5. Project Area Environmental Information

5.1 GENERAL SPATIAL SETTING FOR PROJECT

The proposed Project is located in the Nova Scotia Uplands Ecoregion and the Pictou/Antigonish Highlands Ecodistrict, as defined by the Nova Scotia Department of Natural Resources (Neily, Quigley, Benjamin and Stewart, 2003).

The Nova Scotia Uplands Ecoregion stretches from Cape Chignecto in Cumberland County to Kellys Mountain in Cape Breton. There are eight ecodistricts within this ecoregion, with average elevations of 150 to 300 m on both the mainland and Cape Breton Island.

The ecoregion is geologically diverse and complex with remnants of the Cretaceous peneplain surface, composed of metamorphic, intrusive and volcanic rocks of the Precambrian to Paleozoic eras. The lowlands within this ecoregion are underlain by Paleozoic sedimentary rocks. Several major faults border or transect this ecoregion, most notably the Cobequid-Chedabucto Fault zone and the Hollow Fault. The total area of the ecoregion is 9,862 km_2 or approximately 17.8% of the province (Neily et al., 2003).

5.2 NATURAL SUBREGION

The Nova Scotia Uplands Ecoregion is further subdivided into eight Ecodistricts. The Glen Dhu Wind Power Project exists in the Pictou/Antigonish Highlands Ecodistrict.

This ecodistrict has been described by Roland (1982) as an elevated triangle of resistant strata separating the Northumberland lowlands of Pictou County (530) from the lowlands of St.George's Bay (520). The highlands about the St. Mary's fault block to the south along the Chedabucto fault where the East River St. Mary's flows. This upland ecodistrict is crosscut by subsidiary faults trending north-south and northeast-southwest, creating many narrow valleys. The most notable fault is the Hollow Fault, which extends from Cape George to New Glasgow. The fault is marked by the 200 m scarp which has developed as a result of differential erosion. The total area of this ecodistrict is 1,310 km^2 or 13% of the ecoregion (Neily et al., 2003).

Roland (1982) and Davis and Browne (1986) describe the geology of this ecodistrict as being extremely complex. The rocks display strong metamorphism, folding and distortion. The underlying bedrock consists of Precambrian to Paleozoic sediments and volcanics, strongly deformed and metamorphosed, and intruded by pre-carboniferous granitic to gabbroic plutons. Much of the province's geological history can be viewed in this ecodistrict including ancient volcanoes and the 400- million-year-old fossils at Arisaig. The elevation is generally 210-245 m

above sea level and rises to 300 m at Eigg Mountain. Overall, the highlands summit to a rolling plateau best exemplified by The Keppoch, an area once extensively settled.

The dominant soils are sandy loams which are well drained and fairly stony. Other dominant soils include those derived from shales. Typical of the upland ecodistricts, freshwater accounts for only 0.54% or 702 hectares. The tolerant hardwood forests are especially notable on the crests and upper slopes of hills and larger hummocks. Otherwise, red spruce and hemlock are found on the lower slopes with black spruce occupying the imperfectly drained sites. Mixedwood, tolerant forests of beech, sugar maple, yellow birch, and red spruce with scattered hemlock grow on the steep slopes adjacent to the streams and rivers which flow from the highlands.

On the coarse textured soils derived from glacial outwash, usually found along the streams and rivers, pure stands of white pine will be found. Many of the old field white spruce stands occupy ecosections previously forested with upland hardwoods. Good examples of this occur at Rossfield and The Keppoch.

Climate

The hilly topography of the uplands creates microclimatic environments where sheltered and exposed conditions can vary the local weather, especially temperatures. Overall, summers tend to be warm and winters are long and cold. Average precipitation is between 1200 - 1500 mm, with 250 - 350 cm of snow. The greatest snowfall occurs on the Cobequid Hills and Cape Breton Hills (Shear Wind Inc., 2008)

Parks and Protected Areas

The Eigg Mountain - James River Wilderness Area lies to the east and northeast of the proposed sites north of the Trans-Canada Highway 104. The region of Eigg Mountain has excellent examples of old growth hardwood and mixed wood uplands. It is inhabited by moose, fisher and goshawk. The James River watershed is south of the Eigg Mountain area and is the water source for the Town of Antigonish. (Shear Wind Inc., 2008).

Arisaig Provincial Park lies to the north on the west coast of Cape George, with significant cliff outcrops along the shore that span a great deal of geologic time and include fossils. The park offers picnic sites and the opportunity to investigate the shore.

Beaver Mountain Provincial Park is located east of the proposed development sites to the south of Highway 104. The park offers camping sites, picnic sites, nature watching, and hiking, skiing, and snowshoe opportunities on trails that include a beaver pond.

Figure 16 (below) shows provincial parks and protected areas.

5.3 LAND USE

The following Table (10) displays the land use components and area (in hectares) of each component within the Project area:

Table 10. Calculations of Land Use

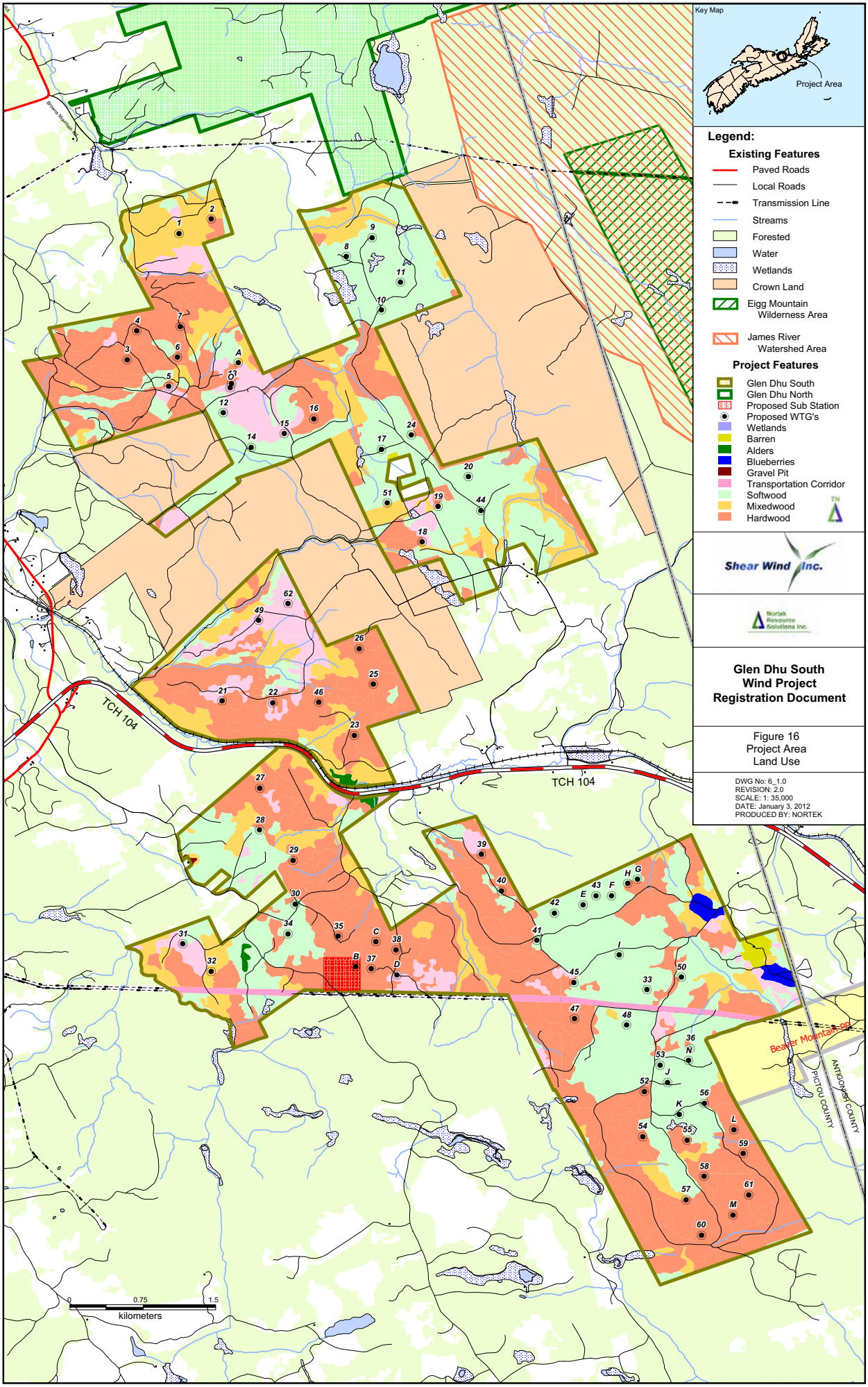
Land Use/Land Type	Area (hectares)	% of Project Area*
Lakes	0.7	0.0%
Agriculture/Pasture/Clearings	29	1.1%
Wetlands	15.6	0.6%
Clear-cuts	189.4	6.9%
Partial Cuts/Managed	61.7	2.2%
Roads	2.2	0.1%
Power line corridor	24.5	0.9%
Plantations	739.9	27.0%
Forested	1682.2	61.3%
TOTAL	2745.2	100%

Land use within the Project area is dominated by relatively undisturbed forest, with the exception of on-going forestry activities. The total area of forests accounts for 66% of the Project land base. The dominant commercial use on forested lands is timber harvesting, and at the time of assessment, nearly 10% of the lands had been either clear-cut or partially cut/managed, and 23% of the lands are being used for tree plantations, mostly red spruce.

