APPENDIX C Baseline Environmental studies

C1- Visual Study

M.K. INCE AND ASSOCIATES LTD.
WIND ENERGY ENGINEERING

P.O. Box 650, 35 Main St N, Suite 32, Waterdown, Ontario, L0R 2H0 Tel (905) 689-3900 Fax (905) 689-8195

June 27, 2007.

Adarsh P. Mehta
ORTECH Power
2395 Speakman Drive
Mississauga, Ontario
L5K 1B3
tel. 905-822-4120 x479

Attention: **Adarsh P. Metha, *Wind Energy Coordinator, ORTECH POWER***

Reference: **Dalhousie Mountain Wind Farm, Photomontage**

Dear Ms. Mehta,

We are pleased to present you with an electronic copy of the Photomontage report for the Dalhousie Mountain Wind Farm, located west of New Glasgow in Nova Scotia. In addition, a panoramic photo consisting of Photo 6 and Photo 7 stitched together has been produced and included.

Photomontage

Three raw photos were provided to MKI by Reuben Burge on June 25 2007, and were processed using WindPRO 2.5.

The following information was used to reference turbine size, location, and appearance in the photos:

- 1:50,000 scale NTS mapping dated 1994
- 1:50,000 scale digital elevation model
- Turbine coordinates as provided by ORTECH
- Turbine dimensions corresponding to the GE 1.5sle or the AAER A-1500-77 -- hub height of 80 m, rotor diameter of 77 m

- Photo location coordinates
- Date and time of photos
- Approximate focal length of photo
- Control points corresponding to features cited on NTS map and visible in photos
- Visual matching of wire-frame digital terrain model to photo landscape
- Assessment of lighting conditions in photos

Conclusions

- The photos provided to MKI were of high quality.
- Turbine size, location, and appearance in all photos are realistic due to the accurate match of the digital terrain model to the real terrain shown in the photographs and the verification of the control points.
- The turbines are quite small in Photos 6 and 7 due to their distance from the photographer and the wide angle of the photographs.
- The panoramic photo consists of Photo 6 and Photo 7 stitched together. This process is rarely perfect and may contain slight irregularities in geometry of certain features. The Panoramic photo serves as a conceptual

We hope this material satisfies your requirement for a Photomontage Assessment of the Dalhousie Mountain Wind Farm. If you require any further analysis or interpretation please do not hesitate to contact us.

Sincerely,
M. K. Ince & Associates Ltd.

Juan Anderson, *B. Eng*

Encl.

Photomontage Report
Panoramic Photo

Project:
DMWF

Description:
Photos 6 and 7 are taken from the same location

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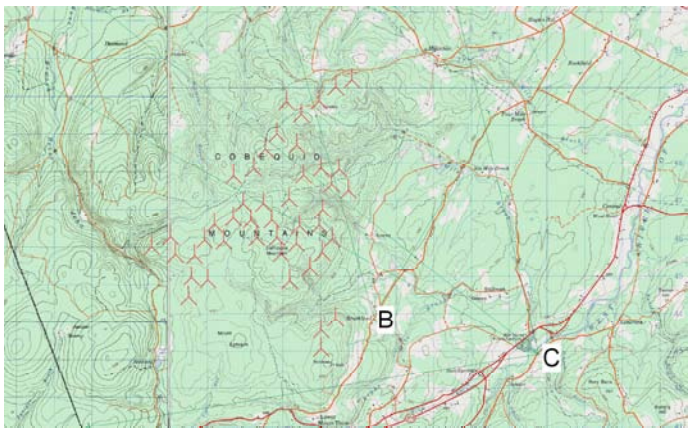
27/06/2007 11:18 AM/2.5.6.78

VISUAL - Main result

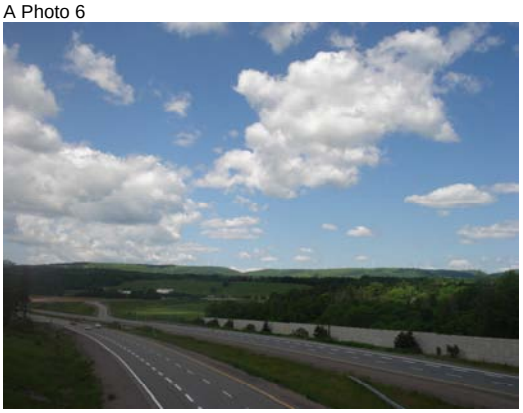
Calculation: Dalhousie Mountain Wind Farm



Scale 1:200,000

New WTG Camera

A Photo 6



UTM NAD83 Zone: 20	East	North	Z	Clouds	:Clear sky (0/8)	Landscape picture file: 2816 x 2112 pixels
Eye point	509,851	5,043,117	55.0	Visibility	:Clear	\\Desktop\working\Ortech\Dalhousie Mountain Wind Farm\dal veiw for mkince 006.JPG
Target point	509,180	5,043,290	145.1	Sun	:Normal	Lens: 39 mm Film: 35x26 mm
Photo dir.	285°			Wind dir.	:90°	

B Photo 9

UTM NAD83 Zone: 20	East	North	Z	Clouds	:Clear sky (0/8)	Landscape picture file: 2816 x 2112 pixels
Eye point	505,465	5,044,136	150.0	Visibility	:Clear	\\Desktop\working\Ortech\Dalhousie Mountain Wind Farm\dal veiw for mkince 009.JPG
Target point	505,545	5,044,728	208.4	Sun	:Normal	Lens: 40 mm Film: 35x26 mm
Photo dir.	8°			Wind dir.	:162°	

C Photo 7

UTM NAD83 Zone: 20	East	North	Z	Clouds	:Clear sky (0/8)	Landscape picture file: 2816 x 2112 pixels
Eye point	509,851	5,043,117	55.0	Visibility	:Clear	\\Desktop\working\Ortech\Dalhousie Mountain Wind Farm\dal veiw for mkince 007.JPG
Target point	509,455	5,043,636	131.5	Sun	:Normal	Lens: 39 mm Film: 35x26 mm
Photo dir.	323°			Wind dir.	:90°	

Project: **DMWF**

Description: Photos 6 and 7 are taken from the same location

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Calculated:
27/06/2007 11:18 AM/2.5.6.78

VISUAL - Main result

Calculation: Dalhousie Mountain Wind Farm

WTG siting

	WTG type							Distance to camera		
	Valid	Manufact.	Type	Power [kW]	Diam. [m]	Height [m]	A [m]	B [m]	C [m]
1 New	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	9,073	5,284	9,073
2 New	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	9,460	6,124	9,460
3 New	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	6,485	2,110	6,485
4 New	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	5,803	1,429	5,803
5 New	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	5,471	1,004	5,471
6 New	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	7,807	3,837	7,807
7 New	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	6,273	2,321	6,273
8 New	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	6,752	2,798	6,752
9 New	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	9,018	5,034	9,018
10 New	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	7,596	4,162	7,596
11 New	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	7,602	3,296	7,602
12 New	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	7,067	2,804	7,067
13 New	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	7,339	2,959	7,339
14 New	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	7,837	4,164	7,837
15 New	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	6,664	3,401	6,664
16 New	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	8,096	3,728	8,096
17 New	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	6,894	3,120	6,894
18 New	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	6,342	2,162	6,342
19 New	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	8,417	4,118	8,417
20 New	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	6,882	2,402	6,882
21 New	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	8,321	4,168	8,321
22 New	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	7,224	4,003	7,224
23 New	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	7,919	3,699	7,919
24 New	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	7,108	3,668	7,108
25 New	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	9,079	5,467	9,079
26 New	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	7,196	3,084	7,196
27 New	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	8,488	4,972	8,488
28 New	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	5,773	1,634	5,773
29 New	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	8,807	6,289	8,807
30 New	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	8,905	6,162	8,905
31 New	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	8,888	5,879	8,888
32 New	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	8,945	5,669	8,945
33 New	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	9,433	4,931	9,433
34 New	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	9,262	4,862	9,262
35 New	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	9,409	4,924	9,409
36 New	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	8,994	4,491	8,994
37 New	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	9,367	4,910	9,367
38 New	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	8,792	4,553	8,792
39 New	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	10,655	6,159	10,655
40 New	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	10,251	5,775	10,251
41 New	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	9,992	5,496	9,992
42 New	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	9,495	5,005	9,495
43 New	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	9,372	5,247	9,372
44 New	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	8,876	4,436	8,876
45 New	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	8,870	4,532	8,870

Project:
DMWF

WTGs: 45

Recommended observation distance: 23 cm
Photo exposed: 25/06/2007 12:00:00 PM
Lens: 39 mm Film: 35x26 mm Pixels: 2816x2112
Eye point: UTM NAD 83 Zone: 20 East: 509,851 North: 5,043,117
Wind direction: 90° Direction of photo: 285°
Camera: Photo 6
Photo: \\Desktop\working\Ortech\Dalhousie Mountain Wind Farm\dal veiw for mkince 006.JPG

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Project:
DMWF

		Valid	Manufact.	Type	Power [kW]	Diam. [m]	Height [m]	Distance [m]
15	New	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	3,401
22	New	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	4,003
29	New	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	6,289
30	New	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	6,162
31	New	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	5,879

Recommended observation distance: 24 cm
Photo exposed: 25/06/2007 12:30:00 PM
Lens: 40 mm Film: 35x26 mm Pixels: 2816x2112
Eye point: UTM NAD 83 Zone: 20 East: 505,465 North: 5,044,136
Wind direction: 162° Direction of photo: 8°
Camera: Photo 9
Photo: \\Desktop\working\Ortech\Dalhousie Mountain Wind Farm\dal veiw for mkince 009.JPG

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Project:
DMWF

WTGs: 45

Recommended observation distance: 23 cm
Photo exposed: 25/06/2007 12:00:00 PM
Lens: 39 mm Film: 35x26 mm Pixels: 2816x2112
Eye point: UTM NAD 83 Zone: 20 East: 509,851 North: 5,043,117
Wind direction: 90° Direction of photo: 323°
Camera: Photo 7
Photo: \\Desktop\working\Ortech\Dalhousie Mountain Wind Farm\dal veiw for mkince 007.JPG

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Project:
DMWF

Description:
Photos 6 and 7 are taken from the same location

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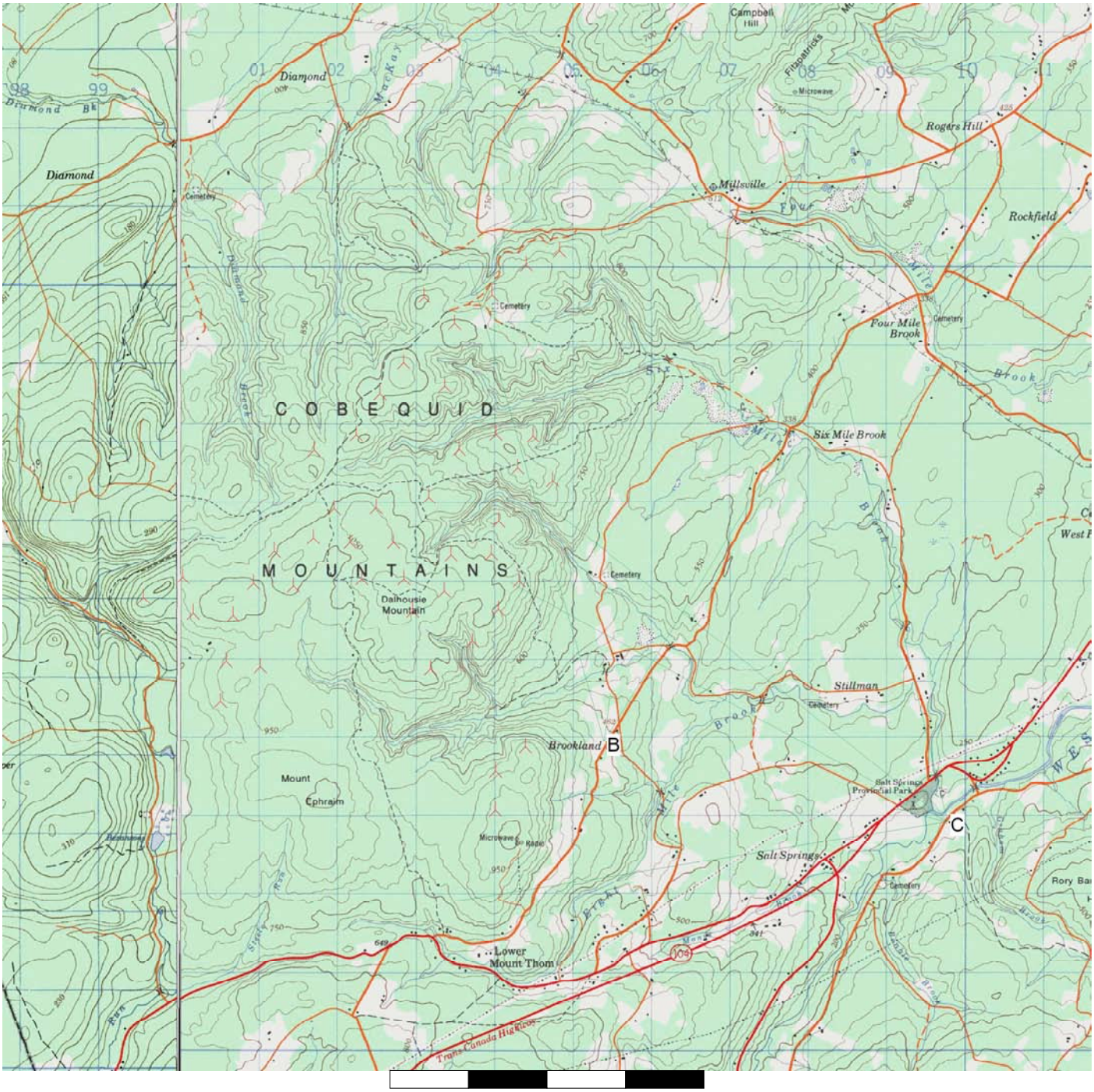
Calculated:
27/06/2007 11:18 AM/2.5.6.78

VISUAL - NTS Stitched

Calculation: Dalhousie Mountain Wind Farm **File:** NTS Stitched.bmi



Map: NTS Stitched , Print scale 1:75,000, Map center UTM NAD 83 Zone: 20 East: 504,719 North: 5,046,758

New WTG Camera

M.K. INCE AND ASSOCIATES LTD.
WIND ENERGY ENGINEERING

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June 15, 2007.

Adarsh P. Mehta
ORTECH Power
2395 Speakman Drive
Mississauga, Ontario
L5K 1B3
tel. 905-822-4120 x479

Attention: **Adarsh P. Metha, *Wind Energy Coordinator, ORTECH POWER***

Reference: **Dalhousie Mountain Wind Farm, Zone of Visual Influence**

Dear Ms. Mehta,

We are pleased to present you with electronic copies of the Zone of Visual Influence reports for the Dalhousie Mountain Wind Farm, located west of New Glasgow in Nova Scotia. Photomontage images will be produced once we receive the raw images for processing.

Zone of Visual Influence

Two scenarios were developed and modeled for the Zone of Visual Influence evaluation using WindPRO 2.5.

Scenario 1: Any portion of a turbine is visible

Scenario 2: Hub level of a turbine must be visible

Scenario 2 serves as an indication of from where turbine aeronautical warning lighting will be visible.

The following assumptions were applied to both scenarios:

- Forest coverage modeled according to 1:50,000 scale NTS mapping dated 1994,
- Recent forest clear cutting not represented on NTS maps is not accounted for

- 10 m tree height
- canopy is considered to be opaque at all times
- 1:50,000 scale digital elevation model
- Observer eye height of 1.5 m
- Calculation grid resolution of 25 m
- 45 turbine layout
- Turbine dimensions corresponding to the GE 1.5sle or the AAER A-1500-77 -- hub height of 80 m, rotor diameter of 77 m
- Modeled area extends roughly 10 km from edges of the wind farm and is approximately 25 km x 27 km

Conclusions

Scenario 1
4.9% of the modeled area surrounding the Dalhousie Mountain Wind Farm will have a line of sight to at least a portion of at least 1 wind turbine from the project. This is considered a small percentage compared to projects in non-forested areas.

Locations in or adjacent to deforested areas not represented on the NTS mapping used for the assessment may also have a line of sight to at least a portion of at least 1 wind turbine from the project even though the ZVI map does not indicate so.

Locations in or adjacent to forested areas with a non-uniform canopy may also have a line of sight to at least a portion of at least 1 wind turbine from the project even though the ZVI map does not indicate so.

Scenario 2
4.2% of the modeled area surrounding the Dalhousie Mountain Wind Farm will have a line of sight to the hub level of at least 1 wind turbine from the project. This is considered a small percentage compared to projects in non-forested areas.

Locations in or adjacent to deforested areas not represented on the NTS mapping used for the assessment may also have a line of sight to the hub level of at least 1 wind turbine from the project even though the ZVI map does not indicate so.

Locations in or adjacent to forested areas with a non-uniform canopy may also have a line of sight to the hub level of at least 1 wind turbine from the project even though the ZVI map does not indicate so.

We hope this information satisfies your requirement for a Zone of Visual Influence Assessment of the Dalhousie Mountain Wind Farm. If you require any further analysis or interpretation please do not hesitate to contact us.

Sincerely,
M. K. Ince & Associates Ltd.

Juan Anderson, *B. Eng*

Encl.

