Appendix D5

Rare Lichen Baseline Study

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List of Abbreviations

Abbreviations	Definitions
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
LiDAR	Light Detection and Ranging
ELC	Ecological Land Classifications
NL ESA	Newfoundland and Labrador Endangered Species Act
GIS	Geographical Information Systems
GPS	Global Positioning System
IUCN	International Union for Conservation of Nature
LP	Limited Partnership
NL	Newfoundland and Labrador Endangered Species Act
SAR	Species at Risk
SARA	Species at Risk Act
UTM	Universal Transverse Mercator

1.0 Introduction

The Rare Lichens Baseline Study has been developed by Argentia Renewables Wind LP (Argentia Renewables), an affiliate of Pattern Energy Group LP (Pattern Energy) for the Argentia Renewables Project (the Project), which entails the development, construction, operation and maintenance, and eventual decommissioning and rehabilitation of an onshore wind energy generation facility (Argentia Wind Facility) and a green hydrogen and ammonia production, storage, and export facility (Argentia Green Fuels Facility). The wind energy facility (i.e., wind turbine farm) will be mostly located on what is known as the Argentia Backlands, a largely uninhabited, forested area with scattered relic military sites and variable habitat types. The Argentia Green Fuels Facility will be located on the Argentia Peninsula, a brownfield industrial complex. The Port of Argentia owns both the Argentia Backlands property and the Argentia Peninsula. The two, along with a Project Interconnect Line, comprise the Argentia Renewables Project Area. This baseline study focuses on the presence/absence of rare lichen species in the Project Area and potential interactions resulting from Project development.

Newfoundland is one of the few known global locations for three rare lichen Species at Risk (SAR): boreal felt lichen (*Erioderma pedicellatum*), vole ears lichen (i.e., graceful felt lichen) (*Erioderma mollissimum*), and blue felt lichen (*Degelia plumbea*). As epiphytic lichens, these species require a phorophyte (i.e., a vegetative host), often a specific tree species (Schmitt & Slack, 1990). Of the three, only boreal felt lichen was initially considered to have high potential for occurring in the Project Area based on an abundance of balsam fir adjacent to wetlands. That assumption pre-dated the discovery of ample amounts of yellow birch in some parts of the Project Area, which elevated the potential for blue felt lichen.

Boreal felt lichen is listed as Vulnerable under the Newfoundland and Labrador **Endangered Species Act** (NL ESA), as a species of Special Concern under the federal **Species at Risk Act** (SARA), and as Critically Endangered by the International Union for Conservation of Nature (IUCN) (Scheidegger, 2003). Newfoundland has more than 95% of the remaining global population of boreal felt lichen (Wiersma & Skinner, 2011). The central Avalon Peninsula hosts one of the largest known populations of this lichen (Environment Canada, 2010). A boreal felt lichen population is also known to inhabit southeast Placentia (Environment Canada, 2010). Proximity to other populations and an abundance of suitable habitat in the Project Area indicated that this species was likely to be found during surveys.

Vole ears lichen is listed as endangered under the SARA and the NL ESA. COSEWIC has recommended the protection of this species based on the rarity of known thalli in Newfoundland (COSEWIC, 2008). Thalli have been identified on only nine trees in two different areas of the Avalon Peninsula (COSEWIC, 2008). One of the two known locations is amongst the boreal felt lichen population in southeast Placentia (COSEWIC, 2008).

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Both boreal felt lichen and vole ears lichen (*Erioderma spp.*) use mature balsam fir (*Abies balsamea*) as their main phorophyte (COSEWIC, 2008; Environment Canada, 2010). The Argentia Backlands consists mainly of coniferous forests with balsam fir dominating the canopy. Mature balsam fir forests adjacent to wetlands, surrounded by wetlands, or adjacent to waterbodies create moisture regimes suitable for healthy lichen growth and reproduction.

