Appendix IV. CANWEA LETTER RE MAINLAND MOOSE

Shear Wind Inc.

May 18, 2011

Attention: Wind Power Project Developers
c/o CANWEA

Reference: Interactions of Wind Power Projects on ungulates – Moose Specifically.

Glen Dhu Wind Energy Partnership LP (in association with Shear Wind Inc.) developed, and is currently operating the 65MW Glen Dhu Wind Power Project (‘Project’) in Nova Scotia.

As a function of our environmental terms and conditions, the Department of Natural Resources requires Shear Wind to attempt to gather information on the effects of wind power project development and operation on ungulate, specifically Moose, species. The rationale for such a condition is that the mainland moose in Nova Scotia were listed as ‘endangered’ in 2003.

Shear Wind Inc., on behalf of Glen Dhu Wind Energy Partnership LP, is asking other project developers that may be situated in areas with moose populations, if they would be willing to share pre-construction or operation monitoring information for moose specifically to help us understand if there are any impacts to moose populations.

In kind, Shear Wind would be willing to provide the results of our mainland moose monitoring activities in our area.

We appreciate any assistance you may provide as this information will not only support Shear Wind in its efforts, but other wind power project developers in Nova Scotia.

Sincerely,
Shear Wind Inc.

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Shear Wind Inc.
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Shear Wind Inc.

Appendix V. VEGETATION COMMUNITIES INFORMATION

Vegetation Community Information

Candidate Assessment Site ID Oct 2011	Field ID May-Aug 2011	Constraints Notes	Vegetation Assessment	Forest Ecosystem Classification Code	Vegetation Grouping
1	85-01/100-01		30+ year mixed stand, with american beech, white spruce, sugar maple and the occasional yellow birch, white birch and service-berry. Very little understorey vegetation; ground cover includes lily-of-the-valley, bunch-berry and dwarf ginseng. Late assessment shows growth of fireweed, whorled aster, canada goldenrod, black bindweed, and blackberry. No rare plants or wildlife signs.	MW1	Mixed stand, 20+ Years
2	85-02/100-02		Very open mixed stand, even mix of white birch, yellow birch, balsam fir and sugar maple, ~15 years. Understorey includes pin cherry, raspberry, lily-of-the-valley, new york fern and dwarf ginseng. Late assessment shows growth of fireweed,whorled aster, canada goldenrod, black bindweed, and blackberry. No rare plants or wildlife signs.	MW5	Mixed stand, <20 Years
3	85-03/100-03		<20 year sugar maple stand, with some white spruce and american beech. Very open understorey contains ostrich fern, soloman's seal, spring beauty, lily-of-the-valley, spring beauty and dwarf ginseng. Blackberry, bracken fern, whorled aster. No rare plants. Deer browse.	TH2	Hardwood stand, <20 years

4	85-04/100-04		Predominantly sugar maple, with striped maple, american beech understorey. Access to site has shrubby vegetation such as raspberry and honeysuckle, but turbine location has very little shrubby vegetation. Other vegetation includes soloman's seal, painted trillium, clintonia, spring beauty and dwarf ginseng. No rare plants. Deer browse throughout.	TH2	Hardwood Stand, 20-40 years
5	85-05/100-05		15 year uneven-aged mixed stand. Balsam fir, white spruce, sugar maple, red maple, pin cherry and gray birch. Understorey contains blackberry, raspberry, whorled aster, hay-scented fern. No rare plants. Deer browse.	MW5	Mixed stand, <20 Years
6	85-06/100-06		Pre-disturbed site, Shrubby vegetation such as wild rose and raspberry dominates, with standard roadside weed community of vegetation. No rare plants	N/A	Cut Block or disturbed site, <10 years
7	85-07/100-07		Pre-disturbed site. Young (10 years) white birch, grey birch, balsam fir, sugar maple, striped maple and speckled alder are found along the roadside. Woodland strawberry, yellow trout lily and grasses dominate ground cover. No rare plants. Access through 30 year hardwood stand, likely selectively harvested at some point. No rare plants.	N/A	Cut Block or disturbed site, 10-20 years
8	85-08/100-08		30 year stand of balsam fir, yellow birch and sugar maple, and the occasional yellow birch. Almost no understorey vegetation, only star flower, false lily-of-the-valley, strawberry, bunch-berry, clintonia, indian pipe and stiff clubmoss. No rare plants. Some deer scat.	MW5	Mixed stand, 20+ Years

9	85-09/100-09		15 year old mixed stand, predominantly balsam fir and sugar maple, with occasional yellow birch and striped maple. Ground-cover includes lily-of-the-valley, bracken fern, clintonia, dwarf ginseng, Indian pipe, stiff clubmoss and some white ash saplings. No rare plants or wildlife signs.	MW5	Mixed stand, <20 Years
10	85-10/100-10		Young (~10-15 years) naturally regenerating mixed forest, composed of an even mix of sugar maple, balsam fir, white spruce and the occasional yellow birch. Very common understorey vegetation includes woodland strawberry, raspberry, tall goldenrod, white ash, fireweed, slender ladies tresses and stiff clubmoss. No rare plants. Some deer browse.	MW1	Mixed stand, <20 Years
11	85-11/100-11	moved to avoid wetland habitat as much as possible. Wetland will still be impacted for access	Softwood stand dominated by both white spruce and balsam fir, with the occasional sugar maple and white birch. Little to no understorey vegetation, but woodland strawberry, gold-thread, pearly everlasting, bunch-berry, star flower, lily-of-the-valley and stiff clubmoss are all present. No rare plants or wildlife signs.	MW5	Mixed stand, <20 Years
12	85-12/100-12		10-15 year regenerating stand of sugar maple with a few balsam fir and elderberry. Painted trillium, soloman's seal, false lily-of-the-valley, white violet, Indian pipe, wild potato vine and star flower comprise the understorey vegetation. No rare plants. Deer browse.	TH2	Hardwood stand, <20 years
13	100-13		5-10 year stand of sugar maple with scattered white spruce and mature sugar maple. Understorey vegetation is very similar to 85-14, plus dwarf ginseng, black bindweed, fireweed and mountain ash. No rare plants or wildlife sign.	N/A	Cut Block or disturbed site, <10 years

14	85-15/100-14		~30 year old mixed stand, pretty evenly mixed with sugar maple and white spruce. Very little understorey includes lily-of-the-valley, spring beauty, wood sorrell, white violet and soloman's seal.	MW5	Mixed stand, 20+ Years
15	85-16/100-15		Young mixed stand, < 20 year old dense stand of sugar maple and balsam fir. Understorey vegetation includes shrubs such as elderberry, raspberry, red currant and honeysuckle. Ground cover includes lily-of-the-valley, spring beauty, dwarf ginseng, canada goldenrod, whorled aster, wild potato vine, fireweed and black bindweed. No rare plants or wildlife signs.	N/A	Mixed stand, <20 Years
16	85-17/100-16		Recent clear cut, highly disturbed site. Regenerating vegetation includes sugar maple, balsam fir and speckled alder. Hay-scented fern, ground pine, dwarf ginseng, spring beauty, honeysuckle, Canada goldenrod, rough-stemmed goldenrod, fireweed, ginseng, black bindweed, hemp nettle and star flower are all present. No rare plants or wildlife concerns.	N/A	Cut Block or disturbed site, <10 years
17	85-18/100-17		Disturbed site, roadside clearing, < 10 years. Trembling aspen, white ask, sugar maple, white spruce and pin-cherry saplings. Ground cover includes tall goldenrod, field bindweed, hemp nettle, swamp candles, pearly everlasting, ox-eye daisy. No rare plants or wildlife signs.	N/A	Cut Block or disturbed site, <10 years
18	85-21/100-18		Recent clear cut 10 year balsam fir and sugar maple, with pin cherry and red osier dogwood. Wild raspberry, blackberry, honeysuckle, false lily-of-the-valley, white violet, white ash, rough-stemmed goldenrod, black bindweed. No rare plants. Moose Browse along main road at access point..	N/A	Cut Block or disturbed site, 10-20 years

19	85-22/100-19		Located on the edge of a cut block, this site has natural regrowth of balsam fir to the north, with some striped maple, white spruce, red osier dogwood, rose, and raspberry. Understorey vegetation includes soloman's seal, clintonia, hickey's clubmoss, gray birch, cinquefoil fireweed, slender ladies tresses and hawkweed. Abundant coarse woody debris and snags. Plantation of balsam fir to the south. No rare plants or	N/A	Cut Block or disturbed site, 10-20 years
20	85-23/100-20		~ 30 year old, even aged stand of white spruce with very little understorey. Star flower, false lily-of-the-valley, and sphagnum mosses. No rare plants or wildlife signs.	SH7	Softwood stand, >20 years
21	85-24/100-21		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. No rare plants. Some eye level browse, likely moose.	IH6	Hardwood stand, <20 years
22	85-25/100-22	stone wall present	10-15 year stand of sugar maple and striped maple, with occasional red maple, white spruce, white birch, balsam fir, american beech and pin cherry. Understorey includes spinulose wood fern, painted trillium, lily-of-the-valley. Shrubby vegetation includes rose, raspberry, honeysuckle and unknown goldenrod. No rare plants. Deer browse.	IH6	Hardwood stand, <20 years
23	85-28/100-23		~50 year old sugar maple stand, even aged, with occasional mature yellow birch. Young striped maple and american beech are common, ground cover includes common species such as honeysuckle and ostrich fern. No rare plants. Some deer browse.	TH2	Hardwood stand, 40+ years

24	85-19/100-24		Recent clear cut adjacent to 30+ year red spruce plantation. Clear cut has young balsam fir, red currant, red osier dogwood and raspberry, false lily-of-the-valley, white violet, star flower, hemp nettle, fireweed, black bindweed, white ash, rough-stemmed goldenrod and pearly everlasting. No rare plants, some deer browse.	N/A	Cut Block or disturbed site, <10 years
25	85-27/100-25		40+ year old sugar maple, and young striped maple. Understorey includes common species such as nodding trillium, honeysuckle, dwarf ginseng, white violet, wild potato vine. No rare plants or wildlife signs.	TH2	Hardwood stand, 40+ years
26	85-26/100-26		30+ year sugar maple stand with shrubby young striped maple, raspberry and honeysuckle. Understorey includes false lily-of-the-valley, wood sorrel, soloman's seal, white violet, spring beauty, star flower, clintonia, ground pine, wintergreen and hemp nettle. No rare plants or wildlife signs.	TH2	Hardwood Stand, 20-40 years
27	85-36/100-27		Pre-disturbed site. Cut block with occasional mature sugar maple, white birch and american beech. Abundant shrubby vegetation commonly found in disturbed sites, such as raspberry and rose. Lily-of-the-valley, ostrich fern, black bindweed and dwarf ginseng are also present. No rare plants. Some deer browse	N/A	Cut Block or disturbed site, <10 years
28		moved west to avoid wetland habitat and watercourses at 85-35/100-28. also to avoid potential habitat for moose access stone mounds	Site is in remnant hardwood patch, 30 years old, in the middle of a cut block at the wetland outflow. White and yellow birch, sugar maple and american beech, with very little understorey. Some young balsam fir, dwarf ginseng, rock polypody and new york fern. Access along wetland and cut block have tall manna-grass, soft bulrush, black bindweed, tall goldenrod, green and purple fringed orchis'. No rare plants, some deer browse.	N/A	Cut Block or disturbed site, <10 years

29	85-34/100-29	access stone mounds	Open, 20 year mixed stand, uneven aged. Contains sugar maple, yellow birch, american beech, white spruce and balsam fir. Abundant raspberry and bracken fern, rough-stemmed goldenrod. No rare plants or wildlife signs.	MW1	Mixed stand, 20+ Years
30	85-33/100-30		30 Year red spruce plantation. Very homogenous with common understorey plants such as dwarf ginseng, star-flower, lily-of-the-valley. No rare plants or wildlife signs.	MW1	Softwood stand, >20 years
31		moved west to avoid wetland habitat at 85-29/100-31 and setback from receptor follow up archaeo required- stone mounds and house	15 year old softwood stand of balsam fir and white spruce. Understorey is dominated by bunch-berry, false lily-of-the-valley, star flower, no rare plants or wildlife signs. Access through delineated wetland contains speckled alder, tall manna grass, sensitive fern, fringed green orchis, small-flowered bulrush, ostrich fern, turtle-head, spotted touch-me-not, halbred-leaved tear-thumb, gray birch, marsh hemp-nettle and hay-scented fern. No rare plants.	SH10	Softwood stand, <20 years
32	85-30/100-32		15 year hardwood stand, with sugar maple, yellow birch, white birch, and american beech. Understorey contains common species such as bracken fern, white violet, hay-scented fern, tall goldenrod, hemp-nettle, ox-eye daisy, pearly everlasting, heal-all and cinquefoil. No rare plants or wildlife signs.	TH1	Hardwood stand, <20 years
33	85-31/100-33		15 year red spruce plantation, with some red pine. Very homogenous, with very little understorey. Occasional Indian pipe and sugar maple sapling. Access has some balsam fir, sugar maple, tall goldenrod, spotted touch-me-not, and turtle-head. No rare plants or wildlife signs	SH5	Softwood stand, <20 years

34	85-32/100-34		30 Year red spruce plantation. Very homogenous with common understorey plants such as dwarf ginseng, star-flower, lily-of-the-valley and bracken fern. No rare plants or wildlife signs.	SH5	Softwood stand, >20 years
35	85-38/100-35		40+ year old sugar maple stand with understorey of striped maple and american beech. Ground cover includes clintonia, lily of the valley, wood sorrell, spring beauty, ostrich fern, soloman's seal, nodding trillium. Access has hawkweed, heal-all, hay-scented fern and broad-leaved plantain. No rare plants.	TH1	Hardwood stand, 40+ years
36	100-36		Thick 15-20 year red spruce plantation. Occasional indian pipe, small wet area has sensitive fern, ostrich fern and New York fern, spotted touch-me-not, halbred-leaved tear-thumb, tall buttercup. No rare plants or wildlife signs	SH5	Softwood stand, <20 years
37	100-37		~40 year old sugar maple stand with understorey of striped maple and american beech. Soloman's seal, ostrich fern, lily-of-the-valley, nodding trillium, and honeysuckle dominate the understorey. Occasional standing dead snag. No rare plants. Deer tracks and browse	TH2	Hardwood stand, 40+ years
38	100-38		Fairly open ~40 year sugar maple stand with frequent dead snags. Occasional young beech. Soloman's seal, ostrich fern, spring beauty, wood sorrel, starflower, dutchman's breeches and goldthread dominate the understorey. No rare plants.	TH2	Hardwood stand, 40+ years

39	85-42/100-39		Recent cut-block in an open rocky site. Regenerating red maple, sugar maple, grey birch, mountain ash, Plentiful raspberry and blackberry, with hay-scented fern, tall goldenrod, fireweed, black bindweed, pearly everlasting and other species common to disturbed sites. No rare plants. Some deer browse	N/A	Cut Block or disturbed site, <10 years
40	85-43/100-40		20 year hardwood stand composed of sugar maple, yellow birch, american beech and young balsam fir. Understorey contains common plants such as lily-of-the-valley, honeysuckle, partridge-berry, twin-flower. No rare plants or wildlife signs.	TH2	Hardwood Stand, 20-40 years
41	85-44/100-41		20 year black spruce stand, understorey contains only common plants such as star flower, lily-of-the-valley. Access along cut line. No rare plants	SP5	Softwood stand, >20 years
42	85-45/100-42		Balsam fir plantation, 20 years old. No understorey vegetation other than the occasional bunch-berry, lily of the valley and star flower	SH8	Softwood stand, >20 years
43	100-43	moved east to avoid wetland at 100-43	Very similar to 85-46. Balsam fir and white spruce stand. Tall, Canada and Rough-stemmed goldenrod, occasional sugar maple and yellow birch. No rare plants or wildlife signs.	SH10	Softwood stand, >20 years
44			~ 30 year old, even aged stand of white spruce with very little understorey. Star flower, false lily-of-the-valley, and sphagnum mosses. No rare plants or wildlife signs.	SH7	Softwood stand, >20 years

45	85-49/100-45		occasional standing balsam fir, white spruce and sugar maple. Understorey dwarf ginseng, yellow trout lily, hemp nettle, cinquefoil, ostrich fern and other common understorey species such as star flower and false lily-of-the-valley, plus nodding trillium. Remaining stand to the west is a young mixed stand, 15-20 years, of balsam fir, white spruce and sugar maple, with very little understorey. Coyote and deer tracks. No rare plants.	N/A	Cut Block or disturbed site, <10 years
46			Very open regenerating cut block. Blackberry shrubs throughout surrounded by young (10 year old) white birch, grey birch, balsam fir, sugar maple, striped maple and speckled alder. Understorey includes solomans seal, strawberry and black bindweed. No rare plants or wildlife signs.	N/A	Cut Block or disturbed site, <10 years
47	85-51/100-47		Uneven aged stand in a mosaic of old forestry roads. Main canopy cover is 30+ year sugar maple with common 15 year balsam fir. Striped maple and american beech are occasional. Understorey is dominated by dwarf ginseng and many species common to disturbed sites, such as raspberry and multi-flora rose. Black bindweed, heal-all, common hawkweed and ox-eye daisy are all present No rare plants, no wildlife signs.	MW1	Mixed stand, 20+ Years
48	85-52/100-48		~20 year old white spruce plantation. Completely homogenous, essentially no understorey vegetation. No rare plants. Deer scat is present.	SH7	Softwood stand, >20 years

49	100-49		Fairly open ~30 year old sugar maple stand with the occasional yellow birch and large-toothed aspen. Frequent standing dead snags. Understorey is young sugar maple, balsam fir, striped maple. Ground cover includes ostrich fern, painted trillium, dwarf ginseng, red currant, hickey's clubmoss, slender ladies' tresses, rough-stemmed goldenrod, lily of the valley, and starflower. Access road has grey birch, white pine and trembling aspen. No rare plants or wildlife signs.	TH2	Hardwood Stand, 20-40 years
50	100-50		Open meadow with young balsam fir and white spruce. Dominated by rough-stemmed goldenrod, dwarf raspberry, pearly everlasting, hemp nettle and tall cinquefoil. No rare plants. Bordered by red spruce plantation.	SH10	Softwood stand, <20 years
51	85-20/100-51		North of a more recent cut block, this site has been harvested within the past ~15 years, showing natural regrowth of sugar maple, white spruce, and occasional white birch and pin cherry. Sparsely vegetated understorey includes spinulose wood fern and white violet. Later in the season, understorey is dominated by blackberry, raspberry and black bindweed. No rare plants. Deer browse.	N/A	Cut Block or disturbed site, 10-20 years
52	100-52		Met tower site. Disturbed, ~5 year re-growth of red maple, and sugar maple. Plenty of shrubby vegetation including blackberry, raspberry and strawberry. Young white ash, black bindweed, pearly everlasting, small-flowered bulrush, cinquefoil and canada thistle. No rare plants	N/A	Cut Block or disturbed site, <10 years
53	100-53	Archaeological concern- stone mound	Young softwood stand similar to 85-37 with mainly white spruce and red spruce. Understorey is sparse, with common species such as bunchberry and lily of the valley. No rare plants.	SH6	Softwood stand, >20 years

54	85-55/100-54	moved to the north to avoid wetland habitat	40 year old stand, predominantly sugar maple with common standing dead snags and mature yellow birch. Understorey contains american beech, striped maple, ostrich fern, honeysuckle, soloman's seal, false soloman's seal, young balsam fir, clintonia, dwarf ginseng, long beech fern and bracken fern	TH2	Hardwood stand, 40+ years
55	100-55		Open, uneven-aged stand, with mature yellow birch, sugar maple, balsam fir and beech. Common understorey vegetation includes ginseng, bunchberry, hay-scented fern and bracken fern.	TH2	Hardwood Stand, 20-40 years
56	85-56/100-56		20+ year hardwood stand along roadside, similar to previous assessment (sugar maple with occasional yellow birch and american beech, dwarf ginseng, soloman's seal, spring beauty and star-flower comprising the sparse understorey), but with community of roadside species such as northern bedstraw, hay-scented fern, cinquefoil, pearly-everlasting, meadow-sweet, sheep-laurel, dwarf ginseng, hawkweed, Indian pipe and small-flowered bulrush.	TH1	Hardwood Stand, 20-40 years
57	85-57/100-57	moved southeast to avoid wetland habitat	40 year hardwood stand, sugar maple, beech and yellow birch. Sparse understorey contains bracken fern, wood sorrel, white violet, ginseng, honeysuckle and soloman's seal. No rare plants or wildlife signs. Access and site characteristics are very similar, no concerns.	TH2	Hardwood stand, 40+ years

58	85-58/100-58	moved south to avoid wetland habitat	Mature hardwood stand, 40 years old, sugar maple and yellow birch are dominant, with american beech and striped maple. Understorey has common species such as young balsam fir, honeysuckle, star flower, clintonia. No rare plants. Location has changed, but vegetation is similar, plus bracken fern, hay-scented fern, sensitive fern, wintergreen, hawkweed and cinquefoil.	TH1	Hardwood stand, 40+ years
59	100-59		Recent clearcut, dominated by ~5 year old sugar maple and occasional balsam fir. Some rushes, sensitive fern, strawberry and raspberry. No rare plants. Late assessment: Rock polypody, halbred-leaved tearthumb, hawksweed. Deer browse.	N/A	Cut Block or disturbed site, <10 years
60	85-60/100-60		40 year old hardwood stand, predominantly sugar maple, with some large yellow birch and young american beech. Understorey contains common species such as honeysuckle, soloman's seal, wood sorrel, white violet and dwarf ginseng. Site has moved, but veg is similar, plus partridge-berry, hemp nettle, oak fern, bracken fern and Indian cucumber-root. No rare plants	TH1	Hardwood stand, 40+ years
61	85-62/100-61		Cut block, very similar to 100-61, young regenerating sugar maple, with nodding trillium and soloman's seal. No rare plants. Site has moved, but contains the same vegetation, and remains in he same cut-block. Late season vegetation includes hemp nettle, common hawkweed, rock polypody, dogbane. Some deer browse and droppings	N/A	Cut Block or disturbed site, <10 years

62	100-62		Very open regenerating cut block. Blackberry shrubs throughout surrounded by young (10 year old) white birch, grey birch, balsam fir, sugar maple, striped maple and speckled alder. Understorey includes solomans seal, strawberry and black bindweed. No rare plants or wildlife signs.	N/A	Cut Block or disturbed site, <10 years
Field assessed - not included in possible layout Oct 2011					
A	85-14		5-10 year sugar maple stand, fairly disturbed site with young shrubby vegetation such as elderberry, red currant, raspberry, lily-of-the-valley, woodland strawberry, clintonia, pearly everlasting, fireweed, hawkweed, whorled aster and a few young yellow birch. No rare plants or wildlife signs.	N/A	Cut Block or disturbed site, <10 years
B	85-39		40+ year old sugar maple stand with understorey of striped maple and american beech. Soloman's seal, ostrich fern, lily-of-the-valley, nodding trillium, and honeysuckle dominate the understorey. Occasional standing dead snag. Wild potato vine. No rare plants.	TH2	Hardwood stand, 40+ years
C	85-40		Recently disturbed cut block. Occasional sugar maple and striped maple. Sedges and other vegetation common in disturbed sites. Swamp candles, blackberry, pearly everlasting, black bindweed, halbred-leaved tear-thumb, wintergreen, fireweed,	N/A	Cut Block or disturbed site, <10 years
D	85-41		Dense young understorey, disturbed site. Occasional mature sugar maple, predominantly 5-10 year old american beech, sugar maple, striped maple, grey birch and white poplar. Occasional balsam fir, raspberry and elderberry. Hemp nettle, wintergreen. No rare plants. Deer browse	N/A	Cut Block or disturbed site, <10 years

E	85-46		20 year balsam fir and white spruce forest. Wetland to the north, east and south. Extremely sparse understorey. No rare plants.	SH10	Softwood stand, >20 years
F	85-47		occasional sugar maple and white spruce. Sparse understorey vegetation contains only common plants. Deer tracks and scat, no rare plants.	SH8	Softwood stand, >20 years
G	85-48		~20 year stand of sugar maple and occasional white spruce and balsam fir. Very sparse understorey. No rare plants.	MW4	Mixed stand, 20+ Years
H	100-44		Even-aged stand of sugar maple, ~25 years old. Full canopy coverage with open understorey dominated by ostrich fern, grasses, starflower and lily of the valley. No rare plants.	TH2	Hardwood Stand, 20-40 years
I	85-50/100-46		Site and access road are through a 15-20 year red spruce plantation, with very little understorey. Indian pipe, northern bedstraw, and some sensitive fern in a small clearing. No rare plants, some deer browse.	SH6	Softwood stand, <20 years
J	85-37		Young softwood stand (20-30 years), dominated by balsam fir and red spruce, with the occasional red maple and grey birch. Sphagnum mosses and bunch-berry dominate the ground cover, trout lily is occasional. Reassessment includes meadow-sweet, pearly everlasting, cinquefoil, tall goldenrod, hay-scented fern, low-bush blueberry and green fringed orchis. No rare plants	SH6	Softwood stand, >20 years
K	85-53		Thick, dense young softwood stand. <20 years old, containing balsam fir and white spruce, with occasional sugar maple. Understorey is extremely sparse, only lily of the valley, star flower and bunch-berry exist. No rare plants.	SH10	Softwood stand, <20 years

L	85-59		20 year old hardwood stand on edge of cut-block, predominantly sugar maple, but yellow birch, american beech, balsam fir and striped maple are all present. Understorey is sparse, contains lily of the valley, ostrich fern, dwarf ginseng, soloman's seal. Late season vegetation includes hemp-nettle, hay-scented fern, Canada goldenrod, scentless chamomile, hawkweed, small-flowered bulrush, and ox-eye daisy.	N/A	Cut Block or disturbed site, 10-20 years
M	85-61		40+ year old sugar maple stand with large yellow birch and occasional american beech and striped maple. Ground cover includes clintonia, lily of the valley, wood sorrel, star flower, honeysuckle and the occasional dwarf ginseng. Access is through same forest stand with similar vegetation. Late assessment includes black bindweed, swamp candles, hemp nettle, water horehound, northern bedstraw. Drainage areas have sensitive fern, field horsetail, spotted touch-me-not, long beech fern and ostrich fern. No rare plants.	TH2	Hardwood stand, 40+ years
N	85-13		20 year old white spruce stand. Quite dense with the occasional sugar maple. Understorey vegetation is sparse, but includes lily-of-the-valley, painted trillium, ground pine and soloman's seal.	SH10	Softwood stand, >20 years
O	85-54		15 year red spruce plantation, with very sparse understorey. Low-bush blueberry, cinquefoil, tall goldenrod. No rare plants or wildlife signs.	SH5	Softwood stand, <20 years

Appendix VI. ATLANTIC CANADA CONSERVATION DATA CENTER DOCUMENTED SPECIES OBSERVATIONS

Atlantic Canada Conservation Data Centre
Centre de données sur la conservation du Canada Atlantique

DATA REPORT 4355: Glen Dhu South, NS

Prepared 21 January, 2011
by S.H. Gerriets

CONTENTS OF REPORT

1.0 PREFACE

The Atlantic Canada Conservation Data Centre (ACCDC) is part of a network of circa 85 NatureServe data centres and heritage programs in 50 states, 10 provinces and 1 territory, plus several Central and South American countries. The NatureServe network is more than 30 years old and shares a common conservation data methodology. The ACCDC was founded in 1997, and maintains data for the jurisdictions of New Brunswick, Nova Scotia, Prince Edward Island, Newfoundland and Labrador. Although a non-governmental agency, the ACCDC is supported by 6 federal agencies, plus 4 provincial governments, outside grants and data processing fees. URL: www.ACCDC.com.

Upon request and for a fee, the ACCDC reports known observations of rare and endangered flora and fauna, in and near a specified study area. As a supplement to that data, the ACCDC includes locations of managed areas with some level of protection, and also known sites of ecological interest. Data summarised in each report is attached as DBF files which may be opened from within data software (Excel, Access) or mapped in GIS (ArcView, MapInfo, AutoCAD).

1.1 RESTRICTIONS

The ACCDC makes a strong effort to verify the accuracy of all the data that it manages, but it shall not be held responsible for any inaccuracies in data that it provides. By receiving ACCDC data, recipients assent to the following limits of use:

a.) Data is restricted to use by trained personnel who are sensitive to its potential threat to rare and endangered taxa.
b.) Data is restricted to use by the specified Data User; any third party requiring data must make its own data request.
c.) The ACCDC requires Data Users to cease using and delete data 12 months after receipt.
d.) ACCDC data responses are restricted to that data in our Data System at the time of the data request.
e.) Data is qualified as to location (Precision) and time (SurveyDate); cf Data Dictionary for details.
f.) ACCDC data reports are not to be construed as exhaustive inventories of taxa in an area.
g.) The non-occurrence of a taxon cannot be inferred by its absence in an ACCDC data report.

1.2 ADDITIONAL INFORMATION

Please direct biological questions about ACCDC data to: Sean Blaney, ACCDC: (506) 364-2658, and technical data queries to: Stefen Gerriets, ACCDC: (506) 364-2657.
For provincial information on rare taxa and protected areas, or information on game animals, deer yards, old growth forest, archeological sites, fish habitat etc, please contact Sherman Boates, NSDNR: (902) 679-6146.

2.0 RARE AND ENDANGERED TAXA

A 100km buffer around the study area contains 2483 records of 409 taxa from 91 sources, a relatively low-to-moderate density of records (quintile 2): 0.08 rec/km2.

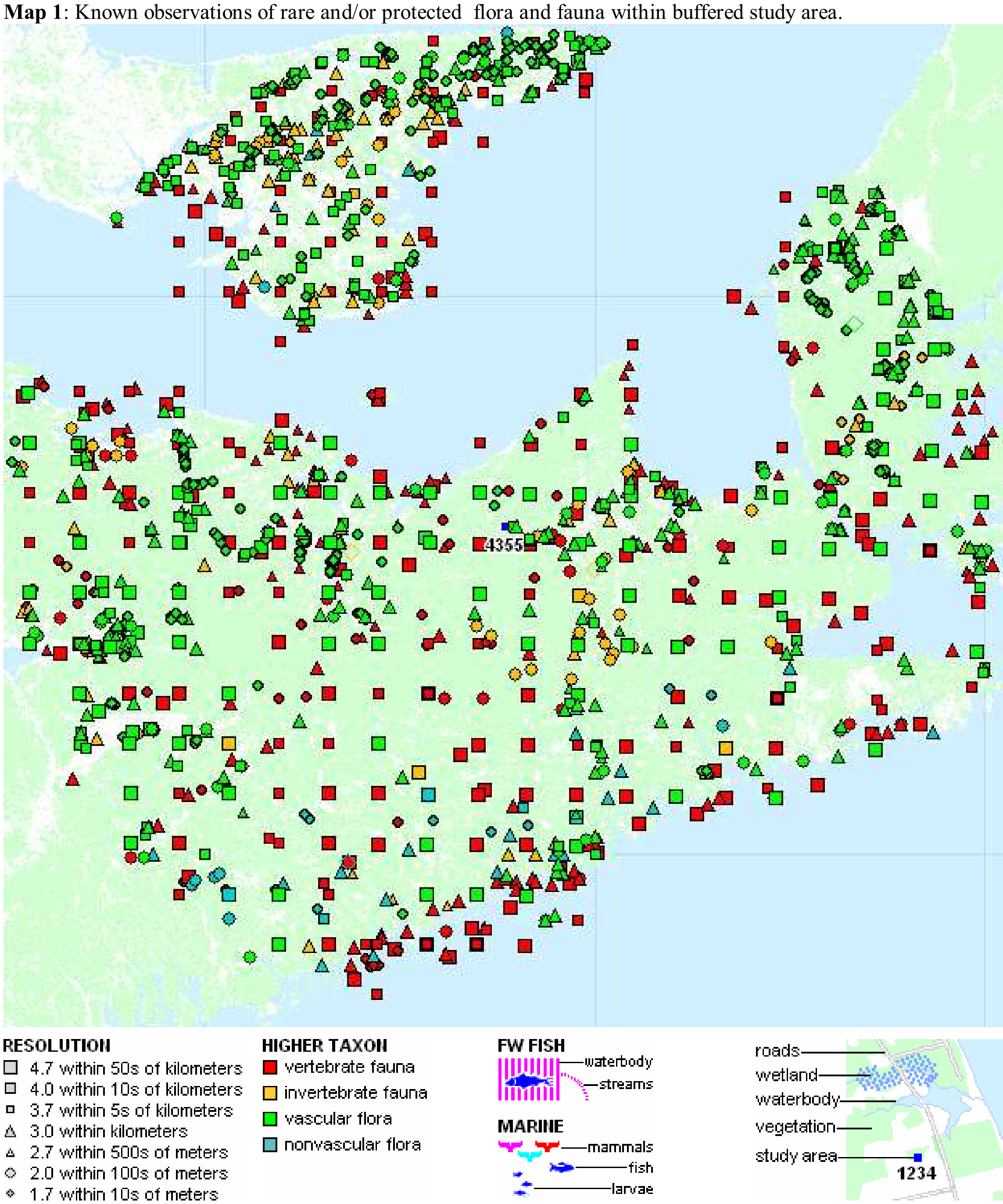
2.1 FLORA

A 100km buffer around the study area contains 1155 records of 267 vascular, 56 records of 15 nonvascular flora (see attached *ob.dbf).

2.2 FAUNA

A 100km buffer around the study area contains 963 records of 56 vertebrate, 309 records of 71 invertebrate fauna (cf attached *ob.dbf). Sensitive data: Wood Turtles are PRESENT in the study area (cf attached WOTU.rtf).

Map 1: Known observations of rare and/or protected flora and fauna within buffered study area.

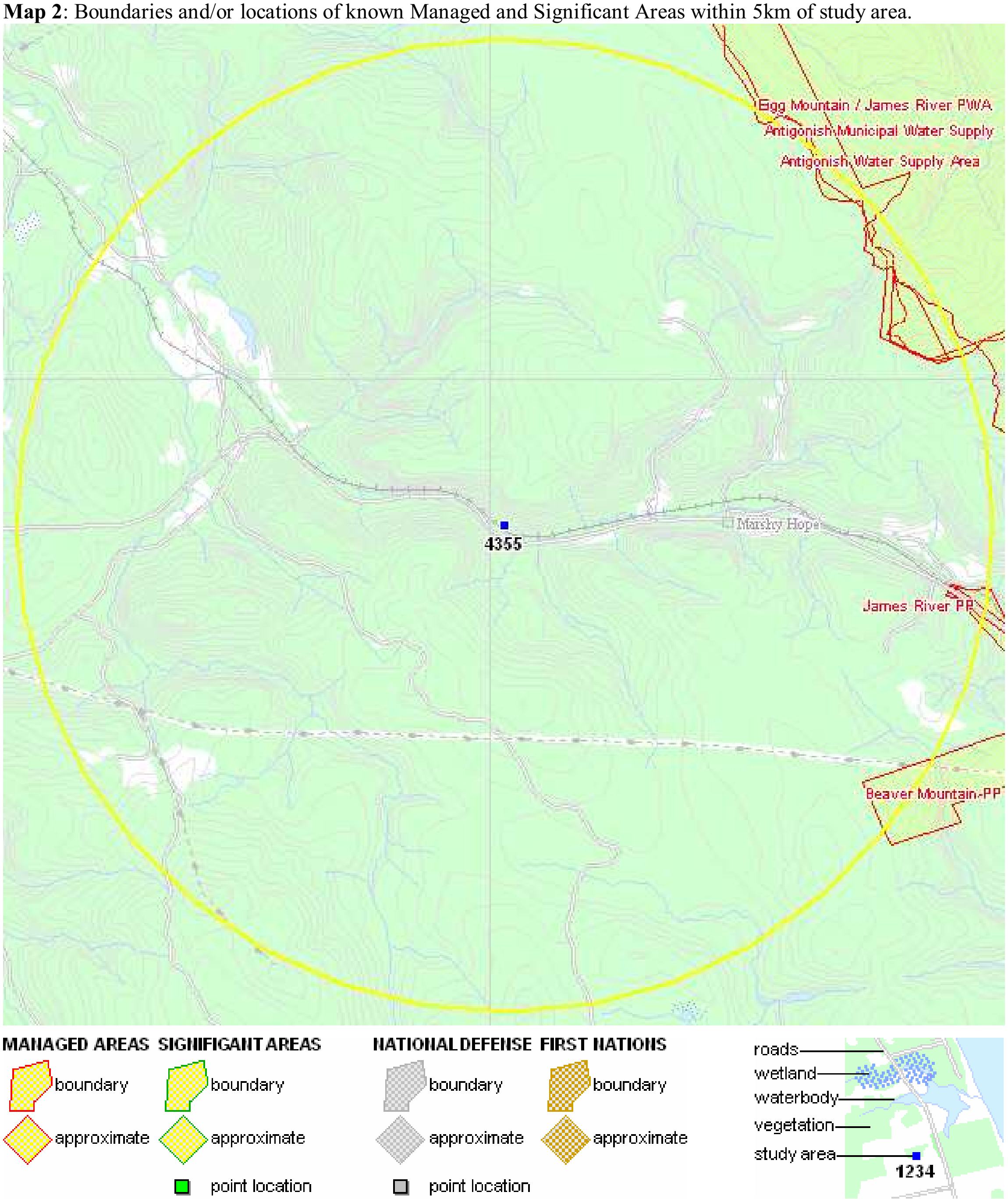


3.0 SPECIAL AREAS

3.1 MANAGED AREAS
The GIS scan identified 5 Managed Areas with some degree of protected status, in the vicinity of the study area (see attached *ma.dbf).

3.2 SIGNIFICANT AREAS
No biologically significant sites were identified.

Map 2: Boundaries and/or locations of known Managed and Significant Areas within 5km of study area.



4.0 TAXON LISTS

Rare and/or endangered taxa within the buffered area listed in order of concern, beginning with legally listed taxa, with the number of observations per taxon and the distance in kilometers from study area centroid to the closest observation. [p] = vascular plant, [n] = nonvascular plant, [a] = vertebrate animal, [i] = invertebrate animal, [c] = community.