ZVI Report – Scenario 1
ZVI Report – Scenario 2

Project:
DMWF

Description:
calculation boundary extends 10 km from nearest turbine
eye height of 1.5 m
25 m resolution
25 km x 27 km area
10 m forest height
45 Turbines Included
results valid for GE 1.5sle or AAER A-1500-77
Any portion of turbine visible

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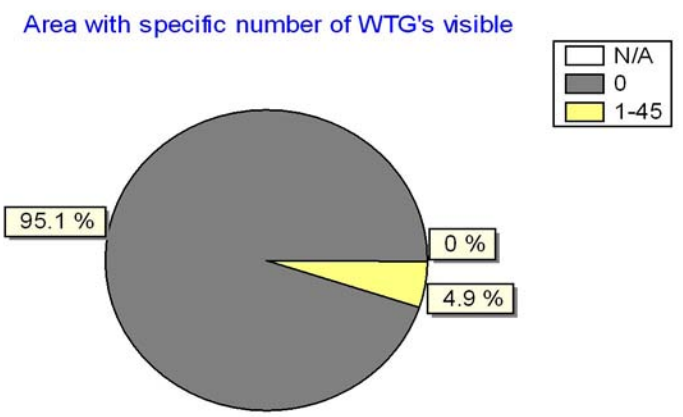
13/06/2007 11:00 AM/2.5.6.78

ZVI - ZVI summary

Calculation: Scenario 1 - Any portion of turbine visible



Scale 1:170,000

New WTG

Assumptions for ZVI calculation

Center for calculation	UTM NAD 83 Zone: 20 East: 502,221 North: 5,046,821
Width of calculation area	25,254 m
Height of calculation area	27,280 m
Calculation step	25 m
Eye height	1.5 m
Calculation area	69,001 ha
Highest relevant visible part of a WTG	Hub height + ½ rotor diameter
Obstacles used in calculation	0
Height contour object used in calculation	Height Contours: DMWF.WPO (1)
Area object(s) used in calculation	Area object (ZVI): ZVI_REGIONS_DMWF_0.w2r (1)
New WTG's used in calculation	45
Existing WTG's used in calculation	0

ZVI Results

WTG's visible	Area [ha]	Area [%]
N/A	2	0.0
0	65,619	95.1
1	287	0.4
2	207	0.3
3	231	0.3
4	139	0.2
5	146	0.2
6	130	0.2
7	118	0.2
8	112	0.2
9	107	0.2
10	97	0.1
11	80	0.1
12	80	0.1
13	76	0.1
14	74	0.1
15	78	0.1
16	69	0.1
17	71	0.1
18	67	0.1
19	64	0.1
20	57	0.1
21	54	0.1
22	65	0.1
23-45	973	1.4

WTGs

	Valid	Manufact.	Type	Power [kW]	Diam. [m]	Height [m]	East	North	Z [m]
1	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	502,608	5,048,581	302.1
2	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	503,170	5,049,814	305.0
3	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	503,787	5,045,415	289.5
4	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	504,085	5,043,766	271.7
5	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	504,463	5,044,070	275.0
6	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	503,231	5,047,255	290.0
7	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	504,382	5,046,189	290.1
8	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	504,029	5,046,537	302.0
9	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	502,303	5,048,053	300.0
10	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	504,085	5,048,062	297.2
11	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	502,910	5,046,219	332.0
12	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	503,426	5,046,061	328.3
13	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	503,022	5,045,805	330.5
14	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	503,618	5,047,868	268.6
15	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	504,808	5,047,473	275.6
16	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	502,373	5,046,219	325.3
17	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	504,123	5,046,953	291.9
18	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	504,117	5,045,826	294.8
19	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	502,223	5,046,676	310.0
20	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	503,252	5,045,071	300.3
21	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	502,558	5,047,124	314.1
22	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	504,560	5,048,036	273.4
23	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	502,778	5,046,677	317.6
24	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	504,363	5,047,634	300.0

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Project:
DMWF

Description:
calculation boundary extends 10 km from nearest turbine
eye height of 1.5 m
25 m resolution
25 km x 27 km area
10 m forest height
45 Turbines Included
results valid for GE 1.5sle or AAER A-1500-77
Any portion of turbine visible

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Calculated:
13/06/2007 11:00 AM/2.5.6.78

ZVI - ZVI summary

Calculation: Scenario 1 - Any portion of turbine visible

...continued from previous page

	Valid	Manufact.	Type	Power [kW]	Diam. [m]	Height [m]	East	North	Z [m]
25	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	502,910	5,048,969	325.0
26	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	503,512	5,046,522	317.9
27	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	503,435	5,048,674	299.5
28	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	504,080	5,043,268	296.5
29	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	504,898	5,050,400	275.0
30	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	504,477	5,050,218	286.1
31	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	504,034	5,049,838	300.0
32	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	503,559	5,049,475	315.0
33	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	500,642	5,045,162	278.9
34	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	501,255	5,046,568	309.1
35	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	500,568	5,044,651	272.6
36	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	501,077	5,045,095	281.6
37	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	500,992	5,046,160	311.0
38	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	502,020	5,047,113	306.9
39	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	499,587	5,045,976	294.3
40	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	500,087	5,046,240	300.0
41	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	500,220	5,045,780	302.1
42	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	500,729	5,045,752	306.4
43	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	501,767	5,047,857	284.5
44	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	501,501	5,046,126	310.2
45	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	501,754	5,046,738	313.5

Project:
DMWF

Description:
calculation boundary extends 10 km from nearest turbine
eye height of 1.5 m
25 m resolution
25 km x 27 km area
10 m forest height
45 Turbines Included
results valid for GE 1.5sle or AAER A-1500-77
Any portion of turbine visible

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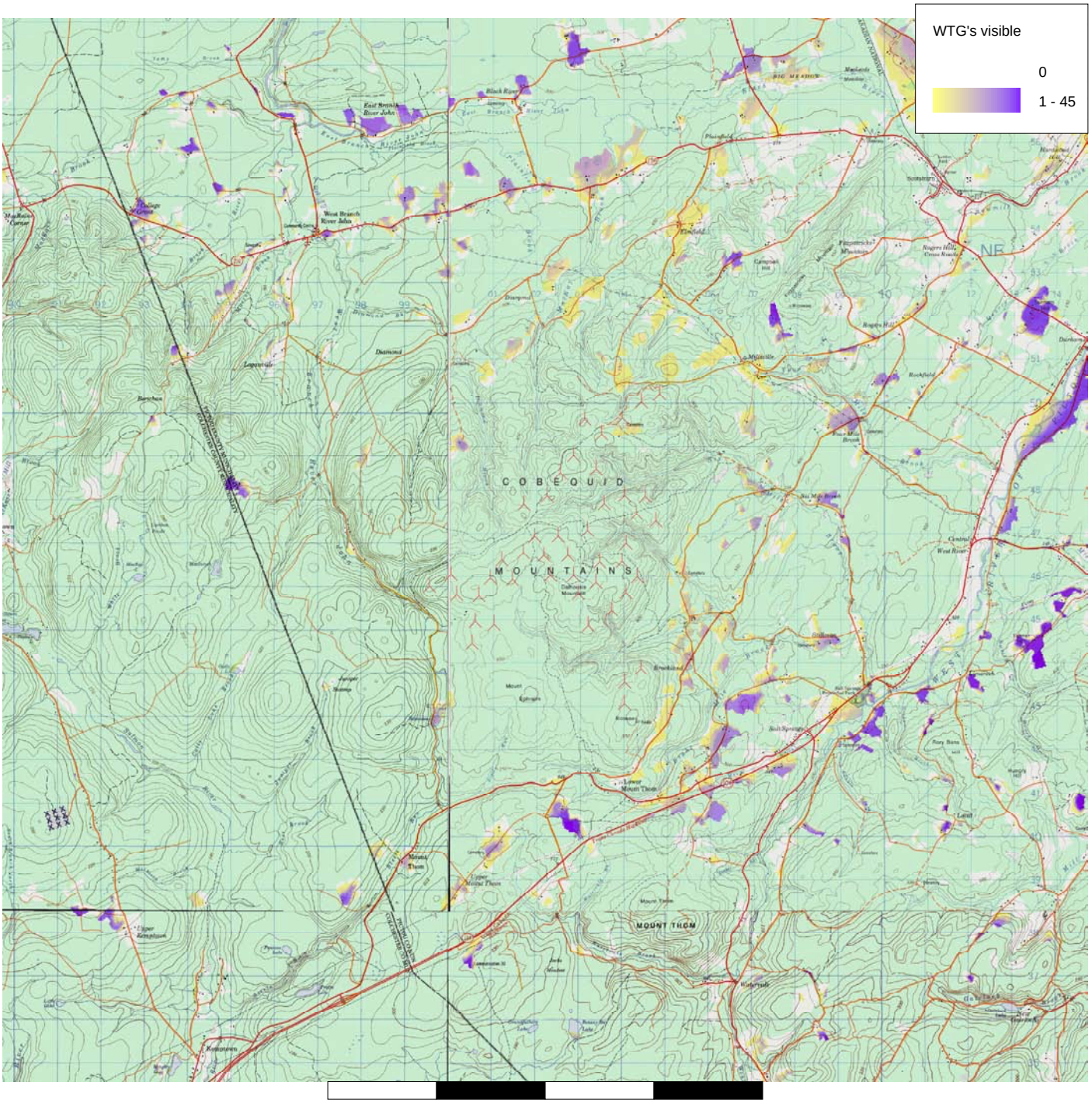
Calculated:
13/06/2007 11:00 AM/2.5.6.78

ZVI - NTS Stitched

Calculation: Scenario 1 - Any portion of turbine visible **File:** NTS Stitched.bmi



Map: NTS Stitched , Print scale 1:135,000, Map center UTM NAD 83 Zone: 20 East: 502,221 North: 5,046,821

New WTG

Project:
DMWF

Description:
calculation boundary extends 10 km from nearest turbine
eye height of 1.5 m
25 m resolution
25 km x 27 km area
10 m forest height
45 Turbines Included
results valid for GE 1.5sle or AAER A-1500-77
Hub level of turbine must be visible

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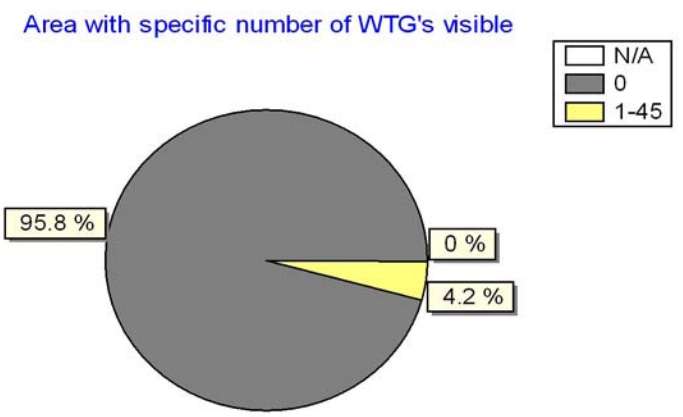
ZVI - ZVI summary

Calculation: Scenario 2 - Hub level must be visible



Scale 1:170,000

New WTG

Assumptions for ZVI calculation

Center for calculation	UTM NAD 83 Zone: 20 East: 502,221 North: 5,046,821
Width of calculation area	25,254 m
Height of calculation area	27,280 m
Calculation step	25 m
Eye height	1.5 m
Calculation area	69,001 ha
Highest relevant visible part of a WTG	Hub height
Obstacles used in calculation	0
Height contour object used in calculation	Height Contours: DMWF.WPO (1)
Area object(s) used in calculation	Area object (ZVI): ZVI_REGIONS_DMWF_0.w2r (1)
New WTG's used in calculation	45
Existing WTG's used in calculation	0

ZVI Results

WTG's visible	Area [ha]	Area [%]
N/A	2	0.0
0	66,115	95.8
1	294	0.4
2	219	0.3
3	245	0.4
4	148	0.2
5	155	0.2
6	149	0.2
7	153	0.2
8	129	0.2
9	115	0.2
10	96	0.1
11	67	0.1
12	66	0.1
13	64	0.1
14	70	0.1
15	55	0.1
16	51	0.1
17	54	0.1
18	50	0.1
19	51	0.1
20	35	0.1
21	33	0.0
22	30	0.0
23-45	557	0.8

WTGs

	Valid	Manufact.	Type	Power [kW]	Diam. [m]	Height [m]	East	North	Z [m]
1	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	502,608	5,048,581	302.1
2	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	503,170	5,049,814	305.0
3	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	503,787	5,045,415	289.5
4	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	504,085	5,043,766	271.7
5	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	504,463	5,044,070	275.0
6	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	503,231	5,047,255	290.0
7	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	504,382	5,046,189	290.1
8	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	504,029	5,046,537	302.0
9	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	502,303	5,048,053	300.0
10	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	504,085	5,048,062	297.2
11	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	502,910	5,046,219	332.0
12	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	503,426	5,046,061	328.3
13	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	503,022	5,045,805	330.5
14	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	503,618	5,047,868	268.6
15	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	504,808	5,047,473	275.6
16	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	502,373	5,046,219	325.3
17	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	504,123	5,046,953	291.9
18	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	504,117	5,045,826	294.8
19	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	502,223	5,046,676	310.0
20	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	503,252	5,045,071	300.3
21	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	502,558	5,047,124	314.1
22	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	504,560	5,048,036	273.4
23	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	502,778	5,046,677	317.6
24	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	504,363	5,047,634	300.0

Continued on next page...

Project:
DMWF

Description:
calculation boundary extends 10 km from nearest turbine
eye height of 1.5 m
25 m resolution
25 km x 27 km area
10 m forest height
45 Turbines Included
results valid for GE 1.5sle or AAER A-1500-77
Hub level of turbine must be visible

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ZVI - ZVI summary

Calculation: Scenario 2 - Hub level must be visible

...continued from previous page

	Valid	Manufact.	Type	Power [kW]	Diam. [m]	Height [m]	East	North	Z [m]
25	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	502,910	5,048,969	325.0
26	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	503,512	5,046,522	317.9
27	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	503,435	5,048,674	299.5
28	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	504,080	5,043,268	296.5
29	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	504,898	5,050,400	275.0
30	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	504,477	5,050,218	286.1
31	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	504,034	5,049,838	300.0
32	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	503,559	5,049,475	315.0
33	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	500,642	5,045,162	278.9
34	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	501,255	5,046,568	309.1
35	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	500,568	5,044,651	272.6
36	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	501,077	5,045,095	281.6
37	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	500,992	5,046,160	311.0
38	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	502,020	5,047,113	306.9
39	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	499,587	5,045,976	294.3
40	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	500,087	5,046,240	300.0
41	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	500,220	5,045,780	302.1
42	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	500,729	5,045,752	306.4
43	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	501,767	5,047,857	284.5
44	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	501,501	5,046,126	310.2
45	Yes	GE WIND ENERGY	GE 1.5sle	1,500	77.0	80.0	501,754	5,046,738	313.5

Project:
DMWF

Description:
calculation boundary extends 10 km from nearest turbine
eye height of 1.5 m
25 m resolution
25 km x 27 km area
10 m forest height
45 Turbines Included
results valid for GE 1.5sle or AAER A-1500-77
Hub level of turbine must be visible

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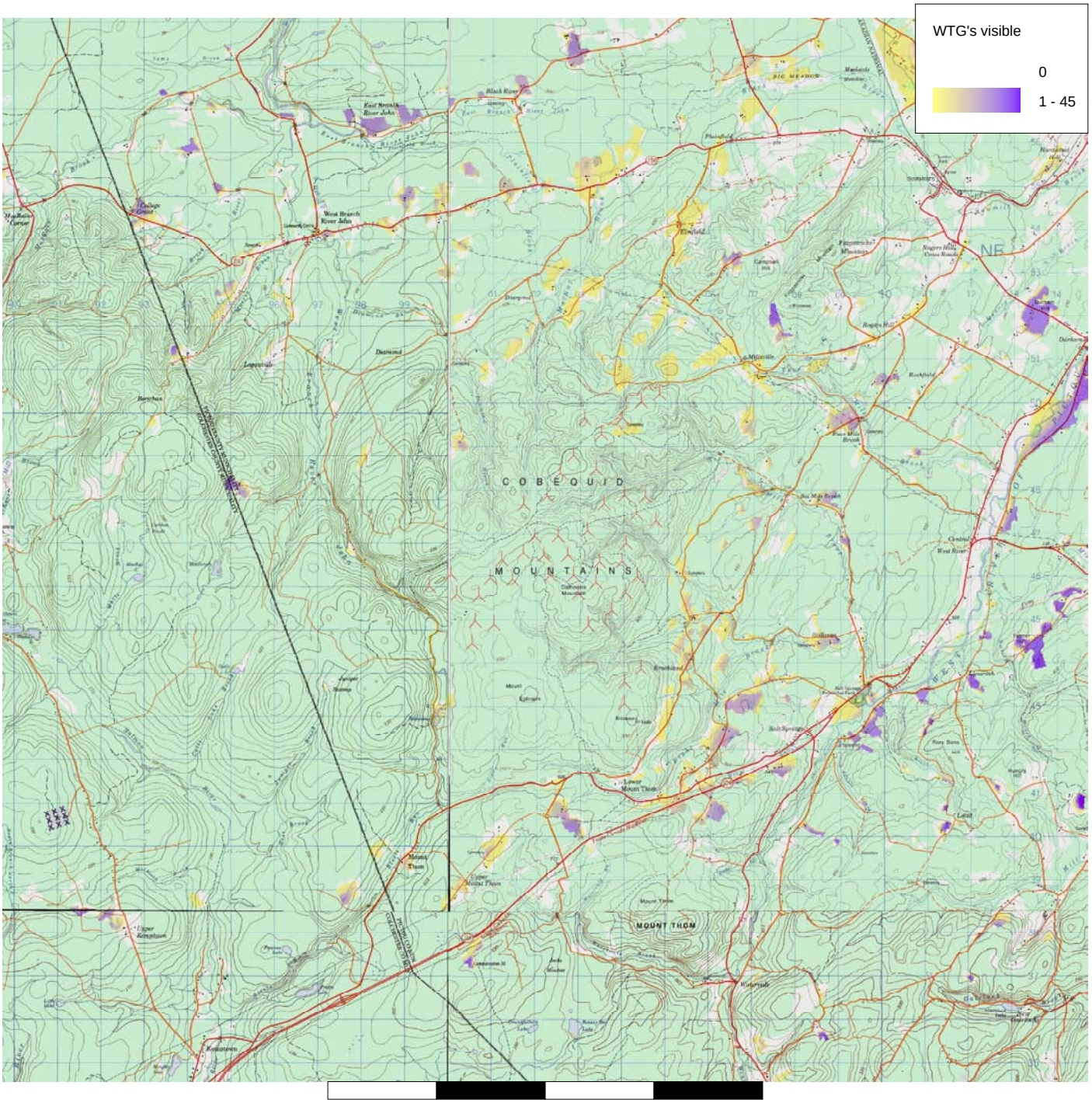
13/06/2007 4:30 PM/2.5.6.78

ZVI - NTS Stitched

Calculation: Scenario 2 - Hub level must be visible **File:** NTS Stitched.bmi



0 2.5 5 7.5 10km

Map: NTS Stitched , Print scale 1:135,000, Map center UTM NAD 83 Zone: 20 East: 502,221 North: 5,046,821

New WTG

C2- Noise Study

D E W I GmbH

Preliminary investigation of the expected noise emissions -Dalhousie (Canada)-

DEWI-W SO 07-035

Service	**Acoustic Prognosis**
Site	**Wind Farm Dalhousie (Canada)**
Project	DEWI-W SO 07-035
Report	DEWI-W SO 07-035
Status	Preliminary investigation
Client	ORTECH Power 2395 Speakman Drive Mississauga – Ontario Canada L5K 1B3
Contact	Mrs. Adarsh Mehta
Contractor	DEWI GmbH, Deutsches Windenergie – Institut Ebertstraße 96 D- 26382 Wilhelmshaven

Circulation:

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PDF Version

Wilhelmshaven, 2007-07-24

Responsible person in charge

Peter Spengemann
Geography MA.
(Group Manager Micrositing Germany)

Contents

1. Overview and used input data

1.1. Introduction

An investigation of the expected noise emissions of a planned wind farm at the site Dalhousie (Canada) has been performed by DEWI.

