Appendix D3

# Ecological Land Classification Baseline Study

# Appendix D3
# Ecological Land Classification (ELC)

# Table of Contents

# List of Figures



# List of Tables



# List of Acronyms and Abbreviations

| Abbreviations | Definitions |
|---|---|
| ATV | All Terrain Vehicle |
| COSEWIC | Committee on the Status of endangered Wildlife in Canada |
| CWCS | Canadian Wetland Classification System |
| DBH | Diameter at Breast Height |
| ELC | Ecological Land Classification |
| GPS | Global Positioning System |
| LIDAR | Light Detection and Ranging |
| LP | Limited Partnership |
| NL | Newfoundland and Labrador |
| RPAS | Remotely Piloted Aircraft System |
| SAR | Species at Risk |

# 1.0 Introduction

An Ecological Land Classification (ELC) 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.

The ELC has been developed as a map that demonstrates the ecotypes across the Project Area. To create the map, high-resolution colour imagery was acquired using remotely piloted aircraft systems (RPAS), leading to the compilation of an imagery dataset. This dataset was then used in conjunction with ArcGIS software to perform an aerial imagery analysis to identify ecotypes. Ground-truthing surveys were undertaken throughout the Project Area in 2022 and 2023. This resulted in the acquisition of GPS and vegetation composition data. The resulting detailed ELC map facilitated the planning of field surveys for avifauna, bats, rare lichens, and rare plants.

The ELC differentiates ten main ecotypes: Wetlands, Open Water, Mature Coniferous Forest, Mixedwood Forest, Coniferous Scrub, Barrens, Regenerating Coniferous Forest, Meadows, Anthropogenic areas, and Coastline. The Mature Coniferous Forest ecotype primarily represented mature balsam fir (*Abies balsamea*) forest and encompassed some areas of treed bog. Coniferous forests including mature forest, regenerating coniferous forest, and coniferous scrub dominated the Project Area. The mature Mixedwood Forest ecotype represented upwards of 34 ha of the Argentia Backlands, comprised of mature yellow birch (*Betula alleghaniensis*) forests with balsam fir regeneration. Mixedwood forests were most dominant in the northern portion of the Argentia Backlands. Balsam fir comprised most of the Regenerating Coniferous Forest ecotype, whereas black spruce (*Picea mariana*) dominated the Coniferous Scrub ecotype (i.e., smaller, densely growing mature spruce stunted by poor growing conditions and/or wind). Coniferous Scrub was often found on the fringes of wetlands, exposed hilltops, and on the edges of rocky outcrops, in the transitional zones between mature forests and open habitats. Most of the open habitats in the Project Area were classified under the Wetland ecotype (i.e., fens, bogs, swamp, and marsh habitat). Wetlands are abundant throughout the Project Area, and most often occupy valleys or depressions in topography. Coastline was primarily comprised of beach (i.e., slightly sloped rocky, eroded plains within 10-50 m of the vegetation line), sometimes infringed upon by eroding dirt banks.

*Cladonia* lichens, heath, and shrubs dominate the natural habitat in areas of high elevation where upland dry conditions exist. These areas are classified under the Barren ecotype and are often associated with rocky outcrops. Barren habitats were also associated with wetlands when bowl-shaped depressions in rock formed wet pockets, creating barren-to-wetland transition zones with wetland and barren species mixing at the transition point. Anthropogenically altered (i.e., developed) habitats and structures form the Anthropogenic ecotype. Areas of historic anthropogenic influence, including relic military infrastructure in the Argentia Backlands and the largely developed (brownfield) Argentia Peninsula, have led to the development of the Meadow ecotype. White spruce (*Picea glauca*) and balsam fir grow between meadow gaps and are the dominant megaflora of the treed areas in meadows. Herbs, meadow grasses, and shrubs dominate the substrate layer and are often seen in the southwestern portion of the Argentia Backlands, where anthropogenic development persists or historically existed.

