Keeyask Generation Project

Terrestrial Effects Monitoring Plan

Long-Term Effects on Habitat Monitoring Report

TEMP-2023-02

KEEYASK

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KEEYASK GENERATION PROJECT

TERRESTRIAL EFFECTS MONITORING PLAN

REPORT #TEMP-2023-02

LONG-TERM EFFECTS ON HABITAT MONITORING
YEAR 1 OPERATION
2022

Prepared for

Manitoba Hydro

By

ECOSTEM Ltd.

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SUMMARY

Background

Construction of the Keeyask Generation Project (the Project) at Gull Rapids began in July 2014. The vast majority of construction activities had been completed by fall 2021 and all generating units were in service by March 2022.

The Keeyask Hydropower Limited Partnership (KHLP) was required to prepare a plan to monitor the effects of construction and operation of the generating station on the terrestrial environment. Monitoring results will help the KHLP, government regulators, members of local First Nation communities, and the general public understand how construction and operation of the generating station are affecting the environment, and whether or not more needs to be done to reduce harmful effects.

This report describes the results of the initial year of the Long-Term Effects on Habitat monitoring conducted during 2022, which was the first year of operation monitoring.

Why is the study being done?

Habitat is the place where a plant, animal or its population lives. Terrestrial habitat includes all land habitat for all species. The habitat for a particular species is named for that species (e.g., moose habitat, rusty blackbird nesting habitat or black spruce habitat). Each habitat type represents a different kind of ecosystem.

Various habitat types found throughout the Keeyask region

The partner First Nations have said that all terrestrial habitats are important. Changes to terrestrial habitat can affect many species and ecosystems. Plants and animals need habitat to exist, and having more good quality habitat helps them to be more widespread and abundant.

Because changes to terrestrial habitat can have such wide-ranging effects across the environment, terrestrial habitat monitoring provides the single best way to see important changes, and to discover any unexpected effects on that environment.

Another study, Habitat Loss and Disturbance, is monitoring direct habitat loss and disturbance from the development of the Project. The goal of this study, Long-Term Effects on Habitat, is to document the nature and extent of indirect Project effects on habitat adjacent to the Construction Footprint.

What was done?

The Long-Term Effects on Habitat study conducts surveys at the same locations along the North and South Access Roads over multiple years during Project operation. In 2022, data was collected within suitable mature forest stands along the access roads. The ground surveys collected detailed vegetation, soil, and environment data within nested belt transects referred to as the environment, tree, tall shrub, and low vegetation belts. Aerial surveys using drones also collected photos that were used to create digital orthographic images of the surveyed area.

What was found?

It was difficult to find suitable forest stands because most of the forest along the North Access Road burned in the 2013 wildfire, and most patches of uniform forest habitat along the access roads are not large. Eleven potential sample stands were identified using desktop information available prior to the field season; however, the field evaluation found that only five of these stands were suitable.

Belt transects were surveyed in the five suitable stands in summer 2022. These stands represented three forest habitat types, which were Jack pine/black spruce mixture on mineral substrate, Black spruce pure on mineral substrate, and Black spruce pure on thin peat substrate.

Digital orthographic imagery of the habitat surrounding each transect was created using imagery captured by a drone. Vegetation structure mapping of the habitat confirmed that the sampled transects were highly uniform.

The tree and tall shrub belts included five tree species and 10 tall shrub species. In the low vegetation belt, a total of 52 vascular plants, seven mosses, and four lichens were recorded. Eleven species were widely distributed across all five stands sampled in 2022.

No plant species of high conservation concern (i.e., ranked as endangered, threatened, provincially critically imperiled or imperiled by the Manitoba Conservation Data Center) was found during the surveys.

Two non-native species of moderately high invasive concern were identified on or near the disturbed segment of sample transects. Management responses for these species are provided in the invasive plants monitoring report (ECOSTEM 2023a).

What does it mean?

Limited results are available to date. This study is monitoring changes in habitat over many years, and this was the first year that data were collected. Also, only about one-half of the desired number of stands could be sampled in 2022.

What will be done next?

The remaining baseline forest stands will be selected and sampled in summer of 2023.

ACKNOWLEDGEMENTS

ECOSTEM Ltd. would like to thank Rachel Boone, Sherrie Mason, and the on-site Manitoba Hydro staff, including Martial Lemoine, James Teskey and Jodi Ross for their support and assistance in planning field activities and providing access to the sites. Rachel Boone and Sherrie Mason are also gratefully acknowledged for coordinating the terrestrial monitoring studies.

Chiefs and Councils of Tataskweyak Cree Nation (TCN), War Lake First Nation (WLFN), York Factory First Nation (YFFN) and Fox Lake Cree Nation (FLCN) are gratefully acknowledged for their support of this program.

We would also like to thank North/South Consultants Inc., in particular Ron Bretecher and Shari Fournier, for their guidance, logistical support and other resources that made these studies possible.

STUDY TEAM

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Data analysis and report writing in 2022 were completed by Alanna Sutton and Brock Epp. Brock Epp and James Ehnes reviewed the report. GIS analysis and cartography were completed by Alex Snitowski.

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1.0 INTRODUCTION

The Keeyask Generation Project (the Project) is a 695-megawatt hydroelectric generating station (GS) and the associated facilities. The Project is located at the former Gull Rapids on the lower Nelson River in northern Manitoba where Gull Lake flows into Stephens Lake, 35 km upstream of the existing Kettle GS. Project construction began in July 2014 and the vast majority of construction activities were completed by fall 2021. The reservoir was first brought to full supply level in September 2020 and the final generating unit went into service on March 9, 2022.

The *Keeyask Generation Project Response to EIS Guidelines* (the EIS), completed in June 2012, provides a summary of predicted effects and planned mitigation for the Project (KHLP 2012a). Technical supporting information for the terrestrial environment, including a description of the environmental setting, effects and mitigation, and a summary of proposed monitoring and follow-up programs is provided in the *Keeyask Generation Project Environmental Impact Statement Terrestrial Supporting Volume* (TE SV; KHLP 2012b). The *Keeyask Generation Project Terrestrial Effects Monitoring Plan* (TEMP; KHLP 2015) was developed as part of the licensing process for the Project. Monitoring activities for various components of the terrestrial environment were described, including the focus of this report, which is long-term effects on habitat monitoring.

Habitat is the place where an organism or a population lives. Because all natural areas are habitat for something, "terrestrial habitat" refers to all land habitat for all species. Habitat for a particular species is identified with the species name of interest, such as moose habitat, rusty blackbird nesting habitat or jack pine (*Pinus banksiana*) habitat. Terrestrial habitat is a keystone driver for ecosystems and, for many reasons, provides the best single indicator for Project effects on terrestrial ecosystems.

Two TEMP studies are monitoring Project effects on terrestrial habitat as a whole. The Terrestrial Habitat Loss and Disturbance study (TEMP, Section 2.1.2) focuses on direct Project effects on stand level habitat composition due to terrestrial habitat loss and disturbance. This study, Long-Term Effects on Habitat, (TEMP, Section 2.1.3) focuses on the long-term indirect effects of Project clearing on inland (i.e., away from the reservoir) habitat. Long-term, indirect effects of the reservoir on terrestrial habitat are being monitored by the Long-Term Effects on Wetlands study (TEMP, Section 2.5.3).

The Long-Term Effects on Habitat study is the subject of this report.

The goal of the Long-Term Effects on Habitat study is to determine the nature of long-term Project effects on terrestrial habitat and the extent of native habitat recovery during operation. The objectives of this study are to:

- Locate and quantify indirect Project effects on habitat;
- Locate and quantify areas recovering to native habitat; and,
- Locate and quantify long-term Project effects on habitat composition.

Monitoring under the Long-term Effects on Habitats study begins during the operation phase because it is expected that such effects take several years to become substantive, and because some areas were still being impacted until the end of construction.

Monitoring for this study began in 2022, and included establishing permanent sample locations adjacent to Project clearing that will be monitored for long-term indirect effects. This report describes the methods used to establish the permanent sample locations, and provides an overview of the habitat attributes at the initial locations established in 2022.

2.0 METHODS

2.1 APPROACH

Indirect Project effects on habitat are effects that develop over time in response to an impact. For example, vegetation clearing will generally have numerous subsequent effects such as higher soil temperatures within the cleared area and adjacent uncleared areas. Additionally, clearing increases light and alters the microclimate in the understorey of the adjacent uncleared vegetation, which then leads to changes in soil conditions and vegetation composition.

Indirect Project effects on habitat are most likely to be observed in situations where Project impacts have created major alterations to environmental conditions. Vegetation clearing combined with site grading in mature forest is generally the predominant type of impact. A second type of impact is flooding from the newly created reservoir. In this case, the adjacent habitat is also affected by fluctuating water levels and wave action.

