ENVIRONMENTAL ASSESSMENT REGISTRATION

Argentia Wind Farm Resubmission

Prepared for:
Department of Environment and Conservation
Environmental Assessment Division
St. John's NL

Submitted by

Wind Project Inc.

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TABLE OF CONTENTS

1.0 NAME OF THE UNDERTAKING 3
2.0 PROPONENT 3
2.1 Name of Corporate Body 3
2.2 Address 3
2.3 Chief Executive Officer 3
2.4 Principal Contact Person for Purposes of Environmental Registration 3
3.0 THE UNDERTAKING 4
3.1 Nature of the Undertaking 4
3.2 Purpose, Rationale and Need for the Undertaking 5
3.2.1 Global Trends 5
3.2.2 Newfoundland Opportunities 5
4.0 DESCRIPTION OF THE UNDERTAKING 7
4.1 Geographic Location 7
4.2 Physical Features 8
4.2.1 Major Physical Features of Wind Farm 8
4.2.2 Area Affected by the Wind Farm 11
4.2.3 Physical and Biological Environments within the Area 13
4.3 Construction 20
4.3.1 Construction Period 20
4.3.2 Construction Activities Affecting Physical Environment 20
4.3.3 Potential Source of Pollutants During Construction 21
4.3.4 Mitigation Measures 21
4.3.5 Potential Resource Conflicts 21
4.4 Operation 21
4.4.1 Description of the Operation 21
4.4.2 Estimated Period of Operation 22
4.4.3 Potential Sources of Pollutants During Operation and Mitigation Measures 22
4.4.4 Potential Causes of Resource Conflicts 22
4.4.5 Project Decommissioning 22
5.0 OCCUPATIONS 22
5.1 Construction Phase 23
5.2 Operational Phase 23
6.0 APPROVAL OF THE UNDERTAKING 24
7.0 PUBLIC AND FIRST NATION CONSULTATION 25
7.1 Public Consultation 25
7.2 First Nation Consultation 26
8.0 SCHEDULE 27
9.0 FUNDING 27
10.0 REFERENCES 27

ATTACHMENTS
Attachment A: Wind Farm Layout 30
Attachment B: Jon Joy's CV 39
Attachment C: Pre-Construction Bird Survey 41
Attachment D: Bird Monitoring Program 64
Attachment E: Lichen Survey 70

1.0 NAME OF THE UNDERTAKING

The name of the undertaking is: **Argentia Wind Farm Resubmission**

2.0 PROPONENT

2.1 NAME OF CORPORATE BODY

The name of the corporate body is: **Wind Project Inc. (WPI)**
WPI is a privately owned company; Certificate of Incorporation 389392-8, Ontario Registration Number 1526792.
WPI business activities are the development of wind farms and consulting services for the wind energy industry.

2.2 ADDRESS

The head office is located at:
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L9T 1R8

2.3 CHIEF EXECUTIVE OFFICER

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2.4 PRINCIPAL CONTACT PERSON FOR PURPOSES OF ENVIRONMENTAL REGISTRATION

Name:	Helge Wittholz, Partner
Address:	as above
Tel.:	as above
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3.0 THE UNDERTAKING

3.1 NATURE OF THE UNDERTAKING

WPI proposes to develop, construct, own and operate a wind farm near Argentia, within the municipal boundaries of the Town of Placentia, NL, on land owned by the Argentia Management Authority (AMA). The project is expected to comprise of nine (9) to eleven (11) wind turbine generators (WTG) with a total capacity of approximately 27.0 MW. The proposed WTG's feature a conical tubular steel tower with a hub height of about 65 to 80 m and a three-bladed rotor with a diameter of up to 90 m. The rated electrical power generation capacity from a single turbine will be up to 3.0 MW.

The proposed power generation will be connected to the grid to supplement the existing power generation from thermal generating plants and hydro. The power will be sold to Newfoundland and Labrador Hydro for distribution and resale to customers.

Construction of the project will include

- 5.5 to 11 meter (m) wide gravel roads at the wind farm and 5.5 meter (m) wide roads accessing the wind farm from the public road. The total length of new gravel access roads to be build will be approximately 3.0km. Please note, that a survey confirmed, that the existing roads, dating back to the use of the area as a US Navy Base, can be used with only minor upgrades required.
- Underground power cables and pole lines for 25 kV feeder and communication lines to connect the individual turbines with the wind farm substation.
- Wind farm substation includes step-up transformer (25kV to 69kV) and switch gears.
- Above ground 69kV power and communication lines from the wind farm substation to the interconnection point, the NF Power station near Freshwater.
- Foundation for each WTG and crane pad (gravel).
- Transformers (690V to 25kV) mounted on a concrete pad beside each WTG or inside the turbine.
- Wind turbines, 9 to 11 each.
- Permanent Met tower, 65 meter (m)-80 meter(m) height.

For details, please refer to **Attachment A: Wind Farm Layout.**

The proponents have completed a wind assessment based on more than four years of wind data collected at the near by Pearce Peak and data from a 60m metrological tower that was installed at the site in May of 2008.

The assessment confirms the excellent long term wind speeds of the site.

A logistics study confirmed that the harbour of Argentia is suitable for the offloading of the wind turbine components and that the existing roads from the harbour to the site can be used with minimal improvements required. This limits the need for additional access roads and disturbance of the environment.

3.2 PURPOSE, RATIONAL , NEED FOR THE UNDERTAKING

3.2.1 Global Trends

Globally, wind electricity is the fastest growing energy source with installed capacity growing at an annual rate in excess of 25%. During 2008, more than 27,000 MW of wind power capacity equivalent to US $54.0 billion investment were installed globally. Total global installed capacity exceeded 120,000 MW by end of 2008.
On the basis of recent trends, it is feasible that wind power will continue to grow at an average annual rate of 25% supplying 12% of the world's electricity demand by the year 2020. This would bring the global wind power capacity to 1.2 million MW with an output of 3,000 TWh creating 1.79 million jobs and an annual capital investment to US $75.2 billion by 2020.

The cost per unit of wind electricity has already been reduced dramatically as manufacturing and other costs have fallen while the cost of fossil fuels skyrocketed in 2008. Further long term reductions are expected as the size and quantity of turbines produced continue to grow, thus making wind energy increasingly attractive when compared with other energy sources. Unlike electricity from fossil fuels, prices for wind electricity are stable (only the maintenance cost are adjusted) while the cost of dwindling fossil fuels are expected to rise.

Environmental benefits, such as a zero carbon dioxide emission, are important benefits from wind electricity. If the environmental cost of burning fossil fuels for electricity generation were considered, wind electricity would become even more competitive.

3.2.2 Newfoundland Opportunities

Wind Project Inc. first submitted its ESR for the Argentia wind farm November 01, 2005 (Registration No. 1224). Due to the uncertainty of additional wind farm projects in Newfoundland and the need to review the feasibility of the project, the application was withdrawn December 15, 2006.

After an detailed review of the opportunities to install additional wind power in Newfoundland, the results of a wind resource assessment and Nalcor's assessment that about 75 MW wind energy capacity are feasible of which 54 MW have been installed, our company decided to resubmit the ESR.

The project design and location remain unchanged, however a more detailed lay-out of the wind farm as well as the bird and lichen study are being provided by the applicant.

While Newfoundland has one of the best wind resources in Canada if not in the world, large-scale installations of WTG have only started in 2008. Currently, there are two wind farms with a total capacity of 54 MW operating. The combination of about 65% Hydro Power on the island, providing large storage capacity, and intermittent Wind Power, may allow to provide up to 20% of the Provinces total electricity supply from wind power. Increased load from new industrial activities, such as the Hydromet processing plant at Long Harbour, and increased demand in the greater St. John’s area, can be partly supplied by wind farms.

A growing supply of wind power could gradually reduce the amount of heavy oil being burned at the Holyrood thermal power station. Contrary to fluctuating oil prices, the cost of wind electricity does not change significantly over the 20-year life span of a wind farm. Therefore, by adding more wind electricity to the energy mix of Newfoundland, electricity generation costs will be stabilized and pollution will be reduced.

Wind power can be more easily integrated into Newfoundland’s electrical grid because the windy season coincides with the peak electrical load during the winter month (electric heating).

New technologies such as “smart grid”, wind generation forecasting, energy storage, frequency regulation and grid upgrades should allow to increase the percentage of wind energy in the generation mix without having a negative impact on grid stability.

Furthermore, the islands hydro facilities can compensate for intermittence in wind electricity generation by storing and releasing energy on demand.

While grid stability issues limit the islands use of wind energy at this point of time, the planned interconnection with the main land would drastically increase the amount of wind energy and provide a potential for exports.

It is further interesting to note the involvement of large oil companies such as Shell, Suncor and Transalta in the wind electricity generation business. These companies have realized that carbon fossil fuels are a dwindling resource and need to be replaced by renewable energy sources in the future. Currently wind electricity generation is being recognized as the lowest renewable source that is readily available. Since the Newfoundland wind resource is one of the best in North

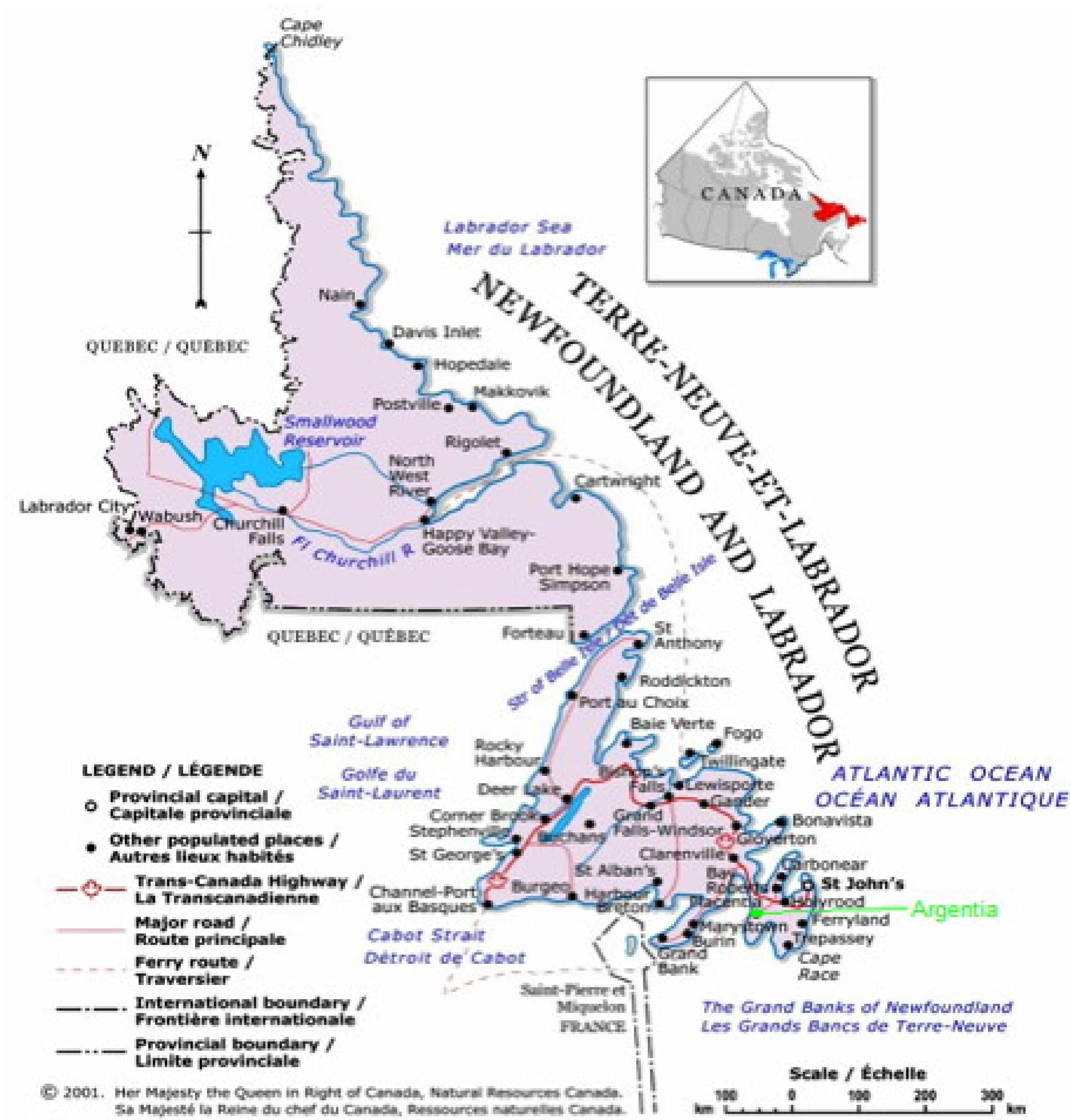
America, the Province has the opportunity to become a leader in low cost renewable energy, providing pollution free electricity to its residents.

4.0 DESCRIPTION OF THE UNDERTAKING

4.1 GEOGRAPHIC LOCATION

The site for the proposed Wind Farm is located near Argentia, and also known as the Argentia Backlands. For details, including the lay-out of the proposed wind farm, please refer to **Attachment A: Wind Farm Layout.**

Map 1 Location of wind farm near Argentia (circled green) in the Province of Newfoundland and Labrador, Canada



The selected site is owned by the Argentia Management Authority. WPI has signed a lease option agreement with the AMA for the purpose of installing a minimum of nine 3.0 megawatt turbines and a substation.

The right of way to access the wind farm and for the power cables is included in the lease option.

4.2 PHYSICAL FEATURES

4.2.1 Major physical features of the Wind Farm

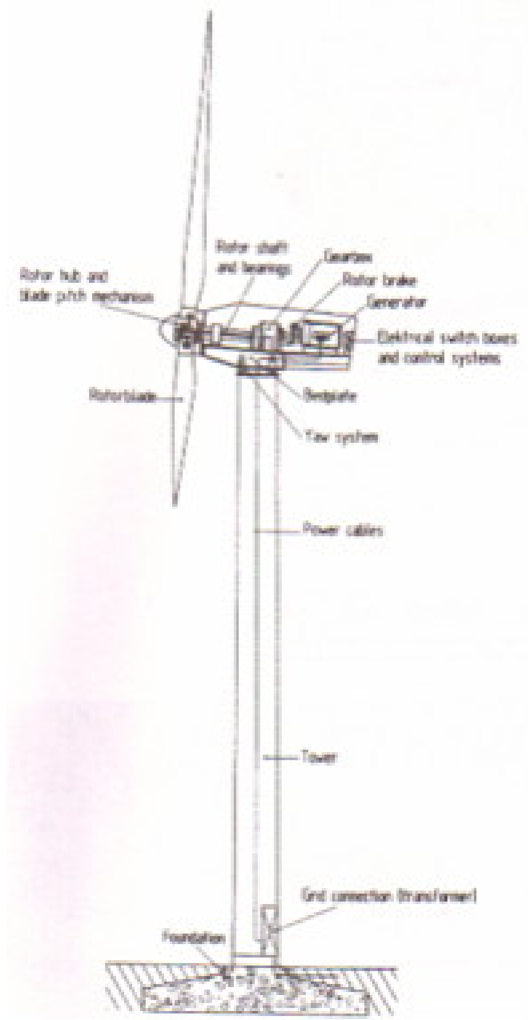
4.2.1.1 Type of Wind Turbine Generator (WTG)

WTG's under consideration for the project vary in capacity between 2.3 MW and 3.0 MW, in hub height between 65 m to 80 m and an rotor diameter between 82.4 m and 90 m.

The final selection of a suitable WTG depends on the life cycle cost of the proposed wind farm and the suitability for the location. Issues such as availability of large cranes, effect of the turbine type on the grid and operating history in similar high wind regimes will be considered.

4.2.1.2 Technical Description of a Wind Turbine Generator

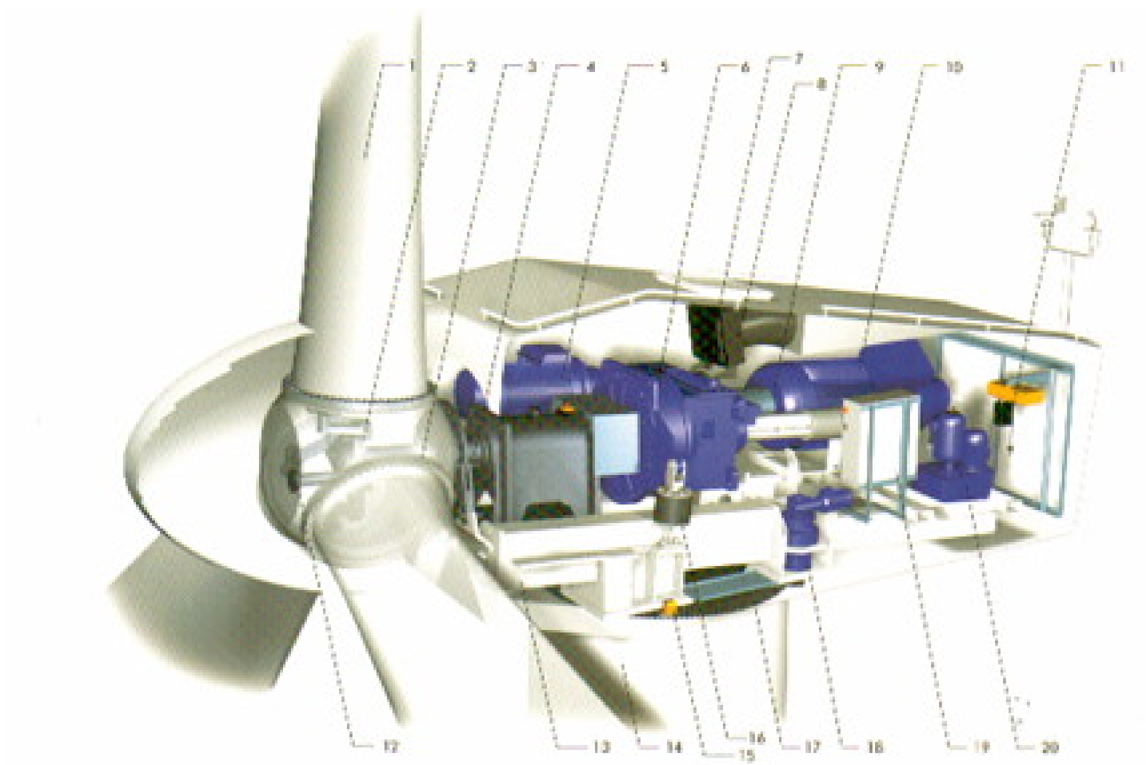
The selected WTG type is a Horizontal Axis Wind Turbine.



The main components are the foundation, tower and nacelle including the rotor. The foundation design is dependent on soil tests to be performed at the site. A standard gravity foundation made of concrete reinforced steel will be used. The diameter will be approximately 15m and the depth 3.0m depending on the WTG selected and the local soil conditions. The conical steel tower will be made in 3 to 4 sections for ease of transportation and installation.