# 2.0 Methods

## 2.1 Ecotype Identification

A comprehensive literature review and data compilation exercise was conducted to compile existing information on the Project Area and to find open-sourced LiDAR imagery. Processes established by Meades & Moores (1994) for identifying Newfoundland habitats were used to develop specific habitat delineations. Next was the preparation of a detailed mapping of the Project Area using high-resolution colour imagery collected with a SenseFly eBee remotely piloted aircraft system (RPAS), as shown in Figure D3-2.1-1.

**Figure D3-2.1-1 RPAS Imagery of Project Terrain.**

The resulting imagery dataset was comprised of high-resolution digital images (3.3 cm/pixel) captured directly from the sensor onboard the RPAS. The orthorectified imagery was imported into ArcGIS for interpretation. ArcGIS and the various layers available were used to obtain slopes, moisture levels, and vegetation cover based on morphology and coloration of habitat features on the map layers.

Unique fine-scale habitats tend to have elevated potential for the occurrence of rare flora species, and many such species have specific habitat associations. Ecotypes were therefore used to determine areas of heightened potential for the occurrence of rare species. Habitat polygons were interpreted at a scale of 1:5,000 using digital imagery and information gathered from ground-truthing efforts in the field. Information was captured consistently based on a static zoom level with the interpreter defining homogeneous regions for each targeted ecotype. Digitization of polygons was supplemented by a point file within ArcGIS that was populated with attribute information related to each vegetation polygon. This centroid point data was entered based on the interpreter's field experience and familiarity with regional ecotypes and field data.

## 2.2 Ecotype Classification and Vegetation Survey

Ecotype classification surveys were conducted in 2022 and 2023. Ecotypes were verified in the field by sampling predetermined points plotted during the boundary interpretation stage. Field verification facilitated ecotype characterization, including species composition (Figure D3-2.2-1). Information gathered in the field was used to refine ecotype boundaries and aggregate ecotypes based on similar characteristics.

**Figure D3-2.2-1 Biologist Conducting Vegetation Surveys.**

Vegetation surveys were completed at each site within a 10 m radius plot surrounding the observer. The vegetation species presence and relative abundance in comparison to other species were documented. All species from the herbaceous layer (including non-vascular bryophytes), shrub layers, and canopy, were recorded to document the entire vegetation composition of each specific ecotype. The indicator of abundance for each species was relative to the surrounding species and expressed on a scale of 1 - 100% dominance of the 10 m survey area. Components that contribute to habitat suitability mapping for fauna include dominant canopy and ground cover species, ecotype, and observations of additional species that occur in the area (e.g., prey fauna).

Baseline vegetation inventories were supplemented with the observation of abiotic habitat features (i.e., rocky terrain, moisture level, closed-canopy shade, or open conditions). These details aided in classifying the habitat in more detail and supplementing constraint mapping and potential mitigation measures. Photos were taken for future reference. A selection of example pictures is included in this report, all taken within the Project Area. At every sampling location, GPS data was recorded, and GPS points were used to develop the ELC map using ArcGIS.

## 2.3 GPX Overlay

After the habitat and vegetation surveys were complete, all data, GPS waypoints, and tracks (GPX) were compiled. Spreadsheets were produced to correlate the GPS coordinates to each ecotype assessment and vegetation survey. These GPS waypoints were overlaid onto the desktop ELC map, checked for accuracy and then provided as supplementary data to support the production of a highly detailed map.