The North and South Access Roads were selected as the Project component that would be used to study long-term, indirect effects on inland (i.e., non-reservoir) terrestrial habitat. This component accounts for a high proportion of the vegetation clearing and site grading in mature forest habitat. Additionally, it is the Project component with a sufficiently long cleared edge to provide a reasonable level of replication of sample locations.

2.2 STUDY DESIGN

Project impacts and direct effects on habitat during construction were documented by the detailed mapping of Project clearing and physical disturbance as of September 2021 (i.e., the Construction Footprint; ECOSTEM 2022;Map 2-1).

The spatial limits for monitoring long-term effects on inland habitat were delineated as the Construction Footprint plus a 150 m buffer of it (Map 2-1). This was expected to capture the maximum potential extent of indirect effects of vegetation clearing and substrate grading. Indirect Project effects were expected to generally decline with distance from Project impacts. Based on research conducted in northern Manitoba, indirect habitat effects generally extended less than 25 m from the edge of the actual Project Footprint, and typically less than 15 m.

An impact-trend by time design was employed to document changes to habitat over time. Permanent sample locations were selected as a stratified, random sample of the most common terrestrial habitat types along the North and South Access roads.

The locations and amounts of the various habitat types within the study area were obtained from the terrestrial habitat map (KHLP 2012b), which includes updates for the 2013 wildfire. The

polygon areas were tabulated to determine the most common mature forest habitat types along the access roads.

Patches of mature forest along the access roads that met the following criteria were selected as potential sample locations: it was one of the most common mature forest habitat types; the patch had at least 150 m of frontage on the access road; the forest extended at least 100 m in a direction perpendicular to the access road; the patch was at least 100 m from the next closest suitable patch; and, the patch was relatively homogeneous. Patches meeting these criteria are referred to as stands.

For the geographic stratification, stands were classified as either north or south of the Nelson River. Potential sample stands were to be randomly selected from each of these two classes.

It was difficult to find stands that met the selection criteria because most of the forest along the North Access Road burned in the 2013 wildfire, and most patches of relatively homogenous forest habitat along the roads were not large. Eleven potential sample stands were identified based on the desktop information available at the time. The habitat types represented by these stands were Jack pine/black spruce mixture on mineral substrate, Black spruce pure on mineral substrate, and Black spruce pure on thin peat substrate.

All eleven potential stands were selected for field evaluation to provide adequate replication for each habitat type, knowing that it was likely that some would be disqualified by the field evaluation.

The field evaluation determined that only five of the potential stands definitely met the selection criteria. These five stands were sampled in summer of 2022 (Map 2-2). The five stands included three habitat types (Table 2-1).

Table 2-1: Broad habitat types of stands sampled in 2022 for Long-Term Effects on Habitat

Fine Habitat Type	Number of Stands Sampled[1]
Jack pine mixture on mineral	2
Black spruce pure on mineral	1
Black spruce pure on thin peatland	2

Notes: [1] Each stand sampled includes two transects.

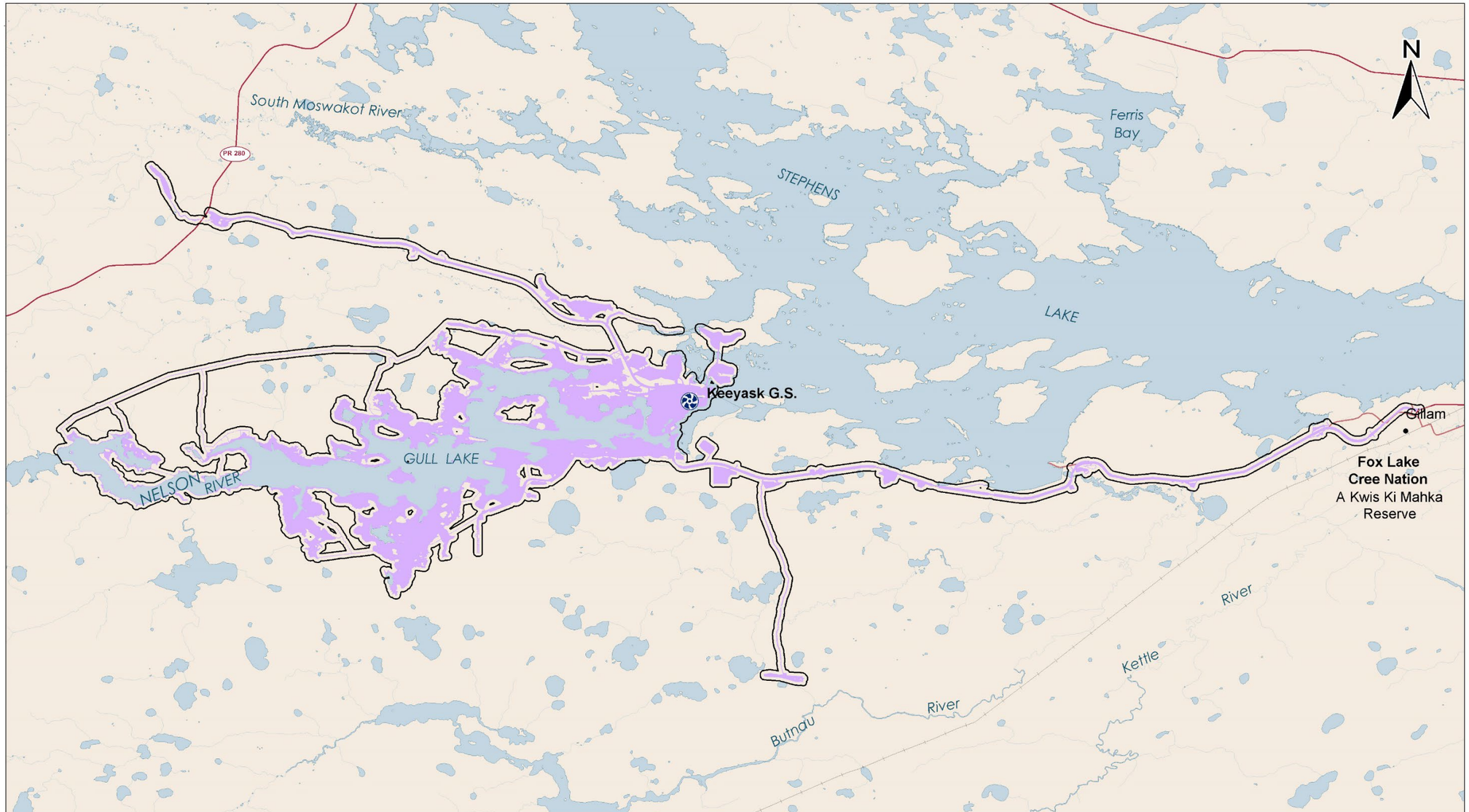
The suitability of the remaining six potential stands will be evaluated using helicopter-based photos and other information acquired along the access roads in 2022. This information will also be used to identify replacement or additional stands.

Two permanent transects were established in each sampled stand. The transect locations were determined in two steps:

1) Subdivide the stand frontage into two portions. Create two equal frontage portions if the minimum stand depth and habitat homogeneity is maintained along the entire frontage, or otherwise what the stand shape best allows; and,

2) Randomly locate one transect within each portion with the constraint that transect tree belts (see below) must be at least 20m apart to avoid overlap of tree sampling.

Each transect was subdivided into two segments: undisturbed and disturbed by the Project. Starting from the cleared edge, the undisturbed segment of the transect extended 30 m into the mature forest, while the disturbed segment extended 5 m into the clearing.



KEEYASK Hydropower Limited Partnership

DATA SOURCE: Footprints - ECOSTEM Ltd.; Roads and Water - Manitoba Hydro.

CREATED BY: ECOSTEM Ltd.