A typical nacelle contains the following key components of the WTG:

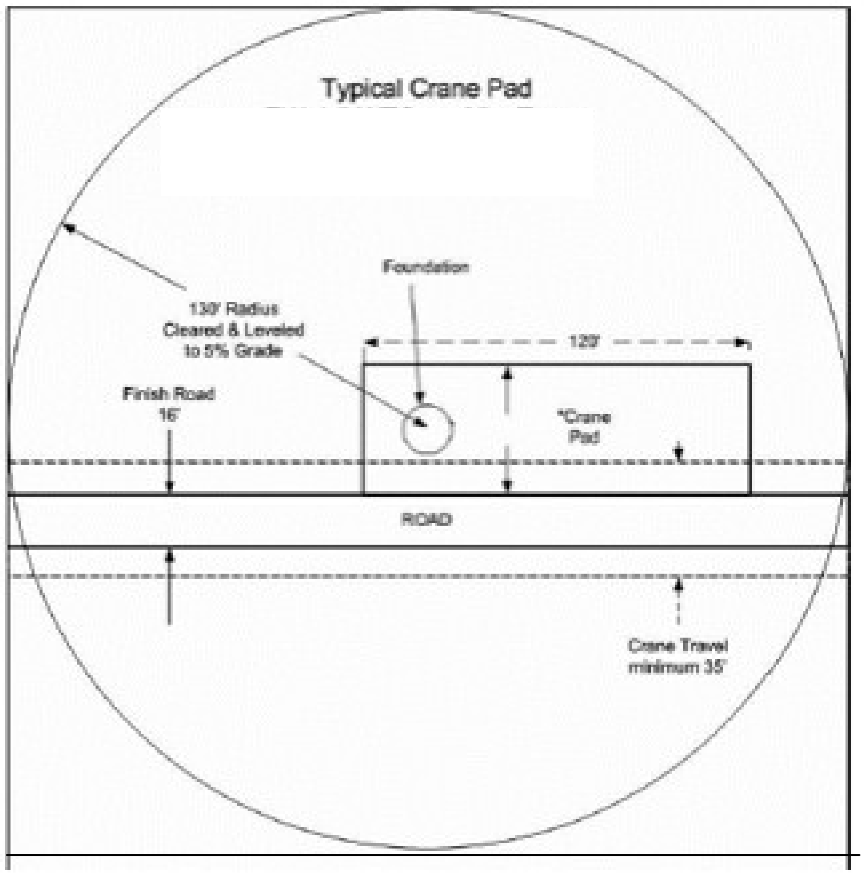
1. *Blade*
2. *Rotor hub (including blade pitching mechanism), connecting the rotor blades to the Main Rotor shaft*
3. *Blade bearing*
4. *Main rotor shaft connecting the rotor with the gearbox*
5. *Secondary generator*
6. *Gearbox, increasing the rotor speed from 16 – 28 rpm to a generator speed of 1200 – 1800 rpm.*
7. *Disc break*
8. *Oil cooler for cooling the gearbox oil*
9. *Cardan shaft*
10. *Primary generator, converting the mechanical energy into electrical energy*
11. *Service crane*
12. *Pitch cylinder*
13. *Main frame, being the base for all nacelle components*
14. *Tower*
15. *Yaw Drive, turning the rotor into the wind*
16. *Gear tie rod*
17. *Yaw ring*
18. *Yaw gears*
19. *Top control unit*
20. *Hydraulic System for braking the rotor*



4.2.2 Area affected by the Wind Farm

The area selected for the wind farm is located in the Argentia Backland near Argentia, Newfoundland. WPI has signed a lease option agreement with the Argentia Management Authority for 15 acres, required for the foundations, crane pads and the substation. The total affected area is about 60 hectares in size.

The Wind Farm is comprised of the individual WTG, adjacent levelled space for cranes, access roads and a transformer station. The power cables and communication lines from each WTG to the transformer station are buried in a trench underground and above ground, while the feeder line between the wind farm substation and the interconnection point at Freshwater will be a pole line.



By selecting a site at the Argentia Backlands, away from dwellings, the proponents ensured that no adverse effect from shadow impact or noise can be expected.

<u>The overall noise</u> of WTG's is composed of aerodynamic noise of the rotor blades and the mechanical noises of the drive train components. Optimized rotor blade tip designs and reduced maximum noise (sound) levels for the main contributing drive train components have drastically reduced the noise levels of modern WTG.

The sound level is a function of rotor speed, the latter of which is, for the turbine type in consideration, increasing with the wind speed. Typically, the sound level reaches a maximum when the nominal (or maximum) rotor speed is reached at wind speeds - measured at 10 m above ground level - of around 8 m/s. By selecting different maximum rotor speeds (and, hence, blade tip speeds), the turbine type in consideration can be adjusted for different maximum sound levels, varying from 102.0 db(A) to 109.4 db(A).

The sound map provided in **Attachment A: Wind Farm Layout** shows with which level the sound is audible at which distance from the proposed wind farm. The sound map was generated for the most conservative situation: (a) the maximum or fastest rotor speed setting, resulting in 109.4 db(A); and (b) the rotor turns with nominal speed. Many jurisdictions use a limit of 45 db(A) that must not be exceeded at any Point of Reception (where "Point of Reception" means any point on the premises of a person within 30 m of a dwelling or a camping area, where sound or vibration originating from other than those premises is received). From the sound map, it can be concluded that no dwelling is situated near enough to be subjected to sound levels higher than the 45 db(A) limit. **The distance of the closest dwellings is about 1,3 km from the wind farm.**

The visual impact of a modern 3 blades WTG using a conical tower is being considered by the general public as quite pleasing. The WTG is painted in an off white colour that blends in with the landscape. The slow revolution per minute (rpm) of the rotor (8 – 18 rpm) provides a restful impression and the WTG’s should fit very nicely into the landscape. A rendering of the wind farm is provided in Attachment 1.

Impact on radio and television transmitters has been taken into consideration and the WTG will be installed at a sufficient distance from the local transmitter stations to avoid any adverse effect. Aviation Safety requirement (obstacle lighting) will be met as and if required by the Department of Transport and NAV Canada. Applications to DOT and NAV Canada will be submitted prior to starting the construction of the wind farm.

4.2.3 Physical and Biological Environment within the Area

4.2.3.1 Vegetation

Argentia region is located within the Southern Barrens sub-region of the Maritime Barrens Eco-region (Damman 1983). This eco-region is characterized by extensive barren areas consisting of dwarf shrub heaths, bogs and shallow fens.

Habitat was assessed by using the 400’ contour line to delimit the boundaries of the proposed wind farm. Analysis using aerial photographs and GIS (Figure 1) showed barrens (48.3%) and woodland (46.3%) to be dominant within the zone (Table 1). This is consistent with the findings of Alexander *et al*. (1996) for the general backlands area.

Habitat Type	Area (Ha)	%
Barrens	137.21	48.3

Woodland	131.51	46.3
Bogs	10.74	3.8
Exposed Rocks	4.06	1.4
Pond	0.51	0.2
Total Area	284.03	100.0

Table 1. Estimated area of habitat types within the proposed Argentia wind farm as delimited by the 450' contour line.

A field visit to the proposed site in June 2005 showed a variety of common plant species in the area. These include the heath land species: *Kalmia angustifloria*, Empetrum nigrum, *Rhododendron canadense* and *Vaccinium angustiflori*; and the forest species *Abies balsamea*, *Picea mariana* and Larix laricina (Jon Joy and Brenda Taylor personal observations). These observations are in agreement with those made in the Argentia area by Penney and Stokes (1998). It is noted that no rare or endangered plant species have been found in the Argentia area (Penney and Stokes, 1998).

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Figure 1. Habitat classification of the proposed Argentia wind farm site based on 1995 aerial photographs.

Access roads, Argentia Backlands

Proposed wind farm site

Clarks Pond, NP transformer station near Freshwater

Common Name	Species Name	Common Name	Species Name
Bog Myrtle	Myrica gale	Balsam Fir	Abies balsamea
Newfoundland dwarf Birch	Betula michauxii	Black Spruce	Picea mariana
Meadow Sweet	Spiraea latifola	Red Raspberry	Rubus idaeus
Leather Leaf	Chamaedaphne calyculata	Crackerberry	Cornus canadensis
Swamp Birch	Betula pumila	New York Aster	Aster novae-belgii
Blackberry	Rubus spp.	Starflower	Trientalis borealis
Dwarf huckleberry	Gaylussacia dumosa	Corn-lily	Clintonia borealis
Bog Aster	Aster nemoralis	Indian Pipe	Monotropa uniflora
Labrador Tea	Ledum groenlandicum	Flat Topped White Aster	Aster umbellatus
Sheep Laurel	Kalmia augustifolia	Wild Lily of the valley	Maianthemum canadense
Blueberry	Vaccinium augustifolium	TwinFlower	Linnaea borealis
Mountain Alder	Alnus crispa	Bullhead- Lily	Nuphar variegatum
Larger Blue Flag	Iris versicolor	Rough-stemmed Goldenrod	Solidago rugosa
Shrubby Cinquefoil	Potentilla fruticosa	Black Knapweed	Centaurea nigra
Northeastern Rose	Rosa nitida	Pearly Everlasting	Anaphalis margaritacea
Canadian Burnet	Sanguisorba canadensis	White Spruce	Picea glauca
Tamarack	Larix liricina	Ladies-Thumb	Polygonum persicaria
Pitcher-Plant	Sarracenia purpurea	Ox-eye Daisy	Chrysanthemum leucanthemum
Cotton Grass	Eriophorum spp.	Eyebright	Euphrasia americana
Common Juniper	Juniperus communis	Yarrow	Achillea millefolium
Partridgeberry	Vaccinium vitis-idaea	Red Clover	Trifolium pratense
Northern Wild Raisin	Viburnum cassinoides	Common Evening-Primrose	Oenothera biennis
White Birch	Betula papyrifera	Fall Dandilion	Leontodon autumnalis
Crowberry	Empetrum nigrum	American Mountain Ash	Sorbus americana
Creeping Snowberry	Gaultheria hispidula	Skunk Current	Ribes glandulosum

Table 2. Terrestrial plant species identified in the Argentia area (Penney and Stokes, 1998).

A **Boreal Felt Lichen Survey** has been completed see **Attachment E: Lichen Survey.**

4.2.3.2 <u>Geology</u>

Coastal hills are a prominent feature in the Argentia area with steep slopes rising to elevations of 125 – 150m (Alexander *et al*., 1996). Rock outcrops are common in the area and soils are generally shallow, achieving their greatest depth on the lower slope of hillsides and in valley bottoms. Over half of the Argentia backland area is estimated to consist of imperfectly drained mineral soils or poorly drained organic soils (Alexander *et al*., 1996). Veneers of glacial till overlie bedrock and organic deposits are found in bogs and fens (Ullah, 1992). The Argentia area bedrock is part of the late proterozoic, Gibbett Hill Formation, comprised of mafic and felsic volcanic and volcanic clastic rocks (Ullah, 1992).

4.2.3.3 Climate

Argentia lies in the South Eastern Barrens sub-region of the Maritime Barrens (Damman, 1983). Summers in this region are typically cool, consisting of frequent fog and strong southerly winds. It has an annual precipitation of 1500-2000 mm (Banfield, 1981), with heaviest rainfalls during southerly air-streams, especially over hills inland. Winters are relatively mild with less than half precipitation falling as snow. Freezing rain is frequent during late winter (Banfield, 1981).

4.2.3.4 Resources and Land Use

Local activities in the area of the proposed wind farm are limited due to its topography to recreational activities such as hiking, and blueberry picking. Hunting at the AMA property is prohibited. It is felt that turbine construction in the proposed area will have a negligible impact on natural resource exploitation within the area.

4.2.3.5 Mammals

Species abundant in the Argentia area include moose (*Alces alces*), meadow vole (*Microtus pennsyvanicus*), snowshoe hare (*Lepus americanus*), mink (*Mustela vison*), red fox (*Vulpes vulpes*), red squirrel (*Tamiasciurus hudsonicus*) and masked shrew (*Sorex cinereus*). Otter (*Lutra canadensis*), Beaver (*Castor canadensis*) and muskrat (*Ondatra zibethicus*) may also be seen in the area (Anon, 2002; Griffiths, 1998; Rowe, 1997). No endangered wildlife species have been recorded in the Argentia area (Penney and Stokes, 1998).

4.2.3.6 Fish

There is a small landlocked pond (0.2ha) located in the boundaries of the farm as defined by the 400' contour line (Figure 1). The aerial photograph covering this pond indicates that it is shallow. It is not known if any fish species are present in this pond.

4.2.3.7 Birds

The most comprehensive listing of birds for the Argentia area was made by Tuck in 1948 (Table 3). A list of bird species compiled for the Demonstration Plant Project Registration by the Voisey's Bay Nickel Company does not provide any information on species of land birds in the backlands area (Anon, 2002). None of the species listed by Tuck (1948) are considered rare (MacTavish *et al*., 2003).

Bird Monitoring Protocol

The avian monitoring protocol for the Argentia site was designed by the Canadian Wildlife Service (Holly Hogan (now with the NL Parks Division)) in consultation with Natural Resources Canada and the Provincial Department of Environment and Conservation (Christine Doucet), see **Attachment D: Bird Monitoring Program**

Pre-Construction Bird Monitoring Program for Argentia, Newfoundland

Jonathan Joy, M.Sc. Instructor, Fish and Wildlife Technician Program, College of the North Atlantic, Bonavista Campus, completed a Pre-Construction Bird Monitoring Program in accordance with the protocol provided.

Twenty point count stations were randomly selected within the study area and stratified according to habitat type. Each station was sampled every three days from during the breeding and migratory seasons. The following conclusions were made as a result of the study:

1. The diversity and densities of breeding songbirds at Argentia are similar to other sites in Newfoundland and Labrador. The impact of a wind farm development on their populations is expected to be negligible.

2. The numbers of raptors observed during the surveys are small and the development of a wind farm in Argentia should have no significant impact on their populations.

3. No species at risk birds were observed during the surveys.

4. Most birds flew at heights of less than 33m. The impact of turbines on birds flying between 25m (the lowest propeller height) and 33m is not known.

5. There is some potential for bird strikes in the fall when migrating songbirds move through the area at higher altitudes.

6. Very few gulls or waterfowl were present in the study and the impact of wind farm development on these species is not likely to be significant.

For details, please refer to **Attachment C: Pre-Construction Bird Survey.**

A **Post-Construction Bird Monitoring Program** has been designed for the Argentia site by the Canadian Wildlife Service in consultation with Natural Resources Canada (Holly Hogan, CWS, Pers. Comm.): see **Attachment D: Bird Monitoring Program.**

4.3 CONSTRUCTION

4.3.1 Construction Period

The construction period will last 12 to 15 months after all permits, the power purchase agreement (PPA), and the financing have been obtained. Furthermore, the severe winter weather conditions have to be taken into account. The preferred season for the construction of the wind farm is from May to November. Anticipating that all mandatory milestones for the implementation of the project have been achieved, contracts for the civil works and WTG's will be awarded by spring of 2011. Civil works at the site would start at that time to be completed by spring of 2012 followed by the installation of turbines with a commissioning date anticipated for October of 2012.

4.3.2 Construction Activities Affecting Physical Environment

The activities at the site started with the installation of a 60m tubular met tower to conduct a wind assessment. It included the improvement of existing road to transport the tower and installation equipment to the site. Once a power purchase agreement and all necessary permits have been obtained, the area will be surveyed to determine the exact locations of access roads, turbine foundations, trenches and pole lines for collection systems, the wind farm substation and above ground feeder lines between the substation station and the interconnection near Freshwater. Furthermore, geotechnical soil tests will be conducted to determine the conditions at the site. This will be followed by the construction of gravel access roads, and excavation for foundations and trenches, as well as the preparation of lay-down and crane pads areas at the foundation sites.

The next step will be the construction of the steel re-enforced concrete foundations for the WTG's, and the wind farm substation, the installation of the power and communication lines in trenches and on pole lines.

The actual erection of a WTG will only take about 3 to 5 days requiring large cranes and special transport trucks.

During the construction period, it is anticipated that there will be a 20' site office trailer and two 40' storage containers at the site. These containers will be removed after the completion of the construction activities. Fuel storage at the site for road construction equipment will be in compliance with applicable laws and regulations.

4.3.3. Potential Source of Pollutants During Construction

During the construction period, potential sources of pollution are from human waste, dust from road building and construction equipment leaking oil, fuel and coolants into the soil.

4.3.4 Mitigation Measures

All normal precautionary measures and standard construction practices will be implemented to minimize disturbances to the site.

This will include measures to control run offs and soil erosion, dust emission from road construction; noise levels, avoiding oil, fuel and coolant spills.

Furthermore, the project proponents will only allow construction and craning equipment in good repair on site. Emergency response spill kits will be stored at the site in order to contain any spill of hazardous fluids. Waste collection bins and self contained toilets will be installed. To ensure the compliance with all the mitigation measures, a Site Supervisor will be appointed.

4.3.5 Potential Resource Conflicts

The use of the construction site for recreational land use will be restricted during the actual construction period for safety and liability reasons.

4.4 OPERATION

4.4.1 Description of the Operation

Wind Turbines convert wind energy into electricity and start generating at wind speeds from 3.5 to 4.0 m/s. At 12 to 14 m/s, they produce their name plate capacity until they shut down when wind speeds reach 25 m/s. At these wind speeds the blades are feathered into the wind and the rotor is stopped. All turbines are monitored by an off site control center. Automatic notification will be given to the control center in the case of malfunction via modem.

Scheduled maintenance is performed twice a year.

4.4.2 Estimated Period of Operation

The expected period of operation for a modern WTG is 25 years after which it can be expected that technological advance will make the turbine obsolete. Upgrading the turbines or replacing them are options to be considered.

4.4.3 Potential Source of Pollutants During Operation and Mitigation Measures

WTG's do not pollute the atmosphere with carbon dioxide, sulphur or hydrocarbons, nor do they create problems at the end of their useful life with regards to the disposal of radioactive waste. Potential sources of pollutants are restricted to fluids used in a WTG. These are:

Hydraulic Oil
Gearbox Oil
Coolant with Anti-freeze
Transformer Oil

In case of a leak, these fluids are contained inside of the turbine and can be removed safely. The transformer is installed on a concrete slab with a lip designed to contain any oil spill or inside of the turbine.

4.4.4 Potential Causes of Resource Conflicts

During the operation of the Wind Farm, no potential causes of resource conflicts are foreseen. The WTG require only a small amount of land and the use for recreational activities will not be restricted. On the contrary, it can be expected that the Wind Farm becomes a tourist attraction.

4.4.5 Project Decommissioning

The advantage of a wind farm for electric power generation lies in the ease of decommissioning. The entire turbine can be removed within a few days with the help of cranes and trucks. The only remaining components of a wind farm would be the service roads and the foundation. Since the foundation is level with the surface of the ground and the service roads may be used for recreational activities, the impact would be negligible. Roads could also be re-habilitated if required or blocked to prevent access.

5.0 OCCUPATIONS

5.1 CONSTRUCTION PHASE

During the construction period a number of trades and equipment will be at the site.

During the excavation phase heavy earth moving equipment and graders will be used. This will be followed by the pouring of the steel re-enforced concrete foundation requiring ironworkers and cement trucks.

The actual erection of the WTG will involve heavy transport trucks for the nacelle, tower sections and the rotor blades. One large 800 to lead crane and a smaller trailing crane will be utilized to lift the components.

During the construction phase, the number of people working at the site will be up to 20 people. The following trades will be used:

Heavy Equipment Operators	NOC 7421	5 persons
Concrete Workers	NOC 7282	10 persons
Iron Workers	NOC 7264	10 persons
Truck Drivers	NOC 7411	8 persons
Crane Operators	NOC 7371	2 persons
Line Workers	NOC 7244	6 persons
Electricians	NOC 7242	4 persons
Construction Trade helpers	NOC7611	8 persons
Millwrights	NOC 7311	4 person
Control Technicians		2 persons
Site Supervisor	NOC 071	1 person
Engineers		1 person

5.2 OPERATIONAL PHASE

During the operational phase the activities at the site will be limited to scheduled and un-scheduled maintenance. The scheduled maintenance will be performed twice per year and require two service technicians 1 to 2 days per turbine. Un-scheduled maintenance may include as little work as re-setting a circuit breaker to replacing a major component requiring the cranes and large trucks.

It is the intention of the proponents to establish a service facility in the vicinity of Placentia including an office for monitoring the WTG's, storage of spare parts, consumables and tools as well as a small workshop for repairs. The project will generate a minimum of two permanent jobs and up to four additional temporary jobs. It is the intention to hire local people and have them trained to maintain the wind farm.