# 3.0 Ecological Land Classification Results

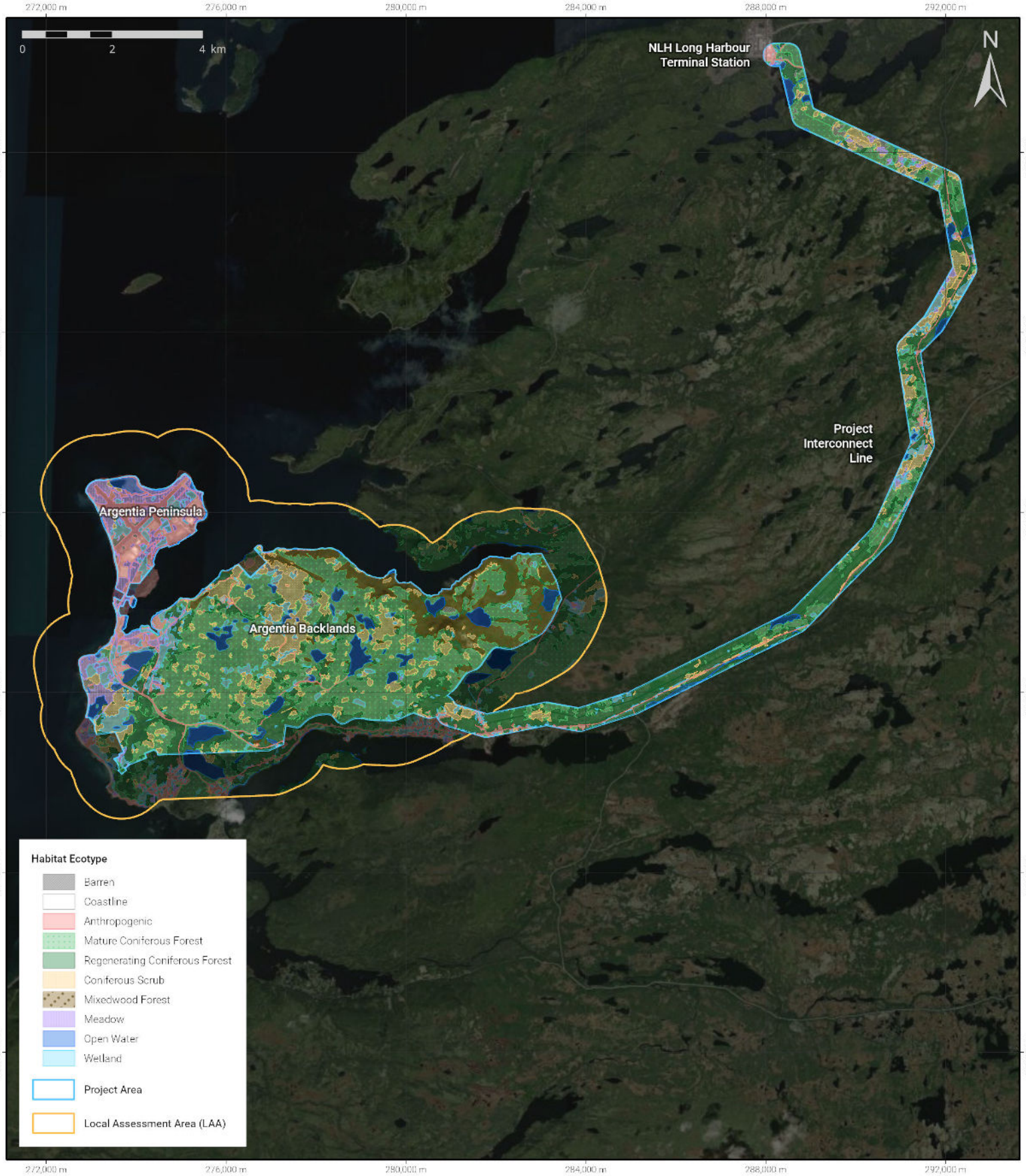
The ELC comprised a thorough generalized land classification for the Project Area. The ELC map (Figure D3-3.0-1) is provided in Table D3-3.0-1 below. This ELC represents broader ecotypes as an overview of the Project Area. Finer differentiation is discussed in sections to follow covering each ecotype. Note that the Open Water ecotype was assessed as part of the aquatic baseline studies (see Registration Appendix B1). The following were the main ecotypes identified in the Project Area:

- Barren (Section 3.1);
- Coastline (Section 3.2);
- Regenerating Coniferous Forest (Section 3.3);
- Mature Coniferous Forest (Section 3.4);
- Coniferous Scrub (Section 3.5);
- Mixedwood Forest (Section 3.6);
- Wetland (Section 3.7);
- Meadow (Section 3.8);

- Anthropogenic (Section 3.9); and
- Open Water (Registration Appendix B1).