Blue felt lichen is listed as Vulnerable under the NL ESA and is listed as Special Concern under the SARA. This species prefers mature deciduous trees, particularly maples and yellow birch (*Betula alleghaniensis*) (COSEWIC, 2010). Historical observations near the Project Area include Sir Robert Bond Park in Whitbourne where blue felt lichen exists on non-native species such as Norway maple (*Acer platanoides*), and native yellow birch (COSEWIC, 2010). Most known thalli in Newfoundland exist on non-native trees; however, within natural forests they are known to be present on yellow birch with a select few observations on white spruce (*Picea glauca*) (COSEWIC, 2010). Yellow birch is present within the Argentia Backlands of the Project Area as small patches of Mixedwood Forest with large, mature yellow birch dominating the canopy. Some such stands also occur in proximity to wetlands, open waterbodies, or streams, elevating the potential for occurrence due to the bolstered moisture levels. Blue felt lichen is sensitive to any reduction in humidity that could result from the opening of the forest due to windfallen trees, cutting/clearing, or browsing of young trees associated with their typical habitat (COSEWIC, 2010).

2.0 Methods

The detection of rare lichens started with a thorough literature review and desktop analysis that focused on the habitat types associated with each lichen. A review of the Ecological Land Classification (ELC) habitat mapping of the Project Area was then used to identify survey locations with heightened potential.

2.1 Habitat Suitability Mapping

The ELC (Appendix D3) informed the desktop component of the rare lichens study by facilitating the identification of potential suitable habitats. The ELC study consisted of a desktop review and numerous surveys throughout the Project Area. An intensive GIS and public database review was undertaken to gain an understanding of the ecotypes associated with the Project Area and their potential for lichen use. In 2022 and 2023, baseline surveys were conducted throughout the Project Area to support production of the ELC map. These surveys were also used to note the habitat potential for rare lichen species. The resulting observations and coordinate collections were then compiled and developed into lichen habitat suitability maps of the Project Area. Open-sourced LiDAR and aerial imagery combined with ArcGIS software were used to create the maps. These maps were then used to direct rare lichen field surveys.

2.2 Field Surveys

Field surveys were undertaken to confirm the presence, location, and number of individuals of lichen SAR in the Project Area. The survey team had experience conducting rare lichen surveys and were educated about the habitats, indicator species, and host species for relevant lichens. Survey teams visited areas with a high potential for rare lichen presence, as identified in the habitat suitability maps. At each site, the habitat type was identified and ranked to determine its suitability as lichen habitat. Key variables included dominant canopy vegetation and maturity level, proximity to water and/or humidity condition, followed by indicator species and thorough surveys of each suitable tree.

When searching an area of high suitability, each tree (trunk and branches) was examined on all sides from base to approximately 4 m from the ground (i.e., as high as could be visually assessed by surveyors). High-quality optics allowed for the detection of any suspected thalli (e.g., white tipped undersides of boreal felt lichen) located high in trees. When thalli were identified, the following information was collected:

- Date and time;
- GPS location (Easting and Northing);
- Tree species;
- Tree diameter (i.e., diameter at breast height);
- Location of lichen on tree (e.g., height above ground, side of tree, branch vs. trunk);
- Habitat description;
- Photographs; and
- Lichen species and abundance.

In addition to designated rare lichen surveys, during all other field activities (e.g., ELC surveys) incidental observations were sought. Any findings were then documented as per the dedicated survey methods.

2.2.1 Survey Indicators

Survey indicators were developed to determine whether a habitat may be suitable for rare lichens. These indicators included forest species composition, diameter at breast height, maturity, and presence of lichen or liverwort indicator species.

The primary phorophyte for boreal felt lichen is mature balsam fir, but it also requires a suitable substrate for growth on the tree, which is a liverwort species, *Frullania asagrayana* (Cornejo & Scheidegger, 2016). The water sacs of *Frullania* host Rhizonema, the cyanobacteria partner which associates with the fungal hyphae of the boreal felt lichen to create a viable, synthesizing lichen (Cornejo & Scheidegger, 2016). *Frullania* grows within closed canopy mature conifer forests and, like boreal felt lichen, requires a phorophyte host such as balsam fir (Cornejo & Scheidegger, 2016). Salted shell lichen (*Coccocarpia palmicola*) (Figure D5-2.2-1) can also be an effective indicator species and occupies a niche like boreal felt lichen. Where vole ears lichen shares the same phorophyte as boreal felt lichen, these indicator species can be used for both.

