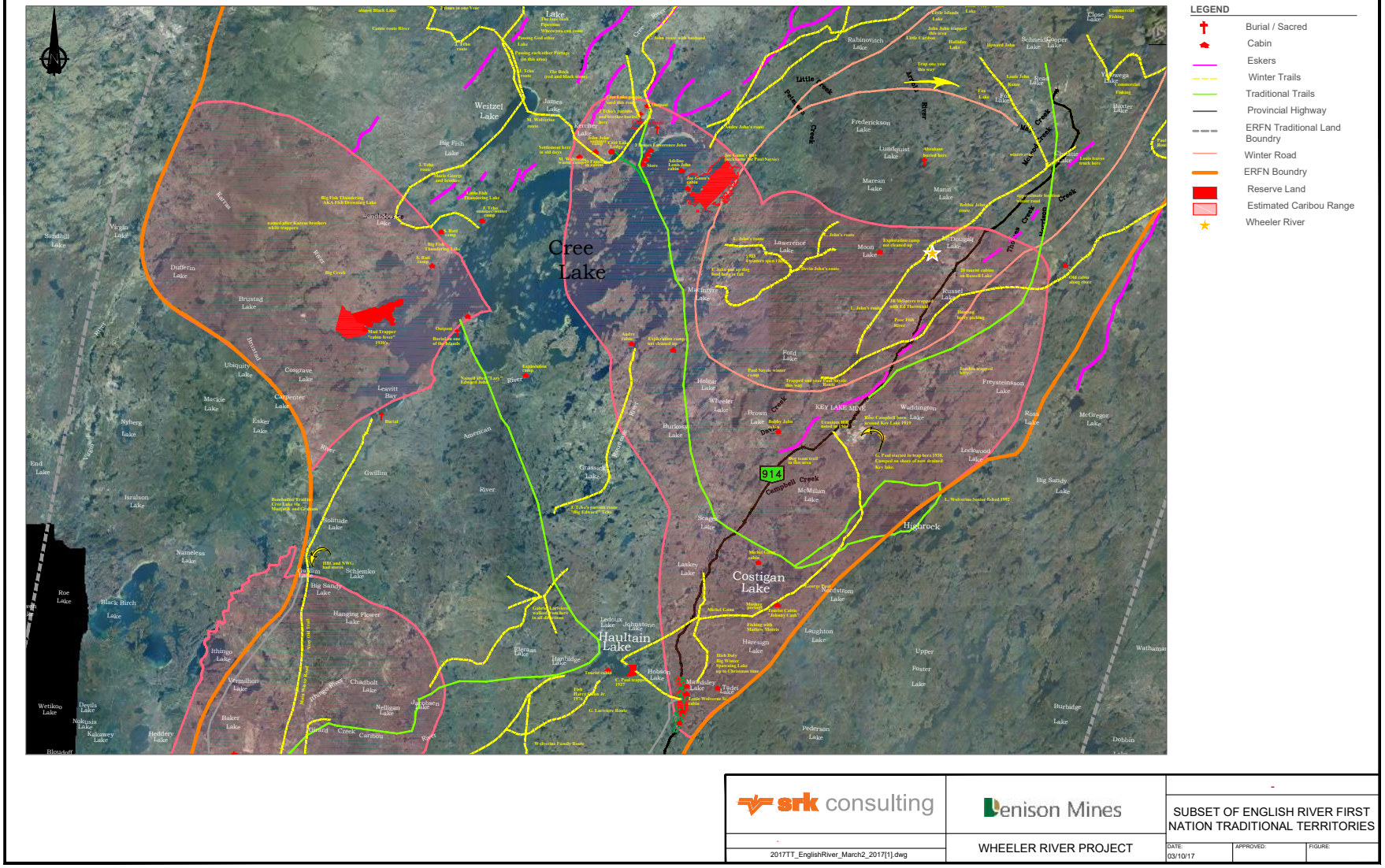


Figure 10-1. Subset of English River First Nation Traditional Territories.

