unlikely that the Study area provides sufficient nectar resources to support a large congregation of migratory Monarchs.

Potential effects of the Project on this species, as well as proposed species-specific mitigation measures, are discussed in more detail in Section 13.2.1.

The requirements as set out in *SARA* and *NSESA* will be adhered to for Project activities. Additional general mitigation measures for terrestrial fauna are provided in Section 4. Where required, species-specific mitigation is provided in Section 13.

## 8.7 Avifauna

The Study area features predominantly mixed-wood forests, with some hardwood stands and significant coverage of regenerating softwood. A large part of the Study area has been clear cut in the past decade. A number of areas of wetland habitat exist at the Study area, mostly in the form of shrub and treed swamps, some of which occur in open areas that have been disturbed by forestry activity. The diversity of habitat types, in particular the prevalence of edge/transitional habitat, provides for the foraging, breeding, and roosting requirements of a variety of resident and migratory bird species.

Baseline information was utilized to gain insight into protected avifauna habitats, species utilization of the area, and to identify SOCI potentially occurring at or near the Study area.

The closest Important Bird Area (IBA) (IBA Canada 2012) is the Cobequid Bay IBA located 21 km north of the Study area. Part of a network of IBAs at the head of the Bay of Fundy, the Cobequid Bay IBA provides key staging habitat for thousands of migratory shorebirds each autumn. Up to 40,000 Semipalmated Sandpipers, representing approximately 1.2% of the global population, have been recorded in Cobequid Bay during late July and early August, when they gather to feed on the millions of amphipods present in the mudflats that become exposed during the Bay of Fundy's low tide. Other shorebird species that congregate in Cobequid Bay include Semipalmated Plover (*Charadrius semipalmatus*), Black-bellied Plover (*Pluvialis squatarola*), Red Knot (*Calidris canutus*), Sanderling (*Calidris alba*), Least Sandpiper (*Calidris minutilla*), Dunlin (*Calidris alpine*), and White-rumped Sandpiper (*Calidris fuscicollis*). In addition, up to 3,000 Canada Geese (*Branta canadensis*) have been recorded at this IBA during the spring migration (IBA Canada 2012).

The Study area is contained within map square 20MQ59 of the Maritime Breeding Bird Atlas (MBBA 2012). In the most recent edition of the MBBA (covering the years 2006-2010), 104 species were identified as being possible, probable, or confirmed breeders within this area. The following SOCI are considered confirmed breeders in the area:

- Barn Swallow (*Hirundo rustica*) – "Endangered" (NS *ESA*), "Threatened" (COSEWIC), "3 - Sensitive" (NSDNR), "S3B" (ACCDC);
- Boreal Chickadee (*Poecile hudsonicus*) – "3 - Sensitive" (NSDNR), "S3" (ACCDC);

- Canada Warbler (*Wilsonia Canadensis*) – "Threatened" (*SARA*), "Endangered" (NS *ESA*), "Threatened" (COSEWIC), "1 – At Risk" (NSDNR), "S3B" (ACCDC);
- Common Nighthawk (*Chordeiles minor*) – "Threatened" (*SARA*), "Threatened" (NS *ESA*), "Threatened" (COSEWIC), "1 – At Risk" (NSDNR), "S3B" (ACCDC);
- Eastern Wood-Pewee (*Contopus virens*) – "Vulnerable" (NS *ESA*), "Special Concern" (COSEWIC), "3 - Sensitive" (NSDNR), "S3S4B" (ACCDC);
- Golden-crowned Kinglet (*Regulus satrapa*) – "3 - Sensitive" (NSDNR), "S4" (ACCDC);
- Gray Jay (*Perisoreus canadensis*) – "3 - Sensitive" (NSDNR), "S3S4" (ACCDC);
- Killdeer (*Charadrius vociferous*) – "3 - Sensitive" (NSDNR), "S3S4B" (ACCDC);;
- Pied-billed Grebe (*Podilymbus podiceps*) – "3 - Sensitive" (NSDNR), "S3B" (ACCDC);
- Pine Siskin (*Spinus pinus*) – "3 - Sensitive" (NSDNR), "S3S4B,S5N" (ACCDC);
- Ruby-crowned Kinglet (*Regulus* calendula) – "3 - Sensitive" (NSDNR), "S4B" (ACCDC);
- Savannah Sparrow (*Passerculus sandwichensis*) – "Special Concern" (*SARA*), "Special Concern" (COSEWIC), "S1B" (ACCDC);
- Spotted Sandpiper (*Actitis macularius*) – "3 - Sensitive" (NSDNR), "S3S4B" (ACCDC);
- Tree Swallow (*Tachycineta bicolor*) – "3 - Sensitive" (NSDNR), "S4B" (ACCDC);
- Wilson's Snipe (*Gallinago delicate*) – "3 - Sensitive" (NSDNR), "S3S4B" (ACCDC); and
- Yellow-bellied Flycatcher (*Empidonax flaviventris*) – "3 - Sensitive" (NSDNR), "S3S4B" (ACCDC).

The NS Significant Species and Habitats database contains 429 unique records pertaining to birds and/or bird habitat within a 100 km radius of the Study area. These records include:

- 188 classified in the database as "Other Habitat", of which the majority relate to Bald Eagle (*Haliaeetus leucocephalus*) (141) and Osprey (*Pandion haliaetus*) (31), but also including records of Great Blue Heron (*Ardea herodias*) (6) and unclassified Cormorant species (3), among others;
- 98 records classified as "Species of Concern", of which the majority relate to Common Loon (41), but also including records of unclassified Tern species (19), Common Tern (*Sterna hirundo*) (14), Northern Goshawk (*Accipiter gentilis*) (6), and Great Blue Heron (4), among others;
- 87 records classified as "Migratory Bird", including Double-crested Cormorant (*Phalacrocorax auritus*) (18), unclassified shorebirds (18), Common Eider (*Somateria mollissima*) (13), Great Blue Heron (13), and American Black Duck (*Anas rubripes*) (7), among others; and
- 56 records classified as "Species at Risk", primarily relating to Piping Plover (*Charadrius melodus*) (19), Peregrine Falcon (*Falco peregrinus*) (8), Harlequin Duck (*Histrionicus histrionicus*) (7), and Common Loon (5) but also including multiple records of Roseate Tern (*Sterna dougallii*), among others.

Four significant habitat features related to birds are present within a 10 km radius of the Study area (Table 8.11).

**Table 8.11. Significant Habitat Features Related to Birds within a 10 km Radius of the Study Area**

| Species | Location | Distance from Study area (km) | Direction |
|---|---|---|---|
| Loon nesting, Bald Eagle Wintering | Rines Brook, Parker Brook, Rose Brook | 5 - 7 km | E and S |
| Bald Eagle Nest | Nine-Mile River | 7.4 | S |
| Bald Eagle Nesting Area | North Salem | 8.4 | NE |
| Loon nesting, Bald Eagle Wintering | Shubenacadie River | 9.2 | E |

Source: NSDNR 2014a

The ACCDC database contains records of 104 bird species within a 100 km radius of the Study area. Table 8.12 lists these species as well as their respective provincial and national conservation status ranks.

**Table 8.12: Bird Species Recorded within a 100 km Radius of the Study Area**

| Common Name | Scientific Name | *SARA* Status[1] | NS *ESA* Status[2] | COSEWIC Status[3] | NSDNR Status[4] | NS S-Rank[5] |
|---|---|---|---|---|---|---|
| American Bittern | *Botaurus lentiginosus* | Not Listed | Not Listed | Not Listed | Sensitive | S3S4B |
| American Coot | *Fulica americana* | Not Listed | Not Listed | Not At Risk | Undetermined | S1B |
| American Golden-Plover | *Pluvialis dominica* | Not Listed | Not Listed | Not Listed | Sensitive | S3M |
| American Three-toed Woodpecker | *Picoides dorsalis* | Not Listed | Not Listed | Not Listed | Undetermined | S1S2 |
| Arctic Tern | *Sterna paradisaea* | Not Listed | Not Listed | Not Listed | May Be At Risk | S3B |
| Atlantic Puffin | *Fratercula arctica* | Not Listed | Not Listed | Not Listed | Sensitive | S1B,S4S5N |
| Baltimore Oriole | *Icterus galbula* | Not Listed | Not Listed | Not Listed | May Be At Risk | S2S3B |
| Bank Swallow | *Riparia riparia* | Not Listed | Not Listed | Threatened | May Be At Risk | S3B |
| Barn Swallow | *Hirundo rustica* | Not Listed | Endangered | Threatened | At Risk | S3B |
| Barrow's Goldeneye - Eastern pop. | *Bucephala islandica (Eastern pop.)* | Special Concern | Not Listed | Special Concern | At Risk | S1N |
| Bay-breasted Warbler | *Dendroica castanea* | Not Listed | Not Listed | Not Listed | Sensitive | S3S4B |
| Bicknell's Thrush | *Catharus bicknelli* | Special Concern | Endangered | Threatened | At Risk | S1S2B |
| Black Guillemot | *Cepphus grille* | Not Listed | Not Listed | Not Listed | Secure | S3S4 |

| Common Name | Scientific Name | *SARA* Status[1] | NS *ESA* Status[2] | COSEWIC Status[3] | NSDNR Status[4] | NS S-Rank[5] |
|---|---|---|---|---|---|---|
| Black Tern | *Chlidonias niger* | Not Listed | Not Listed | Not At Risk | May Be At Risk | S1B |
| Black-backed Woodpecker | *Picoides arcticus* | Not Listed | Not Listed | Not Listed | Sensitive | S3S4 |
| Black-billed Cuckoo | *Coccyzus erythropthalmus* | Not Listed | Not Listed | Not Listed | May Be At Risk | S3?B |
| Black-legged Kittiwake | *Rissa tridactyla* | Not Listed | Not Listed | Not Listed | Sensitive | S2B,S4S5N |
| Blackpoll Warbler | *Dendroica striata* | Not Listed | Not Listed | Not Listed | Sensitive | S3S4B |
| Blue-winged Teal | *Anas discors* | Not Listed | Not Listed | Not Listed | May Be At Risk | S3B |
| Bobolink | *Dolichonyx oryzivorus* | Not Listed | Vulnerable | Threatened | Sensitive | S3S4B |
| Boreal Chickadee | *Poecile hudsonica* | Not Listed | Not Listed | Not Listed | Sensitive | S3 |
| Boreal Owl | *Aegolius funereus* | Not Listed | Not Listed | Not At Risk | Undetermined | S1B |
| Brant | *Branta bernicla* | Not Listed | Not Listed | Not Listed | Sensitive | S3M |
| Brown Thrasher | *Toxostoma rufum* | Not Listed | Not Listed | Not Listed | Undetermined | S1?B |
| Brown-headed Cowbird | *Molothrus ater* | Not Listed | Not Listed | Not Listed | Secure | S2S3B |
| Buff-breasted Sandpiper | *Tryngites subruficollis* | Not Listed | Not Listed | Special Concern | Accidental | SNA |
| Canada Warbler | *Wilsonia Canadensis* | Threatened | Endangered | Threatened | At Risk | S3B |
| Cape May Warbler | *Dendroica tigrina* | Not Listed | Not Listed | Not Listed | Sensitive | S3?B |
| Chimney Swift | *Chaetura pelagica* | Threatened | Endangered | Threatened | At Risk | S2S3B |
| Cliff Swallow | *Petrochelidon pyrrhonota* | Not Listed | Not Listed | Not Listed | May Be At Risk | S3B |
| Common Goldeneye | *Bucephala clangula* | Not Listed | Not Listed | Not Listed | Secure | S2B,S5N |
| Common Loon | *Gavia immer* | Not Listed | Not Listed | Not At Risk | May Be At Risk | S3B,S4N |
| Common Moorhen | *Gallinula chloropus* | Not Listed | Not Listed | Not Listed | Undetermined | S1B |
| Common Nighthawk | *Chordeiles minor* | Threatened | Threatened | Threatened | At Risk | S3B |
| Common Tern | *Sterna hirundo* | Not Listed | Not Listed | Not At Risk | Sensitive | S3B |
| Cooper's Hawk | *Accipiter cooperii* | Not Listed | Not Listed | Not At Risk | Undetermined | S1?B,SNAN |
| Eastern Bluebird | *Sialia sialis* | Not Listed | Not Listed | Not At Risk | Sensitive | S3B |

| Common Name | Scientific Name | *SARA* Status[1] | NS *ESA* Status[2] | COSEWIC Status[3] | NSDNR Status[4] | NS S-Rank[5] |
|---|---|---|---|---|---|---|
| Eastern Kingbird | *Tyrannus tyrannus* | Not Listed | Not Listed | Not Listed | Sensitive | S3S4B |
| Eastern Meadowlark | *Sturnella magna* | Not Listed | Not Listed | Threatened | Sensitive | S1B |
| Eastern Phoebe | *Sayornis phoebe* | Not Listed | Not Listed | Not Listed | Sensitive | S3S4B |
| Eastern Wood-Pewee | *Contopus virens* | Not Listed | Vulnerable | Special Concern | Sensitive | S3S4B |
| Fox Sparrow | *Passerella iliaca* | Not Listed | Not Listed | Not Listed | Secure | S3S4B |
| Gadwall | *Anas strepera* | Not Listed | Not Listed | Not Listed | May Be At Risk | S2B |
| Gray Catbird | *Dumetella carolinensis* | Not Listed | Not Listed | Not Listed | May Be At Risk | S3B |
| Gray Jay | *Perisoreus Canadensis* | Not Listed | Not Listed | Not Listed | Sensitive | S3S4 |
| Great Cormorant | *Phalacrocorax carbo* | Not Listed | Not Listed | Not Listed | Sensitive | S3 |
| Great Crested Flycatcher | *Myiarchus crinitus* | Not Listed | Not Listed | Not Listed | May Be At Risk | S2B |
| Greater Yellowlegs | *Tringa melanoleuca* | Not Listed | Not Listed | Not Listed | Sensitive | S3B,S5M |
| Harlequin Duck - Eastern pop. | *Histrionicus histrionicus pop. 1* | Special Concern | Endangered | Special Concern | At Risk | S2N |
| Horned Lark | *Eremophila alpestris* | Not Listed | Not Listed | Not Listed | Secure | S1S2B,S4N |
| Hudsonian Godwit | *Limosa haemastica* | Not Listed | Not Listed | Not Listed | Sensitive | S3M |
| Hudsonian Whimbrel | *Numenius phaeopus hudsonicus* | Not Listed | Not Listed | Not Listed | Sensitive | S3M |
| Indigo Bunting | *Passerina cyanea* | Not Listed | Not Listed | Not Listed | Undetermined | S1S2B |
| Killdeer | *Charadrius vociferous* | Not Listed | Not Listed | Not Listed | Sensitive | S3S4B |
| Laughing Gull | *Leucophaeus atricilla* | Not Listed | Not Listed | Not Listed | Secure | SHB |
| Least Bittern | *Ixobrychus exilis* | Threatened | Not Listed | Threatened | Undetermined | SNRB |
| Least Sandpiper | *Calidris minutilla* | Not Listed | Not Listed | Not Listed | Secure | S1B,S5M |
| Long-eared Owl | *Asio otus* | Not Listed | Not Listed | Not Listed | May Be At Risk | S2 |
| Marsh Wren | *Cistothorus palustris* | Not Listed | Not Listed | Not Listed | Undetermined | S1B |

| Common Name | Scientific Name | *SARA* Status[1] | NS *ESA* Status[2] | COSEWIC Status[3] | NSDNR Status[4] | NS S-Rank[5] |
|---|---|---|---|---|---|---|
| Northern Bobwhite | *Colinus virginianus* | Endangered | Not Listed | Endangered | Not Listed | |
| Northern Cardinal | *Cardinalis cardinalis* | Not Listed | Not Listed | Not Listed | Secure | S3S4 |
| Northern Gannet | *Morus bassanus* | Not Listed | Not Listed | Not Listed | Secure | SHB,S5M |
| Northern Goshawk | *Accipiter gentilis* | Not Listed | Not Listed | Not At Risk | Secure | S3S4 |
| Northern Mockingbird | *Mimus polyglottos* | Not Listed | Not Listed | Not Listed | Secure | S3B |
| Northern Pintail | *Anas acuta* | Not Listed | Not Listed | Not Listed | May Be At Risk | S2B |
| Northern Shoveler | *Anas clypeata* | Not Listed | Not Listed | Not Listed | May Be At Risk | S2B |
| Olive-sided Flycatcher | *Contopus cooperi* | Threatened | Threatened | Threatened | At Risk | S3B |
| Peregrine Falcon - anatum/tundrius | *Falco peregrinus pop. 1* | Special Concern | Vulnerable | Special Concern | Sensitive | S1B |
| Philadelphia Vireo | *Vireo philadelphicus* | Not Listed | Not Listed | Not Listed | Undetermined | S2?B |
| Pied-billed Grebe | *Podilymbus podiceps* | Not Listed | Not Listed | Not Listed | Sensitive | S3B |
| Pine Grosbeak | *Pinicola enucleator* | Not Listed | Not Listed | Not Listed | May Be At Risk | S3?B,S5N |
| Pine Siskin | *Carduelis pinus* | Not Listed | Not Listed | Not Listed | Sensitive | S3S4B,S5N |
| Piping Plover melodus ssp | *Charadrius melodus melodus* | Endangered | Endangered | Endangered | At Risk | S1B |
| Purple Martin | *Progne subis* | Not Listed | Not Listed | Not Listed | May Be At Risk | S1B |
| Purple Sandpiper | *Calidris maritima* | Not Listed | Not Listed | Not Listed | Sensitive | S3N |
| Razorbill | *Alca torda* | Not Listed | Not Listed | Not Listed | Sensitive | S1B,S4N |
| Red Knot rufa ssp | *Calidris canutus rufa* | Not Listed | Endangered | Endangered | At Risk | S2S3M |
| Red Phalarope | *Phalaropus fulicarius* | Not Listed | Not Listed | Not Listed | Sensitive | S2S3M |
| Red-breasted Merganser | *Mergus serrator* | Not Listed | Not Listed | Not Listed | Secure | S3B,S5N |
| Redhead | *Aythya americana* | Not Listed | Not Listed | Not Listed | Secure | SHB,SNAM |

| Common Name | Scientific Name | *SARA* Status[1] | NS *ESA* Status[2] | COSEWIC Status[3] | NSDNR Status[4] | NS S-Rank[5] |
|---|---|---|---|---|---|---|
| Red-necked Phalarope | *Phalaropus lobatus* | Not Listed | Not Listed | Special Concern | Sensitive | S2S3M |
| Ring-billed Gull | *Larus delawarensis* | Not Listed | Not Listed | Not Listed | Secure | S1?B,S5N |
| Roseate Tern | *Sterna dougallii* | Endangered | Endangered | Endangered | At Risk | S1B |
| Rose-breasted Grosbeak | *Pheucticus ludovicianus* | Not Listed | Not Listed | Not Listed | Sensitive | S3S4B |
| Rusty Blackbird | *Euphagus carolinus* | Special Concern | Endangered | Special Concern | May Be At Risk | S2S3B |
| Savannah Sparrow princeps ssp | *Passerculus sandwichensis princeps* | Special Concern | Not Listed | Special Concern | Sensitive | S1B |
| Scarlet Tanager | *Piranga olivacea* | Not Listed | Not Listed | Not Listed | Undetermined | S2B |
| Semipalmated Plover | *Charadrius semipalmatus* | Not Listed | Not Listed | Not Listed | Secure | S1S2B,S5M |
| Semipalmated Sandpiper | *Calidris pusilla* | Not Listed | Not Listed | Not Listed | Sensitive | S3M |
| Short-eared Owl | *Asio flammeus* | Special Concern | Not Listed | Special Concern | May Be At Risk | S1S2 |
| Solitary Sandpiper | *Tringa solitaria* | Not Listed | Not Listed | Not Listed | Secure | S1?B,S4S5M |
| Spotted Sandpiper | *Actitis macularius* | Not Listed | Not Listed | Not Listed | Sensitive | S3S4B |
| Tennessee Warbler | *Vermivora peregrine* | Not Listed | Not Listed | Not Listed | Sensitive | S3S4B |
| Turkey Vulture | *Cathartes aura* | Not Listed | Not Listed | Not Listed | Sensitive | S2S3B |
| Vesper Sparrow | *Pooecetes gramineus* | Not Listed | Not Listed | Not Listed | May Be At Risk | S2S3B |
| Virginia Rail | *Rallus limicola* | Not Listed | Not Listed | Not Listed | Undetermined | S2B |
| Warbling Vireo | *Vireo gilvus* | Not Listed | Not Listed | Not Listed | Undetermined | S1?B |
| Whip-Poor-Will | *Caprimulgus vociferous* | Threatened | Threatened | Threatened | At Risk | S1?B |
| Willet | *Tringa semipalmata* | Not Listed | Not Listed | Not Listed | May Be At Risk | S2S3B |
| Willow Flycatcher | *Empidonax traillii* | Not Listed | Not Listed | Not Listed | Sensitive | S2B |
| Wilson's Snipe | *Gallinago delicata* | Not Listed | Not Listed | Not Listed | Sensitive | S3S4B |
| Wilson's Warbler | *Wilsonia pusilla* | Not Listed | Not Listed | Not Listed | Sensitive | S3S4B |
| Wood Thrush | *Hylocichla mustelina* | Not Listed | Not Listed | Threatened | Undetermined | S1B |

| Common Name | Scientific Name | *SARA* Status[1] | NS *ESA* Status[2] | COSEWIC Status[3] | NSDNR Status[4] | NS S-Rank[5] |
|---|---|---|---|---|---|---|
| Yellow-bellied Flycatcher | *Empidonax flaviventris* | Not Listed | Not Listed | Not Listed | Sensitive | S3S4B |