Existing roads within the Project area account for 1.7% of existing disturbance and are associated with all land use types, including recreation (i.e. ATV/Snowmobile)

In areas without active timber harvesting, land use is dominated by recreation, camping, and use of seasonal cabins/accommodations. All-Terrain Vehicles (ATV) use is extensive within the Project area and there is a myriad of interconnected trails, stopping locations, and tracks suggesting continuous and extensive use. There are very few open water lakes, ponds and wetlands across the Project area.

In summary, approximately 88% of the land base is forested (either natural or plantations), and the remaining 12% has been altered by logging (clear cut or partial cuts). Figure 16 shows land use.


Key Map
Project Area
Legend:
Existing Features
Paved Roads
Local Roads
Transmission Line
Streams
Forested
Water
Wetlands
Crown Land
Eigg Mountain Wilderness Area
James River Watershed Area
Project Features
Glen Dhu South
Glen Dhu North
Proposed Sub Station
Proposed WTG's
Wetlands
Barren
Alders
Blueberries
Gravel Pit
Transportation Corridor
Softwood
Mixedwood
Hardwood
TN
Shear Wind Inc.
Nortek Resource Solutions Inc.
Glen Dhu South Wind Project Registration Document
Figure 16
Project Area
Land Use
DWG No: 6_1.0
REVISION: 2.0
SCALE: 1: 35,000
DATE: January 3, 2012
PRODUCED BY: NORTEK
TCH 104
TCH 104
Beaver Mountain Rd
PICTOU COUNTY
ANTIGONISH COUNTY
0
0.75
1.5
kilometers

5.4 PROJECT SPECIFIC VALUED ECOSYSTEM COMPONENTS

5.4.1 Soils

The Pictou/Antigonish Highlands, where this project is located, is underlain by a block of old crustal rocks that have been bisected by several faults. The average elevation of this Highland is about 245 metres. Candidate sites are located on Weavers Mountain and Browns Mountain, just north and south of Highway 104 (Shear Wind Inc., 2008).

5.4.2 Physiography and Topography

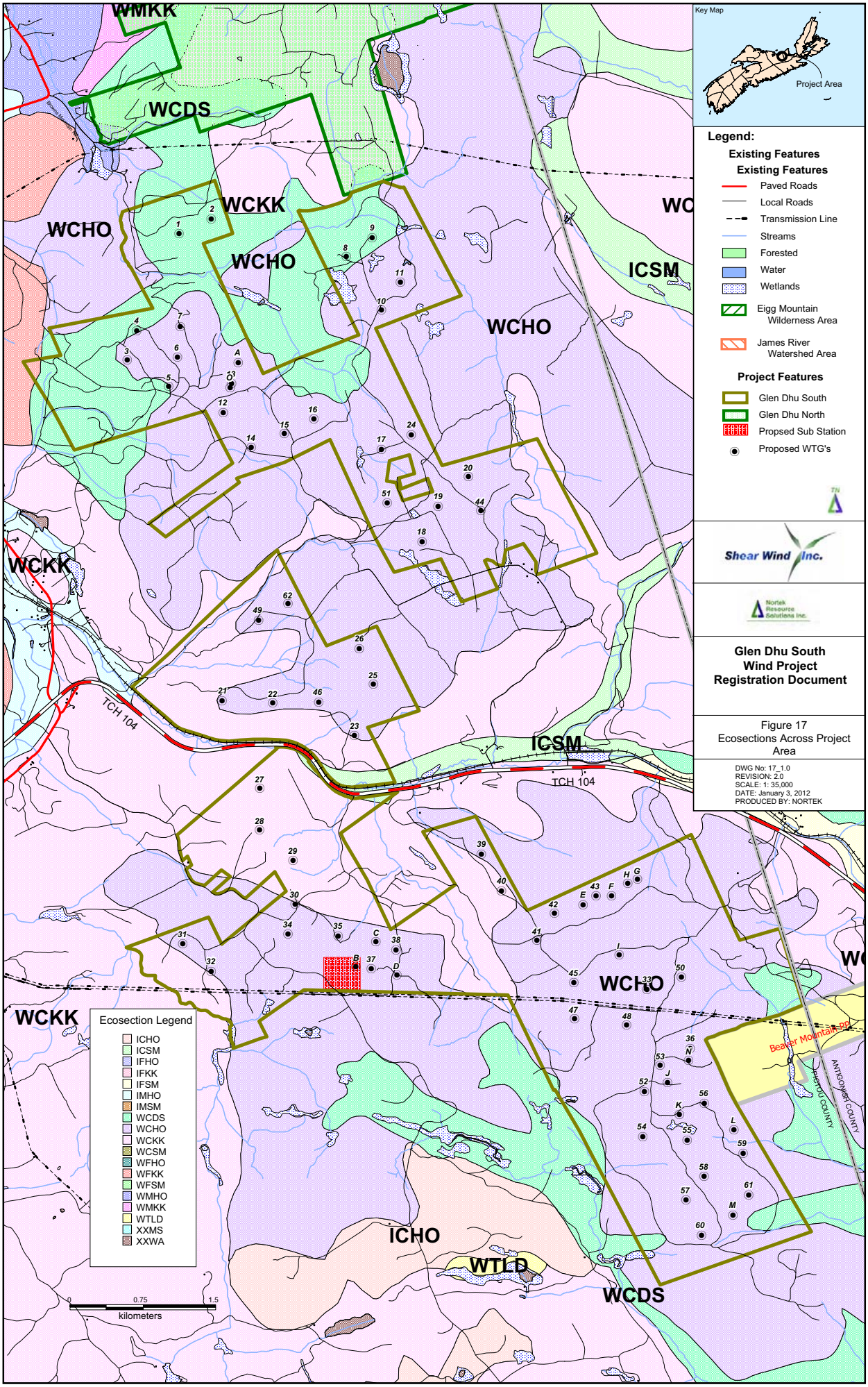
The topography features highland areas with elevations which range up to 250m above sea level intersected by numerous steep sided valleys and streams. Highland areas have perched wetlands of various sizes (typically less than 1 hectare) which form the headwaters of the streams.

5.4.3 Soils and Bedrock Geology

This Highland is underlain principally by soils of the Thom catena. These have developed from a dark grayish-brown sandy loam till derived from shales, gray conglomerate and metamorphic material. On the upland, these soils have an undulating topography that is dissected by steep slopes. Overall drainage is good due the porous nature of the soil. The stoniness of the soil is variable. On slopes and over the summer, the soil dries out. Poorly drained depressions occur where the topography combines or the subsoil is tight enough to restrict the movement of water.

The surficial geology of the wind farm generally consists of five formations. Bedrock is often encountered at the surface (outcropping), while soil cover consists of mainly stoney glacial till (ground moraine) deposits. These stoney glacial tills are generally found to be of a compact to dense relative density. Other formations in this area include hummocky ground moraine (compact gravel and sand), residuum (bedrock that has become mechanically and chemically altered due to weathering) and silty till plain (ground moraine) (Shear Wind Inc., 2008).

Soils across the site are mostly moderately coarse and well-drained. Most of the Project area exists on Ecosections WCHO (well drained, coarse textured soils on hummocky terrain), WCDS (well drained, coarse textured soils on steep slopes or canyons), and WCKK (well drained coarse soils on hilly terrain) (Neily et al., 2003).


WMKK
WCDS
WCKK
WCHO
WCHO
WCHO
WC
ICSM
WCKK
TCH 104
ICSM
TCH 104
WCHO
WCKK
ICHO
WTLD
WCDS
Beaver Mountain Rd
PICTOU COUNTY
ANTIGONISH COUNTY
Key Map
Project Area
Legend:
Existing Features
Existing Features
Paved Roads
Local Roads
Transmission Line
Streams
Forested
Water
Wetlands
Eigg Mountain Wilderness Area
James River Watershed Area
Project Features
Glen Dhu South
Glen Dhu North
Propsed Sub Station
Proposed WTG's
Shear Wind Inc.
Nortek Resource Solutions Inc.
Glen Dhu South Wind Project Registration Document
Figure 17
Ecosections Across Project Area
DWG No: 17_1.0
REVISION: 2.0
SCALE: 1: 35,000
DATE: January 3, 2012
PRODUCED BY: NORTEK
Ecosection Legend
ICHO
ICSM
IFHO
IFKK
IFSM
IMHO
IMSM
WCDS
WCHO
WCKK
WCSM
WFHO
WFKK
WFSM
WMHO
WMKK
WTLD
XXMS
XXWA
0
0.75
1.5
kilometers

5.4.4 Bedrock exposures

The bedrock geology of the Project site generally consists of two groups of bedrock; the Georgeville Group (3GG) and the Arisaig Group (LO-EDA), with the majority of the wind towers in the area of the Georgeville Group. Within these two bedrock groups are various formations.