4.1 FLORA

	scientific name	common name	prov. rarity	prov. status	COSEWIC	obs	dist.km
n	Erioderma pedicellatum (Atlantic pop.)	Boreal Felt Lichen (Atlantic pop.)	S1S2	Endangered	E	40	39 ±1
p	Floerkea proserpinacoides	False Mermaidweed	S2		NAR	11	27 ±1
p	Thuja occidentalis	Eastern White Cedar	S1S2	Vulnerable		3	77 ±10
n	Tetrodontium brownianum	Little Georgia	S1			1	96 ±0.5
n	Ditrichum rhynchostegium	a Moss	S1			1	68 ±0.1
n	Bryhnia graminicolor	a Moss	S1			1	78 ±0.5
p	Ophioglossum pusillum	Northern Adder's-tongue	S1			1	99 ±0
p	Equisetum palustre	Marsh Horsetail	S1			1	79 ±0
p	Dryopteris filix-mas	Male Fern	S1			1	97 ±0
p	Cystopteris laurentiana	Laurentian Bladder Fern	S1			2	94 ±1
p	Cryptogramma stelleri	Steller's Rockbrake	S1			5	87 ±0.1
p	Adiantum pedatum	Northern Maidenhair Fern	S1			1	87 ±1
p	Sparganium fluctuans	Floating Burreed	S1			1	86 ±5
p	Potamogeton nodosus	Long-leaved Pondweed	S1			1	68 ±5
p	Sphenopholis intermedia	Slender Wedge Grass	S1			1	98 ±0
p	Elymus hystrix var. bigeloviana	Spreading Wild Rye	S1			1	33 ±1
p	Elymus wiegandii	Wiegand's Wild Rye	S1			7	34 ±0
p	Cinna arundinacea	Sweet Wood Reed Grass	S1			2	75 ±0
p	Bromus latiglumis	Broad-Glumed Brome	S1			2	75 ±0
p	Spiranthes ochroleuca	Yellow Ladies'-tresses	S1			5	87 ±0.1
p	Malaxis brachypoda	White Adder's-Mouth	S1			1	55 ±10
p	Goodyera oblongifolia	Menzies' Rattlesnake-plantain	S1			1	94 ±0.1
p	Triantha glutinosa	Sticky False Asphodel	S1			2	96 ±0
p	Allium tricoccum	Wild Leek	S1			2	67 ±0.1
p	Iris prismatica	Slender Blue Flag	S1			2	37 ±10
p	Scirpus pedicellatus	Stalked Bulrush	S1			2	75 ±0
p	Rhynchospora capillacea	Slender Beakrush	S1			2	90 ±1
p	Cyperus lupulinus ssp. macilentus	Hop Flatsedge	S1			4	16 ±10
p	Carex wiegandii	Wiegand's Sedge	S1			1	56 ±5
p	Carex viridula var. elatior	Greenish Sedge	S1			1	96 ±0
p	Carex tuckermanii	Tuckerman's Sedge	S1			1	46 ±0.1
p	Carex tincta	Tinged Sedge	S1			2	35 ±1
p	Carex tenuiflora	Sparse-Flowered Sedge	S1			1	81 ±1
p	Carex rostrata	Narrow-leaved Beaked Sedge	S1			1	92 ±5
p	Carex plantaginea	Plantain-Leaved Sedge	S1			3	59 ±0
p	Carex pellita	Woolly Sedge	S1			3	35 ±0
p	Carex haydenii	Hayden's Sedge	S1			3	2 ±5
p	Carex gynocrates	Northern Bog Sedge	S1			1	98 ±0.1
p	Carex garberi	Garber's Sedge	S1			1	67 ±0
p	Carex bromoides	Bromelike Sedge	S1			3	88 ±0
p	Carex argyrantha	Silvery-flowered Sedge	S1			1	61 ±5
p	Carex alopecoidea	Foxtail Sedge	S1			1	35 ±0.5
p	Viola canadensis	Canada Violet	S1			2	79 ±10
p	Pilea pumila	Dwarf Clearweed	S1			6	16 ±10
p	Scrophularia lanceolata	Lance-leaved Figwort	S1			1	56 ±10
p	Salix candida	Sage Willow	S1			1	96 ±0
p	Montia fontana	Water Blinks	S1			1	68 ±1
p	Ribes americanum	Wild Black Currant	S1			1	86 ±5
p	Desmodium canadense	Canada Tick-trefoil	S1			3	36 ±0
p	Cuscuta cephalanthi	Buttonbush Dodder	S1			4	26 ±10
p	Crassula aquatica	Water Pygmyweed	S1			1	100 ±5
p	Hudsonia tomentosa	Woolly Beach-heath	S1			5	17 ±10
p	Hudsonia ericoides	Pinebarren Golden Heather	S1			4	87 ±0
p	Suaeda maritima ssp. richii	White Sea-blite	S1			3	30 ±10
p	Lobelia spicata	Pale-Spiked Lobelia	S1			1	99 ±10
p	Lobelia kalmii	Brook Lobelia	S1			6	77 ±0
p	Cochlearia tridactylites	Limestone Scurvy-grass	S1			5	74 ±10
p	Cardamine pratensis var. angustifolia	Cuckoo Flower	S1			2	89 ±10
p	Ageratina altissima	White Snakeroot	S1			2	26 ±10
p	Hieracium umbellatum	Umbellate Hawkweed	S1			1	61 ±5
p	Pseudognaphalium obtusifolium	Eastern Cudweed	S1			1	68 ±1
p	Bidens hyperborea	Estuary Beggarticks	S1			1	25 ±1
p	Arnica lonchophylla	Northern Arnica	S1			1	95 ±10
p	Antennaria parlinii	Parlin's Pussytoes	S1			1	61 ±0
p	Zizia aurea	Golden Alexanders	S1			8	25 ±0.1
p	Sanicula odorata	Clustered Sanicle	S1			4	41 ±0
n	Sphagnum flavicomans	a Peatmoss	S1?			1	98 ±0.1
n	Dicranum leioneuron	a Moss	S1?			1	98 ±0.1
n	Dicranum bonjeanii	a Moss	S1?			1	90 ±0.1
p	Dichanthelium acuminatum var. lindheimeri	Woolly Panic Grass	S1?			1	30 ±0.1
p	Triglochin gaspensis	Gaspé Arrowgrass	S1?			4	85 ±5
p	Schoenoplectus robustus	Sturdy Bulrush	S1?			1	99 ±10
p	Viola sagittata var. ovata	Arrow-Leaved Violet	S1?			1	99 ±1
p	Rubus pensilvanicus	Pennsylvania Blackberry	S1?			3	56 ±5
p	Rubus flagellaris	Northern Dewberry	S1?			1	100 ±5
p	Crataegus submollis	Quebec Hawthorn	S1?			3	8 ±10

p	Crataegus robinsonii	Robinson's Hawthorn	S1?	3	26 ±50.1
p	Amelanchier stolonifera	Running Serviceberry	S1?	5	53 ±1
p	Humulus lupulus var. lupuloides	Common Hop	S1?	2	57 ±5
p	Hypericum majus	Large St. John's-wort	S1?	1	98 ±0
p	Chenopodium rubrum	Red Pigweed	S1?	3	30 ±10
p	Atriplex acadiensis	Maritime Saltbush	S1?	1	17 ±10
p	Solidago hispida	Hairy Goldenrod	S1?	1	50 ±10
n	Campylostelium saxicola	a Moss	S1S2	1	96 ±0.5
p	Botrychium lanceolatum	Triangle Moonwort	S1S2	1	93 ±0.1
p	Sparganium hyperboreum	Northern Burreed	S1S2	3	67 ±0.1
p	Platanthera flava var. herbiola	Tubercled Orchid	S1S2	1	65 ±0
p	Juncus alpinoarticulatus ssp. nodulosus	Alpine Rush	S1S2	4	76 ±0
p	Juncus greenei	Greene's Rush	S1S2	2	32 ±5
p	Carex tenera	Tender Sedge	S1S2	3	52 ±5
p	Carex pensylvanica	Pennsylvania Sedge	S1S2	1	5 ±0
p	Carex bebbii	Bebb's Sedge	S1S2	7	25 ±10
p	Gratiola neglecta	Clammy Hedge-Hyssop	S1S2	2	82 ±0.1
p	Hepatica nobilis var. obtusa	Round-lobed Hepatica	S1S2	5	57 ±0
p	Anemone virginiana var. alba	Virginia Anemone	S1S2	5	77 ±10
p	Sagina nodosa ssp. borealis	Knotted Pearlwort	S1S2	2	92 ±5
p	Sagina nodosa	Knotted Pearlwort	S1S2	1	99 ±0.5
p	Huperzia selago	Northern Firmoss	S1S3	2	81 ±5
p	Carex vacillans	Estuarine Sedge	S1S3	1	35 ±0.5
p	Equisetum pratense	Meadow Horsetail	S2	5	78 ±0.1
p	Woodsia glabella	Smooth Cliff Fern	S2	2	94 ±0.1
p	Polystichum lonchitis	Northern Holly Fern	S2	3	80 ±100
p	Dryopteris fragrans var. remotiuscula	Fragrant Wood Fern	S2	4	65 ±10
p	Asplenium trichomanes-ramosum	Green Spleenwort	S2	3	92 ±1
p	Asplenium trichomanes	Maidenhair Spleenwort	S2	1	65 ±0.1
p	Potamogeton friesii	Fries' Pondweed	S2	4	75 ±0
p	Piptatherum canadense	Canada Rice Grass	S2	2	96 ±1
p	Spiranthes lucida	Shining Ladies'-Tresses	S2	10	33 ±1
p	Platanthera macrophylla	Large Round-Leaved Orchid	S2	3	62 ±5
p	Platanthera flava var. flava	Tubercled Orchid	S2	1	67 ±10
p	Platanthera flava	Tubercled Orchid	S2	3	65 ±0
p	Listera convallarioides	Broad-Leaved Twayblade	S2	10	93 ±0
p	Listera australis	Southern Twayblade	S2	5	75 ±10
p	Goodyera tesselata	Checkered Rattlesnake-Plantain	S2	10	74 ±0.5
p	Cypripedium reginae	Showy Lady's-Slipper	S2	15	46 ±10
p	Cypripedium parviflorum var. makasin	Yellow Lady's-slipper	S2	1	87 ±0.1
p	Cypripedium parviflorum var. pubescens	Yellow Lady's-slipper	S2	6	29 ±0
p	Allium schoenoprasum var. sibiricum	Wild Chives	S2	2	88 ±10
p	Vallisneria americana	Wild Celery	S2	1	94 ±1
p	Eriophorum gracile	Slender Cottongrass	S2	4	70 ±1
p	Eleocharis quinqueflora	Few-flowered Spikerush	S2	4	76 ±0
p	Carex hystericina	Porcupine Sedge	S2	8	56 ±5
p	Carex comosa	Bearded Sedge	S2	3	69 ±0.1
p	Carex atratiformis	Scabrous Black Sedge	S2	2	94 ±1
p	Carex atlantica ssp. capillacea	Atlantic Sedge	S2	1	42 ±10
p	Viola nephrophylla	Northern Bog Violet	S2	9	36 ±0
p	Limosella australis	Southern Mudwort	S2	6	56 ±1
p	Tiarella cordifolia	Heart-leaved Foamflower	S2	10	42 ±10
p	Saxifraga paniculata ssp. neogaea	White Mountain Saxifrage	S2	1	88 ±10
p	Parnassia palustris var. parviflora	Marsh Grass-of-Parnassus	S2	2	19 ±1
p	Comandra umbellata	Bastard's Toadflax	S2	3	35 ±10
p	Salix pedicellaris	Bog Willow	S2	6	39 ±10
p	Galium labradoricum	Labrador Bedstraw	S2	6	88 ±0.1
p	Ranunculus gmelinii	Gmelin's Water Buttercup	S2	10	58 ±5
p	Ranunculus flammula var. flammula	Lesser Spearwort	S2	2	28 ±10
p	Caltha palustris	Yellow Marsh Marigold	S2	2	19 ±0.1
p	Anemone virginiana var. virginiana	Virginia Anemone	S2	1	92 ±10
p	Anemone virginiana	Virginia Anemone	S2	5	35 ±1
p	Anemone quinquefolia	Wood Anemone	S2	4	50 ±0.5
p	Anemone canadensis	Canada Anemone	S2	2	53 ±0.1
p	Pyrola minor	Lesser Pyrola	S2	1	97 ±10
p	Samolus valerandi ssp. parviflorus	Seaside Brookweed	S2	2	20 ±1
p	Primula mistassinica	Mistassini Primrose	S2	4	65 ±10
p	Plantago rugelii	Rugel's Plantain	S2	2	40 ±0
p	Rumex salicifolius var. mexicanus	Triangular-valve Dock	S2	3	77 ±10
p	Polygonum arifolium	Halberd-leaved Tearthumb	S2	5	58 ±1
p	Oenothera fruticosa ssp. glauca	Narrow-leaved Evening Primrose	S2	3	39 ±10
p	Myriophyllum farwellii	Farwell's Water Milfoil	S2	5	14 ±10
p	Chamaesyce polygonifolia	Seaside Spurge	S2	1	58 ±1
p	Vaccinium caespitosum	Dwarf Bilberry	S2	1	78 ±1
p	Vaccinium boreale	Northern Blueberry	S2	4	68 ±1
p	Empetrum eamesii ssp. atropurpureum	Pink Crowberry	S2	1	91 ±5
p	Empetrum eamesii	Pink Crowberry	S2	3	87 ±0
p	Shepherdia canadensis	Soapberry	S2	5	74 ±0.5
p	Triosteum aurantiacum	Orange-fruited Tinker's Weed	S2	28	16 ±10
p	Stellaria humifusa	Saltmarsh Starwort	S2	8	65 ±0.1
p	Draba arabisans	Rock Whitlow-Grass	S2	1	94 ±1
p	Arabis drummondii	Drummond's Rockcress	S2	2	87 ±1
p	Betula michauxii	Newfoundland Dwarf Birch	S2	9	59 ±0.5
p	Betula borealis	Northern Birch	S2	1	94 ±10
p	Caulophyllum thalictroides	Blue Cohosh	S2	9	29 ±10
p	Impatiens pallida	Pale Jewelweed	S2	6	30 ±10

p	Senecio pseudoarnica	Seabeach Ragwort	S2	6	67 ±1
p	Rudbeckia laciniata var. gaspereauensis	Cut-Leaved Coneflower	S2	2	26 ±10
p	Rudbeckia laciniata	Cut-Leaved Coneflower	S2	5	69 ±0
p	Hieracium robinsonii	Robinson's Hawkweed	S2	2	65 ±10
p	Erigeron philadelphicus	Philadelphia Fleabane	S2	4	16 ±10
p	Panax trifolius	Dwarf Ginseng	S2	21	65 ±5
p	Osmorhiza longistylis	Smooth Sweet Cicely	S2	10	33 ±0
p	Conioselinum chinense	Chinese Hemlock-parsley	S2	1	53 ±5
n	Platydictya jungermannioides	a Moss	S2?	1	76 ±0
n	Calliergon giganteum	a Moss	S2?	1	88 ±1
n	Buxbaumia aphylla	Bug On a Stick	S2?	1	84 ±0.5
n	Atrichum crispum	a Moss	S2?	2	84 ±0.5
p	Dichanthelium linearifolium	Narrow-leaved Panic Grass	S2?	1	35 ±10
p	Juncus dudleyi	Dudley's Rush	S2?	8	35 ±0
p	Eleocharis ovata	Ovate Spikerush	S2?	1	70 ±0.5
p	Carex peckii	Peck's Sedge	S2?	1	83 ±0.1
p	Carex houghtoniana	Houghton's Sedge	S2?	1	95 ±5
p	Amelanchier fernaldii	Fernald's Serviceberry	S2?	3	78 ±1
p	Epilobium coloratum	Purple-veined Willowherb	S2?	2	27 ±0.5
p	Symphyotrichum boreale	Boreal Aster	S2?	7	87 ±0.1
p	Hieracium kalmii var. kalmii	Kalm's Hawkweed	S2?	1	71 ±5
p	Hieracium kalmii	Kalm's Hawkweed	S2?	1	60 ±1
n	Fissidens bryoides	a Moss	S2S3	1	96 ±0.5
n	Dicranella subulata	Awl-Leaved Fork Moss	S2S3	2	74 ±1
n	Amblystegium varium	a Moss	S2S3	1	78 ±0.5
p	Botrychium simplex	Least Moonwort	S2S3	2	26 ±0
p	Botrychium lanceolatum var. angustisegmentum	Triangle Moonwort	S2S3	9	26 ±0
p	Lycopodium hickeyi	Hickey's Tree-clubmoss	S2S3	1	66 ±0.1
p	Potamogeton zosteriformis	Flat-stemmed Pondweed	S2S3	5	86 ±10
p	Potamogeton richardsonii	Richardson's Pondweed	S2S3	4	38 ±1
p	Potamogeton obtusifolius	Blunt-leaved Pondweed	S2S3	8	15 ±10
p	Stuckenia filiformis ssp. alpina	Thread-leaved Pondweed	S2S3	3	84 ±1
p	Stuckenia filiformis	Thread-leaved Pondweed	S2S3	2	86 ±10
p	Poa glauca	Glaucous Blue Grass	S2S3	2	94 ±1
p	Calamagrostis stricta var. stricta	Slim-stemmed Reed Grass	S2S3	4	87 ±0
p	Calamagrostis stricta	Slim-stemmed Reed Grass	S2S3	5	83 ±0
p	Alopecurus aequalis	Short-awned Foxtail	S2S3	6	9 ±1
p	Spiranthes romanzoffiana	Hooded Ladies'-Tresses	S2S3	5	66 ±5
p	Cypripedium parviflorum	Yellow Lady's-slipper	S2S3	7	12 ±0.5
p	Lilium canadense	Canada Lily	S2S3	32	2 ±1
p	Eleocharis olivacea	Yellow Spikerush	S2S3	2	19 ±5
p	Carex hirtifolia	Pubescent Sedge	S2S3	14	33 ±0
p	Carex adusta	Lesser Brown Sedge	S2S3	4	65 ±5
p	Salix pellita	Satiny Willow	S2S3	1	67 ±1
p	Polygonum raii	Sharp-fruited Knotweed	S2S3	4	63 ±1
p	Polygonum ramosissimum var. ramosissimum	Bushy Knotweed	S2S3	2	98 ±5
p	Polygonum ramosissimum	Bushy Knotweed	S2S3	2	98 ±0
p	Polygonum buxiforme	Small's Knotweed	S2S3	1	88 ±10
p	Polygala sanguinea	Blood Milkwort	S2S3	5	33 ±1
p	Fraxinus nigra	Black Ash	S2S3	31	8 ±1
p	Hedeoma pulegioides	American False Pennyroyal	S2S3	3	25 ±5
p	Halenia deflexa	Spurred Gentian	S2S3	3	52 ±1
p	Hypericum dissimulatum	Disguised St John's-wort	S2S3	1	62 ±1
p	Suaeda calceoliformis	Horned Sea-blite	S2S3	6	39 ±1
p	Betula pumila	Bog Birch	S2S3	7	72 ±0
p	Symphyotrichum ciliolatum	Fringed Blue Aster	S2S3	4	28 ±10
p	Asclepias incarnata ssp. pulchra	Swamp Milkweed	S2S3	4	93 ±1
p	Schizaea pusilla	Little Curlygrass Fern	S3	2	63 ±0
p	Botrychium dissectum	Cut-leaved Moonwort	S3	3	17 ±1
p	Isoetes acadiensis	Acadian Quillwort	S3	1	85 ±1
p	Equisetum variegatum	Variegated Horsetail	S3	8	35 ±0
p	Sparganium natans	Small Burreed	S3	10	18 ±1
p	Dichanthelium clandestinum	Deer-tongue Panic Grass	S3	1	47 ±5
p	Platanthera orbiculata	Small Round-leaved Orchid	S3	17	53 ±0
p	Platanthera hookeri	Hooker's Orchid	S3	1	65 ±0.1
p	Platanthera grandiflora	Large Purple Fringed Orchid	S3	13	20 ±5
p	Goodyera repens	Lesser Rattlesnake-plantain	S3	10	60 ±1
p	Corallorhiza trifida	Early Coralroot	S3	10	57 ±0
p	Juncus subcaudatus	Woodland Rush	S3	2	36 ±10
p	Carex rosea	Rosy Sedge	S3	5	35 ±0
p	Carex lupulina	Hop Sedge	S3	2	41 ±0
p	Carex eburnea	Bristle-leaved Sedge	S3	1	26 ±5
p	Verbena hastata	Blue Vervain	S3	16	29 ±1
p	Laportea canadensis	Canada Wood Nettle	S3	7	34 ±0
p	Geocaulon lividum	Northern Comandra	S3	2	75 ±10
p	Salix petiolaris	Meadow Willow	S3	5	58 ±0
p	Galium kamtschaticum	Northern Wild Licorice	S3	4	88 ±1
p	Agrimonia gryposepala	Hooked Agrimony	S3	11	34 ±0
p	Rhamnus alnifolia	Alder-leaved Buckthorn	S3	22	68 ±5
p	Pyrola asarifolia	Pink Pyrola	S3	9	69 ±0
p	Rumex maritimus	Sea-Side Dock	S3	8	34 ±0
p	Polygonum scandens	Climbing False Buckwheat	S3	10	26 ±10
p	Polygonum pensylvanicum	Pennsylvania Smartweed	S3	10	34 ±0
p	Epilobium strictum	Downy Willowherb	S3	7	44 ±0.5
p	Decodon verticillatus	Swamp Loosestrife	S3	1	95 ±5
p	Teucrium canadense	Canada Germander	S3	3	35 ±0

p	Proserpinaca pectinata	Comb-leaved Mermaidweed	S3			1	57 ±1
p	Proserpinaca palustris var. crebra	Marsh Mermaidweed	S3			5	75 ±0
p	Viburnum edule	Squashberry	S3			1	58 ±0
p	Stellaria longifolia	Long-leaved Starwort	S3			6	67 ±1
p	Campanula aparinoides	Marsh Bellflower	S3			17	2 ±1
p	Packera paupercula	Balsam Groundsel	S3			6	35 ±0
p	Megalodonta beckii	Water Beggarticks	S3			7	18 ±0.5
p	Erigeron hyssopifolius	Hyssop-leaved Fleabane	S3			4	13 ±0.1
p	Bidens connata	Purple-stemmed Beggarticks	S3			12	56 ±0.1
p	Asclepias incarnata	Swamp Milkweed	S3			15	28 ±10
p	Polypodium appalachianum	Appalachian Polypody	S3?			1	81 ±0
p	Lycopodium sitchense	Sitka Clubmoss	S3?			4	31 ±1
p	Lycopodium sabinifolium	Ground-Fir	S3?			7	5 ±5
p	Potamogeton praelongus	White-stemmed Pondweed	S3?			9	8 ±1
p	Carex tribuloides	Blunt Broom Sedge	S3?			2	65 ±1
p	Carex foenea	Hay Sedge	S3?			5	7 ±0
p	Lycopodiella appressa	Southern Bog Clubmoss	S3S4			2	50 ±1
p	Lycopodium complanatum	Northern Clubmoss	S3S4			2	65 ±0.1
p	Equisetum scirpoides	Dwarf Scouring-Rush	S3S4			4	80 ±1
p	Cystopteris bulbifera	Bulblet Bladder Fern	S3S4			8	22 ±1
p	Trisetum spicatum	Narrow False Oats	S3S4			1	36 ±0
p	Liparis loeselii	Loesel's Twayblade	S3S4			10	58 ±5
p	Juncus nodosus	Knotted Rush	S3S4			7	54 ±5
p	Sisyrinchium angustifolium	Narrow-leaved Blue-eyed-grass	S3S4			2	34 ±0
p	Lindernia dubia	Yellow-seeded False Pimperel	S3S4			7	36 ±0
p	Polygonum robustius	Stout Smartweed	S3S4			1	75 ±0
p	Sanguinaria canadensis	Bloodroot	S3S4			17	34 ±0
p	Utricularia gibba	Humped Bladderwort	S3S4			2	28 ±10
p	Myriophyllum sibiricum	Siberian Water Milfoil	S3S4			1	97 ±0.1
p	Atriplex franktonii	Frankton's Saltbush	S3S4			2	72 ±1
p	Isoetes lacustris	Lake Quillwort	S4			10	24 ±1
p	Stellaria crassifolia	Fleshy Stitchwort	SH			1	87 ±1
p	Solidago simplex var. randii	Sticky Goldenrod	SH			2	62 ±5
p	Lactuca hirsuta var. sanguinea	Hairy Lettuce	SH			2	98 ±5

4.2 FAUNA

	scientific name	common name	prov. rarity	prov. status	COSEWIC	obs	dist.km
a	Sterna dougallii	Roseate Tern	S1B	Endangered	E	19	69 ±1
a	Calidris canutus rufa	Red Knot rufa ssp	S2S3M	Endangered	E	8	17 ±0.5
a	Salmo salar pop. 1	Atlantic Salmon - inner Bay of Fundy pops	S2		E	6	51 ±10
a	Glyptemys insculpta	Wood Turtle	S3	Vulnerable	T	46	6 ±10
a	Morone saxatilis	Striped Bass	S1		T	1	26 ±10
a	Caprimulgus vociferus	Whip-Poor-Will	S1?B		T	3	16 ±5
a	Dolichonyx oryzivorus	Bobolink	S3S4B		T	140	6 ±5
a	Histrionicus histrionicus pop. 1	Harlequin Duck - Eastern pop.	S2N	Endangered	SC	8	72 ±10
a	Passerculus sandwichensis princeps	Savannah Sparrow princeps ssp	S1B		SC	2	64 ±5
a	Bucephala islandica (Eastern pop.)	Barrow's Goldeneye (Eastern pop.)	S1N		SC	2	34 ±0.1
a	Asio flammeus	Short-eared Owl	S1S2		SC	5	17 ±5
i	Alasmidonta varicosa	Brook Floater	S1S2		SC	7	20 ±10
i	Danaus plexippus	Monarch	S2B		SC	2	85 ±1
a	Euphagus carolinus	Rusty Blackbird	S2S3B		SC	65	6 ±5
a	Lynx canadensis	Canada Lynx	S1	Endangered	NAR	4	79 ±10
a	Aegolius funereus	Boreal Owl	S1B		NAR	2	39 ±0.1
a	Fulica americana	American Coot	S1B		NAR	5	55 ±5
a	Hemidactylium scutatum	Four-toed Salamander	S3		NAR	11	55 ±10
a	Sialia sialis	Eastern Bluebird	S3B		NAR	8	20 ±5
a	Sterna hirundo	Common Tern	S3B		NAR	122	15 ±0.5
a	Accipiter gentilis	Northern Goshawk	S3S4		NAR	28	8 ±5
a	Alces americanus	Moose	S1	Endangered		15	6 ±10
i	Chromagrion conditum	Aurora Damsel	S1			2	59 ±1
i	Enallagma aspersum	Azure Bluet	S1			3	51 ±0.1
i	Enallagma minusculum	Little Bluet	S1			2	86 ±0.1
i	Leucorrhinia frigida	Frosted Whiteface	S1			1	86 ±0.1
i	Celithemis elisa	Calico Pennant	S1			1	86 ±0.1
i	Somatochlora minor	Ocellated Emerald	S1			2	90 ±1
i	Somatochlora kennedyi	Kennedy's Emerald	S1			1	88 ±1
i	Somatochlora incurvata	Incurvate Emerald	S1			3	82 ±1
i	Somatochlora franklini	Delicate Emerald	S1			2	74 ±1
i	Somatochlora forcipata	Forcipate Emerald	S1			3	80 ±0.1
i	Somatochlora cingulata	Lake Emerald	S1			3	86 ±0.1
i	Dorocordulia lepida	Petite Emerald	S1			2	54 ±1
i	Boyeria vinosa	Fawn Darner	S1			2	85 ±1
i	Basiaeschna janata	Springtime Darner	S1			3	85 ±1
i	Aeshna subarctica	Subarctic Darner	S1			2	54 ±1
i	Ophiogomphus mainensis	Maine Snaketail	S1			1	7 ±0.1
i	Ophiogomphus aspersus	Brook Snaketail	S1			3	74 ±0.1
i	Oeneis jutta ascerta	Jutta Arctic	S1			1	60 ±0.1
i	Polygonia gracilis	Hoary Comma	S1			2	34 ±1
i	Callophrys henrici	Henry's Elfin	S1			1	96 ±0.1
i	Satyrium acadica	Acadian Hairstreak	S1			3	39 ±1
i	Lycaena hyllus	Bronze Copper	S1			1	84 ±0
a	Vireo gilvus	Warbling Vireo	S1?B			3	16 ±5
a	Toxostoma rufum	Brown Thrasher	S1?B			2	35 ±5
a	Tringa solitaria	Solitary Sandpiper	S1?B,S4S5M			3	25 ±0.5
a	Hylocichla mustelina	Wood Thrush	S1B			10	16 ±5
a	Progne subis	Purple Martin	S1B			1	65 ±0.5

a	Gallinula chloropus	Common Moorhen	S1B	4	84 ±5
a	Nycticorax nycticorax	Black-crowned Night-heron	S1B	1	30 ±5
a	Myotis septentrionalis	Northern Long-eared Bat	S1S2	1	56 ±1
a	Picoides dorsalis	American Three-toed Woodpecker	S1S2	2	42 ±5
i	Nymphalis vaualbum j-album	Compton Tortoiseshell	S1S2	1	85 ±1
a	Passerina cyanea	Indigo Bunting	S1S2B	2	35 ±5
a	Eremophila alpestris	Horned Lark	S1S2B,S4N	1	72 ±5
a	Charadrius semipalmatus	Semipalmated Plover	S1S2B,S5M	4	66 ±5
a	Salmo salar	Atlantic Salmon	S2	66	6 ±10
a	Asio otus	Long-eared Owl	S2	8	24 ±5
i	Lampsilis radiata	Eastern Lampmussel	S2	20	15 ±0.1
i	Lestes eurinus	Amber-Winged Spreadwing	S2	2	54 ±1
i	Leucorrhinia glacialis	Crimson-Ringed Whiteface	S2	10	51 ±0.1
i	Gomphus spicatus	Dusky Clubtail	S2	6	70 ±0.1
i	Gomphus descriptus	Harpoon Clubtail	S2	7	74 ±0.1
i	Nymphalis vaualbum	Compton Tortoiseshell	S2	1	95 ±1
i	Polygonia satyrus	Satyr Comma	S2	2	86 ±0.1
i	Boloria chariclea	Arctic Fritillary	S2	2	86 ±1
i	Callophrys lanoraieensis	Bog Elfin	S2	2	90 ±1
i	Callophrys niphon	Eastern Pine Elfin	S2	1	94 ±1
i	Satyrium calanus	Banded Hairstreak	S2	1	98 ±1
i	Lycaena dospassosi	Salt Marsh Copper	S2	3	79 ±0.1
i	Pieris oleracea	Mustard White	S2	14	61 ±1
i	Amblyscirtes vialis	Common Roadside-Skipper	S2	2	39 ±1
i	Thorybes pylades	Northern Cloudywing	S2	2	33 ±1
a	Vireo philadelphicus	Philadelphia Vireo	S2?B	9	16 ±5
a	Piranga olivacea	Scarlet Tanager	S2B	5	12 ±0.1
a	Myiarchus crinitus	Great Crested Flycatcher	S2B	2	45 ±5
a	Empidonax traillii	Willow Flycatcher	S2B	1	65 ±5
a	Rallus limicola	Virginia Rail	S2B	9	15 ±5
a	Anas acuta	Northern Pintail	S2B	19	25 ±10
a	Bucephala clangula	Common Goldeneye	S2B,S5N	39	7 ±0.1
i	Alasmidonta undulata	Triangle Floater	S2S3	6	28 ±10
i	Erynnis juvenalis	Juvenal's Duskywing	S2S3	2	21 ±1
a	Icterus galbula	Baltimore Oriole	S2S3B	19	8 ±5
a	Pooecetes gramineus	Vesper Sparrow	S2S3B	8	16 ±5
i	Amphiagrion saucium	Eastern Red Damsel	S3	3	87 ±1
i	Nehalennia gracilis	Sphagnum Sprite	S3	10	54 ±1
i	Sympetrum semicinctum	Band-Winged Meadowhawk	S3	8	70 ±0.1
i	Sympetrum danae	Black Meadowhawk	S3	8	27 ±0.1
i	Nannothemis bella	Elfin Skimmer	S3	2	68 ±0.1
i	Somatochlora williamsoni	Williamson's Emerald	S3	1	99 ±0.5
i	Somatochlora walshii	Brush-Tipped Emerald	S3	6	54 ±1
i	Somatochlora elongata	Ski-Tailed Emerald	S3	13	59 ±1
i	Epitheca spinigera	Spiny Baskettail	S3	4	90 ±1
i	Dorocordulia libera	Racket-Tailed Emerald	S3	12	51 ±0.1
i	Gomphaeschna furcillata	Harlequin Darner	S3	3	68 ±0.1
i	Boyeria grafiana	Ocellated Darner	S3	4	65 ±1
i	Aeshna eremita	Lake Darner	S3	12	51 ±0.1
i	Aeshna constricta	Lance-Tipped Darner	S3	3	39 ±1
i	Aeshna clepsydra	Mottled Darner	S3	2	66 ±1
i	Ophiogomphus carolus	Riffle Snaketail	S3	18	30 ±0.1
i	Lanthus parvulus	Northern Pygmy Clubtail	S3	4	5 ±1
i	Cordulegaster maculata	Twin-Spotted Spiketail	S3	16	74 ±1
i	Enodia anthedon	Northern Pearly-Eye	S3	2	39 ±1
i	Nymphalis milberti milberti	Milbert's Tortoiseshell	S3	3	88 ±1
i	Polygonia faunus	Green Comma	S3	2	85 ±1
i	Euphydryas phaeton	Baltimore Checkerspot	S3	8	44 ±1
i	Hesperia comma laurentina	Laurentian Skipper	S3	4	13 ±1
i	Hesperia comma	Common Branded Skipper	S3	2	9 ±1
a	Coccyzus erythropthalmus	Black-billed Cuckoo	S3?B	32	6 ±5
a	Mimus polyglottos	Northern Mockingbird	S3B	11	16 ±5
a	Sterna paradisaea	Arctic Tern	S3B	36	20 ±5
a	Anas clypeata	Northern Shoveler	S3B	6	94 ±5
i	Polygonia interrogationis	Question Mark	S3B	6	39 ±1
a	Tringa melanoleuca	Greater Yellowlegs	S3B,S5M	25	15 ±0.5
a	Mergus serrator	Red-breasted Merganser	S3B,S5N	50	8 ±5
a	Limosa haemastica	Hudsonian Godwit	S3M	3	25 ±0.5
a	Numenius phaeopus	Whimbrel	S3M	7	17 ±0.5
a	Pluvialis dominica	American Golden-Plover	S3M	7	21 ±0.5
a	Calidris maritima	Purple Sandpiper	S3N	12	43 ±0.5
a	Cardinalis cardinalis	Northern Cardinal	S3S4	5	22 ±0.1
a	Cepphus grylle	Black Guillemot	S3S4	26	19 ±1
i	Polygonia progne	Gray Comma	S3S4	5	46 ±1
i	Speyeria aphrodite	Aphrodite Fritillary	S3S4	5	20 ±100
i	Callophrys polios	Hoary Elfin	S3S4	1	34 ±1
i	Feniseca tarquinius	Harvester	S3S4	5	44 ±1
a	Sayornis phoebe	Eastern Phoebe	S3S4B	24	13 ±0.1

4.3 RANGE MAPS

The legally protected taxa listed below are linked to the study area by predictive range maps based upon expert estimates of distribution. Ranges of rank 1 indicate possible occurrence, those of rank 2 and 3 increasingly less probable.

	scientific name	common name	prov. rarity	prov. status	COSEWIC	range rank
a	Glyptemys insculpta	Wood Turtle	S3	Vulnerable	T	1
p	Listera australis	Southern Twayblade	S2			1
p	Isoetes prototypus	Prototype Quillwort	S2	Vulnerable	SC	1
a	Alces alces (NS mainland)	Moose	S1	Endangered		1
p	Eriocaulon parkeri	Parker's Pipewort			NAR	2

5.0 SOURCE BIBLIOGRAPHY

The recipient of this data shall acknowledge the ACCDC and the data sources listed below in any documents, reports, publications or presentations, in which this dataset makes a significant contribution.

recs	source
365	Lepage, D. 2009. Maritime Breeding Bird Atlas Database. Bird Studies Canada, Sackville NB, 143,498 recs.
243	Erskine, A.J. 1992. Maritime Breeding Bird Atlas Database. NS Museum & Nimbus Publ., Halifax, 82,125 recs.
184	Newell, R.E. 2000. E.C. Smith Herbarium Database. Acadia University, Wolfville NS, 7139 recs.
181	Benjamin, L.K. (compiler). 2007. Significant Habitat & Species Database. Nova Scotia Dept Natural Resources, 8439 recs.
164	Brunelle, P.-M. (compiler). 2009. ADIP/MDDS Odonata Database: data to 2006 inclusive. Atlantic Dragonfly Inventory Program (ADIP), 24200 recs.
117	Pronych, G. & Wilson, A. 1993. Atlas of Rare Vascular Plants in Nova Scotia. Nova Scotia Museum, Halifax NS, I:1-168, II:169-331. 1446 recs.
111	Catling, P.M., Erskine, D.S. & MacLaren, R.B. 1985. The Plants of Prince Edward Island with new records, nomenclatural changes & corrections & deletions, 1st Ed. Research Branch, Agriculture Canada, Ottawa, Publication 1798. 22pp.
101	Blaney, C.S.; Mazerolle, D.M. 2009. Fieldwork 2009. Atlantic Canada Conservation Data Centre. Sackville NB, 13343 recs.
96	Blaney, C.S & Spicer, C.D.; Popma, T.M.; Basquill, S.P. 2003. Vascular Plant Surveys of Northumberland Strait Rivers & Amherst Area Peatlands. Nova Scotia Museum Research Grant, 501 recs.
68	Chardine, J.W. & et al. 2008. Colonial Waterbird Database. Canadian Wildlife Service, Sackville, 2699 sites, 9623 recs (7882 obs).
67	Hicks, Andrew. 2009. Coastal Waterfowl Surveys Database, 2000-08. Canadian Wildlife Service, Sackville, 46491 recs (11153 non-zero).
53	Newell, R.E. 2005. E.C. Smith Digital Herbarium. E.C. Smith Herbarium, Irving Biodiversity Collection, Acadia University, Web site: http://luxor.acadiau.ca/library/Herbarium/project/. 582 recs.
45	Layberry, R.A. & Hall, P.W., LaFontaine, J.D. 1998. The Butterflies of Canada. University of Toronto Press. 280 pp+plates.
42	Zinck, M. & Roland, A.E. 1998. Roland's Flora of Nova Scotia. Nova Scotia Museum, 3rd ed., rev. M. Zinck; 2 Vol., 1297 pp.
40	Roland, A.E. & Smith, E.C. 1969. The Flora of Nova Scotia, 1st Ed. Nova Scotia Museum, Halifax, 743pp.
35	Blaney, C.S.; Spicer, C.D.; Mazerolle, D.M. 2005. Fieldwork 2005. Atlantic Canada Conservation Data Centre. Sackville NB, 2333 recs.
35	Blaney, C.S.; Spicer, C.D. 2001. Fieldwork 2001. Atlantic Canada Conservation Data Centre. Sackville NB, 717 recs.
34	Blaney, C.S. 2000. Fieldwork 2000. Atlantic Canada Conservation Data Centre. Sackville NB, 1265 recs.
29	Cameron, R.P. 2009. Erioderma pedicellatum database, 1979-2008. Dept Environment & Labour, 103 recs.
27	Morrison, Guy. 2006. Maritime Shorebird Survey (MSS) database. Canadian Wildlife Service, Ottawa, 52 taxa, 570 sites, 11496 surveys. 59704 recs.
27	MacDonald, M. 2008. PEI Power Corridor Floral Surveys, 2004-08. Jacques Whitford Ltd, 2238 recs (979 rare).
27	Curley, F.R. 2005. PEF&W Collection 2003-04. PEI Fish & Wildlife Div., 716 recs.
27	Blaney, C.S.; Spicer, C.D.; Popma, T.M.; Hanel, C. 2002. Fieldwork 2002. Atlantic Canada Conservation Data Centre. Sackville NB, 2037 recs.
24	Benjamin, L.K. 2009. D. Anderson Odonata Records for Cape Breton, 1997-2004. Nova Scotia Dept Natural Resources, 1316 recs.
19	Pulsifer, M.D. 2002. NS Freshwater Mussel Fieldwork. Nova Scotia Dept Natural Resources, 369 recs.
19	Benjamin, L.K. (compiler). 2001. Significant Habitat & Species Database. Nova Scotia Dept of Natural Resources, 15 spp, 224 recs.
18	Harding, R.W. 2008. Harding Personal Insect Collection 1999-2007. R.W. Harding, 309 recs.
18	Blaney, C.S.; Spicer, C.D.; Rothfels, C. 2004. Fieldwork 2004. Atlantic Canada Conservation Data Centre. Sackville NB, 1343 recs.
17	Scott, F.W. 2002. Nova Scotia Herpetofauna Atlas Database. Acadia University, Wolfville NS, 8856 recs.
17	Erskine, D. 1960. The plants of Prince Edward Island, 1st Ed. Research Branch, Agriculture Canada, Ottawa., Publication 1088. 1238 recs.
17	Blaney, C.S. 2003. Fieldwork 2003. Atlantic Canada Conservation Data Centre. Sackville NB, 1042 recs.
15	Belland, R.J. 2010. Database of Prince Edward Island moss specimens. Devonian Botanic Garden, University of Alberta, 748 recs.
13	Chaput, G. 2002. Atlantic Salmon: Maritime Provinces Overview for 2001. Dept of Fisheries & Oceans, Atlantic Region, Science Stock Status Report D3-14. 39 recs.
13	Blaney, C.S.; Mazerolle, D.M.; Oberndorfer, E. 2007. Fieldwork 2007. Atlantic Canada Conservation Data Centre. Sackville NB, 13770 recs.
12	Blaney, C.S.; Mazerolle, D.M. 2008. Fieldwork 2008. Atlantic Canada Conservation Data Centre. Sackville NB, 13343 recs.
7	Powell, B.C. 1967. Female sexual cycles of Chrysemy spicta & Clemmys insculpta in Nova Scotia. Can. Field-Nat., 81:134-139. 26 recs.
7	Kelly, G. 2005. Fraxinus nigra. Dept of Agricuture, Fisheries, Aquaculture & Forestry. Pers. comm. to C.S. Blaney, Mar. 2, 11 recs.
7	Benjamin, L.K. & Boreal Felt Lichen, Mountain Avens, Orchid and other recent records. 2009. Nova Scotia Dept Natural Resources, 105 recs.
6	Hall, R.A. 2003. NS Freshwater Mussel Fieldwork. Nova Scotia Dept Natural Resources, 189 recs.
6	Gilhen, J. 1984. Amphibians & Reptiles of Nova Scotia, 1st Ed. Nova Scotia Museum, 164pp.
6	Cam, S. 1999. Cam Stevens field data from PEI vegetation plots. Sent along with specimens to C.S. Blaney. UNB masters research project, 732 recs.
6	Adams, J. & Herman, T.B. 1998. Thesis, Unpublished map of C. insculpta sightings. Acadia University, Wolfville NS, 88 recs.
5	Oldham, M.J. 2000. Oldham database records from Maritime provinces. Oldham, M.J; ONHIC, 487 recs.
5	Neily, T.H. 2010. Erioderma Pedicellatum records 2005-09. Mersey Tobiatic Research Institute, 67 recs.
5	Kelly, Glen 2004. Botanical records from 2004 PEI Forestry fieldwork. Dept of Environment, Energy & Forestry, 71 recs.
5	Downes, C. 1998-2000. Breeding Bird Survey Data. Canadian Wildlife Service, Ottawa, 111 recs.
5	Curley, F.R. 2007. PEF&W Collection. PEI Fish & Wildlife Div., 199 recs.
5	NSDNR. 2007. Restricted & Limited Use Land Database (RLUL).
4	Whittam, R.M. 1999. Status Report on the Roseate Tern (update) in Canada. Committee on the Status of Endangered Wildlife in Canada, 36 recs.
4	Popma, T.M. 2003. Fieldwork 2003. Atlantic Canada Conservation Data Centre. Sackville NB, 113 recs.
4	Olsen, R. Herbarium Specimens. Nova Scotia Agricultural College, Truro. 2003.
4	Hall, R. 2008. Rare plant records in old fieldbook notes from Truro area. Pers. comm. to C.S. Blaney. 6 recs, 6 recs.
4	Giberson, D. 2008. UPEI Insect Collection. University of Prince Edward Island, 157 recs.
4	Edsall, J. 2007. Personal Butterfly Collection: specimens collected in the Canadian Maritimes, 1961-2007. J. Edsall, unpubl. report, 137 recs.
4	Doucet, D.A. 2009. Census of Globally Rare, Endemic Butterflies of Nova Scotia Gulf of St Lawrence Salt Marshes. Nova Scotia Dept of Natural Resources, Species at Risk, 155 recs.
4	Benjamin, L.K. (compiler). 2002. Significant Habitat & Species Database. Nova Scotia Dept of Natural Resources, 32 spp, 683 recs.
4	Basquill, S.P. 2003. Fieldwork 2003. Atlantic Canada Conservation Data Centre, Sackville NB, 69 recs.
3	Spicer, C.D. 2004. Specimens from CWS Herbarium, Mount Allison Herbarium Database. Mount Allison University, 5939 recs.
3	Speers, L. 2001. Butterflies of Canada database. Agriculture & Agri-Food Canada, Biological Resources Program, Ottawa, 190 recs.
3	Rousseau, J. 1938. Notes Floristiques sur l'est de la Nouvelle-Ecosse in Contributions de l'Institut Botanique de l'Universite de Montreal. Universite de Montreal, 32, 13-62. 11 recs.
3	Goltz, J.P. & Bishop, G. 2005. Confidential supplement to Status Report on Prototype Quillwort (Isoetes prototypus). Committee on the Status of Endangered Wildlife in Canada, 111 recs.
3	Doucet, D.A. 2007. Lepidopteran Records, 1988-2006. Doucet, 700 recs.
3	Blaney, C.S. Miscellaneous specimens received by ACCDC (botany). Various persons. 2001-08.
2	Standley, L.A. 2002. Carex haydenii in Nova Scotia. , Pers. comm. to C.S. Blaney. 4 recs.
2	Sollows, M.C,. 2008. NBM Science Collections databases: mammals. New Brunswick Museum, Saint John NB, download Jan. 2008, 4983 recs.
2	Quigley, E.J. 2006. Plant records, Mabou & Port Hood. Pers. comm. to S.P. Basquill, Jun. 12. 4 recs, 4 recs.
2	MacQuarrie, K. 1991-1999. Site survey files, maps. Island Nature Trust, Charlottetown PE, 60 recs.
2	Hinds, H.R. 1989. Greenwich, Blooming Point plant collections in Plant locations. Pers. Comm. to Robin Day (Ag. Can). 2pp, 8 recs, 8 recs.
2	Hill, N. 2003. Floerkea proserpinacoides at Heatherdale, Antigonish Co. 2002. , Pers. comm. to C.S. Blaney. 2 recs.
2	Daury, R.W. & Bateman, M.C. 1996. The Barrow's Goldeneye (Bucephala islandica) in the Atlantic Provinces and Maine. Canadian Wildlife Service, Sackville, 47pp.
2	Clayden, S.R. 2007. NBM Science Collections databases: vascular plants. New Brunswick Museum, Saint John NB, download Mar. 2007, 6914 recs.