The planned wind farm configuration consists of 41 wind turbines. Acoustical prognosis calculations have been carried out for one wind farm configuration consisting the WT-type GE 1.5sl with a planned hub height of 80m.

It is the purpose of this investigation to calculate the expected noise emissions of the planned wind farm site for several nearby housings and to get an impression whether any critical noise problematic is to expect for this site. This report does not replace the necessary detailed investigation of the existing noise restrictions and a official acoustical prognosis. This should be performed in a later phase of this project.

1.2. Location of the site and geographical input data

The designated wind farm area is located in central northern part of the Nova Scotia Peninsula in East Canada (see Figure 1). For the planned wind farm site no topographical maps were available to DEWI for further investigations

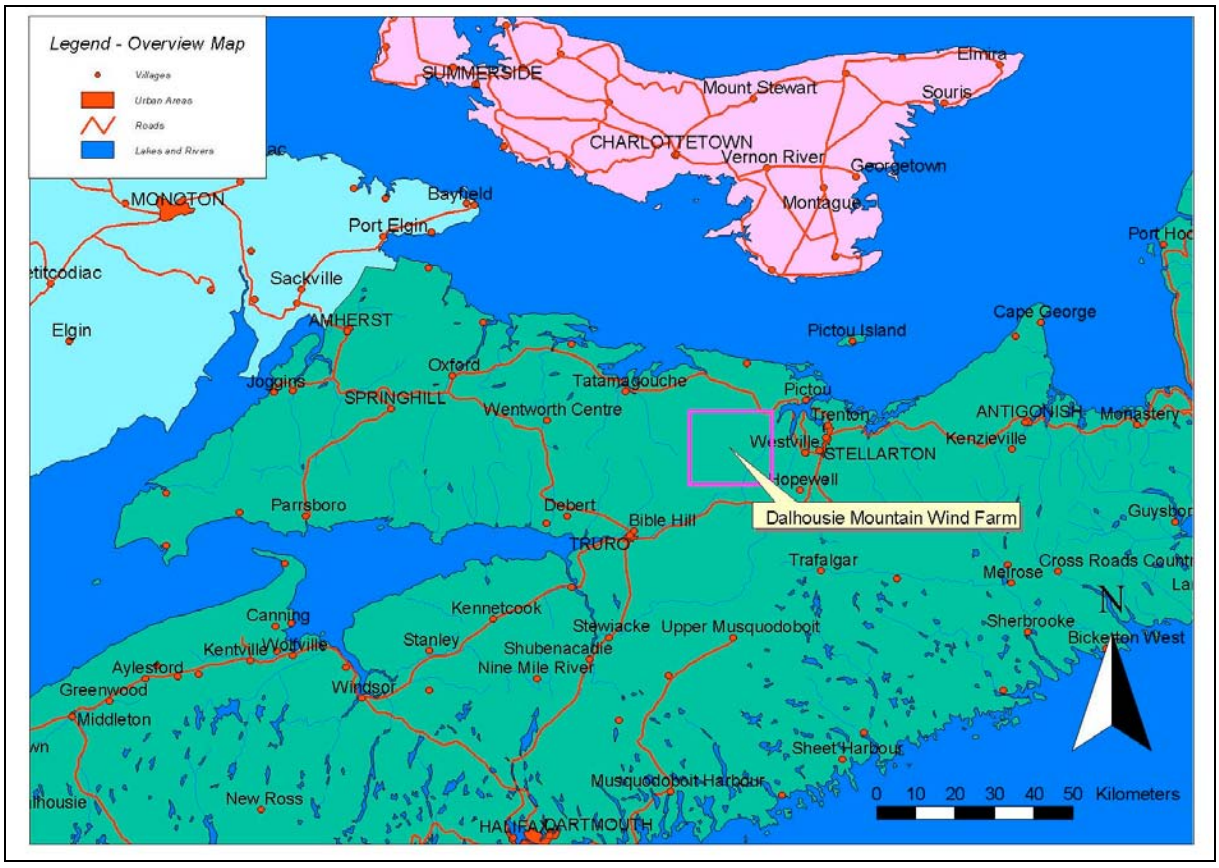

Figure 1: General Overview Map showing the designated wind farm site

The client has submitted the following information concerning the planned wind turbines (Table 1) and the nearby dwellings and houses (NSA) which should be considered in this investigation (Table 2).

Turbine ID	Z – level (in m)	Coordinates (in UTM NAD 83, Zone 20)	
		X-Value (m)	Y-Value(m)
P1-1	302	502'608	5'048'581
P1-3	295	503'851	5'045'436
P1-4	272	504'085	5'043'766
P1-5	272	504'463	5'044'070
P1-6	290	503'231	5'047'255
P1-7	290	504'382	5'046'189
P1-8	310	504'001	5'046'328
P1-9	300	502'303	5'048'053
P1-10	300	504'310	5'048'071
P1-11	334	502'929	5'046'168
P1-12	327	503'482	5'046'163
P1-13	320	503'092	5'045'671
P1-14	290	503'847	5'048'010
P1-15	285	504'703	5'047'403
P1-16	320	502'322	5'046'182
P1-17	290	504'123	5'046'953
P1-18	294	504'117	5'045'826
P1-19	310	502'223	5'046'676
P1-20	300	503'280	5'045'071
P1-21	325	502'498	5'047'058
P1-22	290	503'934	5'047'698
P1-23	317	502'778	5'046'677
P1-24	300	504'419	5'047'689
P1-25	320	502'910	5'048'969
P1-26	314	503'503	5'046'569
P1-27	300	503'435	5'048'674
P1-28	300	504'079	5'042'970
P1-33	278	500'642	5'045'162
P1-34	309	501'255	5'046'568
P1-35	271	500'568	5'044'651
P1-36	283	501'077	5'045'095
P1-37	310	500'992	5'046'160
P1-38	305	502'020	5'047'113
P1-39	290	499'587	5'045'976
P1-40	300	500'087	5'046'240
P1-41	300	500'220	5'045'780
P1-42	307	500'729	5'045'752
P1-43	287	501'767	5'047'857
P1-44	310	501'501	5'046'126
P1-45	310	501'754	5'046'738
P1-46	289	504'332	5'043'470

Table 1: Coordinates of the planned WT

NSA ID	Z – level (in m)	Coordinates (in UTM NAD 83, Zone 20)	
		X-Value (m)	Y-Value(m)
1	196	503'000	5'041'600
2	191	503'500	5'041'700
3	240	503'300	5'042'300
4	185	503'700	5'041'600
5	209	504'100	5'041'700
6	217	504'300	5'041'900
7	214	504'400	5'042'000
8	202	504'800	5'042'400
9	189	505'100	5'043'200
10	167	505'400	5'043'700
11	169	505'300	5'043'800
12	157	505'400	5'043'900
13	150	505'500	5'044'200
14	140	505'600	5'044'400
15	120	505'400	5'045'000
16	120	505'400	5'045'100
17	114	505'600	5'045'300

Table 2: Coordinates of the considered nearby dwellings and houses (NSA)

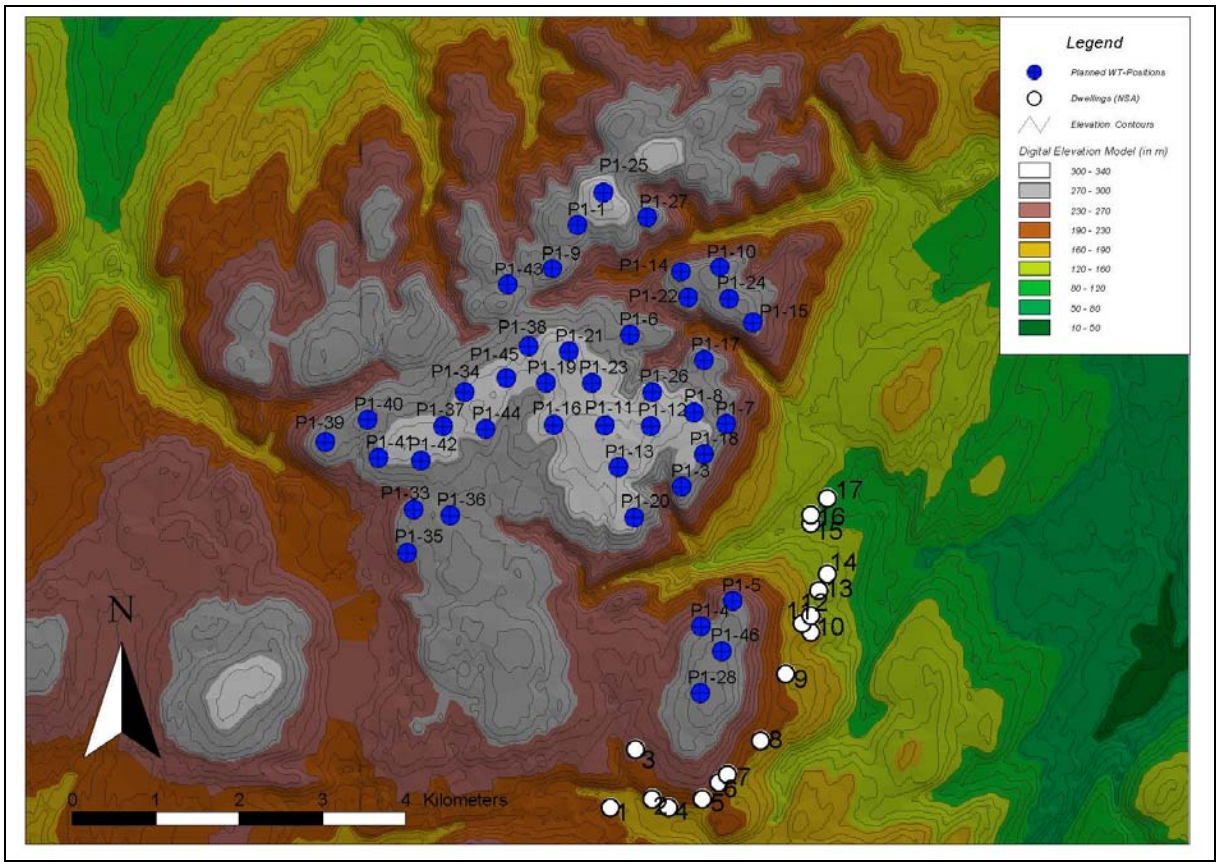

Figure 2: Wind farm configuration and locations of the considered nearby dwellings (NSA)

Note: The coordinates of the considered noise sensitive areas (NSA) were provided from the client and could not be checked from DEWI in its accuracy and correctness. Based on the format of the coordinates it is to suggest that they just have the status of an assumption and are not representing the real and relevant coordinates of the existing NSA. The z-level values were interpolated out of the digital elevation model provided from the client.

DEWI has not performed an onsite inspection or either has sufficient information to validate the accuracy and the quality of the used geographical input data for this investigation. All described and displayed input data and all results of this investigation should therefore be handled as preliminary or draft and should not be used as an official document for the application of the required building and operation permissions by the local authorities.

2. Results

The Calculation was performed with the software WindPRO 2.5. In this context DEWI uses the calculation model according ISO 9613-2 [1] which is the international standard for these kind of acoustical coverage calculations. The calculation results for each regarded noise sensitive area are shown in. The detailed calculation results for each NSA can be found in chapter 4.2. No safety margins and no uncertainty analysis have been investigated within this assessment.

For the used sound power level of 104.0 dB(A) [1] for the planned WT-Type no additional penalties due to tonality have been considered. The maximum allowed noise pressure level for the regarded NSA were assumpted to be 45 dB(A) during defined night time. There is no further information available to DEWI whether other noise restrictions or limitations are existing in the surrounding of the planned wind farm site.

ID	X-Value	Y-Value	Z-Level [m]	NSA height [m]	Noise Demand [dB(A)]	Calculation Result [dB(A)]	Difference Result/Demand [dB(A)]
1	503'000	5'041'600	198	5	45	32.9	12.1
2	503'500	5'041'700	191	5	45	34.4	10.6
3	503'300	5'042'300	240	5	45	37.4	7.6
4	503'700	5'041'600	186	5	45	34.2	10.8
5	504'100	5'041'700	209	5	45	35.1	9.9
6	504'300	5'041'900	217	5	45	36.4	8.6
7	504'400	5'042'000	214	5	45	37	8.0
8	504'800	5'042'400	202	5	45	38.5	6.5
9	505'100	5'043'200	190	5	45	40.7	4.3
10	505'400	5'043'700	167	5	45	39.3	5.7
11	505'300	5'043'800	169	5	45	40.2	4.8
12	505'400	5'043'900	158	5	45	39.5	5.5
13	505'500	5'044'200	150	5	45	38.8	6.2
14	505'600	5'044'400	140	5	45	38.2	6.8
15	505'400	5'045'000	118	5	45	39.2	5.8
16	505'400	5'045'100	116	5	45	39.3	5.7
17	505'600	5'045'300	114	5	45	38.6	6.4

Table 3:Calculation results for each regarded NSA

The following map shows the results of the performed noise calculation.

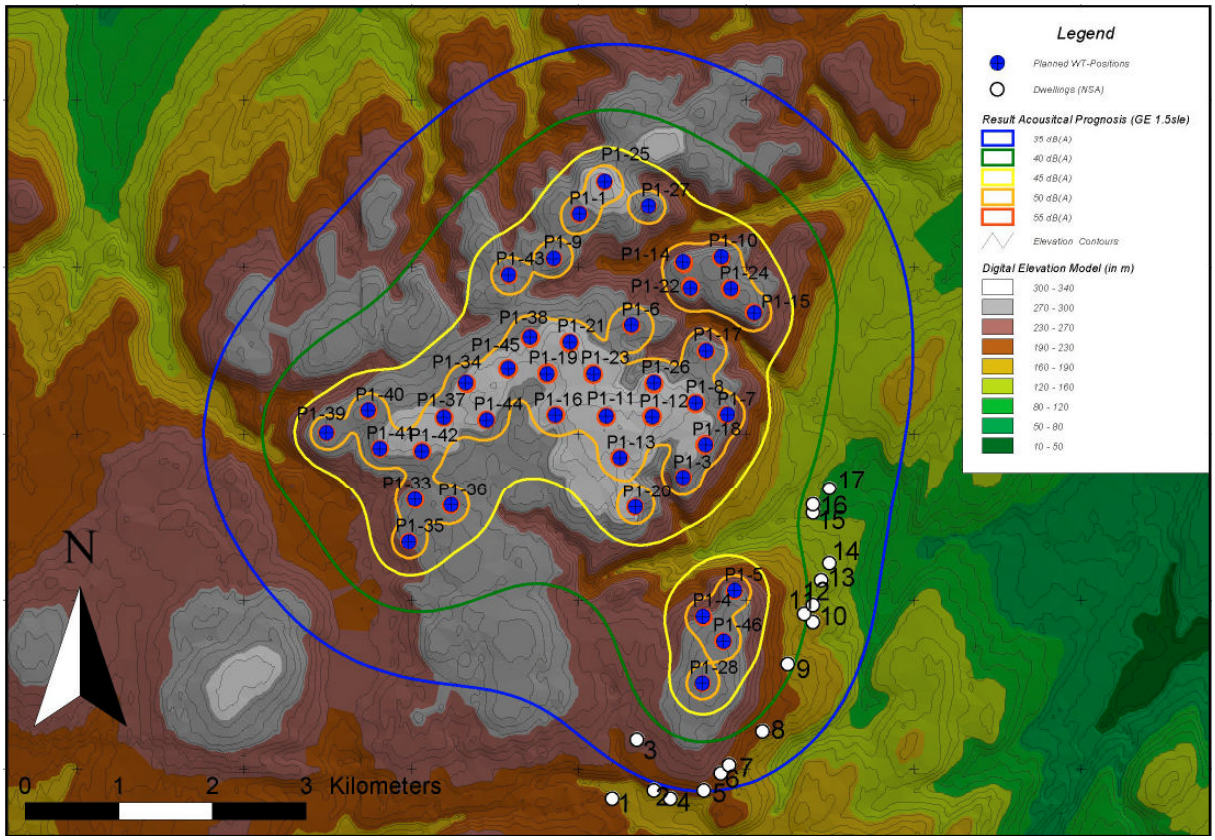

Figure 3: Result of the acoustical coverage calculation

For all regarded noise sensitive areas no exceedance of the assumpted maximum permissible value of 45 dB(A) was calculated. The highest noise pressure levels with 40.7 dB(A) was calculated for the noise sensitive area NSA 09. For all other regarded noise sensitive areas (NSA) significant lower noise pressure levels were calculated. In this context especially the south-east extension of the planed wind farm consisting of the WT P1-4, P1-5. P1-28 and P1-46 is producing the main part of the calculated noise immissions for the regarded NSA south-east of the planned wind farm site. Due to the calculation results and the combined uncertainties in the calculation model an the input data **DEWI could not eliminate the possibility that noise pressure levels of higher than 45 dB(A) are occur at the regarded NSA. This issue should be clarified in a detailed investigation of the noise emissions at a later phase of the project.**

3. Constraints and recommendations

All calculation results are based on the input data provided by the client. In this context the following points have to be listed as constraints:

- The coordinates of the regarded NSA are approximated. Large deviations between the real coordinates of the relevant NSA are to expect.
- DEWI did not perform the necessary onsite inspection of the planned wind farm site. Also the required maps and plans showing the locations of the nearby existing dwellings or other surrounding properties were not available for this examination. Therefore the most important input parameters could not be validated by DEWI for this investigation.
- The used sound power value for the planned WT is the guaranteed sound power level of 104dB(A) from the manufacturer. It must be ensured that the sound characteristics of the planned WT do not include a tonality.
- No insulation or absorbability factors were considered in the calculation.
- The digital elevation model (DEM) was provided by the client. DEWI has no information about the source, the actuality and the accuracy of the used elevation data which could lead to considerable higher uncertainties in the calculation results.

In this context the performed analysis should be treated as preliminary. DEWI strongly recommends a detailed investigation of the planned wind farm project in a later realisation phase of this project. Due to the results of the performed calculation so far and due to the high uncertainties DEWI could not eliminate the possibility that for some regarded dwellings existing noise restrictions are exceeded. For this purpose DEWI generally recommends a technical measurement of the Acoustic Noise Emission of the planned WT-type or control noise immission measurements at a representative NSA.