Included in the Georgeville Group is the Maple Ridge Formation (3GR)- deep water mudstone, siltstone and wacke, James River Formation (3Gj)- conglomerate, wacke, mudstone, and minor basalt, Keppoch Formation (3Gk)- siltstone, slate, and wacke, and the South Rights Formation (3Gs)- deep water laminated mudstone and siltstone.

The Arasaig Group includes the Beechville Cove, Ross Brook, French River, McAdam, Moydart and Stonehouse Formations (SA)- marine siltstone, mudstone, shale, minor limestone, arkose and rhylite, and the Bears Brook Formation (OSAB)- sandstone, arkose, conglomerate, siltstone, basalt, and rhyolite. (Shear Wind Inc., 2008)

Effects of the Project

Three land actions were identified, which may contribute to effects on soils within the Project area. These actions are closely tied to those acting on vegetation. The three actions affecting soils may include:

1. Wind erosion of soils – risk relates to the potential for the soil to be mobilized by wind, particularly when disturbed through construction activities or a high degree of traffic. Loss of (or reduced) vegetative cover during activity can increase the risk for wind erosion. The highest risk for wind erosion tends to occur in areas with coarse-textured soils and sparse vegetative cover;

2. Water erosion along roads - risk relates to the potential for the soil to be mobilized by water, particularly when disturbed through construction activities or a high degree of traffic. The highest risk for water erosion tends to be associated with long or steep slopes (particularly those that are channeled or dissected), higher clay content and low vegetative cover. A combination of these factors tends to produce an extreme risk for water erosion. Compaction caused by excess traffic can increase overland flow, which can promote water erosion in channels or gullies;

3. Compaction along roads – caused by the continued use of equipment on designated minimal disturbance working areas. Compaction due to traffic will cause soil compaction on lease sites and along trails. Maintenance and operations traffic will contribute to this compaction over the life spans of the Project. There are a variety of methods available for compaction relief post operations which include aeration and subsoiling. Ultimately, reclamation will minimize the long-term effects.

Mitigation

In order to mitigate effects to soils, effective soil stripping, storage, replacement, and reclamation will occur. In addition to the construction methods proposed, the Environmental Protection Plan (EPP) developed for this Project (Appendix I) outlines numerous mitigation techniques to be used.

Finally, during, and following construction of the access roads and turbine locations, an effective erosion and sedimentation control plan will be implemented. The success of the erosion and sedimentation control plan implemented on the existing Glen Dhu WPP suggests that the methods proposed in this EPP are likely to be successful. As such it is felt that the effects to soils will be successfully mitigated.

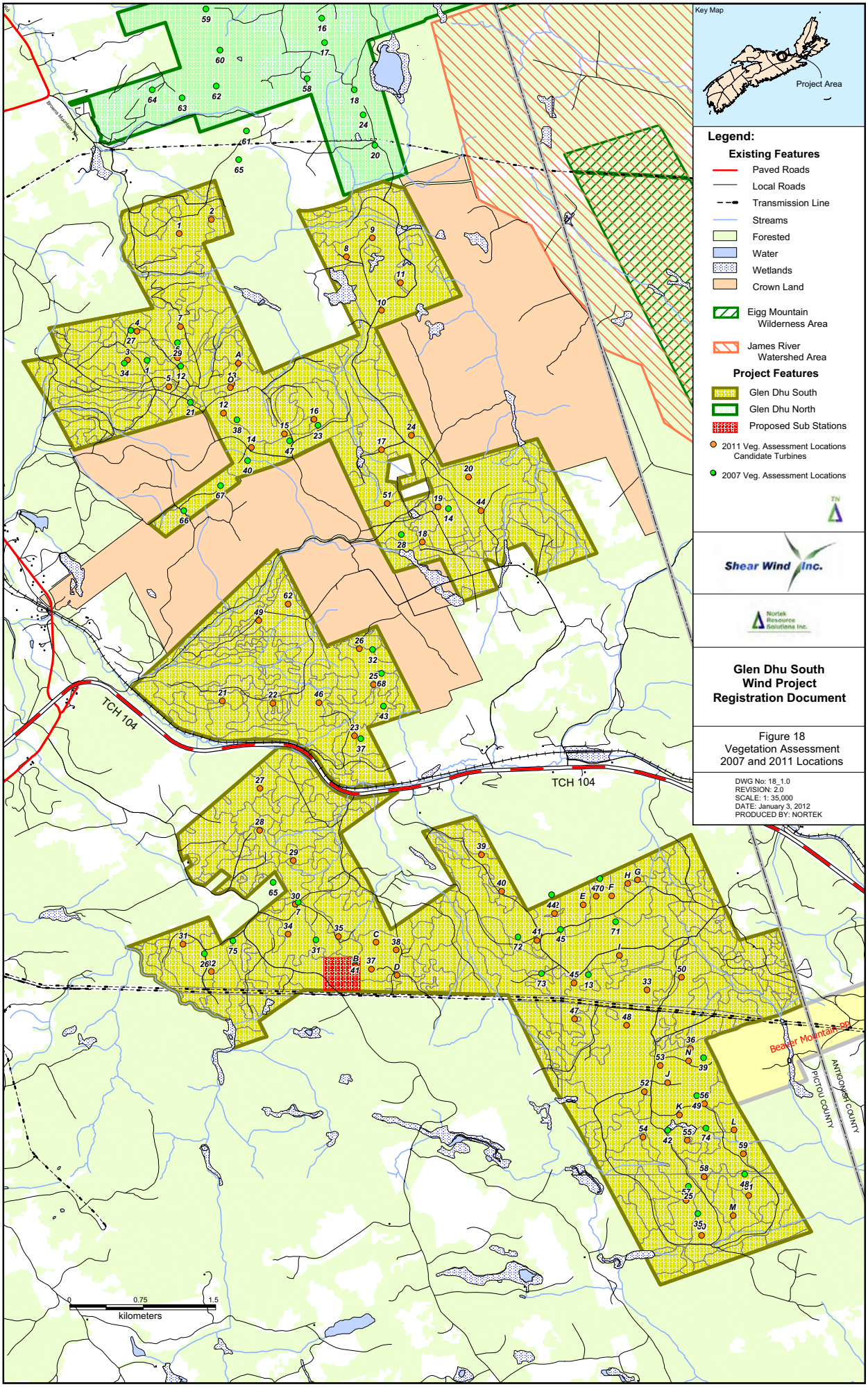
5.4.5 Vegetation

The forests that are naturally found on the plateaus of these uplands or highlands, as they are often called, are removed from the direct effects of the Atlantic Ocean. They are influenced by generally well-drained soils, abundant precipitation and relatively cooler temperatures. Yellow birch, sugar maple and beech were the predominant original tolerant hardwood forest on the uplands. Pockets of red spruce, white spruce, balsam fir and hemlock were scattered on the upland flats, and formed stands of conifers on the lower slopes and valley bottoms.

5.4.5.1 Vegetation Assessment 2007

A field inventory of the vascular plants was undertaken by Sean Blaney and David Mazerolle of the Atlantic Canada Conservation Data Centre (ACCDC) in 2007 as part of the environmental assessment process for the now operational Glen Dhu Wind Power Project (Blaney and Mazerolle, 2007). A full vascular plant list as a whole was compiled for the initial Project area from the scarp slope in the Pictou-Antigonish Highlands south to the Beaver Mountain area. This initial Project area includes the specific Project area for the proposed Glen Dhu South Wind Power Project. For this 2007 survey, a list of all rare species records found within 100 km of the Project area (based on ACCDC recorded observation data) was assembled prior to the survey being undertaken in June and July, 2007. All rare species were noted and descriptions of the plant communities within the Project area were given.

The field staff assessed 75 locations during the 2007 assessment. Thirty five of these 75 locations are inside the current Glen Dhu South Project area and therefore can be used to characterize the present day vegetation communities in the Project area. The site specific plant inventories may not be on the specific turbine sites in the final design; however, the study provides a valid characterization of the plant communities represented in the Project area. The sites from 2007 which apply to the proposed Glen Dhu South Project area are identified on Figure 18 (below). Figure 18 also shows the location of the 2011 vegetation assessment locations.