Figure D5-2.2-1   *Coccocarpia palimcola* **Growing on a Mature Balsam Fir in the Project Area.**

Blue felt lichen prefers mature deciduous species for phorophyte hosts. In Newfoundland, many of these known lichens exist on non-native red maple (*Acer rubrum*), but native phorophyte hosts are often mature yellow birch. Deciduous stands of significant size and age, proximal to humid conditions, are a good indicator of potential blue felt lichen presence. Indicator species such as those in the genus *Coccocarpia* can also indicate the presence of blue felt lichen (COSEWIC, 2010).

3.0 Results

3.1 Habitat Suitability Mapping

From the ELC it was evident that a large portion of the Project Area was dominated by Mature Coniferous Forest, which had the potential to contain suitable boreal felt lichen or vole ears lichen habitat. The Mature Coniferous Forest ecotype comprised 1,640 ha (34%) of the entire Project Area, although incorporating proximity to wetlands, water, and canopy species composition reduced the total amount of potential area.

Mixedwood Forests were limited in the Project Area in preliminary versions of the ELC; however, high-resolution imagery, open-sourced LiDAR data, and field observations were used to refine the amount of Mixedwood Forest in the ELC. These areas often included deciduous trees upwards of 15 m in height. Sites were also identified as potential lichen habitats (specifically blue felt lichen) based on the composition of deciduous trees and their proximity to humid conditions (e.g., water, wetlands). The Mixedwood forest habitat type was estimated at 369 ha (8%) of the total Project Area.

## 3.1.1 Boreal Felt Lichen and Vole Ears Lichen Habitat

Boreal felt lichen and vole ears lichen share the same phorophyte and habitat preferences and were thus identified by the same suitable habitat. Mature balsam fir stands identified during preliminary field programs in 2022 and 2023 were determined to be suitable habitat for boreal felt lichen and vole ears lichen. Mature balsam fir forest habitat can be seen growing in a moist environment where sphagnum moss and upland forest mosses are in transition, indicating high moisture levels. *Frullania* growth is appropriate to support lichen colonization and growth, and indicator species such as healthy *Coccocarpia* exist throughout the forest stand. Areas identified as suitable habitat for boreal felt lichen and vole ears lichen are presented in Figure D5-3.1-2 at the end of this section.

3.1.2 Blue Felt Lichen Habitat

Mixedwood Forests were identified in the Project Area along the northern coast and northeast section of the Argentia Backlands. During preliminary field exercises, Mixedwood forest stands identified in the northeast section, near Shalloway ponds, were comprised of more than 70% mature birch. These areas were observed to contain mature yellow birch with minimal understory growth (and limited to feathermosses or sphagnum mosses on wetland transitions). **Furthermore,** a small patch of this suitable site was observed to contain two thalli of blue felt lichen growing on a large yellow birch (Figure D5-3.1-1). Areas identified as suitable habitats for blue felt lichen are presented in Figure D5-3.1-2.

Figure D5-3.1-1   Blue Felt Lichen Thalli on a Mature Yellow Birch in the Project Area.