COORDINATE SYSTEM:	DATE CREATED:	REVISION DATE:
UTM NAD 1983 Z15N	11-APR-23	11-APR-23
0 2 4 Kilometres / 0 1 2 Miles	VERSION NO: 1.0	QA/QC: JWE/YYY/ZZZ

Legend

- Construction Footprint
- Construction Footprint 150 Metre Buffer

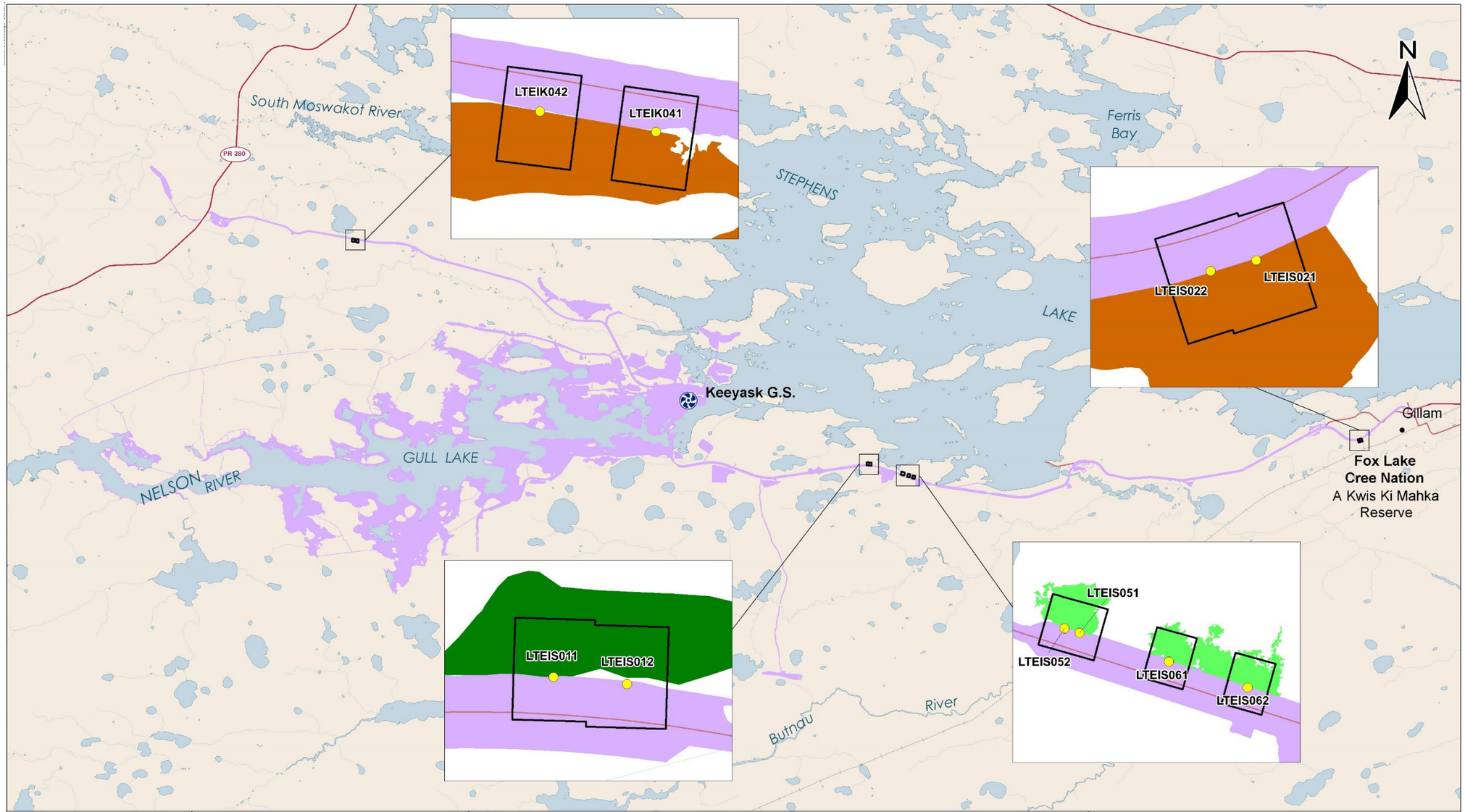
Infrastructure

- Highway
- Secondary Road
- Rail

Construction Footprint

As of September 2022

Map 2-1: Construction Footprint as of September 2022, and the area within a 150 m buffer



Map 2-2: Long-term effects on habitat stands and sample locations in 2022

2.3 DATA COLLECTION

2.3.1 DOIs

Digital orthorectified imagery (DOI) of each transect was created to monitor:

- Environmental conditions surrounding the transect;
- Overstorey canopy closure.

DOIs were created from photos acquired by a drone. Photos of each transect were acquired at two altitudes above ground level: 40 m and 70 m. Photos were acquired with forward and side overlap to produce a DOI for a 110 m wide band centred on each transect, and extended from the center of the road (or 20 m into the infrastructure if it is not a road) and 50 m past the end of the undisturbed segment of the transect.

The photos were acquired using an Autel EVO II Pro drone equipped with a 20 MP RGB camera.

Drone photos were acquired on September 4, 2022.

2.3.2 BELT TRANSECTS

The two transect locations for each of the selected stands were pre-determined in a GIS prior to sampling using information available at the time. Each transect was centered on the frontage of homogenous patches reflecting the stand habitat type.

It was possible that the desktop information was inaccurate due to habitat changes since the habitat mapping was done, photo-interpretation errors, variations too small to map given the minimum polygon size, or subsequent disturbances.

Consistency of the stand and pre-determined transect locations were evaluated in the field. The criteria that were evaluated at the transect location included the homogeneity of the localized habitat type, the general consistency of the vegetation type and the relative straightness of the forest edge. If needed and possible, the transect location was shifted along the frontage to a suitable location. A stand that did not clearly meet the selection criteria was not sampled.

Once the transect location was determined the transect origin was established at the cleared edge (Photo 2-1). The transect was oriented perpendicular to the overall orientation of the cleared edge at the location.

Transect data were collected from July 8 to August 5, 2022.

2.3.2.1 UNDISTURBED TRANSECT SEGMENT

For the undisturbed segment of the transect, data were collected in four nested belts (Figure 2-1) referred to as the environment, tree, tall shrub and low vegetation belts. The nesting reflected finding a balance between the larger area needed to adequately represent the different vegetation components and sampling effort.

The attributes recorded in each belt were:

1. Environment belt
    - Used for vegetation structure and environment attributes.
    - 10 m wide belt with three consecutive 10 m X 10 m quadrats.
    - Attributes for each quadrat included structure class (Table 2-2), average canopy height, average percent slope and aspect, slope position (Figure 2-2), slope shape, and disturbance.
2. Tree belt
    - Used for trees and snags.
    - Trees and snags were tallied within a 4 m wide belt transect along the 30m transect.
    - Attributes for both trees and snags included distance along transect, perpendicular offset distance and direction (left or right), circumference at breast height (CBH, 1.3 m), and species.
    - Additional attributes for trees included tree condition (Table 2-3), and canopy position (Table 2-4).
    - Additional attributes for snags included snag condition (Table 2-5) and snag decay stage (Table 2-6).
3. Tall shrub belt
    - Used for tree recruitment and tall shrubs
    - Tree “pseudospecies”, i.e.: tree seedlings (height < 0.5m), tree saplings (height ≥ 0.5m), and tall shrub species (Table 2-7).
    - Stem tallies for each species within a 2 m wide belt transect for contiguous 2 m X 5 m quadrats.
4. Low vegetation belt
    - Used for plant species composition.
    - Presence by species within a 1 m wide belt transect for contiguous 25 cm X 100 cm quadrats.

2.3.2.2 DISTURBED TRANSECT SEGMENT

For the disturbed segment of the belt transect, the same attributes were recorded in the same way as for the undisturbed segment, except that the vegetation structure and environment belt was a 10 m X 5 m quadrat.