Key Map
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Transmission Line
Streams
Forested
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Wetlands
Crown Land
Eigg Mountain Wilderness Area
James River Watershed Area
Project Features
Glen Dhu South
Glen Dhu North
Proposed Sub Stations
2011 Veg. Assessment Locations Candidate Turbines
2007 Veg. Assessment Locations
Shear Wind Inc.
Nortek Resource Solutions Inc.
Glen Dhu South Wind Project Registration Document
Figure 18
Vegetation Assessment
2007 and 2011 Locations
DWG No: 18_1.0
REVISION: 2.0
SCALE: 1: 35,000
DATE: January 3, 2012
PRODUCED BY: NORTEK
TCH 104
TCH 104
Beaver Mountain Rd
PICTOU COUNTY
ANTIGONISH COUNTY
0
0.75
1.5
kilometers

5.4.5.2 2011 Vegetation Assessment

During the field season in 2011, a total of seventy seven (77) candidate turbine site locations, based on initial constraints analyses and assessment of the wind regime, were identified across the Project area. Biophysical assessment of these seventy seven (77) sites was completed across the project area throughout the field season of 2011 including assessment for vegetation, species at risk (especially the Mainland Moose), wildlife, watercourses and wetlands, and aquatic surveys.

Each candidate site was classified for vegetation by forest cover and age class. Age classifications were based on natural breaks in the data. Forest stand age class was determined through qualitative observations of multiple factors. Dominant tree species were identified at each potential turbine site, as seral stage is a useful determinant of stand age. Red maple and balsam fir, for instance, are early seral stage species which are indicative of a young upland stand, while species such as yellow birch and sugar maple are more representative of a climax forest in this ecoregion. Approximate forest stand age was determined based on a number of criteria, such as total basal area, level of canopy coverage, and species composition of the understory herb and shrub layers. Observations of size and abundance of coarse woody debris were noted. Finally, the level of anthropogenic disturbances was described; particularly the presence of logging roads and harvested trees (clear cut or selective harvest, and approximate time since harvest). All of these factors were used in combination to determine the forest stand age class at each potential turbine location.

Vascular plant surveys were conducted at all candidate sites and proposed access roads. Two series of assessments, completed in May and late August 2011, allowed researchers to identify both early and late season phrenology, As described in the *Guide to Addressing Wildlife Species and Habitat in an EA Registration Document* (NSE, Sept 2008), a full vascular plant survey was not completed. The vascular plant surveys focused on identifying general vegetative communities, with particular focus on identifying priority species. The priority list of vegetation species prepared for this project is attached in Appendix II.

Results

As shown in Table 11 below, twenty-eight percent (28%) of candidate locations are located within forestry cut-blocks or disturbed sites. Twenty-two percent (22%) of all candidate locations are located in recently disturbed areas (<10 years), while six percent (6%) were located in areas disturbed or harvested between 10-20 years ago. Disturbed sites were characterized by little to no canopy coverage, and frequent coarse woody debris. Networks of logging roads were present in and around all disturbed sites.

Amongst candidate sites classified as disturbed sites, saplings and natural regeneration were quite variable. Species found include balsam fir, white birch, yellow birch, gray birch, sugar

maple, striped maple, red maple, red spruce, white ash, speckled alder and pin cherry. Shrubby vegetation was very abundant in disturbed areas, particularly during the second assessment in August. Shrub species commonly found in disturbed candidate sites include wild rose, wild red raspberry, Canada fly honeysuckle, elderberry, red currant, red osier dogwood and blackberry. Herbaceous vegetation was diverse and abundant across disturbed sites. Fern species included spinulose wood fern, hay-scented fern, sensitive fern, ostrich fern, bracken fern and rock polypody. Early in the season, clintonia, Hickey's clubmoss, soloman's seal, star-flower, yellow trout-lily, painted trillium, nodding trillium, dwarf ginseng, false lily-of-the-valley and pearly everlasting were all common occurrences.

Late summer sampling revealed that the majority of disturbed sites were completely dominated by shrub species previously listed. Tall goldenrod, rough-stemmed goldenrod and Canada goldenrod were abundant, along with black bindweed, fireweed, hemp nettle, ox-eye daisy, scentless chamomile and common hawkweed. Halbred-leaved tear-thumb and wintergreen were occasionally found in disturbed sites.

Sixteen percent (16%) of candidate locations are located within mixed forest stands. Eight percent (8%) of all candidate locations are found within mixed stands less than 20 years old, and eight percent (8%) were located in stands greater than 20 years of age. Mixed stands less than 20 years were characterized by dense, often uneven aged stands of a variety of trees. White birch, yellow birch, American beech, striped maple and sugar maple were the most common hardwoods, mixed with predominantly white spruce and balsam fir. Gray birch, red maple, white ash, trembling aspen and pin cherry were common occurrences as well. Wild red raspberry, wild blackberry and Canada fly honeysuckle dominated the shrub layer in the young mixed stands. Herbaceous vegetation among young mixed stands represents a mixture of shade tolerant species and those more closely associated with disturbed areas. The fern community included species such as New York fern, bracken fern and hay-scented fern.

Early in the spring, species such as false lily-of-the-valley, dwarf ginseng, ginseng, clintonia, stiff clubmoss, woodland strawberry, star-flower, bracken fern, painted trillium, gold-thread and spring beauty were all common. Species such as pearly everlasting, whorled aster, tall goldenrod, rough-stemmed goldenrod, Canada goldenrod, fireweed, slender ladies tresses, indian pipe, wild potato vine and black bindweed were common in the understorey late in the season.

Many of the same species were found in 20+ year old mixed stands. Some sites were more uneven aged, lending to a diversity of understorey vegetation, while many older mixed stands fostered a relatively low diversity of understorey vegetation.

Twenty-five percent of candidate sites are located within softwood stands. Eight percent (8%) of all candidate locations are found within softwood stands less than 20 years old, while eighteen percent (18%) were located in stands greater than 20 years of age.

Many candidate sites located in softwood stands were dense, with nearly full canopy coverage. Balsam fir, white spruce, red spruce and black spruce dominated softwood stands, with occasional sugar maple, red pine and striped maple. The majority of softwood sites were characterized by nearly homogenous plantation communities, with extremely sparse understorey vegetation. False lily-of-the valley, bunch-berry, star-flower, painted trillium, soloman's seal, bracken fern and Indian pipe were the most common understorey plants. The greatest diversity of vegetation in softwood stands was often found at the edge of access roads, or within small clearings. Yellow trout-lily, green fringed orchis, hay-scented fern, low-bush blueberry, meadow-sweet, tall buttercup, and northern bedstraw were all found within micro-clearings in softwood stands.

Hardwood forests were prevalent across the Project lands and candidate turbine locations. Thirty-one percent (31%) of candidate sites were located within hardwood stands. Eight percent (8%) of these sites were located in young stands, less than 20 years of age, while eight percent (8%) were in hardwood stands ranging from 20 to 40 years of age. Fourteen percent (14%) of candidate locations were located in mature hardwood stands, greater than 40 years old.

Hardwood stands exhibited similar levels of species diversity across the different age classes. The dominant species across hardwood stands are sugar maple, striped maple, yellow birch and American beech, with occasional occurrences of red maple, white birch, gray birch, pin cherry, white ash, white spruce and balsam fir. Canada fly honeysuckle was common throughout hardwood stands, though elderberry, multi-flora rose, meadow-sweet and sheep laurel were also observed. Ferns were common in the shady understorey. Ostrich fern, rock polypody, spinulose wood fern, bracken fern, hay-scented fern and New York fern were all found in hardwood sites.

Understorey vegetation was often quite sparse, yet diverse. The species composition in hardwood stands represents a mixture of shade-tolerant species, as well as common roadside species. Soloman's seal, painted trillium, nodding trillium, false-lily-of-the-valley, star-flower, spring beauty, wood sorrel and clintonia were all common understorey species. Other commonly occurring species include ground pine, Hickey's clubmoss, dwarf ginseng, tall manna grass, soft bulrush, partridge berry and twin-flower. During the late season assessment, species such as Indian pipe, white fringed orchis, purple fringed orchis, green fringed orchis and wild potato vine were observed. Common roadside species were found in small clearings and access roads, including species such as ox-eye daisy, tall goldenrod, heal-all, and pearly everlasting.