2 Cameron, R.P. 2005. Erioderma pedicellatum unpublished data. NS Dept of Environment, 9 recs.
2 Blaney, C.S.; Mazerolle, D.M.; Klymko, J; Spicer, C.D. 2006. Fieldwork 2006. Atlantic Canada Conservation Data Centre. Sackville NB, 8399 recs.
2 Archibald, D.R. 2003. NS Freshwater Mussel Fieldwork. Nova Scotia Dept Natural Resources, 213 recs.
1 Whittam, R.M. 2000. Senecio pseudoarnica on Country Island. , Pers. comm. to S. Gerriets. 1 rec.
1 Spicer, C.D. 2002. Fieldwork 2002. Atlantic Canada Conservation Data Centre. Sackville NB, 211 recs.
1 Smith, M.E.M. 2008. AgCan Collection. Agriculture Canada, Charlottetown PE, 44 recs.
1 Robinson, C.B. 1907. Early intervale flora of eastern Nova Scotia. Transactions of the Nova Scotia Institute of Science, 10:502-506. 1 rec.
1 New York Botanical Garden. 2006. Virtual Plant Herbarium - Vascular Plant Types Catalog. Sylva, S.; Kallunki, J. (ed.) International Plant Science Centre, Web site: http://sciweb.nybg.org/science2/vii2.asp. 4 recs.
1 Neily, P.D. Plant Specimens. Nova Scotia Dept Natural Resources, Truro. 2006.
1 Morrison, Guy. 2007. Maritime Shorebird Survey (MSS) database. Canadian Wildlife Service, Ottawa, 1149 recs (1373 by species).
1 Macaulay, M. Notes on newly discovered Hepatica nobilis var. obtusa population in Cumberland Co. NS. Pers. comm. to S. Blaney, 1 rec.
1 Gillis, J. 2007. Botanical observations from bog on Skye Mountain, NS. Pers. comm., 8 recs.
1 Curley, F.R. 2003. Glen Kelly records for Betula pumila & Asclepias syriaca on PEI. , Pers. comm. to C.S. Blaney. 9 recs.
1 Clayden, S.R. 1998. NBM Science Collections databases: vascular plants. New Brunswick Museum, Saint John NB, 19759 recs.
1 Christie, D.S. 2000. Christmas Bird Count Data, 1997-2000. Nature NB, 54 recs.
1 Cameron, R.P. 2009. Nova Scotia nonvascular plant observations, 1995-2007. Nova Scotia Dept Natural Resources, 27 recs.
1 Benjamin, L.K., NSDNR Fieldwork & Consultants Reports. 2009. Nova Scotia Dept Natural Resources, 143 recs.
1 Benedict, B. Connell Herbarium Specimens, Digital photos. University New Brunswick, Fredericton. 2005.
1 Benedict, B. Connell Herbarium Specimen Data . University New Brunswick, Fredericton. 2003.
1 anon. 2001. S.. H.. NS Freshwater Mussel Fieldwork. Nova Scotia Dept Natural Resources, 76 recs.

Appendix VII. MOOSE MONITORING REPORT APRIL 2011

Glen Dhu Wind Power Project

Mainland Moose Monitoring Program Summary 2010/2011

Prepared For:
Glen Dhu Wind Energy LP

Prepared by:
McCallum Environmental Ltd.

April 2011

Contents

Appendix A: Mainland Moose Research Report

Appendix B: Drawings

1. Land Use: Glen Dhu Project Area
2. Forestry Activities within Project Area
3. Moose Pellet Pile Survey May 2008 and 2010
4. Snowmobile Survey March 2009
5. Snowmobile Survey January 2011
6. Snowmobile Survey March 2011
7. Aerial Survey January 2011

Appendix C: Nova Scotia Department of Natural Resources (NS DNR) Incidental Sightings of Mainland Moose: Pictou and Antigonish Counties

McCallum Environmental Ltd.

1.0 Introduction

Glen Dhu Wind Energy LP (formerly Shear Wind Inc.) has completed Mainland Moose research and monitoring activities as required under the Terms and Condition 3.2 of the Environmental Assessment approval dated February 02, 2009 for the Glen Dhu Wind Power Project in Barney's River, Nova Scotia.

The goal of this activity, as defined by the Nova Scotia Department of Natural Resources (DNR), is to improve the understanding of habitat suitability, availability and selection by Mainland Moose in the area of the Pictou-Antigonish Highlands.

This report outlines the methods and the results from the Mainland Moose Monitoring Program, completed from 2009 to 2011 and includes:

- Research activities and reporting associated with general availability and selection of habitat for the Mainland Moose;
- Assessment of the habitat surrounding the Glen Dhu South Wind Power Project area, and its suitability, availability and selection by moose; and,
- Monitoring Activities, which include:
  - Identification of individual sightings/documentation of Moose reported to DNR since 2003;
  - Moose Pellet Pile Survey completed in May 2010;
  - Snowmobile Surveys completed in March 2009, January 2011, and March 2011; and,
  - Aerial Survey completed in January 2011.

The methodologies for all monitoring surveys and research activities were determined based on the Nova Scotia Department of Natural Resources (DNR) *Shearwind – Glen Dhu Monitoring Protocols for Mainland Moose*, dated November 13, 2008. Also, communication between Shear Wind Inc. and DNR has been on-going and a round table discussion meeting took place on November 2010 between Shear Wind and DNR staff to further develop and solidify goals and methodologies for this program.

2.0 General Information Regarding Moose Availability and Selection of Habitat

As a key component of the overall Mainland Moose program, research was undertaken to attempt to answer a series of questions relating to the availability and selection of habitat by the Mainland Moose in Nova Scotia. This research was also targeted to investigate what is known about the potential impact on moose and their habitat from wind power projects. Questions included:

- What are the primary, secondary, and tertiary habitat preferences of Mainland Moose?;
- How do moose prefer to move between habitat types?;
- What are the seasonal behavioural characteristics of moose (mating, rearing, etc…)?;
- What is the state of knowledge on impacts of wind projects specifically to moose?;
- How are moose known to be affected by habitat disturbances resulting from:

a. Linear disturbances (pipelines or roads);
b. Larger disturbances (Forestry);
c. Community developments or increases in human populations; and,
d. Wind Power Projects.

2.1 Results

The full Mainland Moose research report is attached to this report as ***Appendix A***. A summary of key points including food requirements of the moose, habitat preference and responses to disturbances are described below.

2.1.1 Habitat and Food requirements

Research determined that the moose eat early successional deciduous vegetation associated with open or disturbed areas. Primary species that moose eat include maple and birch. The moose is also known to eat aquatic vegetation during the summer months. Given these eating preferences, the primary habitat for the moose will be in areas where there is some level of disturbance from forestry practices, road development, linear project development, fire or other natural disturbances.

In the summer months, moose prefers to be near water for relief from heat. As well, to avoid the hottest days, the moose will tend to find cover in dense mature forests with closed canopies for shade. Conifer forests also play a key habitat role in the late winter months when the snow accumulation and extreme weather in more open habitats is not preferred habitat. The moose will move to the dense conifer forests for protection from extreme events and the canopy reduces snow accumulation making movement easier for the moose. However, food is more important than cover in the winter months, so ideal winter habitat for the moose is a mixed forest habitat, where the conifer stands are available, as well as the more open stands with early successional deciduous vegetation.

The research is inconclusive regarding the moose and its choice of habitat relating to proximity of human settlements (towns, cities). Some studies have shown that the densest moose populations occur near towns (increase in browse in these areas, and reduced numbers of predators). Other studies, though, have concluded that moose avoided areas of high-density human settlement and responded to increased human activity by withdrawing further from houses.

2.1.2 Response to Disturbance

Research suggests that the influence of roads on the moose is highly variable and most likely situation specific. Some research clearly states that the moose stays away from road systems, while other studies have shown that the roads allow moose to extend their movements into areas that would otherwise have been inaccessible. A study in Nova Scotia concluded that moose avoid areas of high road density. This study suggested that areas with no roads or low road densities containing suitable moose habitat should be maintained in that state.

The net effect of many forestry operations is the creation of open areas with early successional vegetation, areas which are necessary elements of moose habitat. The quality of this habitat is dependent on forestry practices employed. The research suggests it is important to remove the overstory and complete scarification of the soil in order to achieve the best establishment of early successional hardwoods. It also appears that the moose will select mixed wood recent cutover stands over the equivalent conifer cutover stand.

A number of human activities appear to intrude on moose habitat. Human disturbances (skiers and hikers) appear to elicit flight responses from further away and result in longer periods of elevated heart rates in moose compared to mechanical sources of disturbance (i.e. airplanes). Research also suggests that snowmobiles appear to stress the moose.

2.1.3 Response to Wind Project Disturbance

Data from operational wind power projects and the relationship between ungulates and wind power is extremely limited. One operating wind project in Vermont reported moose using the area directly under a generating turbine. The majority of the observances were while the turbine was on and generating power. Observations were made at a wind project in British Columbia of moose scat and a single observed moose, suggesting that the moose continued to use the area directly surrounding the wind project as habitat once in operation. A parallel study of elk and wind projects in Oklahoma concluded that the elk were not adversely affected by the wind power development.

2.1.4 Research Conclusions – Moose Habitat Availability and Suitability

Habitat: Moose prefer open early successional vegetation for its food source. Therefore, areas where disturbances have occurred are critical habitat for the moose. Moose require shelter from extreme heat and snow accumulation in the summer and winter respectively, and therefore also requires a dense forest cover (often mixed wood; conifer in the winter) during some months. Overall, the moose will require a mixture of habitat, with some disturbed areas and more dense cover, with water access in the summer.

Response to disturbance: The research is inconclusive as to the overall effect of human activities and structures (roads, wind turbines, forestry, rail lines, skiers, hikers, snowmobiles). However, due to the food preference of the moose (early successional vegetation), it is reasonable to conclude that the moose may use areas of human disturbance (like cleared areas associated with a wind project) as habitat.

3.0 Assessment of Availability and Suitability of the Glen Dhu Project Area

This section outlines the current condition of the Glen Dhu Project Area and provides information relating to the suitability and availability of habitat for moose inside this project area. This assessment includes:

- Current habitats present across the project lands;
- Current activity on the project lands- forestry activities, hunting, recreation, commercial activities, and linear developments; and,

- Conclusions relating to the current suitability and availability of moose habitat across the Project lands.

The Glen Dhu project area is located to the north and south of Highway #104 between New Glasgow and Antigonish, Nova Scotia. Phase I of the project was constructed in late 2010 and early 2011 near the northwestern boundary of the project lands. Phase II (Glen Dhu South) of the project is currently in the development stage for areas straddling to the north and south of Highway #104. The following assessment of project habitat will be focused on the Glen Dhu South project lands.

3. 1 Project Area: Current Habitats

The project lands consist of a mix of rural land use. The majority of the project lands are located on upland sites. The majority of the lands are forested, with the dominant forest cover being natural uneven aged tolerant hardwood forests. Softwood dominated forests have been developed on old abandoned, agricultural sites. The project area is comprised of 53% of hardwood cover, 16% of mixed wood cover, 29% of softwood cover, and 2% other (water, wetlands, agriculture, alders etc.). Wetlands and watercourses are located throughout the project area. Two riverine wetlands are located in the southern section of the northern parcel of project lands. An isolated wetland is also located in the same area. There are two riverine wetlands identified in the southwest portion of the project lands, and at the southern extent of the project area there is a large treed bog and a smaller riverine wetland present.

A large area of alders is located straddling Highway 104 in the central portion of the project lands. Agriculture lands are present in the southern portion of north section of the project area and a blueberry growing operation is located on the southeast edge of the project area.

Drawing 1 attached in ***Appendix B*** shows the land use and forest cover across the project area.

3.2 Project Area: Current Activity

There are two transmission lines that run east-west through the project lands. There are residential properties adjacent to the main roads throughout the project area. Human activities include, but are certainly not limited to, hunting, snowmobiling, all-terrain vehicle usage, and cross country skiing. Commercial activities include small levels of agriculture, a fish farm, forestry operations, and a blueberry operation south of the Highway.

The number of farms in Antigonish and Pictou Counties represents approximately 6% and 7% respectively of operating farms in the province. The area has been extensively logged over the past century and a network of private and forest roads provide access within the boundaries of the project area.

Both dominant forest types (hardwood and softwood) present in the project area have been actively managed for forest objectives over the course of the last century. Even aged management is the dominant harvest system to date. Based on available information from NS DNR, 31% of the lands within the project area have been clear cut in the last 20 years (719.5 ha). In 2003, DNR estimated that 23% of the project area comprised of plantations. Of this, 4% consisted of Christmas tree production. Since

2003, DNR estimates that 2% (52 ha) of the project lands have been pre-commercially or commercially thinned.

Drawing 2 attached in ***Appendix B*** show current forestry activity inside the project areas.

3.3 Conclusions: Project Area and Moose Habitat

Human activities across the project lands, most importantly the active and continuous use of these lands by the forestry industry, provide disturbance to the forest cover, segregate and alter forests with logging, access roads, and logging roads. This fragmentation of the forest complex has been ongoing for a century of forestry activities across the project area. The affect these activities, and other development activities (including wind projects) might have on the Mainland Moose across the project area are not fully understood. Human activity has been shown to have both a negative effect (stress from snowmobiles and skiers) and a positive effect (creation of habitat suitable for the moose to find its preferred food source).

4.0 Mainland Moose Monitoring Activities

During project development for components of the Glen Dhu WPP, environmental assessment field studies, construction and planning, and monitoring efforts have been undertaken by Shear Wind Inc. to collect information regarding the presence of the Mainland Moose across the project areas (both Glen Dhu Phase I and Glen Dhu South). These monitoring efforts and results are described below.

4.1 Incidental Sightings

All sightings of Mainland Moose either by individual or a person involved in the Glen Dhu Wind Power Project were reported and details of these sightings are described below.

4.1.1 Methodology

During planning and construction of the Glen Dhu Wind Power Project, all contractors were educated and aware of the importance of the Mainland moose and were asked to be vigilant while on site. Planning activities and field studies were completed from 2006 to 2008, and construction commenced in early 2010. If the Mainland Moose was spotted, the project personnel were asked to collect the coordinates of the sighting and also basic observations of the sighting (number of moose, gender, age etc.) Also, incident sightings by the general population are reported to the local Department of Natural Resources (DNR) office through the provision of coordinates of sighting. The results of all incidental sightings from 2002 (Pictou County) and 2003 (Antigonish County) to current (project related and general sightings at DNR) are included in this report. General sightings from the Pictou and Antigonish offices of DNR were collected and are included in this report.

4.1.2 Results

During project planning and field studies, no incident sightings of the Mainland Moose were reported by any project personnel. During construction, one (1) moose was observed on February 14, 2011 by the contractor. This moose was observed in the early hours of the day at 45° 40’ 09” N, 62°12’37” W. No details on age or sex were recorded. The moose was observed in a clear cut area from previous forestry activities, near the edge of a mixed wood forest.

DNR provided all data relating to incidental sightings of moose from 2002 (Pictou County) and 2003 (Antigonish County) to present day. 2003 was the requested start date requested to provide continuity from the 2003 Status Report on the Eastern (Mainland) Moose. Data was provided by Kim George, Regional Biologist, Pictou County and Mark Pulsifer, Regional Biologist, Antigonish County. This data shows all locations of incidental sightings of moose or moose tracks/pellets across the project lands. The two images are shown in ***Appendix C***.

4.2 Moose Pellet Pile Surveys

Moose pellet pile surveys have been completed as a part of the environmental assessment process and as part of follow up monitoring activities for the Glen Dhu project.

4.2.1 Methodology

A Moose pellet pile survey was completed in May 2008 as part of the larger environmental assessment process for Glen Dhu Phase I. This survey was completed on foot along a series of transects (15 in total) across the Project Area by members of the EA team. The survey consisted of searching one metre on either side of each transect for moose pellet piles and deer pellets, or other incidental sightings associated with the moose (alters, tracks, carcasses etc).

A second moose pellet pile survey was completed in May/June 2010 as part of the follow up monitoring events completed by the proponent. This survey was completed on foot by Jody Hamper, a local resident of the Pictou area. Jody following the same transects that were walked in 2008.

4.2.2 Results

In 2008, no evidence of moose (or deer) was recorded during the pellet pile survey. In 2010, several observed moose tracks were reported during the pellet survey, as well as deer pellets. Moose scat was observed on Transect 4 (east end) and Transect 5 (west end). Deer droppings were observed on several occasions along transects 3, 4, 6, 7, 11 and 13. Specific locations of observed moose pellets/tracks and deer pellets are included on Drawing 3, attached in ***Appendix B***.

4.3 Snow Tracking Survey

To compliment pellet and aerial surveys for moose, snow-tracking surveys have also been completed to assess the presence and distribution of Mainland Moose in the Project Area. The details associated with these surveys are described in this section.

4.3.1 Methodology

Three (3) snow tracking surveys have been completed on the Project lands. These snow tracking surveys involve teams of snowmobilers completing transects on snowmobiles across the project area along existing and heavily used snowmobile trails. Survey teams were looking for sightings of moose and deer, as well as for observable tracks, pellets and carcasses/antlers of the Mainland Moose.

UTM coordinates were recorded using GPS wherever moose and deer track-ways crossed survey trails, or occurred within or adjacent to survey trails. Any unusual sightings (i.e. a moose or deer carcass, bear den, etc.) were photographed with a digital camera and UTM coordinates recorded.

The first survey was completed on March 11, 2009 by two teams of DNR staff from Pictou and Antigonish offices, and Bob Bancroft and Alton Hudson. Three two person teams completed transects of the project area and traversed transect ranging from 17 to 58 km in length. Drawing 4, attached in ***Appendix B***, shows the location of all transects associated with the snow-tracking survey completed in March 2009.

The second survey was completed on January 18-20, 2011 by John Thompson and Adam Hunter, local residents of the Pictou area. This survey involved completion of over 117 km of transects across the project area. Similar techniques were employed to record observations as are described above for the first survey. Drawing 5 attached in ***Appendix B*** shows the transect locations and results associated with the January 2011 snow-tracking survey.

The third survey was completed on March 26, 2011, the day after 10 cm of fresh snow by John Thompson and Adam Hunter. This survey covered the same transects as the January 2011 survey. Results of this survey event are shown on Drawing 6 attached in ***Appendix B***.

4.3.2 Results

The first snow-tracking survey completed in March 2009 observed a total of three (3) moose. One moose was observed alone, and two moose were observed together. The locations of these sightings are shown on Drawing 4. Sightings of deer and coyote were also recorded and are shown on Drawing 4.

The second snow-tracking survey completed in January 2011 observed a total of three (3) moose tracks. No sightings of moose were recorded during this survey event. The third survey event, completed in March 2011, did not observed any moose sighting, tracks, scat etc. However, along these same transects, on various occasions through the Winter 2011, John Thompson observed a bull and cow at the location shown on Drawing 6.

4.4 Aerial Survey

During discussions with NS DNR staff, one component of monitoring for the Mainland Moose that was identified was the completion of an aerial survey every three years of the project area. This monitoring component is discussed in the following sections.

4.4.1 Methodology

An aerial survey was completed on January 28, 2011. A survey team consisting of three individuals (Robert McCallum, Meghan Milloy and Gary Gregory), and the pilot, completed the survey in a Bell 206 JetRange helicopter operated by Vision Air. The helicopter was equipped with one front seat observer and navigator, a gps referenced digital camera, as well as two back seat observers. The aerial survey covered approximately 13,400 hectares of land.

10-15 centimeters of fresh snow fell in the area the day before the aerial survey was completed. On the day of the survey, skies were clear, visibility was excellent and in excess of 30 km, winds were light and a complete ground cover of snow was present across the entire survey Area.

A GPS unit with map display was used as a navigational tool to ensure complete coverage of the survey area. The pilot had pre-programmed transects across the Project Area into the aircraft system. These transects ranged from 500 m to 1500 metres apart depending on ground cover and area. Whenever possible, the aircraft maintained an altitude of 150 m above ground and an air speed of no more than 60 knots. Additional selected areas (ie. river/stream valleys, gorges, cleared areas, and low spots) were also assessed, especially near the eastern edge of the Project Area.

The location and time of each observation was recorded as a GPS waypoint on the aircraft's GPS system. Waypoints and track-logs were saved as MapSource files. As the survey progressed and the visibility and overstory allowed, transects were spread out as per Drawing 7.

4.4.2 Results

Drawing 7, attached in ***Appendix B***, shows locations of all transects and selected areas that were assessed during the aerial survey of the Project Area. This drawing also documents locations of sightings.

During the aerial survey, the survey team observed a total of three (3) moose, travelling together in a group in an open area of a mixedwood forest near the northeastern extent of the project area. These three moose consisted of an adult female and a yearling (male) whose antlers were still present, and a second young moose (age and sex unknown) without antlers.

The survey team recorded no observations of deer over the course of the day, with the exception of one set of deer tracks along a dam across a small river. The team also observed a single red fox and seven bald eagles (mostly in the eastern section of the project area).

5.0 Conclusions

Mainland Moose prefer early successional deciduous vegetation for food, and seem to prefer a mixed wood forest with some level of disturbance in order to find this food source. The moose prefers a dense canopy in the summer to protect it from heat, and also may prefer a conifer cover in the late winter to avoid the deepest snow accumulation. Therefore, the moose habitat preferences are varied, in order to access their preferred food source, but also to stay cool in the summers and to allow movement in the winter and preserve energy by avoiding the deepest snow.

Research on the impact of human disturbance on the Mainland Moose is inconclusive. Forestry activities are the dominant activity across the Project Area. Any significant impact on Moose populations in the project will be primarily from forestry activities, given the dominance of this industry in the area. Further studies would be required in order to assess impact of wind power projects on moose populations; preliminary information would suggest their impact would be minimal, compared to the more significant impact from forestry practices.

Monitoring for the moose across the project areas from 2006 to 2011 by foot, snowmobile and air have documented some modest sightings of moose, tracks, and pellets. 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.

Appendix A: Mainland Moose Research Report

MOOSE HABITAT AND RANGING BEHAVIOUR

While moose habitat preferences can change as the abundance of available habitat changes (Osko et al. 2004) and habitat selection shows a high degree of variability among individuals (McLaren et al 2009), moose generally require large areas with diverse habitat types (Snaith and Beazley 2002). Moose habitat preferences are correlated with forage and cover requirements, as well as breeding behaviours (Peek et al. 1976). Early successional deciduous vegetation is the main source of moose forage, food types often associated with open or disturbed areas (Snaith et al. 2002; Snaith and Beazley 2002; Parker 2003). The presence of such early successional trees and shrubs is particularly important during the winter months (Parker 2003). Regenerating vegetation provides good moose browse for 5-40 years following disturbances such as fire, disease, timber harvest and wind-throw (Snaith et al. 2002; Snaith and Beazley 2002). Fire appears to be the most important disturbance in terms of providing quality moose habitat (Parker 2003 and references therein). Critical habitat for moose in Alberta was described as open lowlands providing high quality food early in the spring (Hauge and Keith 1981).

In Nova Scotia, the most important food species are red, sugar, and mountain maple, as well as yellow and white birch (Snaith and Beazley 2002). In the summer months, particularly in June, aquatic vegetation can be an important component of the diet of moose (Peek et al. 1976; Fraser et al. 1980), but the fact that moose have persisted in areas containing infrequent or unsuitable wetlands suggests that these areas are not essential foraging grounds for moose in Nova Scotia (Snaith and Beazley 2002). This is supported by the findings of Telfer (1967a) who observed no feeding of moose on aquatic vegetation in the Cobequid region. Water bodies such as streams, ponds, and lake shorelines can be important for relief from heat stress in the summer months (Parker 2003), because moose are not well adapted for temperatures above 14-20°C (Snaith and Beazley 2002). Moose have also been shown to preferentially select dense, mature forests with a closed canopy in the summer months (Schwab and Pitt 1991) because the canopy provides shade and heat relief. Dussault et al. (2004) determined that moose showed behavioural adaptations to avoid heat stress in the summer including using thermal shelters during the day and increasing nocturnal activity.

When female moose give birth to their calves in the spring of the year, they often select islands or peninsulas because of the protection from predators they afford, or areas of high elevation because of visibility in availability of escape routes (Wilton and Garner 1991). In mountainous regions of British Columbia, however, only 52% of 31 GPS-collared female moose climbed to higher elevations to calve, while the other 48% changed little in elevation (Poole et al. 2007). These researchers found that those females that remained at lower elevations preferentially selected areas with increased forage, decreased slope, and in closer proximity to water. Langley and Pletscher (1994) characterized calving areas in Montana and British Columbia as having dense hiding cover and open patches with bare ground. Cederlund et al. (1987) found that all cows returned to the same summer range each spring, and Bogomolova and Kurochkin (2002) determined that cows returned to the same area of the forest every year before giving birth.

Although not considered critical habitat (Balsom et al. 1996), mature, conifer forests are extremely important for moose in Nova Scotia during the late winter months (Telfer 1967a; Peek et al. 1976; Parker 2003), because they provide protection from extreme weather and the canopy prevents snow from accumulating to depths hindering moose movement (Snaith and Beazley 2002). Travelling in areas where they sink into the snow can cause moose to expend much energy (Lundmark and Ball 2008) at a time when adequate forage may be scarce. Ideal winter habitat also includes regenerating, mixed woods that provides both hardwood and softwood browse (Parker 2003). In the winter months, moose in northern Nova Scotia concentrate in small areas known as "yards" and move very little (winter range of 2.6 km^2), particularly when the yard is contains good browse as in the Cobequid region (Telfer 1967a,b). In Quebec, the vast majority of these winter yards were less than 0.5km^2 in area (Guertin et al. 1984). Prescott (1968) determined that the use of winter yards by moose in northeastern Nova Scotia was influenced most heavily by having a variety of vegetation types, and that food availability was more important than cover in determining the attractiveness of winter habitat to moose (summarized from Parker 2003). Moose yards in Quebec were characterized by gentle sloped with southern exposure, with pure or mixed stands of black spruce and adjacent patches of white birch, young balsam fir, and alder (Guertin et al. 1984). Other important winter food items include willow, which accounted for 35% of the winter diet of moose in northern British Columbia (Goulet 1985).

A similarly restricted winter range of moose was determined from studies in Minnesota (Ballenberghe and Peek 1971; Phillips et al. 1973). Phillips et al. (1973) found that the late winter ranges of all tracked moose were distinct in habitat from the areas used at other time of year, and that the summer-fall and early winter ranges were much larger. Furthermore, they determined that most moose returned to the same wintering area each year, and that they used similar travel routes each year between seasonal habitats. Geist (1963) suggested that moose return every year to their accustomed summer range. Seasonal movements between winter and summer ranges were reported in moose in Alberta, with individual movement of up to 20km observed (Hauge and Keith 1981). Even greater migrations between winter and non-winter ranges of up to 75km were observed in British Columbia, with non-winter ranges being twice as large as winter ranges (Demarchi 2003). If the habitat in an area is diverse and provides the necessary interspersion of open areas for foraging and dense, mature forests for cover and relief from snow, seasonal ranges need not be widely separated (Snaith and Beazley 2002). For example, only 22% and 38% of adult moose in Michigan migrated between distinct summer and winter ranges in 1999 and 200, respectively. In Alaska, 43% of bulls and cows had distinct winter and summer ranges and distance between ranges were up to 17km (Bangs et al. 1984).In southwestern Nova Scotia, however, the mean home range of moose was found to be large (55.2 km^2) because the rocky, barren conditions mean the moose must range farther to obtain resources (see Snaith and Beazley 2002). When moving between seasonal ranges, moose use well established routes and travel corridors (Neumann 2009). In terms of activity within seasons, daily movement rates of moose are higher in the summer than in the winter (McLaren et al. 2009).

The following table summarized habitat preferences for Mainland moose in Nova Scotia (from Snaith and Beazley 2002):

SPRING/EARLY SUMMER	SUMMER	FALL/EARLY WINTER	LATE WINTER
- Open or disturbed areas with plenty of forage, calving areas, and forest cover - Aquatic vegetation may provide needed nutrients if it is available	- Dense forest cover for protection from heat stress - Forage rich areas to provide energy for growth, lactation, and fat storage - Water bodies - Interspersion of dense forest stands and mixed or disturbed forests with open canopies or mature forests with well a developed understory (for forage)	- Forage rich areas still important - Cover less important because heat stress and snow depth are at low levels - Open or disturbed habitat with early successional vegetation	- Densely forested areas for relief from snow accumulation - Interspersion of forage-rich areas (disturbed areas, forest edges) in close proximity to cover

MOOSE BEHAVIOUR

Moose become preoccupied with breeding in the fall, a period known as the “rut”. During this period, large, bulls can completely abandon foraging (Miquelle 1990), and will stand motionless beside a potential mate for hours on end (Altmann 1959). Either prior to or following the rut, normally solitary male moose congregate in groups in which breeding status is determined through belligerent interactions (Dodds 1958; Peek et al. 1974).During this rut, aggressive interactions between established and intruding cows are also common (Altmann 1959; Geist 1963). As they form groups and move into open areas at the onset of the rut, bull moose become particularly susceptible to harvest (Bangs et al. 1984).

Adult females about to give birth increase their movements greatly nearing parturition (Bogomolova and Kurochkin 2002; Poole et al. 2007), and aggressively drive away yearlings before giving birth. After giving birth to their calves in late May or early June, cows show a tendency to withdraw from disturbances in the distance and to actively defend their calf from disturbances in close proximity (Geist 1963). The formation of a defended territory around a calf was similarly reported in moose in Wyoming (Altmann 1959). The annual survival rate of marked moose calves in Alberta was 0.27, with the likelihood of survival increasing greatly after the first month (Hauge and Keith 1981). Similar survival (0.26) of calves was reported in an Alaskan population (Testa 2004), and in this case high mortality due to wolf and brown bear predation was implicated. In an area of Michigan where predation was not an important mortality factor, calf survival was considerably higher at 0.71 (Dodge et al. 2004), and calf survival in New Hampshire was found to be 0.45 (Musante et al. 2010).

MOOSE RESPONSE TO DISTURBANCE

Linear Disturbances

Moose are affected by a variety of disturbance types, and in a variety of ways. The removal of moose habitat to create linear disturbances can decrease foraging and cover habitat and decrease connectivity of the landscape (MEG Energy Corp. 2010). One such linear disturbance in moose habitat is roads. Much recent research, for example, has been dedicated to the issue of moose-vehicle collisions on highways (Seiler 2005; Dussault et al. 2006; Leblond et al. 2007a,b; Danks and Porter 2010). The presence of roads can affect moose behaviour and habitat usage as well. Laurian et al. (2008) observed that moose usually avoided approaching within 500m of highways and forest roads, although 20% of moose periodically browsed sodium-rich vegetation along road ways. This general avoidance of roads and surrounding areas by moose was interpreted by the authors as meaning that the moose perceived these areas as low-quality habitat. Neumann (2009) determined that moose rarely utilized habitats in close proximity to roads in Sweden. Rudd and Irwin (1985) found the mean distance of bedding and feeding sites from the nearest travelled road to be 1283m and 1101m, respectively, which appears to be in accordance to the findings of Laurian et al. (2008). Goldrup (2003) detected no such avoidance of roads or trails by moose in the Prince Albert National Park in Saskatchewan, finding moose to be indifferent to their presence. Similarly, Belant et al. (2006) determined that overall moose did not avoid the main park road in Denali National park and Preserve in Alaska. Thus, it appears that the response of moose to roads is highly variable and it most likely situation specific.

Dussault et al. (2007) determined that moose did not cross highways frequently, which may suggest that habitat may become fragmented into discontinuous units on opposite sides of the road. In Sweden, a major highway acted as a barrier to moose migration, causing moose to accumulate in habitats on one side of the highway while unable to access wintering ground near the coast (Seiler et al. 2003). In another Swedish study, Neumann (2009) observed that moose seldom crossed roads, but did increase their rates of crossing during migration. In Alaska, individual moose crossed a six lane highway up to 8 times per year (McDonald 1991), and Timmerman and Racey (1989) concluded that the presence of a highway running parallel to a lake did not limit moose access to this aquatic habitat. Moose in Québec were more likely to cross roads during the night when traffic level was at its lowest (Dussault et al. 2008). Dussault et al. (2007) found that topography, vegetation, and the presence of brackish pools were the most influential characteristics determining the locations of crossing points where they did occur. Silverberg et al. (2003), when studying moose behaviour at roadside salt-licks, found that stimuli that decreased feeding and increased incidences of fleeing included trucks passing, suggesting that the noise generated by these vehicles generated a disturbance sufficient to elicit a response by the moose. This same pattern was observed by Rudd and Irwin (1985), who found that trucks caused the greatest escape distance, displaced the greatest percentage of moose, and caused the greatest level of disturbance to moose of the factors examined. These researchers determined that whether or not an access road was adjacent to a forest stand was a key factor in determining the presence/absence of moose in that stand, and went on to suggest that preferred moose habitat should be avoided when selecting the location of drilling rigs and access roads.

In an example of a more indirect effect, roads associated with forestry operations can increase hunter access to moose habitat, leading to higher mortality of the moose within the area (Timmerman and Gollat 1983; Ontario Ministry of Natural Resources 1988; Rempel et al. 1997; Burrows 2001).

Not all road effects are negative however, as Van Ballenberghe and Peek (1971) suggested that the road system in their study area allowed moose to extend their movements into areas that would have been otherwise inaccessible. Numerous moose trails associated with old logging roads in Ontario were noted by Timmerman and Racey (1989), and these trails were all longer and better used than those not associated with old roads.

Beazley et al. (2002) discussed the impacts of roads on moose populations in Nova Scotia, and stated that moose avoid areas of high road density, and that road density affects moose habitat suitability. Furthermore, they associated the presence of highway 101 with the isolation of the small moose population in southwestern Nova Scotia. These authors suggest that to properly manage moose populations in Nova Scotia, areas with no roads or low road densities containing suitable moose habitat should be maintained in such a state. Beazley et al. (2008) found a higher road density in southeastern Cape Breton, Nova Scotia, and suggested that this factor could be related to the absence of moose in the region.

Railways are another type of linear disturbance which can have severe impacts on moose. Most of the research on this topic has dealt moose-train collisions (Child 1983; Anderson et al. 1991b; Becker and Grauvogel 1991; Jaren et al. 1991), and little is known about the behavioural responses of moose to railways. According to Child (1983), winters of above average snowfall take a particularly heavy toll of moose populations, who frequent the plowed railways at these times. This is in accordance with the findings of Gundersen et al. (1998), who noted that the number of moose-train collisions in Norway increased with increasing snow depth.

Larger Disturbances

Large-scale disturbances, such as forestry operations, are particularly important from the perspective of moose management. The net effect of many forestry operations is the creation of open areas with early successional vegetation, areas which are necessary elements of moose habitat (Ontario Ministry of Natural Resources 1988). The quality of habitat created by forestry activities, however, can be related to the timing and management techniques employed in the area, as seen by Collins and Schwartz (1998) in the boreal forest of Alaska. These researchers found that the removal of the overstory and scarcification of the soil, either through the logging activities themselves or by post-logging site preparation, achieved the best establishment of early successional hardwoods favoured by moose. In contrast, birch, balsam poplar, birch-spruce, and balsam poplar-spruce stands that were not scarcified following logging usually developed into grassy areas that are not suitable for moose habitat. In addition, cutover areas that are too far away from suitable cover may not be utilized by moose (Eason 1985), and employing a cut and leave strategy (alternating cutover and undisturbed areas of $1km^2$) as opposed to continuous clearcutting may support higher moose populations through the prvision of better cover (Eason 19889). Peek et al. (1976) correlated increases in the moose population in their Minnesota study area with logging activities that removed large stands of jackpine and replaced them with shrub communities interspersed with fir, aspen, and white birch. Lavsund et al. (2003) related clear-cutting practices in the Scandinavian countries to increased moose densities in these areas due to the provision of prime, early-successional habitat.

The attractiveness of a cutover area to moose may also depend on the type of stand. Courtois et al. (1998) observed that moose were selective of their habitat usage in recent cutovers (2-3 years) of coniferous stands, suggesting that only some of this area was suitable, while the moose showed no such selectivity in their usage of recently cutover mixed stands. In addition, Courtois et al. (2002) found a seasonal component to the usage of cutovers areas, as moose avoided recent clear-cuts except in early winter, when they increased their preference for these habitats.

In terms of possible effects of forestry on coarse scale habitat usage, Courtois et al. (2002) found that females increased the size of their home ranges in the presence of cutover areas, but that they did not increase their movements in accordance. Welch et al. (2000) reported an average distance between annual calving sites of 2.82 ± 2.37 km for cows inhabiting an area that had been logged using patch cuts, whereas this distance for cows inhabiting an area that was clearcut was 4.87 ± 3.62 km. They attributed these differences to “habitat heterogeneity in the size and distribution of cut and uncut patches”. From these results the authors concluded that small patch cuts producing smaller patches of disturbance than contiguous clearcuts result in stronger site fidelity for cows.

Crête (1988) noted that in addition to increasing hunter access to moose habitat through the creating of roads, the removal of cover increases the exposure of moose to hunters until regrowth occurs. This trend was observed in Ontario by Eason (1985), who reported a decline of 75% in the density of moose in a recently logged area due to overharvesting made possible by extensive road networks and greatly reduced cover. 7-11 years after clearcutting in Québec, forest stands had undergone substantial regeneration and featured high vegetative cover for moose (Courtois et al. 1998).

Potential changes in the density, productivity, and mortality of associated with clear-cut blocks of Québec forest were examined by Courtois and Beaumont (2002). Their results indicated that the presence/absence of cut-over blocks did not affect the number of calves produced per100 females, nor were there any significant changes in population structure after cutting.

The literature available on other response of moose populations to other types of large disturbance is sparse. In Norway, the installation of a hydro-electric dam created a lake in what was previously used as a migratory route and a summer range for the area's moose population (Anderson 1991). It was found in this case that although the creation of the lake caused only minor changes in migratory behaviour, some cows either completely or partly abandoned the area and summer home range size increased for those who remained.

The effects of mining, another large-scale disturbance type, have received little study. Westworth et al. (1989) studied the usage of habitat by moose in the vicinity of a copper mine in British Columbia. These researchers determined that habitat type had a more important influence on moose distribution than did distance from the mine site. Specifically, moose pellet densities were as high or higher within 300m of the mine site as they were 1000-2000m from the site. They concluded that moose in the area had habituated to the various disturbances associated with the mining operation, including noise.

The effects of oil and gas activity on moose in Wyoming were reviewed by Rudd and Irwin (1985). Most of the impacts associated with this development were as a result of roads intruding into moose habitat.