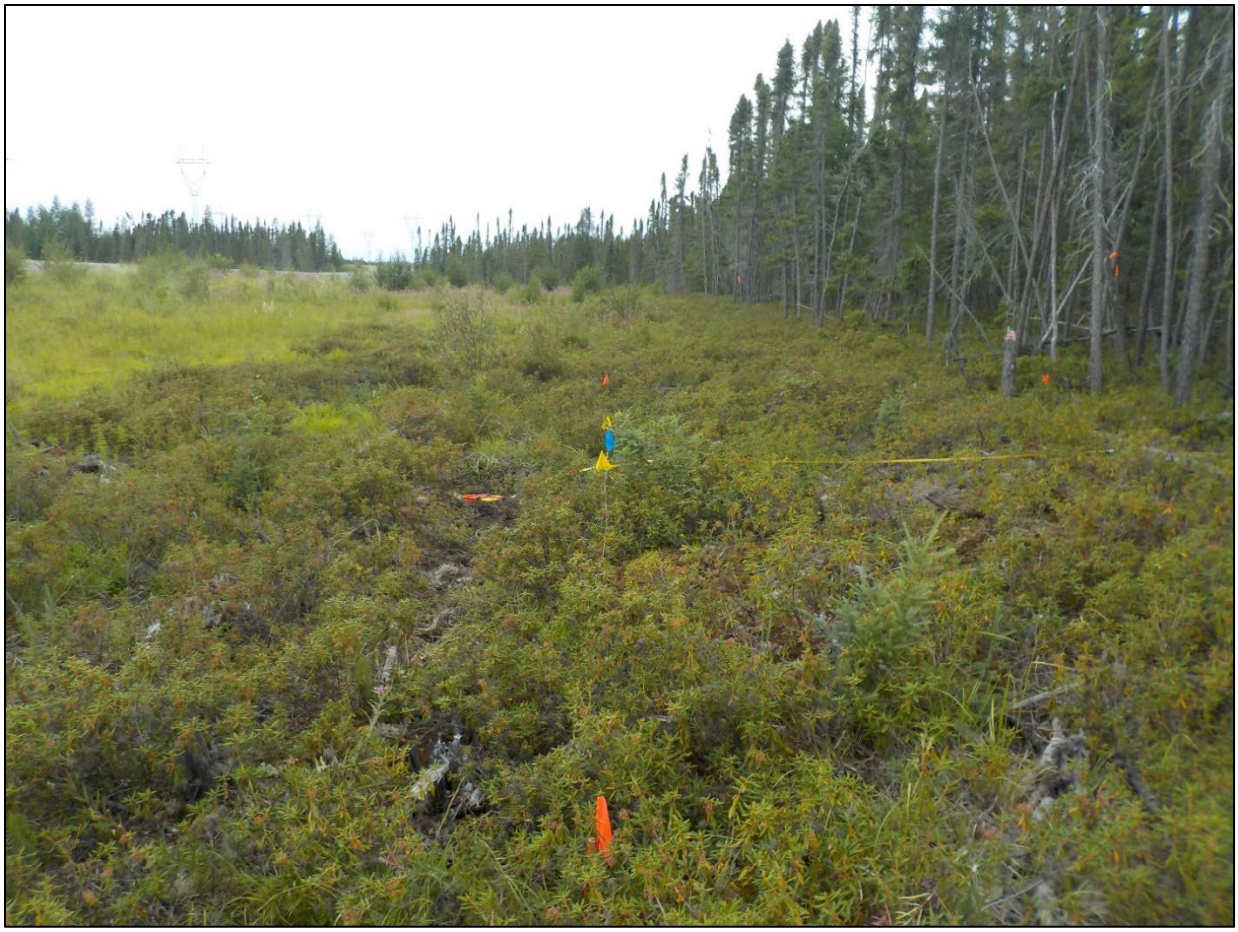


Photo 2-1: Belt transect setup showing a side view of the disturbed segment of the transect at Stand 5, Transect 1 on August 2, 2022

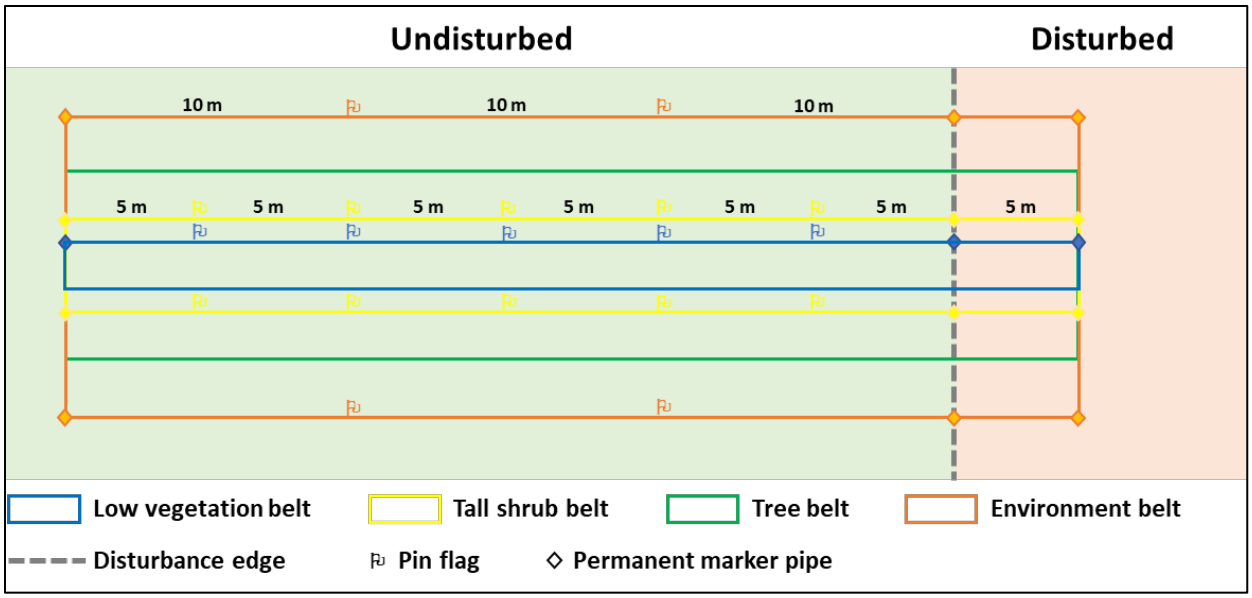


Figure 2-1: Layout of the nested belt transects

Table 2-2: Vegetation structure classes

Code	Type	Criteria
F	Forest	Dominated by trees (i.e., tree species with stems that are > 0cm in circumference) which have ≥ 75% canopy closure.
W	Woodland	Trees (i.e., tree species with stems that are > 0cm in circumference) form the canopy and trees have ≥ 25% and < 75% canopy closure.
T	Shrubland- Tall	Tall shrubs (shrub species whose height ≥ 0.5m) and/or saplings (tree species whose height > 0.5m and < 1.3m) form the canopy and have ≥ 25% cover.
L	Shrubland- Low	Low shrubs (shrub species whose height < 0.5m) or tree seedlings (tree species < 0.5m) form the canopy and have ≥ 25% cover.
G	Grassland/Herbland	Grasses and/or sedges and/or herbs form the canopy and have ≥ 25% cover.
B	Bryoid	Mosses, hepatics and/or lichens are the tallest vegetation with ≥ 25% cover.
S	Sparse	All vegetation combined has ≥ 25% cover if all of the strata are combined but no one stratum has ≥ 25% cover.
N	Barren	All vegetation combined has < 25% cover.
E	Edge	Used to identify the location of a hard edge. Occurs between two other structure types.

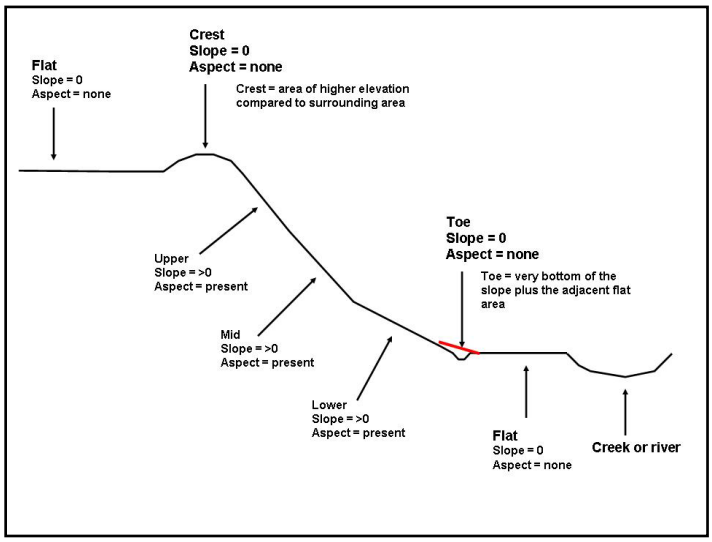


Figure 2-2: Slope Positions

Table 2-3: Tree condition

Code	Condition	Description
1	Intact	Tree has not sustained any damage (i.e. canopy and bole are intact)
2	Broken canopy	Majority of the branches in upper portion of tree are missing
3	Broken bole	Bole broken below canopy
4	Windfall	Tree uprooted by wind
5	Heart rot	Tree with evidence of heart rot
6	Disease	Evidence of other type of disease (e.g., conk)
7	Insect	Evidence of insect attack
8	Knocked down	Tree pushed over by forwarder/harvester as seen by bark scarring
9	Stump	Tree that was cut during Project Footprint clearing
10	Forked canopy	Canopy is forked
11	Browsed	Tree browsed by animals, damaged by birds (e.g. sapsuckers)
12	Dead top	Upper portion of tree canopy is dead

Table 2-4: Tree canopy position

Code	Position	Description
1	Veteran	Tree that survived last stand replacing disturbance
2	Dominant	Top of crown is not shaded by other trees
3	Sub-Dominant	Crown is in upper canopy but slightly below the crowns of dominant trees
4	Secondary	In second tier, if one exists
5	Understorey	Crown below the secondary and upper canopies
9	Not applicable	Stump or windfall

Table 2-5: Snag condition

Code	Condition	Description
1	Intact	Main stem and branches in canopy are unbroken
2	Broken canopy	Majority of the branches in upper portion of snag are missing
3	Broken bole	Entire canopy and upper portion of main stem axis broken off

Table 2-6: Snag decay stage.