4. Appendix

4.1. Distance-Matrix

WTG	NSA01	NSA02	NSA03	NSA04	NSA05	NSA06	NSA07	NSA08	NSA09	NSA10	NSA11	NSA12	NSA13	NSA14	NSA15	NSA16	NSA17
P1-1	6992	6938	6319	7066	7041	6892	6820	6558	5930	5623	5487	5450	5249	5141	4541	4462	4440
P1-3	3929	3752	3184	3839	3744	3564	3479	3180	2561	2326	2185	2181	2060	2032	1609	1585	1754
P1-4	2423	2148	1663	2200	2066	1879	1794	1542	1163	1317	1216	1322	1480	1643	1803	1873	2156
P1-5	2871	2558	2118	2585	2398	2176	2071	1704	1078	1007	879	952	1045	1184	1320	1392	1675
P1-6	5660	5562	4956	5675	5623	5461	5384	5102	4465	4165	4027	3995	3806	3710	3129	3058	3072
P1-7	4792	4574	4036	4639	4497	4289	4189	3812	3074	2689	2559	2505	2281	2164	1565	1490	1508
P1-8	4833	4655	4089	4738	4629	4438	4346	4008	3315	2977	2842	2802	2603	2505	1929	1861	1901
P1-9	6490	6465	5839	6602	6602	6469	6406	6180	5601	5342	5203	5180	5006	4921	4349	4279	4295
P1-10	6602	6422	5859	6500	6375	6171	6072	5692	4935	4505	4384	4311	4050	3891	3259	3165	3057
P1-11	4569	4505	3886	4633	4619	4483	4420	4207	3678	3493	3351	3354	3238	3203	2733	2692	2809
P1-12	4589	4463	3868	4568	4506	4341	4263	3987	3376	3122	2982	2967	2815	2756	2243	2193	2287
P1-13	4072	3991	3377	4116	4096	3959	3897	3690	3184	3035	2894	2909	2821	2811	2403	2377	2535
P1-14	6465	6319	5736	6411	6315	6126	6035	5690	4970	4581	4453	4393	4153	4013	3387	3298	3227
P1-15	6047	5828	5292	5889	5734	5517	5411	5004	4221	3768	3652	3571	3300	3134	2502	2406	2286
P1-16	4632	4634	4003	4785	4822	4717	4670	4522	4076	3954	3814	3832	3746	3731	3297	3263	3395
P1-17	5470	5290	4725	5370	5253	5056	4961	4603	3878	3495	3366	3309	3078	2949	2333	2250	2217
P1-18	4372	4172	3620	4247	4126	3931	3837	3494	2804	2483	2346	2314	2135	2058	1526	1474	1573
P1-19	5135	5138	4507	5287	5318	5208	5158	4993	4512	4353	4212	4219	4107	4072	3592	3546	3646
P1-20	3482	3378	2771	3497	3470	3331	3269	3073	2610	2525	2387	2422	2385	2415	2121	2120	2331
P1-21	5481	5451	4825	5589	5592	5464	5404	5196	4654	4438	4297	4289	4145	4085	3558	3501	3566
P1-22	6169	6014	5435	6103	6001	5810	5717	5369	4647	4259	4131	4071	3833	3695	3071	2983	2920
P1-23	5082	5029	4408	5160	5150	5014	4951	4731	4181	3967	3826	3820	3681	3627	3113	3060	3140
P1-24	6252	6059	5504	6131	5997	5790	5689	5302	4540	4108	3987	3914	3652	3494	2862	2768	2665
P1-25	7370	7293	6681	7411	7366	7205	7127	6836	6171	5828	5695	5648	5427	5302	4686	4601	4550
P1-26	4994	4869	4273	4972	4905	4736	4656	4366	3728	3439	3301	3274	3098	3017	2462	2399	2451
P1-27	7088	6975	6376	7079	7006	6829	6744	6421	5722	5348	5219	5163	4928	4791	4167	4079	4009
P1-28	1744	1396	1027	1421	1270	1092	1021	919	1046	1509	1476	1616	1879	2088	2422	2506	2783
P1-33	4271	4489	3906	4694	4893	4901	4911	4991	4870	4977	4853	4922	4952	5016	4761	4758	4960
P1-34	5265	5361	4732	5537	5638	5573	5546	5471	5111	5040	4901	4929	4860	4855	4431	4397	4526
P1-35	3902	4160	3604	4372	4603	4636	4660	4794	4759	4925	4808	4890	4953	5039	4845	4853	5074
P1-36	3989	4170	3571	4369	4545	4538	4540	4595	4446	4542	4417	4485	4512	4576	4324	4323	4527
P1-37	4983	5117	4497	5303	5436	5394	5378	5351	5063	5048	4912	4954	4916	4933	4558	4534	4688
P1-38	5599	5612	4980	5763	5799	5690	5640	5472	4980	4804	4662	4664	4538	4492	3986	3934	4013
P1-39	5550	5796	5225	6006	6217	6231	6243	6322	6173	6243	6114	6173	6174	6216	5894	5879	6051
P1-40	5479	5680	5084	5881	6059	6048	6048	6079	5863	5889	5756	5805	5784	5812	5456	5434	5592
P1-41	5020	5235	4647	5439	5630	5630	5635	5692	5520	5582	5452	5510	5511	5554	5238	5224	5401
P1-42	4733	4909	4304	5106	5271	5253	5249	5274	5062	5102	4971	5025	5018	5056	4732	4717	4892
P1-43	6378	6397	5765	6549	6585	6474	6422	6244	5727	5521	5380	5372	5226	5162	4622	4561	4608
P1-44	4767	4856	4228	5032	5132	5069	5042	4977	4638	4592	4455	4490	4439	4448	4059	4032	4182
P1-45	5287	5332	4699	5494	5557	5467	5426	5300	4869	4746	4605	4620	4525	4501	4039	3997	4106
P1-46	2296	1956	1560	1974	1785	1570	1471	1168	814	1092	1023	1151	1377	1572	1866	1949	2226

Table 4: Matrix showing the distances in m between planned WT and considered NSA.

4.2. Detailed Calculation Results for each regarded NSA

NSA 1 (coordinates: x=503'000, y=5'041'600)

No.	Distance [m]	Sound distance [m]	Calculated [dB(A)]	LwA,ref [dB(A)]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]	Cmet [dB]
1	6992	6994	5.82	104	3	87.9	13.29	0	0	0	101	0
2	3929	3933	16.63	104	3	82.9	7.47	0	0	0	90.4	0
3	2423	2427	23.69	104	3	78.7	4.61	0	0	0	83.3	0
4	2871	2875	21.37	104	3	80.2	5.46	0	0	0	85.6	0
5	5660	5662	10.18	104	3	86.1	10.76	0	0	0	96.8	0
6	4792	4795	13.27	104	3	84.6	9.11	0	0	0	93.7	0
7	4833	4836	13.12	104	3	84.7	9.19	0	0	0	93.9	0
8	6490	6493	7.41	104	3	87.3	12.34	0	0	0	99.6	0
9	6602	6605	7.05	104	3	87.4	12.55	0	0	0	100	0
10	4569	4574	14.1	104	3	84.2	8.69	0	0	0	92.9	0
11	4589	4593	14.03	104	3	84.2	8.73	0	0	0	93	0
12	4072	4076	16.05	104	3	83.2	7.75	0	0	0	91	0
13	6465	6468	7.5	104	3	87.2	12.29	0	0	0	99.5	0
14	6047	6050	8.87	104	3	86.6	11.49	0	0	0	98.1	0
15	4632	4636	13.87	104	3	84.3	8.81	0	0	0	93.1	0
16	5470	5472	10.84	104	3	85.8	10.4	0	0	0	96.2	0
17	4372	4375	14.87	104	3	83.8	8.31	0	0	0	92.1	0
18	5135	5139	12.02	104	3	85.2	9.76	0	0	0	95	0
19	3482	3487	18.53	104	3	81.9	6.63	0	0	0	88.5	0
20	5481	5485	10.8	104	3	85.8	10.42	0	0	0	96.2	0
21	6169	6172	8.47	104	3	86.8	11.73	0	0	0	98.5	0
22	5082	5086	12.21	104	3	85.1	9.66	0	0	0	94.8	0
23	6252	6254	8.19	104	3	86.9	11.88	0	0	0	98.8	0
24	7370	7372	4.64	104	3	88.4	14.01	0	0	0	102	0
25	4994	4998	12.53	104	3	85	9.5	0	0	0	94.5	0
26	7088	7090	5.52	104	3	88	13.47	0	0	0	101	0
27	1744	1753	27.79	104	3	75.9	3.33	0	0	0	79.2	0
28	4271	4274	15.26	104	3	83.6	8.12	0	0	0	91.7	0
29	5265	5269	11.56	104	3	85.4	10.01	0	0	0	95.4	0
30	3902	3905	16.75	104	3	82.8	7.42	0	0	0	90.3	0
31	3989	3992	16.39	104	3	83	7.58	0	0	0	90.6	0
32	4983	4986	12.57	104	3	85	9.47	0	0	0	94.4	0
33	5599	5602	10.39	104	3	86	10.64	0	0	0	96.6	0
34	5550	5552	10.56	104	3	85.9	10.55	0	0	0	96.4	0
35	5479	5481	10.81	104	3	85.8	10.41	0	0	0	96.2	0
36	5020	5023	12.44	104	3	85	9.54	0	0	0	94.6	0
37	4733	4736	13.49	104	3	84.5	9	0	0	0	93.5	0
38	6378	6380	7.78	104	3	87.1	12.12	0	0	0	99.2	0
39	4767	4771	13.36	104	3	84.6	9.07	0	0	0	93.6	0
40	5287	5290	11.48	104	3	85.5	10.05	0	0	0	95.5	0
41	2296	2302	24.38	104	3	78.2	4.37	0	0	0	82.6	0

NSA 2 (coordinates: x=503'500, y=5'041'700)

No.	Distance [m]	Sound distance [m]	Calculated [dB(A)]	LwA,ref [dB(A)]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]	Cmet [dB]
1	6938	6941	5.98	104	3	87.8	13.19	0	0	0	101	0
2	3752	3756	17.37	104	3	82.5	7.14	0	0	0	89.6	0
3	2148	2153	25.25	104	3	77.7	4.09	0	0	0	81.8	0
4	2558	2563	22.96	104	3	79.2	4.87	0	0	0	84	0
5	5562	5564	10.52	104	3	85.9	10.57	0	0	0	96.5	0
6	4574	4578	14.09	104	3	84.2	8.7	0	0	0	92.9	0
7	4655	4659	13.78	104	3	84.4	8.85	0	0	0	93.2	0
8	6465	6467	7.5	104	3	87.2	12.29	0	0	0	99.5	0
9	6422	6425	7.63	104	3	87.2	12.21	0	0	0	99.4	0
10	4505	4510	14.35	104	3	84.1	8.57	0	0	0	92.7	0
11	4463	4468	14.51	104	3	84	8.49	0	0	0	92.5	0
12	3991	3997	16.37	104	3	83	7.59	0	0	0	90.6	0
13	6319	6322	7.97	104	3	87	12.01	0	0	0	99	0
14	5828	5831	9.61	104	3	86.3	11.08	0	0	0	97.4	0
15	4634	4639	13.86	104	3	84.3	8.81	0	0	0	93.1	0
16	5290	5293	11.47	104	3	85.5	10.06	0	0	0	95.5	0
17	4172	4176	15.65	104	3	83.4	7.93	0	0	0	91.4	0
18	5138	5141	12.01	104	3	85.2	9.77	0	0	0	95	0
19	3378	3383	18.98	104	3	81.6	6.43	0	0	0	88	0
20	5451	5455	10.9	104	3	85.7	10.36	0	0	0	96.1	0
21	6014	6016	8.98	104	3	86.6	11.43	0	0	0	98	0
22	5029	5033	12.4	104	3	85	9.56	0	0	0	94.6	0
23	6059	6062	8.83	104	3	86.7	11.52	0	0	0	98.2	0
24	7293	7296	4.88	104	3	88.3	13.86	0	0	0	102	0
25	4869	4873	12.99	104	3	84.8	9.26	0	0	0	94	0
26	6975	6977	5.87	104	3	87.9	13.26	0	0	0	101	0
27	1396	1408	30.35	104	3	74	2.67	0	0	0	76.7	0
28	4489	4492	14.42	104	3	84.1	8.53	0	0	0	92.6	0
29	5361	5364	11.22	104	3	85.6	10.19	0	0	0	95.8	0
30	4160	4163	15.7	104	3	83.4	7.91	0	0	0	91.3	0
31	4170	4174	15.66	104	3	83.4	7.93	0	0	0	91.3	0
32	5117	5121	12.08	104	3	85.2	9.73	0	0	0	94.9	0
33	5612	5615	10.34	104	3	86	10.67	0	0	0	96.7	0
34	5796	5799	9.71	104	3	86.3	11.02	0	0	0	97.3	0
35	5680	5683	10.11	104	3	86.1	10.8	0	0	0	96.9	0
36	5235	5238	11.66	104	3	85.4	9.95	0	0	0	95.3	0
37	4909	4913	12.84	104	3	84.8	9.33	0	0	0	94.2	0
38	6397	6399	7.72	104	3	87.1	12.16	0	0	0	99.3	0
39	4856	4860	13.03	104	3	84.7	9.23	0	0	0	94	0
40	5332	5335	11.32	104	3	85.5	10.14	0	0	0	95.7	0
41	1956	1963	26.41	104	3	76.9	3.73	0	0	0	80.6	0

NSA 3 (coordinates: x=503'300, y=5'042'300)

No.	Distance [m]	Sound distance [m]	Calculated [dB(A)]	LwA,ref [dB(A)]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]	Cmet [dB]
1	6319	6320	7.98	104	3	87	12.01	0	0	0	99	0
2	3184	3186	19.88	104	3	81.1	6.05	0	0	0	87.1	0
3	1663	1667	28.4	104	3	75.4	3.17	0	0	0	78.6	0
4	2118	2121	25.44	104	3	77.5	4.03	0	0	0	81.6	0
5	4956	4957	12.68	104	3	84.9	9.42	0	0	0	94.3	0
6	4036	4038	16.2	104	3	83.1	7.67	0	0	0	90.8	0
7	4089	4091	15.99	104	3	83.2	7.77	0	0	0	91	0
8	5839	5840	9.58	104	3	86.3	11.1	0	0	0	97.4	0
9	5859	5860	9.51	104	3	86.4	11.13	0	0	0	97.5	0
10	3886	3890	16.81	104	3	82.8	7.39	0	0	0	90.2	0
11	3868	3871	16.89	104	3	82.8	7.35	0	0	0	90.1	0
12	3377	3381	19	104	3	81.6	6.42	0	0	0	88	0
13	5736	5737	9.93	104	3	86.2	10.9	0	0	0	97.1	0
14	5292	5293	11.47	104	3	85.5	10.06	0	0	0	95.5	0
15	4003	4006	16.33	104	3	83.1	7.61	0	0	0	90.7	0
16	4725	4727	13.53	104	3	84.5	8.98	0	0	0	93.5	0
17	3620	3622	17.94	104	3	82.2	6.88	0	0	0	89.1	0
18	4507	4509	14.35	104	3	84.1	8.57	0	0	0	92.7	0
19	2771	2775	21.86	104	3	79.9	5.27	0	0	0	85.1	0
20	4825	4828	13.15	104	3	84.7	9.17	0	0	0	93.9	0
21	5435	5437	10.96	104	3	85.7	10.33	0	0	0	96	0
22	4408	4411	14.73	104	3	83.9	8.38	0	0	0	92.3	0
23	5504	5505	10.72	104	3	85.8	10.46	0	0	0	96.3	0
24	6681	6682	6.81	104	3	87.5	12.7	0	0	0	100	0
25	4273	4276	15.26	104	3	83.6	8.12	0	0	0	91.7	0
26	6376	6377	7.79	104	3	87.1	12.12	0	0	0	99.2	0
27	1027	1036	33.72	104	3	71.3	1.97	0	0	0	73.3	0
28	3906	3907	16.74	104	3	82.8	7.42	0	0	0	90.3	0
29	4732	4735	13.5	104	3	84.5	9	0	0	0	93.5	0
30	3604	3606	18.01	104	3	82.1	6.85	0	0	0	89	0
31	3571	3573	18.15	104	3	82.1	6.79	0	0	0	88.9	0
32	4497	4500	14.39	104	3	84.1	8.55	0	0	0	92.6	0
33	4980	4982	12.58	104	3	85	9.47	0	0	0	94.4	0
34	5225	5227	11.71	104	3	85.4	9.93	0	0	0	95.3	0
35	5084	5086	12.21	104	3	85.1	9.66	0	0	0	94.8	0
36	4647	4649	13.82	104	3	84.4	8.83	0	0	0	93.2	0
37	4304	4307	15.13	104	3	83.7	8.18	0	0	0	91.9	0
38	5765	5766	9.83	104	3	86.2	10.96	0	0	0	97.2	0
39	4228	4230	15.44	104	3	83.5	8.04	0	0	0	91.6	0
40	4699	4702	13.62	104	3	84.4	8.93	0	0	0	93.4	0
41	1560	1565	29.14	104	3	74.9	2.97	0	0	0	77.9	0

NSA 4 (coordinates: x=503'700, y=5'041'600)