Human Development and Activity

While moose are considered more tolerant of human presence than are other ungulates (AXYS 2001), they are nonetheless sensitive to human proximity (Neumann 2009). Geist (1963) reported that the sight of humans at close range caused all moose to flee, although the sounds of powersaws and gunshots had little effect of moose behaviour. A number of human activities intrude on moose habitat. Anderson et al. (1996) determined that human sources of disturbance, as opposed to mechanical sources, elicit flight responses from further away and result in longer periods of elevated heart rates in moose. In this study, skiers and hikers caused moose to flush from as far away as 400m, while F-16 jets flying 150m overhead did not elicit any behavioural or physiological response. Hiking (Neumann 2009) and backcountry skiing (Nuemann et al. 2010) activities were found to elicit short-lived but considerable responses in moose, including increased movement rates following the disturbance and displacement from the site of the disturbance. Cross-country skiing was found to influence the winter distribution of moose in Alberta, as they moved away from area with heavily used trails during the ski season (Ferguson and Keith 1982). Nuemann (2009) reported a similar response to snowmobile activity within moose habitat, and Colescott and Gillingham (1998) noted altered behaviour of moose within

150m of snowmobile traffic on trails. Behavioural responses to the snowmobiles in this study included moving gradually away from the trail, possibly displacing them temporarily from preferred habitat. Tomeo (2000) examined the physiological response of moose to snowmobiles, and found higher levels of stress hormones in the feces of moose from areas with snowmobile traffic than those from areas with no snowmobile traffic.

In Norway, Anderson et al. (1996) found that moose increased their ranges in response to military exercises, and did not reduce their ranges to pre-disturbance sizes after the operations had ceased. The response of moose to approaching research helicopters was examined by Støen et al. (2010). The responses they observed were similar to those elicited by snowmobiles in other studies, namely increased movement rates for a period of several hours following the disturbance, but not an increase in the overall range of the moose. Upon approach of the helicopter, moose fled to cover rather than running large distances from the disturbance.

In interior Alaska, Maier et al. (2005) found that the densest moose populations occurred closer to towns, a trend which they attributed to either a greater availability of browse near the towns or a decrease in the number of predators in these areas. A similar pattern was detected by Schneider and Wasel (2000) in northern Alberta. In this study, a strong positive relationship between human settlement and moose density was observed, as well as a linear decline in moose density with increasing distance from areas of human settlement. The distribution of moose was not heavily influenced by human development in an Alaskan National Park, and their indifference to development was attributed to habituation due to no positive or negative reinforcement (ie no hunting) (Belant et al. 2006). Conversely, Lykkja et al. (2009) found that moose in Norway often avoided areas of high-density human settlement, and responded to increased human activity by withdrawing further from houses. Moose in the study area did use habitats close to human settlement, but only when humans were less active.

Wind Energy Development

There is little established literature pertaining to the response of moose to wind farm development. A wildlife monitoring report from the Searsburg wind project in Vermont reported that moose were using the area under a generating turbine (Multiple Resource Management Inc. 2006). A total of 23 images of moose were captured using a remote camera installed under the turbine, and of these, 61% occurred when the turbine was on and generating power. Observations of moose scat and of a single moose foraging were reported on the site of the Dokie Wind Energy Project in British Columbia (Jacques Whitford AXYS Ltd, UNBC 2008), meaning that moose continued to use the area after the wind farm was in operation.

A study of the response of elk, another ungulate, to wind-power development in Oklahoma was conducted by Walter et al. (2006). They determined that elk in the area were not adversely affected by the wind-power development, either through negative effects on diet or through changes in home range. The elk remained in the area throughout the construction and operation phases of the wind farm, and the access roads were no barrier to elk movement.

LITERATURE CITED

Altmann, M. 1959. Group dynamics in Wyoming moose during the rutting season. *Journal of Mammalogy* **40**: 420-424.

Anderson, R. 1991. Habitat changes in moose ranges: effects on migratory behaviour, site fidelity and size of summer home-range. *Alces* **27**: 85-92.

Anderson, R., Wiseth, B., Pederson, P.H., and V. Jaren. 1991. Moose-train collisions: effects of environmental conditions. *Alces* **27**: 79-84.

Anderson, R., Linnell, J.D.C., and R. Langvatn. 1996. Short term behavioural and physiological response of moose *Alces alces* to military disturbance in Noway. *Biological Conservation* **77**: 169-176.

AXYS Environmental Consulting Ltd. 2001. Thresholds for addressing cumulative effects on terrestrial and avian wildlife in the Yukon.

Ballenberghe, V.V., and J.M. Peek. 1971. Radiotelemetry studies of moose in northeastern Minnesota. *Journal of Wildlife Management* **35**: 63-71.

Balsom, S., Ballard, W.B., and H. A. Whitlaw. 1996. Mature coniferous forest as critical moose habitat. *Alces* **32**: 131-140.

Bangs, E.E., bailey, T.N., and M.F. Portner. 1984. Bull moose behaviour and movements in relation to harvest on the Kenai National Wildlife refuge. *Alces* **20**: 187-207.

Beazley, K.F., Snaith, T.V., Mackinnon, F., and D. Colville. 2002. Road density and potential impacts on wildlife species such as American moose in mainland Nova Scotia. *Proceedings of the Nova Scotian Institute of Science* **42**: 339-357.

Beazley, K., Kwan, H., and T. Nette. 2008. An examination of the absence of established moose (*Alces alces*) in southeasterm Cape Breton Island, Nova Scotia, Canada. *Alces* **44**: 81-100.

Becker, E.F., and C.A. Grauvogel. 1991. Relationship of reduced train speed on moose-train collisions in Alaska. *Alces* **27**: 161-181.

Belant, J.L., Paynter, J.A., Stahlnecker, K.E., and V. Van Ballenberghe. 2006. Moose distribution relative to human development in a National Park. *Alces* **42**: 33-39.

Bogomolova, E.M., and Y.A. Kurochkin. 2002. Parturition activity of moose. *Alces* **38**: 27-31.

Burrows, F.G.M. 2001. The effects of landscape disturbance on the population dynamics and behaviour of moose (*Alces alces*) in the Greater Pukaskwa Ecosystem, Ontario. M.Sc. Thesis, Faculty of Forestry and the Forest Environment, Lakehead University, 109 pp.

Cederlund, G., Sandegren, F., and K. Larsson. 1987. Summer movements of female moose and dispersal of their offspring. *Journal of Wildlife Management* **51**: 342-352.

Child, K.N. 1983. Railways and moose in the central interior of British Columbia. *Alces* **19**: 118-135.

Colescott, J.H., and M.P. Gillingham. 1998. Reaction of moose (*Alces alces*) to snowmobile traffic in the Greys River Valley, Wyoming. *Alces* **34**: 329-338.

Collins, W.B., and C.C. Schwartz. 1998. Logging Alaska's boreal forest: creation of grasslands or enhancement of moose habitat. *Alces* **34**: 355-374.

Courtois, R., Ouellet, J-P., and B. Gagné. 1998. Characteristics of cutovers used by moose (*Alces alces*) in early winter. *Alces* **34**: 201-211.

Courtois, R., and A. Beaumont. 2002. A preliminary assessment on the influence of habitat composition and structure on moose density in clear-cuts of northwestern Québec. *Alces* **38**: 167-176.

Courtois, R., Dussault, C., Potvin, F., and G. Daigle. 2002. Habitat selection by moose (*Alces alces*) in clear-cut landscapes. *Alces* **38**: 177-192.

Crête, M. 1988. Forestry practices in Québec and Ontario in relation to moose population dynamics. *Forestry Chronicles* **64**: 246-250.

Danks, Z.D., and W.F. Porter. Temporal, spatial, and landscape habitat characteristics of moose-vehicle collisions in western Maine. *Journal of Wildlife Management* **74**: 1229-1241.

Demarchi, M.W. 2003. Migratory patterns and home range size of moose in the Central Nass Valley, British Columbia. *Northwestern Naturalist* **84**: 135-141.

Dodds, D.G. 1958. Observations of pre-rutting behaviour in Newfoundland moose. *Journal of Mammalogy* **39**: 412-416.

Dodge, W.B. Jr., Winterstein, S.R., Beyer, D.E. Jr., and H. Campa III. 2004. Survival, reproduction, and movements of moose in the western Upper Peninsula of Michigan. *Alces* **40**: 71-85.

Dussault, C., Ouelett, J-P., Courtois, R., Huot, J., Breton, L., and J. Larochelle. 2004. Behavioural responses of moose to thermal conditions in the boreal forest. *Ecoscience* **11**: 321-328.

Dussault, C., Poulin, M., Courtois, R., and J-P. Ouellet. 2006. Temporal and spatial distribution of moose-vehicle accidents in the Larentides Wildlife Reserve, Quebec, Canada. *Wildlife Biology* **12**: 415-425.

Dussault, C., Ouelett, J-P., Laurian, C., Courtois, R., Poulin, M., and L. Breton. 2007. Moose movement rates along highways and crossing probability models. *Journal of Wildlife Management* **71**: 2338-2345.

Eason, G. 1985. Overharvest and recovery of moose in a recently logged area. *Alces* **21**: 55-75.

Fraser, D., Arthur, D., Morton, J.K., and B.K. Thompson. 1980. Aquatic feeding by moose *Alces alces* in a Canadian lake. *Holoarctic Ecology* **3**: 218-223.

Ferguson, M.A.D., and L.B. Keith. 1982. Influence of Nordic skiing on distribution of moose and elk in Elk Island National park, Alberta. *Canadian Field Naturalist* **96**: 69-78.

Geist, V. 1963. On the behaviour of North American moose (*Alces alces* andersoni Peterson 1950) in British Columbia. *Behaviour* **20**: 377-416.

Goldrup, J.D. 2003. Evaluating the effects of habitat fragmentation on winter distribution of elk (*Cervus elaphus*) and moose (*Alces alces*) in the Prince Albert National Park area, Saskatchewan. Master's Thesis, Simon Fraser University. 133pp.

Goulet, L.A. 1985. Winter habitat selection by moose in northern British Columbia. *Alces* **21**: 103-125.

Guertin, G., Doucet, G.J., and G.C. Weary. 1984. Moose distribution and winter habitat on the lower north shore of the St. Lawrence River – Quebec. *Alces* **20**: 27-45.

Gundersen, H., Andreassen, H.P., and T. Storaas. 1998. Spatial and temporal correlates to train-moose collisions. *Alces* **34**: 385-394.

Hauge, T.M., and L.B. Keith. 1981. Dynamics of moose populations in northeastern Alberta. *Journal of Wildlife Management* **45**: 573-597.

Jacques Whitford AXYS Ltd, University of Northern British Columbia. 2008. Wildlife Monitoring Summary Report, Dokie Wind Energy Project.

Jaren, V., Anderson, R., Ulleberg, M., Pederson, P.H., and B. Wiseth. 1991. Moose-train collisions: the effects of vegetation removal with a cost-benefit analysis. *Alces* **27**: 93-99.

Langley, M.A., and D.H. Pletscher. 1994. Calving areas of moose in northwestern Montana and southeastern British Columbia. *Alces* **30**: 127-135.

Laurian, C., Dussault, C., Ouellet, J-P., Courtois, R., Poulin, M., and L. Breton. 2008. Behaviour of moose relative to a road network. *Journal of Wildlife Management* **72**: 1550-1557.

Lavsund, S., Nygrén, T., and E.J. Solberg. 2003. Status of moose populations and challenges to moose management in Fennoscandia. *Alces* **39**: 109-130.

Leblond, M., Dussault, C., Ouellet, J-P., Poulin, M., Courtois, R., and J. Fortin. 2007a. Management of roadside salt pools to reduce moose-vehicle collisions. *Journal of Wildlife Management* **71**: 2304-2310.

Leblond, M., Dussault, C., Ouellet, J-P., Poulin, M, Courtois, R., and J. Fortin. 2007b. Electric fencing as a measure to reduce moose-vehicle collisions. **71**: 1695-1703.

Lundmark, C., and J.P. Ball. 2008. Living in snowy environments: quantifying the influence of snow on moose behaviour. *Arctic, Antarctic, and Alpine Research* **40**: 111-118.

Lykkja, O.N., Solberg, E.J., Herfindal, I., Wright, J., Rolandsen, C.M., and M.G. Hanssen. 2009. The effects of human activity on summer habitat use by moose. *Alces* **45**: 109-124.

Maier, J.A.K., Ver Hoef, J.M., McGuire, A.D., Bowyer, R.T., Saperstein, L., and H.A. Maier. 2005. Distribution and density of moose in relation to landscape characteristics: effects of scale. *Canadian Journal of Forest Research* **35**: 2233-2243.

McDonald, M.G. 1991. Moose movement and mortality associated with the Glenn Highway expansion, Anchorage, Alaska. *Alces* **27**: 208-219.

MEG Energy Corp. 2010. Mitigation and habitat enhancement plan for the MEG Energy Corp. Christina Lake Regional Project Phase 2/2B.

McLaren, B.E., Taylor, S., and S.H. Luke. 2009. How moose select forested habitat in Gros Morne National Park, Newfoundland. *Alces* **45**: 125-135.

Miquelle, D.G. 1990. Why don't bull moose eat during the rut? *Behavioural Ecology and Sociobiology* **27**: 145-151.

Multiple Resource management Inc. 2006. Results of wildlife movement monitoring using an infrared sensing remote camera located under wind turbine 7, Searsburg wind project.

Musante, A.R., Pekins, P.J., and D.L. Scarpitti. 2010. Characteristics and dynamics of a regional moose *Alces alces* population in the northeastern United States. *Wildlife Biology* **16**: 185-204.

Neumann, W. 2009. Moose *Alces alces* behaviour related to human activity. Ph.D. Thesis, Swedish University of Agricultural Sciences, 56pp.

Neumann, W., Ericsson, G., and H. Dettki. 2010. Does off-trail backcountry skiing disturb moose? *European Journal of Wildlife Research* **56**: 513-518.

Ontario Ministry of Natural Resources. 1988. Timber management guidelines for the provision of moose habitat. 17pp.

Osko, T.J., Hiltz, M.N., Hudson, R.J., and S.M. Wasel. 2004. Moose habitat preferences in response to changing availability. *Journal of Wildlife Management* **68**: 576-584.

Parker, G. 2003. Status report on the eastern moose (*Alces alces Americana* Clinton) in mainland Nova Scotia.

Peek, J.M., LeResche, R.E., and D.R. Stevens. 1974. Dynamics of moose aggregations in Alaska, Minnesota, and Montana. *Journal of Mammalogy* **55**: 126-137.

Peek, J.M., Urich, D.L., and R.J. Mackie. 1976. Moose habitat selection and relationships to forest management in northeastern Minnesota. *Wildlife Monographs* **48**: 3-65.

Phillips, R.L., Berg, W.E., and D.B. Siniff. 1973. Moose movement patterns and range use in northwestern Minnesota. *Journal of Wildlife Management* **37**: 266-278.

Poole, K.G., Serrouya, R., and K. Stuart-Smith. 2007. Moose calving strategies in interior montane ecosystems. *Journal of Mammalogy* **88**: 139-150.

Rempel, R.S., Elkie, P.C., Rodgers, A.R., and M.J. Gluck. 1997. Timber-management and natural –disturbance effects on moose habitat: landscape evaluation. *Journal of Wildlife Management* **61**: 517-524.

Rudd, L.T., and L.L. Irwin. 1985. Wintering moose vs. oil/gas activity in western Wyoming. *Alces* **21**: 279-298.

Schneider, R.R., and S. Wasel. 2000. The effect of human settlement on the density of moose in northern Alberta. *Journal of Wildlife Management* **64**: 513-520.

Schwab, F.E., and M.D. Pitt. 1991. Moose selection of canopy cover types related to operative temperature, forage, and snow depth. *Canadian Journal of Zoology* **69**: 3071-3077.

Seiler, A., Cederlund, G., Jernelid, H., Grägstedt, P., and E. Ringaby. 2003. The barrier effect of high E4 on migratory moose (*Alces alces*) in the High Coast area, Sweden. *Proceedings of the IENE Conference on Habitat Fragmentation due to Transport Infrastructure*, pp 1-18.

Seiler, A. 2005. Predicting locations of moose-vehicle collisions in Sweden. *Journal of Applied Ecology* **42**: 371-382.

Silverberg, J.K., Perkins, P.J., and R.A. Robertson. 2003. Moose responses to wildlife viewing and traffic stimuli. *Alces* **39**: 153-160.

Snaith, T.V., and K.F. Beazley. 2002. The distribution, status, and habitat associations of moose in mainland Nova Scotia. *Proceedings of the Nova Scotian Institute of Science* **42**: 263-317.

Snaith, T.V., Beazley, K.F., MacKinnon, F., and P. Duinker. 2002. Preliminary habitat suitability analysis for moose in mainland Nova Scotia, Canada. *Alces* **38**: 73-88.

Støen, O-G., Nuemann, W., Ericsson, G., Swenson, J.E., Dettki, H., Kindberg, J., and C. Nellemann. 2010. Behavioural response of moose *Alces alces* and brown bears *Ursus arctos* to direct helicopter approach by researchers. *Wildlife Biology* **16**; 292-300.

Telfer, E.S. 1967a. Comparison of moose and deer range in Nova Scotia. *Journal of Wildlife Manegement* **31**: 418-425.

Telfer, E.S. 1967b. Comparison of a deer yard and a moose yard in Nova Scotia. *Canadian Journal of Zoology* **45**: 485-490.

Testa, J.W. 2004. Population dynamics and life-history trade-offs of moose (*Alces alces*) in south-central Alaska. *Ecology* **85**: 1439-1452.

Timmerman, H.R., and R. Gollat. 1983. Age and sex structure of harvested moose related to season manipulation and access. *Alces* **18**: 301-328.

Timmerman, H.R., and G.D. Racey. 1989. Moose access routes to an aquatic feeding site. *Alces* **25**: 104-111.

Tomeo, M.A. 2000. Fecal measurements of stress response to snowmobiles in moose (*Alces alces*). M.Sc. Thesis, Alaska Pacific University. 41pp.

Van Ballenberghe, V., and J.M. Peek. 1971. Radiotelemetry studies of moose in northeastern Minnesota. *Journal of Wildlife Management* **35**: 63-71.

Walter, W.D., Leslie Jr., D.M., and J.A. Jenks. 2006. Response of Rocky Mountain elk (*Cervus elaphus*) to wind-power development. *American Midland Naturalist* **156**: 363-375.

Welch, I.D., Rodgers, A.R., and R.S. McKinley. 2000. Timber harvest and calving site fidelity of moose in northwestern Ontario. *Alces* **36**: 93-103.

Westwoth, D., Brusnyk, L., Roberts, J., and H. Veldhuzien. 1989. Winter habitat use by moose in the vicinity of an open pit copper mine in north-central British Columbia. *Alces* **25**: 156-166.

Wilton, M.L., and D.L. Garner. 1991. Preliminary findings regarding elevation as a major factor in moose calving site selection in south central Ontario, Canada. *Alces* **27**: 111-117.

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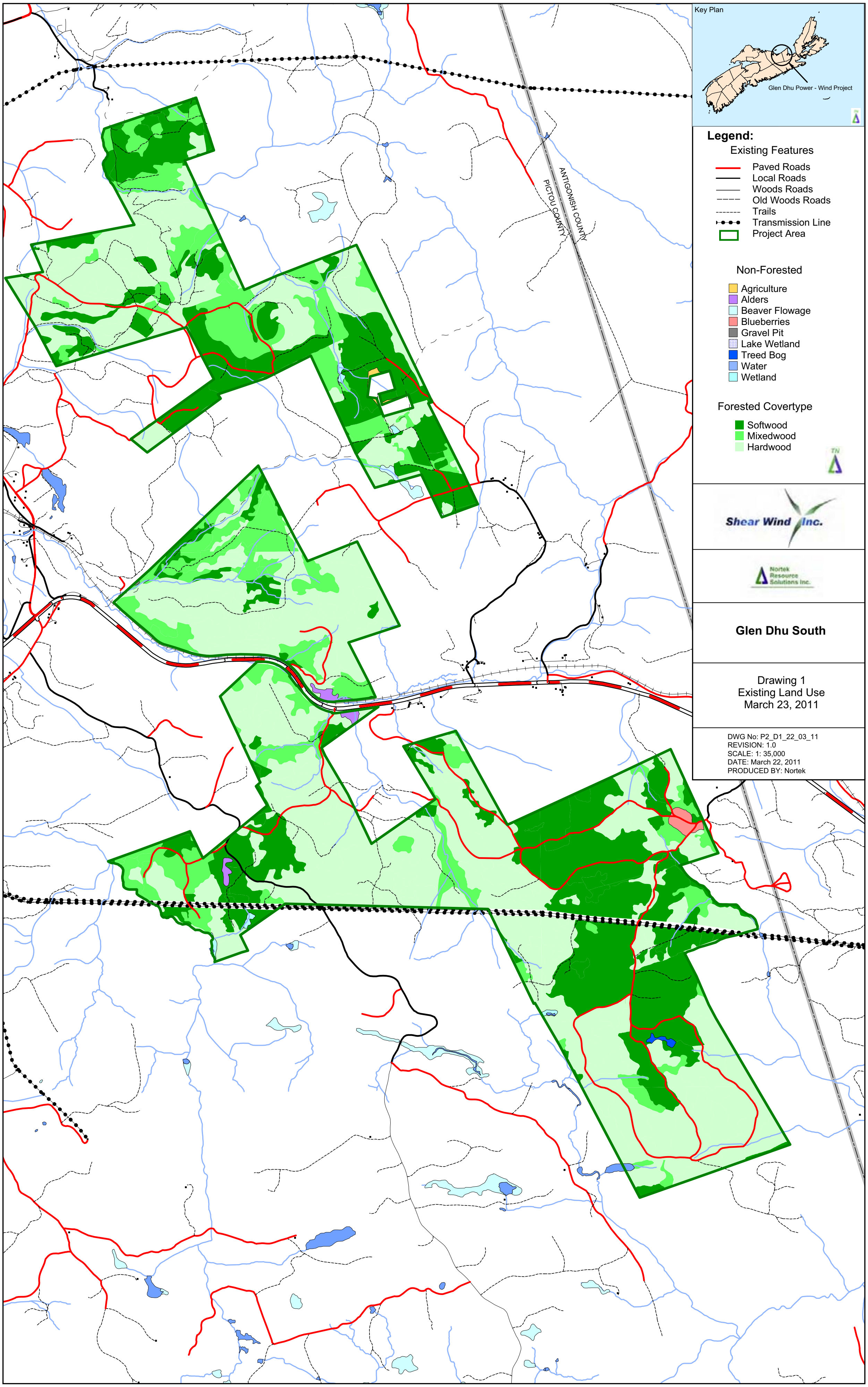
Appendix B: Drawings



Legend:

Existing Features

- Paved Roads
- Local Roads
- Woods Roads
- Old Woods Roads
- Trails
- Transmission Line
- Project Area

Non-Forested

- Agriculture
- Alders
- Beaver Flowage
- Blueberries
- Gravel Pit
- Lake Wetland
- Treed Bog
- Water
- Wetland

Forested Covertype

- Softwood
- Mixedwood
- Hardwood

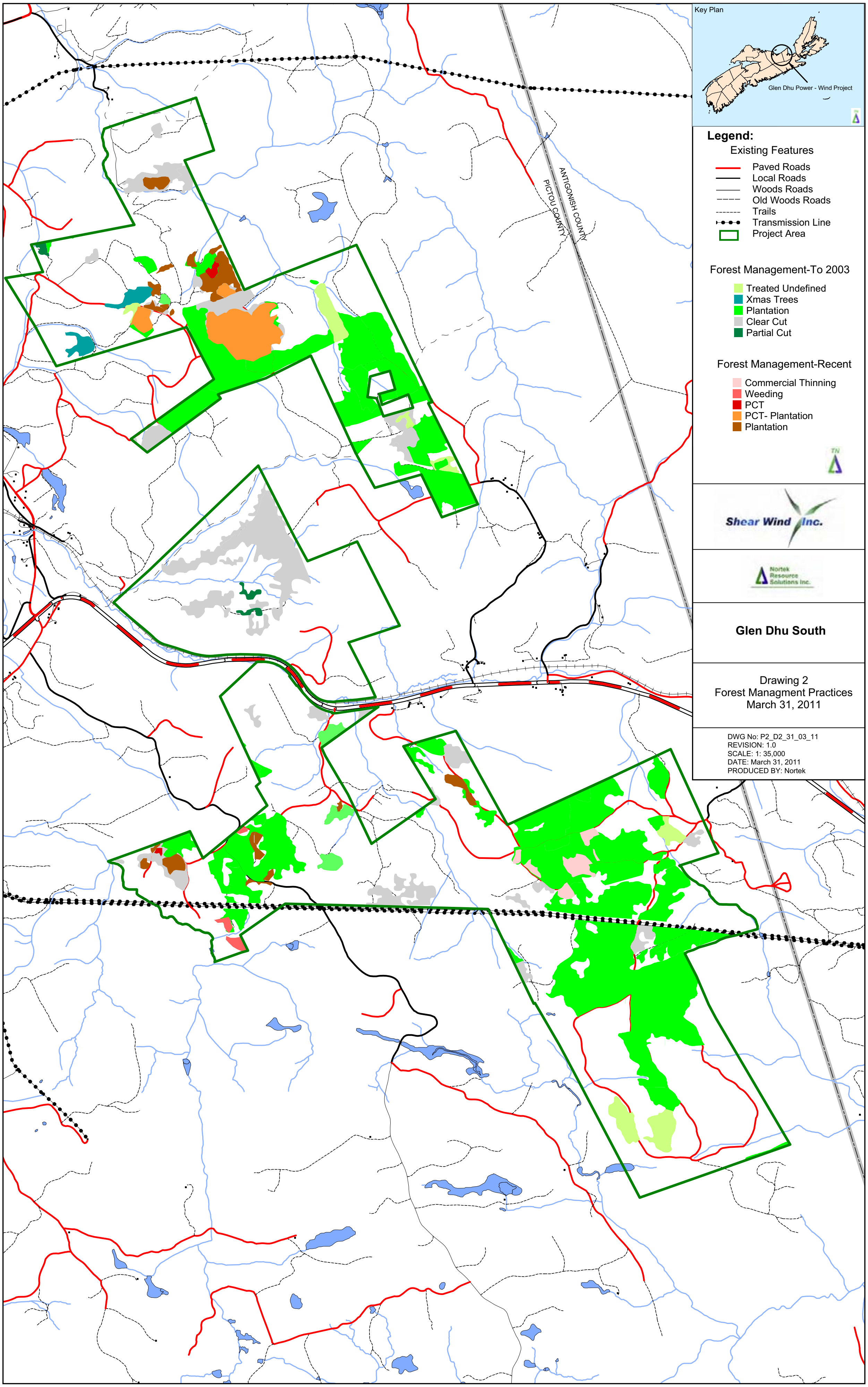
Shear Wind Inc.

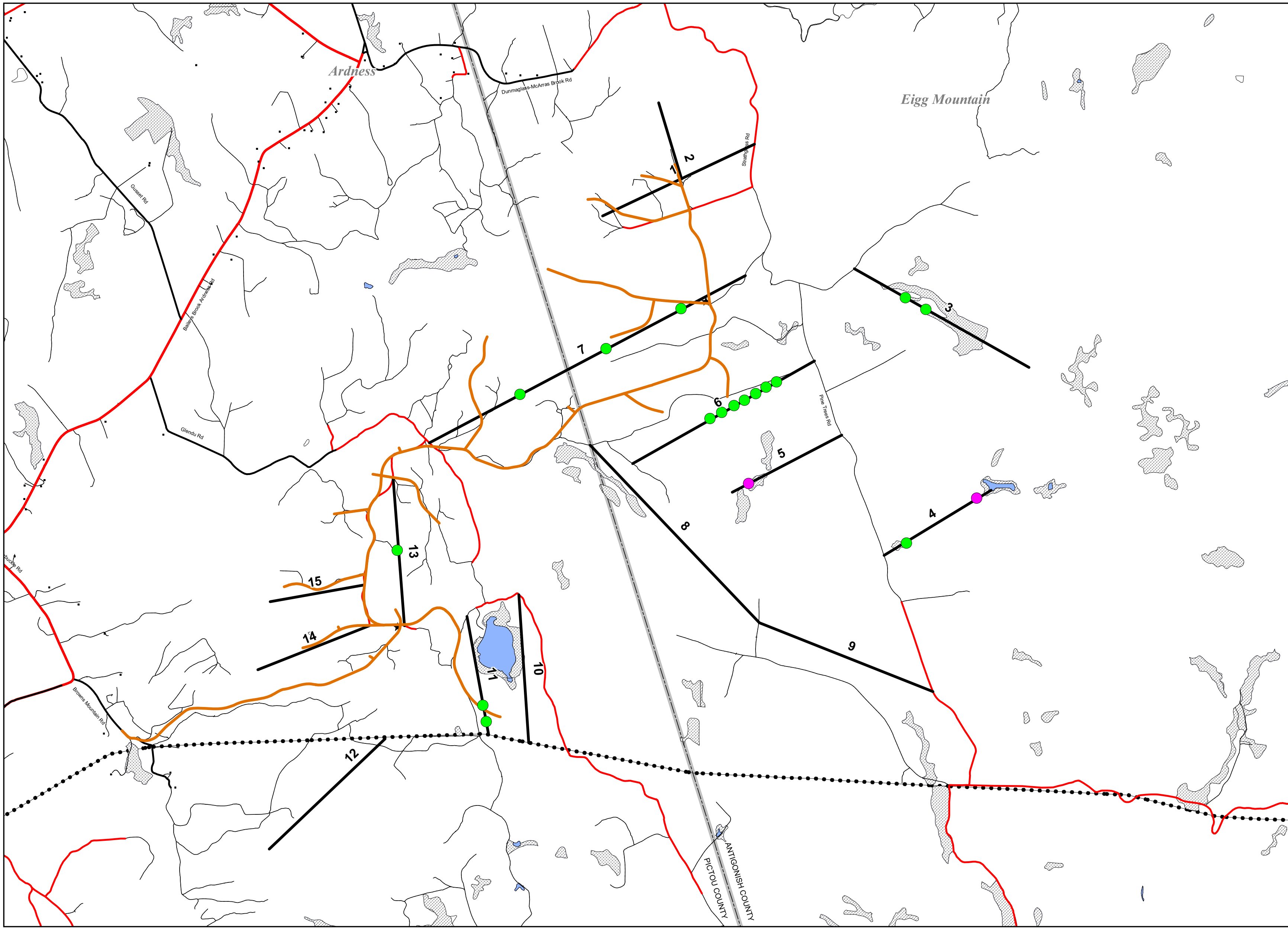
Nortek Resource Solutions Inc.

Glen Dhu South

Drawing 1
Existing Land Use
March 23, 2011

DWG No: P2_D1_22_03_11
REVISION: 1.0
SCALE: 1: 35,000
DATE: March 22, 2011
PRODUCED BY: Nortek


Key Plan
Glen Dhu Power - Wind Project
Legend:
Existing Features
Paved Roads
Local Roads
Woods Roads
Old Woods Roads
Trails
Transmission Line
Project Area
Forest Management-To 2003
Treated Undefined
Xmas Trees
Plantation
Clear Cut
Partial Cut
Forest Management-Recent
Commercial Thinning
Weeding
PCT
PCT- Plantation
Plantation
Shear Wind Inc.
Nortek Resource Solutions Inc.
Glen Dhu South
Drawing 2
Forest Managment Practices
March 31, 2011
DWG No: P2_D2_31_03_11
REVISION: 1.0
SCALE: 1: 35,000
DATE: March 31, 2011
PRODUCED BY: Nortek
ANTIGONISH COUNTY
PICTOU COUNTY



Glen Dhu Power-Wind Project

Legend:

Existing Features

- Paved Roads
- Local Roads
- Woods Roads
- Old Woods Roads
- Trails
- Project Roads
- Transmission Line
- Water
- Wetlands

Pellet Survey

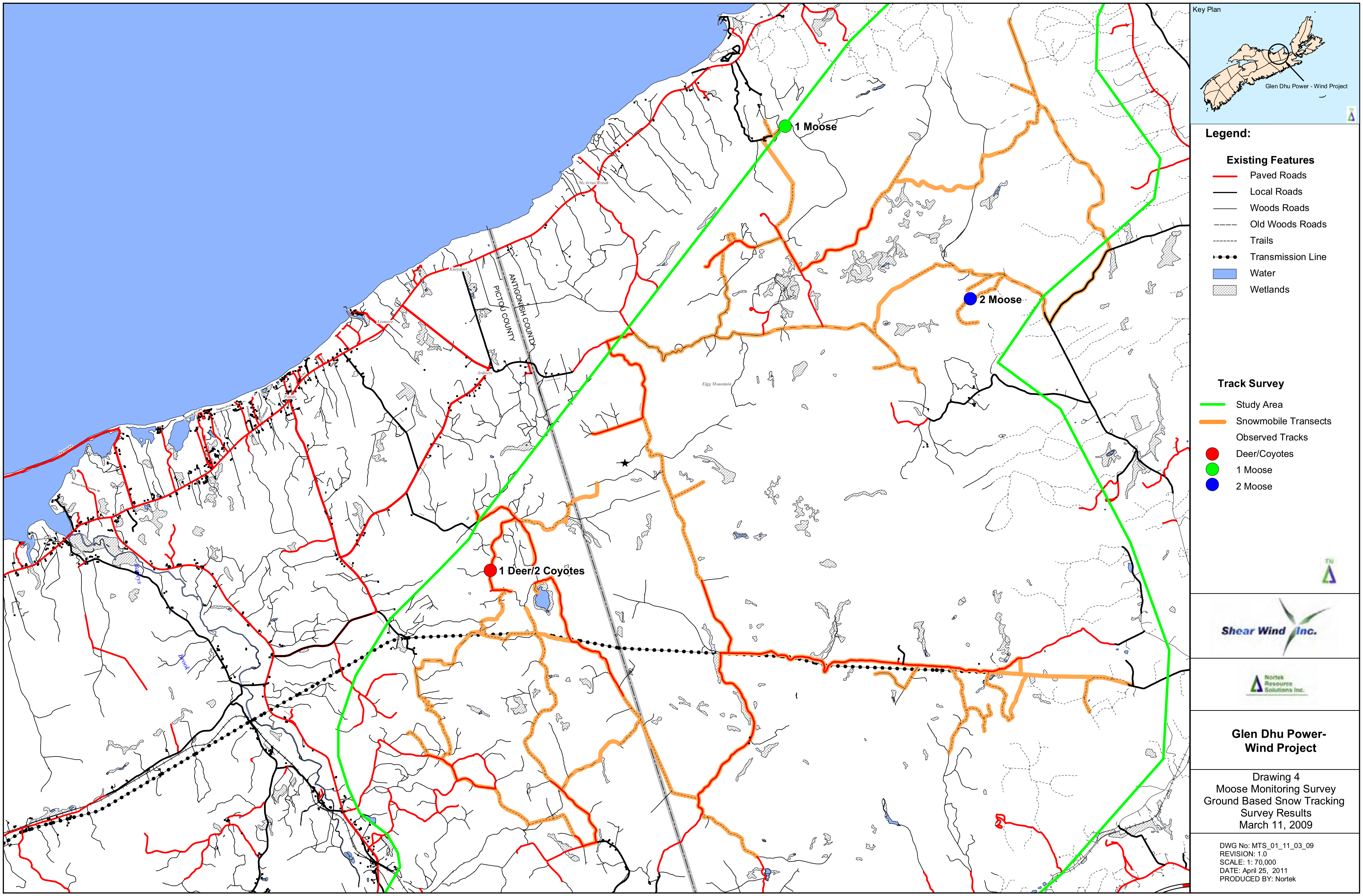
- Ground Transects
- Observed Moose Pellets
- Observed Deer Pellets

Shear Wind Inc.

Nortek Resource Solutions Inc.

Drawing 3
Moose Monitoring Program
Pellet Survey
Survey Results
May, 2010

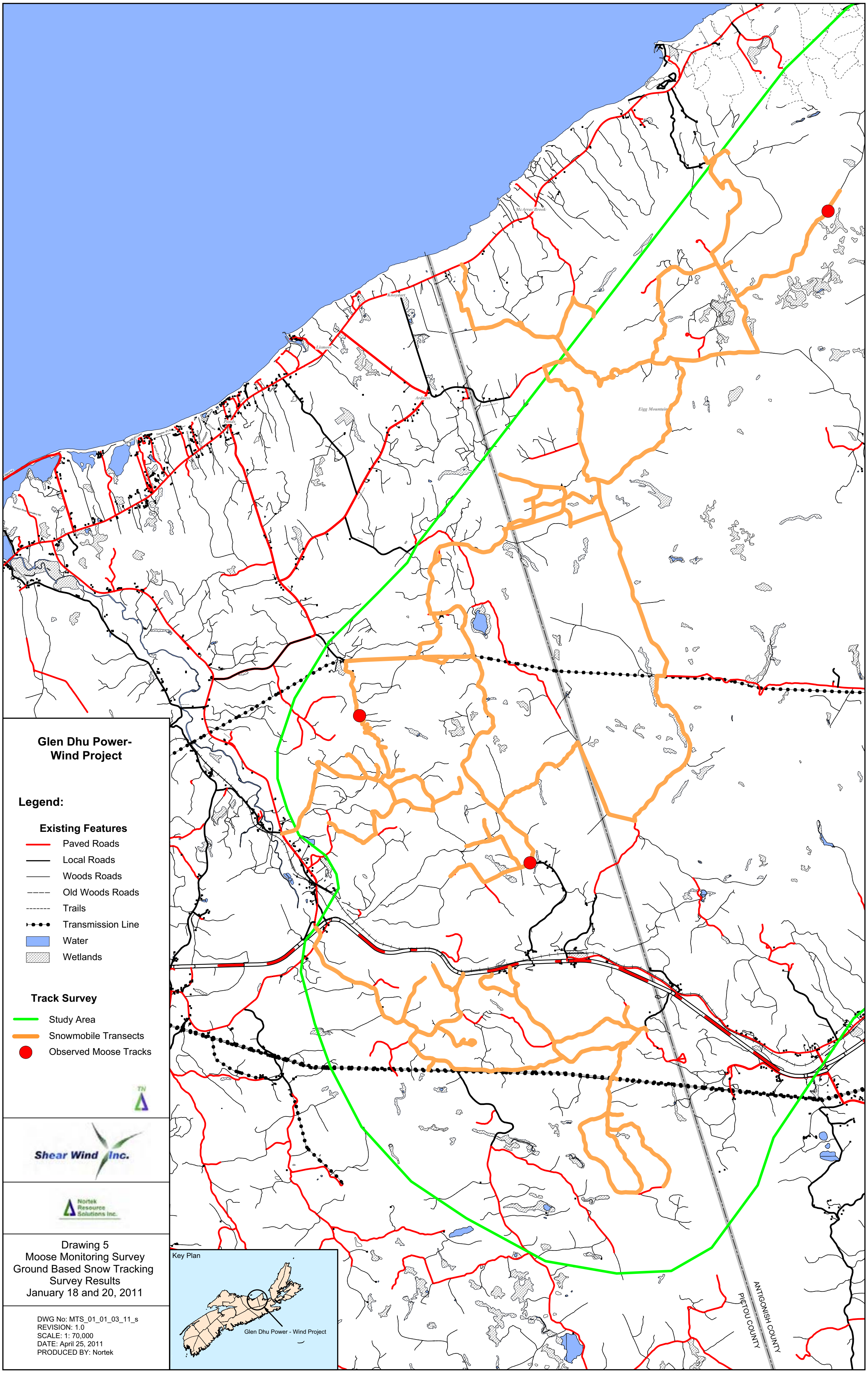
DWG No: MPS_01_01_05_10
REVISION: 1.0
SCALE: 1: 3,000
DATE: March 28, 2011
PRODUCED BY: Nortek



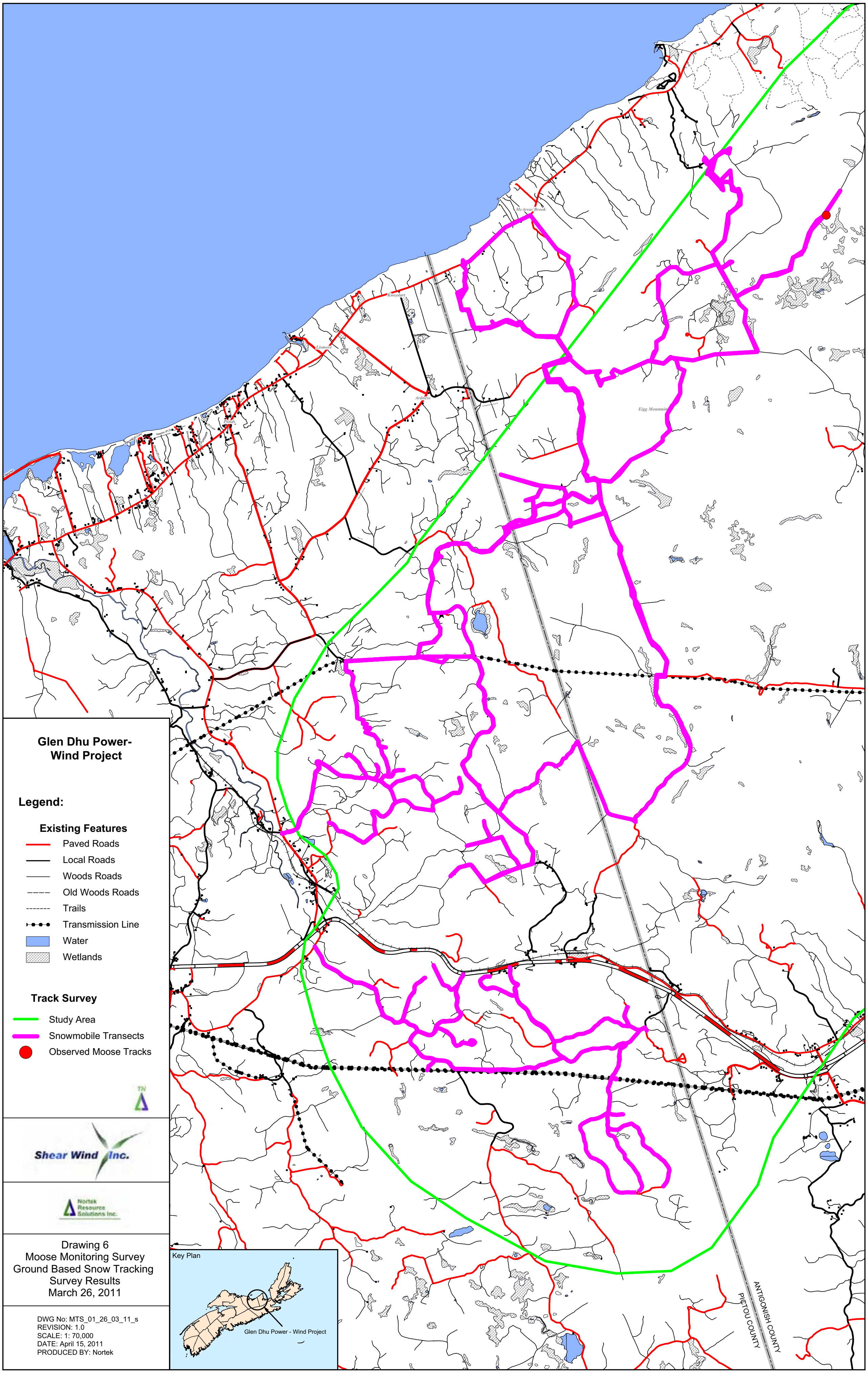
Glen Dhu Power-Wind Project

Drawing 4
Moose Monitoring Survey
Ground Based Snow Tracking
Survey Results
March 11, 2009