**Table D3-3.0-1 Ecotype Composition, Project Area, 2023.**

| Ecotype | Area (ha) | Percentage of Project Area (%) |
|---|---|---|
| Barren | 96 | 1.88 |
| Coastline | 75 | 1.47 |
| Anthropogenic | 500 | 9.78 |
| Mature Coniferous Forest | 1,683 | 32.92 |
| Meadow | 255 | 4.99 |
| Mixedwood Forest | 35 | 0.68 |
| Regenerating Coniferous Forest | 1,031 | 20.16 |
| Coniferous Scrub | 804 | 15.72 |
| Open Water | 266 | 5.20 |
| Wetland | 368 | 7.20 |
| **Total** | **5,113 ha** | **100%** |

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| | FIGURE TITLE: Ecological Land Classification | NOTES: | REVIEWED BY: | |
| | PROJECT TITLE: Argentia Renewables | | APPROVED BY: | sem |

SEM MAP ID: 238-005-GIS-112-Rev1

# 3.1 Barren

Barren areas are represented by shrub-level heath, upland mosses, and stunted coniferous trees such as black spruce and fir. The Upland Barren Ecotype of the Argentia Backlands is shown in Figure D3-3.1-1. This leads to elevated bare rock habitat with mosses, *Cladonia* lichens, and ericaceous shrubs. High-elevation barrens may host species found commonly in alpine areas and atypical of lowland forested habitats (Figure D3-3.1-2).

**Figure D3-3.1-1 Upland Barren Ecotype, Argentia Backlands.**

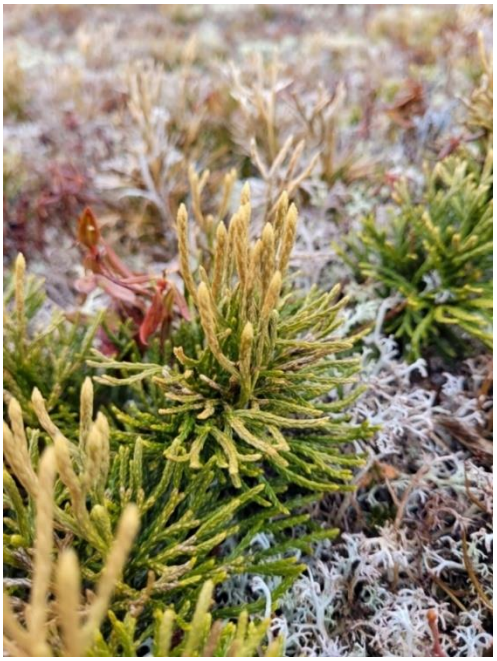

**Figure D3-3.1-2 *Diphasiastrum complanatum* in Barren Ecotype.**

## 3.2 Coastline

The Coastline ecotype for the Project Area was primarily represented by beach (i.e., slightly sloped rocky, eroded plains within 10-50 m of the vegetation line). The vegetation line varied along Project Area shorelines due to the erosion of high dirt banks by waves. Beaches were often dominated by solid bedrock or eroded beach rocks. Much of the coastline in the southern portion of the Project Area has been anthropogenically influenced, with numerous developments altering the vegetation composition. On the northern end of the Argentia Peninsula, natural beach rock dominates the substrate, and sparse beach vegetation like beach grasses (*Ammophila* spp.) grows on elevated banks of eroded beach rock. Small, skinny rock beaches (10-15 m) with slight slopes (10-15% grades) lead to dramatic slopes of much higher grades with coniferous thickets protruding upwards to the plateaus. Bare bedrock cliffs devoid of vegetation occur where the grade is too steep for soil development.

## 3.3 Regenerating Coniferous Forest

Regenerating Coniferous Forest occurs throughout the Project Area. The ecotype is comprised mainly of densely growing juvenile balsam fir, the primary colonizing species of gaps formed by blowdown events, ice damage, or insect infestation (Morin, 1994). In the Project Area, blowdown has been the main driver of gap dynamics. The coastal, hilly terrain of the Project Area contains large swaths of mature forests exposed to wind gusts. Most of the Argentia Backlands are patchy, with mature intact forest bisected by large patches of Regenerating Coniferous Forest (Figure D3-3.3-1). Fir and spruce are known to be highly susceptible to wind damage and blowdown (Rich *et al*., 2007).