No.	Distance [m]	Sound distance [m]	Calculated [dB(A)]	LwA,ref [dB(A)]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]	Cmet [dB]
1	7066	7068	5.58	104	3	88	13.43	0	0	0	101	0
2	3839	3843	17	104	3	82.7	7.3	0	0	0	90	0
3	2200	2206	24.94	104	3	77.9	4.19	0	0	0	82.1	0
4	2585	2590	22.81	104	3	79.3	4.92	0	0	0	84.2	0
5	5675	5677	10.13	104	3	86.1	10.79	0	0	0	96.9	0
6	4639	4642	13.84	104	3	84.3	8.82	0	0	0	93.2	0
7	4738	4742	13.47	104	3	84.5	9.01	0	0	0	93.5	0
8	6602	6605	7.05	104	3	87.4	12.55	0	0	0	100	0
9	6500	6503	7.38	104	3	87.3	12.36	0	0	0	99.6	0
10	4633	4638	13.86	104	3	84.3	8.81	0	0	0	93.1	0
11	4568	4574	14.1	104	3	84.2	8.69	0	0	0	92.9	0
12	4116	4121	15.87	104	3	83.3	7.83	0	0	0	91.1	0
13	6411	6414	7.67	104	3	87.1	12.19	0	0	0	99.3	0
14	5889	5891	9.4	104	3	86.4	11.19	0	0	0	97.6	0
15	4785	4789	13.29	104	3	84.6	9.1	0	0	0	93.7	0
16	5370	5373	11.19	104	3	85.6	10.21	0	0	0	95.8	0
17	4247	4251	15.35	104	3	83.6	8.08	0	0	0	91.7	0
18	5287	5291	11.48	104	3	85.5	10.05	0	0	0	95.5	0
19	3497	3502	18.46	104	3	81.9	6.65	0	0	0	88.5	0
20	5589	5593	10.42	104	3	86	10.63	0	0	0	96.6	0
21	6103	6105	8.69	104	3	86.7	11.6	0	0	0	98.3	0
22	5160	5164	11.93	104	3	85.3	9.81	0	0	0	95.1	0
23	6131	6134	8.59	104	3	86.8	11.65	0	0	0	98.4	0
24	7411	7414	4.51	104	3	88.4	14.09	0	0	0	102	0
25	4972	4977	12.61	104	3	84.9	9.46	0	0	0	94.4	0
26	7079	7082	5.54	104	3	88	13.46	0	0	0	101	0
27	1421	1434	30.15	104	3	74.1	2.72	0	0	0	76.9	0
28	4694	4697	13.64	104	3	84.4	8.92	0	0	0	93.4	0
29	5537	5541	10.6	104	3	85.9	10.53	0	0	0	96.4	0
30	4372	4375	14.87	104	3	83.8	8.31	0	0	0	92.1	0
31	4369	4373	14.88	104	3	83.8	8.31	0	0	0	92.1	0
32	5303	5307	11.42	104	3	85.5	10.08	0	0	0	95.6	0
33	5763	5767	9.82	104	3	86.2	10.96	0	0	0	97.2	0
34	6006	6008	9.01	104	3	86.6	11.42	0	0	0	98	0
35	5881	5884	9.43	104	3	86.4	11.18	0	0	0	97.6	0
36	5439	5442	10.94	104	3	85.7	10.34	0	0	0	96.1	0
37	5106	5110	12.12	104	3	85.2	9.71	0	0	0	94.9	0
38	6549	6552	7.23	104	3	87.3	12.45	0	0	0	99.8	0
39	5032	5036	12.39	104	3	85	9.57	0	0	0	94.6	0
40	5494	5498	10.75	104	3	85.8	10.45	0	0	0	96.3	0
41	1974	1982	26.29	104	3	76.9	3.77	0	0	0	80.7	0

NSA 5 (coordinates: x=504'100, y=5'041'700)

No.	Distance [m]	Sound distance [m]	Calculated [dB(A)]	LwA,ref [dB(A)]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]	Cmet [dB]
1	7041	7043	5.66	104	3	88	13.38	0	0	0	101	0
2	3744	3747	17.41	104	3	82.5	7.12	0	0	0	89.6	0
3	2066	2071	25.74	104	3	77.3	3.94	0	0	0	81.3	0
4	2398	2402	23.83	104	3	78.6	4.56	0	0	0	83.2	0
5	5623	5625	10.31	104	3	86	10.69	0	0	0	96.7	0
6	4497	4500	14.39	104	3	84.1	8.55	0	0	0	92.6	0
7	4629	4632	13.88	104	3	84.3	8.8	0	0	0	93.1	0
8	6602	6604	7.06	104	3	87.4	12.55	0	0	0	99.9	0
9	6375	6377	7.79	104	3	87.1	12.12	0	0	0	99.2	0
10	4619	4623	13.92	104	3	84.3	8.78	0	0	0	93.1	0
11	4506	4510	14.35	104	3	84.1	8.57	0	0	0	92.7	0
12	4096	4101	15.95	104	3	83.3	7.79	0	0	0	91.1	0
13	6315	6317	7.99	104	3	87	12	0	0	0	99	0
14	5734	5736	9.93	104	3	86.2	10.9	0	0	0	97.1	0
15	4822	4826	13.16	104	3	84.7	9.17	0	0	0	93.8	0
16	5253	5255	11.6	104	3	85.4	9.99	0	0	0	95.4	0
17	4126	4130	15.84	104	3	83.3	7.85	0	0	0	91.2	0
18	5318	5321	11.37	104	3	85.5	10.11	0	0	0	95.6	0
19	3470	3473	18.59	104	3	81.8	6.6	0	0	0	88.4	0
20	5592	5596	10.41	104	3	86	10.63	0	0	0	96.6	0
21	6001	6003	9.03	104	3	86.6	11.4	0	0	0	98	0
22	5150	5153	11.97	104	3	85.2	9.79	0	0	0	95	0
23	5997	5999	9.04	104	3	86.6	11.4	0	0	0	98	0
24	7366	7368	4.65	104	3	88.4	14	0	0	0	102	0
25	4905	4908	12.86	104	3	84.8	9.33	0	0	0	94.1	0
26	7006	7008	5.77	104	3	87.9	13.31	0	0	0	101	0
27	1270	1281	31.42	104	3	73.2	2.43	0	0	0	75.6	0
28	4893	4895	12.9	104	3	84.8	9.3	0	0	0	94.1	0
29	5638	5641	10.26	104	3	86	10.72	0	0	0	96.7	0
30	4603	4605	13.99	104	3	84.3	8.75	0	0	0	93	0
31	4545	4548	14.2	104	3	84.2	8.64	0	0	0	92.8	0
32	5436	5439	10.96	104	3	85.7	10.33	0	0	0	96	0
33	5799	5801	9.71	104	3	86.3	11.02	0	0	0	97.3	0
34	6217	6219	8.31	104	3	86.9	11.82	0	0	0	98.7	0
35	6059	6061	8.83	104	3	86.7	11.52	0	0	0	98.2	0
36	5630	5633	10.28	104	3	86	10.7	0	0	0	96.7	0
37	5271	5274	11.54	104	3	85.4	10.02	0	0	0	95.5	0
38	6585	6586	7.11	104	3	87.4	12.51	0	0	0	99.9	0
39	5132	5135	12.03	104	3	85.2	9.76	0	0	0	95	0
40	5557	5560	10.53	104	3	85.9	10.56	0	0	0	96.5	0
41	1785	1792	27.53	104	3	76.1	3.4	0	0	0	79.5	0

NSA 6 (coordinates: x=504'300, y=5'041'900)

No.	Distance [m]	Sound distance [m]	Calculated [dB(A)]	LwA,ref [dB(A)]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]	Cmet [dB]
1	6892	6893	6.13	104	3	87.8	13.1	0	0	0	101	0
2	3564	3567	18.18	104	3	82.1	6.78	0	0	0	88.8	0
3	1879	1883	26.92	104	3	76.5	3.58	0	0	0	80.1	0
4	2176	2180	25.09	104	3	77.8	4.14	0	0	0	81.9	0
5	5461	5463	10.87	104	3	85.8	10.38	0	0	0	96.1	0
6	4289	4292	15.19	104	3	83.7	8.15	0	0	0	91.8	0
7	4438	4441	14.61	104	3	84	8.44	0	0	0	92.4	0
8	6469	6471	7.49	104	3	87.2	12.29	0	0	0	99.5	0
9	6171	6173	8.46	104	3	86.8	11.73	0	0	0	98.5	0
10	4483	4487	14.44	104	3	84	8.53	0	0	0	92.6	0
11	4341	4345	14.98	104	3	83.8	8.26	0	0	0	92	0
12	3959	3963	16.51	104	3	83	7.53	0	0	0	90.5	0
13	6126	6128	8.61	104	3	86.8	11.64	0	0	0	98.4	0
14	5517	5519	10.68	104	3	85.8	10.49	0	0	0	96.3	0
15	4717	4720	13.55	104	3	84.5	8.97	0	0	0	93.5	0
16	5056	5058	12.31	104	3	85.1	9.61	0	0	0	94.7	0
17	3931	3934	16.63	104	3	82.9	7.47	0	0	0	90.4	0
18	5208	5211	11.76	104	3	85.3	9.9	0	0	0	95.2	0
19	3331	3335	19.2	104	3	81.5	6.34	0	0	0	87.8	0
20	5464	5467	10.86	104	3	85.8	10.39	0	0	0	96.1	0
21	5810	5812	9.67	104	3	86.3	11.04	0	0	0	97.3	0
22	5014	5017	12.46	104	3	85	9.53	0	0	0	94.5	0
23	5790	5792	9.74	104	3	86.3	11	0	0	0	97.3	0
24	7205	7207	5.15	104	3	88.2	13.69	0	0	0	102	0
25	4736	4739	13.48	104	3	84.5	9	0	0	0	93.5	0
26	6829	6831	6.33	104	3	87.7	12.98	0	0	0	101	0
27	1092	1104	33.05	104	3	71.9	2.1	0	0	0	74	0
28	4901	4903	12.88	104	3	84.8	9.32	0	0	0	94.1	0
29	5573	5576	10.48	104	3	85.9	10.59	0	0	0	96.5	0
30	4636	4638	13.86	104	3	84.3	8.81	0	0	0	93.1	0
31	4538	4540	14.23	104	3	84.1	8.63	0	0	0	92.8	0
32	5394	5396	11.11	104	3	85.6	10.25	0	0	0	95.9	0
33	5690	5692	10.08	104	3	86.1	10.82	0	0	0	96.9	0
34	6231	6233	8.26	104	3	86.9	11.84	0	0	0	98.7	0
35	6048	6050	8.87	104	3	86.6	11.5	0	0	0	98.1	0
36	5630	5632	10.28	104	3	86	10.7	0	0	0	96.7	0
37	5253	5255	11.6	104	3	85.4	9.99	0	0	0	95.4	0
38	6474	6475	7.47	104	3	87.2	12.3	0	0	0	99.5	0
39	5069	5071	12.26	104	3	85.1	9.64	0	0	0	94.7	0
40	5467	5469	10.85	104	3	85.8	10.39	0	0	0	96.2	0
41	1570	1577	29.05	104	3	75	3	0	0	0	78	0

NSA 7 (coordinates: x=504'400, y=5'042'000)

No.	Distance [m]	Sound distance [m]	Calculated [dB(A)]	LwA,ref [dB(A)]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]	Cmet [dB]
1	6820	6822	6.36	104	3	87.7	12.96	0	0	0	101	0
2	3479	3483	18.54	104	3	81.8	6.62	0	0	0	88.5	0
3	1794	1799	27.48	104	3	76.1	3.42	0	0	0	79.5	0
4	2071	2075	25.72	104	3	77.3	3.94	0	0	0	81.3	0
5	5384	5386	11.14	104	3	85.6	10.23	0	0	0	95.9	0
6	4189	4191	15.59	104	3	83.5	7.96	0	0	0	91.4	0
7	4346	4350	14.97	104	3	83.8	8.26	0	0	0	92	0
8	6406	6408	7.69	104	3	87.1	12.17	0	0	0	99.3	0
9	6072	6074	8.79	104	3	86.7	11.54	0	0	0	98.2	0
10	4420	4425	14.68	104	3	83.9	8.41	0	0	0	92.3	0
11	4263	4267	15.29	104	3	83.6	8.11	0	0	0	91.7	0
12	3897	3901	16.77	104	3	82.8	7.41	0	0	0	90.2	0
13	6035	6037	8.91	104	3	86.6	11.47	0	0	0	98.1	0
14	5411	5413	11.05	104	3	85.7	10.28	0	0	0	96	0
15	4670	4673	13.73	104	3	84.4	8.88	0	0	0	93.3	0
16	4961	4963	12.66	104	3	84.9	9.43	0	0	0	94.3	0
17	3837	3840	17.02	104	3	82.7	7.3	0	0	0	90	0
18	5158	5161	11.94	104	3	85.3	9.81	0	0	0	95.1	0
19	3269	3273	19.48	104	3	81.3	6.22	0	0	0	87.5	0
20	5404	5407	11.07	104	3	85.7	10.27	0	0	0	95.9	0
21	5717	5719	9.99	104	3	86.2	10.87	0	0	0	97	0
22	4951	4954	12.69	104	3	84.9	9.41	0	0	0	94.3	0
23	5689	5691	10.08	104	3	86.1	10.81	0	0	0	96.9	0
24	7127	7129	5.39	104	3	88.1	13.55	0	0	0	102	0
25	4656	4659	13.78	104	3	84.4	8.85	0	0	0	93.2	0
26	6744	6746	6.6	104	3	87.6	12.82	0	0	0	100	0
27	1021	1034	33.74	104	3	71.3	1.96	0	0	0	73.3	0
28	4911	4913	12.84	104	3	84.8	9.33	0	0	0	94.2	0
29	5546	5548	10.57	104	3	85.9	10.54	0	0	0	96.4	0
30	4660	4662	13.77	104	3	84.4	8.86	0	0	0	93.2	0
31	4540	4543	14.22	104	3	84.2	8.63	0	0	0	92.8	0
32	5378	5380	11.16	104	3	85.6	10.22	0	0	0	95.8	0
33	5640	5642	10.25	104	3	86	10.72	0	0	0	96.8	0
34	6243	6245	8.22	104	3	86.9	11.87	0	0	0	98.8	0
35	6048	6050	8.87	104	3	86.6	11.5	0	0	0	98.1	0
36	5635	5638	10.27	104	3	86	10.71	0	0	0	96.7	0
37	5249	5252	11.61	104	3	85.4	9.98	0	0	0	95.4	0
38	6422	6424	7.64	104	3	87.2	12.21	0	0	0	99.4	0
39	5042	5045	12.36	104	3	85.1	9.59	0	0	0	94.6	0
40	5426	5429	10.99	104	3	85.7	10.32	0	0	0	96	0
41	1471	1479	29.79	104	3	74.4	2.81	0	0	0	77.2	0

NSA 8 (coordinates: x=504'800, y=5'042'400)

No.	Distance [m]	Sound distance [m]	Calculated [dB(A)]	LwA,ref [dB(A)]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]	Cmet [dB]
1	6558	6560	7.2	104	3	87.3	12.46	0	0	0	99.8	0
2	3180	3185	19.89	104	3	81.1	6.05	0	0	0	87.1	0
3	1542	1549	29.25	104	3	74.8	2.94	0	0	0	77.8	0
4	1704	1710	28.09	104	3	75.7	3.25	0	0	0	78.9	0
5	5102	5105	12.14	104	3	85.2	9.7	0	0	0	94.9	0
6	3812	3815	17.12	104	3	82.6	7.25	0	0	0	89.9	0
7	4008	4012	16.31	104	3	83.1	7.62	0	0	0	90.7	0
8	6180	6182	8.43	104	3	86.8	11.75	0	0	0	98.6	0
9	5692	5695	10.07	104	3	86.1	10.82	0	0	0	96.9	0
10	4207	4212	15.51	104	3	83.5	8	0	0	0	91.5	0
11	3987	3992	16.39	104	3	83	7.59	0	0	0	90.6	0
12	3690	3695	17.63	104	3	82.4	7.02	0	0	0	89.4	0
13	5690	5692	10.08	104	3	86.1	10.82	0	0	0	96.9	0
14	5004	5006	12.5	104	3	85	9.51	0	0	0	94.5	0
15	4522	4526	14.29	104	3	84.1	8.6	0	0	0	92.7	0
16	4603	4606	13.98	104	3	84.3	8.75	0	0	0	93	0
17	3494	3498	18.48	104	3	81.9	6.65	0	0	0	88.5	0
18	4993	4996	12.54	104	3	85	9.49	0	0	0	94.5	0
19	3073	3078	20.39	104	3	80.8	5.85	0	0	0	86.6	0
20	5196	5200	11.8	104	3	85.3	9.88	0	0	0	95.2	0
21	5369	5371	11.19	104	3	85.6	10.2	0	0	0	95.8	0
22	4731	4735	13.5	104	3	84.5	9	0	0	0	93.5	0
23	5302	5305	11.43	104	3	85.5	10.08	0	0	0	95.6	0
24	6836	6838	6.31	104	3	87.7	12.99	0	0	0	101	0
25	4366	4370	14.89	104	3	83.8	8.3	0	0	0	92.1	0
26	6421	6423	7.64	104	3	87.2	12.2	0	0	0	99.4	0
27	919	935	34.81	104	3	70.4	1.78	0	0	0	72.2	0
28	4991	4994	12.54	104	3	85	9.49	0	0	0	94.5	0
29	5471	5474	10.83	104	3	85.8	10.4	0	0	0	96.2	0
30	4794	4796	13.27	104	3	84.6	9.11	0	0	0	93.7	0
31	4595	4598	14.01	104	3	84.3	8.74	0	0	0	93	0
32	5351	5355	11.25	104	3	85.6	10.17	0	0	0	95.8	0
33	5472	5475	10.83	104	3	85.8	10.4	0	0	0	96.2	0
34	6322	6324	7.96	104	3	87	12.02	0	0	0	99	0
35	6079	6082	8.76	104	3	86.7	11.56	0	0	0	98.2	0
36	5692	5695	10.07	104	3	86.1	10.82	0	0	0	96.9	0
37	5274	5277	11.53	104	3	85.5	10.03	0	0	0	95.5	0
38	6244	6246	8.22	104	3	86.9	11.87	0	0	0	98.8	0
39	4977	4980	12.59	104	3	84.9	9.46	0	0	0	94.4	0
40	5300	5303	11.43	104	3	85.5	10.08	0	0	0	95.6	0
41	1168	1179	32.33	104	3	72.4	2.24	0	0	0	74.7	0

NSA 9 (coordinates: x=505'100, y=5'043'200)