Source: ACCDC 2015

[1]Government of Canada 2012; [2]NS ESA 2013; [3]COSEWIC 2012a; [4]NSDNR 2010; [5]ACCDC 2015

Field surveys were completed to gather data to characterize the year round, pre-construction (baseline) bird community at or near the Study area, and were designed to capture changes in the diversity and abundance of bird species coinciding with such important events as breeding and migration. The majority of survey locations were situated within the Study area boundary; however a few locations are situated directly south of the boundary (within 600 m). These locations were surveyed as part of a previous turbine layout, and resulted in the identification of several priority species. Therefore, the continuation of surveys at these locations was deemed important, given the proximity to the Study area. All field surveys were based on a previously developed methodology designed for wind projects, in consultation with officials from NSDNR and CWS, and in accordance with protocols outlined in the document "Recommended Protocols for Monitoring Impacts of Wind Turbines on Birds" (CWS 2007).

A summary of each bird survey is provided in the following sections. Detailed results for bird surveys are provided in Appendix F.

*Winter Bird Survey*

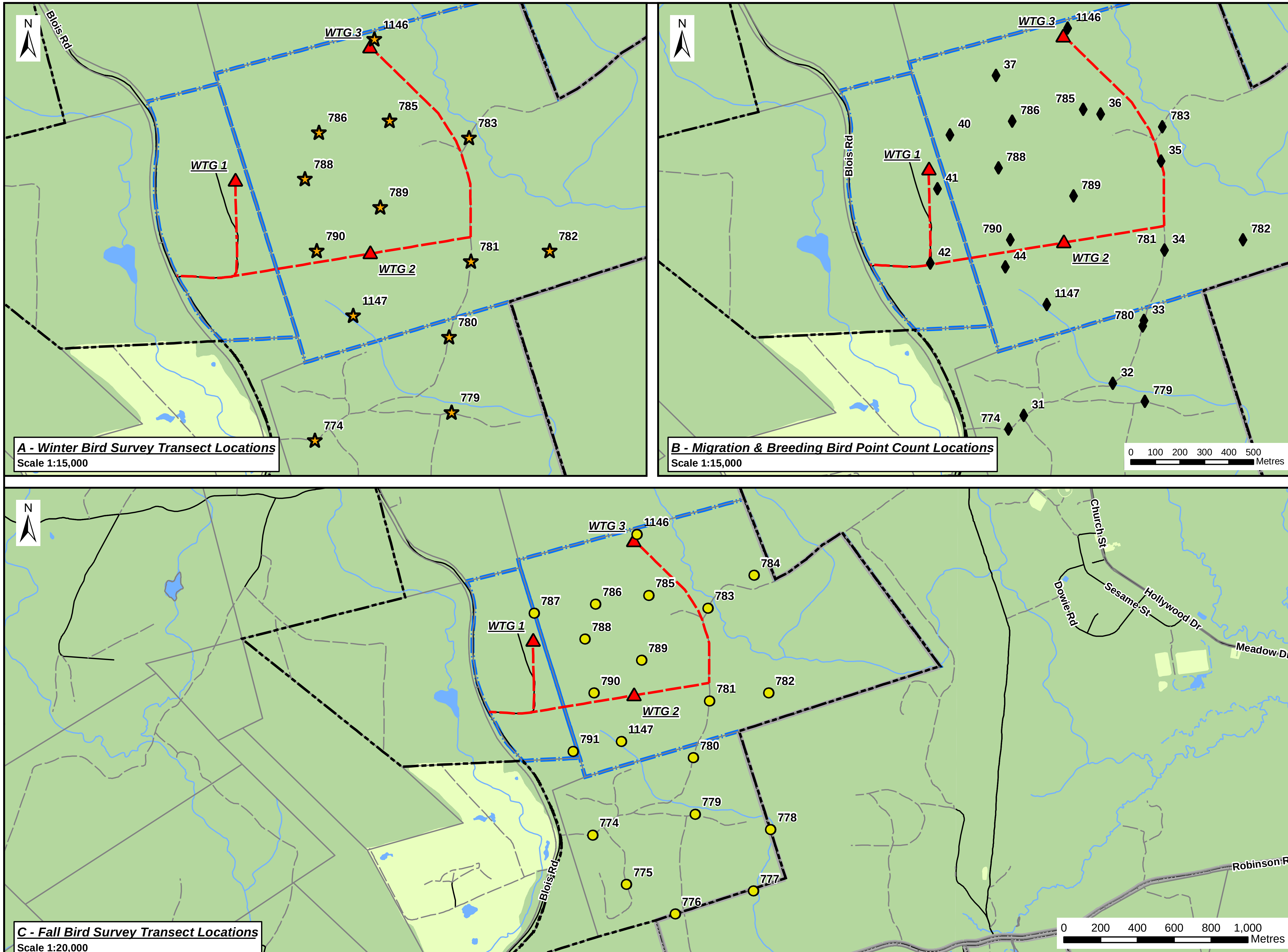
Twenty four standardized area search transects were conducted at or near the Study area on January 21, 2015 and February 26, 2015 at 13 locations (Drawing 8.6A). A total of 12 species were identified, comprising 51 individual bird observations (Tables F1/2, Appendix F). Black-capped Chickadee (*Parus atricapillus*), Common Redpoll (*Acanthis flammea*), and Common Raven (*Corvus Corax*) were the most abundant species.

Overall, there were 2.22 ± 1.06 birds and 1.33 ± 0.56 species (mean ± 95% confidence interval) observed per area search transect during over-wintering surveys.

*Spring Migration Surveys*

Spring migration surveys were conducted at or near the Study area on May 5, May 21 and May 28, 2015, during which a total of 35 standardized area searches were conducted at 24 locations (Drawing 8.6A).

A total of 55 species, comprising 599 individual birds, were observed during the spring migration surveys (Tables F 3/4, Appendix F). Common Yellowthroat (*Geothlypis trichas*), American Robin (*Turdus migratorius*), and White-throated Sparrow (*Zonotrichia albicollis*) were the most frequently observed and most abundant species.




**Notes:**

1. Reference: Digital Topographic Mapping & Property Management Unit MU0904 by Nova Scotia Geomatics Centre.
2. Projection: NAD83(CSRS), UTM Zone 20 North.
3. GPS Points Taken are Typically to +/-5m Accuracy.

**Legend:**

- Proposed Turbine
- Proposed Access Road
- Study Area
- Project Site
- Property Boundary
- Native Reserve
- Public Roads
- Access Roads / Trails
- Mapped Stream
- Mapped Indefinite Stream
- Water Bodies

**Hardwood Lands Community Wind Project - Survey Transects & Point Locations**

Strum CONSULTING

| Date: August 2015 | Project #: 14-5169 |
|---|---|
| Scale: As Shown | Drawing #: 8.6A |
| Drawn By: H. Serhan | |
| Checked By: S. Dickey | |

Overall, there were 15.25 ± 1.72 birds and 12.05 ± 1.07 species (mean ± 95% confidence interval) observed per area search during the spring migration surveys.

*Breeding Bird Surveys*
Twenty four standardize area search surveys were carried out at 24 locations at or near the Study area on June 18 and June 30, 2015 (Drawing 8.6A). A total of 383 individual birds, representing 48 species, were observed during these point surveys (Table F5/6, Appendix F). Five of these species [Brown Creeper (*Certhia Americana*), Canada Warbler (*Cardellina canadensis*), Common Yellowthroat, Dark-eyed Junco (*Junco hyemalis*), White-throated Sparrow] are considered probable breeders based upon the observation of breeding pairs and/or agitated behaviours, and one species are confirmed breeders based upon the observation of a female bird sitting on a nest (MBBA n.d.). The most frequent and abundant species observed were the Common Yellowthroat, Red-eyed Vireo (*Vireo olivaceus*), and White-throated Sparrow.

The majority (79%) of the species identified during the breeding bird surveys were passerines. However, a variety of non-passerine birds were also observed during these surveys, including but not limited to Canada Goose (*Branta canadensis*) (waterfowl); Hairy Woodpecker (*Picoides villosus*), Northern Flicker (*Colaptes auratus*), Pileated Woodpecker (*Dryocopus pileatus*), Yellow-bellied Sapsucker (*Sphyrapicus varius*) (woodpeckers), and Red-tailed Hawk (*Buteo jamaicensis*) (bird of prey).

Overall there were 15.00 ± 1.58 birds and 12.95 ± 1.23 species (mean ± 95% confidence interval) observed per area search during breeding season surveys.

*Fall Migration Surveys*
Forty six standardized area search transects surveys were conducted along 20 transects at or near the Study area on September 29, October 21, and November 10, 2014 (Drawing 8.6A). Thirty-five (35) species, consisting of 372 individual birds, were recorded during these fall migration surveys (Table F7/8, Appendix F). Golden-crowned Kinglet (*Regulus satrapa*), Black-capped Chickadee, and Blue Jay (*Cyanocitta cristata*) were the most frequently observed species. The most abundant species were Black-capped Chickadee, Canada Goose, and American Robin.

Migrant passerines accounted for just 43% of the species and 49% of the individual birds observed during fall migration surveys at or near the Study area. This is likely an over-estimate as migrant passerines for the purposes of this analysis include those species where a portion of the population over-winters in Nova Scotia, including Dark-eyed Junco (*Junco hyemalis*) and White-throated Sparrow. A number of large migratory flocks were also observed near the Study area during the surveys, including a flock of 50 Canada Geese, a flock of 20 American Robins, and a flock of 10 grackles. Overall, there were 7.60 ± 3.15 individual birds and 3.71 ± 3.15 species (mean ± 95% confidence interval) observed per survey transect during fall migration at the Study area during fall surveys.

*Summary of Bird Surveys*

The Study area is situated in a forested landscape adjacent to industrial and agricultural areas. Habitat at the Study area comprises hardwood and mixed wood stands of varying age, but forestry activities in the area are on-going and recent. Pockets of mature forest are present including individual trees of notable diameter. Shrub and treed swamp wetlands are interspersed throughout the site, while a large, treed bog / swamp wetland complex is present bisecting the Study area from south to north, between turbine 1 and turbine 2. The landscape position and habitat character of the Study area influence the bird community during all seasons.

In early spring, moderate numbers of such early migrants/over-wintering residents as American Robin, Black-capped Chickadee, Dark-eyed Junco, Purple Finch (*Carpodacus purpureus*), and Song Sparrow (*Passerculus sandwichensis*) are present at the site. Abundance during this period is generally highest to the south of the planned turbine locations, in association with recently harvested areas that are intermixed with mature hardwood stands and softwood stands that are managed for silviculture.

A migrant influx occurs in mid-May, which is consistent with patterns throughout the region. At this time, moderate numbers of Black-and-white Warbler (*Mniotilta varia*), Black-throated Green Warbler (*Dendroica virens*), Magnolia Warbler (*Setophaga magnolia*), and Chestnut-sided warbler (*Setophaga pensylvanica*) appear on the site. Canada Warblers (*Cardellina canadensis*) were also observed in a number of locations within, and in close proximity to the Study area, most notably within the treed swamp wetland complex that bisects the site from north to south. Canada Warblers are further discussed below.

Sixty-nine percent (69%) of the species observed during spring surveys were also recorded during the breeding season, suggesting that a number of species use the site as a spring stopover during migration but do not establish breeding territories. Forest dwelling birds breed at the Study area at moderate densities. Dominant thrush and warbler species are a reflection of the mid-aged to mature hardwood and mixedwood forest types that are present throughout the site. The representation of a number of sparrow species, namely Song Sparrows (*Melospiza melodia*), White-throated Sparrows, and Dark-eyed Juncos, which were consistently observed throughout the site, are a reflection of the recent forestry activity around the site. Highest breeding densities and number of species were observed towards the site's southern and southeastern extent, in association with hardwood and mixedwood stands of varying age.

A variety of migrant and resident species occur within or near the Study area during the fall migration period. After breeding territories breakdown, significant numbers of Black-capped Chickadees, Golden-crowned Kinglets, Song Sparrows, American Goldfinches, and Blue Jays assemble in the site's diverse habitats. All of these species occur in Nova Scotia throughout the winter, and it is likely that the fall population is augmented by breeders from elsewhere in the region. Bird abundance and diversity decline as the fall season progresses and in late November the site is dominated by resident species.

Large numbers of American Robin and Canada Geese fly over the site during fall migration, taking advantage of the myriad of agricultural fields in the general area.

Habitats at the Study area appear to be attractive to over-wintering Black-capped Chickadees, which occur there in moderate numbers. Other, less hardy species, meanwhile, occur sporadically during the winter season. Common Ravens (*Corvus corax*) were frequently heard in the surrounding landscape, likely congregating in nearby agricultural areas.

Overall, there were 68 different species identified at or near the Study area during surveys conducted throughout the year, including 11 SOCI (Table 8.13, Drawing 8.6B).

**Table 8.13: Bird SOCI identified at or Near the Study Area**

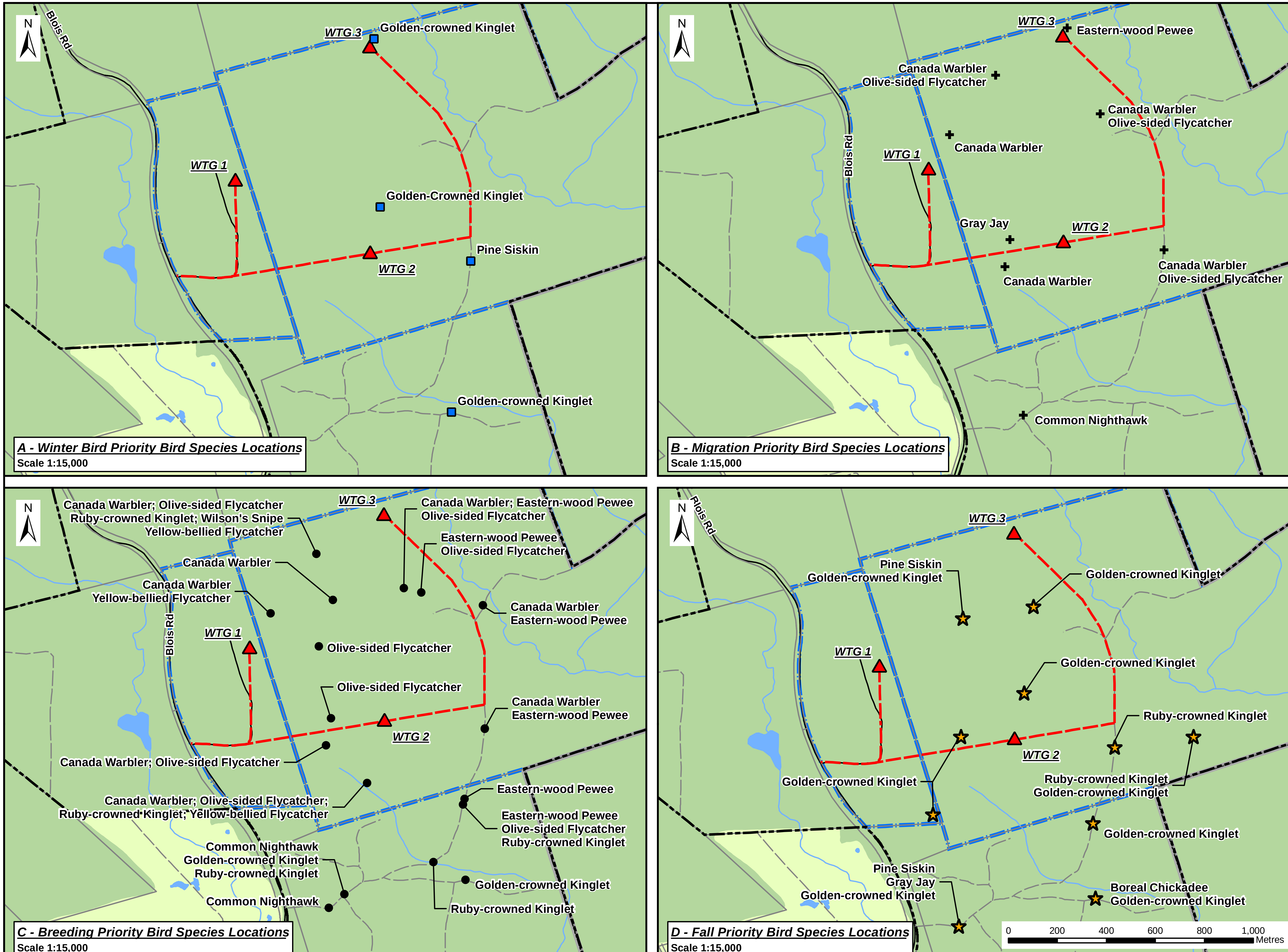
| Common Name | Scientific Name | SARA Status | NSESA Status | COSEWIC Status | NSDNR Status | NS S-Rank |
|---|---|---|---|---|---|---|
| Boreal Chickadee | *Poecile hudsonicus* | Not Listed | Not Listed | Not Listed | Sensitive | S3 |
| Canada Warbler | *Wilsonia canadensis* | Not Listed | Endangered | Threatened | At Risk | S3B |
| Common Nighthawk | *Chordeiles minor* | Threatened | Threatened | Threatened | At Risk | S3B |
| Eastern Wood-pewee | *Contopus virens* | No Status | Vulnerable | Special Concern | Sensitive | S3S4B |
| Golden-crowned Kinglet | *Regulus satrapa* | Not Listed | Not Listed | Not Listed | Sensitive | S4 |
| Gray Jay | *Perisoreus canadensis* | Not Listed | Not Listed | Not Listed | Sensitive | S3S4 |
| Olive-Sided Flycatcher | *Contopus cooperi* | Threatened | Threatened | Threatened | At Risk | S3B |
| Pine Siskin | *Spinus pinus* | Not Listed | Not Listed | Not Listed | Sensitive | S3S4B, S5N |
| Ruby-crowned Kinglet | *Regulus calendula* | Not Listed | Not Listed | Not Listed | Sensitive | S4B |
| Wilson's Snipe | *Gallinaga delicata* | Not Listed | Not Listed | Not Listed | Sensitive | Not Listed |
| Yellow-bellied Flycatcher | *Empidonax flaviventris* | Not Listed | Not Listed | Not Listed | Sensitive | S3S4B |

[1]Government of Canada 2012; [2]NS ESA 2013; [3]COSEWIC 2012a; [4]NSDNR 2010; [5]ACCDC 2015

The requirements as set out in the *MBCA* will be adhered to for Project activities. Additional mitigation measures for avifauna are provided in Section 4 and 13.