**Figure D3-3.3-1** **Balsam Fir Regenerating Coniferous Forest with Blowdown Mature Trees and Dense Regeneration Fir Growth.**

### 3.3.1 Balsam Fir Thicket

Balsam fir thickets were identified throughout the Project Area, mostly on sloped terrain, near valley streams, and on the hillsides of large hills (Figure D3-3.3.1-1). These thickets represent a balsam fir-dominated forest that is transitional between regenerating forests and mature forests, where trees are densely packed with a closed canopy. Thickets represent forests that have reached the age where many understory trees are dying or have already diminished due to the process of faster-growing trees closing off the canopy, known as “self-thinning” (Huang *et al.*, 2013). The lack of light and soil moisture reduces the capability of slower-growing trees beneath the canopy to grow to adult sizes, and they begin to die off and thin out the forest stand as it matures (Huang *et al.*, 2013). The closed canopy and high stem density of the thicket reduces biodiversity in the shrub and herbaceous layer. Some areas were observed to lack ground-covering species, where the forest floor appears as pure organic compacted soil with leaf and needle litter (e.g., steep hillside thickets).

**Figure D3-3.3.1-1 Trailside Balsam Fir Thicket.**

## 3.4 Mature Coniferous Forest

Mature Coniferous Forest was the most prevalent ecotype in the Project Area (33%), found only on the Argentia Backlands portion and along the Project Interconnect Line to Long Harbour. It does not occur on the Argentia Peninsula. The mature coniferous stands were mostly comprised of medium to large-diameter balsam fir trees with some interspersed black spruce.

### 3.4.1 Mature Balsam Fir – Feathermoss

Feathermosses are upland carpeting moss species including Schreber's moss (*Pleurozium schreberi*), shaggy moss (*Rhytidiadelphus triquetrus*), haircap moss (*Polytrichum commune*), broom moss (*Dicranum scoparium*.), plume moss (*Ptilium crista-castrensis*), and stair-step moss (*Hylocomium splendens*). The balsam fir-feathermoss forests in this ELC form part of a larger group of balsam fir forests classified by Meades & Moores (1994). Mature balsam fir-feathermoss habitat typically occurs at mid to upper-level slopes (Meades & Moores, 1994) (Figure D3-3.4.1-1). This habitat may be suitable for epiphytic lichens depending on humidity and tree maturity. Such lichen species tend to occur in humid forests near wetlands (within 80 m) and are associated with forests within 25 km of the Atlantic coast (Cameron *et al*., 2013). Lichens such as boreal felt lichen (*Erioderma pedicellatum*) and graceful felt lichen (*Erioderma mollissimum*) mostly occur within mature balsam fir-feathermoss forests near wetlands, especially where the forest meets a transition point with mature balsam fir-sphagnum forests.

**Figure D3-3.4.1-1 Mature Balsam Fir-Feathermoss Forest Habitat.**

### 3.4.2 Mature Balsam Fir – Sphagnum

At the mid to lower level of slopes, or in slightly upland area surrounding wetlands, mature balsam fir forests exist with transitional characteristics contrasting those of the more upland balsam fir-feathermoss forests (Figure D3-3.4.2-1). One main difference between balsam fir-feathermoss and sphagnum forests is that the dominant herbaceous layer of the latter is mainly sphagnum moss, a typical wetland moss. Other species more representative of wetlands, such as rushes (*Juncus spp*.), graminoid spp., sedges (*Carex spp*.) and others, may occur in wetter areas or lowland mature balsam fir-sphagnum forests near or within wetlands.

**Figure D3-3.4.2-1 Mature Balsam Fir-Sphagnum Forest Adjacent to a Wetland.**

# 3.5 Coniferous Scrub

Coniferous Scrub is identified as low, densely growing coniferous trees, shrubs, or species less than 5 m in height that would typically grow larger but are dense and stunted due to environmental conditions (Meades & Moores, 1994). The two types of Coniferous Scrub identified in the Project Area are black spruce scrub and coastal scrub.