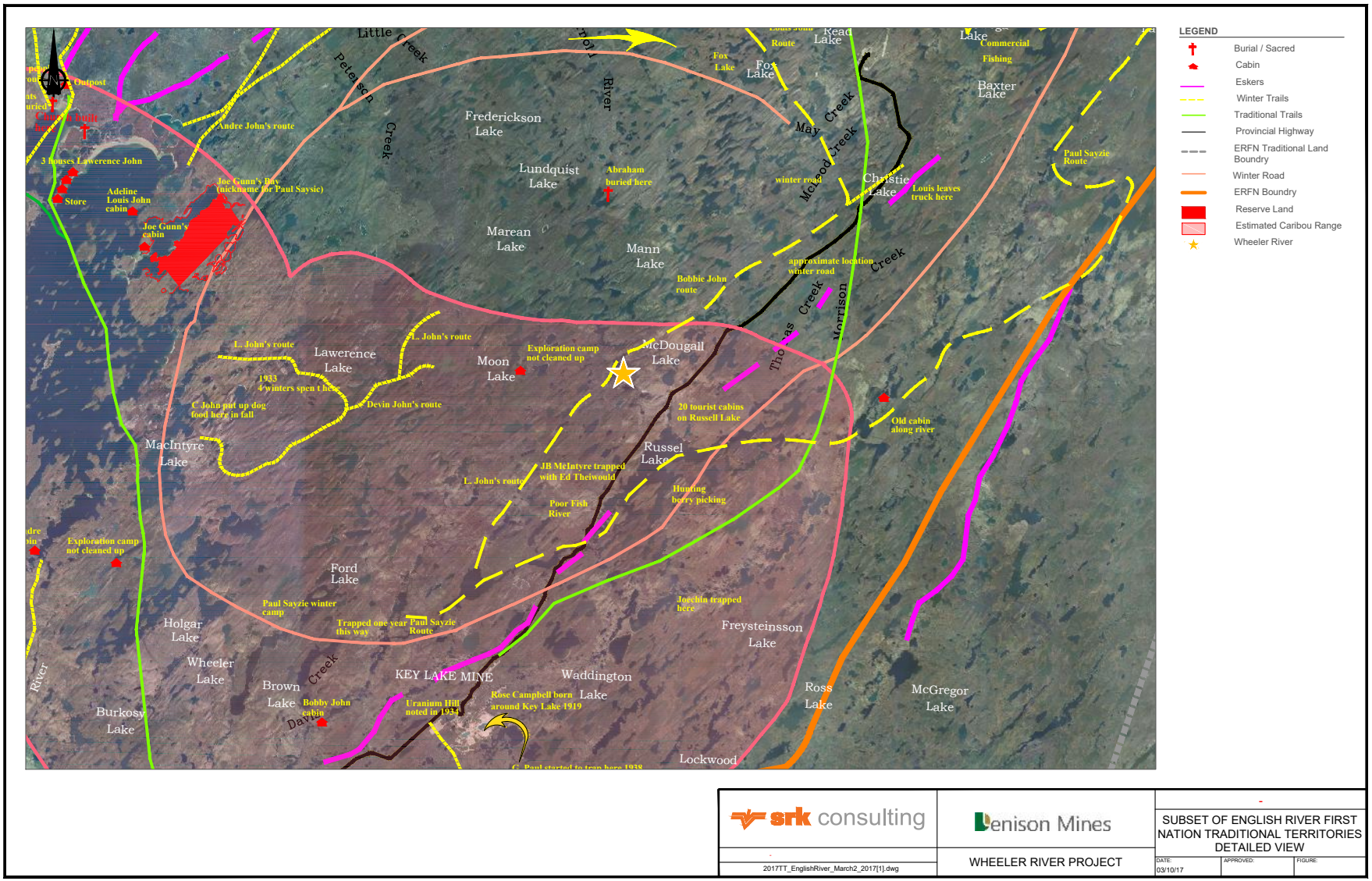


Figure 10-2. Subset of English River First Nation Traditional Territories – Wheeler River Project Area.