DWG No: MTS_01_11_03_09
REVISION: 1.0
SCALE: 1: 70,000
DATE: April 25, 2011
PRODUCED BY: Nortek



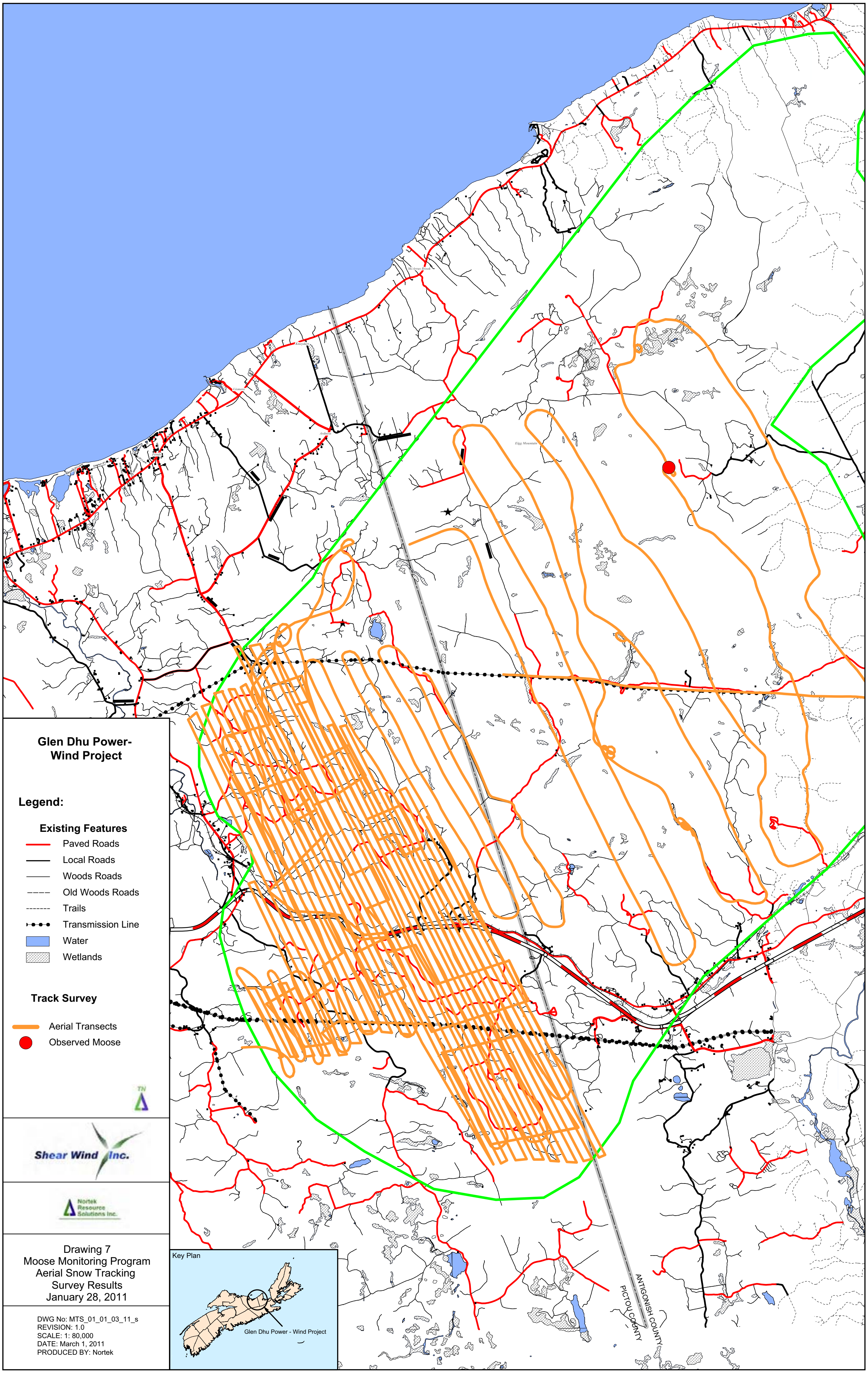
Glen Dhu Power-
Wind Project
Legend:
Existing Features
Paved Roads
Local Roads
Woods Roads
Old Woods Roads
Trails
Transmission Line
Water
Wetlands
Track Survey
Study Area
Snowmobile Transects
Observed Moose Tracks
Shear Wind Inc.
Nortek Resource Solutions Inc.
Drawing 5
Moose Monitoring Survey
Ground Based Snow Tracking
Survey Results
January 18 and 20, 2011
DWG No: MTS_01_01_03_11_s
REVISION: 1.0
SCALE: 1: 70,000
DATE: April 25, 2011
PRODUCED BY: Nortek
Key Plan
Glen Dhu Power - Wind Project
ANTIGONISH COUNTY
PICTOU COUNTY



Glen Dhu Power-Wind Project

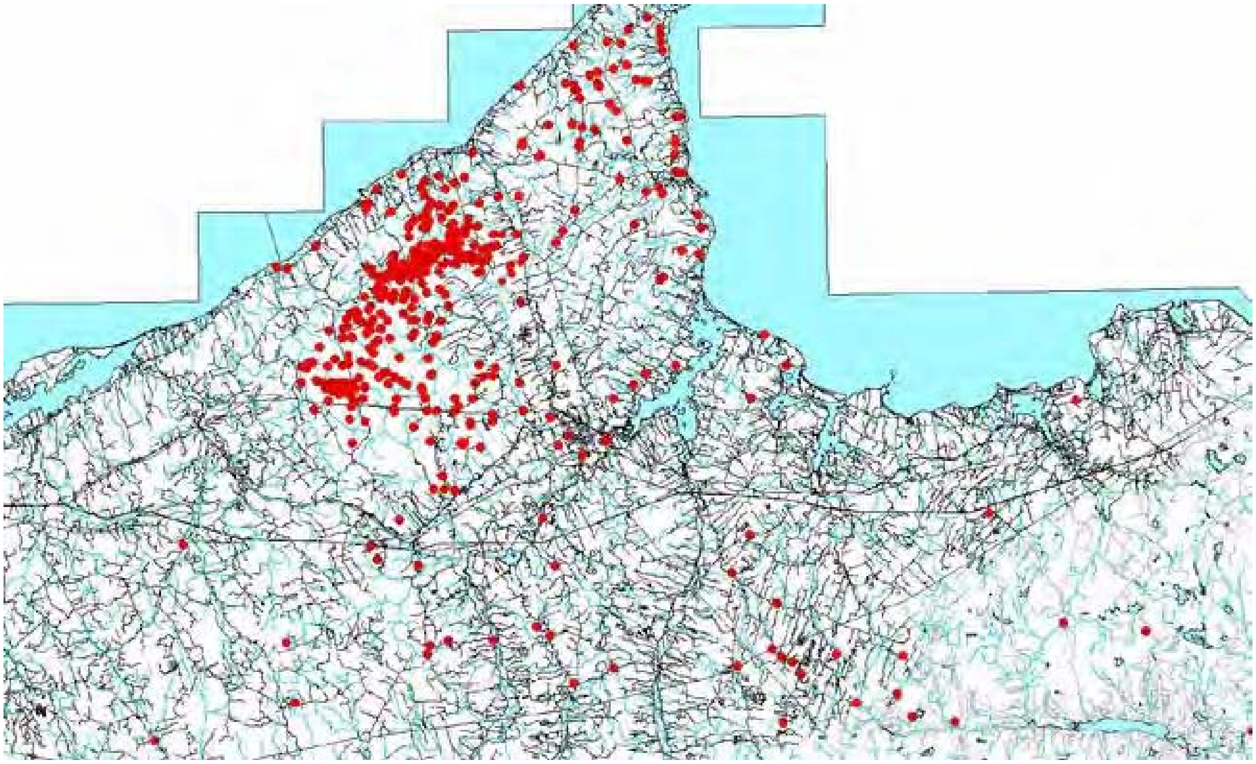
Drawing 6
Moose Monitoring Survey
Ground Based Snow Tracking
Survey Results
March 26, 2011

DWG No: MTS_01_26_03_11_s
REVISION: 1.0
SCALE: 1: 70,000
DATE: April 15, 2011
PRODUCED BY: Nortek

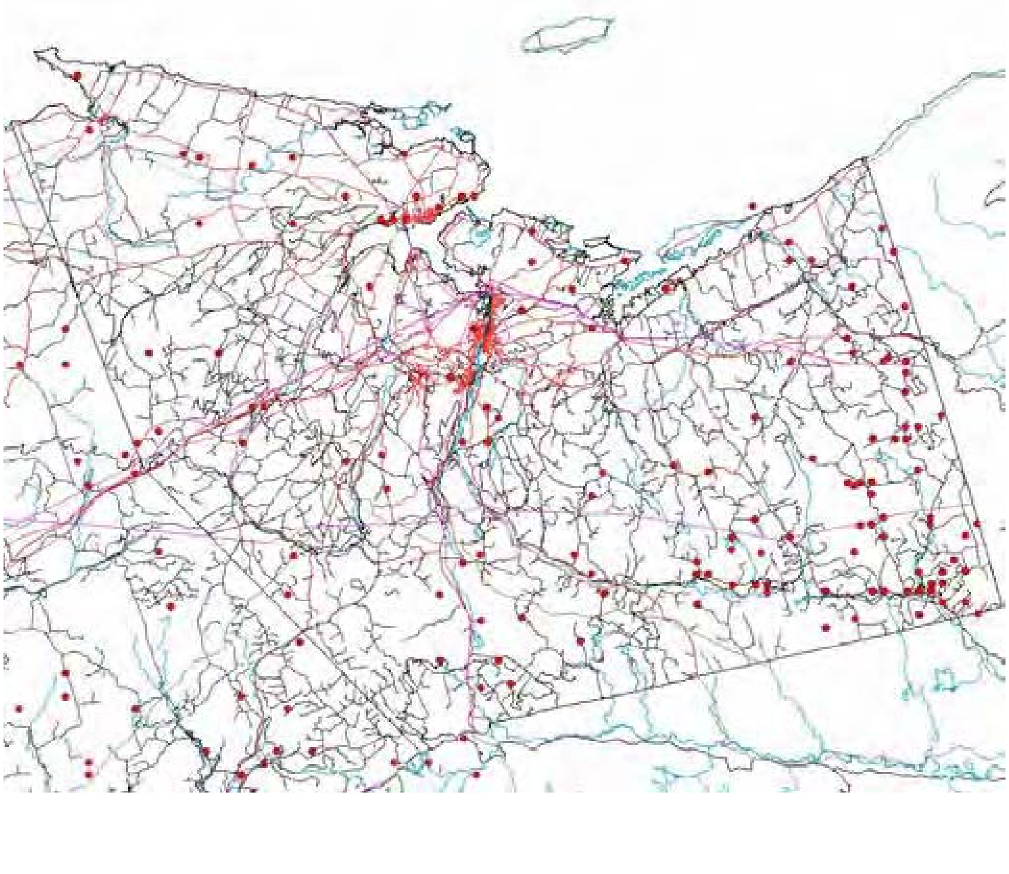

Glen Dhu Power-
Wind Project
Legend:
Existing Features
Paved Roads
Local Roads
Woods Roads
Old Woods Roads
Trails
Transmission Line
Water
Wetlands
Track Survey
Aerial Transects
Observed Moose
Shear Wind Inc.
Nortek Resource Solutions Inc.
Drawing 7
Moose Monitoring Program
Aerial Snow Tracking
Survey Results
January 28, 2011
DWG No: MTS_01_01_03_11_s
REVISION: 1.0
SCALE: 1: 80,000
DATE: March 1, 2011
PRODUCED BY: Nortek
Key Plan
Glen Dhu Power - Wind Project
ANTIGONISH COUNTY
PICTOU COUNTY

Appendix C: Nova Scotia Department of Natural Resources (NS DNR) Incidental Sightings of Mainland Moose: Pictou and Antigonish Counties

Antigonish County: Incidental Moose Sightings 2003-2011 (provided by NS DNR Antigonish County)



Pictou County: Incidental Moose Sightings 2002-2011 (provided by NS DNR Pictou County)



Appendix VIII. BAT ASSESSMENT REPORT

Analysis of ultrasonic anabat recordings with inferences on bat species composition and activity at the site of the proposed wind turbine farm at Glen Dhu, Nova Scotia.

H.G. Broders, Department of Biology, SMU, Halifax, NS, B3H 3C3

30 November 2011

Context

The proponent is proposing to install electricity generating wind turbines at Glen Dhu, Nova Scotia. The Renewable Energy Plan for the Province of Nova Scotia has a commitment that, by 2015, 25% of our energy will be acquired from renewable sources such as wind. Wind energy is commonly cited as a "green" energy source because, once in operation, it does not contribute direct atmospheric emissions, uses limited land area for operation and requires minimal economic expenditure following decommission (Andersen and Jensen, 2000). Despite these advantages, there are several potential negative effects of wind energy generation on wildlife and wildlife habitat. Direct mortality of birds and bats from collisions with turbine has been documented at several facilities (Erickson et al., 2001; Johnson, 2005; Kunz et al., 2007; Osborn et al., 2000). Additionally, bats may also be killed from barotrauma associated with moving turbine blades (Baerwald et al., 2008). Beyond these direct effects, loss or alteration of habitat may also affect impact bats on the short- and long-term.

For this project I have analyzed the raw acoustic files collected by McCallum Environmental on the proposed extension of the wind farm at Glen Dhu in the late summer and fall of 2011. The objectives of this project were: (1) to provide information on occurrence and relative magnitude of activity level in the proposed development area, based on analysis of acoustic data; (2) provide relevant information on resource requirements of local species that might be useful for informing the decision-making process on the proposed development and (3) make any relevant recommendations based on the results of this project and any recent developments in the field.

Background

It is widely known that some wind farms are a major source of mortality for many bat species (Barclay et al., 2007; Johnson, 2005), whereas other farms cause few, if any, direct mortalities. Estimates of the number of bat fatalities is highly variable ranging from less than 3 and up to 50 bats/turbine/year (Jain et al., 2007a; Johnson et al., 2003a; Johnson et al., 2003b; Kerns et al., 2005; Kerns and Kerlinger, 2004; Nicholson, 2003). Approximately 80% of the documented bat fatalities are migratory species (red, hoary and silver-haired bats), especially in areas of western North America (Kunz et al., 2007). Resident hibernating species (e.g., Myotis spp bats) have also been documented among fatalities in high numbers in some areas of the eastern United

States (Kunz et al. 2007; Arnett et al. 2008). The proximate cause of mortalities may be due to direct strikes of the animals with the rotating turbine blades or by experiencing a rapid drop in pressure as they fly in proximity to the rotating blades-barotrauma (Baerwald et al., 2008). Beyond direct mortalities, additional potential impacts to bats from wind farm developments include changes to habitat availability and changes to movement patterns (e.g., foraging movements, localized resident migrations and large scale migrations).

Direct Mortality (Collisions or Barotrauma)

In North America, large bat fatality events occur primarily in late summer and early fall and the species most affected are the long distance migrant species including hoary bats (*Lasiurus cinereus*), silver-haired bats (*Lasionycteris noctivagans*) and eastern red bats (*Lasiurus borealis*). However, bat fatalities have also been reported, in smaller numbers for short-distance migrant (or 'resident') bat species such as the tri-colored bat (*Perimyotis subflavus*), northern long-eared bat (*Myotis septentrionalis*) and little brown bats (*Myotis lucifugus*) (Arnett et al. 2008; Jain et al., 2007a; Johnson, 2005; Nicholson, 2003). Although some mortality has been documented in the spring (see review in Arnett et al., 2008; Brown and Hamilton, 2006) it is thought that spring migration behavior is scattered and less organized and may occur by different routes compared to fall migration.

There have been many explanations proposed to explain the incidence of bat mortalities at wind farms (Cryan and Barclay 2009). The large variability in species composition and rates of fatalities among wind generation facilities may be due to the placement of facilities (e.g., along migratory routes or not), and from the use of increasingly larger turbines which extend into the flight space of migrating bats (Barclay et al., 2007). However, behavioral observations suggest that bats that are killed often display foraging – type flight pattern rather than simply passing through the area (Horn et al., 2008). Others have hypothesized that bats use tall structures as mating sites, and thus may be attracted to these areas following construction (Cryan 2008). Further, bat mortalities tend to occur more often during nights with low windspeed (Horn et al., 2008). Therefore, as mortalities may be a result of site- and design-specific characteristics and conditions, it is important to conduct site-specific monitoring studies to make reliable inferences on the potential impacts of a wind farms on bat populations (Mammalogists, 2008). That being said, it is also critical that we understand basic natural history and seasonal movement patterns of bats (where are the migration corridors, if they exist?).

Movement Patterns

At a local scale, resident bats may be affected by wind power project developments by alterations to foraging areas and possibly by impacting commuting movements between roosting and foraging areas. There is some genetic evidence to suggest that bat movements can be impeded by fragmentation of habitat which can scale up to population or distributional level effects (Kerth and Petit, 2005). However this is not well understood for most species.

Little is also known about the dynamics of movement (e.g., altitude and travel routes) of ‘resident’ bats (e.g., little brown and northern long-eared bats) to and from hibernation sites. Anecdotal evidence suggests that bats would likely use ridges and other linear landscape elements (riparian corridors) as travel routes depending on the landscape (Arnett, 2005; Lausen, 2007). In the late summer, bats begin to congregate at hibernacula 1-2 months before the onset of hibernation when courtship and copulation is believed to occur (Fenton, 1969). During this period bats do not roost inside the hibernaculum and research we are conducting in Nova Scotia indicates that resident bats are ‘on the move’ roosting transiently on the landscape. However, at this time we do not fully understand the dynamics of these behaviors and this is an active area of research.

Movement data from Ontario and Manitoba suggests that resident bats move up to at least 120 km between hibernacula within a year and up to at least 500 km between years (Fenton, 1969; Craig Willis, Pers. Comm.). In New England bats there are records of bat movements of 214 kms between hibernacula within one year with one female moving 128 km in only 3 nights during the spring emergence from hibernation (Davis and Hitchcock, 1965). Obviously, these resident hibernating species are at least capable of large scale migratory movements. Flight behavior (height above ground level, routes, etc.) during this time may be different from when they are on the ‘summering grounds’. The paucity of information on this aspect of bat biology would appear to be one of the largest impediments in accurately predicting the impact of wind farms on bats (Weller et al., 2009). This is, of course, assuming that mortality of bats at wind farms are not the result of being attracted to them out of curiosity, as sites for mating or for some other reason (Cryan, 2008; Horn et al., 2008).

Habitat Availability

The management and removal of vegetation alters the physical structure (species composition, tree densities, seral stage etc.) of existing areas that bats reside. Habitat availability for bats can be altered by the direct loss of resources (e.g., roost trees), fragmentation of habitat components (e.g., foraging and roosting areas), and from disturbances which can cause bats to avoid certain areas. The alteration of forest structure (removal and fragmentation of trees for road building and deployment of turbines, etc.) for the development will likely act to degrade the local environment for colonies/populations that reside in the area during the summer. This negative aspect is likely to occur and will add to the cumulative effect of loss of bat habitat that is occurring throughout the range of these species.

At the site level, small scale clearings have been shown to attract certain bat species to foraging areas relative to adjacent undisturbed forest in forested landscapes (Grindal and Brigham, 1998; Hayes and Loeb, 2007). Vegetation removal can create edge habitats or small clearings which provide ease of flight and can concentrate insect prey. However, the extent to which this loss can be considered as beneficial to bats is not known because there must be a balance between the availability of suitable foraging areas with the availability of roosting resources (within connected, commuting distance) to provide suitable summer habitat for resident bats (e.g., Henderson and Broders, 2008).

Bat Species in Nova Scotia

In Nova Scotia there are occurrence records for seven bat species (each of the 6 mentioned above as well as the big brown bat, *Eptesicus fuscus*; Table 1) (Broders et al., 2003; van Zyll De Jong, 1985), and each have been documented to have experienced fatalities at wind turbine sites (Arnett et al. 2008). Nova Scotia is at, or near the periphery of the current known range for each of these species, except the northern long-eared bat and the little brown bat (van Zyll De Jong, 1985). These two species, as well as the tri-colored bat, appear to be the only bat species with significant populations in Nova Scotia (Broders et al., 2003; Farrow and Broders 2011). Little brown bats and northern long-eared bats are widespread in Nova Scotia but the population of tri-colored bats appear to be restricted to southwestern region (Broders et al., 2003; Farrow and Broders 2011; Rockwell, 2005). The low number of echolocation recordings of migratory species (i.e., red, hoary and silver-haired bats; 15 out of 30 000 echolocation sequences) by Broders (2003) and other unpublished work suggests there are no significant populations or migratory movements of these species in southwest Nova Scotia. As for big brown bats, there is only one unconfirmed observation of 2 individuals of this species hibernating at Hayes Caves, there are no other confirmed records (Moseley, 2007; Taylor, 1997).

Table 1. Bat species previously recorded in Nova Scotia

Species	Overwintering Strategy	Documented fatalities at wind farms?	Global ranking[2]	ACCDA status[3]
Little brown bat	Resident hibernator (NS and NB)	Yes	G5	S4
Northern long-eared bat	Resident hibernator (NS and NB)	Yes	G4	S2
Tri-colored bat	Resident hibernator (NS and NB)	Yes	G5	S1?
Big brown bat	Resident hibernator (NB)	Yes	G5	N/A
Hoary bat	Migratory	Yes	G5	S2?
Silver-haired bat	Migratory	Yes	G5	S1?
Eastern red bat	Migratory	Yes	G5	S2?

[1] Bat species documented in fatality events from carcass surveys conducted at wind energy development sites in N.A.

[2]Global ranking based on the NatureServe Explorer, G5= **Secure**—Common; widespread and abundant: G4= **Apparently Secure**—Uncommon but not rare; some cause for long-term concern due to declines or other factors.

[3]Atlantic Canada Conservation Data Centre ranking, based on occurrence records from NB and NS; S1= **Extremely rare**--May be especially vulnerable to extirpation (typically 5 or fewer occurrences or very few individuals; S2= **Rare**--May be vulnerable to extirpation due to rarity or other factors (6 to 20 occurrences or few remaining individuals); S4= **Usually widespread--** fairly common and apparently secure with many occurrences; (?) qualified as inexact or uncertain.

Summary of the ecology of resident species

Northern long-eared and little brown bats are expected to be the most frequently encountered species in the development area. The life history of both of these species is typical for temperate bats. Their annual cycle consists of a period of activity (reproduction) in the summer and a hibernation period in the winter. Females of the two species bear the cost of reproduction in the summer from pregnancy and by providing sole parental care to juveniles (Barclay, 1991; Broders et al., 2006; Hamilton and Barclay, 1994). The northern long eared bat is a forest interior species that primarily roosts and forages in the interior of forests (Broders et al., 2006; Henderson and Broders, 2008; Jung et al., 2004). Females form maternity roosting colonies in coniferous or deciduous trees, depending on availability (Broders et al., 2006; Foster and Kurta, 1999; Garroway and Broders, 2008). Males typically roost solitarily in either deciduous or coniferous trees (Ford et al., 2006; Jung et al., 2004; Lacki and Schwierjohann, 2001).

The little brown bat is a generalist species, associated with forests, as well as human-dominated environments (Barclay, 1982; Jung et al., 1999b). This species has been found to forage over water and in forests (Anthony and Kunz, 1977; Fenton and Barclay, 1980) and both males and females (i.e., maternity colonies) have been shown to roost in buildings and trees (Broders and Forbes, 2004; Crampton and Barclay, 1998). During the summer it appears that most of the commuting and foraging activity of northern long-eared and little brown bats occurs close to the ground (Broders, 2003). Regardless, our ability to sample bat activity at high altitudes is extremely limited and therefore our ability to make inference on the vertical distribution of bats is extremely limited.

A third species that occurs in Nova Scotia but is not likely to occur in the proposed development area is the tri-colored bat (*Perimyotis subflavus*) (Farrow and Broders, 2011). In Nova Scotia, work that we have done in Kejimkujik National Park suggests that this species roosts is *Usnea* spp. lichen and forage over waterways (Poissant and Broders, 2010). Although there are a few records of tri-colored bats at known hibernacula (Garroway, 2004; Moseley, 2007; Poissant, 2007), we believe that there are other unrecorded sites at which this species hibernate.

Populations of each of the resident bat species of Nova Scotia are being decimated elsewhere by a fungus that causes a condition known as white-nose syndrome (Lorch et al. 2011). The condition was first documented in New York State in 2005-06 and has since spread through much of northeastern North American and in as few as 3-4 years has reduced the population size of many species by 90%. It is not known to what extent bats in Nova Scotia will be impacted, but the fungus has now been confirmed in the province and it is expected that the next few winters will be telling of the impact that it will have here. In the event that white-nose syndrome has similar impacts in Nova Scotia as it has had elsewhere, it would seem likely that we need to be extra cautious to protect any surviving animals, which may be genetically predisposed to surviving the infection.

Environmental Context

The Glen Dhu project area is located between the towns of Antigonish and New Glasgow, NS, in the Pictou-Antigonish Highlands district of the Avalon Uplands theme region. Forests in this area are characterized by shade tolerant hardwood species including yellow birch, sugar maple and American beech (Davis and Browne, 1996).

Currently in Nova Scotia, there are >50 wind turbines in operation and, as of yet, there have been no incidents of major mortality events that I am aware of, but there have been a number of bats killed. For context and qualification though most of these turbines have been operating for only a short period of time (months to a few years) and it is not known how thoroughly existing operational turbines are being surveyed for bat kills and how well documented and reported the findings are. Therefore, it is not advisable to only rely on this data to make predictions for elsewhere in the region and into the future.

Potential for hibernacula in project area

The guide to wind development prepared by the Nova Scotia Department of Environment and Labour (NSDEL, 2007, updated September 2009) states that wind farm sites within 25 km of a known bat hibernaculum have a 'very high' site sensitivity. There is only one site mentioned by Moseley (2007) as a potential hibernaculum. This site (McLennan's Brook Cave) is a limestone cave that is approximately 25 kms from the proposed area and has a length of 85m. Moseley (2007) mentions that there was late summer activity at the site which is indicative of a swarming site but there was no winter count to confirm it was a hibernaculum. Randall (2011) conducted an acoustic survey at the site in the fall of 2010 and never identified the area as a significant site for swarming. This suggests the site may not be a significant hibernaculum.

There are ≥25 government records of abandoned mine openings within 25 kms of the proposed development site, but only 3 of these have original depth records >50 m (COP-1-006, COP-001 and COP-1-005). To my knowledge, none have been surveyed for bats.

Acoustic Detection Methods

McCallum Environmental used Anabat bat detectors (Titley electronics, Ballina, NSW, Australia) to passively record the echolocation calls of bats within the study area. The seasonal timing of the sampled period likely corresponded to the end of the summer residency period and the fall migration period (Griffin, 1945; Kunz et al., 2007). Four detectors sampled at ground level for varying periods of time during the study period. Additionally, one system was deployed on a meteorological tower (30 m AGL) (Tables 2 and 3).

Identification of many bat species is possible because of the distinctive nature of their echolocation calls (Fenton and Bell, 1981; O'Farrell et al., 1999). Species were qualitatively identified from echolocation sequences by comparison with known echolocation sequences recorded in this and other geographic regions. In the case of species in the genus *Myotis* (northern long-eared bat and little brown bat), there was no attempt to identify sequences to the species level, as their calls are too similar to be reliably separated. Identifications were accomplished using frequency-time graphs in ANALOOK software (C. Corben, www.hoarybat.com). An Anabat echolocation file approximates a call sequence, defined as a continuous series of greater than two calls (Johnson et al., 2004), and this was used as the unit of activity.

Table 2: Locations of acoustic sampling in the Glen Dhu Project area, 2011.

Site #	**Location**	**Coordinate NAD83 UTM Zone 20T**	**Date Deployed**	**Date Retrieved**
1	Turbine 22- on the ground	561062.02 m E 5051217.89 m N	August 12, 2011	October 24, 2011
2	SE MET tower	563287.24 m E 5045237.94 m N	August 12, 2011	September 8, 2011
3	NW Met Tower – turbine 6	558461.25 m E 5052699.24 m N	August 12, 2011	October 3, 2011
4	SW MET tower[1]	559486.30 m E 5046899.60 m N	August 19, 2011	October24, 2011

[1]: From the evening of 26 August 2011 up to and including the evening of 7 September 2011 this system was deployed on the ground adjacent to the tower.

Table 3: Site descriptions for each of the acoustic sampling locations (as provided by McCallum Environmental)

Site	Description
1	Shrub clearing with small coniferous trees near a mature forest and along the edge of woods road. No significant water near this location. The sensor was located in a grove of small trees deployed on the ground at 1 m height above the ground.
2	Shrub clearing where a MET tower is located. No significant water near this location. The sensor was deployed on the ground at 1 m height above the ground.
3	Shrub clearing at the edge of a woods road near the MET tower. No surface water at this location. The sensor was deployed on the ground at 1 m height above the ground.
4	At the MET tower and deployed at 30 m height on a bat trolly/hoist. Was up on MET tower for the entire period with the exception of a short window where it was brought down pending a forecasted hurricane.

Acoustic Detection Results

Echolocation surveys were conducted on the site from 12 August until 24 October 2011 (Table 4). In total there were 140,037 acoustic files recorded. However, only 4,685 of these were bat-generated ultrasound; the remaining were extraneous noise. Each of the echolocation sequences recorded were attributable to Myotis species bats (i.e., *Myotis lucifugus* or *M. septentrionalis*), none were consistent with any of the other species recorded in Nova Scotia. As stated, there was no attempt to identify each of the Myotis species sequences to species because of the difficulty in achieving defensible identifications. However, there were echolocation sequences with characteristics that were consistent with both northern long-eared and little brown bat. This is supportive of my expectation that both species are present in the area.

Overall, the average number of bat passes per night was 21.4, but for ground based detectors the average was 28.4 per night. Site number 3 have significantly more bat activity that each of the other sites. Activity within the study area dropped significantly after the first few nights of sampling (around mid-August) and then there was another marked drop in activity at around 30 August and activity was consistently low after that point. There was very little bat activity at 30 m AGL with echolocation activity recorded on only 2 of 54 nights (4 echolocation sequences altogether). It seems likely that there was little bat activity at this height but there were also 84,858 acoustic files recorded at this location that were all extraneous noise. The extent to which these "junk" files impacted the sampling of bats is likely low because it is expected that there would be more "junk" files on windy nights when there is less likely to be bats. However, the relationship was not empirically examined.

To place the relative magnitude of activity recorded at Glen Dhu into context, in 129 nights of monitoring along 5 forested edges from June-August 1999 in the Greater Fundy National Park Ecosystem, the average number of sequences per night was 27 (SD = 44) (Broders, unpublished data). The comparable level of activity recorded in the Glen Dhu project area (i.e., 28.4) was the same as the nightly magnitude of activity found during the summer in southern New Brunswick.

Table 4: Number of Anabat echolocation files recorded on the ground- and tower- based bat detectors at the proposed wind farm site at Glen Dhu, 2011.

Evening	Site 1	Site 2	Site 3	Site 4 (ground)	Site 4 (30 m AGL)	Total
12-Aug-11	89	1	808	-	-	898
13-Aug-11	37	3	263	-	-	303
14-Aug-11	89	1	386	-	-	476
15-Aug-11	32	0	13	-	-	45
16-Aug-11	47	0	44	-	-	91
17-Aug-11	13	0	146	-	-	159
18-Aug-11	91	0	58	-	-	149
19-Aug-11	46	32	103	-	0	181
20-Aug-11	108	36	107	-	2	253
21-Aug-11	71	26	92	-	2	191
22-Aug-11	28	0	12	-	0	40
23-Aug-11	141	11	112	-	0	264
24-Aug-11	153	3	135	-	0	291
25-Aug-11	22	0	26	-	0	48
26-Aug-11	120	17	54	62	-	253
27-Aug-11	156	15	214	0	-	385
28-Aug-11	1	1	2	0	-	4
29-Aug-11	8	15	38	0	-	61
30-Aug-11	29	11	1	0	-	41
31-Aug-11	37	8	0	0	-	45
01-Sep-11	22	7	0	6	-	35
02-Sep-11	5	7	0	4	-	16
03-Sep-11	15	15	0	1	-	31
04-Sep-11	42	4	19	1	-	66
05-Sep-11	4	0	7		-	11
06-Sep-11	3	6	5	2	-	16
07-Sep-11	1	9	6	7	-	23
08-Sep-11	5	-	12	-	0	17
09-Sep-11	4	-	4	-	0	8
10-Sep-11	2	-	3	-	0	5
11-Sep-11	0	-	3	-	0	3
12-Sep-11	3	-	212	-	0	215
13-Sep-11	3	-	5	-	0	8
14-Sep-11	6	-	6	-	0	12
15-Sep-11	0	-	6	-	0	6
16-Sep-11	0	-	3	-	0	3
17-Sep-11	0	-	2	-	0	2
18-Sep-11	0	-	1	-	0	1
19-Sep-11	0	-	0	-	0	0

--- Continued on next page---

Table 4 (cont'd)

Evening	Site 1	Site 2	Site 3	Site 4 (ground)	Site 4 (30 m AGL)	Total
20-Sep-11	0	-	0	-	0	0
21-Sep-11	0	-	0	-	0	0
22-Sep-11	0	-	0	-	0	0
23-Sep-11	0	-	10	-	0	10
24-Sep-11	0	-	2	-	0	2
25-Sep-11	0	-	6	-	0	6
26-Sep-11	0	-	2	-	0	2
27-Sep-11	0	-	2	-	0	2
28-Sep-11	0	-	1	-	0	1
29-Sep-11	0	-	1	-	0	1
30-Sep-11	0	-	1	-	0	1
01-Oct-11	0	-	3	-	0	3
02-Oct-11	0	-	1	-	0	1
03-Oct-11	0	-	-	-	0	0
04-Oct-11	0	-	-	-	0	0
05-Oct-11	0	-	-	-	0	0
06-Oct-11	0	-	-	-	0	0
07-Oct-11	0	-	-	-	0	0
08-Oct-11	0	-	-	-	0	0
09-Oct-11	0	-	-	-	0	0
10-Oct-11	0	-	-	-	0	0
11-Oct-11	0	-	-	-	0	0
12-Oct-11	0	-	-	-	0	0
13-Oct-11	0	-	-	-	0	0
14-Oct-11	0	-	-	-	0	0
15-Oct-11	0	-	-	-	0	0
16-Oct-11	0	-	-	-	0	0
17-Oct-11	0	-	-	-	0	0
18-Oct-11	0	-	-	-	0	0
19-Oct-11	0	-	-	-	0	0
20-Oct-11	0	-	-	-	0	0
21-Oct-11	0	-	-	-	0	0
22-Oct-11	0	-	-	-	0	0
23-Oct-11	0	-	-	-	0	0
24-Oct-11	0	-	-	-	0	0
Total	1,433	228	2,937	83	4	4,685
Number of nights	74	27	52	12	54	219
# sequences per night	19.4	8.4	56.5	6.9	0.1	21.4

Discussion

There was no acoustic evidence of a significant movement or concentration of bats at the study sites during the late summer and fall migration season. The magnitude of activity recorded was comparable to activity levels recorded, during the summer in a forested landscape in southern New Brunswick. All of the echolocation call sequences recorded for this project were attributable to the two Myotis species known to occur in Nova Scotia, the little brown bat and the northern long-eared bat. This was expected as these species are the most common species in the province and are two of only three bat species with significant populations in the province (Broders et al., 2003). Although we did not distinguish the calls of Myotis species, the majority of the sequences recorded at all locations likely represent the little brown bat because the northern long-eared bat has low intensity calls and is thus not recorded as well as the little brown bat (Broders et al., 2004; Miller and Treat, 1993). Further, the northern long-eared bat is a recognized forest interior species (Henderson et al., 2008; Jung et al., 1999a), and is less likely to use open areas for foraging and commuting (Henderson and Broders, 2008). There were no echolocation sequences that were attributable to the tri-colored bat. This species is only abundant in southwest Nova Scotia and the proposed development area is outside the species distribution (Broders et al., 2003; Farrow and Broders 2011). Also, there were no echolocation sequences that were attributable to either hoary bat, red bat, silver-haired bat, or big brown bat. Current data would suggest that these species do not occur in the area in large numbers but it will be not be surprising for these species to occur in the area irregularly, especially during the migration season.

Myotis bats are relatively new to the list of bat fatalities at wind turbine sites. The first large scale wind developments were located in western North America typically in agricultural and open prairie landscapes (reviewed in Johnson, 2005). Fatalities of these non-migratory species were largely absent from these sites. It is likely that this reflects the location of these wind development sites in open non-forested landscapes. These species may be under represented in the bat communities in these open areas due to an association with forested landscapes. More recently however, evidence of Myotis fatalities from wind turbines have been noted at sites in eastern North America (reviewed in Arnett et al., 2008; Jain et al., 2007b; Johnson, 2005). Therefore, although documented fatalities of Myotis are fewer than for migratory species there is still risk.

Other than bat mortality directly as a result of turbines, there is also a high likelihood that disruption of the forest structure (removal and fragmentation of trees for road building and deployment of turbines, etc.) for the development will degrade the local environment for colonies/populations that reside in the area during the summer. This can occur by the elimination of roost trees, the isolation of trees left standing, as well as the elimination or degradation of foraging areas. This negative aspect will almost certainly occur and will add to the cumulative effect of loss of bat habitat that is occurring throughout the range of these species.

Recommendations

1. A rigorous post-construction monitoring program to quantify bat fatality rates is of utmost importance. These surveys need to be appropriately designed to account for searcher efficiency and scavenger rates and need to be conducted over an entire season (April to October), but especially during the fall migration season from mid-August to late-September, for at least the first 2 years. Should fatalities be found, these should be investigated with respect to spatial distribution of fatalities, turbine lighting, weather conditions and other site specific factors which can then be analyzed and operations adjusted in an adaptive management framework. In this manner, mitigation can be focused on any identified high risk areas/infrastructure to minimize any more such fatalities. These data are also essential for assessing potential risks at future developments in the region. It is critically important that the results of these surveys be appropriately reported.
2. Minimize project footprint – Minimize the direct loss of bat habitat resources (e.g., wetlands, riparian areas, mature deciduous-dominated forest stands) and minimize the extent of bat habitat affected.
3. Retain undeveloped key bat habitat - Undeveloped bat habitat should be identified and retained in the project area to continue to support existing summer colonies/populations. Retention of these bat habitat resources should be in a spatial manner that provides connectivity in the project area and larger landscape to ensure foraging and roosting areas remain well connected. Consideration of the potential of fragmentation to bat habitat resources should also be given to the development of road networks and transmission lines in the project.
4. Return to pre-project state upon decommissioning – The project area should be returned to the state that existed prior to the development of the site. This should include planning to ensure the continuity of forest stand succession to provide and maintain appropriate roost trees well in the future as existing trees die off. By incorporating the retention of current young forest stands in the project site, this will provide mature trees for bat roosting resources in the future.
5. Remain up to date with current research - There is presently an abundance of on-going research aimed at determining the impacts of wind energy developments on populations of bats. Other studies are focusing on a number of potential mitigation methods, including the effects of weather on activity patterns and collisions, various mitigation treatments or possible deterrents (including acoustic and radar emissions). As these are active areas of research it is essential that the most current guidelines and studies are used to guide management and development plans for wind projects.

Literature Cited

Andersen, P. D. and Jensen, P. H. (2000). Wind energy today and in the 21st century. International Journal of Global Energy Issues 13, 145-158.

Anthony, E. L. P. and Kunz, T. H. (1977). Feeding strategies of the little brown bat, Myotis lucifugus, in southern New Hampshire. Ecology 58, 775-786.

Arnett, E. B., Brown, W. K., Fiedler, J. K., Hamilton, B. L., Henry, T. H., Jain, A., Johnson, G. D., Kerns, J., Koford, R. R., Nicholson, C. P. et al. (2008). Patterns of bat fatalities at wind energy facilities in North America. Journal of Wildlife Management 72, 61-78.

Arnett, E. B., technical editor. (2005). Relationships between bats and wind turbines in Pennsylvania and West Virginia: an assessment of bat fatality search protocols, patterns of fatality, and behavioral interactions with wind turbines. A final report submitted to the Bats and Wind Energy Cooperative. Austin, Texas, USA: Bat Conservation International.

Baerwald, E. F., D'Amours, G. H., Klug, B. J. and Barclay, R. M. R. (2008). Barotrauma is a significant cause of bat fatalities at wind turbines. Current Biology 18, R695-R696.