## 3.5.1 Black Spruce Scrub

Black Spruce Scrub includes black spruce-dominated habitat on the fringes of wetlands where growing conditions are sufficient to support the acid-tolerant species like black spruce and ericaceous shrubs (Figure D3-3.5.1-1). It also describes areas where uplands are occupied by smaller, stunted fir or spruce.

**Figure D3-3.5.1-1 Black Spruce Scrub on the Fringes of a Fen Complex.**

### 3.5.2 Coastal Scrub

Several areas of coastal scrub exist on the Argentia Peninsula. This wind-swept habitat is associated with low-growing vegetation including herbs, small shrubs, heath, and upland lichen and moss species at the substrate layer (Figure D3-3.5.2-1). These areas were often immediately adjacent to the coastline (e.g., beaches) and were exposed to coastal erosion, high winds, and anthropogenic influence. Several areas of native coastal heath species were intermixed with anthropogenically introduced species where land had been altered historically.

**Figure D3-3.5.2-1 Coastal Scrub Dominated by Tuckamore Balsam Fir and Heath.**

## 3.6 Mixedwood Forests

This ecotype is classified based on the characteristics of the dominant mature canopy, where deciduous trees comprise a significant ratio to coniferous (i.e., neither coniferous nor deciduous comprises more than 75% of the canopy). However, for the purposes of this ELC, relatively pure mature yellow birch was grouped with Mixedwood Forest.

Mixedwood Forests in the Project Area consisted of mature yellow birch as the main deciduous species (Figure D3-3.6-1). Some areas of immature white birch existed as birch-Dryopteris forests, but mature mixedwood forests dominated by yellow birch were much more prevalent.

**Figure D3-3.6-1 Mixedwood Forest.**

## 3.6.1 Mature Yellow Birch

Mature yellow birch dominated forest constituted roughly 34 hectares of the Project Area. These closed-canopy habitats were dominated by large, mature yellow birch with an average DBH (diameter at breast height) of more than 40 cm. Tree bark often hosted healthy lichen growth, and several blue felt lichen (*Degelia plumbea*) thalli were observed to exist on a large mature specimen of birch in this ecotype (see Figure D3-3.6.1-1). Yellow birch is known as the main phorophyte of blue felt lichen and provides a suitable habitat when it exists within areas of coastal humid zones such as those represented by the Argentia Backlands (COSEWIC, 2010).

In many areas it was observed that black spruce, white spruce, and balsam fir shared the sub-canopy, occupying slightly less than 50% of the canopy cover. The understory in areas with intact closed-canopy conditions is less biodiverse due to broadleaf cover producing shade throughout the summer months. Young birch and fir can be seen sporadically throughout the forest stand with a low diversity of feathermosses. The mature yellow birch in the Project Area reach upwards of 16 m in height and more than 30 cm in DBH. This habitat type is relatively uncommon on the Avalon Peninsula and exists mainly in the northern section of the Argentia Backlands in the large valley surrounding Big Shalloway Pond and Outer Shalloway Pond.

**Figure D3-3.6.1-1 Large Mature Yellow Birch Hosting Blue Felt Lichen Thalli.**

## 3.6.2 Birch – Fern

Birch-fern forest represents a very small portion of the Project Area. This habitat type occupies moist upland areas and encompasses characteristics of both Dryopteris-Birch and Gaultheria-Kalmia-Birch forest types as described by Meades & Moores (1994). Ferns of the genus Dryopteris, accompanied by bunchberry (*Cornus canadensis*) and graminoid species make up most of the herbaceous vegetation, and open white birch dominates the tree or canopy layer (Figure D3-3.6.2-1). Graminoids dominate the forest floor. This habitat type would be formed through gap dynamics when windthrow areas are colonized by the pioneer white birch instead of balsam fir.