Of the SOCI listed in Table 8.13, the following four species are listed under either *SARA* or NS *ESA*:

- Canada Warbler;




***Notes:***

1. Reference: Digital Topographic Mapping & Property Management Unit MU0904 by Nova Scotia Geomatics Centre.
2. Projection: NAD83(CSRS), UTM Zone 20 North.
3. GPS Points Taken are Typically to +/-5m Accuracy.

***Legend:***

- Proposed Turbine
- Proposed Access Road
- Study Area
- Project Site
- Property Boundary
- Native Reserve
- Public Roads
- Access Roads / Trails
- Mapped Stream
- Mapped Indefinite Stream
- Water Bodies

## *Hardwood Lands Community Wind Project - Priority Bird Species Locations*

Strum CONSULTING

| Date: August 2015 | Project #: 14-5169 |
|---|---|
| Scale: 1:15,000 | Drawing #: 8.6B |
| Drawn By: H. Serhan | |
| Checked By: S. Dickey | |

- Common Nighthawk;
- Eastern Wood-Pewee; and
- Olive-sided Flycatcher.

The likelihood of these species to be impacted by the Project is evaluated below.

*Canada Warbler*
Canada Warblers were observed early in the spring (mid-May), and persisted on-site through the breeding season. These birds were confirmed to be breeding on-site in mixed wood treed swamps with dense understories, which is typical habitat for these birds. A Canada Warbler management plan has been developed to mitigate Project impacts to these birds and one year of pre-construction behavioural monitoring has been completed (Appendix G). Potential effects of the Project on this species, as well as proposed species-specific mitigation measures, are discussed in more detail in Section 13.2.2.

*Common Nighthawk*
Common Nighthawk was observed in an area to the south of the Study area which was recently cutover. This area is associated with clear cut forest stands and a network of un-used logging roads. These birds prefer open rocky areas as roosting and nesting locations. It is likely that this species is utilizing exposed forest floors or the logging roads themselves as roost or nest locations. These birds were observed during the breeding season over multiple surveys, indicating that they are "possible" breeders in the Study area. Potential effects of the Project on this species, as well as proposed species-specific mitigation measures, are discussed in more detail in Section 13.2.2.

*Eastern Wood-pewee*
Observations of Eastern Wood-pewee were made across the Study area. This species is a known associate of mid-aged to mature hardwood or mixed-wood forests, a habitat type which is prevalent in the area. Given that the species was detected at the same location on separate surveys, Eastern Wood-pewee should be considered a "possible" breeder within the Study area. Potential effects of the Project on this species, as well as proposed species-specific mitigation measures, are discussed in more detail in Section 13.2.2.

*Olive-sided Flycatcher*
Olive-sided flycatcher was observed at multiple locations over multiple surveys throughout, and in close proximity to the Study area. It is likely that these birds are over-represented in the data as their call is distinctive and carries over long distances, making it possible to observe the same bird over several point count locations. These birds have an affinity for forest edges, typically near wet areas such as ponds or open bogs. It is not uncommon for these birds to persistently occur at the edge of recent clear cuts, which may artificially resemble their preferred forest edge habitat. Given the prevalence of clear cut areas amongst somewhat mature forests throughout the Study area, it is likely that these birds were attracted to these artificial forest edges. These birds are also considered "possible" breeders, given that they persisted within or near the Study area in reasonable abundance across multiple surveys, including during the breeding season. Potential effects of the Project on

this species, as well as proposed species-specific mitigation measures, are discussed in more detail in Section 13.2.2.

## 8.8 Bats

The Nova Scotia Significant Species and Habitats database (NSDNR 2014a) indicates eighteen features related to bats and/or bat habitats within a 100 km radius of the Study area. All are classified in the database as "Species at Risk", and relate to Little brown myotis (*Myotis lucifugus*) (13) or bat hibernacula (5). The closest record relating to bats in the vicinity of the Study area is the Cave of Bats, located approximately 11.5 km to the southeast.

Moseley (2007) provided an overview of the known bat hibernacula in the caves and mines of Nova Scotia. This research indicates 16 known hibernacula within a 100 km radius of the Study area (Table 8.14).

**Table 8.14: Known Bat Hibernacula within 100 km of the Study Area**

| Hibernacula | Distance (Km) | Direction |
|---|---|---|
| Cave of the Bats | 11.46 | SE |
| Gayes River Gold Mine | 15.37 | SEE |
| Black Brook | 15.98 | E |
| Hayes Cave | 17.03 | N |
| Centre Rawdon Gold Mine | 19.23 | W |
| Minasville Ice Cave | 30.88 | NW |
| Woodville Ice Cave | 33.55 | SWW |
| Peddlar's Tunnel | 34.55 | NW |
| Walton Barite Mine | 40.24 | NW |
| Miller's Creek Cave | 42.05 | SWW |
| Frenchman's Cave | 42.06 | SW |
| Lear Shaft | 44.06 | N |
| Cheverie Cave | 52.10 | NWW |
| Lake Charlotte Gold Mine | 53.22 | SE |
| New Laing Adit #1 and #2 | 68.28 | NE |
| McLellan's Brook Cave | 86.00 | NE |
| The Ovens | 103.50 | SW |
| Hirschefield Galena Prospect | 113.92 | NEE |
| Vault Cave | 121.82 | W |

Source: Moseley 2007

Hayes Cave, the largest known bat hibernaculum in Nova Scotia, is located approximately 17 km north of the Study area (Moseley 2007). The Little brown myotis is the most common species at this gypsum cave (Poissant and Broders 2008; Randall 2011), although the Northern-long eared myotis, and the Tri-colored bat also occur between September and June (Davis and Browne 1996; Moseley

2007). Up to 6,000 bats have been recorded at Hayes Cave during winter hibernation (Davis and Browne 1996), although recent observations suggest that White-nose syndrome has reduced this hibernating population to approximately 250 (M. Elderkin, personal communication).

Table 8.15 indicates the bat species recorded within a 100 km radius of the Study area, according to ACCDC.

**Table 8.15: Bat Species Recorded within a 100 km Radius of the Study Area**

| Common Name | Scientific Name | *SARA* Status[1] | NS *ESA* Status[2] | COSEWIC Status[3] | NSDNR Status[4] | NS S-Rank |
|---|---|---|---|---|---|---|
| Eastern Pipistrelle | Perimyotis subflavus | Endangered | Endangered | Endangered | At Risk | S1 |
| Hoary Bat | Lasiurus cinereus | Not Listed | Not Listed | Not Listed | May Be At Risk | S1 |
| Little Brown Myotis | Myotis lucifugus | Endangered | Endangered | Endangered | At Risk | S1 |
| Northern Long-eared Myotis | Myotis septentrionalis | Endangered | Endangered | Endangered | At Risk | S1 |

Source: ACCDC 2015

[1]Government of Canada 2012; [2]NS ESA 2013; [3]COSEWIC 2012a; [4]NSDNR 2010; [5]ACCDC 2015

The Northern long-eared myotis, Little-brown myotis, and Tri-colored bat were added to the NS *ESA* list and declared endangered on July 11, 2013. A 90% population decline over the past two years has been attributed to a disease called White-nose Syndrome, cause by the fungus *Geomyces destructans* (NS *ESA* 2013). The disease has killed nearly 7 million bats in eastern North America in the past 8 years. White-nose Syndrome is usually lethal and affects all bat species that congregate in caves and abandoned mines used for hibernation through the winter (NS *ESA* 2013).

Field surveys of bat migration/habitat use were carried out from August 26 to October 3, 2013 using two AnaBat SD2 Detectors (Titley Electronics, Columbia, Missouri) deployed at the initial proposed Project site situated approximately 2.3 km southeast of the current Study area. Through consultation with NSDNR it was determined that the data obtained from the original bat surveys would be sufficient to characterize bat migration/habitat use on the proposed Study area. Field survey methodology and timing was designed in consultation with NSDNR (M. Elderkin, pers. comm.) and encompassed the main period of bat movement across the landscape. Suitable locations for bat detectors were limited at the original Project site due to the primarily forested nature of the site, as over-head canopy coverage can obscure acoustic bat signals. Bat detectors were therefore located in areas with an obstructed view of the sky and in habitats expected to provide suitable foraging habitat for bats, based on established literature. It has been demonstrated, for example, that woodland edges along farmlands are highly exploited by bats (Wolcott and Vulinec 2012). Although the original Project site was located near agricultural operations, there were no open fields within 1 km of the site.

The following sections present the bat monitoring results obtained at the original Project site, approximately 2.3 km southeast of the proposed Study area. Bat detector location details are provided in Table 8.16. Of note is that Detector 2 was damaged on the evening of September 26 and was inoperative thereafter. The field study therefore consisted of 70 survey events, defined here as a detector deployed over a period from dusk until dawn.

**Table 8.16 Bat Detector Location Details**

| Detector | Date (coordinates) | Habitat Type | Turbine | Distance to Proposed Turbine Locations (m) |
|---|---|---|---|---|
| 1 | August 26 – September 5, 2013 (20 T 460112 4989656) | Small clearing along an existing access trail | 1 | 3904 |
| | | | 2 | 3411 |
| | | | 3 | 4206 |
| | September 5 – October 2, 2013 (20 T 460476 4989892) | Small alder swamp bordering an existing access trail | 1 | 3883 |
| | | | 2 | 3347 |
| | | | 3 | 1407 |
| 2 | August 26– September 5, 2013 (20 T 460397 4989344) | Small hay field and shrub hardwoods adjacent to small watercourse | 1 | 4313 |
| | | | 2 | 3807 |
| | | | 3 | 4107 |
| | September 5 – September 26, 2013 (20 T 460771 4989117) | Interface of a corn field and shrub hardwoods | 1 | 4696 |
| | | | 2 | 4171 |
| | | | 3 | 4936 |

In total, 27,229 files were recorded, of which only 71 were determined to be bat generated ultrasound. The remaining files were determined to be caused by extraneous noise such as vegetation rustling or rainfall. Twenty-five (35.2%) of the echolocation calls were associated with Myotis species bats (*i.e.*, Little brown myotis and Northern long-eared myotis). Due to their similarity, calls of Nova Scotia's two resident Myotis species (Little brown myotis and Northern long-eared myotis) can be difficult to reliably distinguish from one another (O'Farrell et al. 1999), so these calls were not identified to species. Thirty-four (47.8%) of the calls, meanwhile, were attributed to Hoary bat (*Lasiurus cinereus*), with most occurring on a single night (September 17) at Detector 2. A single Red bat (*Lasiurus borealis*) call was detected on the night of September 13 at Detector 1 (Table 8.17).

An average of 1.01 ± 0.927 (mean ± 95% confidence interval) bat echolocation calls were detected per survey event, although this number is greatly influenced by the 32 call outlier of September 17. If this observation is excluded, most calls (48.7%) were recorded in late-August, with a subsequent decline as the weeks progress. No calls were detected beyond September 17.

**Table 8.17: Number of Echolocation Calls Recorded at the Original Project Site** (Aug 26th – Oct 2nd)*

| | Detector 1A | | | Detector 2A | | | |
|---|---|---|---|---|---|---|---|
| **Date** | **Myotis Spp.** | **Unknown** | **Hoary Bat** | **Myotis Spp.** | **Unknown** | **Red Bat** | **Hoary Bat** |
| 26-Aug-13 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| 27-Aug-13 | 2 | 0 | 0 | 1 | 0 | 0 | 0 |
| 28-Aug-13 | 3 | 2 | 0 | 0 | 0 | 0 | 0 |
| 29-Aug-13 | 0 | 1 | 0 | 0 | 0 | 0 | 0 |
| 30-Aug-13 | 4 | 2 | 0 | 0 | 0 | 0 | 0 |
| 31-Aug-13 | 2 | 1 | 0 | 0 | 0 | 0 | 0 |
| 01-Sep-13 | 0 | 1 | 0 | 1 | 0 | 0 | 0 |
| 02-Sep-13 | 0 | 1 | 0 | 0 | 0 | 0 | 0 |
| 03-Sep-13 | 2 | 0 | 3 | 1 | 0 | 0 | 0 |
| 04-Sep-13 | 4 | 0 | 0 | 0 | 0 | 0 | 0 |
| | **Detector 1B** | | | **Detector 2B*** | | | |
| **Date** | **Myotis Spp.** | **Unknown** | **Hoary Bat** | **Myotis Spp.** | **Unknown** | **Red Bat** | **Hoary Bat** |
| 05-Sep-13 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 06-Sep-13 | 0 | 0 | 0 | 1 | 0 | 0 | 0 |
| 07-Sep-13 | 1 | 0 | 0 | 0 | 1 | 0 | 0 |
| 08-Sep-13 | 0 | 0 | 0 | 0 | 1 | 0 | 0 |
| 09-Sep-13 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 10-Sep-13 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 11-Sep-13 | 0 | 0 | 0 | 1 | 0 | 0 | 0 |
| 12-Sep-13 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 13-Sep-13 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
| 14-Sep-13 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 15-Sep-13 | 0 | 0 | 0 | 1 | 0 | 0 | 0 |
| 16-Sep-13 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 17-Sep-13 | 0 | 0 | 0 | 0 | 0 | 0 | 32 |
| 18-Sep-13 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 19-Sep-13 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 20-Sep-13 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 21-Sep-13 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 22-Sep-13 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 23-Sep-13 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 24-Sep-13 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 25-Sep-13 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 26-Sep-13 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

| Date | Detector 1B | | | Detector 2B* | | | |
|---|---|---|---|---|---|---|---|
| | Myotis Spp. | Unknown | Hoary Bat | Myotis Spp. | Unknown | Red Bat | Hoary Bat |
| 27-Sep-13 | 0 | 0 | 0 | ... | ... | ... | ... |
| 28-Sep-13 | 0 | 0 | 0 | ... | ... | ... | ... |
| 29-Sep-13 | 0 | 0 | 0 | ... | ... | ... | ... |
| 30-Sep-13 | 0 | 0 | 0 | ... | ... | ... | ... |
| 01-Oct-13 | 0 | 0 | 0 | ... | ... | ... | ... |
| 02-Oct-13 | 0 | 0 | 0 | ... | ... | ... | ... |

* Detector 2B sustained damage and was inoperable from September 26 onward

It is possible that the absence of calls after mid-September can be explained by the fact that most bats had completed their migration through the area to their respective hibernacula. Alternatively, insect prey availability may have diminished in the area, causing bats to forage in more productive habitats (*i.e.*, over open water). The low number of bat calls detected throughout the sampling period suggests that bat activity at the old Project site appears to be low.

Bat species that were identified during field surveys at the original Project site or that have been recorded within a 100 km radius of the proposed Study area were screened against the criteria outlined in the document "Guide to Addressing Wildlife Species and Habitat in an EA Registration Document" (NSE 2009b) to develop a list of priority species. These priority bat species include:

- Little brown myotis – "Endangered" (SARA), "Endangered" (NS *ESA*),"Endangered" (COSEWIC), "At Risk" (NSDNR), "S1" (ACCDC);
- Northern long-eared myotis– "Endangered" (SARA), "Endangered" (NS ESA), "Endangered" (COSEWIC), "At Risk" (NSDNR), "S1" (ACCDC);
- Hoary bat – "May Be At Risk" (NSDNR), "S1" (ACCDC); and
- Tri-colored bat – "Endangered" (SARA), "Endangered" (NS ESA), "Endangered" (COSEWIC), "At Risk" (NSDNR), "S1" (ACCDC).

*Little Brown Myotis*
Little brown myotis is quite general in its habitat requirements (Broder *et al*. 2003). During the spring and summer, the species can be found feeding on small aerial insects over water bodies and at the edges of forest clearings during the evening and night (Barclay 1991). During the day, the Little brown myotis will roost in buildings, trees, under rocks, in wood piles, and in caves, congregating in tight spaces to roost at night (Fenton and Barclay 1980). As a non-migratory species, Little brown myotis are known to congregate in large hibernation groups, known as hibernacula, from September to early or mid-May in abandoned mines or caves (Fenton and Barclay 1980; Moseley 2007).

Little brown myotis is the most common species in Nova Scotia, and is probably ubiquitous in the province (Broders *et al*. 2003). However, this species is suspected to have been most severely affected by the White-nose Syndrome epizootic (COSEWIC 2012c). ACCDC data indicates that the closest Little brown myotis sighting to the Study area was 11.7 km away. Multiple known hibernacula are known to occur within a 100 km radius of the area, including Hayes Caves, the largest known hibernacula in the province.

A number of echolocation calls emitted by *Myotis sp.* were detected during the 2013 survey, most of which were likely generated by Little brown myotis. In addition, suitable habitat is present at the proposed Study area, including forest stands and clear cut lands (Drawing 8.5A and 8.5B). It is therefore likely that this species potentially uses the Study area, either during the early summer breeding season or during late-summer movements to hibernacula.