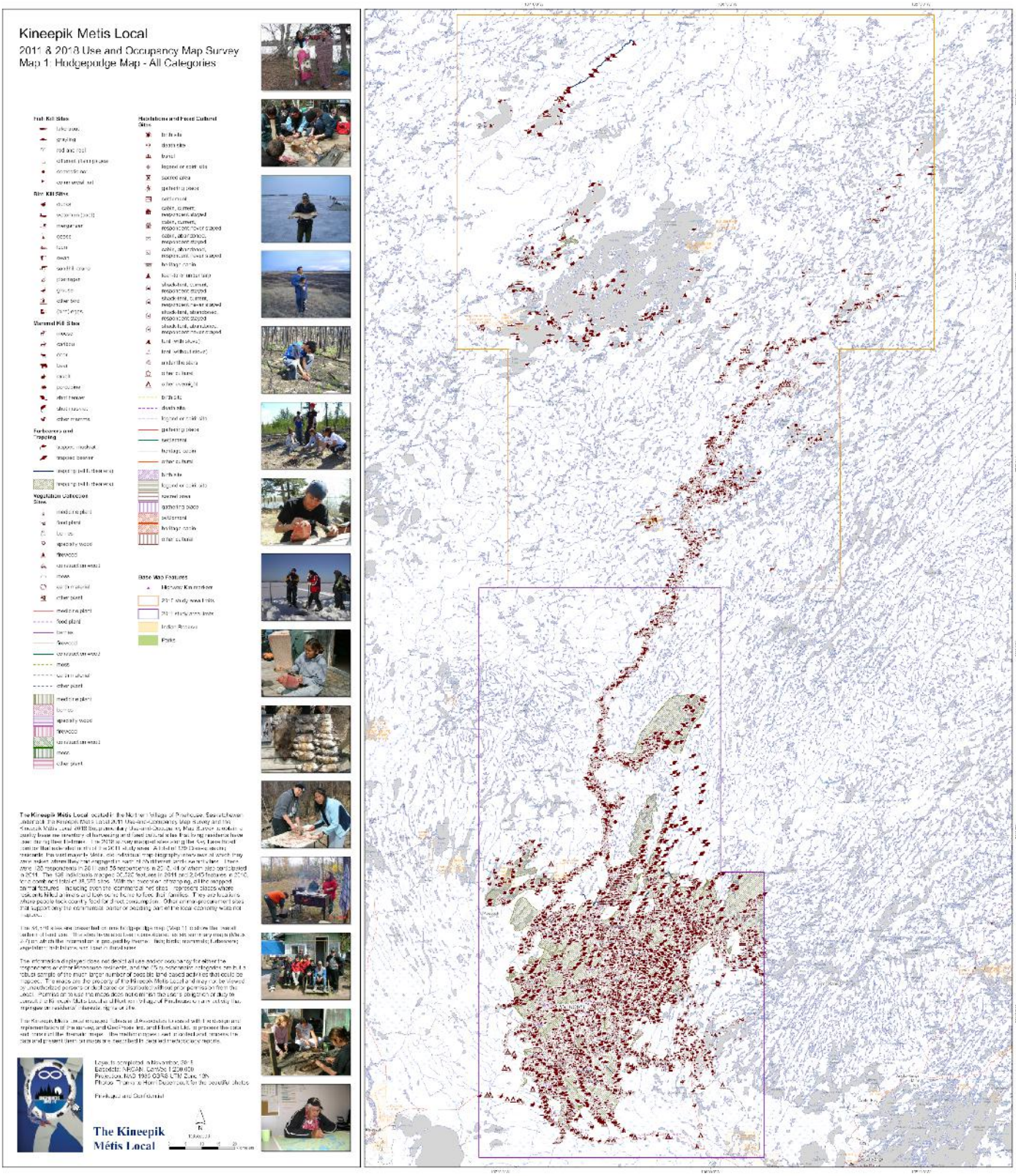


Figure 10-3. Kineepik Metis Local – 2011 & 2018 Use and Occupancy Map Survey.