No.	Distance [m]	Sound distance [m]	Calculated [dB(A)]	LwA,ref [dB(A)]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]	Cmet [dB]
1	5930	5933	9.26	104	3	86.5	11.27	0	0	0	97.7	0
2	2561	2567	22.93	104	3	79.2	4.88	0	0	0	84.1	0
3	1163	1173	32.38	104	3	72.4	2.23	0	0	0	74.6	0
4	1078	1090	33.18	104	3	71.8	2.07	0	0	0	73.8	0
5	4465	4469	14.51	104	3	84	8.49	0	0	0	92.5	0
6	3074	3079	20.38	104	3	80.8	5.85	0	0	0	86.6	0
7	3315	3321	19.26	104	3	81.4	6.31	0	0	0	87.7	0
8	5601	5604	10.38	104	3	86	10.65	0	0	0	96.6	0
9	4935	4938	12.75	104	3	84.9	9.38	0	0	0	94.3	0
10	3678	3684	17.67	104	3	82.3	7	0	0	0	89.3	0
11	3376	3383	18.99	104	3	81.6	6.43	0	0	0	88	0
12	3184	3190	19.86	104	3	81.1	6.06	0	0	0	87.1	0
13	4970	4973	12.62	104	3	84.9	9.45	0	0	0	94.4	0
14	4221	4225	15.46	104	3	83.5	8.03	0	0	0	91.5	0
15	4076	4081	16.03	104	3	83.2	7.75	0	0	0	91	0
16	3878	3882	16.84	104	3	82.8	7.38	0	0	0	90.2	0
17	2804	2810	21.69	104	3	80	5.34	0	0	0	85.3	0
18	4512	4516	14.32	104	3	84.1	8.58	0	0	0	92.7	0
19	2610	2617	22.67	104	3	79.4	4.97	0	0	0	84.3	0
20	4654	4658	13.78	104	3	84.4	8.85	0	0	0	93.2	0
21	4647	4650	13.81	104	3	84.4	8.84	0	0	0	93.2	0
22	4181	4186	15.61	104	3	83.4	7.95	0	0	0	91.4	0
23	4540	4544	14.22	104	3	84.2	8.63	0	0	0	92.8	0
24	6171	6174	8.46	104	3	86.8	11.73	0	0	0	98.5	0
25	3728	3734	17.46	104	3	82.4	7.09	0	0	0	89.5	0
26	5722	5725	9.97	104	3	86.2	10.88	0	0	0	97	0
27	1046	1063	33.45	104	3	71.5	2.02	0	0	0	73.6	0
28	4870	4873	12.98	104	3	84.8	9.26	0	0	0	94	0
29	5111	5115	12.1	104	3	85.2	9.72	0	0	0	94.9	0
30	4759	4761	13.4	104	3	84.6	9.05	0	0	0	93.6	0
31	4446	4450	14.58	104	3	84	8.45	0	0	0	92.4	0
32	5063	5067	12.28	104	3	85.1	9.63	0	0	0	94.7	0
33	4980	4984	12.58	104	3	85	9.47	0	0	0	94.4	0
34	6173	6175	8.45	104	3	86.8	11.73	0	0	0	98.6	0
35	5863	5866	9.49	104	3	86.4	11.14	0	0	0	97.5	0
36	5520	5523	10.66	104	3	85.8	10.49	0	0	0	96.3	0
37	5062	5065	12.28	104	3	85.1	9.62	0	0	0	94.7	0
38	5727	5730	9.95	104	3	86.2	10.89	0	0	0	97.1	0
39	4638	4642	13.84	104	3	84.3	8.82	0	0	0	93.2	0
40	4869	4873	12.98	104	3	84.8	9.26	0	0	0	94	0
41	814	832	36.01	104	3	69.4	1.58	0	0	0	71	0
J 10												
No.	Distance	Sound distance	Calculated	LwA,ref	Dc	Adiv	Aatm	Agr	Abar	Amisc	A	Cmet

NSA 10 (coordinates: x=505'400, y=5'043'700)

No.	Distance [m]	Sound distance [m]	Calculated [dB(A)]	LwA,ref [dB(A)]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]	Cmet [dB]
1	5623	5627	10.3	104	3	86	10.69	0	0	0	96.7	0
2	2326	2335	24.2	104	3	78.4	4.44	0	0	0	82.8	0
3	1317	1329	31	104	3	73.5	2.53	0	0	0	76	0
4	1007	1023	33.86	104	3	71.2	1.94	0	0	0	73.1	0
5	4165	4169	15.68	104	3	83.4	7.92	0	0	0	91.3	0
6	2689	2696	22.26	104	3	79.6	5.12	0	0	0	84.7	0
7	2977	2985	20.83	104	3	80.5	5.67	0	0	0	86.2	0
8	5342	5346	11.28	104	3	85.6	10.16	0	0	0	95.7	0
9	4505	4510	14.35	104	3	84.1	8.57	0	0	0	92.7	0
10	3493	3501	18.46	104	3	81.9	6.65	0	0	0	88.5	0
11	3122	3131	20.14	104	3	80.9	5.95	0	0	0	86.9	0
12	3035	3043	20.55	104	3	80.7	5.78	0	0	0	86.5	0
13	4581	4585	14.06	104	3	84.2	8.71	0	0	0	92.9	0
14	3768	3773	17.3	104	3	82.5	7.17	0	0	0	89.7	0
15	3954	3961	16.52	104	3	83	7.53	0	0	0	90.5	0
16	3495	3500	18.47	104	3	81.9	6.65	0	0	0	88.5	0
17	2483	2492	23.34	104	3	78.9	4.73	0	0	0	83.7	0
18	4353	4359	14.93	104	3	83.8	8.28	0	0	0	92.1	0
19	2525	2533	23.11	104	3	79.1	4.81	0	0	0	83.9	0
20	4438	4444	14.6	104	3	84	8.44	0	0	0	92.4	0
21	4259	4263	15.31	104	3	83.6	8.1	0	0	0	91.7	0
22	3967	3974	16.47	104	3	83	7.55	0	0	0	90.5	0
23	4108	4113	15.9	104	3	83.3	7.81	0	0	0	91.1	0
24	5828	5832	9.6	104	3	86.3	11.08	0	0	0	97.4	0
25	3439	3446	18.7	104	3	81.8	6.55	0	0	0	88.3	0
26	5348	5352	11.26	104	3	85.6	10.17	0	0	0	95.7	0
27	1509	1523	29.45	104	3	74.7	2.89	0	0	0	77.6	0
28	4977	4981	12.59	104	3	85	9.46	0	0	0	94.4	0
29	5040	5045	12.36	104	3	85.1	9.59	0	0	0	94.6	0
30	4925	4928	12.78	104	3	84.9	9.36	0	0	0	94.2	0
31	4542	4546	14.21	104	3	84.2	8.64	0	0	0	92.8	0
32	5048	5053	12.33	104	3	85.1	9.6	0	0	0	94.7	0
33	4804	4808	13.22	104	3	84.6	9.14	0	0	0	93.8	0
34	6243	6246	8.22	104	3	86.9	11.87	0	0	0	98.8	0
35	5889	5892	9.4	104	3	86.4	11.2	0	0	0	97.6	0
36	5582	5586	10.45	104	3	85.9	10.61	0	0	0	96.6	0
37	5102	5107	12.13	104	3	85.2	9.7	0	0	0	94.9	0
38	5521	5525	10.66	104	3	85.9	10.5	0	0	0	96.3	0
39	4592	4597	14.01	104	3	84.3	8.74	0	0	0	93	0
40	4746	4751	13.44	104	3	84.5	9.03	0	0	0	93.6	0
41	1092	1110	32.99	104	3	71.9	2.11	0	0	0	74	0

NSA 11 (coordinates: x=505'300, y=5'043'800)

No.	Distance [m]	Sound distance [m]	Calculated [dB(A)]	LwA,ref [dB(A)]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]	Cmet [dB]
1	5487	5491	10.78	104	3	85.8	10.43	0	0	0	96.2	0
2	2185	2194	25	104	3	77.8	4.17	0	0	0	82	0
3	1216	1229	31.88	104	3	72.8	2.33	0	0	0	75.1	0
4	879	897	35.24	104	3	70.1	1.7	0	0	0	71.8	0
5	4027	4032	16.23	104	3	83.1	7.66	0	0	0	90.8	0
6	2559	2566	22.94	104	3	79.2	4.88	0	0	0	84.1	0
7	2842	2850	21.49	104	3	80.1	5.42	0	0	0	85.5	0
8	5203	5207	11.78	104	3	85.3	9.89	0	0	0	95.2	0
9	4384	4389	14.81	104	3	83.9	8.34	0	0	0	92.2	0
10	3351	3360	19.09	104	3	81.5	6.38	0	0	0	87.9	0
11	2982	2991	20.8	104	3	80.5	5.68	0	0	0	86.2	0
12	2894	2903	21.23	104	3	80.3	5.51	0	0	0	85.8	0
13	4453	4458	14.55	104	3	84	8.47	0	0	0	92.5	0
14	3652	3657	17.79	104	3	82.3	6.95	0	0	0	89.2	0
15	3814	3820	17.1	104	3	82.6	7.26	0	0	0	89.9	0
16	3366	3371	19.04	104	3	81.6	6.41	0	0	0	88	0
17	2346	2355	24.09	104	3	78.4	4.47	0	0	0	82.9	0
18	4212	4217	15.49	104	3	83.5	8.01	0	0	0	91.5	0
19	2387	2396	23.86	104	3	78.6	4.55	0	0	0	83.1	0
20	4297	4303	15.15	104	3	83.7	8.18	0	0	0	91.9	0
21	4131	4135	15.81	104	3	83.3	7.86	0	0	0	91.2	0
22	3826	3833	17.05	104	3	82.7	7.28	0	0	0	90	0
23	3987	3993	16.39	104	3	83	7.59	0	0	0	90.6	0
24	5695	5699	10.05	104	3	86.1	10.83	0	0	0	97	0
25	3301	3308	19.32	104	3	81.4	6.29	0	0	0	87.7	0
26	5219	5223	11.72	104	3	85.4	9.92	0	0	0	95.3	0
27	1476	1491	29.7	104	3	74.5	2.83	0	0	0	77.3	0
28	4853	4856	13.05	104	3	84.7	9.23	0	0	0	94	0
29	4901	4906	12.86	104	3	84.8	9.32	0	0	0	94.1	0
30	4808	4811	13.21	104	3	84.7	9.14	0	0	0	93.8	0
31	4417	4421	14.69	104	3	83.9	8.4	0	0	0	92.3	0
32	4912	4917	12.82	104	3	84.8	9.34	0	0	0	94.2	0
33	4662	4667	13.75	104	3	84.4	8.87	0	0	0	93.3	0
34	6114	6117	8.65	104	3	86.7	11.62	0	0	0	98.4	0
35	5756	5759	9.85	104	3	86.2	10.94	0	0	0	97.2	0
36	5452	5456	10.9	104	3	85.7	10.37	0	0	0	96.1	0
37	4971	4975	12.61	104	3	84.9	9.45	0	0	0	94.4	0
38	5380	5384	11.15	104	3	85.6	10.23	0	0	0	95.9	0
39	4455	4460	14.54	104	3	84	8.47	0	0	0	92.5	0
40	4605	4610	13.97	104	3	84.3	8.76	0	0	0	93	0
41	1023	1041	33.68	104	3	71.4	1.98	0	0	0	73.3	0

NSA 12 (coordinates: x=505'400, y=5'043'900)

No.	Distance [m]	Sound distance [m]	Calculated [dB(A)]	LwA,ref [dB(A)]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]	Cmet [dB]
1	5450	5455	10.9	104	3	85.7	10.36	0	0	0	96.1	0
2	2181	2191	25.02	104	3	77.8	4.16	0	0	0	82	0
3	1322	1336	30.95	104	3	73.5	2.54	0	0	0	76.1	0
4	952	971	34.41	104	3	70.7	1.84	0	0	0	72.6	0
5	3995	4001	16.36	104	3	83	7.6	0	0	0	90.6	0
6	2505	2513	23.22	104	3	79	4.78	0	0	0	83.8	0
7	2802	2811	21.68	104	3	80	5.34	0	0	0	85.3	0
8	5180	5185	11.85	104	3	85.3	9.85	0	0	0	95.2	0
9	4311	4317	15.09	104	3	83.7	8.2	0	0	0	91.9	0
10	3354	3364	19.07	104	3	81.5	6.39	0	0	0	87.9	0
11	2967	2977	20.87	104	3	80.5	5.66	0	0	0	86.1	0
12	2909	2919	21.15	104	3	80.3	5.55	0	0	0	85.9	0
13	4393	4398	14.78	104	3	83.9	8.36	0	0	0	92.2	0
14	3571	3577	18.13	104	3	82.1	6.8	0	0	0	88.9	0
15	3832	3839	17.02	104	3	82.7	7.29	0	0	0	90	0
16	3309	3316	19.29	104	3	81.4	6.3	0	0	0	87.7	0
17	2314	2324	24.26	104	3	78.3	4.42	0	0	0	82.7	0
18	4219	4225	15.46	104	3	83.5	8.03	0	0	0	91.5	0
19	2422	2432	23.66	104	3	78.7	4.62	0	0	0	83.3	0
20	4289	4296	15.18	104	3	83.7	8.16	0	0	0	91.8	0
21	4071	4077	16.05	104	3	83.2	7.75	0	0	0	91	0
22	3820	3827	17.07	104	3	82.7	7.27	0	0	0	89.9	0
23	3914	3920	16.69	104	3	82.9	7.45	0	0	0	90.3	0
24	5648	5653	10.21	104	3	86.1	10.74	0	0	0	96.8	0
25	3274	3283	19.44	104	3	81.3	6.24	0	0	0	87.6	0
26	5163	5167	11.92	104	3	85.3	9.82	0	0	0	95.1	0
27	1616	1630	28.66	104	3	75.2	3.1	0	0	0	78.3	0
28	4922	4926	12.79	104	3	84.9	9.36	0	0	0	94.2	0
29	4929	4934	12.76	104	3	84.9	9.38	0	0	0	94.2	0
30	4890	4894	12.91	104	3	84.8	9.3	0	0	0	94.1	0
31	4485	4489	14.43	104	3	84	8.53	0	0	0	92.6	0
32	4954	4959	12.67	104	3	84.9	9.42	0	0	0	94.3	0
33	4664	4669	13.74	104	3	84.4	8.87	0	0	0	93.3	0
34	6173	6176	8.45	104	3	86.8	11.73	0	0	0	98.6	0
35	5805	5809	9.68	104	3	86.3	11.04	0	0	0	97.3	0
36	5510	5515	10.69	104	3	85.8	10.48	0	0	0	96.3	0
37	5025	5030	12.41	104	3	85	9.56	0	0	0	94.6	0
38	5372	5376	11.18	104	3	85.6	10.21	0	0	0	95.8	0
39	4490	4496	14.4	104	3	84.1	8.54	0	0	0	92.6	0
40	4620	4626	13.91	104	3	84.3	8.79	0	0	0	93.1	0
41	1151	1169	32.42	104	3	72.4	2.22	0	0	0	74.6	0

NSA 13 (coordinates: x=505'500, y=5'044'200)

No.	Distance [m]	Sound distance [m]	Calculated [dB(A)]	LwA,ref [dB(A)]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]	Cmet [dB]
1	5249	5254	11.61	104	3	85.4	9.98	0	0	0	95.4	0
2	2060	2072	25.73	104	3	77.3	3.94	0	0	0	81.3	0
3	1480	1493	29.68	104	3	74.5	2.84	0	0	0	77.3	0
4	1045	1063	33.45	104	3	71.5	2.02	0	0	0	73.6	0
5	3806	3812	17.14	104	3	82.6	7.24	0	0	0	89.9	0
6	2281	2291	24.44	104	3	78.2	4.35	0	0	0	82.6	0
7	2603	2613	22.69	104	3	79.3	4.97	0	0	0	84.3	0
8	5006	5011	12.48	104	3	85	9.52	0	0	0	94.5	0
9	4050	4056	16.13	104	3	83.2	7.71	0	0	0	90.9	0
10	3238	3248	19.6	104	3	81.2	6.17	0	0	0	87.4	0
11	2815	2827	21.6	104	3	80	5.37	0	0	0	85.4	0
12	2821	2832	21.58	104	3	80	5.38	0	0	0	85.4	0
13	4153	4158	15.72	104	3	83.4	7.9	0	0	0	91.3	0
14	3300	3307	19.33	104	3	81.4	6.28	0	0	0	87.7	0
15	3746	3754	17.38	104	3	82.5	7.13	0	0	0	89.6	0
16	3078	3086	20.35	104	3	80.8	5.86	0	0	0	86.7	0
17	2135	2146	25.29	104	3	77.6	4.08	0	0	0	81.7	0
18	4107	4114	15.9	104	3	83.3	7.82	0	0	0	91.1	0
19	2385	2395	23.86	104	3	78.6	4.55	0	0	0	83.1	0
20	4145	4153	15.74	104	3	83.4	7.89	0	0	0	91.3	0
21	3833	3839	17.02	104	3	82.7	7.29	0	0	0	90	0
22	3681	3689	17.65	104	3	82.3	7.01	0	0	0	89.4	0
23	3652	3659	17.78	104	3	82.3	6.95	0	0	0	89.2	0
24	5427	5433	10.98	104	3	85.7	10.32	0	0	0	96	0
25	3098	3108	20.25	104	3	80.9	5.9	0	0	0	86.8	0
26	4928	4933	12.77	104	3	84.9	9.37	0	0	0	94.2	0
27	1879	1893	26.86	104	3	76.5	3.6	0	0	0	80.1	0
28	4952	4956	12.68	104	3	84.9	9.42	0	0	0	94.3	0
29	4860	4866	13.01	104	3	84.7	9.25	0	0	0	94	0
30	4953	4957	12.68	104	3	84.9	9.42	0	0	0	94.3	0
31	4512	4517	14.32	104	3	84.1	8.58	0	0	0	92.7	0
32	4916	4921	12.81	104	3	84.8	9.35	0	0	0	94.2	0
33	4538	4544	14.22	104	3	84.2	8.63	0	0	0	92.8	0
34	6174	6178	8.45	104	3	86.8	11.74	0	0	0	98.6	0
35	5784	5789	9.75	104	3	86.3	11	0	0	0	97.3	0
36	5511	5516	10.69	104	3	85.8	10.48	0	0	0	96.3	0
37	5018	5023	12.44	104	3	85	9.54	0	0	0	94.6	0
38	5226	5231	11.69	104	3	85.4	9.94	0	0	0	95.3	0
39	4439	4445	14.6	104	3	84	8.45	0	0	0	92.4	0
40	4525	4531	14.27	104	3	84.1	8.61	0	0	0	92.7	0
41	1377	1394	30.47	104	3	73.9	2.65	0	0	0	76.5	0

NSA 14 (coordinates: x=505'600, y=5'044'400)