6.0 APPROVAL OF THE UNDERTAKING

The following is a list of permits, approvals, and authorizations required for the undertaking:

PERMIT	AUTHORITY
Building and Accessibility Exemption Registration.	Municipal Council
Municipal plan amendment to accommodate wind mills and wind farms.	Town of Placentia and Minister of Municipal Affairs *Note: Changes to allow windmills and wind farms were adapted* .
Environmental Permit.	Department of Environment (NL)
Building Permits	Municipal Council
Highway Access Permit.	Department of Works, Services and Transportation
Tall Structures Obstruction Clearance.	Transport Canada, NAV Canada
Electrical Permit • Application for permit to install or repair electrical equipment or inspection of work.	NLH Customer Services / Operations

7.0 PUBLIC AND FIRST NATION CONSULTATION

7.1 PUBLIC CONSULTATION

The proponent has met with the elected officials of Placentia on a regular basis since 2003. During these meetings, briefings on the planned wind farm were provided, followed by a question and answer period. Minutes of these meetings are on file.
A public consultation meeting was held on the 28th of February 2005. The public was informed by an ad in the local news paper "The Charter' in addition, the local Chamber, the Mayor, Councillors, and other interested groups received invitations through the Argentia Management Authority. The following are the minutes of the public meeting:

Public consultation meeting

Pearce Peak, Argentia/Placentia Wind Farm, NL
February 28, 2005, 18:30 To 21:30

Location: Legion Hall, Placentia

Purpose of the meeting: Inform the public about the planned installation of a 22.5 MW wind farm on Pearce Peak consisting of 15 ea. 1.5 MW WTG

Presentation provided by: Wind Project Inc.'s two principles, Frank Weber and Helge Wittholz, using a 37 slides Power Point Presentation named Argentia presentation 28 02 2005 (1). Critical topics like noise, bird mortality and ice throw were addressed. A large turning model of a 1.5 MW turbine was displayed for demonstration purposes.

Attendance: Approx. 25 people from Placentia, the Mayor Fred Whelan, the board and members of the AMA management board, the representative of the local chamber of commerce, representatives of the local newspaper and TV station.

The 1.0 hours of presentation was followed by a lively question and answer period.
Most questions were related to issues like job creation, are we going to pay more for our electricity, if wind electricity is competitive with electricity generated at Holyrood, why are we not getting green electricity now, interference with wild life, how wind power plays into the current electricity supply, electromagnetic impact, is there a connection between the developments at Lower Churchill Falls and wind farm development?

There was not a single negative comment about wind turbines at the Argentia Backlands; on the contrary, people from the audience asked how they could assist in making the project happen.

Harvey Brenton offered to place information regarding the project on the AMA web site and provide WPI' s address for people that might have additional questions.

In all, we felt that the audience was very supportive and there was no opposition raised.

The main changes between the project presented at the meeting and the re-submission are:

- No. of turbines changed from, 15 ea. to 9 to 11 turbines
- Size of turbines changed from 1,5 MW to maximum of 3.0 MW per turbine
- Total capacity changed from 22.5 MW to a maximum of 27 MW

The most recent contacts with the town of Placentia have been related to the request for rezoning to allow turbines at the proposed site and took place between May of 2008 and April of 2009.

The town of Placentia registered Municipal Plan Amendment No.1, 2008 with the Department of Municipal Affairs to accommodate windmills and wind farms and similar uses in the area planned for the wind farm. The requested changes came into effect in March of 2009. This process included advertising for a public hearing, public hearing on December 16, 2008 and a notice of registrations in the Charter and the Newfoundland Gazette. The amended zoning Regulation 77A was amended to read:

> “77A Utilities-Wind Mills, Wind Turbines, Wind Farms
> Utilities, which include wind mill, wind turbines, wind farms, together with access roads and other ancillary facilities, are subject to approval of relevant provincial and federal agencies and public utilizes.

The design and location of such facilities shall take into consideration their impact on nearby land uses and persons, the environment and archaeological resources within the town, along with other matters that the Town may deem to be significant”
The current wind farm configuration included in this re-submission was submitted to the Town of Placentia for the rezoning and public consultation process.

Additional public information sessions are planned once a request for proposal for wind energy has been issued by Nalcor Energy.

7.2 First Nation Consultation

Consultations with First Nations do not apply, since there is no recognized First Nation in the vicinity of the planned wind farm. The only recognized First Nation in Newfoundland is located in Conne River, on the South Central Coast of Newfoundland, about 250km to the south.
Source: NL Government, Labrador and Aboriginal Affairs, St. Johns, Tel. 709 729 4776
A letter dated August 26, 2008 was obtained, confirming that the Department is not aware of any Aboriginal Organization with respect of the planned wind farm area.
A copy of the letter will be made available upon request.

8.0 SCHEDULE

The schedule for the construction and operation of the project is dependant on getting all required permits, agreements including a PPA and financing in a timely manner. One to two years lead time will be required for the equipment purchase after the PPA is in place. A tentative schedule is as follows.

Tentative Schedule

Phase	Activity	2010				2011				2012				Comments
		I	II	III	IV	I	II	III	IV	I	II	III	IV	
1	**Planning & Negotiations**													
	Community Consultation	X	X	X	X	X	X	X	X	X	X	X		ongoing
	Land Lease Option	X	X	X	X	X	X	X						obtained
	Wind Assessment	X	X	X	X									ongoing
	Micro Siting	X	X	X	X									80% complete
	Environmental Assess.	X												Application submitted
	Permitting				X	X	X	X						
	Wind Farm Design	X	X	X	X	X	X	X						
	Feasibility Study	X	X	X	X	X	X							75% complete
	Power Purchase Agreement			X	X									Waiting for next RFP
	Tender Preparation			X	X	X	X							
	Financing		X	X	X	X								
2	**Implementation**													
	Contract Awards for Wind Farm						X	X						
	Site Works (roads, trenches, foundation)							X	X		X			
	Substation at wind farm, feeder line								X		X			
	Modify NF transformer station										X			
	Turbine Installation										X			
	Commissioning											X		
3	**Operation**												X	ongoing

9.0 FUNDING

A number of companies are being considered for arranging the required funding for the project. Company with experience in arranging the financing of wind farms will be contacted once the schedule for the next RFP by NLH is known.

The estimated cost of the project is $60.0 million.

10. REFERENCES

Erich Hau, Wind Turbines, Fundamentals, Technologies, Applications, Economics

J. R. Salmon, P.G. Stalker, Zephyr North, May 1, 1999
Wind Resource Assessment for selected sites in Southeast Newfoundland (for Natural Resources Canada).

Wind Force 12, a blueprint to achieve 12% of the world's electricity from wind power by 2020. Prepared by BTI for the European Wind Energy Association (EWEA) and Green peace, 27th of May 2003 (http://www.ewea.org).

Wind Vision for Canada, 10,000 MW by 2010 by the Canadian Wind Energy Association. (CanWEA), June 2001 (www.canwea.ca).

Jonathan Joy (M.Sc.) Coordinating Instructor, Fish and Wildlife Technician Program, College of the North Atlantic, Bonavista Campus, prepared chapter 4.2.3 (Physical and Biological Environment within the Area). Jon has been working in the area since 1989 and made many field trips to proposed site.

His qualifications are documented in **Attachment B: Jon Joy's CV.**

Bio-Physical/Environmental References

Alexander, W; Veitch, G. and Rowe, J. 1996. Argentia Backlands Forest Resource Management Plan. Unpublished. 18pp.

Anonymous 2002. Voisey's Bay Nickel Company Limited Argentia Hydrometallurgical Demonstration Plant Project Registration. Voisey's Bay Nickel Company Ltd., St. John's, NL. p34-46.

Banfield, C.C. 1981. The climatic environment of Newfoundland. In: The Natural Environment of Newfoundland Past and Present. MacPherson A.G. and MacPherson J.B. (Eds.). 83-152.

Damman, W.W.H. 1983. An ecological subdivision of the island of Newfoundland. In Monographiae Biologicae 48: Biogeography and Ecology of the Island of Newfoundland. Edited by G.R. South. Dr. W. Junk Publishers, The Hague. pp. 163-206.

Griffiths, J. 1998. Backlands Trail Report. Argentia Management Authority. Unpublished. 19pp.

Mactavish, B; Maunder, J.E.; Montevecchi, W.A.; Wells, J.L. and Fifield, D.A. 2003. Checklist (2003) of the birds of Insular Newfoundland and its Continental Shelf Waters. Natural History Society of Newfoundland and Labrador.

Penney and Stoke. 1998. Environmental Impact Assessment – Argentia Backlands Trail project. Penney and Stokes Environmental Consortium. 41pp.

Rowe, J. 1997. Argentia Backlands – Forest Improvement Project 1997. Argentia Management Authority. 10pp.

Tuck, L. 1948. Recent Observations on Newfoundland Birds in the Argentia-Dunville Area. The Canadian Field Naturalist. 62:4. p103-112.

Ullah, W. (Ed.), 1992. Water Resources Atlas of Newfoundland, Government of Newfoundland and Labrador, Department of Environment and Lands, Water Resources Division.

ATTACHMENT A

Wind Farm Layout

Wind Farm
Argentia Backlands
Newfoundland, Canada

Layout Proposal

99 Mill Street
Milton, Ontario
Canada L9T 1R8
Tel.: 1 905 876-2245
Fax : 1 905-875-2944
Email: fweber@sympatico.ca

December, 2009

Revision list

Revision date	Description
20.12.09	First issue

Table of Contents

1 EXECUTIVE SUMMARY ____ 32

2 GENERAL LAYOUT ____ 33

3 RENDERING OF WIND FARM ____ 34

4 HABITAT CLASSIFICATION ____ 35

5 NOISE MAP ____ 36

6 LOCATION ON AMA PROPERTY ____ 37

7 LOCATION W/ RESPECT TO PLACENTIA TOTAL ZONING ____ 38

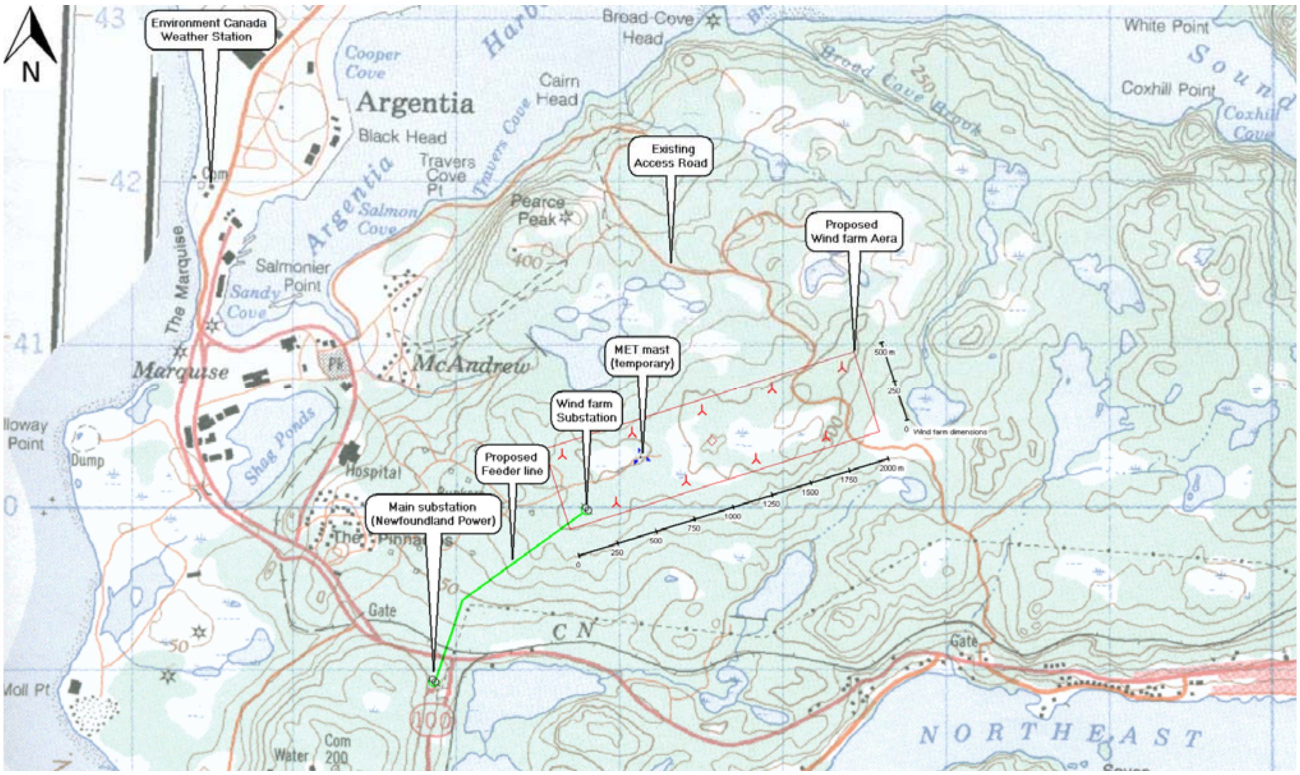
8 REFERENCES ____ 38

Executive Summary

This document contains the general layout proposal and associated maps for an envisaged wind farm of ca. 27 MW installed capacity at Argentia, Newfoundland & Labrador.

General layout

The proposed wind farm is situated approximately 3 km northwest of Town of Freshwater and approximately 4 km southeast of the Argentia Peninsula and former US airbase; specifically it is situated in the so called Argentia Backlands to the southeast of Pearce Peak. The general layout is shown is Map 2.1 below in which the approximate wind farm border is marked by means of a red line.



Map 2.1: General location of proposed wind farm (when viewing on PC pls. increase zoom level for clearer view)

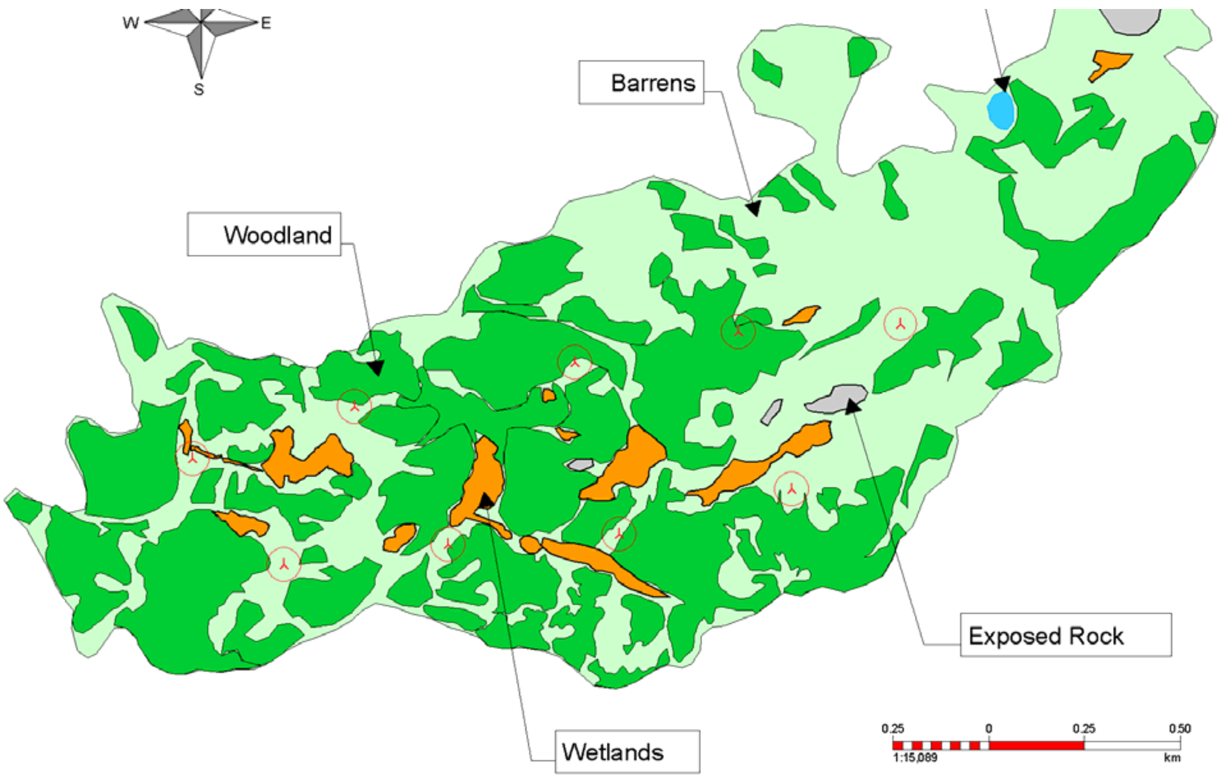
Rendering of wind farm

The photo below shows a rendering of the easterly portion of the wind farm as seen from Pearce Peak.

Photo 3.1: View at rendering of the proposed wind farm from Pearce Peak, looking southeast. The larger pond in the foreground is visible on Map 2.1 to the immediate north of the proposed wind farm.

Habitat classification

As it turned out, the general layout of the wind farm already somewhat fits the habitat situation. That is, for the most part the wind turbines are located at barren sites, as can be seen in the map below. A ring road will have to connect the turbines, however, starting from and ending at the gravel road transects the Argentia Backlands (see Map 2.1). More field work will have to be done to finalize the turbine-, substation and road layout, using natural openings and considering minimal forest clearing, barrens as well the avoidance of wetlands and any water bodies. Avoiding wetlands and water bodies is in the interest of the project management since it will minimize construction costs, especially for the turbine's foundations.



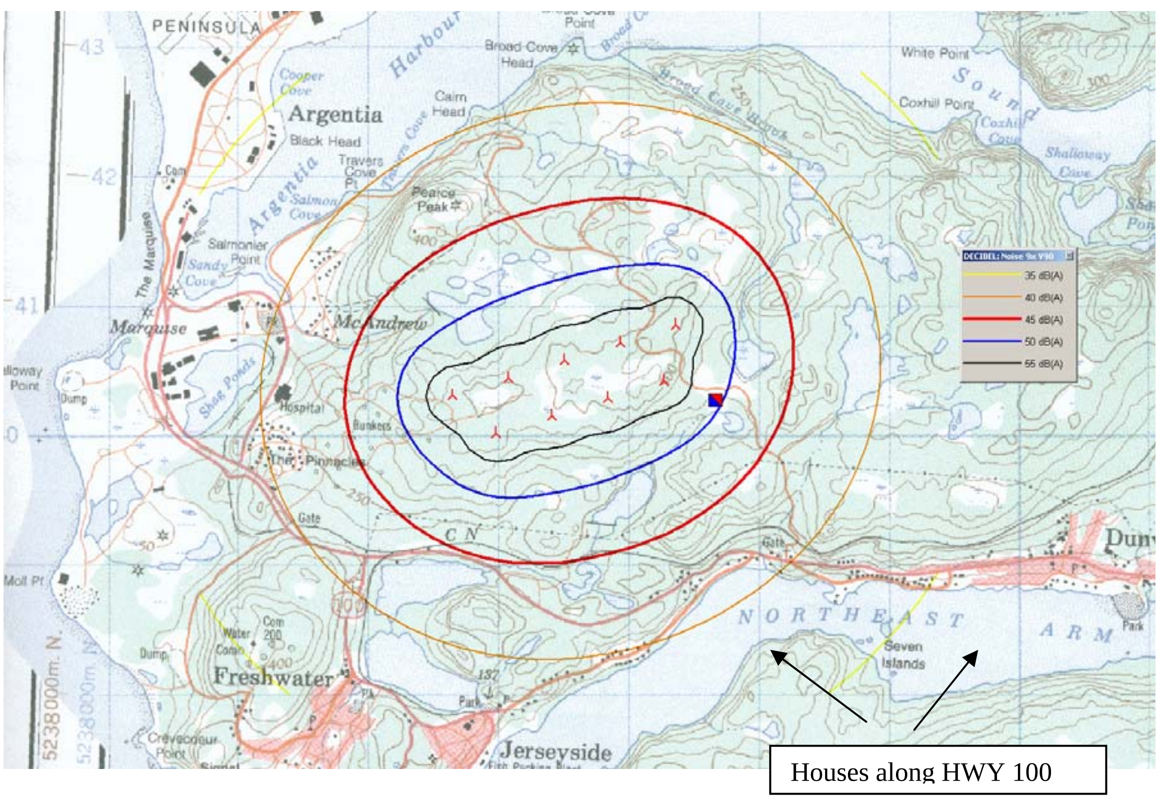
Map 4.1: Wind turbines (encircled red "stars") situated with respect to habitats; the circles represent the rotor diameter – here provided as a reference for the general dimensions.