Potential effects of the Project on bat species, as well as proposed mitigation measures, are discussed in more detail in Section 13.2.3.

*Northern-long Eared Myotis*
The Northern-long eared myotis often feeds shortly after sunset near water bodies and open areas near forest edges (Gill 2006). During the day, Northern long-eared myotis show a preference for roosting in trees, the characteristics of which have been shown to vary according to the reproductive status of bred females (Garroway and Broders 2008). Females appear to prefer shade tolerant deciduous trees over coniferous trees, whereas males roost solitarily in coniferous or mixed-stands in mid-decay stages (Broders and Forbes 2004). Northern long-eared myotis are also non-migratory and are typically associated with the Little brown myotis during hibernation, in caves or abandoned mines (Moseley 2007). Hibernation for this species is thought to begin as early as September and can last until May (as cited in Caceres and Barclay 2000). This species is widely distributed in the eastern United States and Canada, and is commonly encountered during swarming and hibernation (Caceres and Barclay 2000).

Although once considered uncommon throughout Nova Scotia (Moseley 2007), Northern long-eared myotis is likely ubiquitous in the forested regions of the province (Broders *et al*. 2003). However, this species has also been severely affected by the White-nose Syndrome epizootic (COSEWIC 2012d). ACCDC data indicates that the closest Northern long-eared myotis sighting to the Study area was 11.7 km away; in addition, this species has been identified at several known hibernacula within a 100 km radius of the Study area.

A number of echolocation calls emitted by *Myotis sp.* were detected during the 2013 survey, of which a proportion was likely from Northern long-eared myotis. In addition, suitable mid-aged forest habitat is present at the Study area (Drawing 8.5A and 8.5B). It is therefore likely that this species potentially occurs at the Study area, either during the breeding season/summer or during late-summer movements to hibernacula.

Potential effects of the Project on bat species, as well as proposed mitigation measures, are discussed in more detail in Section 13.2.3.

*Hoary Bat*

Hoary bats are the largest species of bat in Canada. They account for one of the three lasiurine bat species recorded in Nova Scotia. The other two species include the Silver-haired bat and Red bat. Hoary bats are solitary individuals, roosting in areas of forest cover. Hoary bats are distributed widely throughout the Americas from northern Canada south to Argentina and Chile (Hall 1981). They undertake long migrations in the spring and fall, as they raise their young throughout Canada and the northern United States but winter in the southern United States and Mexico. Nova Scotia is thought to be at, or beyond the northern range limit for all three species of North American lasiurine bats. Records indicate coastward movement during late summer (Cryan 2003) and fall migration from mid-August to October to southern USA and Mexico.

Given their expansive range, Hoary bats occupy a wide variety of habitats. They are found everywhere from lowland deserts to tropical cloud forests and northern tundra (Tuttle 1995). In Canada, Hoary bats commonly live in deciduous forests along ridges surrounded by wet meadows, marshes, and bays (Tuttle 1995). They roost near the tops of trees and hunt in clearings near sources of water.

This species is thought to be rare in Nova Scotia (Broders et al. 2003, Scott & Hebda 2004). However, based on echolocation recordings collected in 2003, Rockwell (2005) suggest that they are more common in summer than direct observations indicate.

Thirty-five echolocation calls recorded during 2013 field studies were attributed to Hoary bat, with the majority of calls (32) occurring on a single night (September 17) at Detector 2. As this species inhabits a wide range of habitats it is therefore likely that this species potentially uses the Study area, either during the early summer breeding season or during late-summer coastal movements.

Potential effects of the Project on bat species, as well as proposed mitigation measures, are discussed in more detail in Section 13.2.3.

*Tri-colored Bat*

Tri-colored bats, formerly known as the Eastern pipistrelle, forage over water bodies, tree canopies and in open areas (Quinn and Broders 2007; Poissant and Broders 2008). This species requires clumps of *Usnea* lichen for roosting; a habitat feature typically associated with mature spruce and balsam fir trees (Farrow 2007), which are present at the Project site. This species is non-migratory, and generally hibernates alone, or in small numbers, in caves or abandoned mines where it appears to show a preference for small side passages, rather than main passages (Fujita and Kunz 1984; Moseley 2007). Individuals show strong fidelity to specific hibernacula, although in Nova Scotia only 10 hibernating individuals have ever been recorded (Quinn and Broders 2007).

The species occurs throughout most of eastern North America, with Nova Scotia representing the northeastern extent of its range (Fujita and Kunz 1984). Within Nova Scotia the species has a restricted breeding distribution focused in the interior of the southwest region of the province (Farrow and Broders 2011). Research conducted at Kejimkujik National Park found the Tri-colored bat to be locally abundant, and results indicate that this population may represent the only breeding population of the species in Canada (Broders *et al*. 2003). In the summer months, the Tri-colored bat is concentrated in a geographic area bounded by Wolfville to the west, Halifax to the northeast, and Shelburne to the southeast (Quinn and Broders 2007). ACCDC data indicates that the closest observation of this species to the Project site was 11.7 km away, and Tri-colored bat has been recorded in Hayes Cave less than 20 km away.

One echolocation signal recorded during the 2013 field studies had characteristics of Tri-colored bat, although a conclusive species determination was not possible in this instance. Suitable softwood dominated roosting habitat is not present at the Project site in great abundance, and is limited to small areas within central portions of the Study area. In consideration of the site's proximity to Hayes Cave, it is possible that Tri-colored bat occurs at the Study area, probably during late summer movements to hibernacula.

Potential effects of the Project on bat species, as well as proposed mitigation measures, are discussed in more detail in Section 13.2.3.

Mitigation measures for bats are provided in Section 4 and 13.

# 9.0 SOCIO-ECONOMIC ENVIRONMENT

## 9.1 Local Demographics and Industry

The Study area is located on land within the Municipality of the District of East Hants. The largest towns in the Municipality include Enfield (pop. 5,016), Elmsdale (pop. 3,034), and Lantz (pop. 3,326) (Statistics Canada 2011). The nearest communities to the Study area are Hardwood Lands (3.3 km), Nine Mile River (6.0 km), and Micmac (3.9 km).

### 9.1.1 Demography

Population statistics for East Hants from the 2011 census are summarized in Table 9.1.

**Table 9.1 Population in East Hants**

| **Population Statistics** | **East Hants** |
|---|---|
| **Population in 2011** | 22,111 |
| **Population in 2006** | 21,397 |
| **Population change from 2006-2011 (%)** | 3.3 |
| **Total private dwellings in 2011** | 9,396 |
| **Land area (square km)** | 1,786 |
| **Population density per square kilometer** | 12.4 |

Source: Statistics Canada 2011

The age distribution in East Hants reveals a median age of 41.3 years, which is similar to the provincial median age (43.7), and HRM (39.9) (Statistics Canada 2011). A breakdown of age distribution in East Hants is outlined in Table 9.2 below.

**Table 9.2: Age Distribution in East Hants**

| Age Statistics | East Hants |
|---|---|
| **0 - 14 years** | 3,970 (18%) |
| **15 - 64 years** | 15,485 (70%) |
| **65+ years** | 2,655 (12%) |
| **Total Population** | **22,110 (100%)** |

Source: Statistics Canada 2011

The average dwelling value in East Hants is $210,152, is higher than the provincial average of $201,991 but lower than the national average of $345,182 (Statistics Canada 2011). As for average individual income, East Hants ($35,673) slightly exceeds the provincial average of $35,478 while both are below the national average income of $40,650 (Statistics Canada 2011) (Table 9.3).

**Table 9.3: Median Dwelling Value and Individual Income**

| Jurisdictions | Average Dwelling Value | Average Individual Income |
|---|---|---|
| East Hants | $210,152 | $35,673 |
| Province of Nova Scotia | $201,991 | $35,478 |
| Canada | $345,182 | $40,650 |

Source: Statistics Canada 2011

9.1.2 Health Care and Emergency Services

The Nine Mile River Volunteer Department is located approximately 7 km south-southwest of the Study area on Elmsdale Road. The Milford Volunteer Fire Department is also located nearby, approximately 7.3 km southeast of the Study area.

Health services in the region are provided by the Colchester East Hants Health Authority which offers a wide range of services through the Municipality of East Hants' Lloyd E. Matheson Centre in Elmsdale, in addition to the Colchester Regional Hospital in Truro. Health and emergency services exist in the area and are accessible to Project workers if the need should arise.

9.1.3 Industry and Employment

In July 2015, the Annapolis Valley Economic Region (includes Hants County) had an unemployment rate of 7.3%, which is lower than the provincial average of 7.9% (Statistics Canada 2015). The Annapolis Valley employment rate of 54.4% is lower than the provincial rate of 58.5% (Statistics Canada 2015).

A breakdown of the labour force within East Hants is provided in Table 9.4. The highest proportions of workers in East Hants fall into the "Retail trade" category (12.1%). Other significant industries include construction, transportation, and warehousing and public administration (Statistics Canada 2011).

**Table 9.4: Labour Force by Industry in East Hants**

| Industry | Total East Hants |
|---|---|
| Total experienced labour force 15 years + | 12,430 |
| Retail trade | 1,510 |
| Construction | 1,330 |
| Transportation and warehousing | 1,215 |
| Public administration | 1,065 |
| Health care and social assistance | 1,040 |
| Manufacturing | 985 |
| Administrative and support, waste management and remediation services | 670 |
| Accommodation and food services | 665 |
| Wholesale trade | 660 |
| Educational services | 650 |
| Agriculture, forestry, fishing and hunting | 495 |
| Professional, scientific and technical services | 475 |
| Finance and insurance | 370 |
| Real estate and rental and leasing | 200 |
| Other categories | 1,100 |

Source: Statistics Canada 2011

A review of businesses located within 10 km of the Study area is provided in Table 9.5.

**Table 9.5: Local Businesses and Proximity to Study area**

| Business | Proximity to Study area* |
|---|---|
| Marr's One Stop | 2.0 km east of the Study area, on Dowie Road |
| RBK Variety | 5.1 km east of the Study area, on Eagle Nest Avenue |
| The Tractor Dome | 6.8 km southeast of the Study area, on Highway 14 |
| B. Miles Appraisals | 6.8 km southwest of the Study area, on Blois Road |
| Eastern Dairy Services | 7.5 km southeast of the Study area, on Crombe Road |
| ESSO | 7.7 km southeast of the Study area, on NS Trunk 2 |
| Corridor Co-Op Food Market | 7.8 km southeast of the Study area, on Highway 2 |
| Corridor Co-Op Country Store | 7.8 km southeast of the Study area, on Highway 2 |
| Stonehouse Marketing and Golf Group | 8.0 km east of the Study area, on Mill Village Road |

| Business | Proximity to Study area* |
|---|---|
| Atlantic Motorsport Park | 8.1 km northeast of the Study area, on Race Track Road |
| threeD Screenprinting | 8.5 km southeast of the Study area, on Trunk 2 |
| Whispering Winds Campground | 8.7 km northeast of the Study area, on Highway 215 |
| Riverland Campground | 8.8 km southwest of the Study area, on C.P. Thompson Road |
| Links at Penn Hills | 9.0 km northeast of the Study area, on Highway 215 |
| Renfrew Camping | 9.3 km southwest of the Study area, on Renfrew Road |
| Key Note Music Instrument Shop | 9.5 km southeast of the Study area, on Highway 2 |
| Withrow's Farm Market | 9.5 km south of the Study area, on Highway 214 |
| Shubenacadie Provincial Wildlife Park | 9.6 km east of the Study area, on Creighton Road |

*All distances measured from center of the Study area, using the most direct route.

Economic effects as a result of the Project will include job creation and increased revenue for the Municipality of East Hants.

It is estimated that the Project will result in millions of dollars in contracts with Nova Scotia companies for the delivery of equipment and construction materials, as well as professional development, construction, and operational services.

*Job Creation*
Elements of job creation throughout the lifespan of the Project include:

- Project Development - During the development phase of the Project, Nova Scotian professionals will deliver a variety of services, including: civil and electrical engineering services, legal services, financial services, environmental and biological survey services, archaeological services, land and community relations services, website development, and many others. As this project is one of many COMFIT projects being developed in the Province, it is difficult to precisely estimate the number of full-time-equivalent jobs that are created through the development of this Project alone, however it is known that dozens of professionals within Nova Scotia will render their services as part of the development of the Project.
- Construction - Though the construction phase of the Project is relatively short, it will require significant manpower for realization. Much of the construction employment will come through contracting and subcontracting of Nova Scotia construction firms. This will likely include significant elements of civil and electrical construction. During the construction phase, it is estimated that 54 people will be temporarily employed by the Project.
- Operations and Maintenance - Operational wind projects require long-term operations and maintenance professionals to be located either on-site or within short driving distance of the Project. It is generally anticipated that a team of two operations and maintenance technicians can maintain regular operations and maintenance service on approximately a dozen turbines. Once constructed, it is anticipated that this Project will be one of several

projects which share long-term operations and maintenance teams to ensure Project performance. The jobs associated with operations and maintenance are long-term, steady, stable, and high-paying jobs

In addition to the direct investments that the Project would bring to Nova Scotia's economy, a suit of auxiliary economic benefits can also be expected. It has previously been demonstrated that investments in wind power developments can result in significant indirect ancillary benefits to local communities. Workers that are directly involved with the development would contribute to local economies by redistributing wealth to a variety of goods and services such as hotels, restaurants, and grocery stores (USDE 2008).

*Tax Revenue*
As outlined in the *Wind Turbine Facilities Municipal Taxation Act* (2006), the Municipality of East Hants will receive tax revenues per MW on an annual basis and as such, the royalty will annually increase as the Consumer Price Index rises. Property taxes to be paid to the municipality over the lifespan of the Project are estimated at $860,000.

*Investment in the Local Community*
Through a Community Dividend, the proponent is committed to sharing the economic benefits of the Project with the surrounding community. The Project will direct 1% of the annual gross revenues to a local community liaison committee that will decide how it can be used for the betterment of the community. It is estimated that over the lifetime of the Project the Community Dividend will invest more than $470,000 in the local community.

## 9.2 Land Use and Value

The property on which the wind farm is proposed to be built is privately owned "Resource Forest". The Study area is surrounded by "Commercial", "Provincial Forest", "Resource Forest/Farm", and "Commercial Forest" lands (Service NS 2014).

Wind energy development is expected to continue to rise in the United States and Canada. One of the primary concerns of neighbouring residents to wind facilities is the potential effect of wind development on home values in surrounding communities. Although the topic is relatively new, the peer-reviewed literature investigating impacts to property values near wind facilities is growing, and a number of rigorous and statistically defensible studies have reported conclusions on the effect of wind energy developments on surrounding property values. To date, the majority of published research about wind energy and property values has largely concluded that homes sold after nearby wind turbines have been constructed do not experience statistically significant impacts to property values.

Prior to 2013, the most comprehensive study on the impact of wind farms on property values had been completed by Hoen et al. (2009). This research analyzed data on nearly 7,500 sales of single family homes situated within 10 miles (16 km) of 24 existing wind farms in the United States. Eight different hedonic pricing models failed to generate statistically significant evidence that property values for houses located within 10 miles of wind farms are influenced by the developments. Subsequent research by the same laboratory, but employing further analyses, confirmed these results (Hoen et al. 2010).

Carter (2011) analyzed home transactions in a rural landscape surrounding small (1-4 turbines) wind energy developments, while employing a hedonic model to statistically control for variables affecting all real estate transactions such as square footage, age of home, and school zone. This study concluded that proximity to the wind farms did not impact average selling price of homes; in fact, in one case, homes closer to a wind farm sold for significantly higher than those elsewhere (Carter 2011).

A study by Hinman (2010) tracked property transactions in communities located close to a 240-turbine wind farm for an eight year period that spanned pre-development and operation stages. Hinman (2010) found that before project approval, property values in the area decreased. This was attributed to a fear of the unknown effects that the development would have; an effect known as anticipation stigma. However, once the development became operational, property values recovered. This recovery was attributed to a greater understanding of the operational effects of the development. Anticipation stigma, however, was not detected in a similar study in Colorado (Laposa and Mueller 2010), in which it was concluded that the announcement of a large wind energy development did not significantly reduce the selling prices of homes surrounding the proposed development.

Until very recently, the primary limitation of previous research on the effects of wind energy facilities on surrounding home values has been that research has been based on relatively small sample sizes (data sets) of relevant home-sale data. The inability to account for the complexity of the various factors which affect property values has also been cited as a limitation to previous studies. In particular, data had been limited for homes located within about a half mile (800 m) of turbines, where impacts would be expected to be the largest: Hinman (2010) (n~11); Carter (2011) (n~41). This is in part due to the fact that setback requirements generally result in wind facilities being sited in areas with relatively few houses, limiting the number of sales transactions available to be analyzed (Hoen et al. 2013). Although these smaller datasets are adequate to examine large impacts (e.g., over 10%), they are less likely to reveal small effects with any reasonable degree of statistical significance.

A recent study published in August 2013 by Berkeley National Laboratory (principal authors) was conducted to address these gaps in data, and included the largest home-sale data set to date. Researchers collected data from 51,276 home sales spanning 27 counties in nine states, related to 67 different wind facilities (Hoen et al. 2013). These homes were within 10 miles of 67 different wind facilities, and 1,198 of the sales analyzed were within 1 mile (1.6 km) of a turbine, giving a much larger data set than previous studies have collected. The data span the periods well before announcement of the wind facilities to well after their construction (Hoen et al. 2013).

Two types of models were employed during the study to estimate property-value impacts: (1) an ordinary least squares (OLS) model, which is standard for this type of study, and (2) a spatial-process model, which accounts for spatial variability. These models allow the researchers to control for home values before the announcement of a wind facility (as well as the post-announcement, pre-construction period), the spatial dependence of unobserved factors effecting home values, and value changes over time. A series of robustness models was also employed to add an additional level of confidence to the study results.

Regardless of model specification, the results of the study revealed no statistical evidence that home values near turbines were affected in the post-construction or post-announcement/pre-construction periods. Therefore, the authors concluded that if effects do exist, either the average impacts are relatively small (within the margin of error in the models) and/or sporadic (impacting only a small subset of homes) (Hoen et al. 2013).

### 9.3 Recreation and Tourism

Existing outdoor recreation in the area includes hunting, fishing, All-terrain Vehicle (ATV) use, camping, golfing, and hiking. Whispering Wind Campground, Riverland Campground, and Renfrew Camping are all located within 10 km of the Study area. Nearby golf courses include Links at Penn Hills, Fox Hollow Golf Club, and a 9 hole course adjacent to Renfrew Camping. The Atlantic Motorsport Park and Shubenacadie Provincial Wildlife Park lie approximately 8.1 km northeast and 9.6 km east of the site, respectively.

The 2011 Nova Scotia Visitor Exit Survey Community Report outlines the total trips (stopped or stayed) to communities in Nova Scotia, to particular tourist regions, as well as capture rates of communities within tourist regions (Nova Scotia Department of Economic and Rural Development and Tourism 2011). The nearest communities to the Study area examined were Elmsdale in the Halifax Regional Municipality Region and Stewiacke in the Fundy Shore and Annapolis Valley Region. Table 9.6 shows the total trips (people who stopped for at least 30 minutes or stayed overnight) that were made to these communities as well as their capture rate (the percentage of parties that stopped in a specific community compared to other communities within the region) out of the total number of parties who visited the tourism region.