No.	Distance [m]	Sound distance [m]	Calculated [dB(A)]	LwA,ref [dB(A)]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]	Cmet [dB]
1	5141	5147	11.99	104	3	85.2	9.78	0	0	0	95	0
2	2032	2046	25.9	104	3	77.2	3.89	0	0	0	81.1	0
3	1643	1656	28.48	104	3	75.4	3.15	0	0	0	78.5	0
4	1184	1202	32.12	104	3	72.6	2.28	0	0	0	74.9	0
5	3710	3717	17.53	104	3	82.4	7.06	0	0	0	89.5	0
6	2164	2176	25.11	104	3	77.8	4.13	0	0	0	81.9	0
7	2505	2517	23.2	104	3	79	4.78	0	0	0	83.8	0
8	4921	4926	12.79	104	3	84.9	9.36	0	0	0	94.2	0
9	3891	3898	16.78	104	3	82.8	7.41	0	0	0	90.2	0
10	3203	3215	19.75	104	3	81.1	6.11	0	0	0	87.3	0
11	2756	2768	21.9	104	3	79.8	5.26	0	0	0	85.1	0
12	2811	2823	21.62	104	3	80	5.36	0	0	0	85.4	0
13	4013	4019	16.28	104	3	83.1	7.64	0	0	0	90.7	0
14	3134	3141	20.09	104	3	80.9	5.97	0	0	0	86.9	0
15	3731	3740	17.44	104	3	82.5	7.11	0	0	0	89.6	0
16	2949	2958	20.96	104	3	80.4	5.62	0	0	0	86	0
17	2058	2070	25.75	104	3	77.3	3.93	0	0	0	81.3	0
18	4072	4080	16.04	104	3	83.2	7.75	0	0	0	91	0
19	2415	2427	23.69	104	3	78.7	4.61	0	0	0	83.3	0
20	4085	4093	15.98	104	3	83.2	7.78	0	0	0	91	0
21	3695	3702	17.6	104	3	82.4	7.03	0	0	0	89.4	0
22	3627	3635	17.88	104	3	82.2	6.91	0	0	0	89.1	0
23	3494	3502	18.46	104	3	81.9	6.65	0	0	0	88.5	0
24	5302	5308	11.42	104	3	85.5	10.09	0	0	0	95.6	0
25	3017	3027	20.63	104	3	80.6	5.75	0	0	0	86.4	0
26	4791	4797	13.27	104	3	84.6	9.11	0	0	0	93.7	0
27	2088	2101	25.56	104	3	77.5	3.99	0	0	0	81.4	0
28	5016	5021	12.45	104	3	85	9.54	0	0	0	94.6	0
29	4855	4862	13.03	104	3	84.7	9.24	0	0	0	94	0
30	5039	5043	12.37	104	3	85.1	9.58	0	0	0	94.6	0
31	4576	4581	14.08	104	3	84.2	8.7	0	0	0	92.9	0
32	4933	4939	12.74	104	3	84.9	9.38	0	0	0	94.3	0
33	4492	4498	14.39	104	3	84.1	8.55	0	0	0	92.6	0
34	6216	6220	8.31	104	3	86.9	11.82	0	0	0	98.7	0
35	5812	5816	9.66	104	3	86.3	11.05	0	0	0	97.3	0
36	5554	5559	10.54	104	3	85.9	10.56	0	0	0	96.5	0
37	5056	5061	12.3	104	3	85.1	9.62	0	0	0	94.7	0
38	5162	5167	11.92	104	3	85.3	9.82	0	0	0	95.1	0
39	4448	4454	14.56	104	3	84	8.46	0	0	0	92.4	0
40	4501	4507	14.36	104	3	84.1	8.56	0	0	0	92.6	0
41	1572	1588	28.96	104	3	75	3.02	0	0	0	78	0

NSA 15 (coordinates: x=505'400, y=5'045'000)

No.	Distance [m]	Sound distance [m]	Calculated [dB(A)]	LwA,ref [dB(A)]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]	Cmet [dB]
1	4541	4548	14.2	104	3	84.2	8.64	0	0	0	92.8	0
2	1609	1628	28.67	104	3	75.2	3.09	0	0	0	78.3	0
3	1803	1818	27.36	104	3	76.2	3.45	0	0	0	79.6	0
4	1320	1339	30.92	104	3	73.5	2.54	0	0	0	76.1	0
5	3129	3139	20.1	104	3	80.9	5.96	0	0	0	86.9	0
6	1565	1584	28.99	104	3	75	3.01	0	0	0	78	0
7	1929	1947	26.51	104	3	76.8	3.7	0	0	0	80.5	0
8	4349	4356	14.94	104	3	83.8	8.28	0	0	0	92.1	0
9	3259	3269	19.5	104	3	81.3	6.21	0	0	0	87.5	0
10	2733	2749	22	104	3	79.8	5.22	0	0	0	85	0
11	2243	2261	24.62	104	3	78.1	4.3	0	0	0	82.4	0
12	2403	2419	23.73	104	3	78.7	4.6	0	0	0	83.3	0
13	3387	3396	18.93	104	3	81.6	6.45	0	0	0	88.1	0
14	2502	2513	23.22	104	3	79	4.77	0	0	0	83.8	0
15	3297	3309	19.32	104	3	81.4	6.29	0	0	0	87.7	0
16	2333	2346	24.13	104	3	78.4	4.46	0	0	0	82.9	0
17	1526	1546	29.28	104	3	74.8	2.94	0	0	0	77.7	0
18	3592	3602	18.03	104	3	82.1	6.84	0	0	0	89	0
19	2121	2137	25.35	104	3	77.6	4.06	0	0	0	81.7	0
20	3558	3569	18.17	104	3	82.1	6.78	0	0	0	88.8	0
21	3071	3081	20.37	104	3	80.8	5.85	0	0	0	86.6	0
22	3113	3125	20.17	104	3	80.9	5.94	0	0	0	86.8	0
23	2862	2873	21.37	104	3	80.2	5.46	0	0	0	85.6	0
24	4686	4694	13.65	104	3	84.4	8.92	0	0	0	93.4	0
25	2462	2477	23.42	104	3	78.9	4.71	0	0	0	83.6	0
26	4167	4174	15.66	104	3	83.4	7.93	0	0	0	91.3	0
27	2422	2435	23.64	104	3	78.7	4.63	0	0	0	83.4	0
28	4761	4766	13.38	104	3	84.6	9.06	0	0	0	93.6	0
29	4431	4439	14.62	104	3	84	8.43	0	0	0	92.4	0
30	4845	4850	13.07	104	3	84.7	9.22	0	0	0	93.9	0
31	4324	4330	15.04	104	3	83.7	8.23	0	0	0	92	0
32	4558	4566	14.13	104	3	84.2	8.67	0	0	0	92.9	0
33	3986	3995	16.38	104	3	83	7.59	0	0	0	90.6	0
34	5894	5900	9.37	104	3	86.4	11.21	0	0	0	97.6	0
35	5456	5462	10.88	104	3	85.8	10.38	0	0	0	96.1	0
36	5238	5244	11.64	104	3	85.4	9.96	0	0	0	95.4	0
37	4732	4739	13.48	104	3	84.5	9	0	0	0	93.5	0
38	4622	4629	13.9	104	3	84.3	8.79	0	0	0	93.1	0
39	4059	4067	16.09	104	3	83.2	7.73	0	0	0	90.9	0
40	4039	4047	16.17	104	3	83.1	7.69	0	0	0	90.8	0
41	1866	1882	26.93	104	3	76.5	3.58	0	0	0	80.1	0

NSA 16 (coordinates: x=505'400, y=5'045'100)

No.	Distance [m]	Sound distance [m]	Calculated [dB(A)]	LwA,ref [dB(A)]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]	Cmet [dB]
1	4462	4470	14.5	104	3	84	8.49	0	0	0	92.5	0
2	1585	1605	28.84	104	3	75.1	3.05	0	0	0	78.2	0
3	1873	1887	26.9	104	3	76.5	3.59	0	0	0	80.1	0
4	1392	1411	30.33	104	3	74	2.68	0	0	0	76.7	0
5	3058	3068	20.44	104	3	80.7	5.83	0	0	0	86.6	0
6	1490	1510	29.55	104	3	74.6	2.87	0	0	0	77.5	0
7	1861	1880	26.94	104	3	76.5	3.57	0	0	0	80.1	0
8	4279	4287	15.21	104	3	83.6	8.14	0	0	0	91.8	0
9	3165	3175	19.93	104	3	81	6.03	0	0	0	87.1	0
10	2692	2708	22.2	104	3	79.7	5.14	0	0	0	84.8	0
11	2193	2211	24.91	104	3	77.9	4.2	0	0	0	82.1	0
12	2377	2393	23.87	104	3	78.6	4.55	0	0	0	83.1	0
13	3298	3307	19.33	104	3	81.4	6.28	0	0	0	87.7	0
14	2406	2418	23.74	104	3	78.7	4.59	0	0	0	83.3	0
15	3263	3274	19.48	104	3	81.3	6.22	0	0	0	87.5	0
16	2250	2264	24.6	104	3	78.1	4.3	0	0	0	82.4	0
17	1474	1495	29.67	104	3	74.5	2.84	0	0	0	77.3	0
18	3546	3556	18.22	104	3	82	6.76	0	0	0	88.8	0
19	2120	2136	25.35	104	3	77.6	4.06	0	0	0	81.7	0
20	3501	3512	18.42	104	3	81.9	6.67	0	0	0	88.6	0
21	2983	2993	20.79	104	3	80.5	5.69	0	0	0	86.2	0
22	3060	3072	20.41	104	3	80.8	5.84	0	0	0	86.6	0
23	2768	2780	21.84	104	3	79.9	5.28	0	0	0	85.2	0
24	4601	4609	13.97	104	3	84.3	8.76	0	0	0	93	0
25	2399	2414	23.76	104	3	78.7	4.59	0	0	0	83.2	0
26	4079	4087	16.01	104	3	83.2	7.76	0	0	0	91	0
27	2506	2519	23.19	104	3	79	4.79	0	0	0	83.8	0
28	4758	4764	13.39	104	3	84.6	9.05	0	0	0	93.6	0
29	4397	4405	14.75	104	3	83.9	8.37	0	0	0	92.3	0
30	4853	4858	13.04	104	3	84.7	9.23	0	0	0	94	0
31	4323	4329	15.05	104	3	83.7	8.23	0	0	0	92	0
32	4534	4541	14.23	104	3	84.1	8.63	0	0	0	92.8	0
33	3934	3943	16.59	104	3	82.9	7.49	0	0	0	90.4	0
34	5879	5884	9.43	104	3	86.4	11.18	0	0	0	97.6	0
35	5434	5440	10.95	104	3	85.7	10.34	0	0	0	96.1	0
36	5224	5230	11.69	104	3	85.4	9.94	0	0	0	95.3	0
37	4717	4724	13.54	104	3	84.5	8.98	0	0	0	93.5	0
38	4561	4568	14.13	104	3	84.2	8.68	0	0	0	92.9	0
39	4032	4041	16.19	104	3	83.1	7.68	0	0	0	90.8	0
40	3997	4006	16.34	104	3	83.1	7.61	0	0	0	90.7	0
41	1949	1964	26.41	104	3	76.9	3.73	0	0	0	80.6	0

NSA 17 (coordinates: x=505'600, y=5'045'300)

No.	Distance [m]	Sound distance [m]	Calculated [dB(A)]	LwA,ref [dB(A)]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]	Cmet [dB]
1	4440	4448	14.58	104	3	84	8.45	0	0	0	92.4	0
2	1754	1773	27.66	104	3	76	3.37	0	0	0	79.3	0
3	2156	2169	25.16	104	3	77.7	4.12	0	0	0	81.8	0
4	1675	1691	28.22	104	3	75.6	3.21	0	0	0	78.8	0
5	3072	3082	20.37	104	3	80.8	5.86	0	0	0	86.6	0
6	1508	1529	29.41	104	3	74.7	2.9	0	0	0	77.6	0
7	1901	1920	26.69	104	3	76.7	3.65	0	0	0	80.3	0
8	4295	4303	15.15	104	3	83.7	8.18	0	0	0	91.9	0
9	3057	3068	20.43	104	3	80.7	5.83	0	0	0	86.6	0
10	2809	2824	21.62	104	3	80	5.37	0	0	0	85.4	0
11	2287	2305	24.37	104	3	78.3	4.38	0	0	0	82.6	0
12	2535	2551	23.02	104	3	79.1	4.85	0	0	0	84	0
13	3227	3237	19.65	104	3	81.2	6.15	0	0	0	87.4	0
14	2286	2299	24.4	104	3	78.2	4.37	0	0	0	82.6	0
15	3395	3406	18.88	104	3	81.7	6.47	0	0	0	88.1	0
16	2217	2231	24.79	104	3	78	4.24	0	0	0	82.2	0
17	1573	1594	28.92	104	3	75.1	3.03	0	0	0	78.1	0
18	3646	3656	17.79	104	3	82.3	6.95	0	0	0	89.2	0
19	2331	2346	24.14	104	3	78.4	4.46	0	0	0	82.9	0
20	3566	3577	18.13	104	3	82.1	6.8	0	0	0	88.9	0
21	2920	2931	21.09	104	3	80.3	5.57	0	0	0	85.9	0
22	3140	3153	20.04	104	3	81	5.99	0	0	0	87	0
23	2665	2678	22.36	104	3	79.6	5.09	0	0	0	84.6	0
24	4550	4558	14.16	104	3	84.2	8.66	0	0	0	92.8	0
25	2451	2467	23.47	104	3	78.8	4.69	0	0	0	83.5	0
26	4009	4018	16.29	104	3	83.1	7.63	0	0	0	90.7	0
27	2783	2795	21.76	104	3	79.9	5.31	0	0	0	85.2	0
28	4960	4966	12.65	104	3	84.9	9.43	0	0	0	94.4	0
29	4526	4534	14.26	104	3	84.1	8.61	0	0	0	92.7	0
30	5074	5079	12.23	104	3	85.1	9.65	0	0	0	94.8	0
31	4527	4534	14.26	104	3	84.1	8.61	0	0	0	92.7	0
32	4688	4695	13.65	104	3	84.4	8.92	0	0	0	93.4	0
33	4013	4022	16.27	104	3	83.1	7.64	0	0	0	90.7	0
34	6051	6056	8.85	104	3	86.6	11.51	0	0	0	98.2	0
35	5592	5598	10.4	104	3	86	10.64	0	0	0	96.6	0
36	5401	5407	11.07	104	3	85.7	10.27	0	0	0	95.9	0
37	4892	4900	12.89	104	3	84.8	9.31	0	0	0	94.1	0
38	4608	4615	13.95	104	3	84.3	8.77	0	0	0	93.1	0
39	4182	4190	15.59	104	3	83.5	7.96	0	0	0	91.4	0
40	4106	4115	15.9	104	3	83.3	7.82	0	0	0	91.1	0
41	2226	2240	24.74	104	3	78	4.26	0	0	0	82.3	0

4.3. Manufacturers Information

GE Energy — Sound Power Levels

1 Introduction

The noise emission characteristics of the GE Energy wind turbine series GE 1.5sl and 1.5sle with a rotor diameter of 77-m, 50 and 60 Hz versions, including Cold Weather Extreme versions, comprise sound power level data, tonality values, third octave band and octave band spectra.

This document describes the noise characteristics of the turbine for normal operation. Noise-reduced operation (NRO) is described in document [1.5sl_sle_SCD_allcomp_NRO].

The data here provided is calculated from simulations and has been confirmed by several measurements, including those performed by independent institutes.

The sound power level (L_{WA}) is calculated at hub height over the entire wind speed range from cut-in wind speed to cut out wind speed. For the maximum sound power level a reference value and uncertainty band are specified. Tabled L_{WA}-values are given as function of hub height wind speed (reference values) and as a function of wind speed at 10-m height, assuming standard hub height and logarithmic wind profile for surface roughness ($z_{0,ref}$) = 0.03 m, see section 2.2. Characteristics as a function of wind speed at 10-meter height for different combinations of hub height and wind shear profile can be provided at request.

If a wind turbine noise performance test is carried out, it needs to be done in accordance with the regulations of the international standard IEC 61400-11: 2002 (abstract available upon request).

2 Sound Power Level Data

2.1 L_{WA} as a function of hub height wind speed

The following table provides the calculated reference mean sound power level values as a function of wind speed.

Wind speed at hub height [m/s]	GE 1.5 sl/sle all hub heights L_{WA} [dB]
3	< 96
4	< 96
5	< 96
6	96.6
7	99.8
8	102.7
9 – cut out	≤ 104.0

Table 2-1: Mean sound power level as function of hub height wind speed

2.2 L_{WA} as a function of wind speed at 10-m height

Following are tabled values for the L_{WA} as a function of the wind speed at 10-meter height for different hub heights. The wind speed is converted using a standard logarithmic wind profile, in this case using a surface roughness of (z_{0ref}) = 0.03 m, which is representative for average terrain conditions.

$$V_{10m\ height} = V_{hub} \frac{\ln\left(10m / z_{0ref}\right)}{\ln\left(hub\ height / z_{0ref}\right)} \quad [1]$$

Characteristics for other combinations of surface roughness and hub height are available upon request.

Wind speed at 10-m height [m/s]	GE 1.5 sl/sle 61.4-m HH L_{WA} [dB]	GE 1.5 sl/sle 70-m HH L_{WA} [dB]	GE 1.5 sl/sle 80-m HH L_{WA} [dB]	GE 1.5 sl/sle 85-m HH L_{WA} [dB]	GE 1.5 sl/sle 100-m HH L_{WA} [dB]
3	< 96	< 96	< 96	< 96	< 96
4	< 96	< 96	< 96	< 96	96.1
5	98.4	98.7	99.1	99.3	99.7
6	102.4	102.8	103.0	103.1	103.3
7– cut out	≤ 104	≤ 104	≤ 104	≤ 104	≤ 104

Table 2-2: Sound power level characteristics for different hub heights as function of wind speed at 10 m height

3 Uncertainty Levels

Mean uncertainty levels for the sound power, or K-factors, are derived from independent measurements. Their value depends on the applied probability level and standard deviation for reproducibility (σ_R), as described in the IEC 61400-14 TS ed. 1[2]. Because the K-factor depends on the quality of the measurements, the number of the measurements, and on local regulations, a fixed value is here used instead to define the uncertainty band with respect to the reference sound power level.

For all 1.5sl and 1.5sle turbines an uncertainty band of **(K) = ± 2.0 dB** is defined.

4 Tonality

At the reference measuring point R_o, a ground distance from the turbine base equal to hub height plus half the rotor diameter, the GE 1.5sl/sle turbine has a value for tonality of **(ΔL_o) ≤ 4 dB**, irrespective of wind speed, turbine type, hub height, and grid frequency.[3]

1 Simplified from IEC 61400-11: 2002 equation 7

[2] Here referring to the unofficial release of the IEC 61400-14 TS ed. 1, labeled as 'CDV' (committee draft for voting)

[3] R_o and ΔL_o are defined here according to IEC 61400-11: 2002

4.4. Used Software Versions

DEWI used the following software for the investigation in hand:

- ArcView GIS, version 3.3, Environment Systems Research International (ESRI)
- WindPRO, version 2.5, EMD International A/S, Denmark

4.5. References

[1] DIN ISO 9613-2, General, October 1999

[2] GE Wind, "Technical Documentation Wind Turbine Generator System GE 1.5sl/sle 50 & 60 Hz" – Part noise emissions characteristics (normal operation according IEC), Salzbergen (Germany) 2005

C3- Species at Risk Study

Prepared for Dalhousie Mountain Wind Farms 2007 by Ross Hall, Biologist
Wild Species in Nova Scotia with Red and Yellow Status Rank

(1) Mammals

	Common Name	Scientific Name	
RED	Moose	*Alces alces*	Refer section xx Ross Hall report
RED	Lynx	*Lynx lynx*	Not in Pictou County
RED	American Marten	*Martes americana*	Not in Pictou County
YELLOW	Fisher	*Martes pennanti*	Refer section xx
YELLOW	Southern Flying Squirrel	*Glaucomys volans*	Not in Pictou County
YELLOW	Bat species	*Pipistrellus subflavus*	Refer section xx Hugh Broders report
YELLOW	Long-tailed Shrew	*Sorex dispar*	Refer section xx
YELLOW	Gaspe Shrew	*Sorex gaspensis*	Not in Pictou County

(1-1) Mainland Moose addressed in the Ross Hall Study 2007, presently no moose population exists

(1-2) Fisher

Fisher are expected to occur in Pictou County and at the Dalhousie Mountain area. Cumberland, Colchester and Pictou Counties have the larger populations of fisher in Nova Scotia. In these counties, licensed fur harvesters are allowed to keep and market one fisher that they catch inadvertently while trapping for other species. During the 2005/2006 season numbers of fisher taken in Nova Scotia were:

Cumberland	48
Colchester	38
Pictou	36
Other	16
	138

Fisher diet is varied and fishers opportunistic in what they can over power and eat including snowshoe hare and porcupines. Carrion and berries contribute to the diet. Their non specialized diet takes them into many forest habitats, including young and old stands. Fisher do not travel well in deep snow and in winter are often found in mature softwood stands. They require cavities in trees and logs for shelter. They are often found in steep river valleys that drain off the Cobequid Hills.