Table 11.Vegetation Communities

77 Candidate Turbine Locations			
Dominant vegetation type	**Age Class**	**Number of sites**	**Percent of candidate sites**
Cut-block or disturbed site	<10 years	17	22%
	>10 years	5	6%
Mixed Stand	<20 years	6	8%
	>20 years	6	8%
Softwood Stand	<20 years	6	8%
	>20 years	14	18%
Hardwood Stand	<20 years	6	8%
	20-40 years	6	8%
	>40 years	11	14%
Total Number of Candidate Turbine Locations		**77**	**100%**

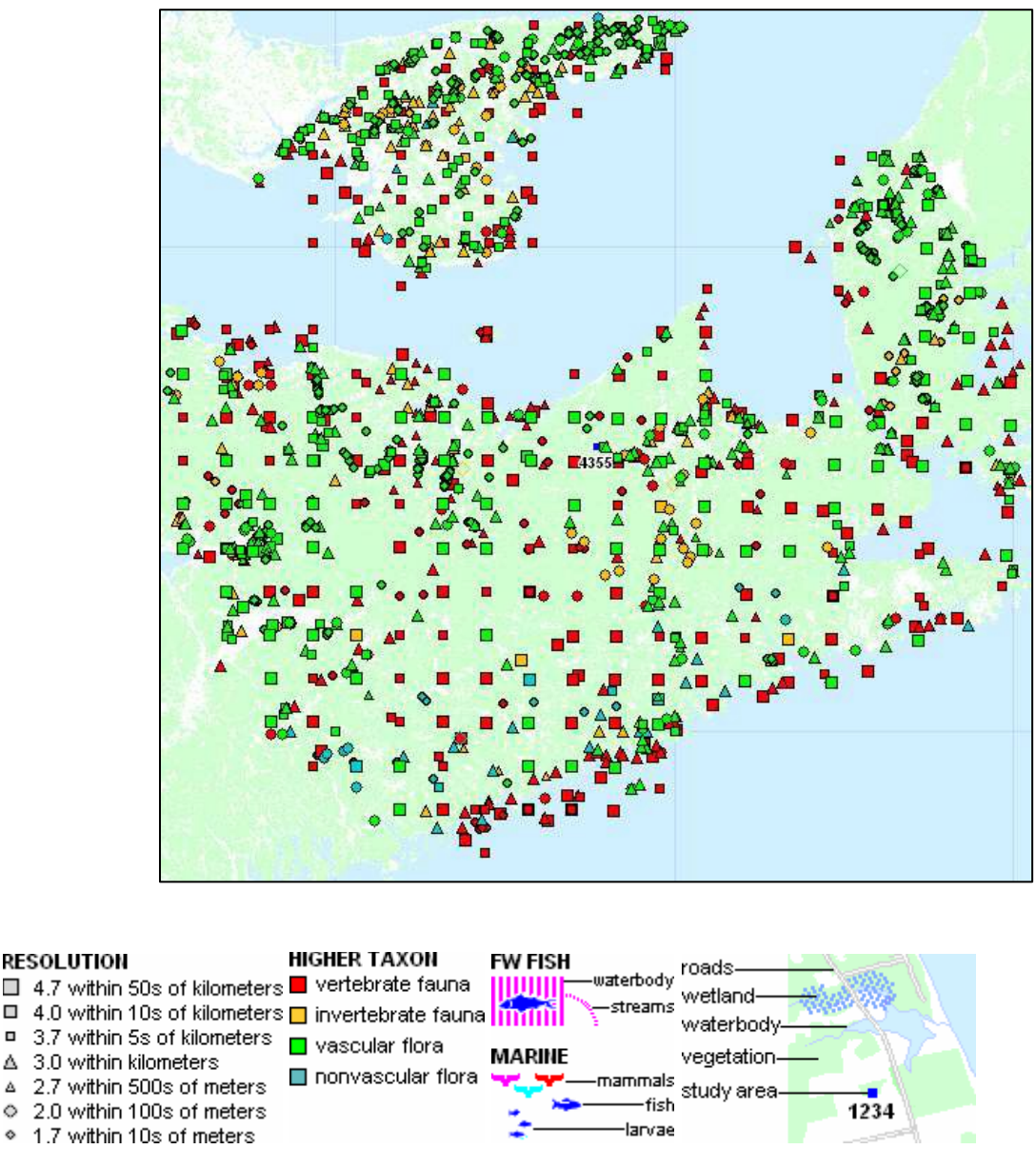
The vegetative communities are consistent with expectations, given the eco-regional framework, land use patterns, and previous assessments. The Pictou-Antigonish Highlands have a relatively low growing season of 192 days, dominated by shade tolerant hardwoods such as striped maple, sugar maple, yellow birch and American beech.

Detailed vegetation community descriptions from the 2011 field surveys can be found in Appendix V.

5.4.5.3 Species of Conservation Concern

Each candidate site was assessed for rare, sensitive and at-risk vegetation during spring and summer field surveys in 2011. Additional species at risk assessment was completed during the initial vegetation survey completed in 2007. Assessment was completed for all priority species identified during preliminary evaluations (desktop) as described in Chapter 3. Care was also taken to assess for potential rare vegetation species that were identified from the ACCDC data search. The complete table of the 2483 observations of 409 taxa documented by the ACCDC is present in Appendix VI and the image from the ACCDC of known locations of sensitive species is shown below.

Figure 2. Species of Conservation Concern Known Locations



(An image of the Atlantic Canada Conservation Data Center observation records for 100 km radius around the Glen Dhu South Wind Power Project Site. The Project Site is indicated by the blue square numbered "4355".)

The ACCDC data search reported that the 100km buffer around the study area contains 1155 records of 267 vascular, 56 records of 15 nonvascular flora.

During field studies in spring and late summer at the 77 candidate sites and access roads, no Federally or Provincially listed Species at Risk (flora) were identified. No NSDNR red or yellow listed species were identified. During initial vegetation surveys in 2007 across the Project area, no species at risk or red/yellow species were identified.

In 2007, the following species were discussed in greater detail due to varying degrees of rarity across the province. None of these species are present on the priority list for vegetation assessment as part of the 2011 field surveys, based on current NS DNR methodologies. They are included here for additional information regarding vegetation communities and individual species identified in the Project area. (Blaney and Mazerolle, 2007).

Pennsylvania Sedge - *Carex pensylvanica* (NS DNR Undetermined)
This species was thought to be observed on site. However, the potential *Carex pensylvanica* specimen from Glen Dhu in 2007 was determined by Tony Reznicek at University of Michigan (leading North American sedge expert) to be a probable hybrid sedge likely involving the common *Carex novae-angliae* and another related sedge (both relatives of *C. pensylvanica*).

Hickey's Clubmoss - *Lycopodium hickeyi* (NS DNR Undetermined)
This species was only recently separated from similar clubmosses in the tree-like Clubmoss group and as such is still poorly known in the province. It is likely widespread but uncommon.

Dry-Spike Sedge - *Carex foenea* (NS DNR Secure)
One clump of this species was identified on the recently disturbed margin of a gravelly roadway in the Project area. It is far more common to find Dry-Spike Sedge in human-disturbed habitats such as logging roads and clearcuts than in natural habitats, and as such the species is minimally threatened province-wide. The species is uncommon in Nova Scotia but occurs throughout the province. The number of records of the species is undoubtedly somewhat limited because of its similarity to other relatives in *Carex* section *Ovales*.

Brome-Like Sedge - *Carex bromoides* (NS DNR Secure)
This species was seen in two locations on site (in a young plantation and in a deciduous forest clearing). It has recently been found to be widespread and locally abundant in floodplain habitats in rich, river and stream valleys in northern Nova Scotia.

Broad-Leaved Twayblade - *Listera convallarioides* (NS DNR Secure)
This species was seen in a single spot, with large numbers of plants present in a rich, seepage depression within sugar maple forest where Silvery Glade-Fern (*Deparia acrostichoides*) was dominant and the only locations on site for the uncommon Rattlesnake Fern (*Botrychium virginianum*) and Daisy-Leaved Grape-Fern (*Botrychium matricariifolium*). Broad-lipped Twayblade is locally quite common in seepy, shaded sites along Cape Breton Highland rivers but is rare on the mainland of Nova Scotia where it is known primarily from rich, seepy sites in sugar maple forest.

Tall Millet-Grass - *Milium effusum* var. *cisatlanticum* (NS DNR Secure)
Plants were seen in many locations, sometimes in large numbers, widely scattered around the site in richer, moist deciduous forest and in disturbed forest edges. This grass species is uncommon to locally common in richer, higher elevation sugar maple forests in the Cape Split area, the Cobequid Mountains and in Cape Breton but is very rare in lowland deciduous forests in Nova Scotia.

Dwarf Ginseng - *Panax trifolius* (NS DNR Secure)
Dwarf Ginseng was widely but uncommonly scattered around the site with most sites having relatively small numbers of individuals. Recent 2007 fieldwork by Sean Blaney and the AC CDC in Cobequid Mountain sites between Portapique and Marshy Hope has found this species to be widespread and locally abundant in deciduous forests.

Braun's Holly-Fern - *Polystichum braunii* (NS DNR Secure)
A single, very large plant was found in a seepy opening in rich sugar maple – yellow birch – ironwood – spruce forest on a ridge top. This species is locally common in Cape Breton and the Blomidon area and widespread but uncommon in cool ravines and steep slopes throughout the northern mainland of Nova Scotia.