**Table 9.6: Communities Visited in Nova Scotia**

| Region/Community | Total Trips (% who stopped or stayed) | Capture Rate (%) |
|---|---|---|
| **Fundy Shore and Annapolis Valley** | **37%** | |
| Stewiacke | 3% | 8% |
| **Halifax Regional Municipality** | 79% | |
| Elmsdale | 2% | 2% |

Source: Nova Scotia Department of Economic and Rural Development and Tourism 2011

The data shows tourism in Elmsdale and Stewiacke is not a major economic driver.

The Study area is privately owned, though evidence of various forms of recreational activity have been observed on the site, including hunting and ATV use.

It is difficult to determine with certainty how tourists will react to a wind development. Wind farms are objects of fascination for many and thus can generate tourism for the local community. Some wind farms get upwards of 60,000 visits a year and the benefits of even drawing a fraction of that amount of visitors to a community can be felt by many businesses including shops, restaurants, and hotels (CanWEA 2006). Pincher Creek, Alberta developed a 19 MW wind farm in 1993, since that time tourism revenue from visitors from as far away as Russia has generated $5,000 in annual sales of clothing and souvenirs branded with the "Naturally Powerful Pincher Creek" logo (CanWEA 2006).

A 2002 study from Market & Opinion Research International (MORI) interviewed tourists visiting Argyll and Bute, Scotland and asked them about their attitudes towards the presence of wind farms in the area. Of those who knew about the surrounding wind farms (40% of those interviewed), 43% felt that wind farms had a positive effect on the area, 43% felt it made no difference, and 8% felt it had a negative effect (MORI 2002).

No negative effects from the Project are expected to the broader recreational community, as access to the turbines will be limited due to the fact that they will be located on private lands and generally removed from public areas and provincial roads.

## 10.0 CULTURAL AND HERITAGE RESOURCES

### 10.1 Archeological Resource Impact Assessment

Boreas Heritage Consulting Inc. conducted an ARIA for the Project. The purpose of the assessment was to determine the potential for historic and pre-contact period archeological resources within the Study area through background research and site reconnaissance.

The Study area was once part of the greater Mi'kmaq territory known as *Sipekne'katik,* meaning 'Wild Potato Area'. It is also noted that the Study area is located less than 1 km west of the Indian Brook Reserve (IR 14), one of the largest Mi'kmaw communities in the province. The Shubenacadie First Nation was formed in 1820, when the parcel of land, now known as Indian Brook, was officially established as a reserve. Oral traditions indicate that the Mi'kmaq traditionally used this land in preparation for hunting and fishing excursions, as well as to perform rituals and ceremonies. A review of the Maritime Archaeological Resource Inventory determined that there are no registered archaeological sites located within the Study area. During the course of the assessment, Boreas Heritage Consulting Inc. was informed of the reported location of a historic burial ground of European settlers, located 800 m southeast of the proposed turbine site 3 and approximately 480 m west of the proposed access road. The burial ground was not located during the field survey; however it presents a culturally significant zone and must be avoided.

Based on the background study and field survey completed on July 27, 2015 it was determined that all three proposed turbine locations exhibit high potential for encountering Precontact and/or early historic Native archaeological resources. In addition, two small areas measuring 10 m by 5 m situated on either side of the stream bed located within the proposed access road alignment to turbine site 3 are also considered to exhibit high potential for encountering Precontact and/or early historic Native archaeological resources. Based on the nature of the terrain, the distance to a significant water source, and the lack of evidence indicating significant cultural modification, the remainder of the Hardwood Lands Community Wind Project Study area is considered to exhibit low potential for encountering significant archaeological resources (Boreas Heritage Consulting Inc. 2015).

In order to identify any significant deposits or features associated with the Precontact or early historic occupation of the Study area the following recommendations were forwarded:

- a 15 m x 15 m area within the centre of the proposed footprints of turbine site 1 and 3 be subjected to a strategic program of shovel testing;
- any mechanical excavation and/or construction activity within the proposed turbine site 2 footprint that may have an impact on potential archaeological resources be monitored by an archaeologist;
- a 10 m x 5 m area on both sides of the stream bed located within the proposed access road to turbine site 3 be subjected to a strategic program of shovel testing; and
- the area in the vicinity of the reported burial ground must be avoided to prevent accidental impact during construction activities.
- The remainder of the Study area is cleared of any requirement for future archaeological investigation therefore development may proceed as planned.

The ARIA was forwarded to Kwilmu'kw Maw-klusuaqn Negotiation Office (KMKNO) for review and comment. Recommendations outlined in the ARIA were supported by KMKNO.

The ARIA was submitted to the NS Department of Communities, Culture, and Heritage (CCH) for review on August 13, 2015, and approval to initiate the sub-surface shovel testing program was provided on August 21, 2015 (Heritage Research Permit # A2015NS081). The sub-surface shovel testing program will commence during late August 2015 with results provided to KMKNO, CCH, and NSE during September 2015.

Procedures related to potential discovery of archaeological items or sites during construction/decommissioning will be described in the EPP.

## 11.0 OTHER CONSIDERATIONS

### 11.1 Shadow Flicker

Shadow flicker can occur when rotating blades cast flickering shadows during times of direct sunlight. The magnitude of shadow flicker is determined by the position and height of the sun, wind speed and direction, geographical location, time of year, cloud cover, turbine hub height, and rotor diameter, and proximity to the turbine (CanWEA 2011).

For shadow flicker to occur, the following criteria must be met:

1. The sun must be shining and not be obscured by clouds/fog.
2. The source turbine must be operating.
3. The wind turbine must be situated between the sun and the shadow receptor.
4. The wind turbine must be facing directly towards, or away from, the sun such that the rotational plane of the blades (rotor plane) is perpendicular to the azimuth of incident sun rays. For this to occur, the wind direction would have to be parallel to the azimuth of the incident sun rays throughout the day.
5. The line of sight between the turbine and the shadow receptor must be clear. Light-impermeable obstacles, such as vegetation, tall structures, etc., will prevent shadow flicker from occurring at the receptor.
6. The shadow receptor has to be close enough to the turbine to be in the shadow.

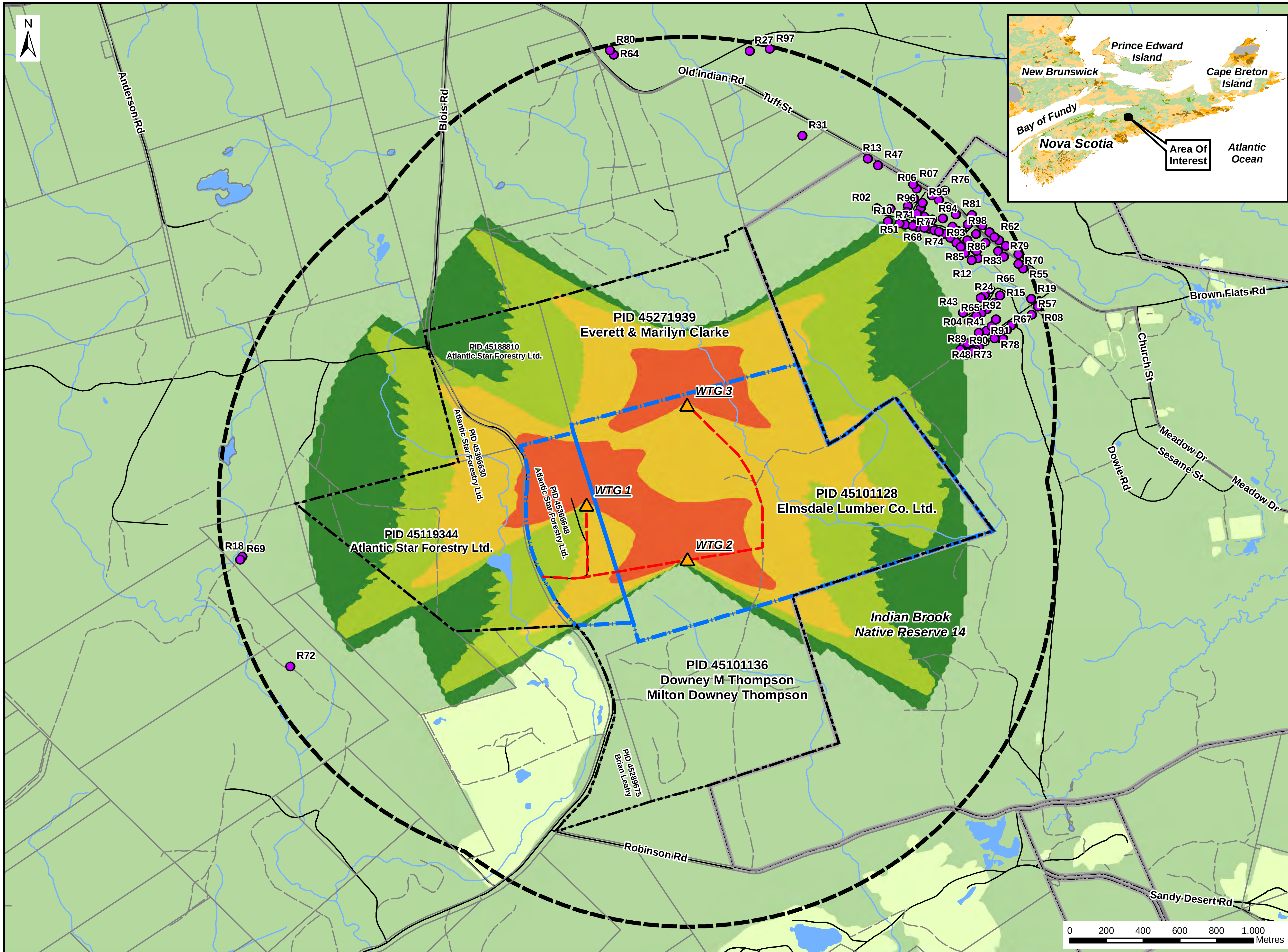
A shadow flicker assessment was completed for the proposed Project to assess the potential effect on surrounding shadow receptors. For the purposes of this model, receptors included all structures identified in the provincial topographic mapping, as well as any additional identifiable structures based on aerial imagery. No attempt to distinguish sheds and outbuildings from dwellings or cottages was made. The assessment was completed using the “Shadow” module of the WindPro v. 3.1 software package using worst case scenario conditions, including:

- Constant sunshine during daylight hours;
- Turbines are always operational;
- Turbine blades are oriented perpendicular to the line between the sun and all receptors;
- No obstructions are present that may obscure shadows; and
- Receptor windows are oriented towards the turbine(s).

There are no municipal, provincial, or federal guidelines related to shadow flicker, but many jurisdictions have adopted the industry standard of no more than 30 hours of shadow flicker per year, or no more than 30 minutes of shadow flicker on the worst day of the year. These guidelines were used in the shadow flicker assessment for the Project.

A list of 98 non-participating structures (i.e. those not located within the Study area) within a 2 km radius of the proposed turbine locations was developed using GIS data from the Nova Scotia Geomatics Centre and aerial imagery. For modeling purposes, the receptor list is considered to be conservative as no distinction has been made between habitable dwellings and barns, sheds, or outbuildings.

Modeling results (Appendix H) indicated that all residential receptors are predicted to comply with the 30 hours of shadow flicker per year/30 minutes of shadow flicker per day guideline (Drawing 11.1).




***Notes:***

1. Reference: Digital Topographic Mapping & Property Management Unit MU0904 by Nova Scotia Geomatics Centre.
2. Projection: NAD83(CSRS), UTM Zone 20 North.
3. Shadow Calculation Model was done Using Wind Turbine Data Supplied by Client.

***Legend:***

- Existing Receptors
- Proposed Turbine
- Proposed Access Road
- Study Area
- Project Site
- 2km Buffer
- Property Boundary
- Native Reserve
- Public Roads
- Access Roads / Trails
- Mapped Stream
- Mapped Indefinite Stream
- Water Bodies
- Cleared Area

**Shadow Flicket Modeling Results**

**Predicted Shadow (Hrs/Yr)**

- 0-10
- 10-30
- 30-100
- 100 +

# *Hardwood Lands Community Wind Project - Shadow Flicker Modeling Results*

Strum CONSULTING

| Date: August 2015 | Project #: 14-5169 |
|---|---|
| Scale: 1:20,000 | Drawing #: 11.1 |
| Drawn By: H. Serhan | |
| Checked By: A. Walter | |

### 11.2 Electromagnetic Interference (EMI)

The rotating blades and support structures of wind turbines can interfere with various types of electromagnetic signals emitted from telecommunication and radar systems (RABC and CanWEA 2012). In response to this phenomenon, the Radio Advisory Board of Canada (RABC) and CanWEA developed guidelines for assessing the EMI potential from a wind turbine development. These guidelines outline a consultation based assessment protocol that establishes areas, called "consultation zones", around transmission systems, based on the type and function of the system.

Consultation with relevant agencies was completed throughout the EA process and results are provided in Table 11.1.

**Table 11.1: Radar Transmission Array Interference Consultation Results**

| Signal Source | Operator | Required/ Suggested Consultation Zone Radius | Consultation Results |
|---|---|---|---|
| Air defense and air control radar systems | Department of National Defense (DND) | 100 km | No objections or concerns. |
| DND Radio Communications | DND | n/a | No objections or concerns. |
| Maritime vessel traffic system radars | Canadian Coast Guard | 60 km | No objections or concerns. |
| VHF omnidirectional range | Nav Canada | 15 km | Although potential impacts were identified (see correspondence in Appendix I), all were determined to be acceptable by Nav Canada. |
| Primary air traffic control surveillance radar | | 80 km (primary surveillance)<br>10 km (secondary surveillance) | |
| Weather radar | EC | 50 km | No objections or concerns. |

Relevant correspondence from operators is provided in Appendix I. All agencies consulted prior to the final layout selection have been provided with the updated Project design. Should additional layout modifications be required, the above agencies will be provided with the updated information, as appropriate.

### 11.3 Visual Landscape

Representative photos were taken from vantage points within the community to represent the existing and future visual landscape. GIS software was used to plot the photo locations and bearing in a 3D model. The 3D model was created by importing a scale model turbine into Google Earth at the coordinates consistent with the site plan. Views captured in the photographs were recreated in the 3D model by placing the viewer at the location and orientation the photographs were taken, and .jpeg files were exported. Digital photographs were overlaid on the model renderings, aligned by matching the dominant ridge line and other landscape features. Simulated wind turbines were added to the digital photographs consistent with the location and scale represented in the 3D renderings.

Photos were taken from five locations as shown in Drawing 11.2. Simulated results are provided in Figures 11.1-11.5.

**Figure 11.1. View looking south-southeast from MacPhees Corner (intersection of Indian Road and Blois Road).**

**Figure 11.2. View looking west-southwest from the end of Burma Road.**

**Figure 11.3. View looking west-southwest from the Sipekne'katik Baseball Diamond off of Tuff Street.**

**Figure 11.4. View looking west-southwest from the Sipekne'katik Church on Hollywood Drive.**

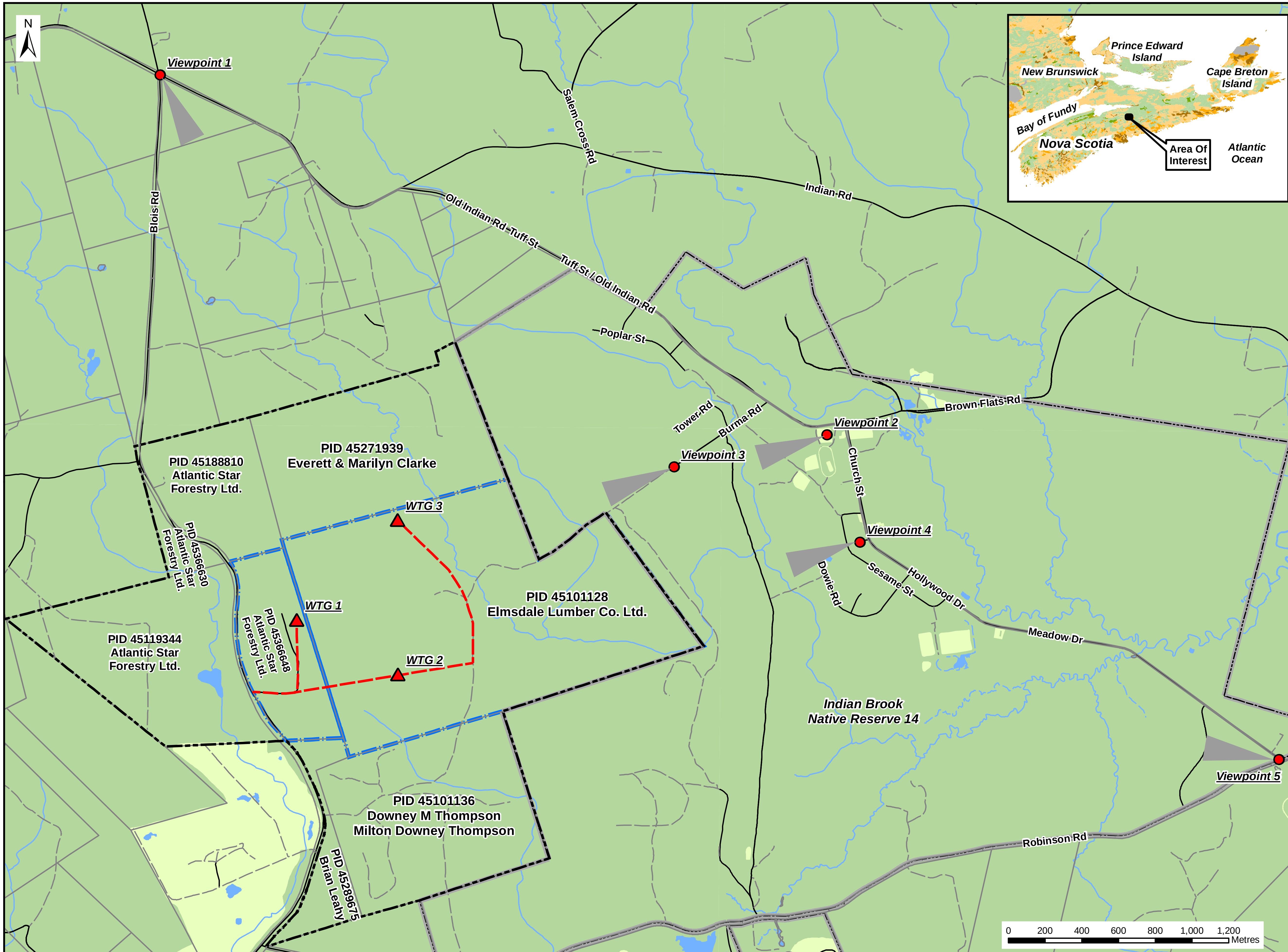
**Figure 11.5. View looking west-northwest from Meadow Variety located at 21 Meadow Drive.**

### 11.4 Sound

Sound from wind turbines comes from two general sources: the mechanical equipment, and the interaction of the air with the turbine parts, primarily the blades (NSDE 2008). In modern turbine designs, much of the mechanical noise is mitigated through the use of noise insulating materials. Aerodynamic noise, however, is a product of the turning of turbine blades and is thus an unavoidable aspect of wind power operations. Turbines can emit noises of different frequencies, and an individual's perception of the noise can depend on hearing acuity and tolerance for particular noise types (NRC 2007). Furthermore, the propagation of sound from the turbine source to a receptor, such as a residential dwelling, is influenced not only by the sound power level emitted from the turbine, but also by local factors such as distance to the receptor, topography, and weather conditions (Hau 2006). For example, increases in wind speed result in increases in ambient, natural noise (from vegetation movement) (NRC 2007).