Noise map

The sound map below shows with which level the sound is audible at which distance from the proposed wind farm. The sound map was generated for the most conservative situation: (a) the maximum or fastest rotor speed setting, resulting in 109.4 dB(A); and (b) the rotor turns with nominal speed.

Many jurisdictions use a limit of 45 dB(A) that must not be exceeded at any Point of Reception (where "Point of Reception" means any point on the premises of a person within 30 m of a dwelling or a camping area, where sound or vibration originating from other than those premises is received). From the sound map, it can be concluded that no dwelling is situated near enough to be subjected to sound levels higher than the 45 dB(A) limit (that is, within the red, blue or black area).

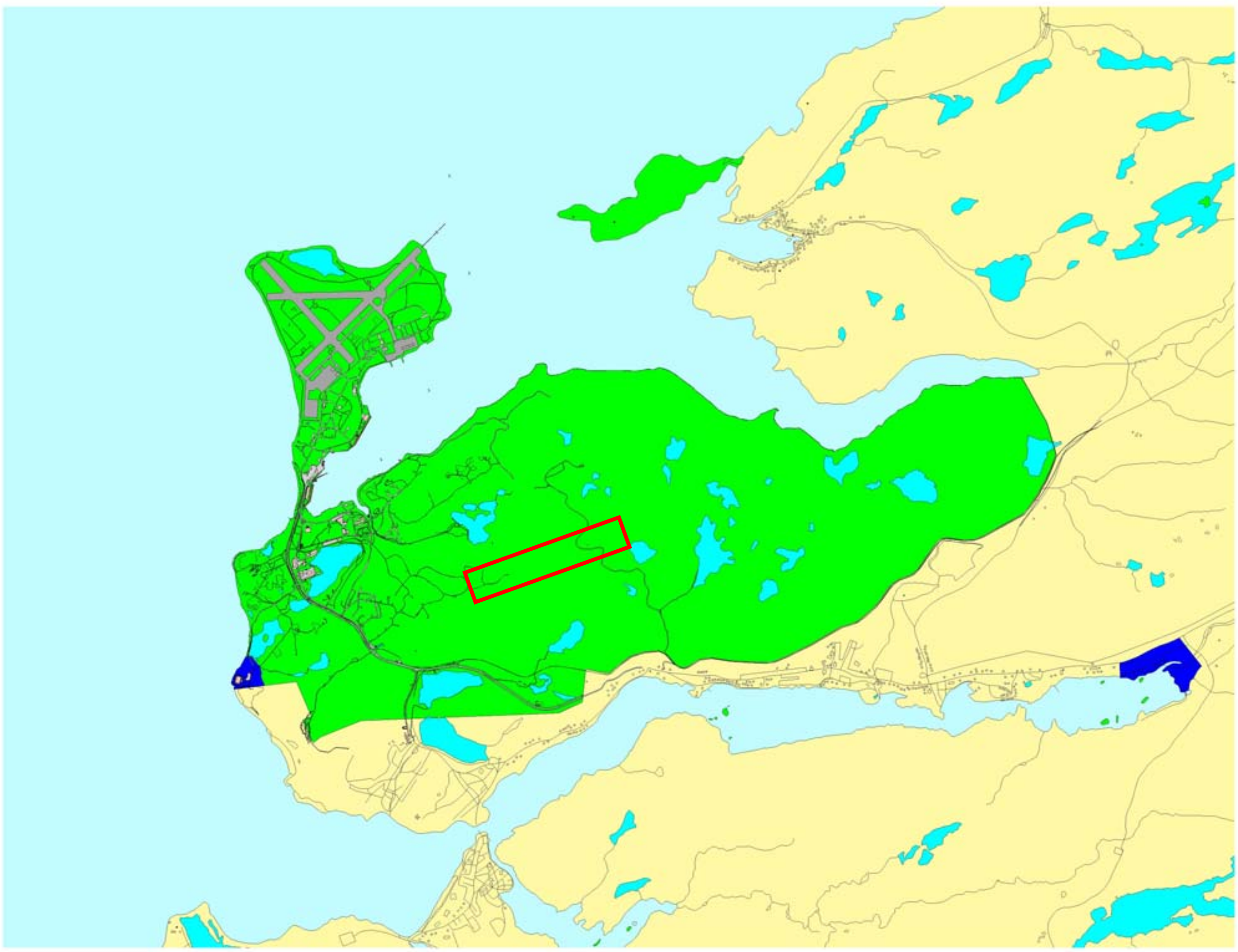
It should also be noted, that the closed houses - along HWY 100 to the south of the wind farm - are approximately 150m lower lying than the Argentia Backlands. Due to a steep terrain slope and forestation, they are shielded acoustically (as well as visually) from the wind farm. The acoustic map below does not take these sound mitigating terrain effects into account.



Map 5.1: Sound map at 8 m/s (10m a.g.l.) wind speed; sound levels outside the red line are 45 dB(A) or less; the **dwellings closest** to the limits of the wind farm are app. **1300m** away, along HWY 100

Location on AMA property

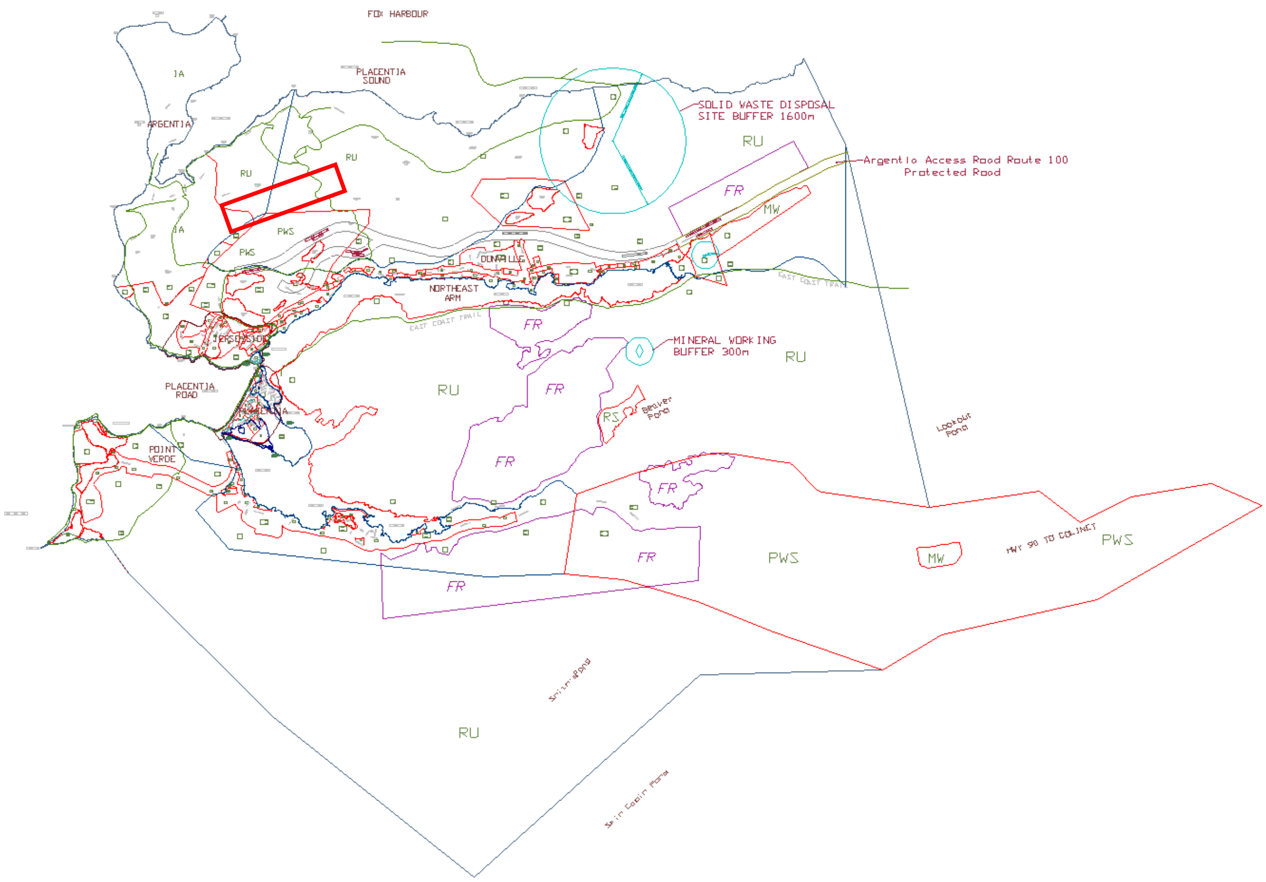
The map below shows the approximate location of the proposed wind farm on Argentia Management Authority (AMA) property. The wind farm is fully located on AMA managed land.



Map 6.1: The approximate wind farm extents on Argentia Management Authority (AMA) property (green area) /1/ are shown in red

Location w/ respect to Placentia Total Zoning

The map below shows the approximate location of the proposed wind farm with respect to the Placentia Total Zoning map.



Map 7.1: The approximate wind farm extents w/ respect to the Placentia Total Zoning map /1/ are shown in red (thick outline)

References
/1/ Map provided by Argentia Management Authority (AMA), November 2009

ATTACHMENT B

Jon Joy's CV

Box 142,
Bonavista, NL
A0C 1B0

Telephone: 709 468 1707
Fax: 709 468 2004
Email: Jon.Joy@cna.nl.ca

Jonathan Bruce Joy

Experience

Jan 1993 – Present College of the North Atlantic Bonavista, NL

Instructor, Fish and Wildlife Technician Program

- Instruct natural resource management courses.
- Coordinate the instruction of law enforcement courses.
- Coordinate the instruction of short courses offered by Coast Guard etc.
- Course/Program Development.
- Development of distributed learning courses (WebCt).

Feb 1996 – Present College of the North Atlantic Bonavista, NL

Instructor, Firearm Safety/Hunter Education Program

- Instruct Canadian Firearm Safety Course.
- Instruct Atlantic Provinces Hunter Education Course.

Feb 1992 - Oct 1992 Eastern College Bonavista, NL

Program Development Officer: Natural Resources Technician Program

- Form an advisory committee.
- Develop program curriculum.
- Develop training modules.
- Identify program budgetary requirements.

May 1985– May 1989 Dept. Agric and Fisheries for Scotland Shetland

British Sea Fishery Officer

- Enforce EC and U.K. fishery legislation.
- Assist fishermen in oil related gear loss compensation claims
- Collect biological data on fish species.

Education

Jan 1987 - Dec 1988 Aberdeen University Aberdeen, Scotland

Master of Science Degree

- Fishery Biology of Ommastrephid Squid in Shetland Waters.
- Part time research degree.

Oct 1980 - June 1984 Edinburgh University Edinburgh, Scotland

Bachelor of Science Degree (Honors)

- B.Sc. in Ecological Science.
- Honors in Fish and Wildlife Management.

Additional Training

Canadian Aquatic Biomonitoring Network training, Wolfville, NS. 2003

Electrofishing Certification Course, Lindsay, Ontario. 2004.

Ground search and rescue.

Wilderness survival.

Small craft safety (red cross).

Marine radio telephone.

Canadian Firearms Safety Course (restricted and non restricted).

Hunter education.

Animal care seminar (Memorial University).

Pleasure craft operator's certificate.

Quality awareness seminar.

Stress management seminar.

WHMIS.

Additional Education

Biol7531 Biological Oceanography (MUN)

Phys3300 Introduction to Physical Oceanography (MUN)

ED2710 Course Organization and Development in Post-Secondary Education (MUN).

Other

Conduct Breeding Bird Surveys for the Canadian Wildlife Service. 2002, 2003, 2004

ATTACHMENT C

Pre-Construction Bird Survey
Argentia, NL, Wind Farm

February 27, 2009

Prepared by:

Jonathan Joy, M.Sc.
Box 203
Elliston, NL
A0C 1N0

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and

Pamela Woodman
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Introduction

Wind Project Inc. is proposing to construct and operate a wind farm at Argentia, NL in an area known as the "Argentia Backlands". The farm would consist of fifteen 1.5 MW or nine 3.0 MW turbines depending factors such as cost and availability. The turbines would be mounted on conical steel towers with a hub height of 65 to 80m and be powered by a three bladed rotor with a diameter of 80 to 90m.

Wind farms are thought to be generally safe for most birds (Curry and Kerlinger, 2002) and there are not many examples of bird populations being affected. However, increased levels of bird mortality have been found in some sites located in coastal areas (Kerlinger, 2001) and birds of prey in some upland sites (Sterner, 2002). The influence of turbines on breeding birds is thought to be low for behavioral reasons (Hanowski and Hawrot, 2000).

There has been very little avian research carried out in the Argentia area despite the interest in developing the grounds formerly occupied by a military base. Dr. Leslie Tuck compiled the most comprehensive listing of birds for the area more than 60 years ago (Tuck, 1948) with none of the species listed considered rare (MacTavish *et al.*, 2003). A list of bird species adjacent to the former military base was provided for the Demonstration Plant Project Registration by the Voisey's Bay Nickel Company. However, this document does not provide any information on species of land birds in the backlands area (Anon, 2002). The purpose of this project was to monitor the types, numbers and seasonal activities of birds found within the proposed wind farm boundaries on Argentia, NL.

Study Area

Argentia region is located within the Southern Barrens sub-region of the Maritime Barrens Eco-region (Damman, 1983). This eco-region is characterized by extensive barren areas consisting of dwarf shrub heaths, bogs and shallow fens.

The proposed wind farm is located in the "Argentia Backlands", about 2km north east of the community of Freshwater (Figure 1, Topographic Map 01-N-05). It is an upland area ranging in elevation from 400 to 550' above sea level. The study area was defined using the 400' contour line, which delimits the boundaries of the wind farm (Figure 2). Analysis using aerial photographs and GIS (Figure 2) showed kalmia barrens (48.3%) and coniferous woodland (46.3%) to be dominant within the zone (Table 1). This is consistent with the findings of Alexander *et al*. (1996) for the general backlands area.

A field visit to the proposed site in June 2005 showed a variety of common plant species in the area. These include the heath land species: *Kalmia angustifloria*, *Empetrum* nigrum, *Rhododendron canadense* and *Vaccinium angustiflori*; and the forest species *Abies balsamea*, *Picea mariana* and *Larix laricina* (Jon Joy and Brenda Taylor personal observations). These and other common species were also recorded by Penney and Stokes (1998).

Habitat Type	Area (Ha)	%
Barrens	137.21	48.3
Woodland	131.51	46.3
Bogs	10.74	3.8
Exposed Rocks	4.06	1.4
Pond	0.51	0.2
Total Area	284.03	100.0

Table 1. Estimated area of habitat types within the proposed Argentia wind farm as delimited by the 400' contour line**.**

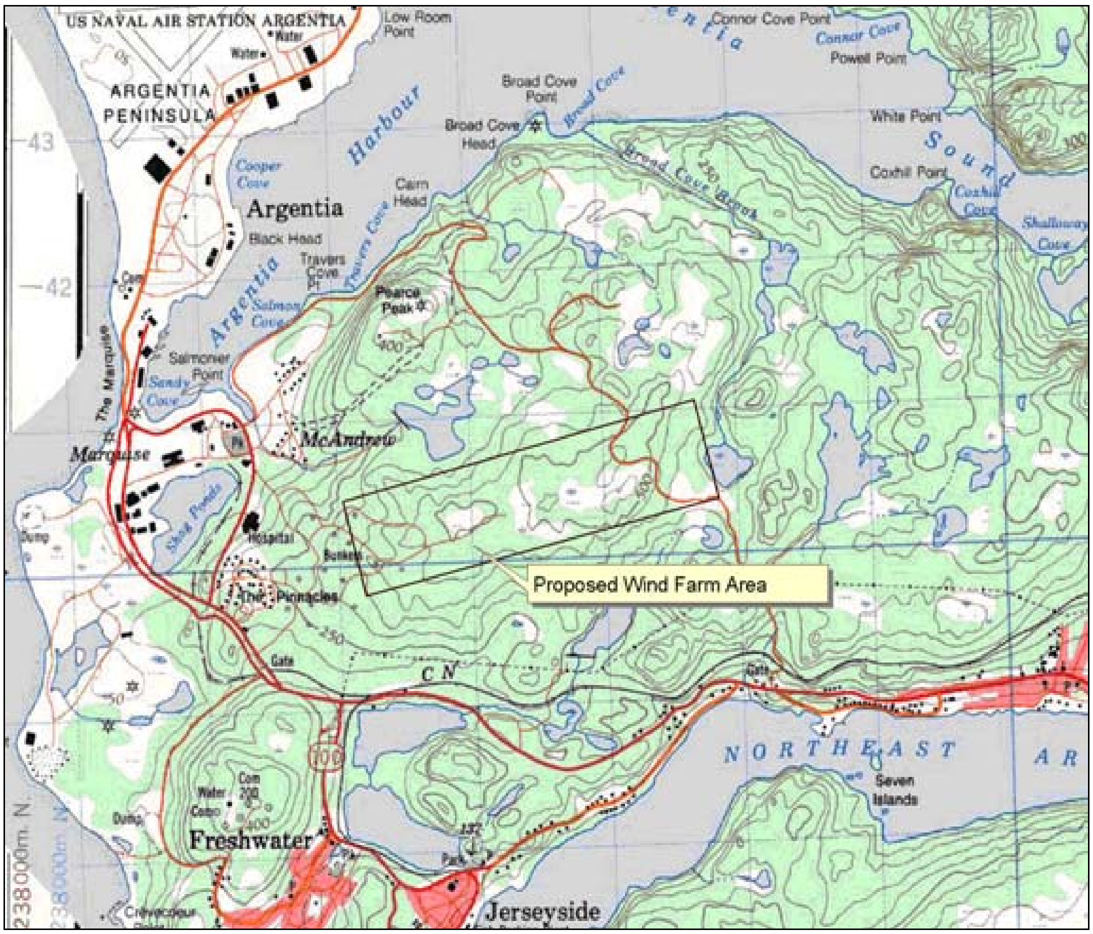


Figure 1. Location of the proposed wind farm at Argentia. Taken from NTS map 01-N-05.