Effects of the Project

Construction activities will be limited to the turbine locations and access roads, as well as the substation location. These areas were assessed during field investigations in early Spring and late Summer 2011, as well as a more general vegetation assessment completed across a wide Project area in 2007, as part of the original environmental assessment completed for the Glen Dhu Wind Power Project. No species of concern were identified during any of these assessments. Therefore, the Project will have no effect on species of conservation concern.

Mitigation

As no species of special conservation concern, or those listed as being at risk will be impacted by the Project, no mitigation will be employed.

5.4.6 Herpetofaunal Species

Herpetofaunal species were inventoried at the Project area through both targeted searches of appropriate habitats and through incidental observations. Specific focus was given to priority species identified as having appropriate habitat within the Project area. These species included:

- Wood turtle; and,
- Snapping turtle.

Assessed habitats included deadfall within hardwood areas, south facing rocky outcrops, and aquatic habitats such as wetlands, streams, riparian zones, lakeshores, and vernal pools across the landscape.

Table 12. Herpetofaunal species inventoried during 2011 field surveys.

Scientific Name	Common Name	ACCDC Prov. Rank	NSDNR Gen. Status
Rana sylvatica	Wood Frog	S5	**Green**
Rana palustris	Pickerel Frog	S5	**Green**
Rana clamitan	Green Frog	S5	**Green**
Thamnophis sirtalis	Maritime Garter Snake	S5	**Green**

No turtles were observed within the Project area, likely due to the lack of appropriate nesting areas. Appropriate habitats for nesting would include areas of sand, gravel or cobble, typically in the form of exposed river bars, beaches, and road, railroad or bridge embankments (MacGregor and Elderkin, 2003).

Wood turtle life cycles require slow-moving, meandering streams and rivers like the St. Mary's River which have considerable amounts of sand and gravel. Although Wood turtles are found in adjacent woodlands over the summer, they tend to range out from these habitats. None of these habitats exist near the proposed sites, nor does the range map for Wood turtle distribution in Nova Scotia indicate their presence in this area.

Other visually confirmed herpetofauna on the proposed Project area include the Maritime Garter Snake (*Thamnophis sirtalis)*. Garter snakes were observed across the subject property in larger wetlands.

The Project area provides limited, but relatively high quality herpetofaunal habitat. The limitation for many turtle and amphibian species is the lack of open water habitats, particularly associated with wetlands. Although there are a number of wetlands across the site, most do not exhibit vernal pool and open channel habitat. In those wetland areas where there is limited open water habitat, it is extremely unlikely that fish are present, and therefore predation would be low. Species that may use intermittent stream channel habitats are more likely to find adequate habitat within the Project area. Wood Frog (*Rana sylvatica)* and Pickerel Frogs *(Rana palustris)*, which reproduce in running water and ephemeral bodies of water, were observed quite commonly and widespread over the Project area. In contrast, Green Frogs (*Rana clamitans)* require deeper and more permanent water bodies for reproduction (University of Guelph, 2011). Observations of Green frogs were relatively more limited across the Project.

5.4.6.1 Rare, Sensitive, At-Risk Herpetofaunal Species

No herpetofaunal Species at Risk or species of conservation concern where found within the Project area during 2011 field surveys.

Effects of the Project

Minimal negative effects on the herpetofaunal community within the Project area are anticipated. Wetlands with open water, a primary herpetofaunal habitat, have been avoided to the maximum extent possible.

Mitigation

Several small potential wetland alterations will be required to accommodate individual turbine locations and access roads across the Project Lands. These proposed wetland alterations will fall under the Nova Scotia Wetland Alteration Approval process, and compensation will be developed in association with that process.

All other wetland areas, lakes and streams have been given a minimum 30m buffer in the design of the Project activities in order to maintain values associated with those habitat features, including mitigation of impacts to herpetofauna that may use such habitats.

5.4.7 Mammals

Incidental observation of mammal species was documented during all field survey activities during 2011. Specific focus was given to priority species identified as having appropriate habitat within the Project area. These species included:

- Mainland Moose;
- Little Brown Bat;
- Long-Tailed Shrew;
- Northern Long-Eared Bat;
- Eastern Pipistrelle;
- Southern Flying Squirrel; and,
- Fisher;

Table 13 lists those species that were confirmed on the Project area either visually or by sign (scat, footprints, etc.). Presence of bats in the Project area is described in subsequent sections.

Table 13. Confirmed mammalian species during 2011 field surveys.

Scientific Name	Common Name	ACCDC Prov. Rank	NSDNR Gen. Status
Alces alces Americana	Moose	S1 (Endangered)	Red
Odocoileus virginianus	White Tailed Deer	S5	Green
Ursus americanus	Black Bear	S5	Green

Procyon lotor	Raccoon	S5	Green
Canis latrans	Coyote	S5	Green
Erithizon dorsatum	American Porcupine	S5	Green
Tamiasciursus hudsonicus	American Red Squirrel	S5	Green
Castor canadensis	American Beaver	S5	Green

Ungulate species expected to inhabit the vicinity of the Project were established by examination of distribution maps, comparison of preferred habitat with that in the vicinity of the proposed location and field assessments. Mammal species observed within the Project lands include the white-tailed deer **(***Odocoileus virginianus)***.** Optimal habitat for deer species occurs within young forest stands and riparian and shoreline areas within drainage systems within the Project lands. White-tailed deer forage on grasses, forbs and shrubby browse. They require large amounts of easily digested food (Buckmaster et al., 1999).

Black bear (*Ursus americanus)* are common throughout Nova Scotia. They were observed on occasion within the Project area. Bear scat was observed on several occasions within the Project area during 2011 field surveys. A mosaic of forest cover and clearings or early successional habitat represents the most suitable habitat for black bears. Black bears will use dense cover and/or trees to escape from threats, and commonly bed in dense shrub communities (Buckmaster et al., 1999). Such habitats are quite frequent within the Project Site.

Raccoon and coyote sign were regularly observed within the Project area. Other common carnivore/omnivore species such as Red fox *(Vulpes vulpes),* Bobcat (*Lynx rufus),* American mink (*Mustela vision),* Striped skunk (*Mephitis mephitis)*, Short-tailed weasel (*Mustela erminea)* are expected to inhabit the Project area, at least periodically.

5.4.7.1 Rare, Sensitive, At-Risk Mammals

Mainland Moose (*Alces americana)* is the only Species at Risk or Species of conservation concern observed within the Project Area during the 2011 field surveys.

Table 14. Mammalian species of conservation concern within Project lands

Scientific Name	Common Name	ACCDC Provincial Rank	NS Protection or NSDNR General Rank	Dist to Project (km)
Alces alces americana	Moose	S1	Endangered	6±10
Glaucomys volans	Southern Flying Squirrel	SNA	Yellow	n/a
Martes pennanti	Fisher	S2	Yellow	n/a

The Fisher is a Yellow ranked species in the Province of Nova Scotia, and the ACCDC ranks it as an S2 for the Province. These rankings suggest the species is both rare and sensitive to human or natural disturbance. Mixed wood forests and rock piles, both found on the Project area, are

appropriate habitats for the Fisher. Fishers inhabit upland and lowland forests, including coniferous, mixed, and deciduous forests. They occur primarily in dense coniferous or mixed forests, including early successional forest with dense overhead cover. Fishers commonly use hardwood stands in summer but prefer coniferous or mixed forests in winter. They generally avoid areas with little forest cover or significant human disturbance and conversely prefer large areas of contiguous interior forest . The habitat preferences for the fisher are present within the Project area. No observations of this species were noted during field surveys (Shear Wind Inc., 2008).

The Southern Flying Squirrel (yellow ranking) prefers deciduous and mixed forests, particularly beech- maple, oak-hickory and poplar and also occurs in old orchards. The squirrel favours small, abandoned woodpecker holes for den sites; also uses nest boxes and abandoned bird and squirrel nests outside tree cavities. *G. volans* occurs in southern Nova Scotia in an area roughly bounded by the South Mountains in the north, the Gaspereau Valley (Kentville) to the west, the New Ross area in north-east Lunenburg County to the south and Kejimkujik National Park in the west.

5.4.7.2 Moose

Assessment for the Mainland Moose was completed during field surveys completed in 2011 across the Project area at the seventy seven candidate assessment sites. These 77 locations reflect all habitat types present in the Project area as described in previous sections. A small number of observations of scat and browse were documented during these field surveys.

All results from 2011 field assessments (including transect results described below) for moose observations are shown on Figure 20.

Turbine 18: moose browse was observed along main road at access point in August 2011. The site description consisted of a recent clear cut with 10 year balsam fir and sugar maple, with pin cherry and red osier dogwood. Herbaceous vegetation included Wild raspberry, blackberry, honeysuckle, false lily-of-the-valley, white violet, white ash, rough-stemmed goldenrod, and black bindweed.