Baerwald, E. F., Edworthy, J., Holder, M. and Barclay, R. M. R. (2009). A large-scale mitigation experiment to reduce bat fatalities at wind energy facilities. Journal of Wildlife Management 73, 1077-1081.

Barclay, R. M. R. (1982). Night roosting behavior of little brown bat, Myotis lucifugus. Journal of Mammalogy 63, 464-474.

Barclay, R. M. R. (1991). Population structure of temperate zone insectivorous bats in relation to foraging behavior and energy demand. Journal of Animal Ecology 60, 165-178.

Barclay, R. M. R., Baerwald, E. F. and Gruver, J. C. (2007). Variation in bat and bird fatalities at wind energy facilities: assessing the effects of rotor size and tower height. Canadian Journal of Zoology 85, 381-387.

Broders, H. G. (2003). Summmer roosting and foraging behaviour of sympatric Myotis septentrionalis and M. lucifugus, vol. PhD. Fredericton, N.B.: University of New Brunswick.

Broders, H. G., Findlay, C. S. and Zheng, L. (2004). Effects of clutter on echolocation call structure of Myotis septentrionalis and M. lucifugus. Journal of Mammalogy 85, 273-281.

Broders, H. G. and Forbes, G. J. (2004). Interspecific and intersexual variation in roost-site selection of northern long-eared and little brown bats in the Greater Fundy National Park ecosystem. Journal of Wildlife Management 68, 602-610.

Broders, H. G., Forbes, G. J., Woodley, S. and Thompson, I. D. (2006). Range extent and stand selection for forest-dwelling northern long-eared and little brown bats in New Brunswick. Journal of Wildlife Management 70, 1174-1184.

Broders, H. G., Quinn, G. M. and Forbes, G. J. (2003). Species status, and the spatial and temporal patterns of activity of bats in southwest Nova Scotia, Canada. Northeastern Naturalist 10, 383-398.

Brown, W. K. and Hamilton, B. L. (2006). Monitoring of Bird and Bat Collisions with the Wind Turbines at the Summerview Wind Power Project, Alberta 2005-2006. Report prepared for Vision Quest Windelectric, Calgary, AB. Calgary, AB: Terrestial & Aquatic Environmental Managers ltd., and BLH Environmental Services.

Crampton, L. H. and Barclay, R. M. R. (1998). Selection of roosting and foraging habitat by bats in different aged aspen mixedwood stands. Conservation Biology 12, 1347-1358.

Cryan, P. M. (2008). Mating behavior as a possible cause of bat fatalities at wind turbines. Journal of Wildlife Management 72, 845-849.

Cryan, P. M. and Barclay, R.M.R. (2009). Causes of bat fatalities at wind turbines: Hypotheses and predictions. Journal of Mammalogy 90, 1330-1340.

Davis, D. S. and Browne, S. (1996). The Natural History of Nova Scotia: Theme Regions. Halifax, Nova Scotia: Nimbus Publishing and the Nova Scotia Museum.

Davis, W. H. and Hitchcock, H. B. (1965). Biology and migration of the bat, Myotis lucifugus, in New England. Journal of Mammalogy 46, 296-313.

Erickson, W. P., Johnson, G. D., Strickland, M. D., Young, D. P. J., Sernka, K. J. and Good, R. E. (2001). Avian collisions with wind turbines: A summary of existing studies and comparisons to other sources of avian collision mortality in the United States. In Report for the National Wind Coordinating Committee (NWCC). Washington DC: Western EcoSystems Technology Inc.

Farrow, L. J. and Broders, H. G. (2011). Loss of forest cover impacts the distribution of the forest-dwelling tri-colored bat (*Perimyotis subflavus*). Mammalian Biology 76, 172-179.

Fenton, M. B. (1969). Summer activity of Myotis lucifugus (Chiroptera: Vespertilionidae) at hibernacula in Ontario and Quebec. Canadian Journal of Zoology 47, 597-602.

Fenton, M. B. and Barclay, R. M. R. (1980). Myotis lucifugus. Mammalian Species 142, 1-8.

Fenton, M. B. and Bell, G. P. (1981). Recognition of species of insectivorous bats by their echolocation calls. Journal of Mammalogy 62, 233-243.

Ford, W. M., Owen, S. F., Edwards, J. W. and Rodrigue, J. L. (2006). Robinia pseudoacacia (black locust) as day-roosts of male Myotis septentrionalis (northern bats) on the Fernow Experimental Forest, West Virginia. Northeast Naturalist 13, 15-24.

Foster, R. W. and Kurta, A. (1999). Roosting ecology of the northern bat (Myotis septentrionalis) and comparisons with the endangered Indiana bat (Myotis sodalis). Journal of Mammalogy 80, 659-672.

Garroway, C. J. (2004). Inter- and intraspecific temporal variation in the activity of bats at two Nova Scotia hibernacula. Halifax, NS: Saint Mary's University.

Garroway, C. J. and Broders, H. G. (2008). Day roost characteristics of northern long-eared bats (Myotis septentrionalis) in relation to female reproductive status. Ecoscience 15, 89-93.

Griffin, D. R. (1945). Travels of banded cave bats. Journal of Mammalogy 26, 15-23.

Grindal, S. D. and Brigham, R. M. (1998). Short-term effects of small-scale habitat disturbance on activity by insectivorous bats. Journal of Wildlife Management 62, 996-1002.

Hamilton, I. M. and Barclay, R. M. R. (1994). Patterns of daily torpor and day-roost selection by male and female big brown bats (Eptesicus fuscus). Canadian Journal of Zoology 72, 744-749.

Hayes, J. P. and Loeb, S. C. (2007). The influences of forest management on bats in North America. In Bats in Forests: Conservation and management, eds. M. J. Lacki A. Kurta and J. P. Hayes), pp. 207-234. Baltimore, MD: Johns Hopkins University Press.

Henderson, L. E. and Broders, H. G. (2008). Movements and resource selection of the northern long-eared bat (Myotis septentrionalis) in a forest-agriculture landscape. Journal of Mammalogy 89, 952-963.

Henderson, L. E., Farrow, L. J. and Broders, H. G. (2008). Intra-specific effects of forest loss on the distribution of the forest-dependent northern long-eared bat (Myotis septentrionalis). Biological Conservation 141, 1819-1828.

Horn, J. W., Arnett, E. B. and Kunz, T. H. (2008). Behavioral responses of bats to operating wind turbines. Journal of Wildlife Management 72, 123-132.

Jain, A., Kerlinger, P., Curry, R. and Slobodnik, L. (2007a). Annual Report for the Maple Ridge Wind Power Project Postconstruction Bird and Bat Fatality Study - 2006. unpublished.

Jain, A., Kerlinger, P., Curry, R. and Slobodnik, L. (2007b). Annual report for the Maple Ridge Wind Power Project Postconstruction bird and bat fatality study - 2006. Syracuse, NY: Curry and Kerlinger, LLC.

Johnson, G. D. (2005). A review of bat mortality at wind-energy developments in the United States. Bat Research News 46, 45-50.

Johnson, G. D., Erickson, W., White, J. and McKinney, R. (2003a). Avian and bat mortality during the first year of operation at the Klondike Phase I Wind Project, Sherman County, Oregon.

Johnson, G. D., Erickson, W. P., Strickland, M. D., Shepherd, M. E. and Shephern, D. A. (2003b). Mortality of bats at a large-scale wind power development at Buffalo Ridge, Minnesota. American Midland Naturalist 150, 332-342.

Johnson, G. D., Perlik, M. K., Erickson, W. P. and Strickland, M. D. (2004). Bat activity, composition, and collision mortality at a large wind plant in Minnesota. Wildlife Society Bulletin 32, 1278-1288.

Jung, T. S., Thompson, I. D. and Titman, R. D. (2004). Roost site selection by forest-dwelling male Myotis in central Ontario, Canada. Forest Ecology and Management 202, 325-335.

Jung, T. S., Thompson, I. D., Titman, R. D. and Applejohn, A. P. (1999a). Habitat selection by forest bats in relation to mixed-wood stand types and structure in central Ontario. Journal of Wildlife Management 63, 1306-1319.

Jung, T. S., Thompson, I. D., Titman, R. D. and Applejohn, A. P. (1999b). Habitat selection by forest bats in relation to mixedwood stand types and structure in central Ontario. Journal of Wildlife Management 63, 1306-1319.

Kerns, J., Erickson, W. P. and Arnett, E. B. (2005). Bat and Bird Fatality at Wind Energy Facilities in Pennsylvania and West Virginia. In Relationships between bats and wind turbines in Pennsylvania and West Virginia: an assessment of bat fatality search protocols, patterns of fatality, and behavioral interactions with wind turbines. A final report submitted to the Bats and Wind Energy Cooperative, (ed. E. B. Arnett). Austin, TX, USA: Bat Conservation International.

Kerns, J. and Kerlinger, P. (2004). A study of bird and bat collision fatalities at the Mountaineer wind energy center, Tucker County, West Virginia: Annual report for 2003.

Kerth, G. and Petit, E. (2005). Colonization and dispersal in a social species, the Bechstein's bat (Myotis bechsteinii) Molecular Ecology 14, 3943-3905.

Kunz, T. H., Arnett, E. B., Erickson, W. P., Hoar, A. R., Johnson, G. D., Larkin, R. P., Strickland, M. D., Thresher, R. W. and Tuttle, M. D. (2007). Ecological impacts of wind energy development on bats: questions, research needs, and hypotheses. Frontiers of Ecology and the Environment 5, 315-324.

Lacki, M. J. and Schwierjohann, J. H. (2001). Day-roost characteristics of northern bats in mixed mesophytic forest. Journal of Wildlife Management 65, 482-488.

Lausen, C. L. (2007). Roosting ecology and landscape genetics of prairie bats. In Department of Biological Sciences, pp. 271. Calgary, AB: University of Calgary.

Lorch JM, Meteyer CU, Behr MJ, Boyles JG, Cryan PM, Hicks AC, Ballmann AE, Coleman JTH, Redell DN, Reeder DM, Blehert DS. (2011) Experimental infection of bats with *Geomyces destructans* causes white-nose syndrome. Nature. doi:10.1038/nature10590.

Mammalogists, A. S. o. (2008). Effects of wind-energy facilities on bats and other wildlife. from the website-http://www.mammalsociety.org/ downloaded 31mar09.

Miller, L. A. and Treat, A. E. (1993). Field recordings of echolocation and social signals from the gleaning bat Myotis septentrionalis. Bioacoustics 5, 67-87.

Moseley, M. (2007). Records of bats (Chiroptera) at caves and mines in Nova Scotia. In Curatorial Report Number 99, pp. 21. Halifax: Nova Scotia Museum.

Nicholson, C. P. (2003). Buffalo Mountain windfarm bird and bat mortality monitoring report, October, 2001 - September, 2002. Knoxville, Tennessee.

NSDEL. (2007, updated September 2009). Proponent's guide to wind power projects: Guide for preparing an environmental assessment registration document.

O'Farrell, M. J., Miller, B. W. and Gannon, W. L. (1999). Qualitative identification of free-flying bats using the Anabat detector. Journal of Mammalogy 80, 11-23.

Osborn, R. G., Higgins, K. F., Usgaard, R. E., Dieter, C. D. and Neiger, R. D. (2000). Bird mortality associated with wind turbines at the Buffalo Ridge Wind Resource Area, Minnesota. American Midland Naturalist 143, 41-52.

Poissant, J. (2007). Differentiation of two Myotis species at Hayes Cave, Nova Scotia, based on echolocation call characteristics and an identification of their ectoparasites. In Biology, vol. BSc, pp. 48. Halifax, N.S.: Saint Mary's University.

Poissant, J. A., Broders, H.G. and Quinn G.M. (2010) Use of lichen as a roosting substrate by *Perimyotis subflavus*, the tricolored bat, in Nova Scotia. Ecoscience 17, 372-378.

Randall, J. (2011). Identification and characterization of swarming sites used by bats in Nova Scotia. MES thesis, Dalhousie University.

Rockwell, L. (2005). Summer distribution of bat species on mainland Nova Scotia. In Biology. Halifax, Nova Scotia: Saint Mary's University.

Taylor, J. (1997). The development of a conservation strategy for hibernating bats of Nova Scotia. In Honours thesis. Halifax, Nova Scotia: Dalhousie University.

van Zyll De Jong, C. G. (1985). Handbook of Canadian Mammals: Bats. Ottawa, Canada: National Museums of Canada.

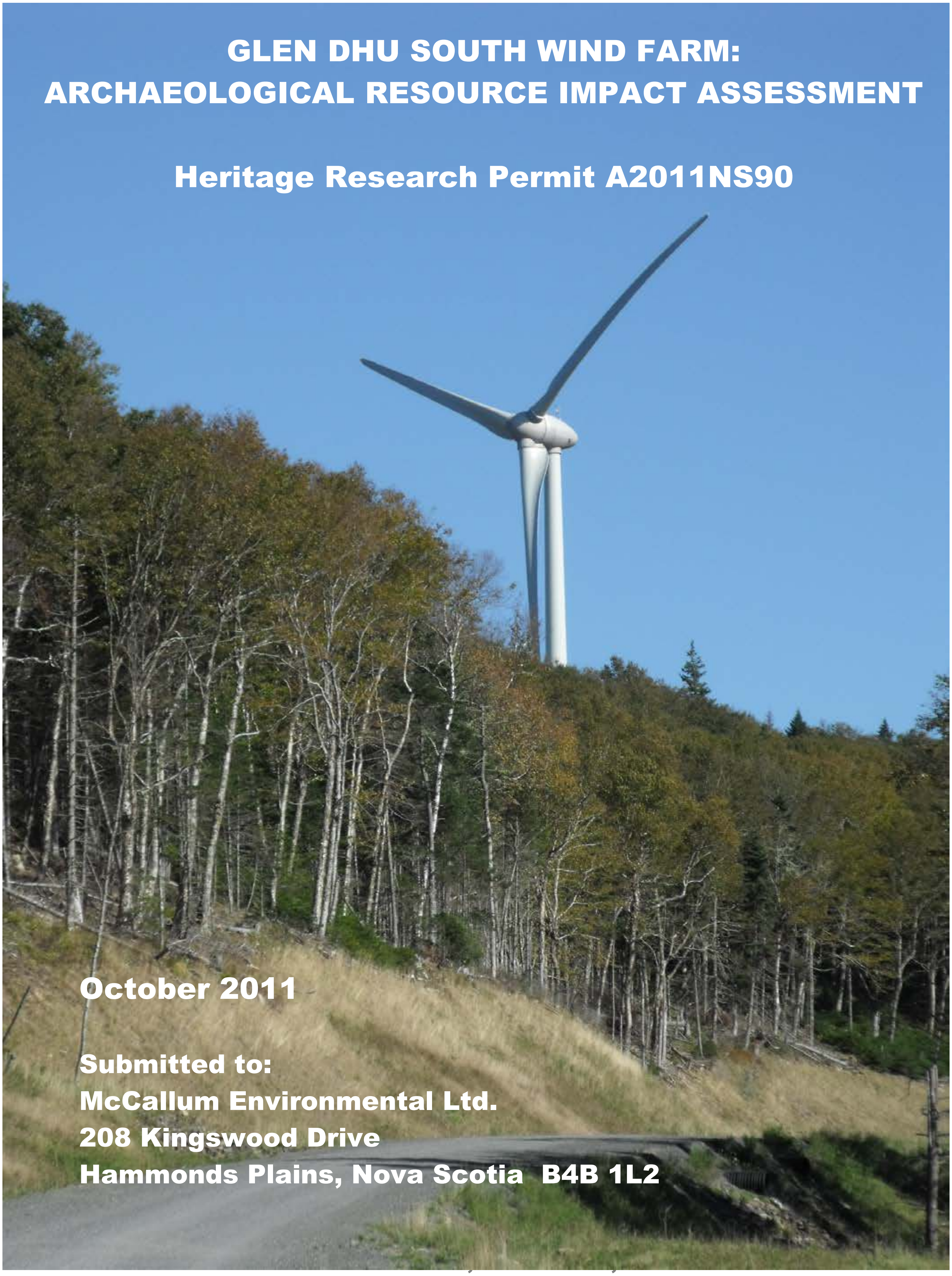
Weller, T. J., Cryan, P. M. and O'Shea, T. J. (2009). Broadening the focus of bat conservation and research in the USA for the 21st century. Endangered Species Research 8, 129-145.

Weller, T. J. and Zabel, C. J. (2002). Variation in bat detections due to detector orientation in a forest. Wildlife Society Bulletin 30, 922-930.

Appendix IX. ARCHAEOLOGICAL REPORTS

GLEN DHU SOUTH WIND FARM: ARCHAEOLOGICAL RESOURCE IMPACT ASSESSMENT

Heritage Research Permit A2011NS90



October 2011

Submitted to:
McCallum Environmental Ltd.
208 Kingswood Drive
Hammonds Plains, Nova Scotia B4B 1L2

GLEN DHU SOUTH WIND FARM: ARCHAEOLOGICAL RESOURCE IMPACT ASSESSMENT

Heritage Research Permit A2011NS90
Category C

Davis MacIntyre & Associates Limited
Project No.: 11-031.1MCE

Principal Investigator: Laura A. de Boer
Report Compiled by: Laura A. de Boer, Stephen A. Davis & April D. MacIntyre

Cover: An existing turbine at Glen Dhu.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF PLATES

EXECUTIVE SUMMARY

In October 2011, Davis MacIntyre & Associates (DM&A) Ltd. was contracted by McCallum Environmental Ltd. to conduct an archaeological resource impact assessment of the proposed Glen Dhu South Wind Farm. The purpose of the assessment was to determine the potential for archaeological resources within the development zones (turbine candidate sites and access roads) and to provide recommendations for further mitigation if deemed necessary. The assessment consisted of a reconnaissance of the study area, as well as consultation with local residents and historians.

Research and field reconnaissance in the study area has revealed the presence of only a few confirmed archaeological sites. A house foundation of moderate significance and an unidentified stone feature near the John Munro Road have both been identified, and avoidance is recommended by means of improving the adjacent access road on its south side rather than the north in both cases.

Two stone walls have been located which may be impacted by the construction of access roads. They are not themselves of high archaeological significance. However, their presence suggests that homesteads and associated archaeological resources such as middens, privies, and barn foundations may be nearby. It is recommended that archaeological monitoring of any clearing and grubbing activities in proximity to each feature be undertaken to ensure that no significant archaeological resources are disturbed during construction.

Finally, it is recommended that a collection of stone mounds in proximity to turbine candidate site 53 be tested by a professional archaeologist to determine their origin and significance, should candidate site 53 be chosen in the final turbine layout.

1.0 INTRODUCTION

In October 2011, Davis MacIntyre & Associates (DM&A) Ltd. was contracted by McCallum Environmental Ltd. on behalf of Shear Wind Inc. to conduct an archaeological resource impact assessment of the proposed Glen Dhu South Wind Farm. A previous desk-based study had been conducted in May 2010 under permit A2010NS63. Additionally, the original Glen Dhu Wind Farm was investigated by DM&A (then operating as Davis Archaeological Consultants Ltd) under permits A2007NS45 and A2008NS41.

The purpose of the assessment was to determine the potential for archaeological resources within the development zones (turbine candidate sites and access roads) and to provide recommendations for further mitigation if deemed necessary. The assessment consisted of a reconnaissance of the study area, as well as consultation with local residents and historians. Using the provided turbine candidate site layout that had not been available at the time of the initial desktop study, historical maps were overlaid on modern topographic mapping to predict the locations of historic structures in relation to the proposed impact areas.

The impact assessment was completed under Category C Heritage Research Permit A2011NS90 issued by the Nova Scotia Heritage Division. This report conforms to the standards required by the Heritage Division under the Special Places program.

2.0 STUDY AREA

Shear Wind Inc. is proposing to extend its previous 65 MW wind farm development at Glen Dhu in Pictou County, approximately 40 kilometres east of New Glasgow along the Trans Canada Highway, with lands located on both the north and south sides of the East/West Trans-Canada Highway corridor. The project will include the construction of up to a 100 MW wind farm. The project will be developed on private and crown lands which are predominantly used for lumbering. The total area of the project is contained within approximately 2,350 hectares, with much of this land having already been assessed. At the time of the initial survey, 75 possible turbine sites or “candidate sites” were on the layout, all of which were investigated during the course of the field reconnaissance (Figure 2.0-1 and 2.0-2). Access roads to each turbine location were also proposed.

The development area is located over a convergence of two Nova Scotia Theme Regions, the Pictou-Antigonish Highlands and the Dissected Margins (sub unit# 320b French River) regions. In close proximity are two other theme regions, the Northumberland Plain (Northumberland Straight sub unit) and Pictou Valleys (McArras Brook sub unit) units.

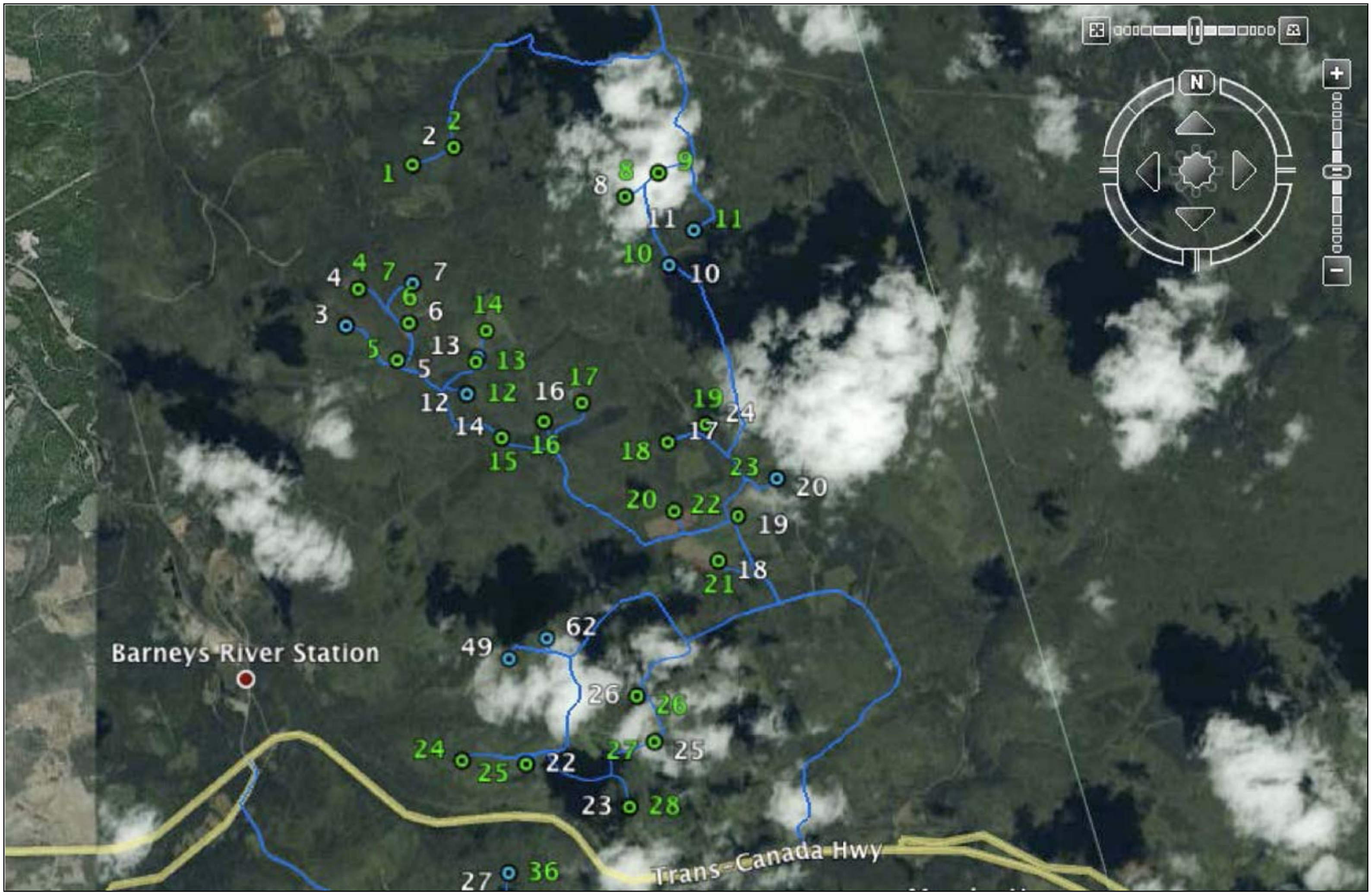


Figure 2.0-1: The northern turbine sites and access roads at Glen Dhu. Base map courtesy Google Earth, KMZ data courtesy McCallum Environmental.

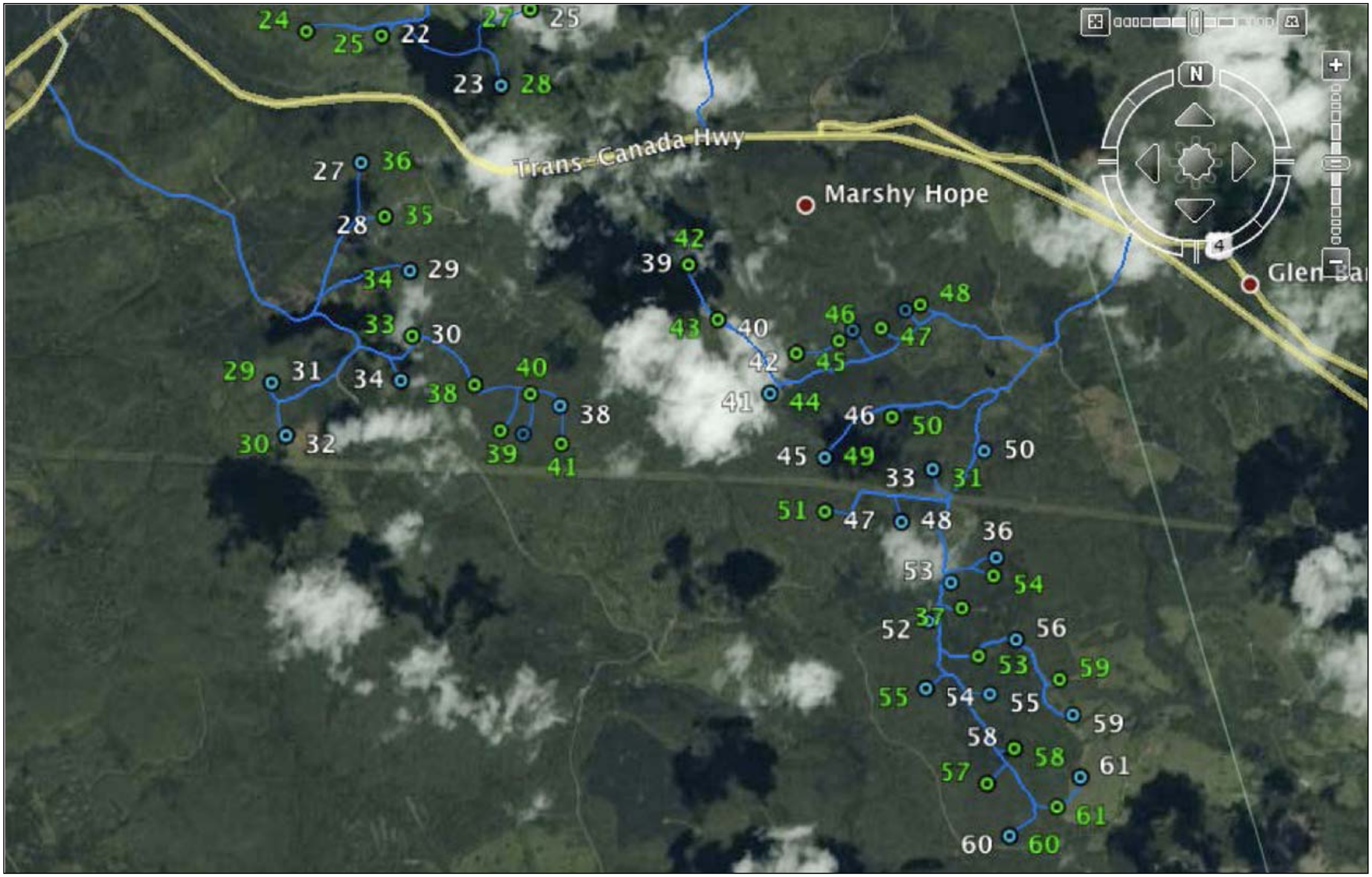


Figure 2.0-2: The southern turbine sites and access roads at Glen Dhu. Base map courtesy Google Earth, KMZ data courtesy McCallum Environmental.

The Pictou-Antigonish Highlands (natural region # 312) is an area of old crustal rocks of Precambrian and Ordovician origin, characterized within the current study area by soils, "…developed on shaly loam tills derived principally from Silurian shales…[with the] Barney series [well-drained loam]…somewhat less stony and…finer textured than the others". These soils are considered marginally productive and supported only subsistence level farming for the Scottish settlers who were here in the early nineteenth century. East of Kenzieville lie softer strata that have been downfaulted, such as the portion of the Arisaig Formation known as the Kenzieville Trough. This natural theme region has dendritic drainage patterns that are heavily influenced by fault lines and supports abundant wildlife of which relatively little is known, though it does include moose, fishers, White Sucker, Brook Trout, sticklebacks, Golden Shiner, Yellow Perch and Banded Killifish. The drainage patterns across these highland areas also support many mills constructed by settlers from the eighteenth to the twentieth centuries. Forests in the study area portion of this region are comprised of White Spruce colonized on old farmlands, Yellow Birch, Sugar Maple, American Beech, Red Spruce, Eastern Hemlock and Balsam Fir with diverse and vigorous shrubby vegetation.[1]

The French River sub unit of the Dissected Margins theme region is defined by kame and esker fields, which create foothills and uplifted plateaus. This landscape is hilly with steep narrow valleys and its soils result from varied bedrock and Carboniferous glacial material redeposited from the north. Here, again, Barney soils have developed on shaly clay loams that have been derived from Silurian shales. Animals in this region mimic the array in the Cobequid Hills region with Goshawk, Red-tailed Hawk, Barred Owl and the Great Horned Owl, Common Raven, Pileated Woodpecker, Ruffed Grouse, Grey jay, chickadees, warblers and insectivorous birds, Eastern Redback Salamanders, beaver, coyotes, bobcats and Snowshoe Hares as well as Brown Trout and Brook Trout, common in smaller tributaries.[2]

3.0 METHODOLOGY

A field reconnaissance of the proposed impact areas (access roads and turbine candidate sites) was conducted by Stephen Davis and Laura de Boer between 3 October and 14 October 2011. A total of 75 proposed turbine locations were visited, consisting of two layouts (the "85" and the "100" series) of 62 turbines each, all but 13 of which overlapped between the two layouts. Following the initial reconnaissance, the proposed layout was revised, resulting in the selection of the "100" layout and the replacement of five candidate sites with new locations and in the minor realignment of several proposed access roads. The coordinates of each turbine site are listed in Table 1 below. All candidate sites were visited. In several

[1] Davis and Browne 1996:30-32.
[2] Davis and Browne 1996:38-39.

cases, the realigned access roads were not re-surveyed given their close proximity to previously surveyed areas and the lack of evidence for any elevated archaeological potential.

Table 1: The turbine UTM coordinates (NAD83).

Turbine Sites			Coordinates
November Layout	100 Layout	85 Layout	
1	100-01	85-01	20 T 558509 5054031
2	100-02	85-02	20 T 558842 5054174
3	100-03	85-03	20 T 557979 5052731
4	100-04	85-04	20 T 558077 5053028
5	100-05	85-05	20 T 558403 5052457
6	100-06	85-06	20 T 558493 5052756
7	100-07	85-07	20 T 558521 5053075
8	100-08	85-08	20 T 560226 5053790
9	100-09	85-09	20 T 560492 5053985
10	100-10	85-10	20 T 560586 5053242
11	100-11	85-11	20 T 560783 5053525
12	100-12	85-12	20 T 558966 5052187
13	100-13		20 T 559050 5052488
14	100-14	85-15	20 T 559250 5051836
15	100-15	85-16	20 T 559589 5051973
16	100-16	85-17	20 T 559893 5052125
17	100-17	85-18	20 T 560588 5051813
18	100-18	85-21	20 T 561006 5050864
19	100-19	85-22	20 T 561167 5051226
20	100-20	85-23	20 T 561480 5051531
21	100-21	85-24	20 T 558953 5049233
22	100-22	85-25	20 T 559471 5049211
23	100-23	85-28	20 T 560309 5048875
24	100-24	85-19	20 T 560894 5051960
25	100-25	85-27	20 T 560504 5049401
26	100-26	85-26	20 T 560359 5049769
27	100-27	85-36	20 T 559339 5048336
28	New	New	20 T 559335 5047905
29	100-29	85-34	20 T 559682 5047595
30	100-30	85-33	20 T 559703 5047148
31	New	New	20 T 558550 5046738
32	100-32	85-30	20 T 558840 5046456
33	100-33	85-31	20 T 563313 5046268
34	100-34	85-32	20 T 559628 5046841
35	100-35	85-38	20 T 560146 5046817
36	100-36		20 T 563758 5045667
37	100-37		20 T 560484 5046482
38	100-38		20 T 560737 5046678
39	100-39	85-42	20 T 561613 5047656

40	100-40	85-43	20 T 561819 5047281
41	100-41	85-44	20 T 562183 5046777
42	100-42	85-45	20 T 562363 5047054
43	New	New	20 T 562791 5047230
44	New	New	20 T 561607 5051186
45	100-45	85-49	20 T 562565 5046340
46	New	New	20 T 559943 5049217
47	100-47	85-51	20 T 562570 5045970
48	100-48	85-52	20 T 563103 5045905
49	100-49		20 T 559327 5050059
50	100-50		20 T 563668 5046397
51	100-51	85-20	20 T 560646 5051260
52	100-52		20 T 563286 5045224
53	100-53		20 T 563448 5045492
54	100-54	85-55	20 T 563273 5044759
55	100-55		20 T 563727 5044725
56	100-56	85-56	20 T 563904 5045101
57	100-57	85-57	20 T 563713 5044109
58	100-58	85-58	20 T 563899 5044352
59	100-59		20 T 564301 5044587
60	100-60	85-60	20 T 563872 5043750
61	100-61	85-62	20 T 564357 5044160
62	100-62		20 T 559629 5050227
A		85-14	20 T 559117 5052700
B		85-39	20 T 560326 5046504
C		85-40	20 T 560531 5046757
D		85-41	20 T 560747 5046418
E		85-46	20 T 562657 5047143
F		85-47	20 T 562949 5047233
G		85-48	20 T 563217 5047397
H	100-44		20 T 563115 5047359
I	100-46	85-50	20 T 563030 5046624
J		85-37	20 T 563524 5045317
K		85-53	20 T 563645 5044985
L		85-59	20 T 564206 5044831
M		85-61	20 T 564197 5043953
N/A	100-28	85-35	20 T 559505 5047967
N/A		85-54	20 T 563742 5045541
N/A	100-43		20 T 562753 5047215
N/A		85-13	20 T 559037 5052448
N/A	100-31	85-29	20 T 558737 5046818

Many proposed access roads are centred on existing mountain or woods roads, enabling easier access to the candidate sites. Both existing roads in need of upgrades and proposed roads were included in the reconnaissance, as was a radius of at least 100m around each proposed candidate turbine location to allow for the broad square of terrain that is impacted by the installation of a turbine pad. GPS tracklogs of all reconnaissance areas were retained for records, and any sites determined to have potential for archaeological resources were recorded with photographs and GPS coordinates. The terrain and vegetation at each of the candidate sites was noted in the interest of recording negative evidence for historic cultural activity.

3.1 Historical Background In Brief

The history of human occupation in Nova Scotia has been traced back approximately 11,000 years ago, to the Palaeo-Indian period or Sa'qewe'k L'nu'k (11,000 – 9,000 years BP). The only significant archaeological evidence of Palaeo-Indian settlement in the province exists at Debert/Belmont in Colchester County. This period was followed by the Mu Awsami Kejikawe'k L'nu'k (Archaic period) (9,000 – 2,500 years BP), which included several traditions of subsistence strategy. This period transitioned into the Woodland / Ceramic period or Kejikawek L'nu'k (2,500 – 500 years BP), which saw the first exploitation of marine molluscs is seen in the archaeological record. Ceramic technology was also introduced during this period.

The Woodland period ended with the arrival of Europeans and the beginning of recorded history. The initial phase of contact between First Nations people and Europeans, known as the Protohistoric period, was met with various alliances particularly between the Mi'kmaq and French.

Historically, the chief Mi'kmaq encampment in this area was said to be at the "foot" of Barney's River on the east side where they had some clearings on which they raised Indian corn and beans. At the time of English settlement in the eighteenth century, they had a burial ground "near the west end of Big Island on the south side, a short distance east of Savage Point."[3] This burial ground was marked by a number of white crosses and was in use until the 1830s. After that, they began using Chapel Island or Indian Island, which was set aside for that purpose by Governor Wentworth.[4]

Subsequent to the original background study, a local source has reported an additional Mi'kmaq encampment along Bailey's Brook in the mid-twentieth century. The natives were known for making axe handles to sell. The small settlement was located in a valley, where the brook bends northwards from a confluence at its eastern extent.[5] This location is surrounded on three sides by the study area, but because its location is deep in an incised valley it is not in close proximity to any proposed impact zone.

Some of the earliest known European settlers to Pictou County were the French Acadians, who unfortunately left behind few written records of their presence in the

[3] Patterson 1877:29-31.
[4] Patterson 1877:27.
[5] Williams, Nick. Personal communication 13 October 2011.

region. Later English settlers following the Acadian deportation of the mid-eighteenth century reported the remains of French dwellings on Merigomish Island. Other French settlements have been reported at the head of French River, at Little Harbour, and at Caribou, all seeming to relate to a strong relationship to fishing.[6]

The eighteenth century deportation of the Acadians by the English was the result of a dispute between England and France over claims to this portion of the New World. By the 1750s England had firmly established its claim and sought to remove the Acadian settlers, who wished to remain neutral and would not swear loyalty to the English Crown. The Acadians were subsequently deported and scattered, replaced by settlers loyal to England including a great number of New England Planters. The Philadelphia Grant, awarded in 1765, encompassed much of the township of Pictou and Colchester County. The grant was named for the common origin of many of the New Englanders who arrived to take up or manage the grant. Barney's River takes its name from one of the original township settlers, Barnabas McGee, who moved to the area from Rogers Hill in 1776 or 1777.[7]

Following the arrival of the Philadelphia grantees, another influx of settlers arrived from Scotland on the ship *Hector* in 1773. Thirty-three families and 25 unmarried men were on board, settling on lands that were not granted to them until a decade later, after being escheated from the vast grant of Colonel Alexander McNutt along the East, Middle, and West Rivers of Pictou. Another major wave of settlers arrived after the close of the American Revolution in 1783, most of whom were members of the 82nd or Hamilton Regiment. Shortly thereafter, the 84th Highlanders arrived and occupied the upper lands of the East River.[8] Immigrants from the Scottish Highlands continued to arrive into the 19th century. Early settlers to the upper woods around Barney's River included Angus McKay, Simon Bannerman, John Sutherland, and William Irving.

Consultation with Nova Bannerman at the Barney's River Station School Museum revealed only a few small elements of activity on the mountain. A tannery existed somewhere on the mountain at one point. The Robertson family homestead was also present and is also indicated on historic mapping. Ernest Foote, whose residence still stands on Weaver's Mountain Road, was well-known historically as Chaplain of the Fleet and eventually Chaplain General of the Armed Forces in Canada.[9] His house is located adjacent to the proposed access of Weaver's Mountain Road and is still occupied. The "Foote place" was also once known as the best dairy farm in the county, despite the poor quality of the soil on the mountain.[10]

Following consultation with Ms. Bannerman, the team met with local Grant

[6] Patterson 1877:24-40.
[7] Patterson 1877:108.
[8] Patterson 1877:114-123.
[9] Bannerman, Nova. Personal communication 7 October 2011.
[10] Williams, Nick, personal communication 13 October 2011.

Williams, who was born in nearby Marshy Hope and has spent a long life living and working around the mountain. Mr. Williams noted that “the Weavers” had a residence described as being across from an existing cabin on the mountain, though where exactly is not clear.[11] The “Weavers,” the namesake of “Weaver’s Mountain,” were members of the MacDonald family who owned three properties on the mountain where they raised sheep and made cloth from their wool.[12]

The Robertsons are thought to have kept a home “next to the Foote place.” The Bard McLean, a famous Nova Scotian Gaelic poet, lived on the mountain for a time but did not like his situation and chose to move elsewhere. An African-Canadian family, the Rudolphs, also kept a homestead on the mountain, though again exactly where is not clear. Finally, at least 30 mills have existed in Mr. Williams’ lifetime of the past eighty years or so.[13]

Finally, three members of the Williams family reported the presence of a Williams family homestead in a blueberry field off Pushee Road within the study area.[14] The homestead was constructed around 1914 but had been demolished by the early 1960s.[15] A second, older homestead cellar was also reportedly present in the blueberry field, but it was filled in by another member of the Williams family in order to use the space for blueberries.[16]

In the interest of more accurately predicting the presence of historical features in proximity to the impact areas, a predictive model was generated and later supplemented by oral accounts and field data. The model, presented on an NRCan topographic map, was created by overlaying the topographic map with GPS data, turbine sites, and an 1893 geological survey map of the region. This map was chosen given its level of geographic accuracy, which is greatly superior to maps that are one or two decades older. The final map is presented in Figures 3.2-1 and 3.2-2.