*Acoustic Assessment*

An acoustic assessment was conducted for the Project to predict sound pressure levels at identified receptors within a 2 km radius of the proposed turbine locations. The assessment was completed using the "Decibel" module of the WindPro v. 3.1 software package. For the purposes of this model, receptors included all structures identified in the provincial topographic mapping, as well as any additional identifiable structures based on aerial imagery. No attempt to distinguish sheds and outbuildings from dwellings or cottages was made.




**Notes:**

1. Reference: Digital Topographic Mapping by Nova Scotia Geomatics Centre.
2. Projection: NAD83(CSRS), UTM Zone 20 North.

**Legend:**

- Viewpoint Locations
- Proposed Turbine
- Proposed Access Road
- Study Area
- Project Site
- Property Boundary
- Native Reserve
- Public Roads
- Access Roads / Trails
- Mapped Stream
- Mapped Indefinite Stream
- Water Bodies

## Hardwood Lands Community Wind Project - Visual Assessment Locations

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| | |
|---|---|
| Date: August 2015 | Project #: 14-5169 |
| Scale: 1:6,000 | Drawing #: 11.2 |
| Drawn By: H. Serhan | |
| Checked By: M. Henley | |

The sound assessment model followed ISO 9613-2 Acoustics – Attenuation of sound during propagation outdoors – Part 2: General method and calculations, and was based on the following input information:

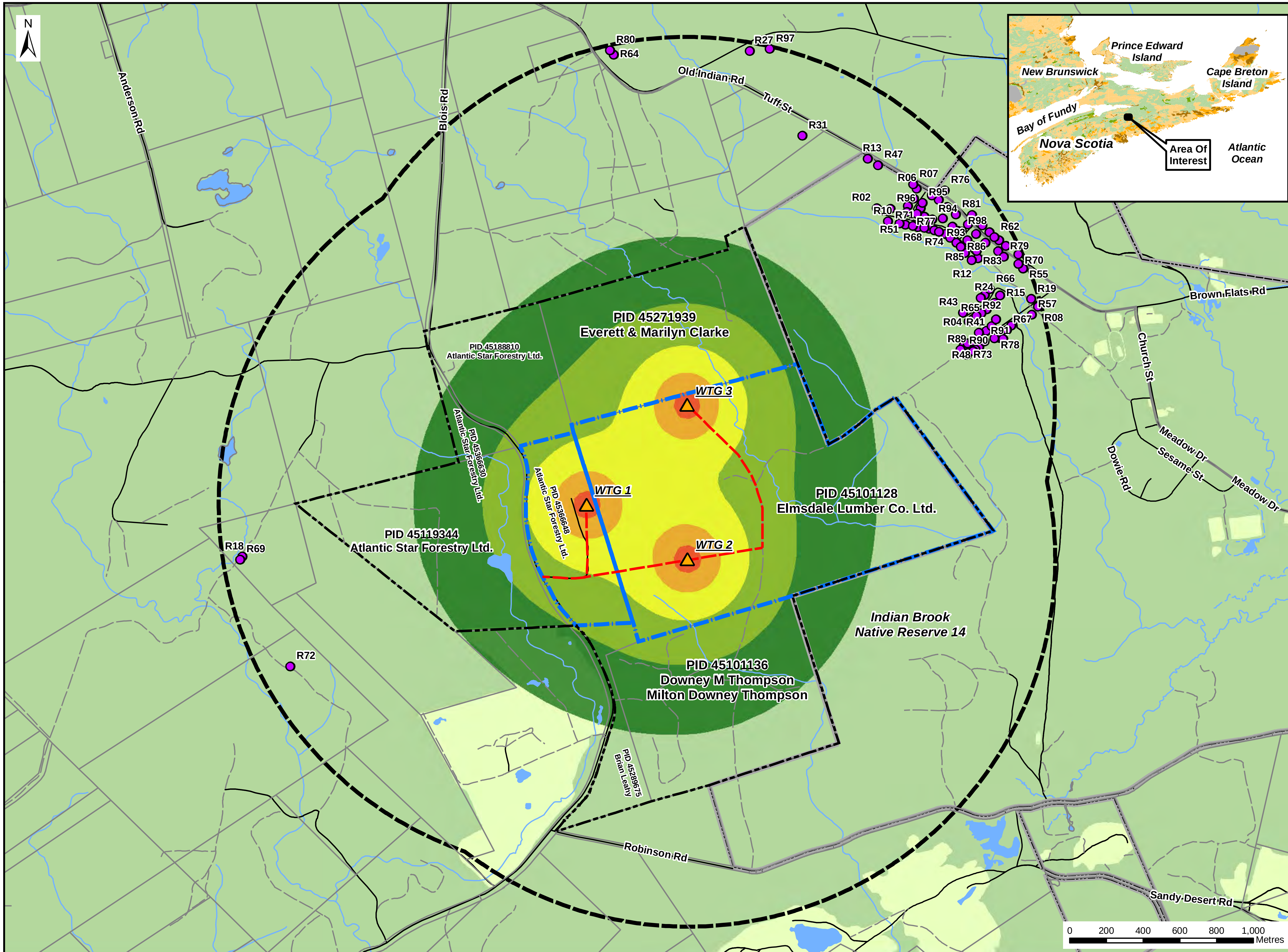
- Universal Transverse Mercator (UTM) coordinates for the wind turbines;
- UTM coordinates for existing receptors (98) within a 2 km radius of the Project site;
- A wind speed of 9 m/s at hub height;
- Overall sound emission data for the V110-2MW, provided by the manufacturer in the document "V110-2MW-Mk10 – Third Octave According to General Specification" (Vestas 2014);
- Topographic data for the surrounding area; and
- 1/3rd octave level data provided by the manufacturer.

The ISO 9613-2 calculation method assumes meteorological conditions that are ideal for noise propagation, including a ground temperature of 10ºC and 70% relative humidity. A conservative ground factor of 0.7 was applied to the model, although the forested nature of the landscape (e.g. predominantly porous ground which is capable of supporting vegetative growth) could support a higher value. Transformer noise has been accounted for in the modeling sound outputs due to its integration into the turbine structure.

Nova Scotia has no specific sound guidelines for wind farms; however, through the EA process, NSE requires that predicted noise levels at identified residential receptors (as well as daycares, hospitals, and schools) not exceed 40 dBA. As this guideline is intended to be protective of human sleep disturbance, 40 dBA does not apply to commercial/industrial receptors. Mapping illustrating the predicted sound levels relative to receptors is provided in Drawing 11.3.

A total of 98 existing non-participating structures (i.e. those not located on Project lands) were identified within a 2 km radius of the proposed turbine locations. Modeling results indicated that all residential receptors are predicted to comply with the NSE standard of 40 dBA. Excessive noise resulting from turbine operation is therefore not expected to be an issue at any existing dwellings/residences. Detailed results are provided in Appendix J.

A literature review related to infrasound is provided in Appendix C.




***Notes:***

1. Reference: Digital Topographic Mapping & Property Management Unit MU0904 by Nova Scotia Geomatics Centre.
2. Projection: NAD83(CSRS), UTM Zone 20 North.
3. Noise Calculation Model was done in Accordance with ISO 96313-2 General Guidelines and Using Wind Turbine Data Supplied by Client.

***Legend:***

- Existing Receptors
- Proposed Turbine
- Proposed Access Road
- Study Area
- Project Site
- 2km Buffer
- Property Boundary
- Native Reserve
- Public Roads
- Access Roads / Trails
- Mapped Stream
- Mapped Indefinite Stream
- Water Bodies
- Cleared Area

**Sound Modeling Results**

**Predicted Sound Level [dB(A)]**

- 35-40
- 40-45
- 45-50
- 50-55
- 55 +

# *Hardwood Lands Community Wind Project - Sound Modeling Results*

Strum CONSULTING

| | |
|---|---|
| Date: August 2015 | Project #: 14-5169 |
| Scale: 1:20,000 | Drawing #: 11.3 |
| Drawn By: H. Serhan | |
| Checked By: A. Walter | |

# 12.0 CONSULTATION AND ENGAGEMENT

## 12.1 Public Consultation

A summary of the consultation for this Project is provided in Table 12.1. Detailed information on community events and the website is provided below.

**Table 12.1: Consultation Meetings and Events**

| Date | Stakeholder | Activity Summary |
|---|---|---|
| March 12, 2012 | CWS and NSDNR | Bird monitoring protocol provided to CWS and NSDNR. |
| April 24, 2012 | CWS | Received written feedback from CWS regarding the bird monitoring program. |
| June 13, 2012 | NSDNR | Phone conversation with NSDNR staff to discuss bat monitoring and timing. |
| December 5-7, 2012 | NSDNR | Provided moose monitoring protocol to NSDNR staff and incorporated feedback into protocol. |
| February 18, 2013 | NSDNR | Received feedback on moose protocol update. |
| May 2014 | NSDNR | Received feedback concerning bird and bat monitoring program regarding site location change. |
| April 9, 2014 | Sipekne'katik Band Council | Met with the band council to provide a Project update. |
| June 10, 2014 | Sipekne'katik Band Council | Meeting regarding Mi'kmaq Ecological Knowledge Study (MEKS) and feasibility of acquiring an easement over Band Lands for Component delivery. |
| June 12, 2014 | NSE EA Branch | Met with NSE staff to discuss the Project. |
| July 6, 2014 | KMKNO | Phone conversation with KMKNO to discuss the process of archaeological consultation |
| July 15, 2014 | Municipality of East Hants | Meeting with staff regarding the interpretation of bylaws to confirm that a Non-Turbine Land Agreement will be sufficient to incorporate adjacent parcels as 'project lands'. |
| January 20, 2015 | East Hants Council | Presentation to East Hants Council regarding the upcoming project proposals. |
| February 5, 2015 | Sipekne'katik Band Council | Presentation to Sipekne'katik Council for project update and regarding proposed Non Turbine Land Agreement (NTLA) |
| March 2, 2015 | Community | First Open House event held at the Nine Mile River Community Centre. |

| Date | Stakeholder | Activity Summary |
|---|---|---|
| May 5, 2015 | Municipality of East Hants | Input provided for Citizen review panel on East Hants renewable energy bylaw. |
| June 8, 2015 | Community | Second Open House event held at the Shubenacadie Royal Legion. |
| June 23, 2015 | NSDNR | Phone conversation regarding the presence of Canada Warblers and how best to mitigate impacts on populations. |
| June 25, 2015 | NSE and NSDNR | Submission to NSE and NSDNR regarding the presence of Canada Warbler habitat, and mitigation strategies. |
| June 26, 2015 | NSDNR | Phone conversation regarding layout and warbler mitigation plan. |
| July 14, 2015 | Indian Brook residents and Sipekne'katik Band Members | Open House. |
| July 16, 2015 | INAC | Update regarding communication with Sipekne'katik |
| July 27, 2015 | KMKNO | Delivery of Archaeological Screening report to KMKNO for their review. Sub-surface testing will not occur until KMKNO feedback is received. |
| July 28, 2015 | Indian Brook residents and Sipekne'katik Band Members | Bus tour to the Nine Mile River Community Wind Project site. |
| July 30, 2015 | NSE | Email regarding the timing of submission for on-going archaeological surveys. |
| August 12, 2015 | KMKNO | Emails regarding the archaeology report – confirmation that the KMKNO has no additional recommendations. |
| August 12, 2015 | Department of Community, Culture and Heritage | Phone conversation regarding the timing of submission for ongoing archaeological surveys. |

*Community Events*

Three community open house events were held near the Project site (Nine Mile River Community Centre, Shubenacadie Royal Legion, and St. Catherine's Church) in March, June, and July 2015 from 6:30-8 pm to inform the public about the Project and to hear local comments and concerns. The open house featured posters that provided information about the Project and associated studies that were underway. Copies of the posters and newsletter from the open house are provided in

Appendix K. Attendees had the opportunity to speak one-on-one with Project team members and submit written comments and/or questions.

The Project Team will continue to help address any concerns raised by local citizens over the duration of the Project's development.

*Website*

A website for the Project has been developed and can be accessed at: http://www.scotianwindfields.ca/wind/projects/hardwood-lands-community-wind-project. The website provides an overview of the Project and wind technology, shares information on upcoming events, and Project news, and provides answers to frequently asked questions as well as a forum for interested public to pose questions to the Project team. The website is dedicated to providing information related to the Project and is intended for use by the general public and local residents to stay up to date on all aspects of project development. In the interest of transparency and public engagement, the Project team continues to add information to the website as it becomes available.

*Aboriginal Engagement*

Throughout the Project development, the Proponent has maintained open communication with the Sipekne'katik community, providing project updates, general wind energy information and discussing impacts and benefits for the community. Open house events for the residents of Indian Brook and the band members of Sipekne'katik were held in February 2015 and July 2015 to provide an overview of the Project and encourage feedback from community members. The Proponent provided a bus tour for the Sipekne'katik community on July 28, 2015 to the nearby Nine Mile River Community Wind Project site in order to demonstrate the intended Project. Discussions were also held with Council regarding the provision of a renewable energy feasibility study and an invitation to the Sipekne'katik band to act as part of the Community Liaison Committee (CLC) once developed. The CLC will be established in the Project community to provide an open line of communication between the Proponent and the community. A percentage of gross revenue from the Project will be distributed to the community through the CLC.

Throughout the development phase, the proponent was active in addressing particular concerns raised by community members, or councillors. Table 12.2 outlines such concerns, and provides applicable proponent responses.

**Table 12.2 Community Concerns and Proponent Responses**

| Concern | Response |
|---|---|
| The effect of the operational project on ground water quality and quantity. | • Case study details of a wind project located in a municipal watershed was provided as a part of letter dated Feb 19, 2015.<br>• Commitment to develop an Erosion and Sedimentation Control Plan in the EPP. |
| The noise levels of the operational turbines. | • Commitment to complete sound modeling to ensure conformance with NSE guidelines.<br>• A site tour of Nine Mile River Wind Project with chief, council and community to demonstrate noise of operational turbines. |
| The restriction of future development on Band owned parcel. | • Layout was adjusted to locate turbines beyond the municipal setback requirement. |

Correspondence and open house materials presented to the Sipekne'katik band and community are provided in Appendix K.

## 13.0 EFFECTS ASSESSMENT

Based on the discussion in Section 7, the following VECs have been identified for additional assessment:

- SOCI;
- Avifauna; and
- Bats.

To ensure all relevant issues and concerns related to the proposed Project are identified, an interaction matrix was used to evaluate the interactions between the Project phases and the VECs (Table 13.1). The potential for accidents and malfunctions is also considered for each Project phase.

**Table 13.1: Interaction Matrix**

| Project Phases/Activities | SOCI | Avifauna | Bats |
|---|---|---|---|
| **Site Preparation and Construction** | | | |
| Land Surveys for Placement of Roads, Turbines and Associated Works | | | |
| Geotechnical Investigations | X | X | |
| Placement of Sedimentation and Erosion Control Measures | | | |
| Clearing of Trees and Grubbing Areas for Construction | X | X | X |
| Access Road Upgrading and Construction | X | X | X |

| Project Phases/Activities | SOCI | Avifauna | Bats |
|---|---|---|---|
| **Site Preparation and Construction** | | | |
| Laydown Area and Turbine Pad Construction | X | X | X |
| Transportation of Turbine Components | | | |
| Turbine Assembly | X | X | X |
| Grid Connection | | | |
| Removal of Temporary Works and Site Restoration | X | | |
| Commissioning | | | |
| **Operation & Maintenance** | | | |
| General Operation and Maintenance | X | X | X |
| Vegetation Management | | X | |
| **Decommissioning** | | | |
| Dismantling and Removal of Turbines from Study area | X | X | X |
| Removal of Turbine Foundations to Below Grade and Reinstatement of Topsoil | X | X | X |
| Removal of On-site Roads and Reinstatement of Lands | X | X | X |
| Removal and Disposal of Collection System, Conductor and Poles | X | X | X |
| Removal of All Other Equipment and Stabilization of Lands | X | X | X |

### 13.1 Environmental Effects Analysis Methodology

The completion of the environmental effects analysis involves consideration of the following elements:

- Description of potential negative environmental effects;
- Mitigation measures;
- Residual effects;
- Significance of residual environmental effects; and
- Monitoring or follow up programs.

This EA is structured to include proposed mitigation to reduce or eliminate potential adverse environmental effects. The determination of significance of adverse environmental effects is based on post-mitigation (residual) effects, rather than unmitigated potential effects. The significance of residual effects of the Project will be determined using the criteria, based on federal and provincial EA guidance (Table 13.2).

The expectation for, and significance of, residual effects determines the need for a monitoring and/or follow-up program.

**Table 13.2: Criteria for Identification and Definition of Environmental Impacts**

| Attribute | Options | Definition |
|---|---|---|
| Scope (Geographic Extent) | Local | Effect restricted to area within 1 km of the Study area |
| | Regional | Effect extends up to several km from the Study area |
| | Provincial | Effect extends throughout Nova Scotia |
| Duration | Short-term | Effects last for less than 1 year |
| | Medium-term | Effects last for 1 to 10 years |
| | Long-term | Effects last for greater than 10 years |
| Frequency | Once | Occurs only once |
| | Intermittent | Occurs occasionally at irregular intervals |
| | Continuous | Occurs on a regular basis and regular intervals |
| Magnitude | Negligible | No measurable change from background in the population or resource; or in the case of air, soil, or water quality, if the parameter remains less than the standard, guideline, or objective |
| | Low | Effect causes <1% change in the population or resource (where possible the population or resource base is defined in quantitative terms) |
| | Moderate | Effect causes 1 to 10% change in the population or resource |
| | High | Effect causes >10% change in population in resource |

The potential level of impact after mitigation measures are applied (e.g. residual effects) was identified based on the criteria and definitions provided in the NRCan document, "Environmental Impact Statement Guidelines for Screenings of Inland Wind Farms Under the Canadian Environmental Assessment Act" (NRCan 2003), as shown in Table 13.3.