Code	Stage
1	Recently killed
2	Twigs and leaves lost; bark intact
3	Small branches lost; bark beginning to peel; wood hard
4	Only major branches remaining; >20% bark lost; wood condition soft to hard
5	Canopy broken; bark condition variable; wood conditions variable
6	Decomposing stump; wood soft; bark peeling

Table 2-7: Tall Shrubs (includes tree saplings) identified during surveys

Species	Common Name
Alnus alnobetula	Green alder
Betula papyrifera	Paper birch
Betula pumila	Bog birch
Larix laricina	Tamarack
Picea mariana	Black spruce
Pinus banksiana	Jack pine
Populus balsamifera	Balsam poplar
Prunus pensylvanica	Pin cherry
Rosa acicularis	Prickly rose
Rubus ideaus	Red raspberry
Salix arbusculoides	Shrubby willow
Salix bebbiana	Bebb's willow
Salix planifolia	Plane-leaved willow
Salix pseudomyrsinites	Myrtle-leaved willow
Salix spp	Other willow species
Viburnum edule	Mooseberry

The soil sampling method was intended to be sufficient, at a minimum, to detect moisture regime changes in the rooting zone. Soils were sampled in pits (Photo 2-2) and from soil cores obtained using a Dutch auger. The soil pits collected detailed soil information while the soil cores focused on moisture regime (Figure 2-3). Soil pits were dug at 1m and 10m. Soil cores was completed at

5m, 15m, 20m and 30m on the undisturbed segment of the transect, and at 1m and 5m on the disturbed segment.

Data recorded at soil pits included:

- LFH and/or organic matter depth.
- Depth to prominent mottling, gleying, ice, water table and bedrock.
- Soil horizon information, such as depth, texture and stoniness.
- Collected at 1m and 10m on the undisturbed segment of the transect.

Photo 2-2: Full soil pit from Stand 4, Transect 2

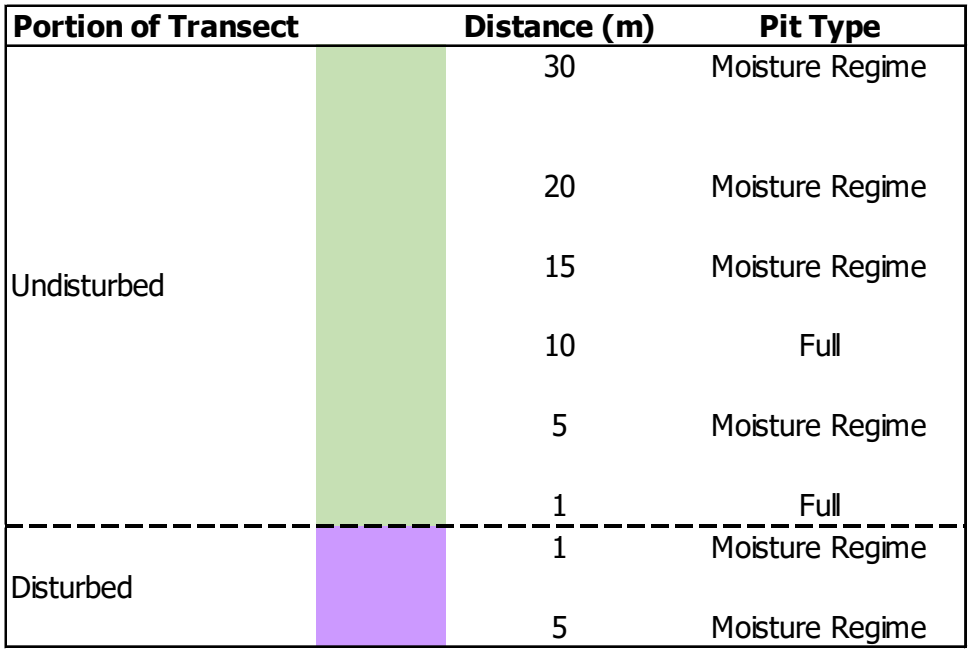


Figure 2-3: Locations and type of soil sampling

2.3.2.3 PLANT TAXA

Plant nomenclature followed the Manitoba Conservation Data Centre (MBCDC 2021) species and plant community database standards.

Plants recorded in the belt transects were identified to species if it was a taxon for which this was generally feasible in the field and to a taxon otherwise. Trees were recorded as pseudospecies based on growth form (Section 2.3.1). In this report, the singular "taxon" and plural "taxa" are used to refer to species, broader taxa, and pseudospecies collectively.

Additionally, plants of ecological concern (see Section 2.4.4) encountered between sampling locations were recorded as incidentals. These species were also included as incidentals in other monitoring studies (ECOSTEM 2023a, b).

2.4 DATA ANALYSIS

Data analysis for this report was limited to basic descriptive statistics and percent occurrences as this was the first year that the transects were sampled, and establishing some of the baseline sample locations was deferred to 2023. A more detailed analysis will be provided after all the planned locations have been sampled for the first time.

2.4.1 DOIs

For 2022, analysis of the digital orthographic imagery focused on confirming that the undisturbed portion of each stand met the study requirements for homogeneity (Section 2.2).

Homogeneity was assessed by interpreting the vegetation structure and canopy closure of the undisturbed portion of the habitat surrounding the two transects in each stand. The degree of homogeneity was characterized by the number of distinct patches within the undisturbed area, and the variety and proportion of distinct structure types for a given stand.

Distinct patches of vegetation structure were heads-up digitized over the DOI captured from an elevation of 70m in a GIS. A minimum polygon size of 200 m^2 was used, which was small enough to capture localized differences in structure and disturbances that may be associated with possible variations in environmental conditions such as soil moisture regime.

The attributes that were interpreted included:

- Vegetation structure (Table 2-8)
- Upper canopy closure estimated to the nearest 10% class (1=10%, 2=20%, …, 10=100%)

The mapped vegetation structure classes differed slightly from the vegetation structure class determined from the ground in the transects (see Section 2.3.2). This is because of the different criteria used to classify vegetation cover from above rather than below and using photo interpretation.

Table 2-8: Mapped vegetation structure classes and interpretation criteria

Division (based on dominant life form)	Code	Class	Criteria if the Dominant Stratum
Treed	F	Forest	61 - 100% cover with crowns overlapping.
	D	Woodland	26 - 60% cover with crowns generally not touching.
	S	Sparsely Treed	10 - 25% cover with crowns generally not touching.
Shrub	TS	Tall Shrub	Taller than 0.5m and cover > 25% with Trees < 10%; Cover can be less than 25% when the cover of each of the other life forms < 25% and shrub cover exceeds others.
	LS	Low Shrub	Up to 0.5m tall and cover > 25% with Trees < 10% and Tall Shrubs < 25%; Cover can be less than 25% when the cover of each of the other life forms < 25% and shrub cover exceeds others.
Herb	LG	Graminoid	Cover > 25% with Trees < 10% and Tall Shrubs < 25%; Can be less than 25% when the cover of each of the other life forms < 25% and graminoid cover exceeds others.

Division (based on dominant life form)	Code	Class	Criteria if the Dominant Stratum
	LF	Forb	Cover > 25% with Trees < 10% and Tall Shrubs < 25%; Can be less than 25% when the cover of each of the other life forms < 25% and forb cover exceeds others.
Non-vascular	LB	Bryoid	Cover > 25% with Trees < 10% and Tall Shrubs < 25%; Can be less than 25% when the cover of each of the other life forms < 25% and bryoid cover exceeds others.
Bare ground	B	Sparse/Barren	All vegetation cover < 25%.

2.4.2 ENVIRONMENT AND SOILS

Environment attributes and soil data from both transects were pooled for each sample location pair. Descriptive statistics generated included average slope, total quadrat occurrences for each slope position category, and total soil profile occurrences for each moisture regime and drainage regime category.

2.4.3 VEGETATION

Tree, snag, and tall shrub tallies were pooled for both transects for each sample location. Descriptive statistics for tree snag and tall shrub tallies included percent occurrence for each species.

Descriptive statistics generated for species distributions were based on species data collected in the low vegetation belt. As this is the first data collection, all species occurring in at least 1 quadrat in one of the transects were retained for analysis.

Species meeting the criterion for inclusion were classified into the distribution classes shown in Table 2-9 based on the percentage of locations they were found in.

Table 2-9: Species distribution classes, calculated as a percentage of sample locations

Distribution Class	Percentage range	Generalized Distribution
Very Widespread	90% ≤ D ≤ 100%	Widely
Widespread	75% ≤ D < 90%	
Scattered	25% ≤ D < 75%	Narrowly
Localized	0% < D < 25%	
Absent	0%	Absent

2.4.4 PLANTS OF ECOLOGICAL CONCERN

Plant species of ecological concern were examined. These included priority and non-native plants.