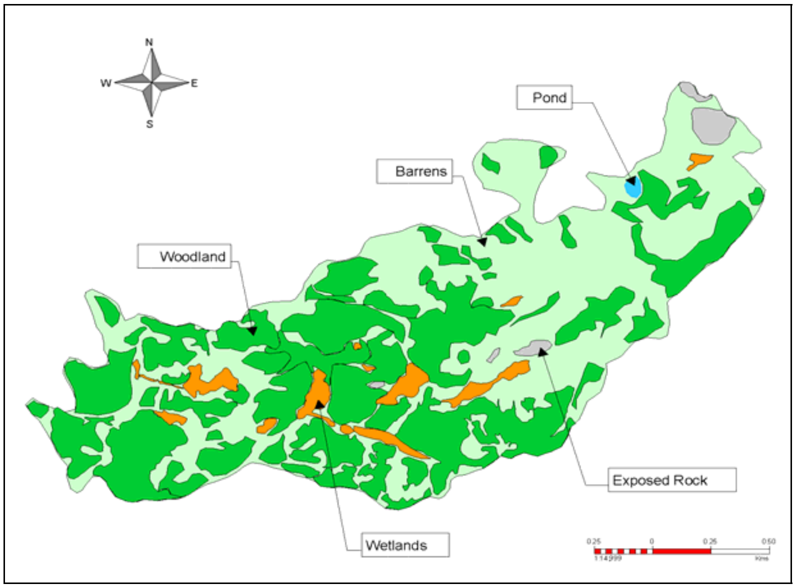


Figure 2. Habitat classification of the Argentia study area based on aerial photographs and topographic map number 01-N-05. The 400' contour line delimits the boundary of the site.

Methods

Argentia Avian Monitoring Protocol

The avian monitoring protocol for the Argentia site was designed by the Canadian Wildlife Service (Holly Hogan (now with the NL Parks Division)) in consultation with Natural Resources Canada and the Provincial Department of Environment and Conservation (Christine Doucet). Twenty point count stations were randomly selected within the study area using a grid overlay and stratified according to habitat type (Figure 3). GIS was used to determine the grid reference numbers (UTM) for the centre of each stations these were then located in the field using a GPS. Every point station had a radius of 100 meters (Area: 31,428m^2) and was surveyed for ten minutes during each visit. The bird surveys were conducted during the spring/summer migratory/breeding season (May1 – July 7, 2008) and fall migratory season (August 15 – October 31, 2008). Surveys commenced at sunrise and were conducted every third day. All bird sighting, vocalizations and flying heights (if applicable) were recorded by species during each survey (Figure 4).

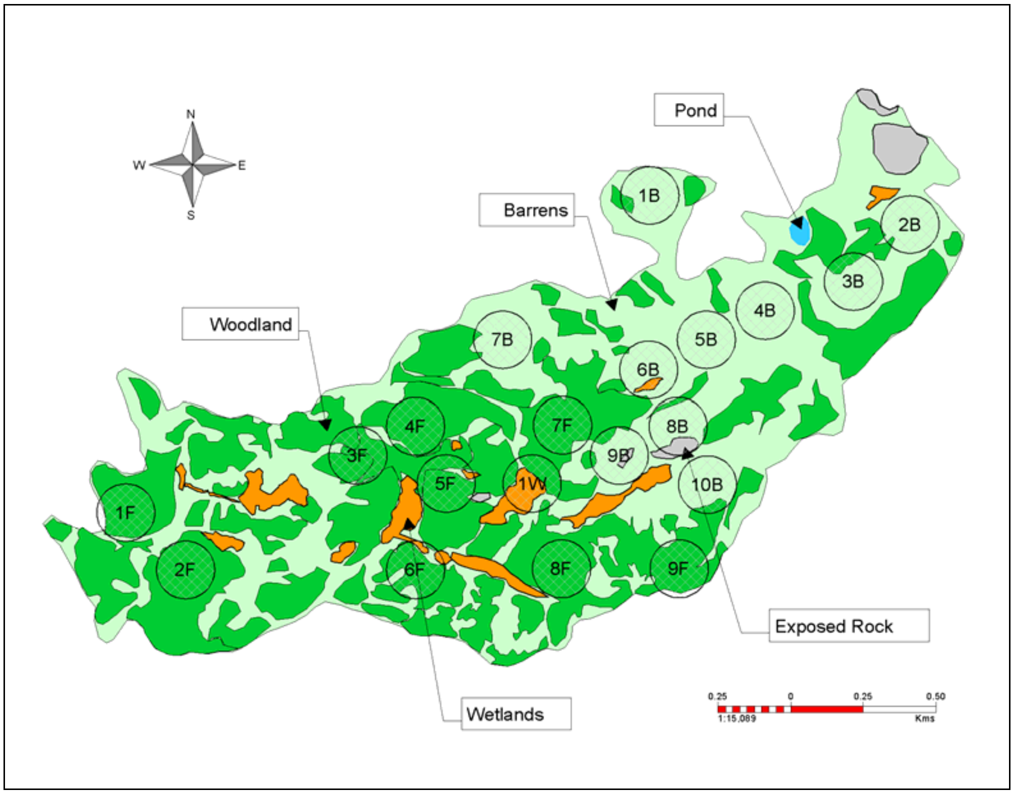


Figure 3. The positions of the 100 meter radius point count stations used for the Argentia bird monitoring survey from May 1 – October 31, 2008. (F= forest, B = Barrens, W = Wetlands).

Avian Monitoring Program Datasheet
Argentia, NL

Date:	Start Time:	End Time:
Plot Number:	Observer(s):	
Temperature:	Wind Speed:	Wind Direction:
Visibility:	Weather:	

Species Code	Distance From Observer (m)			Flying Height (m)	Flight Direction	Seen	Vocal	
	0 - 33	33 - 66	66 - 100				Song	Call

Figure 4. Avian monitoring data sheet used for Argentia, NL from May 1 to October 31, 2008.

Results

Habitat Assessment

The general characteristics of the habitat were described for each of the sampling stations (Table 2). There was a discrepancy between the habitat characterized using aerial photography and the field observations for three of the barrens sites (4B, 6B and 10B). These sites should have been classified as coniferous forest.

1F	Coniferous forest	1B	Kalmia Barrens adjacent to a pond
2F	Grassy field/ Coniferous forest	2B	Kalmia Barrens
3F	Deadwood coniferous forest	3B	Kalmia Barrens
4F	Deadwood coniferous forest	4B	Coniferous Forest
5F	Coniferous forest	5B	Kalmia Barrens
6F	Coniferous forest and deadwood	6B	Coniferous forest adjacent to road
7F	Coniferous forest	7B	Kalmia Barrens
8F	Coniferous forest	8B	Grassy plateau/barren
9F	Coniferous forest	9B	Kalmia Barrens
1W	Wetlands/Bog	10B	Coniferous forest adjacent to road

Table 2. Habitat characteristics of each point station sampled for the Argentia bird monitoring survey from May 1 – October 31, 2008. (F= forest, B = Barrens, W = Wetlands). Note that 4B, 6B and 10B were classified incorrectly

Spring Migration and Breeding Bird Survey

A total of 1536 bird observations from 38 species were made during the 23 sampling days from May 1 and July 7, 2008 (Table 3). Most (74%) of the 38 species were identified as a result of vocalization (Figure 5).

The majority of birds recorded (Table 4) were passerines (93.1%) followed by gulls/snipe (5.8%), raptors (0.8%), waterfowl (0.2%) and cormorants (0.1%). Ten birds were unidentified (8 gulls and 2 ducks).

Spring/Summer Survey

Forest (12 Plots)			
Species	Total	%	Density
WTSP	190	19.65	2.19 (2.65)
BPWA	139	14.37	1.60 (1.94)
AMRO	137	14.17	1.58
YBFL	80	8.27	0.92 (1.63)
BCCH	65	6.72	0.75 (1.32)
DEJU	60	6.20	0.69
CHSP	50	5.17	0.58 (1.33)
NOWA	49	5.07	0.57
HETH	47	4.86	0.54
COSN	27	2.79	0.31
YRWA	25	2.59	0.29
GREJ	19	1.96	0.22
AMCR	15	1.55	0.17
HERG	6	0.62	0.07
BOCH	8	0.83	0.09
UNGULLS	6	0.62	0.07
WIWA	6	0.62	0.07
RBNU	5	0.52	0.06
NOFL	4	0.41	0.05
OSPR	4	0.41	0.05
TTWO	3	0.31	0.03
GBBG	3	0.31	0.03
DCCO	2	0.21	0.02
RCKI	2	0.21	0.02
UNDUCKS	2	0.21	0.02
MERL	2	0.21	0.02
PIGR	2	0.21	0.02
NOHA	1	0.10	0.01
BBWO	1	0.10	0.01
DOWO	1	0.10	0.01
YWAR	1	0.10	0.01
RBGU	1	0.10	0.01
CORA	1	0.10	0.01
BAEA	1	0.10	0.01
BLJA	1	0.10	0.01
CAGO	1	0.10	0.01
	Σ967		

Barrens (7 Plots)			
Species	Total	%	Density
AMRO	123	24.07	2.43
WTSP	92	18.00	1.82 (2.20)
CHSP	43	8.41	0.85 (1.95)
HETH	41	8.02	0.81
BPWA	39	7.63	0.77 (0.98)
COSN	34	6.65	0.67
YBFL	33	6.46	0.65 (1.15)
YRWA	21	4.11	0.42
BCCH	16	3.13	0.32
SAVS	12	2.35	0.24
NOWA	10	1.96	0.20
AMCR	8	1.57	0.16
HERG	6	1.17	0.12
RBNU	5	0.98	0.10
GREJ	4	0.78	0.08
DEJU	4	0.78	0.08
OSPR	3	0.59	0.06
NOFL	3	0.59	0.06
RCKI	2	0.39	0.04
DOWO	2	0.39	0.04
YWAR	2	0.39	0.04
FOSP	2	0.39	0.04
UNGULLS	2	0.39	0.04
PIGR	1	0.20	0.02
BAEA	1	0.20	0.02
RBGU	1	0.20	0.02
BWWA	1	0.20	0.02
	Σ511		

Wetlands (1 Plot)			
Species	Total	%	Density
WTSP	15	25.86	2.10 (2.51)
AMRO	13	22.41	1.82
AMCR	5	8.62	0.70
BPWA	5	8.62	0.70 (0.88)
NOWA	4	6.90	0.56
COSN	3	5.17	0.42
YRWA	3	5.17	0.42
YBFL	3	5.17	0.42
BCCH	2	3.45	0.28
HETH	2	3.45	0.28
CHSP	2	3.45	0.28
GCKI	1	1.72	0.14
	Σ58		

Table 3. Bird species observed by habitat type at Argentia, NL from May 1 to July 7, 2008. Density represents the average number of birds per day per 10 hectares. See Appendix 1 for the species codes. Data in brackets represents density of the most common species after first observation date (based on Figure 7).

Species richness was related to habitat (Table 3) with the most species (n=34) being associated with woodland habitat. Less species were found in Barrens (n=26) and bog (n=12).

Order	Passeriformes	Charadriiformes	Falconiformes	Anseriformes	Pelecaniformes
# Birds	1430 (93.1%)	89 (5.8%)	12 (0.8%)	3 (0.2%)	2 (0.1)
# Unidentified	0	8	0	2	0
# Species	28	4	4	1	1

Table 4. Statistics on the number of birds identified by order during the spring/summer surveys.

Passerines made up 93% of the birds observed during the spring/summer surveys (Table 4). The white throated sparrow (*Zonotrichia albicollis*) first appeared on May 13 (Figure 7). It was the most abundant species overall and was the most common species in forest and bog habitat and the second most common species in heathland habitat. The American robin (*Turdus migratorius*) was present from May 1 (Figure 7) and was the most common species in barrens habitat. It was also abundant in both forest and bog. Hermit thrush (*Catharus guttatus*) and chipping sparrow (*Spizella passerina*) were present in all habitats but most abundant in barrens (Figure 6; Table 3).

Blackpoll warblers (*Dendroica striata*) began appearing on May 16 (Figure 7) and were the most abundant warbler within all habitats. Other species of warbler including northern waterthrush ( ) and yellow rumped warbler (*Dendroica coronata*) were present in both forest and barrens habitat but in relatively small numbers (Figure 6; Table 3).

The yellow bellied flycatcher (*Empidonax flaviventris*) first appeared on May 31 (Figure 7) and was present in all habitat types but most commonly seen in forest (Figure 6; Table 3).

Members of the order Charadriiformes made up 5.8% of the total observations during the spring/summer surveys (Table 4). Common snipe (*Gallinago gallinago*) was the most common species in this order and were relatively common on both bog and barren habitat (Figure 6). Snipe were also associated with forest edge (Table 3). A total of 25 gulls were observed in the forest and barren plots. The most common species was the herring gull (*Larus argentatus*), followed by greater black-back gull (*Larus* marinus) and ring billed gull (*Larus delawarensis*).

Twelve raptors were observed during the spring/summer survey. They included two bald eagle (*Haliaeetus leucocephalus*), seven osprey (*Pandion haliaetus*), two merlin (*Falco columbarius)* and one northern harrier (*Circus cyaneus*).

A solitary Canada goose (*Branta canadensis*) represented the only waterfowl species identified during the spring/summer survey. Two ducks were unidentified.

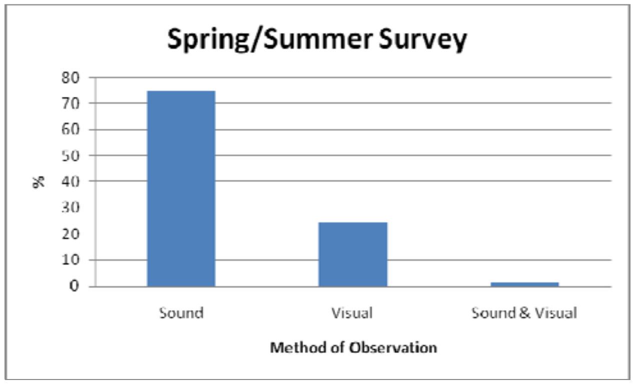
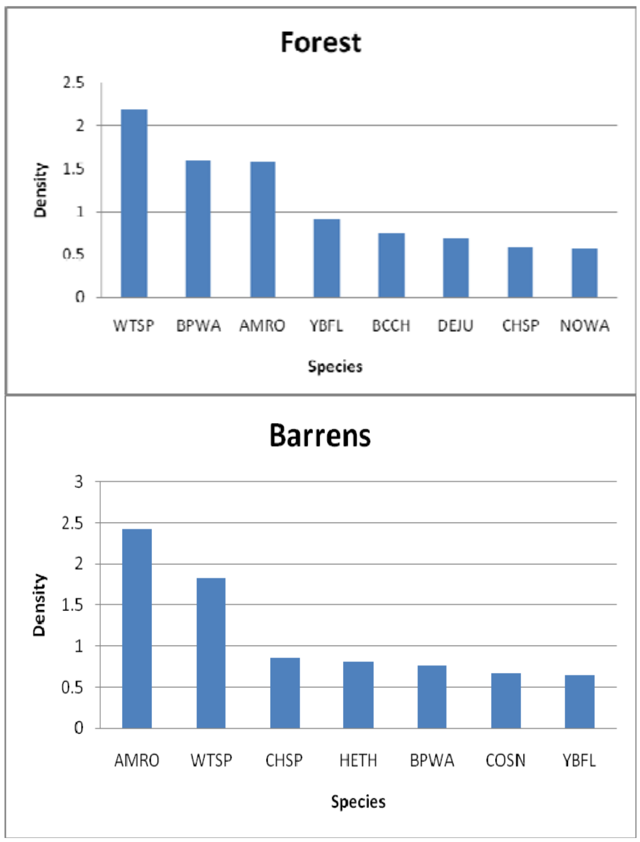


Figure 5. Method of observation (%) for birds identified during the spring/summer surveys.



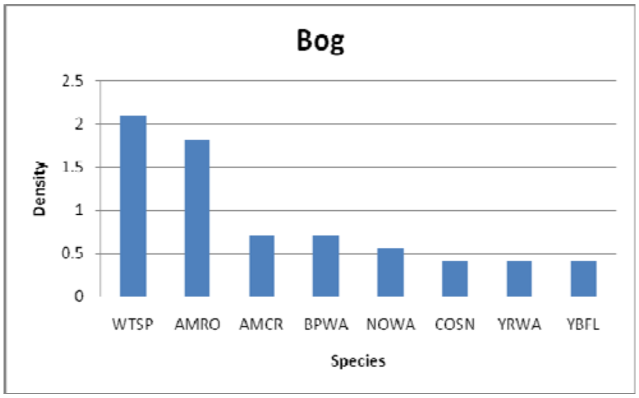
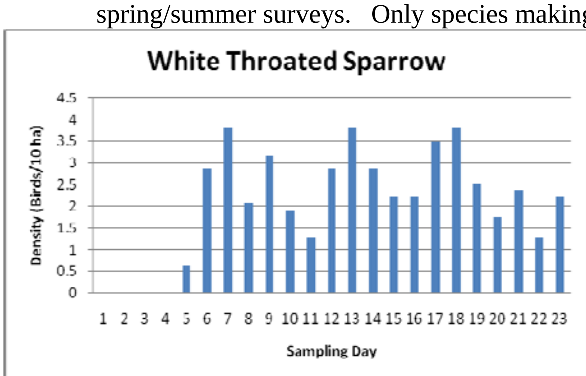
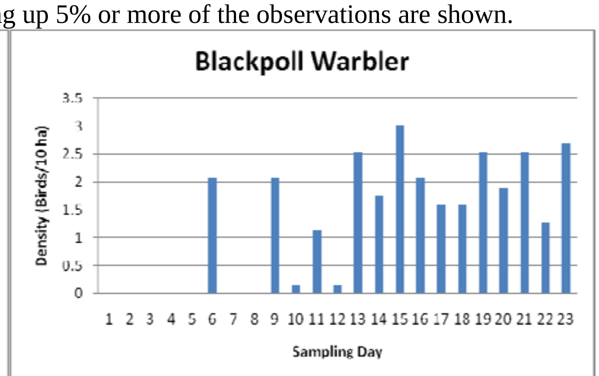
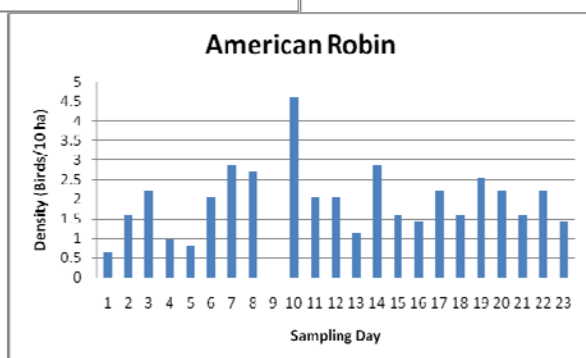
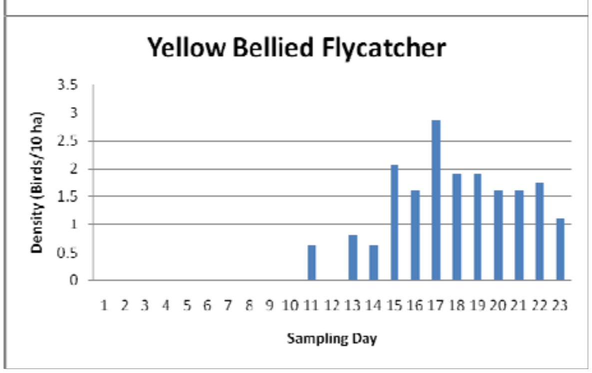


Figure 6. Density by habitat type of the most common bird species identified during the spring/summer surveys. Only species making up 5% or more of the observations are shown.









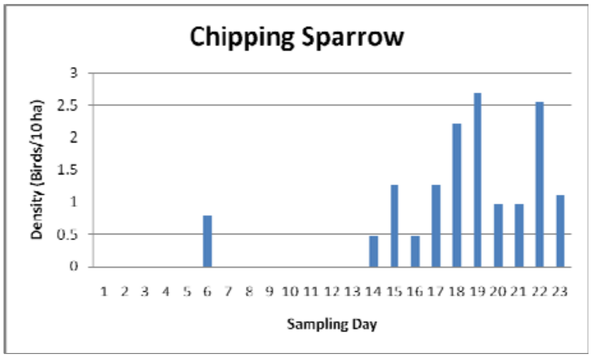


Figure 7. Density (birds/10 ha) by sampling day for the most common bird species identified during the spring/summer surveys (May 1 to July 7, 2008).