**Table 13.3: Definition of Significant Residual Environmental Impact**

| Significance Level | Definition |
|---|---|
| High | Potential effect could threaten sustainability of the resource and should be considered a management concern. Research, monitoring, and/or recovery initiatives should be considered. |
| Medium | Potential effect could result in a decline in resource to lower-than-baseline but stable levels in the Study area after project closure and into the foreseeable future. Regional management actions such as research, monitoring, and/or recovery initiatives may be required. |
| Low | Potential effect may result in slight decline in resource in Study area during life of the project. Research, monitoring, and/or recovery initiatives would not normally be required. |
| Minimal/None | Potential effect may result in slight decline in resource in Study area during construction phase, but should return to baseline levels. |

## 13.2 Effects Assessment

Effects and mitigation measures related to each VEC are described below. Potential effects of the Project on the identified VECs are further analyzed in Tables 13.4 to 13.6 to identify and evaluate the significance of residual effects, based on the criteria listed above. Mitigation measures are also summarized.

13.2.1 Species of Conservation Interest

It is widely acknowledged that wind energy development can have a suite of potential direct and indirect effects on terrestrial fauna (Arnett *et al.* 2007; Kuvlesky, Jr. *et al.* 2007). General construction activities within and adjacent to watercourses and water bodies, can affect aquatic fauna and habitat. The extent and magnitude of these effects can vary with the stage of the Project but are present for all phases.

During the site preparation and construction phases of wind energy projects, potential effects to SOCI will be related to:

- sensory disturbance;
- habitat loss/alteration and/or fragmentation;
- effects to fish passage/migration and
- collision mortality.

*Sensory Disturbance*

Sensory disturbance to terrestrial fauna SOCI may occur from a variety of anthropogenic sources. For wind energy projects, disturbance effects are typically most significant during the construction phase, which involves increased presence of on-site personnel, vehicles, and heavy equipment (Helldin *et al.* 2012). Avoidance effects related to the construction phase have been reported for large mammals in two cases [e.g., Rocky Mountain Elk (*Cervus elaphus*) (Walter *et al.* 2006) and wolves (Álvares *et al.* 2011)], but in both cases the effects were temporary and subsided once construction was completed. It is expected that avoidance or displacement effects related to the site preparation and construction phases of the Project will not persist in the long-term.

It is also important to distinguish wind energy facility roads from high-use motorways in regards to sensory disturbance. Many of the documented effects of roads are related to avoidance due to traffic noise (Forman and Alexander 1998). The magnitude of such effects will be greatly reduced in the context of this wind energy development, as road traffic will be minimal (maintenance vehicles during operations) and limited.

Sensory disturbance during the operations and maintenance phase of the Project will be limited to the presence of on-site personnel conducting maintenance on Project infrastructure. Although literature on the topic is sparse, most evidence suggests that in general, terrestrial fauna are not adversely affected by operating wind turbines. It was determined that a population of elk in Oklahoma, for example, did not change their home range or experience reduced dietary quality within an operating wind power development (Walter *et al.* 2006). It is therefore unlikely that ungulates in the Study area, including White-tailed deer and potentially Mainland moose, will be affected. Likewise, small mammal communities at wind energy developments do not appear to be affected by turbine operations (de Lucas *et al.* 2005).

Effects to terrestrial fauna SOCI during the decommissioning phase of the Project will be similar to those experienced during the site preparation/construction phase (Helldin *et al.* 2012). Namely, sensory disturbance due to the increased presence of on-site personnel and the operation of heavy equipment may elicit temporary displacement/avoidance behaviours in mobile wildlife species.

Sensory disturbance impacts related to aquatic SOCI are not expected.

*Habitat Loss/Alteration*

Although the permanent footprint of a wind energy facility is generally estimated to be just 5 to 10% of the Study area (Arnett *et al.* 2007), there is the potential that significant habitat elements for certain terrestrial fauna SOCI may be altered/removed during site preparation activities, such as clearing, for turbine pads and access roads. The effects may be negligible if the habitat is in adequate supply in the general area surrounding the Study area (Arnett *et al.* 2007). The permanent disturbance area of the Project footprint represents 2.2% of the total Study area and much of this area is previously cleared area. The remaining intact forest stands are similar in age and composition to those in areas nearby, and forest stands of similar age and composition are prominent in nearby areas, the effects of habitat loss/alteration on terrestrial fauna SOCI will be minimized.

The construction of roads has a variety of well-documented, adverse effects including fragmentation of otherwise continuous segments of suitable habitat and restriction of movement of individuals between habitat patches (Trombulak and Frissell 2000, Eigenbrod *et al.* 2008 ), avoidance of adjacent habitat, increased access for hunters/poachers (Brody and Pelton 1989; Helldin *et al.* 2012), which can potentially result in increased mortality of certain wildlife species while also facilitating the expansion of interspecific competitors (Beazley *et al.* 2004) and exotic species (Trombulak and Frissell 2000). The road network for this Project will have a small footprint due to the overall size of the Project, which will significantly reduce the magnitude of any potential effects.

Effects to aquatic SOCI and its habitat during the site preparation and construction phases of the Project are primarily related to the construction and upgrading of access roads and the installation of crossing structures where roads intercept watercourses. Vegetation clearing along banks and land adjacent to watercourses could result in significant habitat degradation for fish and other aquatic biota if appropriate mitigation techniques are not employed. The alteration or removal of riparian vegetation may result in bank instability and erosion, leading to sedimentation of the water body and degradation of water quality.

Removal of overhanging vegetation from stream banks decreases shade/cover for fish resulting in increased vulnerability to predators and potentially increased localized water temperatures. Likewise, the removal of instream cover, such as coarse woody material or edge habitat (e.g. undercut banks) may have a similar effect on fish habitat. Coarse woody material also provides habitat for aquatic invertebrates, increasing food availability for fish. Alterations to channel morphology and interference with sediment transport may also lead to fish habitat modification/degradation (MTO 2009). Many effects to fish habitat can be mitigated through thoughtful planning and the incorporation of standard mitigation and BMPs (refer to Section 4).

The potential effects of the Project on fauna SOCI habitat during the operational phase are likely to be minimal. Aside from surface disturbance and the possible removal of regenerated vegetation, decommissioning will not include additional habitat loss/alteration. Therefore, the effects to fauna SOCI during this phase of the Project are not expected to be significant in magnitude nor long-term in duration.

*Effects to Passage/Migration*

Lack of consideration for fish migration/passage during the design of crossing structures and/or appropriate installation techniques may also lead to a number of effects on fish SOCI. These effects typically manifest as modifications or barriers to fish movement through the affected watercourse. Barriers to fish passage include velocity barriers, alteration of the stream gradient and insufficient flow/depth (MTO 2009).

Many effects to fish passage can be mitigated through thoughtful planning and the incorporation of standard mitigation and BMPs (refer to Section 4.0).

*Mortality*

Increased vehicle and heavy equipment traffic during all phases of the Project may result in collisions with terrestrial wildlife. It is expected that these collision events will be minimized by the implementation of safe work practices (e.g., strict adherence to speed limits, obeying all warning signs). Collisions, should they occur, will be infrequent and will not have a significant effect on population levels.

*General Mitigation Measures*

The following specific mitigative measures will be implemented to avoid and mitigate any potential effects on fauna and aquatic SOCI:

- Minimization of the footprint of physical disturbance by:
  - Designing and constructing access roads to avoid environmentally sensitive habitats, where possible, and ensuring the most efficient means to access turbines is achieved.
  - Maintenance of a buffer around sensitive habitats such as watercourses and wetlands, where possible.
  - Minimizing routine vegetation clearing:
    - clearing of land only if required for construction area footprint;
    - restoration of areas of disturbance where possible, post construction; and
    - siting construction compounds in/on non-sensitive areas.
  - Completion of a comprehensive schedule and determination of timelines to efficiently complete Project activities within the shortest time frames possible.

*Species-Specific Mitigation*
Desktop and field analyses for terrestrial and aquatic fauna SOCI revealed several species that have the potential to occur at the Study area. Addressing the potential effects from the Project on these species will require species-specific mitigation techniques, as described below:

Atlantic salmon, American eel, and Striped bass:
- The siting, design, installation and decommissioning of all crossing structures will incorporate on-going consultation with DFO, and NSE, and will avoid areas of sensitive habitat and ensure that fish passage is maintained.
- Additional mitigation for the protection of fish habitat will be ensured through the NS watercourse alteration permitting process.

Mainland moose:
- Pre-construction snow-tracking and pellet count surveys revealed no evidence of Mainland moose at the Study area. The EPP for the Project will require Project personnel to report any Mainland moose sightings to NSDNR.

Wood turtle:
- Based on recommendations outlined in the document 'Protecting and Conserving Wood Turtles: A Stewardship Plan for Nova Scotia' (MacGregor and Elderkin 2003), and the NS Transportation and Public Works Generic Environmental Protection Plan for the Construction of 100 Series Highways (NSTPW 2007), the following general procedures will be implemented to ensure the protection of Wood turtles:
    - Any turtles found (identification booklet to be provided to site personnel) will be relocated outside of the construction zone, along the same habitat corridor in the direction of travel the turtle was originally oriented and preferably upstream within the same riparian habitat corridor (< 400 m).
    - Any sightings of wood turtle will be reported to the NS Wood Turtle Recovery Team at 1-866-727-3447
    - Adequate, permanent buffers of vegetation will be left around important Wood turtle habitat. If necessary (e.g., in the event that Wood turtles are confirmed at the site), an appropriate mixture of shrubs and trees shall be planted to create a buffer.

Monarch:
- Should congregations of Monarchs be found at the Study area, Project activities in the area should cease until the migrating group has left the Study area. This is most likely to occur in late summer, prior to the fall migration.

13.2.2 Avifauna
The effects of a wind farm on birds are variable and depend on factors such as the development design, topography of the area, habitats affected, and the bird community in the wind farm area (Drewitt and Langston 2006). Although some effects are related to construction (e.g. habitat alteration), most potential effects on avifauna are mainly related to operation and may include:

- habitat loss/alteration;
- mortality resulting from direct collision; and
- sensory disturbance.

*Habitat Loss/Alteration*
Habitat alterations resulting from the site preparation and construction phases of wind energy developments have the potential to affect bird populations either directly or indirectly (Arnett *et al.* 2007). However, effects are considered less severe than those from other energy extraction developments such as oil and gas exploration because the disturbance is limited to the construction footprint (turbine pads, roads, associated buildings, etc.) (Kuvlesky *et al.* 2007). The magnitude of these effects, however, may be increased if the disturbed area contains sensitive plant communities that provide important habitat to local bird populations (Kuvlesky *et al.* 2007). Altered landscapes can potentially lead to displacement of species with sensitive habitat requirements (Arnett *et al.* 2007). Site clearing and preparation may involve the removal of key habitat features, such as standing deadwood, mature trees, or shrub cover required as foraging and/or breeding habitat for certain bird species.

Proposed project infrastructure coincides with small areas of mature forest cover, notably a hardwood stand in northern portions of the Study area, and a small portion of softwood habitat surrounding the proposed road in southern portions of the Study area. As well, shrub cover habitat (in the form of regenerating softwood) occurs at the location of turbine 1.

Surface disturbance is greater in the construction phase than in the operational phase because large right of ways need to be created to accommodate large construction equipment and transport vehicles (Arnett *et al.* 2007). It can therefore be assumed that impacts associated from direct habitat alteration are greatest in the short-term, except when key habitat features are permanently removed. Depending on the availability of nearby alternative habitat, habitat alterations associated with wind energy infrastructure may have detrimental effects on local bird populations. The landscape of the Study area and immediately surrounding area features forest stands that would appear to provide large expanses of suitable alternative habitat to bird species displaced due to habitat alteration at the Study area.

*Collision Mortality*
The most overt potential effect of the Project on birds is direct mortality resulting from collision with Project infrastructure, namely turbine blades, during the operational phase. Most evidence suggests that mortality levels resulting from turbine collisions are low (EC *et al.* 2012) although many studies do not adequately incorporate carcass removal by scavengers into mortality estimates. In a review of night migrant fatalities at wind farm sites in North America, Kerlinger *et al.* (2010) found fatality rates of less than one bird/turbine/year to approximately seven birds/turbine/year, even with corrections made for scavenger removal and searcher efficiency. Furthermore, multi-bird fatality events, in which more than three birds were killed at a turbine site in a single night, were found to be rare and may have been related to lighting and/or inclement weather (Kerlinger *et al.* 2010).

Evidence cited by Erickson *et al.* (2001), NAS (2007), and Manville (2009) in NWCC (2010), demonstrates that although only general estimates are available, the number of birds killed at wind energy developments is substantially lower than the estimated annual bird casualty rates from a variety of other anthropogenic factors including vehicles, buildings, and windows, power transmission lines, communication towers, toxic chemicals (including pesticides), and feral and domestic cats (NWCC 2010). In summary, available research suggests that the probability of large-scale fatality events occurring at wind farms is extremely low (Kerlinger *et al.* 2010).

Collision risk is greater on or near areas used by large numbers of foraging or roosting birds or in important migratory flyways (Drewitt and Langston 2006). In Canada, passerines account for 70% of all fatalities, with most occurring during the fall migration season (EC *et al.* 2012). The probability of raptor collision with wind turbines depends on the species, turbine height, and local topography, i.e. the higher the turbine is above sea-level, the greater risk it poses to raptors (de Lucas *et al.* 2008). Collision risk can therefore be greatly reduced by incorporating knowledge of avifauna into the design and placement of wind power infrastructure. Four (4) raptor species, constituted of nine (9) individual birds were observed at the Project site during bird surveys conducted from September 2014 through July, 2015. None of these species were confirmed as breeders at or near the Project site. This abundance and diversity of raptor species is relatively low, indicating the Project site is not heavily used as nesting or foraging habitat by this guild. Additionally, topography across the Project site is relatively flat, with variation in elevation of only 20 m, providing relatively little opportunity to micro-site turbines in areas of lower elevation. All the turbines are located between 80 m and 85 m above sea level, so no one turbine should provide a greater risk to raptors than another.

*Sensory Disturbance*

Sensory disturbance to birds can occur during the construction, operational, and decommissioning phases of wind power projects, and can be caused by the increased presence of personnel, vehicle movement, operation of heavy equipment, and the operation of the turbines themselves (Drewitt and Langston 2006). It is thought that disturbance to birds may have a greater population impact than collisions, although research is lacking in this area (Kingsley and Whittam 2005). Primary concerns with regards to sensory disturbance are related to displacement and potential effects on key physiological processes such as breeding.

Some studies have shown that birds will exhibit avoidance behaviours post-construction, leading to a variable degree of displacement from previously used habitat (reviewed in Drewitt and Langston 2006) which essentially amounts to habitat loss. In most cases, such displacement is on the scale of tens to hundreds of metres, which can lead to localized changes in bird densities (Leddy *et al.*1999; Pearce-Higgins *et al.* 2009). However, while birds may avoid specific sites, the evidence does not suggest that birds abandon the general area as a whole. Other research indicates that the presence of wind turbines has no effect on the distribution of the bird community (Devereux *et al.* 2008) and birds may habituate to the presence of operating wind turbines (Madsen and Boertmann 2008). The tolerance to Project related disturbance may be species specific but may also be related to the availability of alternative habitat (Kingsley and Whittam 2005). Thus, careful site selection of turbines to avoid any unique habitat types will alleviate some disturbance and/or displacement effects, especially during the operational phase of the Project.

*General Mitigation Measures*
The following mitigative measures will be implemented to avoid and mitigate any potential effects on avifauna:

- Where possible, clearing of site vegetation will be conducted outside of the breeding and nesting season for most bird species (May 1 to August 31). If this is not possible, a mitigation plan will be developed in consultation with NSDNR and CWS prior to clearing activities.
- Use of lighting during construction will be limited to minimum levels.
- Use of lighting on turbine hubs and blades will be limited to minimum levels while still meeting requirements of Transport Canada.
- There will be no general lighting at the Study area. Lighting will only be used when technicians are working on-site.
- Where possible, placement of Project infrastructure in habitats significant to bird species (as identified during avian surveys) will be avoided. These include wetlands, mature forests, and areas with large, hollow trees.
- Post-construction monitoring will be implemented under direction from NSE and in consultation with CWS and NSDNR to monitor for significant mortality trends.

*Species-Specific Mitigation*
Desktop and field analyses for avifauna SOCI revealed four species listed under either *SARA* or NS *ESA* that have the potential to occur at the Study area. Addressing the potential effects from the Project on these species will require species-specific mitigation techniques, as described below:

Canada Warbler:

- Project activities will avoid and/or minimize disturbance to Canada Warbler nesting habitat, including mature forest habitats with well-developed shrub layers and wetland habitats, and especially treed and shrub swamps.
- An increased buffer distance will be maintained between turbine locations and delineated wetland edges where evidence of breeding was identified during surveys.
- A post-construction monitoring program for Canada Warblers has been developed and will be implemented within the appropriate timing window once turbines are operational. Potential changes to Canada Warbler presence/absence and behaviour will be evaluated (Appendix G).

Common Nighthawk

- Project activities will avoid and/or minimize disturbance to Common Nighthawk nesting habitat including rock barrens, peat bogs, blueberry fields, exposed forest floors, cleared areas, and existing logging roads.

Eastern Wood-Pewee:

- Project activities will avoid and/or minimize disturbance to Eastern Wood-Pewee nesting habitat, including areas of low canopy cover, near or within large deciduous or mixed wood forest stands.

Olive-sided Flycatcher:

- Project activities will avoid and/or minimize disturbance to Olive-sided Flycatcher resources and nesting habitat, including tall trees or snags within clearings (required for perching and foraging), especially near wetlands or edges of mature coniferous forest stands.

13.2.3 Bats

The installation of wind turbines has the potential to affect bats both directly and indirectly (Arnett *et al.* 2007). Although some effects are related to construction (e.g. habitat alteration), most potential effects on bats are mainly related to operation and may include:

- habitat loss/alteration;
- mortality resulting from direct collision and/or barotrauma; and
- sensory disturbance.

The significance of these effects at the population level depends on a number of biotic and abiotic variables, including the number of individuals affected and the stability of the population, season, physiologic condition of the individuals affected, and weather factors.

*Habitat Loss/Alteration*

Habitat alterations, including vegetation clearing and soil disruption (NRC 2007) resulting from the site preparation and construction phases, may affect bats (Arnett *et al.* 2007).

Some studies, however, suggest that habitat changes related to wind power developments may in fact create benefits to bats by increasing cleared areas and creating access roads, both of which can be used by bats as foraging habitat (as cited in Arnett *et al.* 2007; Kunz *et al.* 2007a). In relation to this, small-scale disturbances, including creating small cutblocks or small scale access roads through forested habitat, have been shown to stimulate an increase in bat activity relative to previous years (Grindal and Brigham 1998). It is important to note, however, that increased edge habitat due to forest clearing may subsequently increase the risk of mortality by virtue of attracting bats to the area of the operating turbine (Kunz *et al.* 2007b).