Turbine 21: Moose browse observed at eye level at candidate site location in August 2011. This site description consisted of a young hardwood stand, 5-10 years old. Predominantly white birch, but striped maple, sugar maple, trembling aspen, pin cherry, yellow birch and white ash are also present. Ground cover includes grasses, ostrich fern, rock polypody, spinulose wood fern, tall goldenrod, and fringed white orchis.

Moose scat was observed at two locations near this turbine during field surveys in May 2011.

Turbine 25: moose scat was observed in a wetland located to the southeast of Turbine 25. This area southeast of the turbine was determined to not be appropriate for a turbine location based on

the presence of the wetland itself, as well as the evidence of the Mainland Moose. A turbine site located south of Turbine 25 was removed from the Project as a result.

Turbine 28: moose scat was observed along with bear scat in the wetland present east of Turbine 28. The candidate site was originally placed directly in this wetland. Due to the presence of the wetland and the evidence of the Mainland Moose, the Turbine was moved to the west, closer to the access road and away from the wetland and potential moose habitat.

Significant monitoring for the Mainland Moose has been completed across the Project area since the original environmental assessment was completed for the Glen Dhu Wind Power Project in 2007. This monitoring program was a term and condition of the approval of the environmental assessment for Glen Dhu WPP. The program was created in consultation with Nova Scotia Department of Environment, Nova Scotia Department of Natural Resources and SWI.

Moose pellet inventories and snow tracking (snowmobile) transects were completed as part of the 2007 environmental assessment process, as well as part of monitoring efforts from 2008 to 2011. Also, an aerial survey was completed in January 2011 across an area encompassing both the Glen Dhu WPP, as well as the Glen Dhu South Project area, and on lands to the east of both Project areas.

Monitoring for the moose across both the Project areas from 2006 to 2011 by foot, snowmobile and air have documented some sightings of moose, tracks, and scat. The majority of sightings appear to be concentrated towards the eastern edge of the study area, in Antigonish County. This area does not encompass the Glen Dhu South Project area, which is located entirely in Pictou County.

Details associated with these monitoring activities and results were compiled in a recent monitoring report that was submitted to NSE in April 2011, as part of the on-going terms and conditions relating to the Glen Dhu North project. Current on-going monitoring commitments for Glen Dhu North have been extended by Shear Wind Inc. to include the Glen Dhu South Project lands.

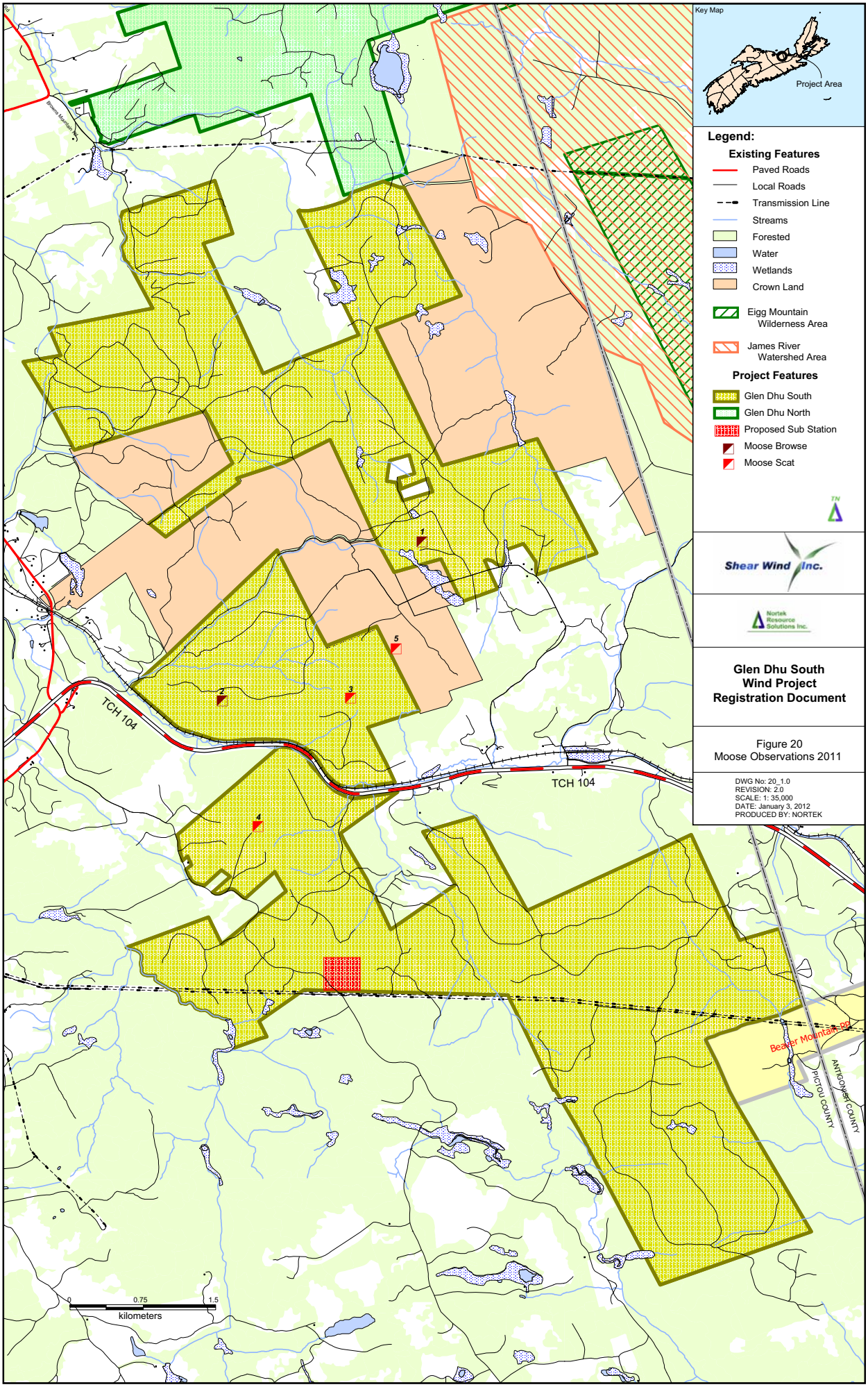
A copy of the April 2011 monitoring report for the mainland moose is included as Appendix VII. This monitoring report includes locations of incidental observations of moose from NSDNR offices in Antigonish County and Pictou County (obtained from Mark Pulsifer and Kim George, NSDNR).

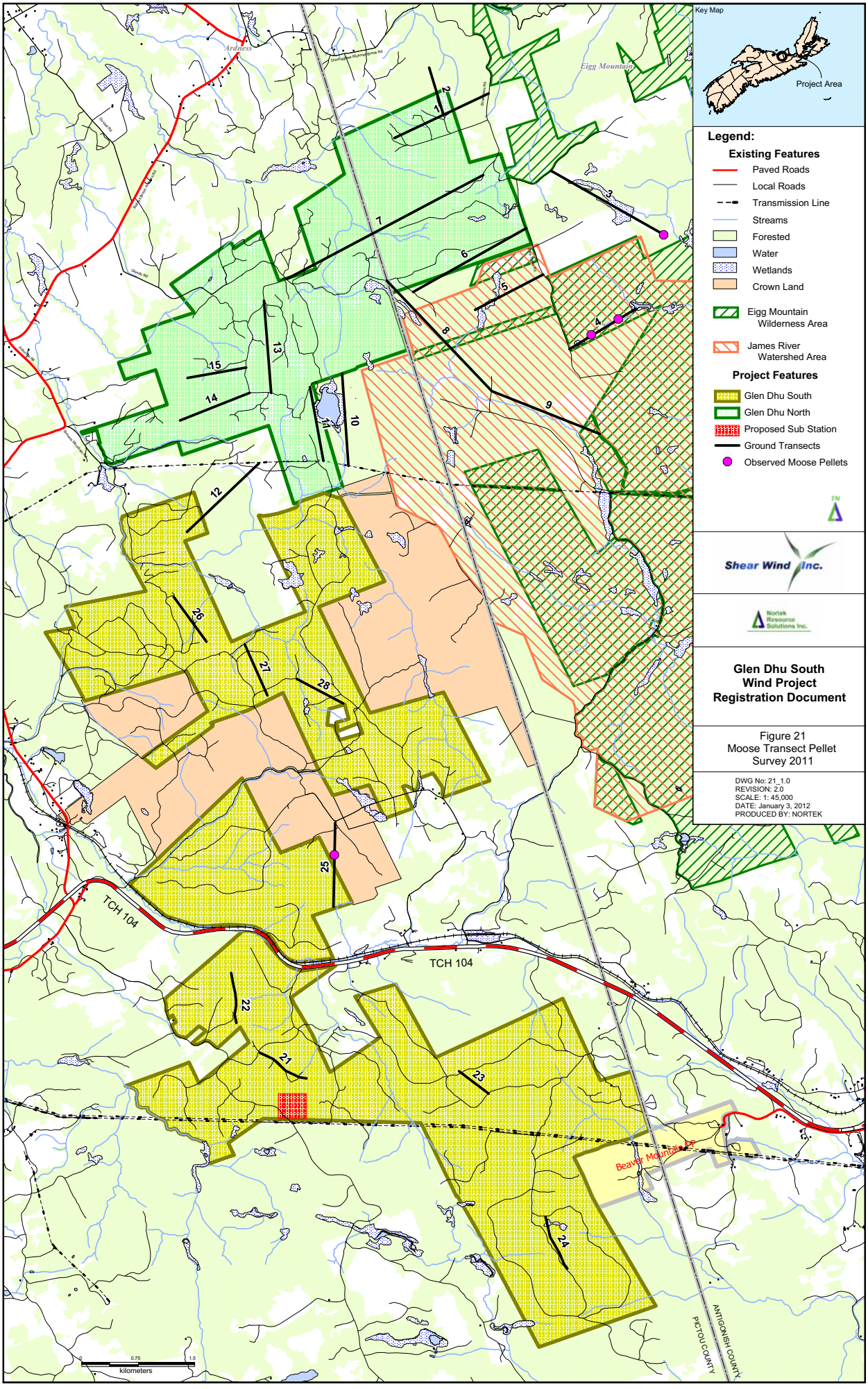
In May 2011, after the moose monitoring report was compiled, another moose pellet pile survey was completed by Jody Hamper across the Glen Dhu North Project area. These results are included on Figure 21. Two observations of moose pellets were recorded from Transect #4 and a single observation of moose pellets were observed on Transect #3 (east end).