3.2 Field Reconnaissance

Candidate turbine sites and access roads throughout the study area were found in varied forests, chiefly of two types: middle-aged to mature hardwoods (maple, birch, and beech) with an understory of ferns (Plate 1), and young to mature softwoods (almost exclusively spruce) (Plate 2). Glacial erratics and boulders were not uncommon, and the soil was generally of poor quality for agriculture. Some of the softwood forests included small cut stumps indicating a managed forest destined for pulp wood or softwood lumber.

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[11] Williams, Grant. Personal communication 7 October 2011.
[12] Williams, Nick. Personal communication 13 October 2011.
[13] Williams, Grant. Personal communication 7 October 2011.
[14] Personal communications: Williams, Brian; 4 October 2011; Williams, Grant, 7 October 2011; Williams, Nick, 13 October 2011.
[15] Williams, Nick. Personal communication 13 October 2011.
[16] Williams, Brian. Personal communication 4 October 2011.

Forests were occasionally mixed, typically on intermediate slopes. Hardwoods were found on the highest and best-drained knolls while softwoods were found in lower areas or areas of re-growth following clear cutting. Open areas of thorns and very young spruce were also found throughout, most being the result of clear cutting less than five years old (Plate 3).

In general, little evidence of historic cultural activity was noted at these high elevations. When it was observed, it was mostly related to logging and at times overgrown pastureland could be identified. Evidence of agriculture was scarce. In the interest of avoiding repetition, only those turbines and access roads that yielded evidence of cultural activity will be described below. Full notes on all candidate turbine sites can be found in the field notes included as Appendix B.

Field reconnaissance commenced on 3 October 2011 on the southern side of the 104 Highway. Access to the study area was gained through Weaver's Mountain Road, which branches southeast off of the Highway 4 near the Barney's River Station School Museum. Along this road areas of old field were noted, corresponding with the structures shown on historic mapping as "Ken McIvor," "Forge," and "A. Robertson." No cellars or other archaeological features were noted in close proximity to the road, which will be upgraded and widened to allow heavy equipment access to the turbine sites. The "Foote House" was also noted, a historic farmstead which has been heavily renovated and is still occupied.

The access road to candidate 29 was the first location where evidence of cultural activity was encountered. A low stone boundary wall was found running north-northwest to south-southeast (Plate 4). The wall was approximately two metres in width and rose less than 50 centimetres off the forest floor, indicating it had slowly collapsed over the years since it was built. The wall was observed to run for at least 50 metres in either direction. Dense spruce cover surrounds the feature, making it difficult to view from a distance. The access road was found to intersect the wall at a perpendicular angle at coordinates 20 T 559529 5047613.

The size of this wall suggested a significant level of effort in gathering and placing the stones, suggesting that a homestead was nearby. However, no other archaeological features were observed within or near the proposed impact zone. Predictive modeling suggests that associated homesteads might be found several hundred metres to the southeast and to the north, in close proximity to candidate 85-36 / 100-28 on the older layout. However, this candidate site was found to rest on a hardwood-covered knoll adjacent to clear cutting. No visible evidence of historic activity was observed in that area during the survey.

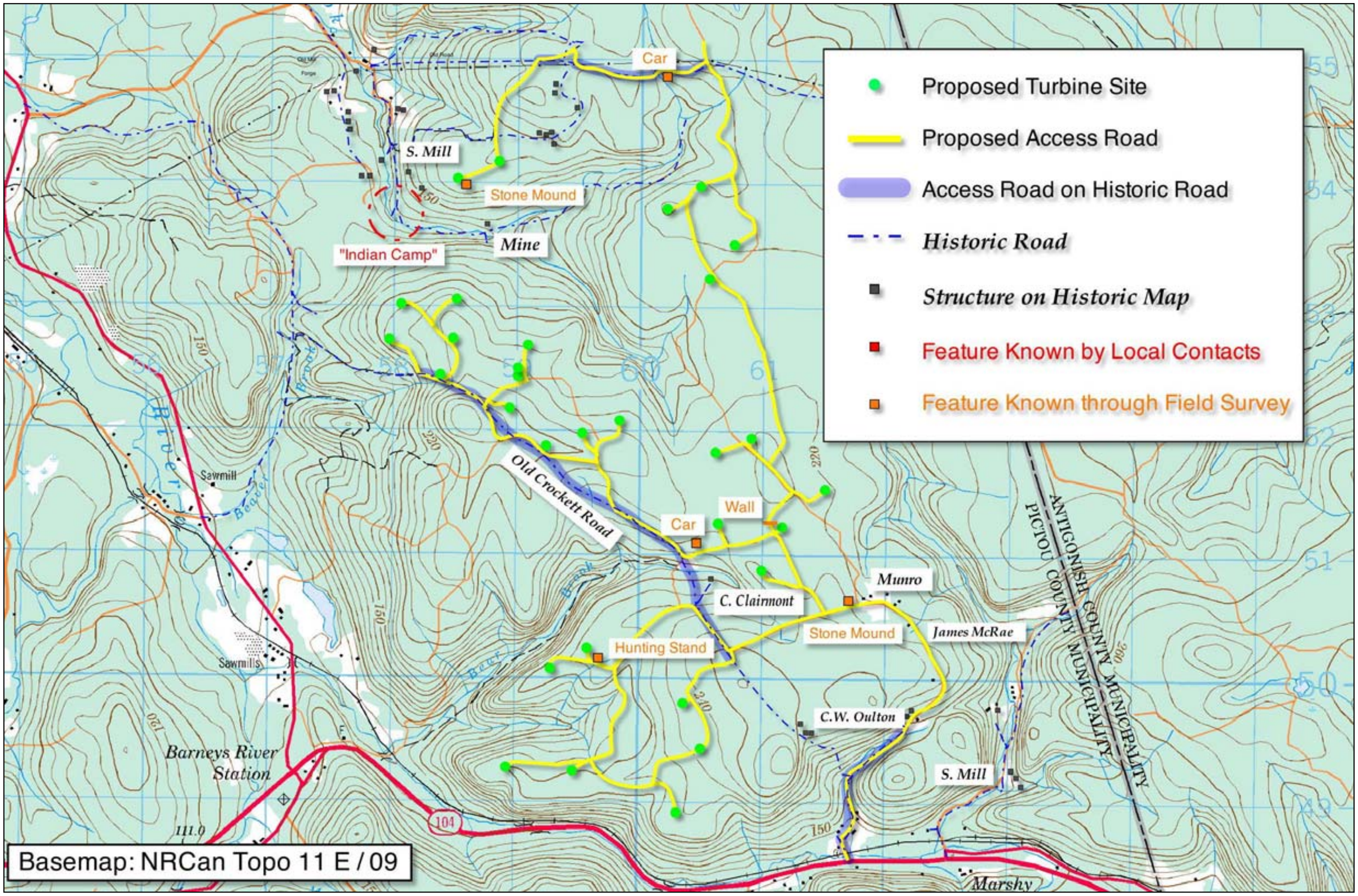

Figure 3.2-1: A map showing historic roads and structures as well as proposed turbine sites in the northern portion of the study area.

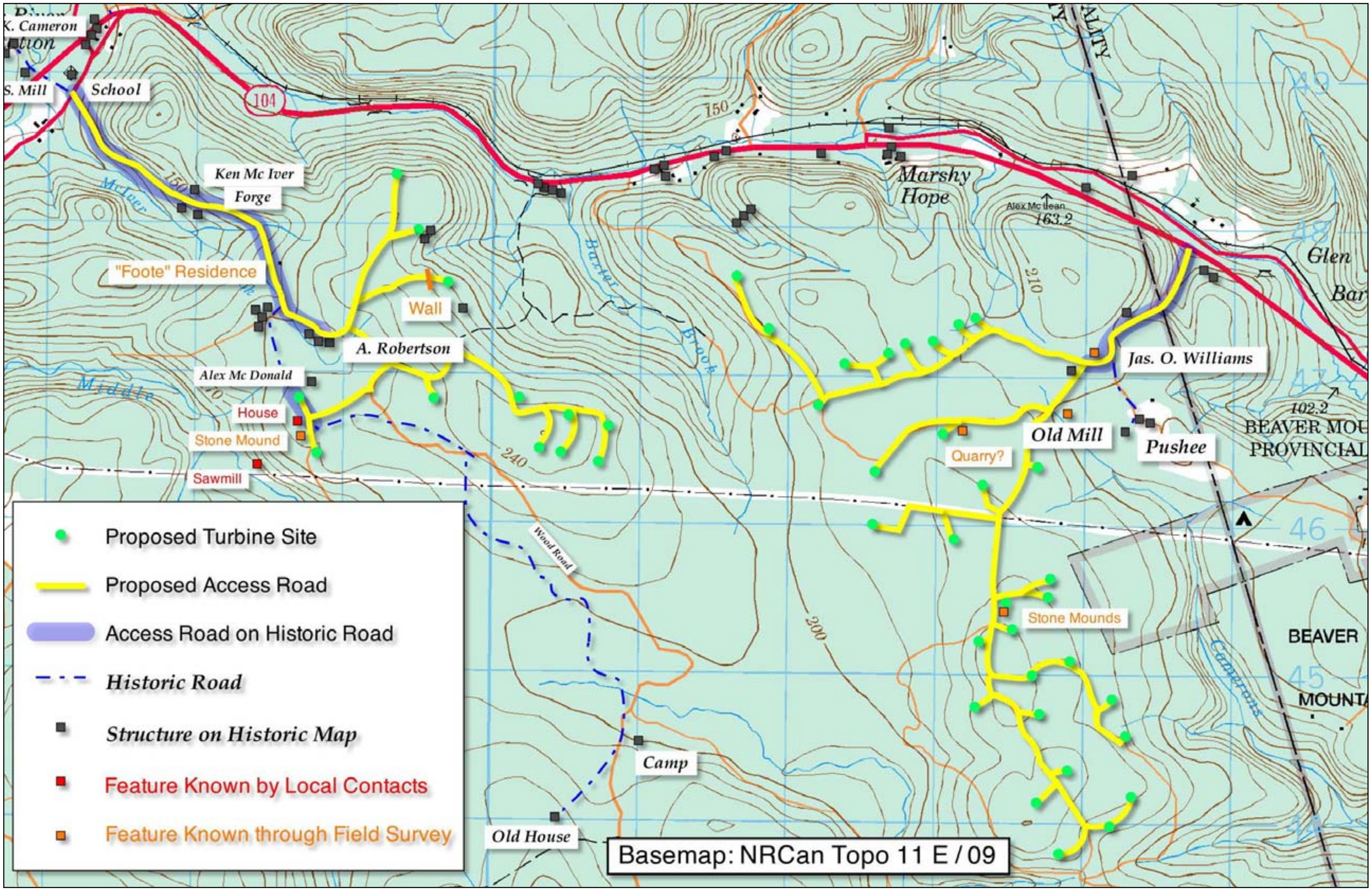

Figure 3.2-2: A map showing historic roads and structures as well as proposed turbine sites in the northern portion of the study area.

The access road to candidate site 30 runs through a managed spruce forest near "Joe's Road" off Weaver's Mountain Road. A small 20th century midden of tin cans and plastic was observed within the footprint of the proposed road. Similarly, scraps of relatively modern corrugated metal were observed near a data collector at candidate site 32.

Immediately east of the access road to candidate turbine site 32, a grassy area was observed which is being overgrown with spruce saplings. A stone mound, 7.8 metres west of the edge of the existing road, was found within this clearing. It measured 3.6 by 2.5 metres in area and was overgrown with strawberry and raspberry plants as well as goldenrod and grass. The mound was found at coordinates 20 T 558774 5046555, in close proximity to a pile of logs which may have been part of a staging area for logging trucks. Historic mapping and local oral reports suggest there is a house foundation or cellar just north of this feature, though it could not be located at the time of the reconnaissance.

A pond which may be the result of historic or 20th century quarrying activity was observed just over 100 metres east of candidate site 85-50 / 100-46 on the older layout, at 20 T 563160 5046629. There was no indication of associated features within the proposed impact area. The turbine itself is in a relatively wet area with evidence of clearing and cutting for pulpwood. Signs of beaver activity were observed at the turbine site (Plate 5).

On the access road to candidate site 33, a copse of spruce trees marked and numbered in blue spray paint was encountered (Plate 6). It is assumed that this modern activity is related to a cutting or sampling procedure.

Unidentified cultural activity has taken place within the 100 metre buffer zone around candidate turbine site 53. Several dozen stone piles were encountered on the forest floor, ranging in size from approximately 1.5 to 3 metres in diameter and up to a metre in height (Plate 7). The mounds are found in an area of at least 40 metres square, though it is difficult to gage exact numbers and coverage under the dense mixed spruce and hardwoods that cover the area. One of the largest piles was marked with a GPS point at 20 T 563437 5045495. A modern quarry pit separates some of the piles from an existing mountain road, found at 20 T 563386 5045452 (Plate 8).

Two final areas of archaeological and historical interest were noted on the south side, both in proximity to the historic Pushee Road. The first is the remains of the Williams homestead, which is surrounded by blueberry fields. The homestead is now evidenced only by a deep concrete foundation and cellar, surrounded by mixed trees and somewhat overgrown (Plate 9). As stated above, the house is believed to have been constructed around 1914 and torn down in the 1960s. The quality of the concrete and state of the feature is consistent with this report. The foundation is found at 20 T 564021 5047119, north of a fork in the existing road, both portions of which are proposed turbine access roads.

The rest of the blueberry field was searched but no clear evidence of the older homestead was visible from the surface. Several stone piles resulting from field clearing were present in small valleys throughout the field. One included a broken nineteenth century bottle (Plate 10).

The second feature near Pushee Road is a former sawmill, which was identified both in historic mapping and by local residents. The team walked as much of the area as possible, but were unable to find the remains of the sawmill itself. A sawdust pile at least 10 metres across and approximately three metres proud of the surrounding forest was the only discernable evidence of the mill, found at 20 T 563776 5046778 (Plate 11). A beaver dam to the east of the pile has caused flooding in the area, possibly submerging any mill remnants. Small 20th century garbage dumps were found on the eastern side of this pond, but no artifactual material predating the 20th century was observed.

Reconnaissance on the north side of the Highway 104 began on 11 October 2011. The first evidence of cultural activity to be encountered was a simple wooden hunting stand that had collapsed near the proposed access road leading to turbine 100-62, at 20 T 559649 5050157 (Plate 12).

Candidate site 1 appears to be situated on land that was historically agriculture or more likely pasture land. A stone pile which may be the result of field clearing or of the root activity of large maple trees was observed less than 30 metres from the centre of the proposed turbine pad, at 20 T 558523 5054023. The land is notably flatter than the undulating forest floor of the surrounding landscape, and the access road between candidate sites 1 and 2 is the only location in the entire survey where rose bushes were observed. Predictive modeling with historic mapping shows that two buildings were likely located approximately 300 metres west of the turbine site, on the slope leading down to Bailey's Brook. No cultural features beyond the stone pile were observed within the 100m buffer around the turbine site.

Directly east of candidate site 19, in proximity to a proposed four-way intersection of access roads, another stone boundary wall was identified. This wall was smaller and less distinct than the wall located on the south side of the highway. It was found to run almost exactly East-West for at least 100 metres, intersecting the proposed northern branch of the four-way intersection at 20 T 561084 5051242. Piles of stones resulting from field clearing were found about a dozen metres south of the wall. The surrounding landscape undulates slightly but is relatively hospitable, being a grassy area with spruce trees growing up throughout. Despite a thorough examination of all locations suitable for construction of a homestead, no foundation or cellar could be identified.

Level pastureland overgrown with spruce was noted on both sides of an existing access road southwest of candidate site 51. The land is located in close proximity to a portion of the "Old Crockett Road" according to historical mapping. No archaeological features were observed. However, the presence of a stripped white car, possibly a 1950s Thunderbird, was found in the pastureland at 20 T 560431 5051020 associated with two "stubby" beer bottles. Another abandoned car was noted along the access road to candidate sites 1 and 2, at 20 T 560125 5054910.

Finally, an area of unknown cultural activity was identified along the John Munro Road at 20 T 561725 5050598. Stone has been piled just off the north side of the road, and although it does not appear to have a discernable structure it appears to be cultural in some way (Plate 13). Other historic homes and areas of historic pasture were also noted along the John Munro Road, but were sufficiently distant from the road to be outside of the impact area when the road is upgraded during turbine construction.

4.0 RESOURCE INVENTORY

Despite evidence for a series of homesteads on the mountain, only one house foundation (the Williams house) was located during the reconnaissance. Additionally, two stone walls and five locations with stone mounds were identified.

Twentieth century material encountered within the study area include two areas of dumped midden material (cans and bottles), a stripped and abandoned car, scraps of corrugated metal, and a hunting stand or blind.

Table 2: Areas of cultural activity with UTM coordinates (NAD83).

Site	Coordinates	Significance
Stone Wall	20 T 559529 5047613	Low, but may be associated with other features
Stone Mound	20 T 558774 5046555	Low, but may be associated with other features
Possible Quarry (Pond)	20 T 563160 5046629	Low
Stone Mounds	20 T 563437 5045495	Unknown
Quarry	20 T 563386 5045452	Low
Williams Homestead	20 T 564021 5047119	Moderate
Sawdust from sawmill	20 T 563776 5046778	Low, but may be associated with other features outside the impact zone
Hunting Stand	20 T 559649 5050157	Low

Stone Mound	20 T 558523 5054023	Low
Stone Wall	20 T 561084 5051242	Low, but may be associated with other features outside the impact zone
Car	20 T 560431 5051020	Low
Car	20 T 560125 5054910	Low
Stone Mound	20 T 561725 5050598	Unknown

5.0 RESOURCE EVALUATION

The twentieth century material consists almost exclusively of discarded metal and glass. Given the relatively modern origins the middens, discarded metal, and hunting blind have all been determined to be of very low cultural significance.

The concrete foundation of the Williams house identified in a blueberry field off Pushee Road is known through oral history to be slightly less than 100 years old. The house was occupied for only a few decades before abandonment in the 1960s. As a result, the foundation should be considered of moderate archaeological significance. A Maritime Archaeological Resource Inventory (MARI) form has been completed for this site. The stone piles resulting from clearing in the blueberry field are of low significance.

The sawmill site appears to be significantly distant from the proposed access road that it will not be impacted by the development. In the absence of firm evidence of a foundation or other mill features, the site is of unknown significance.

The collection of stone mounds in proximity to candidate site 53 are of unknown significance, since their function and origin could not be determined solely through reconnaissance and neither archival research nor oral accounts shed any light on the subject.

The evidence of cultural activity around candidate site 1 suggests a homestead in close proximity. The mound itself is either the result of field clearing or of the root activity of a large maple tree bringing stones to the surface, as observed elsewhere on the mountain. The mound is therefore of low archaeological significance.

The mounded stones on the north side of the John Munroe Road are of unknown significance and purpose. They may relate to field clearing or to a structure that has been obscured by adjacent road construction.

The stone wall located on the south side of the Highway 104 is a linear feature which extends significantly beyond the proposed impact area. The dismantling of a section of the wall to allow passage of the access road would therefore not be a significant loss of cultural heritage. However, the presence of the wall may indicate the proximity of a more significant archaeological resource such as a homestead.

Finally, the stone wall and associated terrain on the north side of the highway is suggestive of a very early and short-lived attempt at settlement and farming on the mountain. However, given the absence of a clear homestead site or cellar, this area is of unknown archaeological significance.

6.0 RESULTS AND DISCUSSION

The results of the archaeological reconnaissance are unsurprising given the elevated terrain that comprises the study area. Settlement and attempts at agriculture in the highlands of Nova Scotia were often unsuccessful, resulting in short-lived sites that are quickly engulfed by forests and forgotten. The houses constructed were in many cases simple structures, meant as temporary shelters until a more permanent and sturdy home could be built. Log cabins, not dissimilar to those still built on the same mountain today, were often the choice of these early settlers (Plate 14). It is believed that this temporary nature is a significant factor in the apparent absence of visible cellars and foundations within the study area.

7.0 RECOMMENDATIONS AND CONCLUSIONS

Research and field reconnaissance in the study area has revealed the presence of only a few confirmed archaeological sites. Avoidance is the preferred method of mitigation in all instances where archaeological resources are present.

In the cases of the Williams house foundation and the unidentified stone feature on the John Munro Road, avoidance can be achieved simply by ensuring that any widening of the roadbed during construction is done to the south rather than the north side of the existing road.

The two stone walls which may be impacted by the construction of access roads are not themselves of high archaeological significance. However, their presence suggests that homesteads and associated archaeological resources such as middens, privies, and barn foundations may be nearby. It is recommended that archaeological monitoring of any clearing and grubbing activities in proximity to each feature be undertaken to ensure that no significant archaeological resources are disturbed during construction.

Finally, it is recommended that the stone mounds in proximity to site 53 be tested by a professional archaeologist to determine their origin and significance, should site 100-53 be chosen in the final turbine layout.

8.0 REFERENCES CITED

Davis, Derek and Sue Browne. 1996. *The Natural History of Nova Scotia, Volume II: Theme Regions*. The Nova Scotia Museum and Nimbus Publishing, Halifax.

Davis Archaeological Consultants Limited. July 2007. Glen Dhu Wind Farm: Archaeological Resource Impact Assessment. Heritage Research Permit A2007NS45. Report submitted to Fulton Energy Research and Nova Scotia Heritage Division.

Davis Archaeological Consultants Limited. July 2008. Glen Dhu Wind Project: Archaeological Resource Impact Assessment. Heritage Research Permit A2008NS41. Report submitted to Fulton Energy Research and Nova Scotia Heritage Division.

Davis MacIntyre & Associates Limited. June 2010. Glen Dhu Wind Farm, Phase II: Archaeological Resource Impact Assessment. Heritage Research Permit A2010NS63. Report submitted to McCallum Environmental and Nova Scotia Heritage Division.

Patterson D.D., Rev. George. 1877. *A History of Pictou County*. Reprinted in 1972 by Mika Studio.

PLATES

Plate 1: A typical mature birch and maple forest, this example found at candidate site 4. Looking east.

Plate 2: A typical softwood (spruce) forest, located at turbine candidate site 85-46 on the old layout, looking south.

Plate 3: A clear-cut area overgrown with thorns and young spruce saplings. At candidate site 18.

Plate 4: A stone boundary wall on the access road to candidate site 29. Looking north.

Plate 5: Archaeologist Stephen Davis indicates a beaver-chewed stump at candidate site 85-50 / 100-46 ont eh old layout. Looking east.

Plate 6: A copse of spruce trees marked with blue spray paint on the access road to candidate site 33. Looking west.

Plate 7: One of the larger stone piles near candidate site 53, looking west.

Plate 8: A small modern quarry pit near candidate site 53, looking northeast. The stone mounds are located in the spruce trees behind the pit.

Plate 9: The concrete foundation of the Williams homestead. Looking north.

Plate 10: A 19th century bottle deposited on one of the piles of stone in the blueberry field.

Plate 11: The top of a sawdust pile remaining from the Pushee Road sawmill. Looking northeast.

Plate 12: A collapsed hunting blind near the access road to turbine candidate 62. Looking east.

Plate 13: Mounded stones near the John Munro Road, looking northeast.

Plate 14: An abandoned cabin near the study area, resting on wooden sills on the ground likely in the same style of many pioneer structures. Looking north.

APPENDIX A: HERITAGE RESEARCH PERMIT

NOVA SCOTIA
Tourism, Culture and Heritage

Heritage Division

Special Places Protection Act, R.S.N.S. 1989

Heritage Research Permit (Archaeology)

(Original becomes Permit when approved by the Executive Director of the Heritage Division)

Office Use Only A2011NS90
Permit Number: A2011NS90

Greyed out fields will be made publically available. Please choose your project name accordingly

Surname de Boer	First Name Laura
Project Name Glen Dhu South Wind Farm, Phase II	
Name of Organization Davis MacIntyre & Associates Limited	
Representing (if applicable)	
Permit Start Date 12 September 2011	Permit End Date 31 December 2011
General Location: Barney's River Station/Kenzieville	
Specific Location: (*cite Borden numbers and UTM designations where appropriate and as described separately in accordance with the attached Project Description. Please refer to the appropriate Archaeological Heritage Research Permit Guidelines for the appropriate Project Description format*)	

Permit Category:
Please choose one:

☐ Category A - Archaeological Reconnaissance
☐ Category B - Archaeological Research
☒ Category C - Archaeological Resource Impact Assessment

☒ I certify that I am familiar with the provisions of the *Special Places Protection Act* of Nova Scotia and that I have read, understand and will abide by the terms and conditions listed in the Heritage Research Permit Guidelines for the above noted category.

☐ I currently hold a treasure trove license or pending application for a licence related to this Heritage Research Permit.

Signature of applicant [signature] For Laura de Boer	Date 25 August 2011
Approved by Executive Director [signature]	Date Sept 12/11

Appendix X. MI'KMAQ ECOLOGICAL KNOWLEDGE STUDY

MI'KMAQ ECOLOGICAL KNOWLEDGE STUDY

Glen Dhu South Wind Power Project - Phase ll

Prepared for

Shear Wind Inc.

CMM Environmental Services
The Confederacy of Mainland Mi'kmaq
P.O. Box 1590
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Tel: (902) 895-6385
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August, 2011

TABLE OF CONTENTS

TABLE OF FIGURES

1.0 INTRODUCTION

1.1 CMM Environmental Services

CMM Environmental Services is a program operated by the Lands, Environment, and Natural Resources Directorate of The Confederacy of Mainland Mi'kmaq (CMM) that provides fee for service environmental consulting services. CMM provides advisory services to six Mi'kmaw communities in the province of Nova Scotia: Paqtnkek First Nation, Annapolis Valley First Nation, Bear River First Nation, Glooscap First Nation, Millbrook First Nation, and Pictou Landing First Nation.

CMM Environmental Services Contact Information:

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sidney@cmmns.com

1.2 Project Description

The Confederacy of Mainland Mi'kmaq (CMM) Environmental Services were contracted to conduct a Mi'kmaq Ecological Knowledge Study (MEKS) for the Glen Dhu South Wind Power Project, Phase II. An MEKS has been completed for the first phase of this project in September of 2008 by CMM. The area of study is located west of Antigonish, Nova Scotia, in the Barneys River and Marshy Hope area, Pictou County, Nova Scotia.

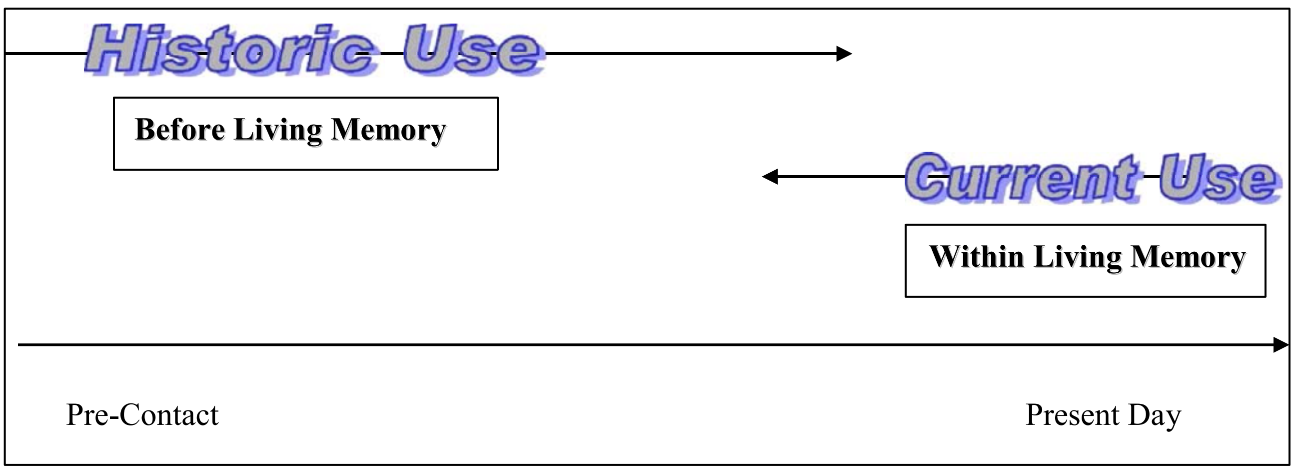
2.0 DEFINITION OF TERMS

Living Memory is the memory of living Mi'kmaw. The period of time included in living memory varies from knowledge holder to knowledge holder. Living memory often extends to the parent and grandparent of the knowledge holder and can be estimated at three to four generations.

Current Mi'kmaq Land and Resource Use occurred within living memory or is occurring at the present day (Figure 1)

Historic Mi'kmaq Land and Resource Use occurred before living memory (Figure 1)

Figure 1: Historic and Current Use Timeline



Mi'kmaq Ecological Knowledge (MEKS) is the collective body of knowledge which Mi'kmaq possess based on their intimate relationship with their natural surroundings, which involves exploitation, conservation and spiritual ideologies, and has been passed on from generation to generation, "*kisaku kinutemuatel mijuijij",* elder to child.

Mi'kmaq Land and Resource Use Sites are locations where Mi'kmaq land and resource use activities have taken place or are taking place at present day. These sites may or may not display physical evidence of Mi'kmaq use.

Mi'kmaq/Mi'kmaw: *Mi'kmaq* means the Family and is an undeclined form. The variant form, *Mi'kmaw,* plays two grammatical roles: 1) it is the singular of Mi'kmaq and 2) it is an adjective in circumstances where it precedes a noun.

Mi'kma'ki is the Mi'kmaw homeland (Atlantic Provinces and Gaspé Peninsula)

Specific Land Claim arises when a First Nation alleges that the federal government has not honoured its treaties, agreements or legal responsibilities. According to federal policy, a valid specific claim exists when a First Nation can prove the government has an "outstanding lawful obligation". The Mi'kmaq are currently pursuing several specific land claims in Nova Scotia.

Comprehensive Claim is based on underlying Aboriginal Title to traditional territory that has not been dealt with by treaty or other means. Aboriginal Title to lands exists as a legal right derived from First Nations historical occupation and possession of their tribal lands. The process of negotiating the settlement of comprehensive claims, which is known as modern-day treaty making, clarifies access and ownership to land and resources. Currently, the Mi'kmaq have a comprehensive claim to all lands within the province of Nova Scotia including all inland and adjacent waters.

3.0 PURPOSE AND SCOPE OF THE MI'KMAQ ECOLOGICAL KNOWLEDGE STUDY

3.1 Purpose of the Mi'kmaq Ecological Knowledge Study

The purpose of the Mi'kmaq Ecological Knowledge Study is to support the integration of Mi'kmaq knowledge of use and occupation of Mi'kma'ki into development decisions via the environmental assessment process.

3.2 Scope of the Mi'kmaq Ecological Knowledge Study

The MEKS includes:

1) a study of historic and current Mi'kmaq land and resource use;
2) an evaluation of the potential impacts of the Project on Mi'kmaq use and occupation and constitutionally based rights;
3) an evaluation of the significance of the potential impacts of the Project on Mi'kmaq use and occupation; and
4) Recommendations to proponents and regulators that may include recommendations for mitigation measures, further study, or consultation with Mi'kmaq.

3.3 Not included in the scope of the Mi'kmaq Ecological Knowledge Study

3.3.1 Section 35 Consultation

This study is not consultation for justification of the infringement of constitutionally protected aboriginal and treaty rights. If the project involves possible infringements of Mi'kmaq constitutional rights, the MEKS recommends further action.

3.3.2 Archaeological Screening and Resource Impact Assessment

The study is not an Archaeological Screening or Archaeological Resource Impact Assessment. Results presented in the study can inform and be informed by archaeological screenings and assessments.

3.3.3 Notification of Mi'kmaw individuals or communities of the Project

The study is not intended to inform or notify Mi'kmaw individuals or communities of the Project, solicit the opinions or concerns of Mi'kmaw individuals or communities on the Project, or promote the Project to Mi'kmaw individuals or communities.

4.0 METHODOLOGY

4.1 Historic Mi'kmaq Land and Resource Use

Historic Mi'kmaq land and resource use occurred before living memory. The study of historic land and resource use paints a broad portrait of Mi'kmaq use and occupation of Mi'kma'ki in centuries past.

4.1.1 Study Area

The study area lies within Pictou County adjacent to Ardness and Bailey's Brook, just a short distance from the county line, where Antigonish meets Pictou, running down adjacent to Marshy Hope and Beaver Mountain. The closest Mi'kmaq communities lie just west of the Baileys Brook, at Merigomish #31and Fisher's Grant #24, 24G and Boat Harbour #35. To the east are the Mi'kmaq parcels belonging to Paqtnkek First Nation, Pomquet and Afton #23, and Summerside #38.

Pictou County lies on the Northern Shore of the Northumberland Strait, and has a length of about 50 miles. It extends inward to a distance of over 20 miles and is bounded on the south by Guysborough County, on the east by Antigonish County, and on the west by Colchester County.[2] It lies with the Mi'kmaq districts known as Epekwitk aq Piktuk. The definition of the district means "lying in the water" and "the explosive place" respectively.

The major industries of Pictou County were agriculture, fishing and timber. The area was a "mixture of hardwood and softwood habitat and old fields, with few bogs or lakes."[3] Some of the trees found along this area were White Spruce, Balsam Fir, Sugar Maple, and Yellow Birch. Until the discovery of coal in the late 1700's, timber was the main resource. The county also boasted the best agricultural land, more than any of the other counties within the province.

4.1.2 Methods

Research was completed from within The Confederacy of Mainland Mi'kmaq research department library as well as external sources from the Nova Scotia Public Archives, Nova Scotia Museum, Cape Breton University's Mi'kmaq Resource Centre and the Colchester library. Secondary sources include Crown Land index sheets, church records, cemetery record, maps and published papers and books on Nova Scotia History.

4.1.3 Limitations

Recorded documents are the primary source of information for the study of historic Mi'kmaq land and resource use. There are no recorded documents in the pre-contact period and recorded documents in the post-contact period are not comprehensive. Furthermore, existing documentation has largely been written by people of a different culture. This means that information may either not be completely accurate or may be incomplete.

[2] Patterson, George A. A History of the County of Pictou, p. 9
[3] Davis, Derek S. and Sue Browne. The Natural History of Nova Scotia: Topics & Habitats, Volume One

4.2 Current Mi'kmaq Land and Resource Use

Current Mi'kmaq land and resource use occurred within living memory or is presently occurring. The MEKS includes a study of:

1) Current Mi'kmaq land and resource use sites
2) Species of Significance to Mi'kmaq
3) Mi'kmaw Communities

4.2.1 Study Areas

The study areas are described in Figure 2.

4.2.1.1 Current Mi'kmaq Land and Resource Use Sites

The study area for current Mi'kmaq land and resource use sites is the proposed area of development – five-kilometre radius surrounding proposed project site.

4.2.1.2 Species of Significance to Mi'kmaq

Study areas are marked on Figure 2.

4.2.1.3 Mi'kmaw Communities

The study area for Mi'kmaw communities is a 5 km radius surrounding the proposed development area.

4.2.2 Methods

4.2.2.1 Current Mi'kmaq Land and Resource Use Sites

Mi'kmaq knowledge on current land and resource sites will be gathered through a review of information collected through oral interviews with Mi'kmaw knowledge holders.

All individuals, whom will be interviewed, will sign consent forms. Knowledge will be gathered in accordance within the spirit of the *Mi'kmaq Ecological Knowledge Protocol.*

Knowledge collected is reported in a general format only. No names or specific locations are published. Collected knowledge will be digitized and compiled to allow for an analysis of potential impacts of the project on current Mi'kmaq land and resource use.

4.2.2.2 Species of Significance to Mi'kmaq

A system of stratified random sampling was employed to identify flora species present in the study areas of significance to Mi'kmaq. Plants were surveyed in the spring and fall of 2011. Information collected is reported in a general format only. The names of the species are not recorded.

4.2.2.3 Mi'kmaw Communities

A review of outstanding specific land claims within the study area was undertaken by CMM. There are no known specific land claims identified within the project area, however, the record of outstanding specific land claims in no way infers that specific land claims may not arise in the future. A list of the land claims for Pictou Landing First Nation are included later on in this report.

4.2.3 Limitations

While every attempt was made to document all available Mi'kmaw knowledge, the knowledge gathering process may not have captured some available Mi'kmaw knowledge. It is also recognized that over generations of cultural and political suppression, much Mi'kmaq knowledge has been irretrievably lost.

5.0 RESULTS

Results of the study are divided into two categories:

1) Historic land and resource use, that is, use that occurred before living memory, and
2) Current land and resource use, or use that occurred within living memory or is occurring at the present day.

Land and resource use may be for hunting, burial/birth, ceremonial, gathering, or habitation purposes.

5.1 Historic Mi'kmaq Land and Resource Use

5.1.1 General Overview of study area

The geographical description of the study area is a mix of various trees, such as maple, fir, spruce and birch, making it good for forest industry. The composition of the land contains various types of rocks, such as granite, slate, limestone and sandstone. The wildlife is extremely good, making this area excellent for hunting and farming. Scottish settlers were well established along this area, having small farms scattered across the county. There are many streams and small rivers running along the area, but are very few lakes.[1]

Pictou County lies on the Northern Shore of the Northumberland Strait, and has a length of about fifty miles. It extends inward to a distance of over twenty miles, and is bounded on the South by the Guysborough County, on the East by Antigonish County, and on the west by the Colchester County.[2] Proceeding from Pictou Harbor eastward, along the coast, we pass some small harbours known as Chance, Boat, and Little Harbours, and then meet Merigomish, formed by what is called the Big Island of Merigomish.[3] Here seems to have been the original entrance to the harbor. The early French explorers in the 17th century speak of this as the entrance, but represent it as becoming choked with sand so that only small vessels could enter,

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[1] Davis, Derek S and Sue Browne. Natural History of Nova Scotia, Volume II, page vi
[2] Patterson, George A. A History of the County of Pictou, p. 9
[3] Ibid, p.12

and that only at high tide. When the first English settlers arrived, the old Indians could recollect when there was sufficient water to afford passage of their canoes.4

In Merigomish the same thing is noticed, particularly in the eastern portion of the harbour, between French and Barneys River. Residents have observed that the flats are widening and the water upon them becoming more shallow. The bottom too, consists of rich, soft, fine mud, extending up to the beach itself, evidently brought down by the rivers.[5] Pictou County has few lakes, compared with some of the other counties of the Province, and these are all small. The principle lakes are: Eden, Brora, Sutherlands, and McDonalds Lakes.[6]

Pictou County's geological structure may be described in general terms as follows: Across the whole southern side of the county extends a range of hills of Upper Silurian formation, composed principally of beds of quartzite and slates. This band, which commences on the east at Cape Porcupine and Cape George, is about fifteen miles broad from the east side of the county until it approaches the East River, where it suddenly bends to the south, allowing carboniferous strata to extend far up into the valley of the river. Farther west it again widens and so continues beyond the boundaries of the county.[7]

The remaining portion of the county, stretching along the straits of the Northumberland, consists of newer carboniferous rocks. Copper ores are found at Caribou River, the West River a little below Durham, the East river a few miles above the Albion Mines, and River John.[8]

The county of Antigonish (formerly named Indian Gardens) is situated in the north east of Nova Scotia. It is nearly triangular in form, the base of the triangle being bounded by the Gulf of St. Lawrence and the Bay of St. George, while the apex is wedged between the counties of Pictou and Guysborough.[9]

Commencing at Cape George, a range of hills composed of syenite and metamorphic rocks extends westward to the upper part of the West River. Another range of similar structure, commencing at Cape Porcupine on the Strait of Canso, runs along the southern border of the

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[4] Patterson, George. A History of the County of Pictou, p. 12.
[5] Ibid, p. 16
[6] Ibid, p. 17
[7] Ibid, p. 18
[8] Ibid, p. 19
[9] Rankin, Rev. D.J. A History of the County of Antigonish, p. 3

county. The triangle thus formed comprises of the carboniferous system of rocks. With the exception of the hills mentioned above, the surface of the county is undulating, intersected with numerous streams and here and there diversified by lakes. From the richness in limestone and gypsum, it has that fertile calcareous soil which, combined with the rich intervals along its many streams, renders it perhaps the best fitted for agricultural purposes of any in the province.[10]

Most of the archeological sites occur in the five estuaries along the south side of George Bay. This large u-shaped bay is connected to the Atlantic side by the Strait of Canso and opens out to Northumberland Strait on the Gulf of St. Lawrence. George Bay is a shallow, warm bay drawing its water from Northumberland Strait and with a flushing time of 2-4 weeks for the water (and its associated fish eggs and larvae). The steady current flow in the Strait generates a major clockwise circulation in the bay, but tidal flow also results in an anti-clockwise gyre. By mid-January, the bay is filled with close pack ice with ice conditions being less severe towards the east in the Strait of Canso and Chedabucto Bay.[11]

The rivers, although generally larger than those of Cape Breton, are still relatively short such that the Micmac were never more than two days canoe travel from the sea.[12] There are numerous streams and small rivers flowing into the estuaries and harbors on Northumberland Strait and George Bay—five rivers converge at Antigonish, which is sometimes translated as 'the place where the rivers meet.' To the East are several important rivers—the Guysborough, County Harbor, and St. Mary's which discharge into elongate drowned river valleys on the Atlantic Coast. The St. Mary's is the largest and most important salmon-river. One of its branches has its headwaters in the Pictou-Antigonish uplands, the other flows for a considerable distance along the edge of the escarpment before the two branches converge 17.3 km from the sea.[13]

Coniferous forest predominates and consists of species such as balsam fir, white, red and black spruce, white pine, eastern hemlock and tamarack. But with changing elevation, there is a shift in species producing vegetation zones in a "layercake" arrangement. Evergreens are found in

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[10] Rankin, Rev. D.J. A History of the County of Antigonish, p. 3
[11] Nash, Ronald J. Mi'kmaq: Economics and Evolution, p. 5
[12] Nash, Ronald J. Mi'kmaq: Economics and Evolution, p. 5
[13] Ibid, p. 5.

the lowlands and valley bottoms. Mixed woods higher up on the ridge tops and the upper slopes are deciduous hardwood sugar species—sugar maple, yellow and white birch and beech. Red maple, trembling aspen and gray birch occur in both upland and lowland stands. The hardwoods have been important historically: birch for wigwams and canoes; maple for bows; ash for baskets, snowshoes and handles.[14]

On October 10 1955, Kenneth Jopps was digging a drain on his property at Lowdens Beach near Pictou, N.S, where he discovered a burial ground. The copper-pot burial discovered that day, and the second burial site found nearby a year later have provided a wealth of information through the quality and quantity of both the Native-made and European made grave gifts, and their relatively good state of preservation. In the 1980s, the date of the burials was established as being 1580-1590.[15]

The Pictou site represents an interesting variation on the Northport type of interment. Both pits contained secondary burials—in which the bodies are first laid out on scaffolding in the open air for a period of months or years, and the bones then buried in the earth. The first pit was presumed, by the grave gifts, to have contained the skeletal remains of an adult male. Only small pieces of bone were recovered. The second pit held skeletal fragments of a child, a woman, and five other adults, whose gender could not be determined.[16]

The grave's contents included 11 axes, chisels, knives, scrapers, fleshing tools; a reed basket three inches long; reed and bulrush mats, about two pounds of red ochre, apparently deposited in a leather pouch; a large piece of woolen blanket; thongs of rawhide and woven fabrics; a fragment of a wooden dish; and a rectangular piece of wood about 8 inches in diameter and one eight inch thick, thought to be a fragment of a breastplate. There was also a quantity of beads scattered throughout the find, ranging from about one quarter to almost one half inch in size, colored green, turquoise, brown, purple, and purple and white.[17]

The first Burial Pit was excavated in 1955, and was divided into two distinct areas or sections.