Priority plants included species on the Manitoba Endangered Species Act (MESA), the Species at Risk Act (SARA) or the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) lists, as well as species ranked provincially critically imperiled to vulnerable (S1 to S3 ranked).

Non-native plants included species that were categorized based on their level of invasive concern (Table 2-10 for classification criteria). Species in the level 1 and 2 concern levels were considered for immediate management within the Study Area where possible (ECOSTEM 2023a).

Table 2-10: Levels of invasive concern for plants in the Project footprint

Invasive Concern Level	Plant Species Included
Level 1	Species the ISCM classifies as "Category 1" or "Category 2"
Level 2	Species the ISCM classifies as "other" or White et al. (1993) classify as "high" or "moderate" invasives
Level 3	Species that either White et al. (1993) classify as "minor" invasives, or government sources classify as noxious weeds or weed seed species[1]
Level 4	All remaining non-native plant species

Notes: [1] The government regulations list some native boreal plant species (e.g., foxtail barley) as weeds since they focus on species that are problematic for agriculture. Native boreal species appearing on these lists are not considered to be invasive for the Project area.

3.0 RESULTS

3.1 DOIs

The total area covered by the DOIs (Figure 3-1) for the five stands sampled in 2022 was 13.65 ha (Table 3-1). The area covered for each stand ranged from 2.18 ha to 3.08 ha, depending on the distance between the two transects (separation less than 110 m resulted in overlap of the bands centred on each transect). The total area in undisturbed portions of the stands ranged from 1.17 ha to 1.75 ha (Table 3-1).

Following interpretation of vegetation structure, the undisturbed portions of the stands were subdivided into between one and six polygons, or homogeneous patches depending on the stand (Table 3-2).

A total of four structure types were identified across the undisturbed portions of the stands (Table 3-2), including forest structure, at 78.8% of the overall structure, woodland structure (20.7%), and tall shrub structure (0.4%). Nearly 100% of the structure in the undisturbed portions of all the stands was treed. Forest was the dominant structure in all the stands, ranging from 55.7% to 100% of the undisturbed area (Table 3-2). Woodland made up the remaining structure, except for Stand 4, where tall shrub structure formed one small patch covering 1.9% of the stand.

Figure 3-1: Example of DOI created for LTEIK041 (Stand 4, Transect 1). Blue outlined area is the 110m-wide band of habitat centred on the transect, with the undisturbed area subdivided by structure type, and the yellow line is the transect location

Table 3-1: Total area covered by the DOI for the undisturbed and disturbed portions of each stand

Stand Number	Planned Habitat Type	Area Covered by DOI (ha)		
		Undisturbed	Disturbed	Both
1	Black spruce pure on mineral	1.62	1.35	2.97
2	Jack pine mixture on mineral	1.31	1.09	2.40
4	Jack pine mixture on mineral	1.69	1.39	3.08
5	Black spruce pure on thin peatland	1.17	0.95	2.13
6	Black spruce pure on thin peatland	1.75	1.33	3.08
All		*7.54*	*6.10*	*13.65*

Table 3-2: Number of polygons and structure composition of the undisturbed portions of stands covered by the DOIs

Stand Number	Planned Habitat Type	Total Undisturbed Area (ha)	Number of Polygons	Percent of undisturbed area in structure type		
				Forest	Woodland	Tall Shrub
1	Black spruce pure on mineral	1.62	4	55.7	44.3	-
2	Jack pine mixture on mineral	1.31	1	100.0	-	-
4	Jack pine mixture on mineral	1.69	6	68.0	30.1	1.9
5	Black spruce pure on thin peatland	1.17	4	79.2	20.8	-
6	Black spruce pure on thin peatland	1.75	4	94.5	5.5	-
All		*7.54*	*19*	*78.8*	*20.7*	*0.4*

3.2 TRANSECTS

3.2.1 ENVIRONMENT AND SOILS

Across the five stands, 40 10 m X 10 m environment quadrats were sampled in 2022.

Quadrat slope varied from 0 to 16, with 90% of quadrats having a slope of 3% or less (one stand accounted for all the slopes above 3%). Nearly half of the quadrats were in the flat position, while 28% were on the lower slope and the rest were split between the mid and upper slope (Table 3-3). Eighty-five percent of the quadrats had a flat shape.

Soil data were collected at 20 full pits (two at each transect) and 80 auger pits, for a total of 100 soil profiles. Average organic matter thickness ranged from 8.5 cm to 35.5 cm. Just over half of the soil profiles had a moderately wet to very wet moisture regime (Table 3-4) and 43% had a fresh moisture regime. In terms of drainage regime, over half of the soil pits were very poor (Table 3-5), while moderately well and well drained regimes were each recorded in 24% of soil pits.

Table 3-3: Environment quadrat position during the first year of Project operation, 2022

Position	Percent of quadrats
Flat	45
Lower	28
Mid	13
Upper	15
Total number of quadrats	*40*

Table 3-4: Moisture regime during the first year of Project operation, 2022

Moisture Regime	Percent of soil profiles
Moderately fresh	5
Fresh	43
Very Fresh	1
Moderately wet to very wet	51
Total number of quadrats	*40*

Table 3-5: Drainage regime during the first year of Project operation, 2022

Drainage Regime	Number of pits
Rapid	1
Well	24
Moderately well	24
Very poor	51
Total number of quadrats	*40*

3.2.2 VEGETATION

Five tree species were recorded within the tree belts across all sampled stands (Table 3-6). Black spruce (*Picea mariana*) trees made up 89% of the trees tallied (and 59% of the snags). The next most abundant tree species was jack pine (*Pinus banksiana*) at 5% (and 21% of snags). Tree height ranged from 1.3 m to 18.3 m and maximum circumference at breast height was 71 cm. Nearly all trees were intact and 55% of the trees were dominant or co-dominant, and 24% were in the understorey.

Table 3-6: Tree and snag species counts within the tree belt during the first year of Project operation, 2022

Position	Percent of tree stems	Percent of snag stems
Betula papyrifera	2	8
Larix laricina	2	-
Picea mariana	89	59
Pinus banksiana	5	21
Populus balsamifera	2	5
Unknown	-	7
Total stems	*589*	*75*

Plant taxa recorded in the low vegetation belt included 52 vascular plants, seven moss and four lichen species or broader taxa (See Appendix Table 5-2 for species list). A pseudospecies is a characterisation of the tree species into their height classes. A tree pseudospecies is therefore recorded as a seedling, sapling, or tree, based on its height.

3.2.2.1 UNDISTURBED SEGMENT OF TRANSECTS

Tree recruitment (seedlings and saplings) in the undisturbed segment included four species (Table 3-7). Black spruce seedlings and saplings accounted for 97% of the stems counted in the shrub belt. Paper birch (*Betula papyrifera*) saplings, tamarack (Larix laricina) and jack pine seedlings accounted for 1% of the recorded stems each.

Nine tall shrub taxa were recorded in the tall shrub belt of the undisturbed segment across all locations (Table 3-8). Green alder (*Alnus alnobetula*) and prickly rose (*Rosa acicularis*) were the most abundant species in the undisturbed segment.

Table 3-7: Tree recruitment stem counts within the tall shrub belt on the disturbed and undisturbed segment during the first year of Project operation, 2022

Pseudospecies	Percent of stems in undisturbed segment	Percent of stems in disturbed segment
Paper birch sapling	1	9
Paper birch seedling	0	8
Tamarack seedling	1	1
Black spruce sapling	18	2
Black spruce seedling	79	38
Jack pine sapling	0	18
Jack pine seedling	1	21
Balsam poplar sapling	-	1
Balsam poplar seedling	-	2
Total stems	*704*	*103*

Table 3-8: Tall shrub stem counts within the tall shrub belt on the disturbed and undisturbed segment during the first year of Project operation, 2022

Taxa	Percent of stems in undisturbed segment	Percent of stems in disturbed segment
Green alder	65	16
Bog birch	0	-
Pin cherry	-	0
Prickly rose	19	22
Red raspberry	6	39
Shrubby willow	0	-
Bebb's willow	0	4
Plane-leaved willow	3	3
Myrtle-leaved willow	-	12
Unidentified willow	1	3
Mooseberry	5	-
Total stems	*1443*	*401*

In the undisturbed segment of the transects, 10 taxa (Table 3-9) were found to be widely distributed, six of which were very widespread (see Table 2-9 for class definitions).

Very widespread species included black spruce trees (Photo 3-1), Labrador-tea (*Rhododendron groenlandicum*) (Photo 3-2), prickly rose (Photo 3-3), bog cranberry (*Vaccinium vitis-idaea*), bunchberry (*Cornus canadensis*) and stairstep moss (*Hylocomium splendens*). Bog cranberry and stairstep moss were found in all undisturbed segments. All the remaining very widespread taxa were found in the undisturbed segment of all but one of the stands.