Legend:
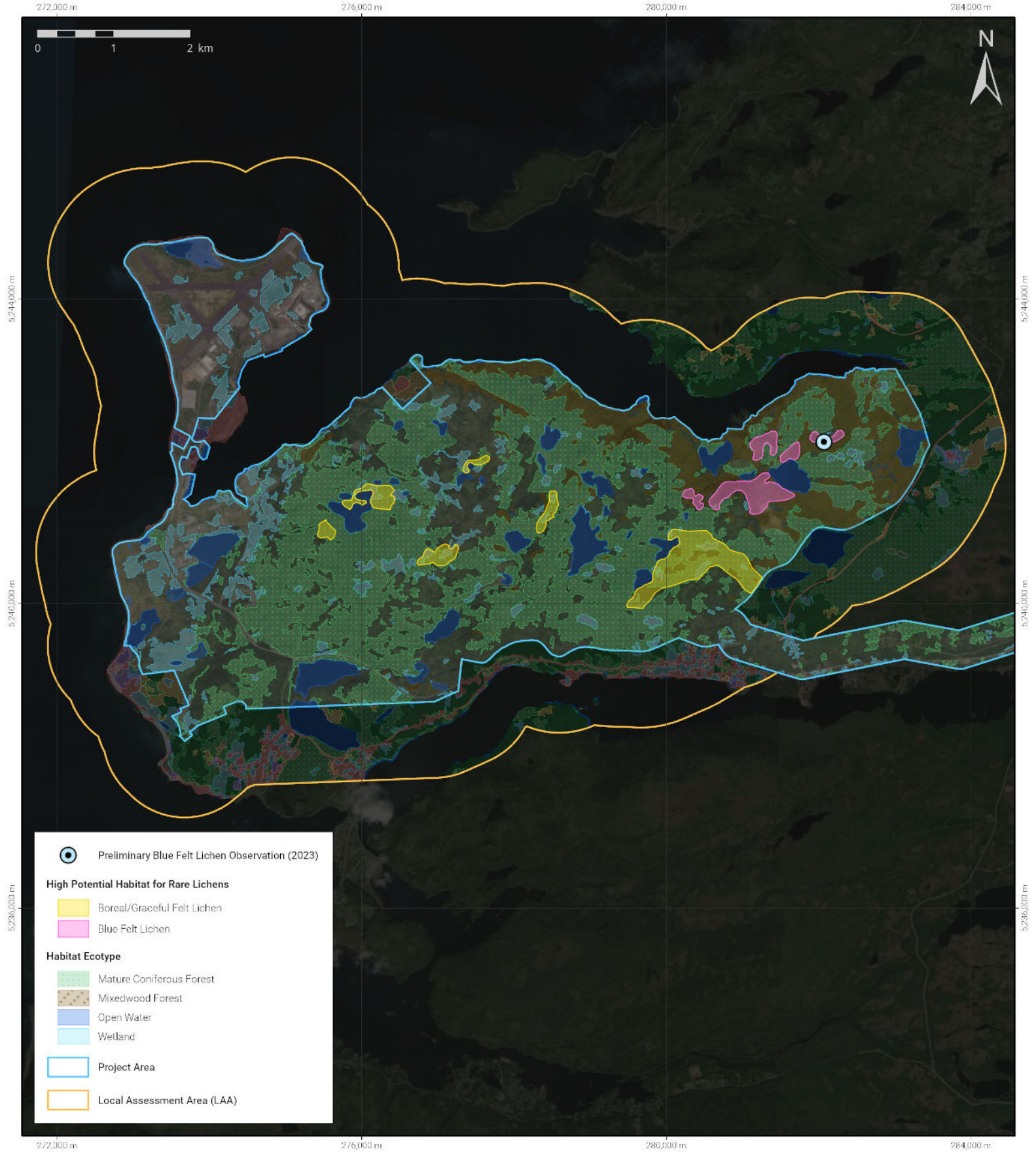
- ⊙ Preliminary Blue Felt Lichen Observation (2023)

High Potential Habitat for Rare Lichens
- Boreal/Graceful Felt Lichen
- Blue Felt Lichen

Habitat Ecotype
- Mature Coniferous Forest
- Mixedwood Forest
- Open Water
- Wetland
- Project Area
- Local Assessment Area (LAA)