Fall Migration Survey and Breeding Bird Survey

A total of 2033 bird observations representing 35 species were made during the 26 sampling days between August 15 and October 31, 2008 (Table 5). Most observations were made as a result of visual identification (Figure 8).

Passerines were the most common birds observed in the fall survey with 2014 identified birds from 29 species and 4 unidentified birds (Table 6). This order represented 99.3% of the total bird observations during this period. The most abundant species (black-capped chickadee (*Poecile atricapillus*), white winged crossbill (*Loxia leucoptera*), white throated sparrow and dark eyed junco (*Junco hyemalis*)) were associated with forest habitat (Table 5) and to a lesser degree, heathlands and wetlands (Table 5; Figure 9). The American robin, white-throated sparrow and black-capped chickadee were the most common species observed in heathland habitat (Table 5; Figure 9).

Flocks of passerines were commonly seen in the fall survey and often produced signature "pulses" in associated density data (Figure 10). This is most pronounced with the white-winged crossbill which appeared in large numbers on three sampling days during October resulting in it becoming the third most common species overall.

Raptors represented 0.4% of the total observations with only 4 species being observed. Five Merlin, one northern harrier, one goshawk (*Accipiter gentilis*) and two American kestrel (*Falco sparverius*) were identified. No bald eagle or osprey were observed during the fall surveys.

One herring gull and 3 snipe represented the only members of the order Charadriiformes observed during the fall component of the study

Overall, species richness during the fall (n=35) was less than in the spring/summer survey (n=38). Species richness was related to habitat (Table 5) with most species being observed in woodland habitat (n=35) followed by barrens (n=21) and bog (n=15).

Fall Survey											
Forest (12 Plots)				Barrens (7 Plots)				Wetland (1 Plot)			
Species	**Total**	**%**	**Density**	**Species**	**Total**	**%**	**Density**	**Species**	**Total**	**%**	**Density**
BCCH	213	16.88	2.17	WTSP	103	15.10	1.80	BCCH	27	30.34	3.30
WWCR	197	15.61	2.01	AMRO	94	13.78	1.64	WWCR	18	20.22	2.20
WTSP	167	13.23	1.70	BCCH	89	13.05	1.56	BOCH	10	11.24	1.22
DEJU	150	11.89	1.53	SAVS	61	8.94	1.07	DEJU	6	6.74	0.73
BPWA	87	6.89	0.89	CHSP	61	8.94	1.07	WTSP	5	5.62	0.61
AMRO	77	6.10	0.79	BPWA	50	7.33	0.87	AMCR	5	5.62	0.61
SAVS	63	4.99	0.64	AMCR	48	7.04	0.84	CORA	5	5.62	0.61
CHSP	37	2.93	0.38	DEJU	44	6.45	0.77	AMRO	3	3.37	0.37
RBNU	30	2.38	0.31	YRWA	37	5.43	0.65	SAVS	2	2.25	0.24
AMCR	30	2.38	0.31	GRAJ	31	4.55	0.54	CHSP	2	2.25	0.24
GRAJ	29	2.30	0.30	RBNU	14	2.05	0.24	MERL	2	2.25	0.24
BOCH	27	2.14	0.28	CORA	14	2.05	0.24	BPWA	1	1.12	0.12
BWWA	26	2.06	0.27	YBFL	8	1.17	0.14	RBNU	1	1.12	0.12
YRWA	22	1.74	0.22	BWWA	7	1.03	0.12	GCKI	1	1.12	0.12
CORA	20	1.58	0.20	BOCH	5	0.73	0.09	PIGR	1	1.12	0.12
YBFL	19	1.51	0.19	AMGO	3	0.44	0.05		**89**		
NOFL	13	1.03	0.13	UNPAS	3	0.44	0.05				
AMGO	12	0.95	0.12	NOFL	3	0.44	0.05				
FOSP	11	0.87	0.11	COSN	2	0.29	0.03				
WIWA	6	0.48	0.06	BLJA	2	0.29	0.03				
NOWA	5	0.40	0.05	GCKI	2	0.29	0.03				
BLJA	3	0.24	0.03	NOHA	1	0.15	0.02				
MERL	3	0.24	0.03		**682**						
HETH	2	0.16	0.02								
AMKE	2	0.16	0.02								
HERG	1	0.08	0.01								
HAWO	1	0.08	0.01								
GCKI	1	0.08	0.01								
UNPAS	1	0.08	0.01								
DCCO	1	0.08	0.01								
RCKI	1	0.08	0.01								
RUGR	1	0.08	0.01								
DOWO	1	0.08	0.01								
COSN	1	0.08	0.01								
BRCR	1	0.08	0.01								
NOGO	1	0.08	0.01								
	1262										

Table 5. Bird species observed by habitat type at Argentia, NL from August 15 to October 31, 2008. Density represents the average number of birds per day per 10 hectares. See Appendix 1 for the species codes.

Order	Passeriformes	Charadriiformes	Falconiformes	Galliformes	Pelecaniformes
# Birds	2018 (99.3%)	4 (0.2%)	9 (0.4%)	1 (0.05%)	1 (0.05%)
# Unidentified	4	0	0	0	0
# Species	29	2	4	1	1

Table 6. Statistics on the number of birds identified by order during the fall surveys.

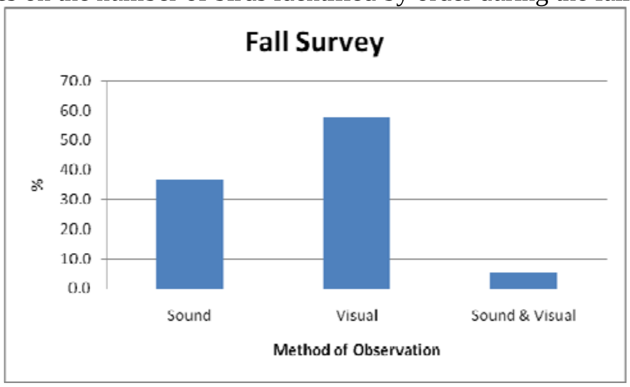
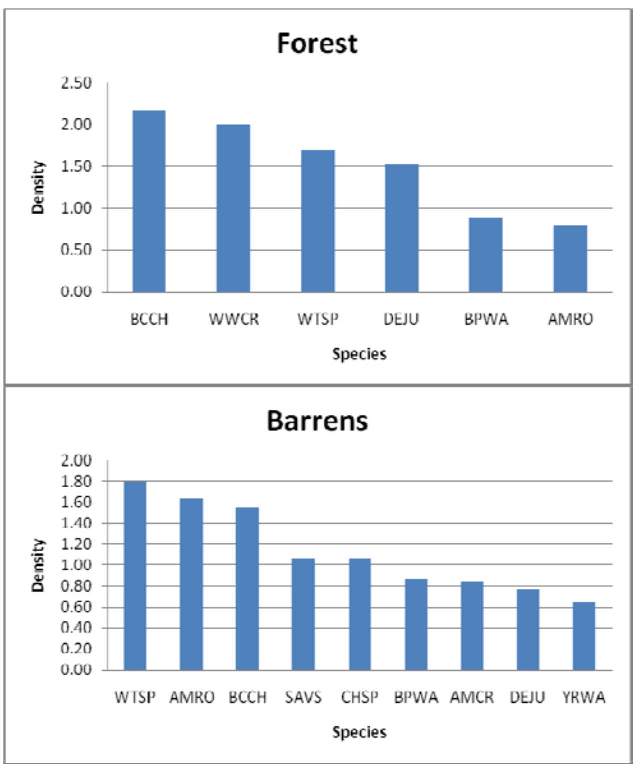


Figure 8. Method of observation (%) for birds identified during the spring/summer surveys.



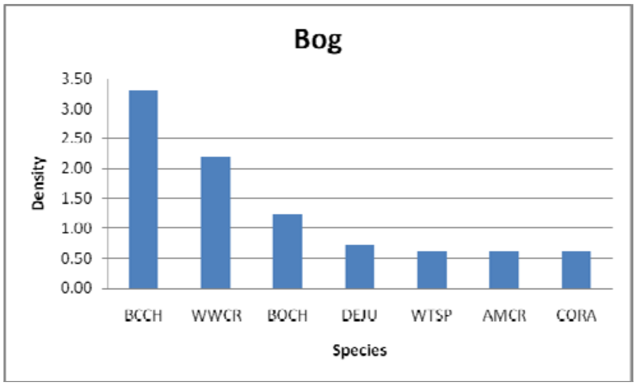
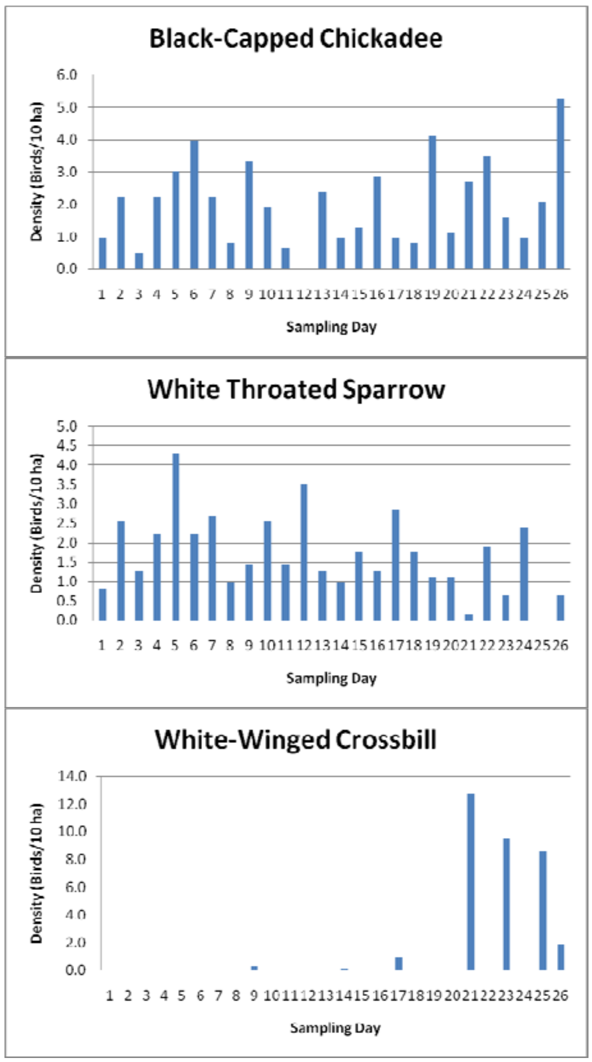


Figure 9. Density (birds/day/10 ha) by habitat type for the most common bird species identified during the fall surveys (August 15 to October 31, 2008).   Only species making up 5% or more of the observations are shown.



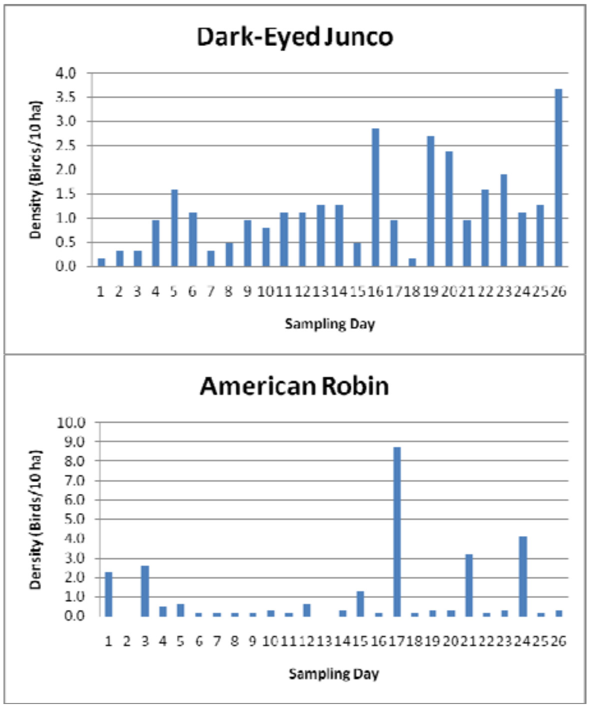


Figure 10. Density (birds/10 ha) by sampling day for the most common bird species identified during the fall surveys (August 15 to October 31, 2008).

Flying Heights

A total of 169 birds were observed flying during the spring/summer surveys, the majority of which (78.1%) were less than 33m above the ground (Table 7). Only 12 birds from 3 species (American crow (*Corvus brachyrhynchos*), American robin and herring gull) were observed flying above 66m with none exceeding 100m in height. The only raptors observed flying during the spring/summer survey were 2 bald eagles and 1 northern harrier. These 3 birds were seen at a height of 33 to 66m.

During the fall surveys, 1177 birds were observed flying most of which (78.3%) were below 33m in height (Table 7). Flocks of American robin (n=43) accounted for most of the birds observed flying between 66 and 100m in height and 23 were observed flying above 100m. There were also 9 American crow, 23 red breasted nuthatch (*Sitta canadensis*), 1 common raven (*Corvus corax*) and 2 American Kestrel observed flying above 100m in height.

Three other raptors were seen in addition to the American kestrel. These included 2 merlin flying below 33m and 1 goshawk flying between 33 and 66m in height. No bald eagles were observed flying during the fall.

The anticipated danger zone for the two types of turbine being considered range in height from 25m to 105m for the 65m hub height tower; and 35m to 125m for the 80m hub height tower (Table 7). There is a potential for bird strikes with 21.8% of birds for the 80m hub height tower (Table 7). We can assume that this number will be higher for the 65m hub height tower as the blades are closer to the ground. However, the potential number of strikes is unknown due to the resolution of our measurements.

Influence of Wind Conditions on Bird Observations

There was a low negative correlation between the number of birds observed during each site visit and the mean wind speed recorded at Argentia (Environment Canada data) for both the spring/summer and fall surveys (Figure 11 and Figure 12). Most observations were made when winds blew between a southeasterly and southwesterly direction (Figure 13), which is the prevailing wind direction for the area (Banfield, 1981). .

Flying Height (spring)

		80m Tower		
	65m Tower			
Species	0 - 33	33 - 66	66 - 100	> 100
GBBG	0	2	0	0
AMRO	36	10	2	0
GRJA	15	1	0	0
BBWO	1	0	0	0
YRWA	18	0	0	0
BOCH	8	0	0	0
PIGR	0	1	0	0
BCCH	9	0	0	0
MERL	0	1	0	0
YWAR	1	0	0	0
AMCR	5	0	6	0
HERG	1	2	4	0
TTWO	0	1	0	0
DEJU	21	1	0	0
RBGU	0	2	0	0
COSN	4	0	0	0
BAEA	0	2	0	0
RBNU	0	1	0	0
WTSP	3	0	0	0
NOHA	0	1	0	0
CHSP	4	0	0	0
WIWA	1	0	0	0
NOWA	1	0	0	0
BWWA	2	0	0	0
YBFL	2	0	0	0
Total	132	25	12	0
Percentage	78.11	14.79	7.10	0.00

Flying Height (fall)

		80m Tower		
	65m Tower			
Species	**0 - 33**	**33 - 66**	**66 - 100**	**> 100**
RUGR	1	0	0	0
AMRO	37	0	43	23
GRJA	41	0	0	0
HAWO	1	0	0	0
YRWA	55	0	0	0
BOCH	30	0	0	0
PIGR	1	0	0	0
BCCH	175	0	0	0
MERL	2	0	0	0
DCCO	1	0	0	0
AMCR	25	7	6	9
SAVS	92	0	0	0
FOSP	11	0	0	0
DEJU	122	0	0	0
RCKI	1	0	0	0
COSN	3	0	0	0
GCKI	3	0	0	0
RBNU	10	0	0	23
WTSP	125	0	0	0
NOHA	0	0	1	0
CHSP	47	0	0	0
WIWA	4	0	0	0
NOWA	1	0	0	0
BWWA	19	0	0	0
YBFL	6	0	0	0
CORA	6	8	3	1
BPWA	12	0	0	0
DOWO	1	0	0	0
HETH	2	0	0	0
BRCR	1	0	0	0
NOGO	0	1	0	0
AMKE	0	0	0	2

WWCR	84	129	0	0
UNPASS	2	0	0	0
Total	921	145	53	58
Percentage	78.25	12.32	4.50	4.93

Table 7. Flying heights for birds observed in the spring/summer and fall bird surveys at Argentia in 2008. Propeller heights from top to bottom are indicated in red for turbines with 80m (35m to 125m propeller height) and 65m (25m to 105m propeller heights) hub heights.

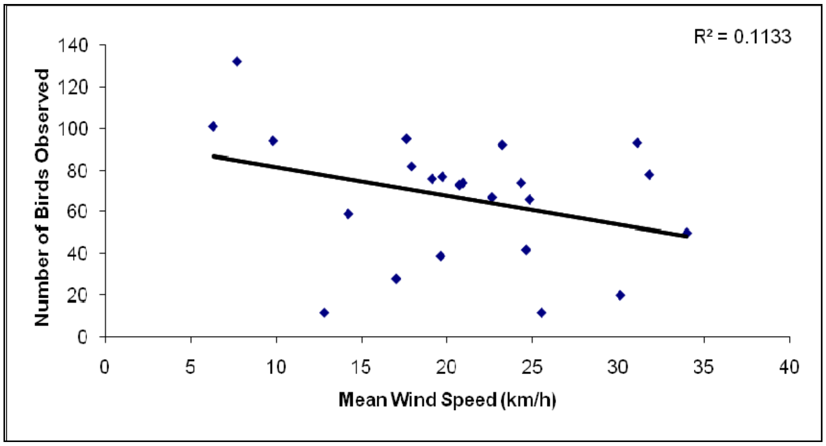


Figure 11. Regression analysis and corresponding correlation coefficient for the relationship between Mean Wind Speed (kph) and the number of birds observed on each site visit during the spring/summer bird surveys at Argentia in 2008.

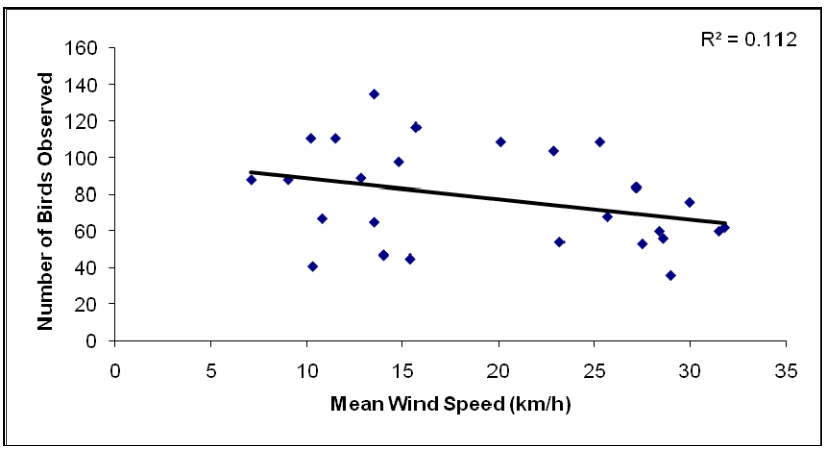


Figure 12. Regression analysis and corresponding correlation coefficient for the relationship between Mean Wind Speed (kph) and the number of birds observed on each site visit during the fall bird surveys at Argentia in 2008.