*Mortality*

Mortality of bats is a potential effect during the operational phase of wind energy projects, Necropsy of recovered carcasses found that the cause of death for bats killed at wind-energy facilities is an indiscernible combination of direct collision with the turbine blades and barotrauma (Grodsky *et al.* 2011), although more recent pathological research has found that traumatic injury is the major cause of bat mortality at wind farms and that post-mortem artifacts may manifest themselves as pulmonary barotrauma lesions (Rollins *et al.* 2012). Barotrauma is characterized by a drop in atmospheric pressure along the top of a rotating turbine blade, which causes thoracic, abdominal, and pulmonary injury to bats when passing through the low pressure area (Baerwald *et al.* 2008).

Much of the established literature has not attempted to elucidate the causes of bat mortality but has instead reported on the magnitude of mortalities. In Canada, EC reports that bat fatalities outnumber bird fatalities (EC *et al.* 2012). This causes concern as bats are long-lived and have low reproductive rates (Arnett *et al.* 2007).

Research suggests that migratory tree-roosting species suffer the highest fatalities at wind farms (Kunz *et al.* 2007a; Kuvlesky *et al.* 2007; Cryan and Barclay 2009), although deaths of Tri-colored bats constituted 25.4% of total bat fatalities at wind facilities in the eastern United States (as cited in Arnett *et al.* 2007). Migratory species, including Hoary bat, Eastern red bat, and Silver-haired bat, accounted for 71% of 2,270 bat fatalities recorded at wind energy facilities across Canada between 2006 and 2010 (EC *et al.* 2012). Most bat fatalities are reported in the late summer months (Johnson 2005) coinciding with the start of swarming and autumn migration (Arnett *et al.* 2007: EC *et al.* 2012). Periods of high mortality may therefore be linked with the timing of large-scale insect migrations when bats feed at altitudes consistent with wind turbine heights (Rydell *et al.* 2010). It has been found that bat fatalities increase exponentially with wind tower height, with turbine towers 65 m or taller having the highest fatality rates (Barclay *et al.* 2007). This hypothesis is also supported by the findings of Horn *et al.* (2008), who reported that bats were not being struck by turbine blades when flying in a straight line en route to another destination, but were struck while foraging in and around the rotor-swept zone of the turbine.

Temporal variation in bat activity and subsequent fatality rates can be influenced by weather variables, as well as the characteristics of the facility (Baerwald and Barclay 2011). Although bats exhibit species-specific responses to environmental variables (Baerwald and Barclay 2011), in general they appear to be more active when wind speeds are low, which increases the risk of collisions with rotating turbine blades (Arnett *et al.* 2007) and mortality resulting from barotrauma.

*Sensory Disturbance*

Increased human presence may also disturb roosting bats (Arnett *et al.* 2007), but it is unknown if this disturbance is sufficient to disrupt normal behaviour or physiology. Sensory disturbance to bats is most likely during the site preparation/construction and decommissioning phase of the Project, during which the presence of on-site personnel and equipment will be the highest. During hibernation, bats are sensitive to human presence, and human intrusion into hibernacula can lead to increased arousals leading to a premature depletion of fat reserves (Thomas 1995). Siting wind-energy facilities away from hibernacula is therefore recommended in the design phases of these projects.

It is unknown if noise associated with the operational phase of wind energy projects has any measureable effect on bats, although it is thought that bats may become acoustically disoriented by the low-frequency noise emitted from rotating turbines (Kunz *et al.* 2007a). Bats have been shown, experimentally, to avoid foraging in areas with intense, broadband noise (Schaub *et al.* 2008), however this research was not conducted in the context of wind-energy development and other studies indicate that bats have been shown to forage in close proximity to operational turbines (Horn *et al.* 2008).

*General Mitigation Measures*

The following specific mitigative measures will be implemented to avoid and mitigate any potential effects on bats:

- Use of lighting during construction and on turbine hubs and blades will be limited to minimum levels while still meeting requirements of Transport Canada.
- Where possible, placement of Project infrastructure in or directly adjacent to habitats significant to bat species will be avoided. These include hibernacula, wetlands, and lands directly adjacent to open bodies of water.
- Post-construction monitoring will be implemented under direction from NSE and in consultation with CWS and NSDNR to monitor for significant mortality trends.

## 13.3 Environmental Effects Analysis

The following tables (Tables 13.4 to 13.6) identify and evaluate the significance of residual effects for each phase of the Project on each VEC. Accidents and malfunctions are also analyzed. As most of the mitigation is the same for avifauna and bats, these VECs are considered together in order to decrease repetition.

**Table 13.4: Environmental Effects Analysis – Construction Phase**

| Environmental Component (VEC) | Potential Effect | Mitigation Summary | Significance Criteria | Residual Effects | Significance of Residual Effect |
|---|---|---|---|---|---|
| SOCI | • Sensory disturbance<br>• Habitat loss/alteration and/or fragmentation.<br>• Effects to fish passage/migration.<br>• Mortality. | *General Mitigation Measures*<br>• Implementation of the EPP.<br>• Minimize of the footprint of physical disturbance.<br>• Avoid sensitive habitats during Project siting.<br>• Implementation of Safe Work Practices and strict adherence to speed limits and warning signs to avoid traffic collisions.<br>• Maintenance of a buffer around sensitive habitats such as watercourses and wetlands, wherever possible.<br>• Minimize vegetation clearing, wherever possible.<br>• Prompt restoration of cleared areas post-construction.<br>• Maintain efficient timelines to complete Project activities within the shortest amount of time possible.<br>• Herbicides will not be utilized in the removal of vegetation during construction activities.<br><br>*Species-specific Mitigation* | Scope: Local<br>Duration: Short-term<br>Frequency: Once<br>Magnitude: Negligible-Low | No residual effect anticipated | Not applicable |

| Environmental Component (VEC) | Potential Effect | Mitigation Summary | Significance Criteria | Residual Effects | Significance of Residual Effect |
|---|---|---|---|---|---|
| | | • The EPP for the Project will require Project personnel to report any Mainland moose sightings to NSDNR.<br>• Should large congregations of Monarchs be found at the Study area, Project activities in the area should cease until the migrating group has left the Study area.<br>• Leave adequate, permanent buffers of vegetation around important Wood turtle habitat.<br>• Report any Wood turtle sightings to the Wood Turtle Recovery Team.<br>• Relocate any wood turtles outside of the construction zone (as per guidelines outlined in MacGregor and Elderkin 2003, and NSTPW 2007).<br>• All watercourses on the Study area will be treated as salmonid bearing during all phases of the Project.<br>• All in-stream work will be conducted “in-the-dry” and adhere to timing windows (Atlantic salmon, striped bass and American eels).<br>• The siting, design, installation and decommissioning of all crossing structures will incorporate on-going consultation with DFO, and NSE, and will | | | |

| Environmental Component (VEC) | Potential Effect | Mitigation Summary | Significance Criteria | Residual Effects | Significance of Residual Effect |
|---|---|---|---|---|---|
| | | avoid areas of sensitive habitat and ensure that fish passage is maintained for Atlantic salmon, striped bass and American eels.<br>• Additional mitigation for the protection of fish habitat will be ensured through the NS watercourse alteration permitting process. | | | |
| Avifauna and Bats | • Habitat loss/Alteration<br>• Mortality<br>• Sensory disturbance. | • Implementation of the EPP.<br>• Conduct vegetation clearing outside of the breeding and nesting season for most bird species (May to August).<br>• If this is not possible, a mitigation plan will be developed in consultation with NSDNR and CWS prior to clearing activities.<br>• Limit the use of lighting during construction to minimum acceptable levels.<br>• Avoid placement of Project infrastructure in habitats significant to bird and bat species. These include wetlands, hibernacula, mature forests, land directly adjacent to open water and areas with large, hollow trees. | Scope: Local<br>Duration: Short-term<br>Frequency: Once<br>Magnitude: Low | No residual effect anticipated | Not applicable |

| Environmental Component (VEC) | Potential Effect | Mitigation Summary | Significance Criteria | Residual Effects | Significance of Residual Effect |
|---|---|---|---|---|---|
| Accidents and Malfunctions | • Accidental spill/release.<br>• Failure of erosion and sediment / control measures. | • Implementation of the EPP, including the spill prevention plan and contingency plans (as necessary). | Scope: Local<br>Duration: Short-term<br>Frequency: Once<br>Magnitude: Negligible-Low | No residual effect anticipated | Not applicable |

**Table 13.5: Environmental Effects Analysis – Operation/Maintenance Phase**

| Environmental Component (VEC) | Potential Effect | Mitigation Summary | Significance Criteria | Residual Effects | Significance of Residual Effect |
|---|---|---|---|---|---|
| SOCI | • Sensory Disturbance<br>• Collision Mortality | • Implementation of the EPP.<br>• Implementation of Safe Work Practices and strict adherence to speed limits and warning signs to avoid traffic collisions.<br>• Minimize road traffic to the extent possible.<br>• Implement efficient timelines to complete Project activities within the shortest possible time frame.<br>• To the extent possible, plan operation and maintenance activities to avoid sensitive habitats and minimize time on-site.<br>• Herbicides will not be utilized in the removal of vegetation during maintenance activities.<br><br>*Species-specific Mitigation*<br><br>• In-stream maintenance activities will be conducted “in-the-dry”, and adhere to timing windows (Atlantic salmon, striped bass, and American eels). | Scope: Local<br>Duration: Long-term<br>Frequency: Intermittent<br>Magnitude: Negligible | No residual effect anticipated | Not applicable |

| Environmental Component (VEC) | Potential Effect | Mitigation Summary | Significance Criteria | Residual Effects | Significance of Residual Effect |
|---|---|---|---|---|---|
| Avifauna and Bats | • Mortality from collision (avifauna and bats) or barotrauma (bats).<br>• Sensory disturbance. | • Implementation of the EPP.<br>• To the extent possible, plan operation and maintenance activities to minimize time on-site.<br>• Avoid routine vegetation clearing during breeding and nesting season.<br>• Avoid all unnecessary lighting at the Study area. Lighting will only be used when technicians are working on-site.<br>• Limit lighting on turbine hubs and blades to minimum levels while still meeting requirements of Transport Canada.<br>• Implement post-construction monitoring under direction of NSE and in consultation with CWS and NSDNR to monitor for significant mortality trends. | Scope: Local<br>Duration: Long-term<br>Frequency: Continuous<br>Magnitude: Low | It is expected that birds and bats will avoid the immediate area of the turbines (but not the Project site and surrounding area), which will reduce the number of bird collisions. Bird and bat fatalities due to turbine collisions are not expected to be significant. | Low-Medium |
| Accidents and Malfunctions | • Accidental release.<br>• Failure of erosion and sediment control measures. | • Implementation of the EPP, including the spill prevention plan and contingency plans (as necessary). | Scope: Local<br>Duration: Short-term<br>Frequency: Once<br>Magnitude: Negligible-Low | No residual effect anticipated | Not applicable |

**Table 13.6: Environmental Effects Analysis – Decommissioning Phase**

| Environmental Component (VEC) | Potential Effect | Mitigation Summary | Significance Criteria | Residual Effects | Significance of Residual Effect |
|---|---|---|---|---|---|
| SOCI | • Sensory Disturbance.<br>• Habitat alteration and/or degradation.<br>• Mortality. | • Implementation of the EPP.<br>• Minimize the footprint of physical disturbance to the extent possible.<br>• Avoid disturbing sensitive habitat during decommissioning.<br>• Prompt restoration of cleared areas post-construction.<br>• Maintain efficient timelines to complete Project activities within the shortest amount of time possible.<br>• Limit access to existing roads only.<br>• Avoidance of known significant habitat, where possible.<br>• Herbicides will not be utilized in the removal of vegetation during decommissioning activities.<br><br>*Species-specific Mitigation*<br>• In-stream decommissioning work will be conducted “in-the-dry” and adhere to timing windows (Atlantic salmon, striped bass, and American eels).<br>• The siting, design, installation, and decommissioning of all crossing structures will incorporate ongoing consultation with DFO, and NSE, and will | Scope: Local<br>Duration: Short-term<br>Frequency: Once<br>Magnitude: Negligible | No residual effect anticipated | Not applicable |

| Environmental Component (VEC) | Potential Effect | Mitigation Summary | Significance Criteria | Residual Effects | Significance of Residual Effect |
|---|---|---|---|---|---|
| | | avoid areas of sensitive habitat and ensure that fish passage is maintained for Atlantic salmon, striped bass and American eels.<br>• Stream banks will be promptly re-stabilized and re-vegetated post-decommissioning (Atlantic salmon, Striped bass, American eels). | | | |
| Avifauna and Bats | • Sensory disturbance. | • Implementation of the EPP.<br>• Limit access to existing roads only.<br>• Limit time on site.<br>• Avoid decommissioning activities during breeding/nesting season, to the extent possible.<br>• Restore vegetation promptly following decommissioning.<br>• Limit the use of lighting during decommissioning to minimum acceptable levels. | Scope: Local<br>Duration: Short-term<br>Frequency: Once<br>Magnitude: Negligible | No residual effect anticipated | Not applicable |
| Accidents and Malfunctions | • Accidental release.<br>• Failure of erosion and sediment control measures. | • Implementation of the EPP, including the spill prevention plan and contingency plans (as necessary). | Scope: Local<br>Duration: Short-term<br>Frequency: Once<br>Magnitude: Negligible-Low | No residual effect anticipated | Not applicable |

### 13.4 Follow-up Measures

A potential residual effect for avifauna and bats was noted in Table 13.5. The potential effect of collisions and/or fatalities to avifauna and bats will be addressed in post-construction monitoring programs that will be initiated during 2016 to assess the effects of the operation of the proposed wind farm.

During field studies conducted as part of the EA, the presence of Canada Warbler was observed in wetlands near the proposed turbines. Through subsequent consultations with appropriate government agencies the Proponents were requested to collect additional data with respect to Canada Warbler behaviour at the Project site to further the understanding of this endangered species' habitat affiliations and response to disturbance. Pre-construction surveys were completed at the site in July 2015, the results of which are provided in Appendix G. Surveys will be completed at the same locations during the appropriate timing window once turbines are operational and an interpretation and comparison of the pre and post construction observations will be provided. Potential changes to Canada Warbler presence/absence and behaviour will be evaluated.

## 14.0 EFFECTS OF THE ENVIRONMENT ON THE PROJECT

Environmental factors that have the potential to have damaging effects on wind turbines include:

- Extreme wind (typically associated with hurricanes);
- Hail;
- Ice storms/ ice formation;
- Heavy snow;
- Lightning; and
- Fire.

The primary mitigative measure employed during the construction and operation of the Project will be to educate and train site personnel. Environmental and safety orientations will be conducted prior to the start of construction and all staff will be informed of the potential effects of the environment on the Project. Staff responsible for the operation and maintenance of the Project will be trained on the design and operation of the turbine, including applicable operating procedures, safety protocols and evacuation plans.

Modern wind turbines are equipped with a number of mechanisms to reduce damage caused by extreme weather and are designed to shut down when certain thresholds are detected (CanWEA 2011). Further, best practices and industry standards will be applied to the operation of the Project to manage risks of damage from extreme events. Table 14.1 demonstrates potential effects resulting from environmental events and the mitigation associated with each.

**Table 14.1 Effects of Environmental Events and Associated Mitigation**

| Environmental Event | Effect | Mitigation |
|---|---|---|
| Hurricane/ Extreme winds | Damage to blades. | • Turbine design equipped to shut down. |
| Hail | Damage to blades. | • Turbine maintenance according to best practices and industry standards. |
| Ice storms | Ice formation.<br>Potential ice throw. | • Turbine design equipped to shut down.<br>• Appropriate safety protocol.<br>• Signage to indicate potential falling ice. |
| Heavy snow | Damage to turbines. | • Turbine design equipped to shut down. |
| Lightning strike | Potential fire during operation.<br>Damage to electrical systems. | • Turbine design equipped with built-in grounding system.<br>• Appropriate safety protocol. |
| **Environmental Event** | **Effect** | **Mitigation** |
| Fire | Fire during construction due to materials and machinery. | • Appropriate safety protocol.<br>• Fire prevention plan.<br>• Evacuation plan.<br>• Local training of first responders. |

## 15.0 CUMULATIVE EFFECTS ASSESSMENT

Concerns are often raised about the long-term changes that may occur not only as a result of a single action but of the combined effects of each successive action on the environment (Hegmann *et al.*1999).

The cumulative effects assessment focuses only on adverse effects of the Project remaining after the application of mitigation measures (e.g., only residual effects). For this Project, the only VECs identified to have a potential residual effect are avifauna and bats (i.e., collision mortality). Therefore, known or anticipated activities within a 20 km radius of the Study area were reviewed to identify the potential for cumulative effects on collision mortality for avifauna and bats.

A search for existing or proposed wind farm developments was completed within the 20 km radius of the Study area. The Nine Mile River Community Wind Project, a 4.0 MW project, and the North Beaverbank Community Wind Project, an 8.0 MW project (both within 20 km of the Study area), were commissioned in April, 2015 and March 2015 respectively, and have the potential to act cumulatively with this Project. These two projects are also relatively small in size and combined, the three Projects consist of nine turbines in total; therefore the potential for cumulative effects related to avifauna and bat mortality as a result of three Projects is considered not significant.

## 16.0 OTHER APPROVALS

In addition to the EA Approval, several other permits and/or approvals may be required prior to the start of construction (Table 16.1).

**Table 16.1: Future Approvals**

| Approval/Notification/Permit Required | Government Agency |
|---|---|
| **Municipal** | |
| Large Scale Wind Turbine (LWT) Development Approval | Municipality of the District of East Hants |
| **Provincial** | |
| EPP/Sediment and Erosion Control Plan | NSE |
| Watercourse Alteration Approval | NSE |
| Wetland Alteration Approval | NSE |
| Notification of Blasting (if required) | NSE |
| Work within Highway Right-of-Way (if required) | NSTIR |
| Access Permit | NSTIR |
| Use of Right-of-Way for Pole Lines | NSTIR |
| Electricity Standard Approval | NSDE |
| Elevator/Lift License | Nova Scotia Department of Labour and Advanced Education |
| Overweight/ Special Move Permit | Service Nova Scotia |
| **Federal** | |
| Blasting Near Watercourses Approval (if required) | DFO |
| Lighting design for navigational purposes | Transport Canada |
| Aeronautical Obstruction Clearance | NavCan |

## 17.0 CONCLUSIONS

In accordance with "A Proponent's Guide to Wind Power Projects: Guide for Preparing an Environmental Assessment" (NSE 2012a), the studies, regulatory assessments, and VEC evaluations described within this document have been considered both singularly and cumulatively.

The results indicate that there are no significant environmental concerns or effects that may result from the Project that cannot be effectively mitigated or monitored.

Best practices and standard mitigation methods will be implemented during all phases of the Project, to ensure methods and practices are comprehensive and are adhered to. Furthermore, an EPP will be developed and communicated to all employees working on the Project.

The proposed capacity of the three turbines (6 MW) will produce enough energy to power 1,728 households with local, clean renewable energy and will contribute to reaching Nova Scotia's renewable energy commitments.

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**Personal Communication**

M. Elderkin, personnel communications. June 13, 2012. Bat Monitoring.