Scale: 0 — 1 — 2 km

272,000 m | 276,000 m | 280,000 m | 284,000 m

5,244,000 m | 5,240,000 m | 5,236,000 m

N

3.2 Field Surveys

Field surveys were conducted in all high-potential habitats for the rare lichens deemed possible for the Project Area. Observations were made of boreal felt lichen and blue felt lichen but not vole ears lichen (Figure D5-3.2-1). Results of the field surveys are discussed in the sections below.
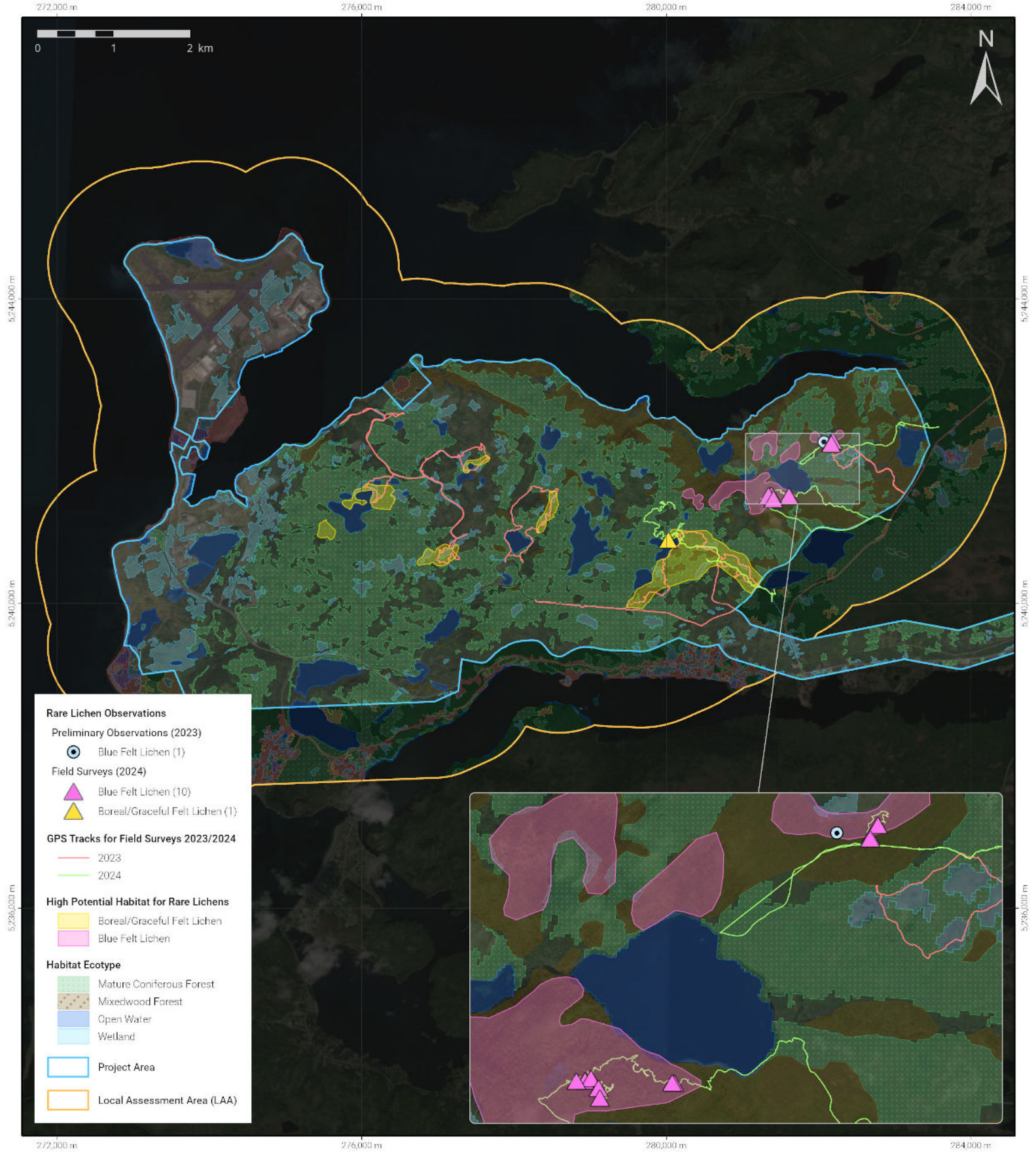
0 1 2 km