The widespread taxa in the undisturbed segment included black spruce seedlings, northern comandra (*Geocaulon lividum*), red-stemmed feather moss (*Pleurozium schreberi*) and leaf lichen.

Table 3-9: Distribution[1] (presence as a percentage of all locations) of very widespread, widespread and scattered taxa during the first year of Project operation, 2022

Distribution	Undisturbed Segment	Disturbed Segment
Very Widespread	Bunchberry Stairstep moss Black spruce tree Labrador-tea Prickly rose Bog cranberry	Bog cranberry
Widespread	Northern comandra Leaf lichen Black spruce seedling Red-stemmed feather moss	Fireweed Red-stemmed feather moss

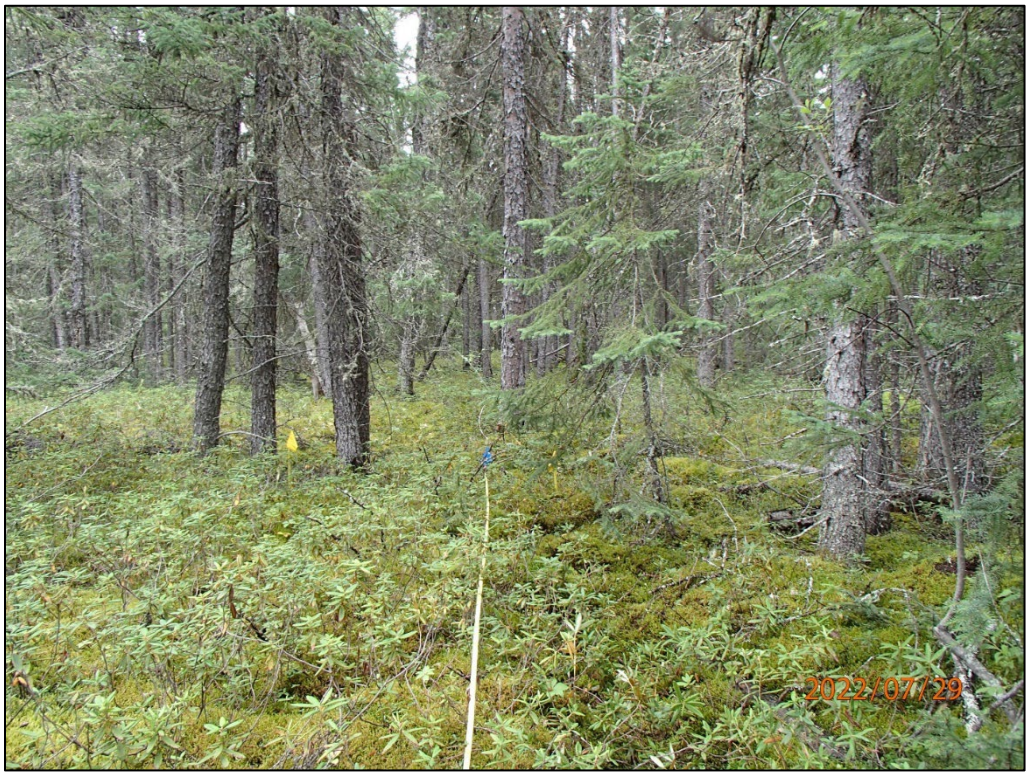


Photo 3-1: Black spruce trees growing at LTEIS022 (Stand 2, Transect 2) on July 29, 2022

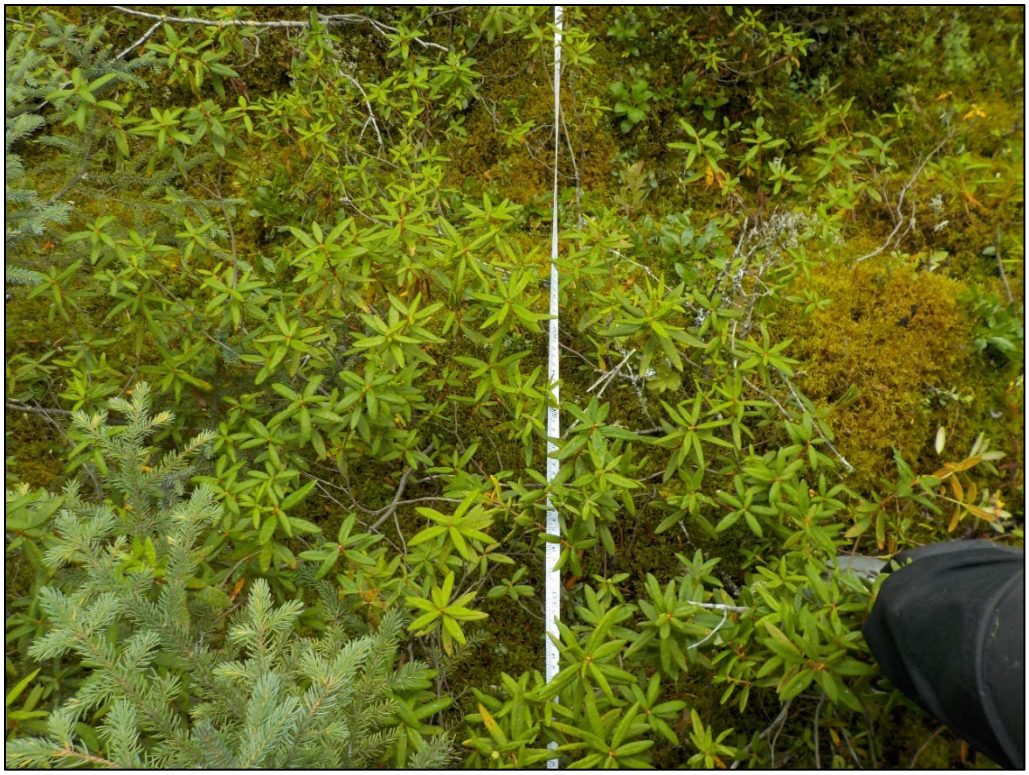


Photo 3-2: Labrador tea growing at LTEIS051 (Stand 5, Transect 1) on August 2, 2022

Photo 3-3: Prickly rose growing at LTEIK042 (Stand 4, Transect 2) on July 10, 2022

3.2.2.2 DISTURBED SEGMENT OF TRANSECTS

In the disturbed segment of the transects, tree recruitment (seedlings and saplings) included the same four species as in the undisturbed segment, plus balsam poplar (*Populus balsamifera*). Black spruce saplings accounted for 38% of the stems counted in the disturbed segment of the locations (Table 3-7), with jack pine saplings and seedlings accounting for a combined 39% of the stems. Paper birch saplings and seedlings made up 17% of the tree recruitment stems.

Eight tall shrub taxa were recorded in the tall shrub belt of the disturbed segment across all stands (Table 3-8). Red raspberry (*Rubus idaeus*) and prickly rose were the most abundant tall shrubs in the disturbed segment, followed by green alder and myrtle-leaved willow.

In the disturbed segment of the transects, three species were widely distributed, one of which (bog cranberry) was very widespread (Table 3-9). The other widely distributed species included fireweed (*Chamaenerion angustifolium*; Photo 3-4) and red-stemmed feather moss. Fireweed was the only species that was widely distributed in the disturbed segment of the transects that was not widely distributed in the undisturbed segment.

Photo 3-4: Fireweed (purple/pink flowers) growing in the disturbed segment at LTEIS022 (Stand 2, Transect 2) on July 29, 2022

3.2.3 PLANTS OF ECOLOGICAL CONCERN

No MESA, SARA or COSEWIC list species (see Appendix1, Table 5-1) or provincially critically imperiled or imperiled (S1 or S2 rank) were found along any of the sample transects, nor were they incidentally found near any of the sample locations.

Shrubby willow (*Salix arbusculoides;* Photo 3-5), was the only provincially possibly imperiled species (S2S3) recorded during habitat surveys. One individual was found along a single transect during the 2022 survey. None of the remaining provincially critically imperiled to vulnerable species that had been identified in the EIS (KHLP 2012a) were found along the sampled transects, or incidentally during surveys.

Photo 3-5: Shrubby willow in 2022 (close-up on right side of photo)

None of the non-native Level 1 species of invasive concern were identified.

Only one Level 2 invasive species, white sweet clover (*Melilotus albus*; Photo 3-6), was recorded on the disturbed segment of a transect in one stand during the 2022 surveys. Incidentally, four non-native species were observed in or near the disturbed segment of transects. The four incidentally observed non-native species were white sweet clover, narrow-leaved hawks-beard

(*Crepis tectorum*), dandelion (*Taraxacum officinale*) and tufted vetch (*Vicia cracca*). Of the non-native species, white sweet clover and tufted vetch were of invasive concern Level 2, while narrow-leaved hawks-beard and dandelion were of concern Level 3.