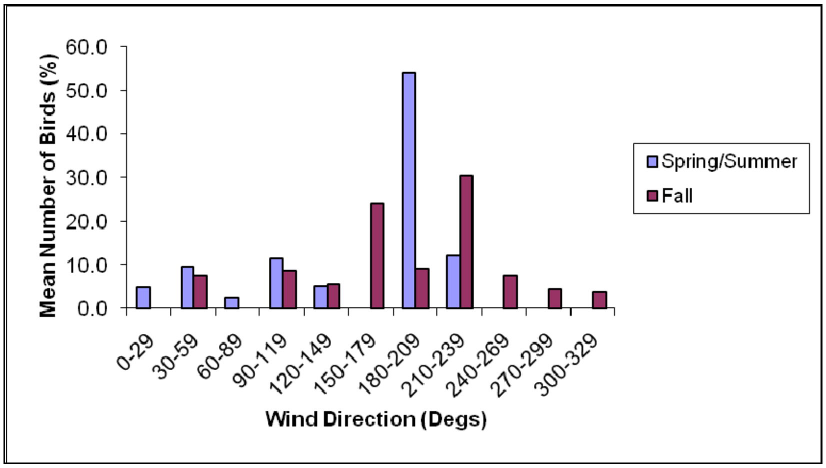


Figure 13. Relationship between wind direction (degrees) and the mean number of birds observed on each site visit during the spring/summer and fall bird surveys at Argentia in 2008.

Discussion

The spring/summer and fall surveys produced 38 and 35 species of birds respectively. This diversity was greater than that observed during the Burnt Ridge bird monitoring study where only 31 species of bird were observed in both the spring/summer and fall (Joy and Taylor, 2005). Of the 38 species recorded in the spring/summer, 28 were potentially breeding songbirds. This is similar to songbird diversity at Burnt ridge where 27 species of potentially breeding songbirds were observed and slightly less than that of Western Newfoundland forests where 32 potentially breeding species have been recorded (Thompson *et al*., 1999). Species richness was affected by habitat in both spring/summer and fall surveys, with forest containing the most species followed by barrens and then bog.

Forest stands contained the greatest densities of most songbird species compared to the other habitats in the study. However, some species were very common in all habitats (e.g. white-throated sparrow) and others such as the American robin were more abundant in open habitat associated with heathland and bog. Similar results have been seen in Labrador where American robin were much more abundant in open clear-cut areas (density = 3.5 territories/10 ha) than in mature forest (densities = 0.8 territories/10ha) (Simon *et al*., 2000). Most species of songbird had higher densities in Argentia than in Burnt Ridge (Joy and Taylor, 2005) or Western Labrador (Simon *et al*., 2000) and probably reflects a difference in habitat quality between these sites.

There was a notable decrease in the densities of most common songbird species observed between the spring/summer and fall surveys. This is most likely due to a reduction in territorial vocalization associated with the close of the breeding season. Some species did however, increase in abundance during the fall (e.g. black-capped chickadee, white – winged crossbill and dark eyed junco) as a result of flocking behaviour (Table 3; Table 5).

There results indicate that the species composition and densities of potentially breeding songbirds were normal for Newfoundland. Other studies in North America have shown that the impact of wind farms on breeding songbirds is minimal (Hanowski and Hawrot, 2000; Kerns and Kerlinger, 2004). For this reason, there is nothing to indicate that the development of a wind farm in Argentia would have any significant impact on breeding passerines in the area.

A total of 20 raptors represented by 6 species were observed during the study. Bald eagle (n=2) and osprey (n=7) were observed in the spring/summer but it is unlikely that they were breeding in the vicinity of the study area as none were recorded in the fall surveys, which began on August 15, 2008. Other species included merlin (n=7), goshawk (n=1) and northern harrier that are associated with the boreal forest and adjacent heathlands in Newfoundland. The American kestrel (n=2) observed in the fall are listed as very uncommon breeders (Mactavish *et* al, 2003) and were probably transient given that they were flying at a height of more than 100m.

The potential for turbine associated mortality with raptors is known in upland areas (Sterner, 2002). However, studies have shown that collision mortality is minimal when bird densities are low (Krone, 2003) and raptor mortality in other eastern North American has been shown to be relatively low (Kerns and Kerlinger 2004, Koford et al. 2005). Given the low densities of raptors observed at during the study, it is unlikely that the proposed wind farm in Argentia would have any significant impact on their populations.

There were very few observations made of waterfowl (n=3) during the study despite the presence of fresh water ponds adjacent to the study area. These results are similar with those found at Burnt Ridge (Joy and Taylor, 2005), a plateau of similar elevation to the Argentia site. It is very unlikely therefore, that the development of a Wind farm would impact waterfowl species in the area.

No species at risk (e.g. red crossbill (*Loxia curvirostra percna*)) were observed during the spring/summer or fall surveys.

There was a large increase in the number of birds observed flying in the fall surveys compare to spring/summer. This is almost certainly due to flocking behavior for both adult and young of the year as they prepare for migration. Migratory behavior may also explain the increased numbers of birds observed flying at higher altitudes in the fall (Table 7). Because most birds (78%) were observed flying below 33m in both spring/summer and fall the potential impact of turbines may be reduced by increasing the hub height of the towers.

Conclusion

1. The diversity and densities of breeding songbirds at Argentia are similar to other sites in Newfoundland and Labrador. The impact of a wind farm development on their populations is expected to be negligible.
2. The numbers of raptors observed during the surveys are small and the development of a wind farm in Argentia should have no significant impact on their populations.
3. No species at risk birds were observed during the surveys.

4. Most birds flew at heights of less than 33m. The impact of turbines on birds flying between 25m (the lowest propeller height) and 33m is not known.
5. There is some potential for bird strikes in the fall when migrating songbirds move through the area at higher altitudes.
6. Very few gulls or waterfowl were present in the study and the impact of wind farm development on these species is not likely to be significant.

Appendix 1

Species Code	Species
TTWO	Three-toed Woodpecker
DCCO	Double Crested Cormorant
AMRO	American Robin
AMCR	American Crow
GBBG	Greater Black-backed Gull
COSN	Common Snipe
HETH	Hermit Thrust
HERG	Herring Gull
GRAJ	Gray Jay
BCCH	Black-capped Chickadee
DEJU	Dark-eyed Junco
PIGR	Pine Grosbeak
BAEA	Bald Eagle
RCKI	Ruby Crowned Kinglet
RBNU	Red-breasted Nuthatch
YRWA	Yellow-rumped Warbler
WTSP	White-throated Sparrow
CHSP	Chipping Sparrow
BPWA	Blackpoll Warbler
NOWA	Northern Waterthrush
NOHA	Northern Harrier
BOCH	Boreal Chickadee
BBWO	Black-backed Woodpecker
DOWO	Downy Woodpecker
YWAR	Yellow Warbler
UNDU	Unidentified Duck
RBGU	Ring-billed Gull
MERL	Merlin
YBFL	Yellow-bellied Flycatcher
SAVS	Savannah Sparrow
BLJA	Blue Jay
WIWA	Wilson's Warbler
NOFL	Northern Flicker
BWWA	Black and White Warbler
GCKI	Golden Crowned Kinglet
FOSP	Fox Sparrow
OSPR	Osprey
AMGO	American Goldfinch

Species Code	Species
UNPAS	Unknown Passerines
UNGU	Unidentified Gull
CAGO	Canada Goose
CORA	Common Raven
HAWO	Hairy Woodpecker
WWCR	White-winged Crossbill
RUGR	Ruffed Grouse
AMKE	American Kestral
NOGO	Northern Goshawk
BRCR	Brown Creeper

References

Alexander, W; Veitch, G. and Rowe, J. 1996. Argentia Backlands Forest Resource Management Plan. Unpublished. 18pp.

Anonymous 2002. Voisey's Bay Nickel Company Limited Argentia Hydrometallurgical Demonstration Plant Project Registration. Voisey's Bay Nickel Company Ltd., St. John's, NL. p34-46.

Banfield, C.C. 1981. The climatic environment of Newfoundland. In: The Natural Environment of Newfoundland Past and Present. MacPherson A.G. and MacPherson J.B. (Eds.). 83-152.

Curry, R., and Kerlinger, P. 2002. Avian Risk Assessment for The Allegheny Heights Wind Power. 44pp.

Damman, W.W.H. 1983. An ecological subdivision of the island of Newfoundland. In Monographiae Biologicae 48: Biogeography and Ecology of the Island of Newfoundland. Edited by G.R. South. Dr. W. Junk Publishers, The Hague. pp. 163-206.

Hanowski, J. M. and Hawrot, R. Y. 2000. An Assessment of Avian Issues in the Development of Wind Energy in Western Minnesota. Pgs. 80-87 in: Proceedings of the National Wind Power Interaction Workshop III, San Diego, CA.

Joy, J.B. and Taylor, B. 2005. Preconstruction bird monitoring program for Burnt Ridge, NL. Prepared for Bonavista Windpower Inc. 2005.

Kerlinger, P. 2001. Avian Issues and Potential Impacts With Wind Power. 20pp.

Kerns, J. and P. Kerlinger. 2004. A Study of Bird and Bat Collision Fatalities at the Mountaineer Wind Energy Center, Tucker County, West Virginia: Annual Report for 2003.

Technical Report prepared for FPL Energy and Mountaineer Wind Energy Center Technical Review Committee. Curry and Kerlinger, LLC. 39 pp.

Koford, R., A. Jain, G. Zenner. 2005. Avian Mortality Associated with the Top of Iowa Wind Farm, Calender. Iowa State University and Iowa Department of Natural Resources. February 2005.

Krone, O. 2003. Two white tailed sea eagles collide with wind generators in Northern Germany. J.Raptor Res. 37(2). 174-176.

Mactavish, B., Maunder, J.E., Montevecchi, W.A., Wells, J.L. and Fifield, D.A. 2003. Checklist (2003) of the birds of Insular Newfoundland and its Continental Shelf Waters. Natural History Society of Newfoundland and Labrador.

Penney and Stoke. 1998. Environmental Impact Assessment – Argentia Backlands Trail project. Penney and Stokes Environmental Consortium. 41pp.

Simon, N.P.P., Schwab, F.E., and Otto, R.D. 2002. Songbird Abundance in Clear-cut and Burned Stands: a Comparison of Natural Disturbance and Forest Management. Can. J. For. Res. **32:** 1343-1350.

Sterner, D. 2002. A Roadmap for PIER Research on Avian Collisions With Wind Turbines in California. 54pp.

Thompson, I. D., Hogan, H. A., and Montevecchi, W. A. 1999. Avian Communities of Mature Balsam Fir Forests in Newfoundland: Age-Dependence and Implications for Timber Harvesting. The Condor 101:311-323.

Tuck, L. 1948. Recent Observations on Newfoundland Birds in the Argentia-Dunville Area. The Canadian Field Naturalist. 62:4. p103-112.

ATTACHMENT D

Bird Monitoring Program

Bird Monitoring Program to Assess Impacts of the Wind Turbine Project on Birds at Elliston (Burnt Ridge), Newfoundland

Prepared by:

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This monitoring program has been designed using 'Wind Turbines and Birds: A Guidance Document for Environmental Assessment. Phase III Report. Draft (Kingsley and Whittam, December 2003)'.

The book "Peterson's Field Guide to the Birds of Eastern and Central North America" will help with bird identification.

Monitoring is required for a minimum of one year pre-construction and at least two years post-construction, at which point the need for further monitoring will be assessed.

A *Migratory Bird Convention Act* (MBCA) permit is required to collect migratory bird/ bird parts during collision monitoring, and for carcass persistence and searcher efficiency trials (see *Post-construction Monitoring* below). A Species At Risk Act (SARA) permit is also required to collect dead birds listed under SARA. For permit applications and information contact Donna Johnson: (506) 364-5017; or donna.johnson@ec.gc.ca

Methods

Pre-construction Monitoring

Line transects should be conducted through the path of the proposed turbine sites. This would involve recording all birds seen or heard while slowly walking along the transect line. Data collected includes date, observation start and end times, location (start and end of line, current weather conditions, bird species, number of birds, height above ground level (a.g.l.), and distance from observer (estimated as: 0 - 50m, 51m – 100m, >100m) (see Appendix A below for layout and details). Surveys should commence at dawn during the spring –summer (April 1 – July 7) and fall (August 15 – October 31) survey periods, which will encompass spring migration, breeding and fall migration. Survey frequency should be every third day. Line transects should be selected so that all major habitats are represented, roughly in the ratio that they occur (i.e. if 50% of the habitat in the project area is open barrens, then 50% of the lines should run through this type of habitat).

Post-construction Monitoring

Bird utilization rates and bird mortality rates need to be measured every week during migration and breeding periods (April 1 – October 31) and monthly for the remainder of the year (November 1 – March 31). These surveys must be conducted at the turbine site (impact site) and a control site (no impact site). The control site should be located in an area with similar landscape and habitat characteristics as the turbine site. The control site should also be located at a sufficient distance (~ 250 m) from the turbine site so that bird carcasses found within this site can't be attributed to the turbine.

The proposed site at Elliston will contain 13-14 turbines. For the purposes of this monitoring program, every other turbine (7) will be considered a single survey point. Therefore, 7 control points on the control site should be spaced at distances similar to those of the turbines being surveyed. The control points are flagged and geo-referenced with a GPS and on an aerial photograph. A total of 14 points (7 turbines and 7 control points) will be surveyed. (Note: Given that the exact number of turbines and turbine placement has not yet been determined, the turbines selected for the survey should be representative of the project area. The control site should then be laid out in the exact array as the project site.)

Bird Utilization Rate

Bird utilization rate is measured using stationary point counts where all birds seen passing through each turbine and control point are counted according to their zone of passage (Appendix B). The Observers should sit or stand quietly at any location that optimizes data recording. Movement should be minimized to avoid influencing bird behaviour. The number of birds seen passing the turbine and control points should be recorded for 8 minute periods at dawn, midday and dusk (Total observation period for 14 points = 112 minutes). Data collected includes date, observation start and end times, location (turbine number 1, 2, 3 etc. or control point 1, 2, 3 etc.), current weather conditions, bird species, number of birds, behaviour, height (zone a-d, in Table 1, Appendix B), and distance and direction from observer (see sample Data Form A in Appendix B below for layout and details). The points are visited randomly, although each turbine and its associated control point are visited successively (e.g. turbine 6, control point 6, turbine 2, control point 2, etc.).

Bird Mortality Rate

Bird mortality rate (usually expressed as birds killed per turbine per time period of interest) is measured at the turbine and control points. Mortality is measured by searching for carcasses after each 8 minute observation period. Carcass searches should occur within a 50 m radius around each of the turbine and control points.

Carcasses, including single or groups of feathers, should be picked up (wearing vinyl or latex gloves) and placed in separate plastic bags which should be labeled with the date, location, observer, and identification number. The identification number should correspond to the same field on the data sheet (sample Data Form B in Appendix B) which should also include information on species, sex and age (if known), condition and freshness of the carcass (see Table 2 in Appendix B), cause of death (turbine strike, shooting, poisoning, unknown) distance and direction from the turbine, and geo-referenced location (latitude and longitude calculated with a GPS). Once carcasses have been fully identified, they should be discarded at least 500 m away from either the turbine or control site. For species that cannot be identified, digital photos could also be taken and sent to the Canadian Wildlife Service for identification.

It is important that the carcass searches occur on the same day as the bird point counts. It is possible to have two different observers conducting the bird point counts and the carcass counts, so long as they are not at the same point at the same time, which would disrupt the bird point counts.

Injured birds should be carefully described on the data form so that it can be recognized if later found dead.

If possible, the same observer or set of observers should conduct the utilisation and mortality surveys for the entire duration of the study, to reduce inter-observer difference It is also extremely important that measurements be made consistently throughout the area and for the duration of the study.

Correcting bird mortality rate for carcass removal rates and searcher efficiency: In order to determine how long carcasses generally persist in the environment (and thus how many carcasses are being missed due to scavenging or decay), *carcass removal* experiments should be conducted. These involve placing freshly dead carcasses of varying sizes in known locations and monitoring them daily to measure how long they persist.

Carcasses for use in the experiments can be road-killed birds and/or carcasses from wildlife control projects at nearby landfills, airports or other facilities; if none are available, chickens may be used. To determine how many carcasses might be missing due to observer error during searches, *searcher efficiency* experiments should be conducted. These can be combined with carcass removal experiments. After fresh carcasses are placed in random locations within an impact or reference site by someone other than the regular observer, the observer is then asked to search the area as they normally would. Preferably the observer will not know that an efficiency test is underway as it might impact his/her searching strategy. All observers should be tested for searcher efficiency and rates should be calculated separately for each observer. It should be noted that all mortality estimates, even when corrected for scavenging and searcher efficiency, will be minimum numbers as there is the possibility of birds being wounded by the turbines and leaving the search area before succumbing.

If sites are stratified based on habitat or other factors that might impact carcass removal rates or searcher efficiency, then carcass removal and searcher efficiency experiments should be conducted separately in each strata. Any bird mortality rates calculated through carcass searches should be corrected for the searcher efficiency rate and the predator removal rate. See Johnson *et al.* (2002) for more details on calculating carcass removal and predator efficiency rates.

Johnson, G. D., W.P. Erickson, M.D. Strickland, M. F. Shepherd, D. A. Shepherd, and S. A. Sarappo. 2002. Collision mortality of local and migrant birds at a large-scale wind-power development on Buffalo Ridge, Minnesota. Wildlife Society Bulletin 30:879-887.

<u>Analyses</u>

The bird utilization rate (# birds observed/unit time) and bird mortality rate (# dead birds/point: corrected for the searcher efficiency rate and the predator removal rate) can be calculated for each turbine and control point. Utilization rate can also be calculated separately for each passage zone (a-d). An index of risk can then be calculated as the ratio of mortality to utilization. This ratio can be compared for turbine and control sites, to see if the area immediately around turbines is considered to be more risky than the area at some distance from the turbines. This ratio can also be compared across the season to determine if risk is higher during the migration, breeding, or wintering seasons, and across various weather conditions to determine if risk is higher during periods of low visibility.

<u>Evaluation and Revision</u>

Canadian Wildlife Service and the provincial Wildlife Division will be provided with the opportunity to review and provide comment on any proposed revisions to the program.

<u>Reporting</u>

A report of the monitoring program, together with any recommended changes, will be completed annually and provided to the provincial Minister of Environment and the Canadian Wildlife Service for information purposes. Following completion of the monitoring program, a final report, including an effects analysis, will be produced and provided to the provincial Minister of Environment and the Canadian Wildlife Service.

Appendix A

Pre-construction Line Transects for Avian Monitoring at Wind Turbine Sites

Project Name:	________________	Observer:	________________	
Date:	__________			
Start Time:	__________	Start location (GPS):	N	E
End Time:	__________	Stop location (GPS):	N	E
Temperature:	__________	Visibility:	__________	

	Number			
	Distance from line			Height (m)
Species	0-50m	51-100m	>100m	(a.g.l.)*

* these data can be categorical as well, and will be determined by the turbine height and blade diameter: below blade, within blade sweep height, and above blade height.

Appendix B

Data Forms: Bird Monitoring Program
(Adapted from Kingsley and Whittam 2001, Jacques-Whitford Environment Limited 2003 and James 2002)

A. BASIC INFORMATION

Date:_____________ **Start time**:___:___(use 24-hr clock) **End time:**___:___ **Point Number:**_____ ☐ Turbine ☐ Control **Observer:**_______________

Temperature: ____°C **Visibility:** ☐ low ☐ medium ☐ high **Wind speed** (km/hr)**:** ____ **Cloud Cover (%):** ______ **Wind direction:** _____

Precipitation: ☐ none ☐ rain ☐ snow ☐ fog **Barometric pressure:** ____________ **Turbine Operating? (Y/N)** _____ **Rotation Speed:** _____ rpm

A. BIRD UTILIZATION POINT COUNT. Use one line per bird or group of birds of the same species. Record information for each bird or group of bird only once (i.e. if a bird or group of birds is known to fly through the point count zone more than once, mark only the first instance of this behaviour on a single line).