[14] Nash, Ronald J. Mi'kmaq and Economics, p. 7
[15] Whitehead, Ruth Holmes. Nova Scotia: The Protohistoric Period 1500-1635, p. 49.
[16] Whitehead, Ruth Holmes. Nova Scotia: The Protohistoric Period 1500-1635, p. 51.
[17] Whitehead, Ruth Holmes. Nova Scotia: The Protohistoric Period 1500-1635, p. 51.

Section One was a circular depression of 6' diameter and 3' deep. A Second depression, Section Two, lay to the north and slightly overlapped the first section. It was of the same depth, covered roughly the same area, but was irregular in shape; this second section was much less carefully prepared. Both portions had nearly vertical sidewalls. The floor of Section One was covered with twigs and small branches. Over these, there was a carefully prepared birch bark sheathing, which covered the entire floor and then reached up along the sides to a height of 1'6" from the bottom. Five layers of pelts lay above the bark on the floor. The final pelt layer lay with flesh side up and was painted red. Three intact, inverted copper kettles lay on the painted skin. Beneath each kettle was a very black layer of decayed organic material. Several grave gifts lay on the black stratum and were protected by the kettles from the earthen grave fill. These included a wooden bow, iron trade axe with handle, awls, fragments of cloth, and a glazed pottery beaker.

Section Two adjoined the first part on the northerly side. Seemingly the carefully prepared portion was not large enough to receive all gifts necessitating the hasty preparation of an extension. All the kettles in the second section were mutilated; some were badly crushed by deliberate flattening under heavy pressure and the rest were slashed with an axe. Many French trade objects and some native artifacts thrown into the grave along with the kettles were scattered about in no definite order.[18]

The second burial pit was a circular excavation with a total depth of 48" along the northerly side and 40" on the southerly; the floor was level and the difference in depth was a result of the sloping surface of the ground. The sides were virtually vertical to a depth of 34" when they sloped inwards to make a pit bottom measuring 68" x 63". The lowest 14" contained skeletal remains from either three or four bodies together with a compact mass of grave goods. In the next 15" were skeletal fragments from a single body together with two inverted copper kettles and stone and earthen fill; the third section, 11" deep, showed traces of two fires lit over the grave, evidently of a ceremonial nature.[19]

Other artifacts that were found included: a porcupine skin, with quills still attached; a hair roach of moose neck hairs, painted with red ochre and slip-knotted at one end over sinew

[18] Whitehead, Ruth Holmes. Nova Scotia: The Protohistoric Period 1500-1635, p. 53.
[19] Whitehead, Ruth Holmes. Nova Scotia: The Protohistoric Period 1500-1635, p. 55.

cordage, the cord then coiled into a tubular headdress (probably from the suspected male burial in Pit 1); and a collection of nine beaver molars and pre-molars. Five smooth round pebbles coated with red ochre, labeled "Pit A," may represent symbolically the firestones dropped into bark containers of water to bring them to a boil. Pelts included moose, deer, bear, and beaver.[20]

The known archaeological sites of Merigomish harbor comprise eighteen shell-heaps, the prehistoric cemetery excavated by Patterson, a modern cemetery, and places that may possibly be, respectively, a modern wigwam site, a burial place of "battle field", an earthwork, and workshop.[21] A single wigwam site is said to be located at Hardwood point, about three quarters of a mile north of Merigomish. The spot is among alders; about 150 feet back from the beach and about the same distance west of the east line of the Olding farm. It was probably the site of a modern Mi'kmaq Indian camp.[22]

There is a consecrated French and Indian cemetery on the high land at the south side of Big Island, on the north side of Savage cove. It is 1 5/8 miles northwest of Merigomish. Patterson states that the Mi'kmaq Indians used it as a cemetery until about 1837; but he gives its location at about a half mile west of a prehistoric cemetery. This cemetery was located on the farms of Mr. James McGlashan and Mr. Donald McGregor; the McGregor land now being owned by the son, Mr. George McGregor. Patterson claimed that it had been distributed in a search for specimens before he excavated it, and a number of stone axes and arrowheads taken away.[23]

A site at the east side of the Barney River bridge is thought, by Mr. Wallace Copeland of Merigomish, to be a burial place or "battle field" because many bones have been ploughed up at the place.[24] A supposed earthwork, locally known as the "Boars Back", is near Barney River. Patterson relates to a tradition recorded by Silas T. Rand, to the effect at the time of the last war there, in which the Mi'kmaq of the harbor fought other Indians.

The Mi'kmaq were entrenched in a blockhouse or a fort at the mouth of Barney River. These

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[20] Whitehead, Ruth Holmes. Nova Scotia: The Protohistoric Period 1500-1635, p. 60.
[21] Smith, Harian I. The Archeology of Merigomish Harbour, p. 7.
[22] Smith, Harian I. The Archeology of Merigomish Harbour, p. 9.
[23] Smith, Harian I. The Archeology of Merigomish Harbour, p. 10.
[24] Smith, Harian I. The Archeology of Merigomish Harbour, p. 14.

blockhouses were constructed of logs raised up around a vault first dug in the ground. The old Indian fortifications were a sort of palisade enclosures, formed of trees and stakes driven into the ground between them, with branches of trees interlaced. In times of war the women and children were always kept in such fortifications, but that after obtaining axes from Europeans they may have made one like the blockhouse referred to above. This supposed earthwork, however, is probably natural or made by white-men, as earthworks of aboriginal origin are not known in the Maritime Provinces or nearer than Massachusetts.[25]

Many chipped points for arrows and a very great number of chippings have been found on Thomas Patton's point, now owned by Mr. R. Patterson, at Lower Barney River. The site may have been a workshop where stone was chipped into points for arrows, knives, and scrapers.[26]

There are a number of sites on Pictou harbor, at the beaches, and at Fisher's Grant. There is a small adze made of stone from the beach at Pictou, a fragment of adze made of stone from Town gut, two adzes made of stone, one of them double bitted, from Bug gut, East River, Pictou. In the same collection from East River, Pictou, are two adzes made of stone, one of them grooved on the rounded side of the head. There is also a shell-heap, which is the site of old campfires, composed of oyster, clam, and mussel shells on Ives Point, on the east side of East River, Pictou.[27] Stone axes and knives were found a few hundred yards north of Indian Cross point, a little below Ives point.

Many shell-heaps have been found in this area of study, including: Quarry Island, Indian Island, Olding island (Point Betty island), Savage Cove, Big Island, Smashem head, Finlayson island, Pig island, Kerr point, Smith point, Barney River, Central Ponds, Little Harbor, Ives Point, East River, Fraser Point, and Caribou Island.[28]

When European voyagers first visited our coasts, the Walrus was still found in this latitude; and with the memory of the persons still living, the Seal was also in abundance. The first visitors to Pictou describe in glowing terms the size and abundance of the oysters to be found

[25] Smith, Harian I. The Archeology of Merigomish Harbour, p. 14.
[26] Smith, Harian I. The Archeology of Merigomish Harbour, p. 14.
[27] Smith, Harian I. The Archeology of Merigomish Harbour, p. 15.
[28] Smith, Harian I. The Archeology of Merigomish Harbour, p. 7-15.

in our harbour and the shell heaps on the site of old Indian encampments.[29]

The Mi'kmaq lived mainly on the coast. Explorers and pioneer settlers found evidence of Micmac settlements on both the east and west sides of the East River estuaries; at West River, at the Big Island of Merigomish, at the mouth of Barney's River, at Middle River Point, at Cariboo, and Little Harbor. Pictou was the center of the district on Nova Scotia's north shore, those belonging to it being called "Pectougawak"(Pictonians). The Pictougawak tribe's headquarters was probably at Merigomish, and near here they buried their dead on Indian Island, a place which has religious and emotional significance to the remaining Indians who live on the Federal Government Reservation at Pictou Landing. The river-mouths on Pictou's coastline were advantageous campsites for the aboriginal inhabitants. The waters were filled with an abundant supply of shell and vertebrate fish, the water surface was filled with wild fowl, and the forests were stocked with small game, moose, and caribou.[30]

The name Pictou was supposed by many to have been a corruption of Poictou, the name of an old Province of France. The Mi'kmaq have a traditional story as to the name of Pictou: Their story or tradition is that at one time there had been a large encampment up the West River. On one occasion they all left on their canoes on a cruise down the harbor. During their short absence, the whole encampment was burned up, including the woods surrounding it. No person could tell how the fire originated. They always spoke of the event as the "Miskeak Bucto", or big fire, which naturally became associated with the place. When the whites came, hearing the Mi'kmaq speak of it in this way, they corrupted the name and called the whole north side of the harbor Pictou, because they could not pronounce it right.[31]

Of the seven divisions, Pictou was the center of the district extending along the north shore of Nova Scotia. Merigomish however, seems to have been their headquarters. This was a favorable position for them because it was near the fishery of the Gulf; the islands abounded in wild fowl, the rivers swarmed with fish, and the woods in rear were plentifully stocked with game.[32] Their principle place of encampment was at the foot of Barneys River, on the east side, where they had some clearings on which they grew Indian corn and a few beans, at the

[29] Patterson, Rev. George. A History of the County of Pictou, p. 20.
[30] Cameron, James M. Pictou County's History, p.1
[31] Patterson, Rev. George A. A History of the County of Pictou, p. 23
[32] Patterson, Rev. George. A History of the County of Pictou, p. 23.

time of English arrival. Other places such as: the Big Island, some of the smaller islands in the harbor, and some of the points on the shore were also sites of their encampments.[33]

Their burying ground, when the English settled, was near the west end of the Big Island on the south side, a short distance east of Savage Point. They used this until about forty years ago, and here stood a number of crosses till a recent period. All the Indians of the county now burry on Chapel Island or Indian Island, an island in the harbor donated to them by Governor Wentworth.[34]

The mouth of the East River is marked as the site of an Indian village. There, close by the river is a beautiful flat where the land was clear when the English settlers arrived. When it was ploughed, various articles were turned up such as broken pieces of cookery, a gun barrel, and on one occasion a pewter basin (which was about eight inches in diameter, with a narrow rim), and five or six tablespoons. Quite a number of stone hatchets, and oyster shells have also been found. These facts show that the Mi'kmaq occupied this place both before and after the arrival of the Europeans.[35]

Down the river, south of where Fisher's Grant is located today is another burying place. A large iron cross stood here at the arrival of the English settlers, which was about ten feet high. Hence the place is still known as Indian Cross Point, though the locality is known among the Mi'kmaq, as Soogunagade, or rotting place. Erosion is wasting away the bank, so at times human bones may be found exposed on the shore.36 In D McLeod's Old Time Recollection, published in the Pictou Advocate, he stated that "One day, over fifty years ago, the Indians turned out in force to repair the breach that time and tide had made on their old burial ground."[37] The Mi'kmaq stopped burying their dead there in the around 1867 as the land was acquired by others who had acquired the land. There was no official grant to the Indians for this area.

Mr. Donald McGregor of the Big Island, was ploughing a spot on his field when he turned up a human skull. Upon examination, he found a mass of decayed human bones; among them a

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[33] Patterson, Rev. George. A History of the County of Pictou, p. 27.
[34] Patterson, Rev. George. A History of the County of Pictou, p. 27.
[35] Patterson, Rev. George. A History of the County of Pictou, p. 27.
[36] Patterson, Rev. George. A History of the County of Pictou, p. 29.
[37] Brown, Douglas. Indian Cross Point Burial Ground Research: Final Report, page 4

skull, transfixed by a flint arrowhead which yet remained in its place. Along with these remains were a large number of ancient implements, stone axes, flint arrowheads, etc., but none of them showing contact with Europeans. The transfixed skull, and the whole appearance of the place, plainly showed that these were the bodies of those who had fallen in some battle and had been heaped together, "in on red burial blent."[38]

The burial ground was very shallow, being no more than fifteen to twenty inches deep. At the bottom there were decayed fragments of the birch bark, in which, according to the custom of the ancient Mi'kmaq, the dead were laid. The shallowness of the pit also indicates that this burial took place previous to the coming of Europeans, when sharpened sticks of wood were their only instruments of digging.[39]

The burying ground was used by the Mi'kmaq till about forty years ago and was about half a mile further to the west. Some of the belongings seemed to indicate that they belonged to another race, a people of small size, like the Esquimaux. That the Algonquin race came from the south-west is now received opinion of American Antiquarians and there are also strong reasons to believe that the Esquimaux occupied the shores of North America, to a point much farther south than they now do. Charlevoix describes the Mi'kmaq in his day as maintaining a constant warfare with the Esquimaux, and the probability is that the Mi'kmaq, on first occupying this region, drove out the Esquimaux, and these remains may be the relics of their conflicts.[40]

One curious fact was found in this cemetery, which has not been noticed in connection with Mi'kmaq customs: the use of fire in some way in connection with the dead. Some of the graves give no indication of this, and in one it was possible to trace the position in which the body was laid, viz., on its side in a crouching posture. But in other cases the remains were mixed with ashes, small pieces of charcoal, and burnt earth showing the use of fire for some unexplained purpose. In another case, a quantity of ashes with small fragments of burnt bones had been found. The whole had been carefully buried, and was probably the remains of some

[38] Patterson, Rev. George. A History of the County of Pictou, p. 29.
[39] Patterson, Rev. George. A History of the County of Pictou, p. 30.
[40] Patterson, Rev. George. A History of the County of Pictou, p. 31.

captive whom they had burned.[41]

In 1842, Joseph Howe wrote a letter to John Whidden recommending that land should be set aside for the Indians in Pictou County. He had stated that they had no fuel, and no place to improve their lives. Peter Crerar, Deputy Surveyor, had suggested that 1000 acres of land be set aside for the Indians on the east side of the Barney River, including the whole of Brown Lake, as shown on McKay's map[42.]

In reviewing the census records for 1871, 1881, and 1891, there appears to be small groups of Mi'kmaq families includes in the records for Barney's River, Bailey's Brook, and McLellans Mountain. In tracing the names, in the consecutive census records, these families, small in number, moved to Merigomish, Little Harbour, Fisher's Grant and Heatherton. By the 1901 and 1911 censuses, no other families were located within or near the study area. In a few rare cases, Mi'kmaq individuals were listed within other areas of Pictou, not on reserve, but are listed as Boarders. However, these individuals eventually moved on the Fisher's Grant or Heatherton.

The settlement of Pictou County by English and Gaelic speaking settlers began after French power in Nova Scotia had ceased, and with it the Indian opposition to the British. Mi'kmaq leaders in 1760 appeared before the Legislative Council in Halifax to make peace. In 1762 a proclamation was issued to prevent encroachment on Indian lands, which was a follow up to a ten-year-old statute that forbade acts of aggression against the Indians.[43]

As the settlers fanned out from Pictou, they found Indians with small plots under primitive cultivation, e.g., Middle River Point, and Barney's River. These and others were purchased from the Mi'kmaq for a meager amount, by the whites. The Indians' principal district, Merigomish (an Anglicized spelling and pronunciation of the Indians name for the district "Mallogomichk", meaning a hardwood grove) was taken over entirely by the whites, except two small islands.[44]

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[41] Patterson, Rev. George. A History of the County of Pictou, p. 31.
[42] Indian Affairs Records, RG 1 Volume 432, page number 145, Archives of Nova Scotia
[43] Cameron, James M. Pictou County's History, p. 2.
[44] Cameron, James M. Pictou County's History, p. 2.

At time of Confederation, some Indians were living on the land later called Chapel Cove, one of the smaller Indian camping places that was in use before the whites had arrived. It was first designated by the whites and Fisher's Grant, later known as Pictou Landing. It was recognized as Indian land by the Province of Nova Scotia and was transferred to the Dominion at Confederation in keeping with the BNA Act, which put administration of Indian affairs within the jurisdiction of the Federal Government. Following Confederation, a number of land parcels at Pictou Landing-Chance Harbour were acquired by the Dominion as a reserve for the Pictou Landing Indians—89 acres in 1874, 16 acres in 1876, etc. until the total encompassed 1158 acres, classified by the Federal authorities as Fishers Grant Indian Reserve No. 24. Additionally, Chapel Island and Wooley Island, 30 acres and 5 acres respectively in Merigomish Harbor were set aside. In 1960 they were designated Merigomish Harbour Indian Reserve No. 31 for the use and benefit of Pictou Landing Indians.[45]

For the Indians, the white man brought disaster. In 1775 Magistrate Harris reported their number in the County to be 885. The first federal census almost a century later, 1871, reported the County's Indian population to be 125, which was a shocking decline, said to have been caused by Indians lacking immunity to the white man's diseases; small pox, and tuberculosis. By 1961 the census showed the Pictou Landing Indian band had increased in the intervening ninety years to over 200. White settlements on the coast and up-river crowded them off their fishing and hunting grounds.[46]

In 1722, there were ninety-three Mi'kmaq in Antigonish, and forty-five in Pictou; in 1735, 127 in Antigonish and sixty-three in Pictou. According to map and census data 1600-1735. Also, in 1688, there were fifty-two Mi'kmaq.[47]

Edward Mortimer recommended that part of the Philadelphia grant near Caribou Point be granted to the Indians in the county. He stated, "It would make a good reserve. There is plenty of grass, good soil, no roads, continuous hunting grounds, plenty of timber convenient for water carriage."48 During the years 1819 – 1820 the government of the province finally divided the province into ten areas in which there was to be land set aside for the Indians.

[45] Cameron, James M. Pictou County's History, p. 2.
[46] Cameron, James M. Pictou County's History, p. 3.
[47] Wicken, William C. Encounters with tall sails and tall tales: Mi'kmaq Society, 1500-1632, p. 96.
[48] Francis, Barry. Pictou Landing Reserve: A History, p. 3.

Unfortunately for the Indians in Pictou, they were not considered in the plan. In 1828 the Indians were prevented for the planting crops and the cutting of firewood by a Mr. Mudie (to whom the land had been granted) even though the Indians lived on the spot for more than fifty years prior.[49]

In 1842 Robert McKay and some other people of Pictou petitioned the assembly for an allotment of land for the Indians in Pictou and again there was no action. On November 30, 1842 J. Dawson wrote to Joseph Howe asking if the Indians could reasonably expect anything in the shape of "Royal Bounty because the Indians never had more need of it." The Indians at the time were destitute and in need of clothing. On December 5 of that same year Howe replied by sending a few blankets and coats to be given to the aged, or poor families only. In addition, Howe asked if there were crown lands available that would suit them for there would be no difficulty in getting a grant of 500 to 1000 acres for them. Mr. Dawson wrote to the government in January of 1843 suggesting that Mr. McArthur at Boat Harbor would be willing to sell his land to the crown and later be used by the Indians. The government did not adopt Mr. Dawson's recommendations, and it was some time before land was reserved for the Indians at Pictou.[50]

It wasn't until the eve of confederation in 1867 that the Indians in Pictou were granted land. The amount of land purchased after more than eighty years was fifty acres. The land was not purchased by government funds, but funds collected from the sale of Indian land, which had been encroached upon in Cape Breton.[51] In 1874 another eighty-nine acres were purchased from Wm. Ives for $1157 which became known as Fisher's Grant, 24 A. In 1876 sixteen acres were cut off and exchanged for eleven acres of land, which became known as Fisher's Grant, 24 B. The Indians received less in the exchange but it gave the reservation access to both the Northumberland Gulf Shore and Boat Harbour. Additional parcels of land were acquired in 1888 of thirty acres known as 24 C, thirty-five acres in 1903 and was known as 24 D, eighty acres in 1907 known as 24 E, 120 acres in 1910 known as 24 F, and 128 acres in 1928 known as 24 G. All these parcels of land were acquired for firewood, which was much needed by the

[49] Francis, Barry. Pictou Landing Reserve: A History, p. 6.
[50] Francis, Barry. Pictou Landing Reserve: A History, p. 7.
[51] Francis, Barry. Pictou Landing Reserve: A History, p. 7.

Indians.[52]

Indians from Indian Island moved to Pictou Landing to live where work was available close by. Now the island is uninhabited, but Indians all over the Maritimes visit each year in July to celebrate the "Feast of St. Anne's." Prior to 1838 the Indians used to have a similar celebration, usually in the month of September at Fraser's Point or Middle River Point. There would be about a hundred to a hundred and fifty canoes drawn up on shore while the two days would be spent in racing and other events.[53]

An overview of Crown Land Index Sheets 93, 94, 98 and 99 did not uncover any land grants to Indians or individuals within the study area. There are no archaeological sites listed within the Nova Scotia Museum Inventory collection within the proposed study area.

The Mikmaq spelling of the various place-names within Pictou and Antigonish County were corrected from the previous report, using Smith-Francis Orthography. It was developed by Bernie Francis and Doug Smith using Father Pacifique's system of language, and is recognized by the Mi'kmaq-Nova Scotia-Canada Tripartite Forum, under a MOU signed in 2002, as the official orthography used by the Mi'kmaq.

5.2 Current Mi'kmaq Land and Resource Use

The study of current Mi'kmaq land and resource use is comprised of a study of current Mi'kmaq land and resource use sites, species of significance to Mi'kmaq, and Mi'kmaw communities.

5.2.1 Current Mi'kmaq Land and Resource Use Sites

Current Mi'kmaq land and resource use activities are divided into five categories:

1) Kill/hunting

[52] Francis, Barry. Pictou Landing Reserve: A History, p. 9.
[53] Francis, Barry. Pictou Landing Reserve: A History, p. 9.

2) Burial/birth
3) Ceremonial
4) Gathering food/ medicinal
5) Occupation/habitation

Table 1 provides a description of activities undertaken at the sites.

Table 1: Description of Activities Undertaken in Current Mi'kmaq Land and Resource Use Sites

TYPE OF SITE	DESCRIPTION OF ACTIVITIES IN STUDY AREA
HUNTING/KILL	Deer, Trout, Salmon, Rabbit, Partridge, Moose, Smelt, Beaver, Sucker, Quahogs, Pheasant, Porcupine, Eel
BURIAL/BIRTH	
CEREMONIAL	
GATHERING	Decoration Plants, Medicinal Plants, Food Plants, Specialty Wood, Water
HABITATION	Overnight Site, Group Campsite

The majority of Mi'kmaq land and Resource use located within the study area is outside of the project site boundary. Burial or Ceremonial sites were not identified within the project footprint. However, research indicated that Paqtnkek and Pictou Landing campsites were identified within the Glen Dhu/Maryvale Wind Power 2008 MEKS, along the Baileys Brook water system. (See Figure 2) There was no additional information pertaining to the locations of the Paqtnkek and Pictou Landing campsites, documented within this MEKS.

5.2.2 Species of Significance to Mi'kmaq present in study area

Species of significance to Mi'kmaq in the study area are divided into three categories:

1) Medicinal
2) Food/Beverage
3) Craft/Art

The following table describes the number of plants of significance present in the study areas during the spring and fall surveys.

Table 2: Number of Species of Significance to Mi'kmaq Present in the Study Areas Spring & Fall 2011

TYPE OF USE	NUMBER OF SPECIES PRESENT SPRING 2011
MEDICINAL	39
FOOD/BEVERAGE	19
CRAFT/ART	16

TYPE OF USE	NUMBER OF SPECIES PRESENT FALL 2011
MEDICINAL	57
FOOD/BEVERAGE	21
CRAFT/ART	16

5.2.3 Mi'kmaw Communities

Fisher's Grant I.R.#24

Fisher's Grant is located 10 kms north of New Glasgow in Pictou County. The reserve was formed in 1866 from several parcels that were amalgamated in to what is now known as Pictou Landing Reserve. The band has 3 other parcels of land at Boat Harbour #37; Merigomish Harbour #31 and Fisher's Grant #24G which is located near Boat Harbour. In Cumberland County, Pictou Band has co-ownership of Franklin Manor IR #22* with Paqtnkek First Nation. The main parcel at Fisher's Grant is roughly 229.31 acres, Merigomish is 35.09 acres, and Boat Harbour is 242.66 acres. (*Paqtnkek has 48% ownership of 196.2 acres of Franklin Manor and Pictou has 52% ownership of Franklin Manor amounting to 525.09 acres).

At Fisher’s Grant, there are approximately 455 members living on reserve, 139 members live off-reserve, and 19 live on other bands.

Paqtnkek First Nation IR #23

Paqtnkek First Nation is located 24 kms east of Antigonish and was first set aside by Order-In-Council in 1820 and is divided into three lots: A, B, and C. The band changed their corporate name from Pomquet and Afton #23 to Paqtnkek in 2002 and will be changing the names of their parcels to their traditional Mi’kmaw names. There are an estimated 380 members living on reserve, while 137 members are living away from the community, while 27 members live on other bands. The number of total band members may fluctuate under Bill C-3. The band has 107.24 acres of land located east of Antigonish where the St. Ann’s Church is located. This parcel is known as Summerside IR #38 (in Mi’kmaq this parcel is known as Walne’k). The band has co-ownership over Franklin Manor #22 (48% = 485.56 acres).

The following is a list of Mi'kmaq place names:

Place-name	Mi'kmaq Name	Translation
Pictou Island	Kensenkuk	No meaning given
Moody's Point	Poqnipkek	No meaning given
Merigomish	Maliko'mijk	a hardwood grove
Caribou Harbour	Kumaqn	a decoy place, duck decoys were set
Green Hill	Espaqamitkek	High land
Mount Thom	Pmtnuk	A mountain chain
Middle River	Menjipukuek	Straight flowing
West River	Waqamitkuk	Clear water
East River	Apchechkumooch-waakade	Duckland
Saw Mill Brook	Nawiknij	Saw mill brook
Fisher's Grant	Piktuk Walne'k	No meaning given
Roger's Hill	Nimnoqna'qnikt	Black birch cove
Little Caribou Entrance	Tetu tkesit	running into the bushes
Toney River	Pukumkek	spark of fire
Little harbor	Menpekwik	Little harbor
Point Betty Island	Mkopit	Beaver place
Middle River	Menjipukuek	No meaning given
Pictou	Piktuk	Explosion of gas
Sutherland's Island	Kun'tewe'katik	A Stone Quarry
River John	Kajipukuek	A Lonely River
Caribou Island	Kumaqnek	No Meaning given
Trenton	Apij'jkmujue'katik	Duck Land
Pictou Landing	Puksaqte'kne'katik	No Meaning given
Boat Harbour	Wisaso'q	Yellow Rock
Chance Harbour	Menpekwik	No Meaning given
Mullis Island	Tma'kniewe'katik	Shell Duck Place
Sutherland Island	Kun'tewe'katik	A Stone Quarry
Big Merigomish Island	Sunati'jk	Little Ship Yard
Barney's River	Skikiankataqank	No Meaning given
Antigonish (river & harbour)	Nalikitquniejk	Where branches are tore off
Arisaig	Klatuowe'sk	Rocky prop
Barneys River	Skikiankataqank	No Meaning given
Bowman Head	Metkatpawliek	No Meaning given
Cape Blue	Mijikue'katik	turtles' home
Cape George	Memkejk	clear field
Cape Jack	Ki'kli'kwe'ji'jk	chickens' home
Havre Boucher	Nulo'qnek	Little stopping place for meals
Indian Gardens	Mekwasek	Red Rock

Knoydart Brook	Walatek	Cove Like
Little Tracadie	Poqomkuakitk	flowing over dry sand
Mahoneys Beach	Tuiten	No meaning given
Malignant Cove	Amnipenek	frightening
McArras Brook	Apsaqaqnji'jk	No Meaning given
Monks Head	Mulansek	No Meaning given
Morristown	Kaqaio'qikejk	lime banks
North River	Kaqaio'qijej'jk	No Meaning given
Pomquet	Poqomkek	dry sand
Pomquet & Afton Reserves	Poqomkek (Utan)	No Meaning given
Pomquet Beach	Pataluti'jk	Little table
Pomquet Ferry	Pqotmau'taqnek	No Meaning given
Pomquet Forks	Niktui Psitenij (forks)	No Meaning given
Pomquet Island	Paqtnkek Mmiku	No Meaning given
Pomquet Point	Pkawikn	facing the island
Pomquet River	Amasipukeuk	long river
Pomquet Road	Skitamka'taqnk	No Meaning given
South River	Peskikuktukwek	branching off
Summerside	Niktue'k	No Meaning given
Tracadie	Tlaqatik	Settlement, Inhabited place
West River	Wisike'ji'jk	No Meaning given
William Point	Maqtewatqek	No Meaning given

Land Claims

Pictou Land Claims

Claim 00024-301	Franklin Manor #22, illegal surrender timber
Claim 00024-302	Loss of merchantable timber 1891 surrender I.R. #22 timber sale. [Joint claim with Paqtnkek First Nation]
Claim 00024-401	Fisher Grant #24, Department of Highways road allowance
Claim 00024-402	Fisher Grant #24, Nova Scotia Power Company easement
Claim 00024-501	Failure to include Mooley's Island as Indian Reserve in 1867 (Legal review completed Statement of Fact completed ready for Presentation to the claimant Band pending scheduling)
Claim 00024-502	Fisher Grant #24, loss of reserve land post confederation
Claim 00024-503	Franklin Manor #22, loss of reserve land post confederation

Claim 00024-504	Unlawful alienation of 85 acres on Fisher Grant I.R. #24
Claim 00024-505	Unlawful alienation of 200 acres from Franklin Manor #22
Claim 00024-506	Loss of reserve land, 1783 Licence of Occupation to Anthony Bernard et al, December 18, 1783, Antigonish Harbour NS. [Joint claim Paqtnkek] (Claim ready for Legal review)
Claim 00024-507	Indian Cross Point, illegal disposition of Indian Lands
Claim 00024-508	An illegal disposition of Indian lands, 1783 Licence of Occupation to Indians, River Philip, Cumberland County, NS. [Joint claim Paqtnkek First Nation]. (Being Researched)
Claim 00024-509	A Illegal disposition of Indian lands, Licence of Occupation December 18, 1893, Merigomish Indian Reserve #31
Claim 00024-604	Mismanagement of federal government's obligation to ensure proper and adequate compensation for utility grants and provincial / federal agreements on Fisher Grant I.R. #24
Claim 00024-606	A breach of obligations arising out of the Indian Act, Shiminicas Indian Reserve Cumberland County NS. [Joint claim with Paqtnkek]. (Ready for Legal review)

Paqtnkek Land Claims

00019-301	Pomquet #23, illegal surrender, post confederation
00019-302	Franklin Manor #22, illegal surrender, timber
00019-303	Loss of merchantable timber, 1891 surrender of Indian Reserve #22, timber sale. Joint claim with Pictou Band
00019-401	Breach of fiduciary trust responsibility, highway right-of-way, Afton Indian Reserve, Sept. 24, 1968. (Claim submitted to SCB counter research completed/reviewed claim and resubmitted)
00019-402	Pomquet #23, Department of Highways, road allowance
00019-403	Afton #23, Department of Highways road allowance
00019-404	Afton #23 CNR easement
00019-501	Afton #23, Summerside land grant, loss of reserve land
00019-502	Franklin Manor #22, loss of reserve land post confederation. Joint

claim with Pictou Landing Band.

00019-503	Loss of reserve land, 1827 alienation of Afton & Pomquet #23.
00019-504	Loss of reserve land, 1783 Licence of Occupation to Anthony Bernard et al, December 18, 1783, Antigonish Harbour, NS. (Claim ready for Legal review)
00019-505	An illegal disposition of Indian lands 1783 Licence of Occupation to Indians, River Philip, Cumberland Co., NS. (Being Researched)
00019-601	Failure to follow proper procedures of Legatte in setting aside Summerside as an Indian Reserve. (Being researched)
00019-602	A breach of obligation arising out of the Indian Act Shiminicas Indian Reserve, Cumberland Co., NS. (Ready for Legal review)

6.0 POTENTIAL PROJECT IMPACTS ON MI'KMAQ LAND AND RESOURCE USE

The following table presents potential project impacts on historic and current Mi'kmaq land and resource use.

Table 3: Potential Project Impacts on Mi'kmaq Land and Resource Use

POTENTIAL IMPACTS ON MI'KMAQ LAND AND RESOURCE USE	
6.01	The historic review of Mi'kmaq use and occupation documents historic Mi'kmaq use and occupation in the study area, and potentially the project area. A potential impact of the project is the disturbance of archaeological resources and Burial sites.
6.02	Several species of significance to Mi'kmaq have been identified in the study area. Permanent loss of some species is an impact of the project.

7.0 SIGNIFICANCE OF POTENTIAL PROJECT IMPACTS ON MI'KMAQ LAND AND RESOURCE USE

The concept of significance in the Mi'kmaq Ecological Knowledge Study is distinct from the concept of significance under the *Canadian Environmental Assessment Act* or the *Nova Scotia Environmental Assessment Regulations*. Significance to Mi'kmaq is evaluated only in accordance with the criteria listed below. The MEKS evaluation of the significance of the potential project impacts on Mi'kmaq should be used by regulators to inform their determination of the significance of the environmental effects of the Project.

7.1 Significance Criteria

The following criteria are used to analyze the significance of the potential project impacts on Mi'kmaq use:

1) Uniqueness of land or resource
2) Culture or spiritual meaning of land or resource
3) Nature of Mi'kmaq use of land or resource
4) Mi'kmaq constitutionally protected rights in relation to land or resource.

7.2 Evaluation of Significance

Table 4: Significance of Potential Project Impacts on Mi'kmaq Land and Resource Use

POTENTIAL IMPACT	EVALUATION OF SIGNIFICANCE
6.01 The historic review of Mi'kmaq use and occupation documents Mi'kmaq use and occupation in the study area, and potentially the project area. A potential impact of the project is the disturbance of archaeological resources and burial site.	7.2.01 Mi'kmaq archaeological resources are extremely important to Mi'kmaq as a method of determining Mi'kmaq use and occupation of Mi'kma'ki and as an enduring record of the Mi'kmaq nation and culture across the centuries. Archaeological resources are irreplaceable. Any disturbance of Mi'kmaq archaeological resources is significant. The Burial sites are not located within the proposed project site, therefore, impact of the project is not likely significant.
6.02 Several species of significance to Mi'kmaq have been identified in the study areas. Permanent loss of some specimens is an impact of the Project.	7.2.02 The plant species of significance to Mi'kmaq identified within the study area exist within the surrounding area. The destruction of some specimens within the study areas does not pose a threat to Mi'kmaq use of the species. The impact of the permanent loss of some specimens of plant species of significance to Mi'kmaq is evaluated as not likely significant.

8.0 CONCLUSIONS AND RECOMMENDATIONS

8.01 In the event that Mi'kmaw archaeological deposits are encountered during construction or operation of the Project, all work should be halted and immediate contact should be made with Laura Bennett, Special Places Co-ordinator, at the Nova Scotia Museum and Janice Maloney, Executive Director, KMKNO (Kwilmu'kw Maw-klusagn Negotiation Office).

8.02 There are no land claims registered with the Specific Claims branch of Indian and Northern Affairs Canada in Ottawa for any of the Mi'kmaq communities in Nova Scotia within the Project area. However, that does not suggest that any other Mi'kmaw claimants for this area may not submit land claims in the future.

9.0 REFERENCES, SOURCES, AND RECORDS CONSULTED

Bartlett, Richard H. Indian Reserves in the Atlantic Provinces of Canada. University of Saskatchewan Native Law Centre. 1986.

Brown, Douglas. Indian Cross Point Burial Ground Research: Final Report; 1998

Cameron, James M. Pictou County's History. Pictou County Historical Society: New Glasgow. 1972.

Church, Ambrose F. Topographical Township Map of Pictou County, 1879.

Confederacy of Mainland Mi'kmaq: Research Department. Merigomish.

Confederacy of Mainland Mi'kmaq: Research Department. Pictou Landing: Fisher's Grant.

Confederacy of Mainland Mi'kmaq: Research Department. Pomquet/Afton No. 23.

Davis, Derek S. and Sue Browne, eds. The Natural History of Nova Scotia: Topics and Habitats, Volume 1. Halifax; Nimbus Publishing/Nova Scotia Museum; 1996

Davis, Derek S. and Sue Browne, eds. The Natural History of Nova Scotia: Theme Regions, Volume 2. Halifax; Nimbus Publishing/Nova Scotia Museum; 1996

Davis, Stephen A. Micmac. Four East Publications, Nova Scotia. 1991.

Department of Education. Mi'kmaq Past and Present: A Resource Guide.

Ferguson, Charles Bruce. Place-Names and Places of Nova Scotia. Halifax, Public Archives of Nova Scotia, 1967.

Frame, Elizabeth. A List of Micmac Place Names, Rivers, Etc., in Nova Scotia. Cambridge: John Wilson and Son, 1892.

Francis, Barry. Pictou Landing Reserve. 1986. (Unpublished)

Gibb, John E, & Karen A. McMullin. Regional Water Resources, Pictou County, Nova Scotia. Nova Scotia Department of the Environment. 1980.

Julien, Donald M. O.N.S. Historical Perspective of Micmac Indians Pre and Post Contact Period.

Confederacy of Mainland Mi'kmaq (Unpublished)

Julien, Donald M. O.N.S. Mi'kmaq History: Pictou Landing First Nation. 2000. (Unpublished)

MacLean, Raymond A. (ed.) History of Antigonish, vol. 1. Casket Printing and Publishing Co. Ltd. 1976.

Meachem, J.H. Historical Atlas of the County of Pictou, Nova Scotia. Belleville: Mika Silk Screening, 1972.

Miller, Peter. Notice of three Micmac arrowheads from Merigomish Harbour, on the Northern Coast of Nova Scotia, now presented to the Nova Scotia Museum. From the Proceedings of the Society of Antiquities of Scotland, vol. IX, NS. 1886-7.

Nash, Ronald J. Mi'kmaq: Economics and Evolution. The Nova Scotia Museum, Halifax, NS. 1986.

Nietfeld, Patricia Kathleen Linskey. Determinants of Aboriginal Micmac Political Structure. The University of New Mexico, 1981.

Nova Scotia Development Statistical Services Branch. Antigonish County Profile. 1977.

Patterson, Rev. George. A History of the County of Pictou, Nova Scotia. Dawson Brothers: Montreal, 1877.

Rand, Silas Tertius. Dictionary of the Language of the Micmac Indians, who reside in Nova Scotia, New Brunswick, Prince Edward Island, Cape Breton and Newfoundland. Halifax; Nova Scotia Printing Company, 1888

Rankin, Rev. D.J. A History of the County of Antigonish, Nova Scotia. The MacMillan Company of Canada Limited. 1929.

Stevens, Arlene. Mi'kmaq Place Names. Mi'kmaq Association for Cultural Studies.

Smith, Harian I. The Archeology of Merigomish Harbour, Nova Scotia. National Museum of Canada. Bulletin No. 47, Anthropological Series, No. 9.

Torey, H.B. Historic Pictou County.
New Glasgow; Pictou County Historical Society, 1968

Whitehead, Ruth Holmes. Nova Scotia: The Protohistoric Period 1500-1635. Nova Scotia Museum, 1993.

Wicken, William C. Encounters with tall sails and tall tales: Mi'kmaq Society, 1500-1760. Department of History, McGill University, Montreal. 1994.

10.0 RECORDS CONSULTED

Records Consulted

RG 1 Volume 430
RG 1 Volume 431
RG 1 Volume 432
Miscellaneous Indians Microfiche, Public Archives of Nova Scotia

Indian Affairs Annual Reports 1864-1920

MG 15 Volumes 3-6, and Volumes 17-19

DIAND HQ's Indian Affairs Files

3642-101	3643-101	8270	644
2610-62	X14890	X14921	X14922
X14919	X14894	X14903	X18910
1180-7	X14905	X15826	X14336
X14585	X14586	X14588	X14589
X14602	X14607	X14975	X14976
X14977	X14980	X14981	X14982
X14983	X14984	X14985	X14986
X15119	X20611	X20612	X20613

11.0 SOURCES CONSULTED

Archivia Net
Archway
Canadian Archival Information Network
Cape Breton University (Mi'kmaq Resource Centre)
DocuShare - Union of Nova Scotia Indians Collection
Nova Scotia Archives and Records Management

Figure 2: Map of Current Mi'kmaq Land and Resource Use Study Areas