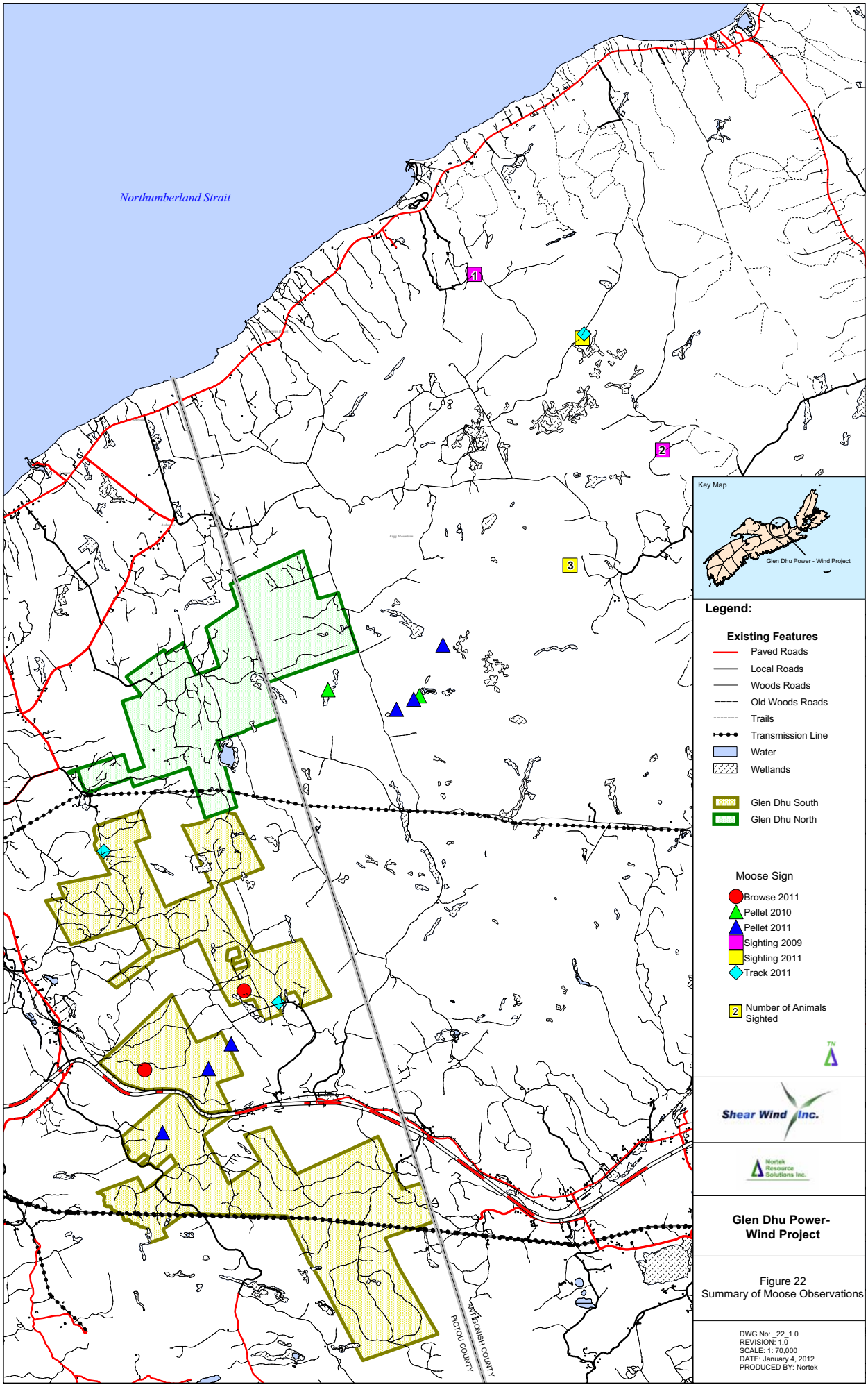
Transects were also completed across the Glen Dhu South Project area (8 in total) on foot by Mr. Jody Hamper (Figure 21). Moose scat was observed at one location, on Transect 25. Transect 25 was 1115 m in length. This transect was through mature/over-mature hardwood. There was one small wet section with scattered over-mature softwood scattered throughout. The remainder of the transect length was well-drained. There was browsing observed on the young hardwood saplings. One pile of moose pellets was observed on this transect.

Observations of deer browse and scat were observed along all transects, with the exception of one transect.

A summary of all moose observations from 2007 to 2011 has been compiled for ease of review and is included as Figure 22.


Key Map
Project Area
Legend:
Existing Features
Paved Roads
Local Roads
Transmission Line
Streams
Forested
Water
Wetlands
Crown Land
Eigg Mountain Wilderness Area
James River Watershed Area
Project Features
Glen Dhu South
Glen Dhu North
Proposed Sub Station
Moose Browse
Moose Scat
TN
Shear Wind Inc.
Nortek Resource Solutions Inc.
Glen Dhu South Wind Project Registration Document
Figure 20
Moose Observations 2011
DWG No: 20_1.0
REVISION: 2.0
SCALE: 1: 35,000
DATE: January 3, 2012
PRODUCED BY: NORTEK
TCH 104
TCH 104
Beaver Mountain Rd
PICTOU COUNTY
ANTIGONISH COUNTY
1
2
3
4
5
0
0.75
1.5
kilometers


Key Map
Project Area
Legend:
Existing Features
Paved Roads
Local Roads
Transmission Line
Streams
Forested
Water
Wetlands
Crown Land
Eigg Mountain Wilderness Area
James River Watershed Area
Project Features
Glen Dhu South
Glen Dhu North
Proposed Sub Station
Ground Transects
Observed Moose Pellets
TN
Shear Wind Inc.
Nortek Resource Solutions Inc.
Glen Dhu South Wind Project Registration Document
Figure 21
Moose Transect Pellet Survey 2011
DWG No: 21_1.0
REVISION: 2.0
SCALE: 1: 45,000
DATE: January 3, 2012
PRODUCED BY: NORTEK
Ardness
Eigg Mountain
TCH 104
TCH 104
Beaver Mountain Rd
ANTIGONISH COUNTY
PICTOU COUNTY
0.75
1.5
kilometers


Northumberland Strait
1
2
3
PICTOU COUNTY
PICTOU COUNTY
Key Map
Glen Dhu Power - Wind Project
Legend:
Existing Features
Paved Roads
Local Roads
Woods Roads
Old Woods Roads
Trails
Transmission Line
Water
Wetlands
Glen Dhu South
Glen Dhu North
Moose Sign
Browse 2011
Pellet 2010
Pellet 2011
Sighting 2009
Sighting 2011
Track 2011
2 Number of Animals Sighted
TN
Shear Wind Inc.
Nortek Resource Solutions Inc.
Glen Dhu Power-
Wind Project
Figure 22
Summary of Moose Observations
DWG No: _22_1.0
REVISION: 1.0
SCALE: 1: 70,000
DATE: January 4, 2012
PRODUCED BY: Nortek