Species	Number of Birds	Behaviour*	Height (zone a-d) see Table 1	Distance from observer (m)	Direction from observer (N,S,E,W, NE,SE,NW,SW)

*Behaviour should be recorded as: **foraging, mobbing** (either an animal predator or the observer), **flying – migration** (purposeful flight southward in the fall, or northward in the spring, **flying – other**, **perching** or **walking.**

B. CARCASS SEARCH (If conducting carcass search at same location as point count, the same basic information can be collected for both counts; if carcass searches are separate from point counts, basic information should be collected separately for each survey.

ID #	Species	Sex	Age	ID procedure	Carcass location (from GPS) NAD ______		Carcass condition see Table 2	Probable cause of death	Justification of cause, additional comments
					Latitude	Longitude			

The identification procedure should be recorded as Observer ID, Collected, or Photographed
(if one of the latter two, identification may take place sometime after the carcass has been found). Carcass condition should be recorded according to Table 2.
Cause of death should be noted as turbine strike, shooting, poisoning, or unknown, and can be filled out after a necropsy if deemed necessary.

Table 1.
Bird height categories used at turbine (impact) sites.

Zone	Description
A	Within the blade sphere.
B	Close to the blades, including passes that are along the edge of rotation.
C	Not in the blade sphere but below the bottom tip of the blade.
D	Out of and well above the top of the blade.

Table 2.
Categories of carcass condition
(from Jacques-Whitford Environment Limited 2003).

Code	Description
I	Injured or dying.
F	Freshly dead with little or no decay or scavenging by insects; likely died within 48 hours.
R	Recently dead but with noticeable decay or scavenging; likely died within 2-7 days.
D	Decomposed carcass, may not be identifiable to species; likely died more than 1 week ago.
U	Unknown; impossible to determine because only feathers remain.

ATTACHMENT E
Lichen Survey

ERIODERMA LICHEN RECONNAISSANCE SURVEY

ARGENTIA BACKLANDS

PREPARED FOR:

Argentia Wind Farm Proposal

PROPOSED BY:

Wind Project Inc.
99 Mill Road
Milton ON
L9T 1R8

PREPARED BY:

W. Shawn Avery
July 2008

Scope of the Work

The intent of this reconnaissance survey was to establish the presence/absence of *Erioderma pedicellatum* in the Argentia Backlands area as a result of a proposed wind farm for the area.

Approximately 18,000 meters of transect was conducted and over 9,000 trees searched in locations throughout the study area.

Introduction/Background

Erioderma pedicellatum, commonly referred to as Boreal Felt Lichen, is a cyanolichen (uses blue-green algae as a symbiont) which grows predominantly on mature and over mature Balsam fir (*Abies balsamea*). *Erioderma pedicellatum* seems to prefer cool, moist stands and grows most regularly in the transition zones from mid-slope forest to sphagnum rich bogs.

Erioderma pedicellatum is listed as of Special Concern by the Federal Species at Risk Act (SARA) and Vulnerable by the Provincial Endangered Species Act.

Globally, Erioderma lichens are tropical in nature with boreal (northern) species being limited. The vast majority of the world's *Erioderma pedicellatum* occurs in Newfoundland and Labrador.

Methodology

STUDY AREA

The study area for this survey is near Argentia, in an area locally known as the Argentia Backlands, within the municipal boundaries of the Town of Placentia. The region is located within the Southern Barrens sub-region of the Maritime Barrens Eco-region (Damman, 1983).

An earlier habitat assessment used the 400 ft contour line to delimit the boundaries of the undertaking (Joy, Environmental Assessment Registration Document, 2005). This same boundary was used to define the study area for this *Erioderma pedicellatum* reconnaissance survey. See Appendix 1, page 4. As an added note, the surveying effort was focused to best optimize searching of appropriate habitat.

METHODS

This reconnaissance survey adheres to the Erioderma Survey Protocol of the Wildlife Division of the Provincial Department of Environment and Conservation (Hanel, 2007). See Appendix 2, page 6.

Some modifications to the survey protocol were necessary to best capture Erioderma habitat within the study area. For example, forests typed as Scs (scrub) on the Newfoundland Forest Services' global forest inventory is inclusive of all softwood scrub types from rich, fern/Balsam fir to poor, Kalmia/Balsam fir/Eastern larch. Most scrub in the north and the northeast portion of the study area was of the later type, limiting the potential for Erioderma and, therefore, the search effort.

Although these sites were scanned, the Scs search effort was concentrated on the Balsam fir transitional zones in the central portion of the study area. Likewise, the southwest portion contains a high proportion of immature forest again limiting the Erioderma potential and therefore the search effort.

An aging Newfoundland Forest Services global forest inventory (1995) complicated the delineation of forest stand types in the field. The "on the ground picture" shows much more wind disturbance than is indicated by inventory mapping. For this reason, some forest types had to be adjusted. This was particularly true for age class 4 stands (60-80 years old). A lot of those stands have undergone a density class change, from density class 2 (51 - 75% crown closure) to 3 (26 - 50 %) or from 3 to wind disturbed (<26%). Efforts were made to ensure transect segments had appropriate stand typing although they did not necessarily adhere to the global forest inventory mapping. See Appendix 3, pages 10-12.

Results

The intent of this reconnaissance survey was to establish the presence/absence of *Erioderma pedicellatum* in the Argentia Backlands area. After nearly 18,000 meters of transects and searching more than 9,000 trees in locations throughout the study area with the greatest potential for the species, none was found.

A secondary intent was to establish the presence/absence of lichen species considered to be indicators for *Erioderma pedicellatum*, namely:

- *Coccocarparia palmicola*
- *Lobaria scrobiculata*
- *Erioderma mollissimum*
- *Fuscopannaria ahlneri*
- *Lichinodium sirorsiphoideum*.

Of these species only *Coccocarparia palmicola* and *Lobaria scrobiculata* were found in the study area and both were found in very small amounts and on limited sites. See Appendix 3, pages 8-10.

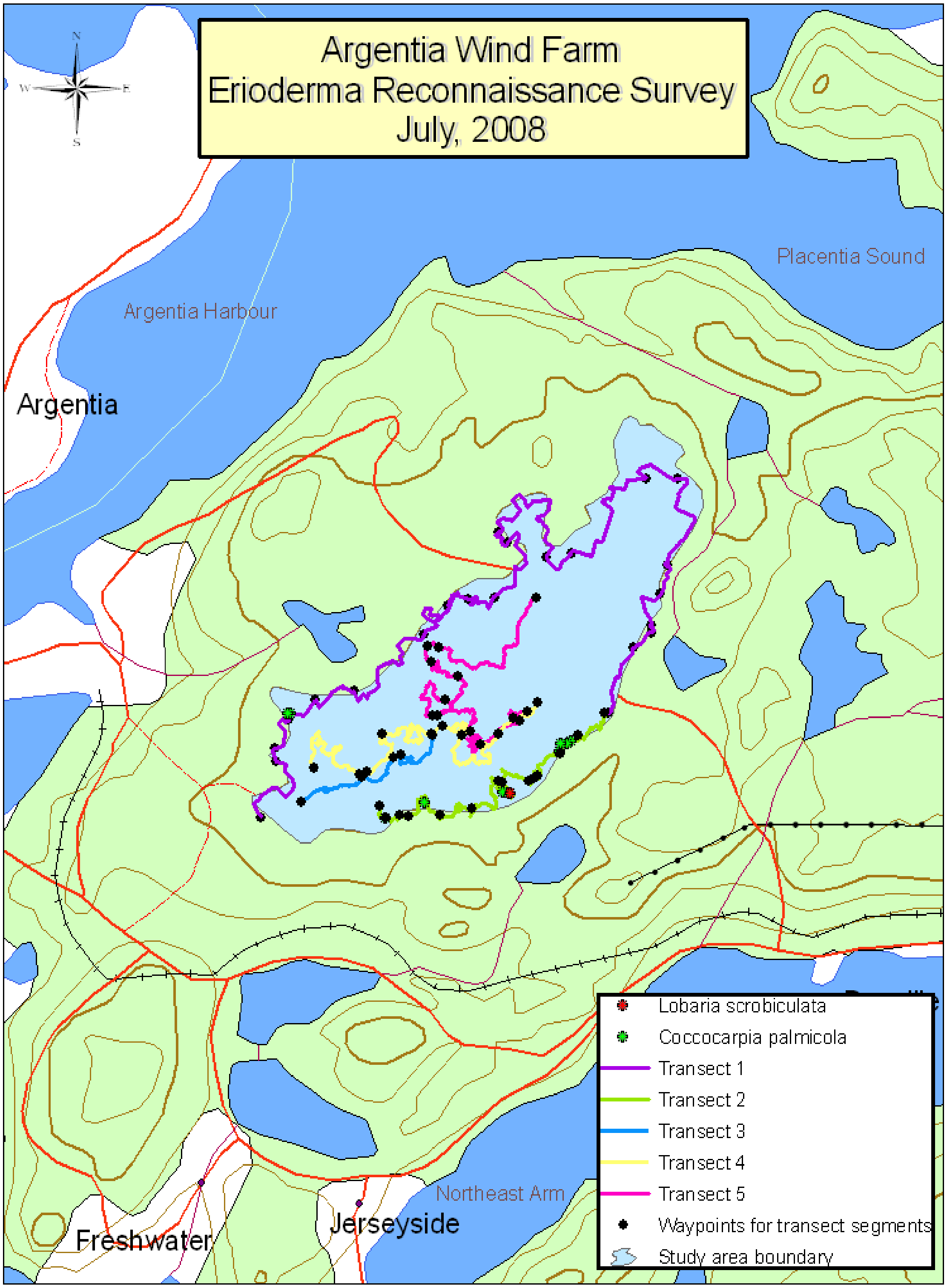
The liverwort *Frullanmia asagrayana*, considered key for the establishment of *Erioderma pedicellatum*, was persistent throughout most forest types.

Conclusion

Based on approximately 18,000 meters of transect data and searching more than 9,000 trees in locations with the most suitable habitat; the near absence of indicator species; plus a general assessment of habitat, it is concluded that if *Erioderma pedicellatum* exist in the Argentia Backlands, it does so in negligible quantities.

Appendix 1

Study Area and Transect Locations


Argentia Wind Farm
Erioderma Reconnaissance Survey
July, 2008
Placentia Sound
Argentia Harbour
Argentia
Northeast Arm
Jerseyside
Freshwater
Lobaria scrobiculata
Coccocarpia palmicola
Transect 1
Transect 2
Transect 3
Transect 4
Transect 5
Waypoints for transect segments
Study area boundary

Appendix 2

Erioderma Survey Protocol

By Claudia Hanel, Wildlife Division, Department of Environment and Conservation,
April 20, 2007

The goal of Boreal Felt Lichen surveys is twofold:

- To determine where the lichen is present in the survey area
- To determine if any of the sites with the lichen are "important" to the extent that one would consider applying the landscape management approach outlined in the management plan

This Document outlines a minimum survey protocol for the Boreal Felt Lichen (*Erioderma pedicellatum*), which is listed as "Vulnerable" under the provincial Endangered Species Act and as "Special Concern" under the federal Species at Risk Act.

If, in order to feel confident that he/she has captured the essence of *Erioderma* distribution in the area, the surveyor feels the need to expend more survey effort, or to sample habitats other than those outlined in this document, this is encouraged by the Wildlife Division, as is surveying for other rare lichen species. If either of these occurs, a quantification of the extra effort should be recorded, including the extra transect length and number of trees searched, and the lichen species searched for.

These surveys can be carried out any time of the year, but times when parts of the tree trunks are covered by snow should be avoided. Surveys are not recommended in very wet weather, when the visibility of some indicator species is reduced.

Within the known range of *Erioderma* (see attached map) surveys should be done in all forest stands (as identified in the Forest Inventory) over 40 years old with a large component of balsam fir where epiphytic lichens are present. Stands with a crown closure exceeding 75% (class 1 on the Forest Inventory) do not need to be sampled. Start with Protocol A – Reconnaissance. Softwood scrub where excessive moisture is the limiting factor and transitions of productive forest to wetlands should also be searched, and if a scrub patch is large enough to be identified in the Forest Inventory it should be considered a separate stand. A map of the stands to be sampled with a unique number for each stand (including scrub), hereafter referred to as the stand number, will be supplied. The area of the stands to be sampled will also be supplied in a table.

GPS coordinates should be recorded in Universal Transverse Mercator (UTM) North American Datum (NAD) 83. Some GPS units do not have NAD 83 as an option and these should be set to WGS 84.

Protocol A – Reconnaissance

1. Walk at least 100 m of transect line per hectare. This transect:
   - does not need to be a straight line, but should pass through the habitat considered to be most suitable for *Erioderma* by the surveyor(s). Special

attention should be paid to the transition zones between merchantable stands and scrub stands.

- can be broken into segments, which can be done in separate locations within the stand as long as the portions add up to 100 m per hectare. If there is more than one surveyor, each can do a transect segment, either in parallel or in separate locations. The segments can cross each other. In large stands it is important that the transect segments provide representative coverage of the entire stand.

- can cross into an adjacent stand, but if crossing is noticed in the field, a GPS waypoint should be taken. The portions in the different stands should be considered separate transect segments.

2. If the stand boundaries are very indistinct in the field, a basic survey intensity of 100 m of transect line per hectare should be maintained. The transects should be relatively evenly spread across the landscape and an effort should be made that no potentially suitable stand remains unsurveyed. GPS tracks can be used to ensure the survey area is adequately covered.
3. Search at least 40 trees per hectare along the transect, concentrating on balsam fir. Trees of species other than balsam fir, including black spruce and hardwoods, should be searched when present but should make up no more than 10% of the trees searched along the transect. Only trees old enough to support lichen growth and *Frullania* (>40 years) should be searched. Some old trees can be of a very small diameter (~2.5 cm) and these should be searched. Trees of this diameter that are obviously young do not need to be searched.
4. For each tree, visually scan all of the trunk area from the ground to 2.5 m and also the lower branches up to 2m (the part near the trunk without needles) for indicator species and *Erioderma pedicellatum*.
5. If the liverwort *Frullannia asagrayana* and any of the following five lichens *(Coccocarpia palmicola, Erioderma mollissimum, Fuscopannaria ahlneri, Lichinodium sirosiphoideum, Lobaria scrobiculata,*) are present, record a GPS waypoint and switch to Protocol B – *Erioderma* survey.
6. If any *Erioderma pedicellatum*, or lichens that the surveyor cannot identify that may be *Erioderma*, are found, skip directly to Protocol C – Detailed Thallus Survey.
7. If the indicators mentioned above are not found, provide the following:
    - A filled in Transect Data Sheet, including the time and GPS waypoints at the start and end of each transect segment, an indication of which transect segments represent which stand, the stand number, stand size, tree species in the stand, the number of each species of tree checked, and the GPS waypoint and direction.
    - GPS track(s) and waypoints marking the beginning and end of transect segments
    - a digital stand photograph per stand which includes something to provide scale

Protocol B – *Erioderma* Survey

1. Survey at least 100 m of transect per hectare in addition to the 100 m in Protocol A. Record a waypoint at the location where the indicator species has been located and note the species. All transect parameters outlined in Protocol A also apply to the *Erioderma* transects.
2. Search at least 40 additional trees per hectare, in the same manner as described for Protocol A.
3. For large stands >5 ha the extra survey effort needs to be expended in the hectare where the indicator lichen was found.
4. Provide the following:
   - GPS track(s) and waypoints marking the beginning and end of transect segments
   - A GPS waypoint of the location where the first indicator lichen was encountered
   - A data sheet filled out with the same information as in Protocol A
   - The names of all the indicator lichens encountered along the transect
5. If any *Erioderma pedicellatum* or lichens that the surveyor cannot identify that may be *Erioderma*, are found, follow Protocol C – Detailed Thallus Survey.

Protocol C – Detailed Thallus Survey

1. Flag the tree with two orange ribbons of winter quality flagging tape, preferably both flags below the thallus, but not within 30 cm of it. Ensure that the ends of the flagging tape are not long enough to damage the thalli if flapping in the wind.
2. Provide digital photographs of:
   - the stand to bring the total number of photographs in the stand to three
   - each thallus, and also a photo of the section of the tree with the flags and the thallus (it is especially important to provide a photo if the identity of the thallus is in doubt, and to include something that provides scale in the photo)
3. Use the Site Data Sheets to provide the following information:
   - A GPS reading of the coordinates of the tree, including the accuracy of the reading (if several trees are located within 5 m of one another, a single coordinate may be used)
   - The species and condition of the tree
   - The number of juvenile (without apothecia) and adult thalli on the tree, and if applicable, specify % of necrosis and degree of attachment for each thallus
   - Any other noteworthy information about the trees or thalli
   - The time when the Thallus Survey was started and finished
4. Search all appropriate balsam fir trees within a 20 m radius of the *Erioderma*-bearing tree, and repeat steps 1-3 for all thalli found.
5. If more than 10 thalli are found in one site, search the lower branches of black spruce as well within the 20 m radius of any new *Erioderma*-bearing tree.

6. If no more thalli are found with step 4, resume Protocol B, but **not** including the trees in the 10 m radii as part of the total transect for the stand.

Appendix 3

Summary Tables

Table 1: Transect Segments by Stand Type

bF322			bF332			bF342		
Transect distance (meters)	Trees searched		Transect distance (meters)	Trees searched		Transect distance (meters)	Trees searched	
	bF	bS		bF	bS		bF	bS
266	180		90	64		70	30	
			72	56	10	314	120	
			161	82				
			90	60				
			250	150				
			191	100				
266	**180**	**0**	**854**	**512**	**10**	**384**	**150**	**0**

bF443			bF433			bF432		
Transect distance (meters)	Trees searched		Transect distance (meters)	Trees searched		Transect distance (meters)	Trees searched	
	bF	bS		bF	bS		bF	bS
247	220	18	270	200		150	100	
548	300		112	100		72	40	
715	400					474	250	
						286	150	
						45	15	
1510	**920**	**18**	**382**	**300**	**0**	**1027**	**555**	**0**

bF442			Scs			DIW		
Transect distance (meters)	Trees searched		Transect distance (meters)	Trees searched		Transect distance (meters)	Trees searched	
	bF	bS		bF	bS		bF	bS
225	100		472	400		810	250	
720	300		76	38		140	20	
210	100		766	500	39			
610	300	20	1090	500	60			
327	150		1100	400				
216	200		744	300				
449	200		180	80				
140	0		277	120				
			80	40				
			330	400				
			387	200				
			105	50				
			520	200				
			672	400	20			
			483	200				
			152	100				
			463	200	20			
			365	180				

			1180	350				
2897	**1350**	**20**	**9442**	**4658**	**139**	**950**	**270**	**0**

Table 2: Transect Summary by Stand Type

Stand Type	Total Transect Distance (m)	Total Trees Searched		Search Requirement
		bF	bS	
Scs	9442	4658	139	3777
DIW	950	270	0	380
bF322	266	180	0	106
bF332	854	512	10	342
bF342	384	150	0	154
bF432	1027	555	0	411
bF443	1510	920	18	604
bF442	2897	1350	20	1159
bF433	382	300	0	153
TOTAL	**17712**	**8895**	**187**	**7085**

Table 3: Prevalence of Indicator Species

	INDICATOR SPECIES									
Transect #	***Coccocarpia palmicola***		***Lobaria scrobiculata***		***Erioderma mollissimum***		***Fuscopannaria ahlneri***		***Lichinodium sirosiphoideum***	
	# of host trees	# of thalli	# of host trees	# of thalli	# of host trees	# of thalli	# of host trees	# of thalli	# of host trees	# of thalli
1	3	32+								
2	37	180+	1	20+						
3										
4										
5										

Note: *Indicator species were counted to a maximum of 20 thalli per host tree*