272,000 m 276,000 m 280,000 m 284,000 m

5,244,000 m 5,240,000 m 5,236,000 m

N

Rare Lichen Observations

Preliminary Observations (2023)
- ◉ Blue Felt Lichen (1)

Field Surveys (2024)
- ▲ Blue Felt Lichen (10)
- ▲ Boreal/Graceful Felt Lichen (1)

GPS Tracks for Field Surveys 2023/2024
- —— 2023
- —— 2024

High Potential Habitat for Rare Lichens
- Boreal/Graceful Felt Lichen
- Blue Felt Lichen

Habitat Ecotype
- Mature Coniferous Forest
- Mixedwood Forest
- Open Water
- Wetland

- ☐ Project Area
- ☐ Local Assessment Area (LAA)

3.2.1 Boreal Felt Lichen and Vole Ears Lichen

Areas of high potential for boreal felt lichen and vole ears lichen were surveyed according to the habitat suitability map. Based on topographic characteristics from aerial imagery, transects were created to allow for thorough surveys. Despite extensive efforts with 100% coverage of all high potential areas (Figure D5-3.2-1), only two boreal felt lichen thalli were observed on a single tree at one site north of Hickey's Pond in the eastern portion of the Project Area (Table D5-3.2.1-1). No vole ears lichen was observed during field surveys.

Table D5-3.2.1-1   Recorded Observations of Boreal Felt Lichen.

Survey Year	Coordinates (UTM, Zone 22T)		Number of Thalli per Tree
2024	280023.89 m E	5240847.59 m N	2

3.2.2 Blue Felt Lichen

The relatively low proportion of Mixedwood Forest in the Project Area facilitated a focus on those areas of heightened potential for blue felt lichen. Full coverage of each suitable yellow birch (to the height that was practical and safe) was necessary to determine the presence of thalli. During ELC surveys in 2023, two thalli were observed out of approximately 100 surveyed trees. An additional 80 potential thalli were identified during dedicated surveys in 2024. The 2023 and 2024 survey results are shown in Table D5-3.2.2-1. Consultations with Wildlife Division began in 2023 to confirm the identification of these thalli as blue felt lichen (from photographs). To date, more than half of the thalli have been confirmed as being blue felt lichen. Twenty hectares of suitable Mixedwood Forest remains to be surveyed and will be completed in the summer of 2024.

Table D5-3.2.2-1   Recorded Potential Observations of Blue Felt Lichen.

Survey Year	Coordinates (UTM, Zone 22T)		Number of Thalli per Tree
2023	282069.00 m E	5242121.00 m N	2
2024	281613.24 m E	5241422.66 m N	1
2024	281607.35 m E	5241423.10 m N	1
2024	281363.00 m E	5241429.00 m N	1
2024	281380.00 m E	5241435.37 m N	2
2024	281400.91 m E	5241407.76 m N	3
2024	281339.00 m E	5241428.00 m N	14
2024	281404.77 m E	5241380.66 m N	2
2024	282163.01 m E	5242113.90 m N	10
2024	282183.94 m E	5242145.50 m N	15
2024	282162.46 m E	5242107.12 m N	31

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4.0 Discussion

Surveys have confirmed that boreal felt lichen and blue felt lichen are present within the Project Area. While habitat suitability maps indicated that there would be a high likelihood of boreal felt lichen presence throughout the Project Area, only two thalli were found. No development will occur near the known population of boreal felt lichen and vole ears lichen in Southeast Placentia. Rare lichens found in the Project Area will be protected through mitigation measures (e.g., mandatory set-back distances) as committed to in Chapter 4.2 of the Registration document. Additional surveys of potential habitat will be completed once Project infrastructure design is more advanced.

Conversely, despite the low expectation for blue felt lichen to be found in the Project Area, more than 80 thalli are likely to be confirmed. Stands/polygons identified as mixedwood will be surveyed for blue felt lichen prior to any construction activities, if it is possible for interaction with Project infrastructure.

5.0 References

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