Photo 3-6: White sweet clover growing along access road on August 25, 2022

4.0 SUMMARY AND CONCLUSIONS

The Long-Term Effects on Habitat study is monitoring the nature of long-term Project effects on inland terrestrial habitat and the extent of native habitat recovery during operation. This report describes the methods used to establish the permanent sample locations, and provides an overview of the habitat attributes at the locations established in 2022.

This study conducts periodic surveys at permanent sample locations along the North and South Access Roads. A field evaluation confirmed that five of the eleven potential sample stands satisfied all selection criteria. Helicopter-based photos and other information acquired along the access road in 2022 will be used to evaluate which of the remaining six potential stands can be sampled, and if replacement stands exist for those that are disqualified.

In the summer of 2022, permanent sample transects were established and surveyed on the ground and by drone within five of the eleven potentially suitable stands. The five sampled stands represented three habitat types, which were Jack pine/black spruce mixture on mineral substrate, Black spruce pure on mineral substrate, and Black spruce pure on thin peat substrate.

Vegetation structure mapping of the stands using the DOIs indicated a high degree of homogeneity in all the stands sampled in 2022. Nearly 100% of the undisturbed habitat across all stands was treed. Differences in structure were due to variation in canopy openness, and variation was between two adjacent structure classes, which were forest and woodland. One of the stands had no variation in structure class over the entire DOI area. A high degree of homogeneity increases confidence that changes detected over time are Project-related because it better controls for potential confounding factors, and increases statistical power to detect effects by controlling natural variability. Natural stand dynamics are a potential confounding factor. An example of this would be older stands in a “gap dynamics” phase, where canopies are naturally breaking apart and forming different structure types.

In this report, results from the transect data are limited to basic descriptive statistics. This was the first year that the transects were sampled, and establishing some of the required sample stands was deferred to 2023. Additional detail will be provided after all the stands have been sampled for the first time.

Black spruce was by far the most common tree and snag species recorded in the tree belt. Black spruce seedlings accounted for 80% of the tree recruitment stems in the undisturbed segment of the tall shrub belt in the undisturbed segment, and 38% in the disturbed segment. Jack pine saplings and seedlings accounted for a combined 39% of the stems in the disturbed segment.

Green alder accounted for 68% of the tall shrub stem counts in the undisturbed segment shrub belt, followed by prickly rose which accounted for just under 20% of the tallied stems. Red raspberry accounted for nearly 40% of the stems in the disturbed segment followed by prickly rose at around 20%.

Of the 69 taxa (i.e., species, species group, or tree growth form) recorded on the transects, 10 were found to be widely distributed in the undisturbed segment of the five stands that were

sampled in 2022, six of which were very widespread. In the disturbed segment, three species were widely distributed.

No plant species of very high conservation concern (i.e., MBCDC ranked S1 or S2) were recorded either on the transects or incidentally during fieldwork.

No non-native plant species of the highest invasive concern (Level 1) were recorded along the transects, or incidentally during surveys. One Level 2 non-native species, white sweet clover, was recorded along one of the transects. This species is well-established in the access road ditches. A second Level 2 non-native species, tufted vetch, was also recorded incidentally, near one of the sampled stands. Management responses for these species are provided in the invasive plants monitoring report (ECOSTEM 2023a).

The remaining stands required to create the baseline dataset will be selected and sampled in summer of 2023.

5.0 LITERATURE CITED

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APPENDIX 1:

SPECIES LISTS

Table 5-1: SARA, COSEWIC and MESA listed endangered species which occur in Manitoba

Species	Common Name	SARA	COSEWIC	MESA
Endangered				
Agalinis aspera	Rough agalinis	X	X	X
Agalinis gattingeri	Gattinger's agalinis	X	X	X
Chenopodium subglabrum	Smooth goosefoot			X
Cypripedium candidum	Small white lady's-slipper	X		X
Pellaea gastonyi	Gastony's cliffbrake			X
Platanthera praeclara	Western prairie fringed-orchid	X	X	X
Spiranthes magnicamporum	Great Plains lady's tresses			X
Vernonian fasciculata	Fascicled ironweed	X	X	X
Threatened				
Bouteloua dactyloides	Buffalograss			X
Celtis occidentalis	Common hackberry			X
Chenopodium subglabrum	Smooth goosefoot	X	X	
Cypripedium candidum	Small white lady's-slipper		X	
Dalea villosa	Prairie clover	X		X
Solidago riddellii	Riddell's goldenrod			X
Symphyotrichum sericeum	Western silvery aster	X	X	X
Tradescantia occidentalis	Western spiderwort	X	X	X
Veronicastrum virginicum	Culver's-root			X
Leptogium rivulare[1]	Flooded jellyskin			

Notes:
1 *Leptogium rivulare* was rated as threatened at the time of the EIS (KHLP 2012b), but has since been adjusted to ."special concern".

Table 5-2: List of species and broader taxa identified on Long-Term Effects on Habitat transects, including their common name, MBCDC S-rank and the number of transect occurrences in 2022

Scientific Name	Common Name	S-Rank	EIS	2022
Achillea millefolium	Common Yarrow	SNA	26	2
Alnus alnobetula	American Green Alder	NA	208	5
Anemonastrum canadense	Canada Anemone	S5	8	1
Arctous alpina	Alpine Bearberry	S3S4	69	3
Aster spp				3
Betula papyrifera	Paper Birch	S5	197	2
Carex spp				5
Carex vaginata	Sheathed Sedge	S5	65	3
Chamaenerion angustifolium	Fireweed	S5	223	8
Cladonia arbuscula ssp. mitis	Green Reindeer Lichen	S4	350	6
Cladonia rangiferina	Gray Reindeer Lichen	S5	189	6
Cladonia spp			282	1
Cladonia stellaris	Star-tipped Reindeer Lichen	S5	128	6
Cornus canadensis	Bunchberry	S5	216	9
Diphasiastrum complanatum	Northern Ground-cedar	S3S4	24	1
Empetrum nigrum	Black Crowberry	S5	65	2
Equisetum arvense	Field Horsetail	S5	260	3
Equisetum scirpoides	Dwarf Scouring-rush	S4S5	154	4
Equisetum sylvaticum	Woodland Horsetail	S5	175	3
Geocaulon lividum	Northern Comandra	S5	111	8
Grass spp				5
Hylocomium splendens	Stairstep Moss	S4S5	347	10
Juniperus communis	Common Juniper	S5	39	1
Larix laricina tree	Tamarack	S5	220	2
Linnaea borealis	Twinflower	S5	140	4
Melilotus albus	White Sweet Clover	SNA	30	1
Mertensia paniculata	Tall Lungwort	S5	45	3
Mitella nuda	Mitrewort	S5	77	2
Moss spp			584	8
Orthilia secunda	One-sided Wintergreen	S5	74	1
Peltigera spp			150	8
Petasites frigidus var. palmatus	Palmate-leaved Colt's-foot	S5	106	5
Picea mariana	Black Spruce	S5	638	7
Pleurozium schreberi	Red-stemmed Feather Moss	S4S5	494	8
Polytrichum juniperinum	Juniper Haircap Moss	S4S5	12	1
Prunus pensylvanica	Pin Cherry	S5	4	2

Scientific Name	Common Name	S-Rank	EIS	2022
Ptilium crista-castrensis	Knight's Plume Moss	S4S5	47	4
Pyrola spp				2
Rhododendron groenlandicum	Labrador-tea	S5	627	9
Ribes triste	Wild Red Currant	S5	66	2
Rosa acicularis	Prickly Rose	S5	199	9
Rubus arcticus	Stemless Raspberry	S5	121	2
Rubus chamaemorus	Cloudberry	S5	178	1
Rubus idaeus	Red Raspberry	S5	30	5
Rubus pubescens	Dewberry	S5	55	2
Salix arbusculoides	Shrubby Willow	S2S3	39	1
Salix bebbiana	Bebb's or Beaked Willow	S5	213	4
Salix myrtillifolia	Myrtle-leaved Willow	S5	150	3
Salix planifolia	Plane-leaved Willow	S5	241	1
Salix spp				2
Sphagnum spp				1
Spinulum annotinum	Stiff Clubmoss	S5	31	3
Symphyotrichum ciliolatum	Lindley's Aster	S5	32	1
Symphyotrichum puniceum	Purple-stemmed Aster	S5	6	1
Vaccinium myrtilloides	Velvet-leaf Blueberry	S5	98	4
Vaccinium oxycoccos	Small Cranberry	S5	202	1
Vaccinium uliginosum	Bog Whortleberry	S5	309	4
Vaccinium vitis-idaea	Bog Cranberry	S5	392	10
Viburnum edule	Mooseberry	S5	90	3
Viola spp				1