**Figure D3-3.6.2-1 White Birch Fern Forest Habitat in the Western Hillsides of the Project Area.**

# 3.7 Wetland

Wetlands were abundant throughout the Project Area (Figure D3-3.7-1). Fens, bogs, treed fens and bogs, and some limited marshy areas near waterbody-wetland transitions existed throughout. Wetlands in NL can be characterized into five classes (according to the Canadian Wetland Classification System (CWCS)): (i) bog; (ii) fen; (iii) swamp; (iv) marsh; and (v) shallow water wetlands (National Wetlands Working Group, 1997); however, for the purposes of the ELC, this level of resolution was not required. Sphagnum moss (*Sphagnum sp.*), accompanied by sedges (*Carex sp.*) make up most of the herbaceous vegetation in wetlands, with increased diversity where the wetland approaches riparian vegetation and meadows.

Based on preliminary design, the quantity of habitat that will be altered for turbine pad/laydown area and road construction is outlined in Table R-3.1.1-1 of Appendix R. This calculation excluded collector lines, the Project Gen-Tie, and the Interconnect Line, as such the ELC habitat data excluded the Project Interconnect Line right-of-way. At the time of this calculation, Project infrastructure is estimated to alter 4.32 ha of wetland, however, the Project maintains the goal to minimize their effects on wetlands. This is calculated currently by the use of a preliminary Project layout and ELC mapping (Appendix D3) for this modelling. The Project layout will still undergo micro-siting adjustments prior to construction to avoid minimize effects on wetlands in the Project Area where practicable.

**Figure D3-3.7-1 Wetland Ecotype in the Project Area.**

# 3.8 Meadow

Meadow was classified as any open habitat with low-growing graminoids, herbs, shrubs, and heath. Treed meadows include sparse coniferous tree growth (often white spruce or balsam fir) throughout open areas. The Meadow ecotype in the Project Area is comprised of anthropogenically-altered land on the Argentia Peninsula, meadows west and southwest in the Argentia Backlands, and meadows near military infrastructure such as bunkers, and along roadsides and ATV trails (Figure D3-3.8-1). These meadows are comprised mainly of graminoid spp., herbs such as hawkweed (*Hieracium caespitosum*), goldenrod (*Solidago* spp.), thistle (*Cirsium* spp.), Canada burnet (*Sanguisorba canadensis*), and strawberry (*Fragaria vesca*). Meadows were often sparsely populated with large white spruce or balsam fir at the periphery. Other species that may occupy the ground cover in these habitats include dryland mosses such as Schreber's moss, hair cap moss, and clovers (*trifolium* spp.).

The anthropogenically-disturbed coastal meadows on the Argentia Peninsula are comprised of similar meadow species but are interspersed with patches of stunted coniferous trees associated with exposure to coastal winds and salt air (Figure D3-3.8-2). Substrate is dominated by graminoids and herbs in areas of previous disturbance and between roadways. In areas with conifer growth, crowberry makes up the most abundant ground-covering species. This habitat could be classified as heathland, but for now will be encompassed by the Meadow ecotype. Differences in specific vegetation cover may be analyzed to further differentiate these ecotypes.

**Figure D3-3.8-1** **Meadow Habitat Surrounding Historical Access Road and Current ATV Trail in the Argentia Backlands.**

**Figure D3-3.8-2 Anthropogenically Disturbed Meadow on the Argentia Peninsula.**

## 3.9 Anthropogenic

The Anthropogenic ecotype represents all areas that are currently occupied by human development and infrastructure, and areas where natural habitat does not exist. Paved roads, crushed stone roads, buildings, docks, wharves, and other working equipment (e.g., platform, runway, and crane on the Argentia Peninsula) are anthropogenic and are encompassed within this ecotype.

# 4.0 Discussion

The Project Area is diverse, ranging from relatively untouched mature forests to highly disturbed landscapes with anthropogenically affected vegetation. The ELC facilitated the identification of ecotypes, which aided in planning the field efforts for various baseline studies, including Species at Risk (SAR) surveys. With an understanding of the ecotypes present in the Project Area and their use by SAR, Project design can incorporate precise habitat features, especially to avoid important/sensitive habitat and potentially minimize habitat fragmentation.

# 5.0 References

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