At Dalhousie Mountain wind turbines are not expected to adversely affect fisher, except for an estimated 2% habitat alteration, a result of turbine placement and service roads.

(1-3) Bat Species as indicated in Hugh Broders 2007 Study, no adverse effect on bats is expected

(1-4) Long-tailed Shrew

Long-tailed Shrew are restricted to slopes in highland areas that have differing amounts of rocky outcrops and talus. They are often near mountain streams and have an overstory of mature yellow birch and sugar maple. Long-tailed Shrew are similar to Gaspe Shrew but differ primarily in body size. The Long-tailed Shrew was originally discovered on Cobequid Hill slopes along the Wentworth Valley but more recent studies indicate a wider distribution. They are hard to detect, requiring intensive trapping effort. Long-tailed Shrew live amongst the network of space amongst talus rocks.

The Long-tailed Shrew is mentioned in this review since it is conceivable that this species could be found along the steep streams and talus sloops of Dalhousie Mountain.

However, since turbines are planned for ridges and higher ground, no adverse effect on Long-tailed Shrews is expected, should this species occur here.

Reference: COSEWIC. Assessment and Update Status Report on the Gaspe Shrew, Sorex gaspensia in Canada. 2006

(2) Reptiles and Amphibians

Status	**Common Name**	**Scientific Name**	
RED	Blanding's Turtle	*Emydoidea blandingi*	Not in Pictou County
YELLOW	Northern Ribbon Snake	*Thamnophis sauritus septentrionalis*	Not in Pictou County
YELLOW	Wood Turtle	*Clemmys insculpta*	Refer Section 2-1

(2-1) Wood turtles make their home in shaded, wet-mesic forested (coniferous or deciduous) flood plains or riparian zones. Clear medium sized (2 – 30 m wide) rivers and streams are ideal. There is a requirement for under water hibernation such as in stream or ox-bow ponds and for sand-gravel nesting opportunity.

Dalhousie Mountain is a head-water for three watersheds. Steele Run continues into the Salmon River watershed. Six Mile Brook contributes to West River of Pictou. Dalhousie Brook contributes to the River John watershed. It is possible that all three watersheds have small populations of wood turtles.

The head water brooks of these watersheds are not suitable habitat for wood turtles. The placement of wind turbines is away from streams and will not impact any riparian habitat. It is not believed that the proposed wind farm development will impact wood turtle.

Reference: Protecting and Conserving Wood Turtles: A Stewardship Plan for Nova Scotia. Michelle K. MacGregor & Mark Elderkin. 2003. Biodiversity Program, Wildlife Division, Nova Scotia Department of Natural Resources

(3) Birds

Status	**Common Name**	**Scientific Name**	
RED	Peregrine Falcon	*Falco peregrinus*	Bay of Fundy coastal nesting sites
RED	Piping Plover	*Charadrius melodus*	Coastal Habitats
RED	Purple Martin	*Progne subis*	May no longer nest in NS
RED	Roseate Tern	*Sterna dougallii*	Coastal Habitats
YELLOW	Short-eared Owl	*Asio flammeus*	
YELLOW	Black-crowned Night-Heron	*Nycticorax nycticorax*	
YELLOW	Brant	*Branta bernicla*	Coastal Habitats
YELLOW	Harlequin Duck	*Histrionicus histrionicus*	Coastal Habitats
YELLOW	Barrow's Goldeneye	*Bucephala islandica*	
YELLOW	Northern Goshawk	*Accipiter gentilis*	
YELLOW	Red Knot	*Calidris canutus*	Coastal Habitats
YELLOW	Purple Sandpiper	*Calidris maritima*	Coastal Habitats
YELLOW	Common Tern	*Sterna hirundo*	Coastal Habitats
YELLOW	Arctic Tern	*Sterna paradisaea*	Coastal Habitats
YELLOW	Common Loon	*Gavia immer*	
YELLOW	Atlantic Puffin	*Fratercula arctica*	Coastal Habitats
YELLOW	Rusty Blackbird	*Euphagus carolinus*	
YELLOW	Common Nighthawk	*Chordeiles minor*	
YELLOW	Chimney Swift	*Chaetura pelagica*	
YELLOW	Olive-sided Flycatcher	*Contopus borealis*	
YELLOW	Barn Swallow	*Hirundo rustica*	
YELLOW	Gray Jay	*Perisoreus canadensis*	
YELLOW	Boreal Chickadee	*Parus hudsonicus*	
YELLOW	Eastern Bluebird	*Sialia sialis*	
YELLOW	Bicknell's Thrush	*Catharus bicknelli*	
YELLOW	Canada Warbler	*Wilsonia canadensis*	
YELLOW	Vesper Sparrow	*Pooecetes gramineus*	
YELLOW	Ipswich Sparrow	*Passerculus sandwichensis princeps*	Subspecies that occurs on Sable Island
YELLOW	Bobolink	*Dolichonyx oryzivorus*	
YELLOW	Razorbill	*Alca torda*	Coastal Habitats

Steve Vines report on breeding birds 2007 indicates no findings of any of the above mentioned species

(4) Butterflies

Status	Common Name	Scientific Name	
RED	Jutta Arctic	*Oeneis jutta*	Sphagnum bogs
RED	Early Hairstreak	*Erora laetus*	Edge deciduous forests
RED	Bog Elfin	*Incisalia lanoraieensis*	Spruce-tamarack bogs
YELLOW	Monarch	*Danaus plexippus*	Habitats with milkweeds
YELLOW	Hoary Comma	*Polygonia gracilis*	Forests, clearings, rivers
YELLOW	Satyr Anglewing (Comma)	*Polygonia satyrus*	Wooded canyons, streamsides, forest edges
YELLOW	Arctic (Titania) Fritillary	*Boloria chariclea*	Border bogs, northern woodlands
YELLOW	Short-tailed Swallowtail	*Papilio brevicauda*	Glades evergreen forests, grassy sea cliffs
YELLOW	Northern Cloudywing	*Thorybes pylades*	Open woods, edges, fields, meadows

The Jutta Arctic and Bog Elfin are northern butterflies that push south into cold acid spruce-tamarack sphagnum bogs. These habitats are not found at Dalhousie Mountain. It is possible that intensive sampling might encounter a red or yellow status butterflies, yet it is believed that the proposed wind farm development would not impact this taxonomic group of species.

(5) Odonata

Status	Common Name	Scientific Name	
RED	Ringed Emerald	*Somatochlora albicincta*	Boreal bog – margined ponds
RED	Taiga Bluet	*Coenagrion resolutum*	Wetlands and streams
RED	Ebony Boghaunter	*Williamsonia fletcheri*	Wet sphagnum bogs
RED	Williamson's Emerald	*Somatochlora williamsoni*	
RED	Brook Snaketail	*Ophiogomphus aspersus*	Clear rapid streams
RED	Twinhorned Snaketail	*Ophiogomphus mainensis*	Streams and small rivers
RED	Rusty Snaketail	*Ophiogomphus rupinsulensis*	Fast streams with rocky outcrops
RED	Skillet Clubtail	*Gomphus ventricosus*	
YELLOW	Harpoon Clubtail	*Gomphus descriptus*	Clean rivers, near gravel bars
YELLOW	Zorro Clubtail	*Lanthus parvulus*	
YELLOW	Prince Baskettail	*Epitheca princeps*	Ponds, lakes or streams
YELLOW	Little Bluet	*Enallagma minusculum*	Wetland ponds
YELLOW	Muskeg Emerald	*Somatochlora septentrionalis*	
YELLOW	Clamptipped Emerald	*Somatochlora tenebrosa*	Woodland edges and streams

YELLOW	Seaside Dragonlet	*Erythrodiplax berenice*	Coastal salt marshes
YELLOW	Harlequin Darner	*Gomphaeschna furcillata*	Bogs, lakes and adjacent roadsides

Dragonflies and damselflies occur in a variety of wetland habitats and streams. Bezanson Lake west of the proposed wind farm site offers one of the better wetlands near Dalhousie Mountain. There are no extensive sphagnum bog habitats at Dalhousie Mountain. High gradient brooks that flow off Dalhousie Mountain potentially provide habitat for snaketail (*Ophiogomphus*) species.

The proposed wind farm will not impact wetlands or watercourses and no negative impact is anticipated on Odonata species.

Freshwater Mussels

Status	**Common Name**	**Scientific Name**	
RED	Squawfoot	*Strophitus undulatus*	Presently known only in one lake in NS. Not found in high gradient streams.
RED	Delicate Lamp Mussel (Tidewater Mucket)	*Lampsilis ochraceae*	Coastal lakes and ponds. Variety of substrates.
RED	Yellow Lamp Mussel	*Lampsilis cariosa*	Known Cape Breton only.
YELLOW	Brook Floater (Swollen Wedge Mussel)	*Alasmidonta varicosa*	Flowing water habitats, neither fast flow or slow water. Found in wind swept shallow lake shore in Cumberland County.
YELLOW	Triangle Floater	*Alasmidonta undulata*	Streams, rivers, lakes. Frequently sand or gravel substrate.

Freshwater mussels no not survive outside permanent water habitats. Small, intermittent, high gradient brooks will not support freshwater mussels. Lower and wider reaches of the Salmon and River John do support Eastern pearl shell (*Margaritifera margaritifera*) that has a green status..

It is very unlikely that any red or yellow status freshwater mussels occur at Dalhousie Mountain and development of a wind farm would not impact any watercourse.

Reference: The Freshwater Mussels of Maine. Ethan J. Nedeau, Mark A. McCollough, and Beth I. Swartz. 2000. Maine Department of Inland Fisheries and Wildlife

Fish

Status	Common Name	Scientific Name	Photo Link
RED	Striped Bass	*Morone saxatilis*	Enters costal rivers such as the Shubenacadie River to spawn at the head of tide.
RED	Atlantic Salmon (Anadromous pops.)	*Salmo salar*	Spawning and nursery habitats in clear, swift-flowing, gravel-cobble substrate streams.
RED	Atlantic Salmon (Landlocked Pops.)	*Salmo salar*	Grand Lake and Lake Charlotte
RED	Atlantic Whitefish	*Coregonus huntsmani*	Not in Pictou County
RED	Atlantic Sturgeon	*Acipenser oxyrhynchus*	Spawns in estuaries.
YELLOW	Brook Stickleback	*Culaea inconstans*	One record only.
YELLOW	Pearl Dace	*Margariscus margarita*	Boggy Lakes and streams. Known Cumberland and Pictou Counties and Lake Ainslie.
YELLOW	Lake Trout (Char)	*Salvelinus namaycush*	Not known in Pictou County.
YELLOW	Brook Trout (Char)	*Salvelinus fontinalis*	Cool well oxygenated waters of lakes and streams.
YELLOW	Gaspereau (Alewife)	*Alosa pseudoharengus*	Enters suitable steams from the sea to spawn in lakes and quiet stretches of streams.

Brook trout and brown trout (*Salmo trutta*) are known in suitable small tributaries at Dalhousie Mountain. There are no boggy lakes or streams in close vicinity to the proposed wind farm development so pearl dace are not expected.

The construction of the wind turbines is on higher elevations and ridges and unlikely to affect any watercourse habitat. Any road construction for the wind farm development will follow NSDEL and Canada Fisheries and Oceans requirements so as not to degrade any fish habitat.

Reference: The Fishes of Nova Scotia's Lakes and Streams. John Gilhen. 1974. Nova Scotia Museum

Vascular Plants

Sean Blaney report findings indicate 9 species of plants are addressed in mitigation procedures to avoid certain habitats where thes are located, this will be performend by Mr Blaney prior to construction

C4- Plant Inventory and Communities with notes on Birds 2007

A vascular plant inventory of the proposed wind turbine array, Dalhousie Mountain, Nova Scotia with notes on plant communities and breeding birds

Error!

Squashberry (*Viburnum edule* – ranked S2 and Sensitive provincially), found at one location on the site. This record represents the first documented mainland Nova Scotia occurrence and is 190 and 160 km disjunct from the next nearest records in northern Cape Breton and Fundy National Park in New Brunswick.

July 27, 2007

Conducted by Sean Blaney and David Mazerolle

for RMS Energy

METHODS

Screening pre-existing records for rare vascular plants

RMS Energy consulted the Atlantic Canada Conservation Data Centre (AC CDC) in February 2007 to determine what rare species were known from the area of the study site and what other rare species might be found there. As recommended by the Nova Scotia Department of Natural Resources, the AC CDC provided a list of all rare species records found within 100 km of the site, along with distance of each record from a central point in the proposed development area. I summarized the vascular plant results by species, listing the closest known record to the Dalhousie Mountain site. I then evaluated the habitat requirements of each species. Appendix 1 lists the 94 rare species identified as having some potential for occurrence on the site. These species were considered species to watch for during field survey efforts. Appendix 2 lists the 169 species considered very unlikely to occur based on habitat.

Vascular Plant Inventory

Fieldwork was conducted by Sean Blaney and David Mazerolle. We visited the study site on June 18, 19 and 20, 2007, spending 39.5 person hours on site and covering 52.1 km on foot. We had pre-programmed the proposed turbine sites into GPS units before fieldwork and visited each turbine site, taking photographs, recording notes on species composition, stand age of forested sites and any obvious disturbance history of the plant community present. We concentrated search effort on the footprint of the proposed development, but also moved outside the linear corridors of the proposed development to cover different or interesting habitats when noted or because of difficulties following straight lines through dense habitats.

We compiled a full vascular plant list for the site as a whole, with estimates of species' relative abundance as follows: rare – seen in small numbers in 4 or fewer locations; uncommon – seen in small numbers in approximately 5 to 8 locations, potentially in larger numbers at one or two of the locations; fairly common – seen in small numbers in approximately 8 to 12 locations, potentially in larger numbers at several of the locations; common – seen at more than 12 (estimated) locations. These categories are not intended to represent precise descriptions of abundance but do provide some measure of relative abundance.

For plant species tracked by the Atlantic Canada Conservation Data Centre (those ranked S1, S2, S3 or S3S4 in Nova Scotia, for which all locations are databased), we recorded GPS locations along with habitat descriptions and more detailed estimates of local abundance.

Breeding Bird Inventory

Although not part of the work we were hired to complete, Sean Blaney made some effort to record bird species by listening for birds and occasionally attempting to attract birds

into view using pishing. He recorded breeding evidence using the codes of the Maritimes Breeding Bird Atlas (http://www.mba-aom.ca/english/mbbaguide.pdf, and listed below). Bird breeding evidence will be entered online into the Maritimes Breeding Bird Atlas.

Results and Discussion

I. Site Coverage

Figure 1 maps the tracks covered on foot during the site visit by Sean Blaney and David Mazerolle. Tracks were recorded by GPS set to record position approximately every 15 seconds while moving (the "more often" track recording setting on a Garmin GPS 76Cx unit).

No site inventory is ever entirely complete, but we visited all turbine sites, walked along all development corridors and visited the full diversity of habitats within those areas. We are confident that the turbine sites and development corridors are relatively thoroughly covered for vascular plants, especially for native species, and that there is a very low probability of significant numbers of additional rare vascular plant species being present within the development footprint.

II. Plant Communities

Descriptions of the plant communities at the proposed turbine sites and the substation site are given in Table 1.

The 41 turbine sites and the single substation site fell into the following broad categories relative to natural heritage value:

1) Young stands (age estimated <20 years) generated following clearcutting, or from old field. 22 sites: Turbines 1, 3, 4, 10, 14, 15, 22, 24, 26, 27, 28, 33, 35, 37, 39, 40, 41, 42, 43, 44, 44A, 45 and the substation. Several of these sites are in clearcuts of forest regenerated from old fields.
2) Young to intermediate aged (estimated stand age 35-75) deciduous or mixed forest. Eight sites: 6, 11, 13, 19, 23, 24, 34, 36, 38.
3) Mature (estimated stand age 75+) deciduous forest, with minimal recent anthropogenic disturbance. 12 sites: Turbines 5, 7, 8, 9, 12, 16, 17, 18, 20, 21, 25, 46. Minor selective cutting had taken place around turbine 21 in the past 10 to 15 years. Turbine sites 12 and 25 had extensive blowdown, probably from Hurricane Juan.

The natural heritage value of the 22 proposed turbine sites in category one above is low because sites are already substantially human-altered, meaning that they are relatively good candidates for turbine development. Although certainly not provincially rare communities, the remaining turbine sites, especially those mature stands in category 3, are generally within good examples of the type of sugar maple – yellow birch – beech forest that predominates in the Cobequid Mountains of northern mainland Nova Scotia. It would be desirable from a natural heritage perspective, where possible, to shift turbine, road and powerline construction away from natural forest, especially the oldest stands,

and toward the more highly altered clearcut, plantation, regenerating old field and logging road habitats. Certainly though, potential impacts of turbine construction do need to be considered in the context of a working landscape in which substantial clearcutting and other forest harvesting is already taking place, meaning that mature forest may not remain as such into the future, independent of the addition of wind turbines.

The most significant community observed was in the area between turbine sites 13 and 20, where a fairly extensive rich seepage area under sugar maple and yellow birch forest occurred. This community type is uncommon but not rare provincially and the example at this site was an especially good one of its type, being unusually rich, quite mature, and containing a number of rare species including the extremely rare Round-Lobed Hepatica (*Hepatica nobilis* var. *obtusa*). This area should be the highest priority community for alterations to the site plan in order to avoid impacts.

Groundwater seepage is very extensive in the study area and the 75m radius construction footprint around a number of turbine sites (turbines 11, 12, 19, 20, 36, 44 and 45) included large, wet seepage areas. In some cases drier potential turbine sites in the immediate area are described in the Notes column of Table 1.

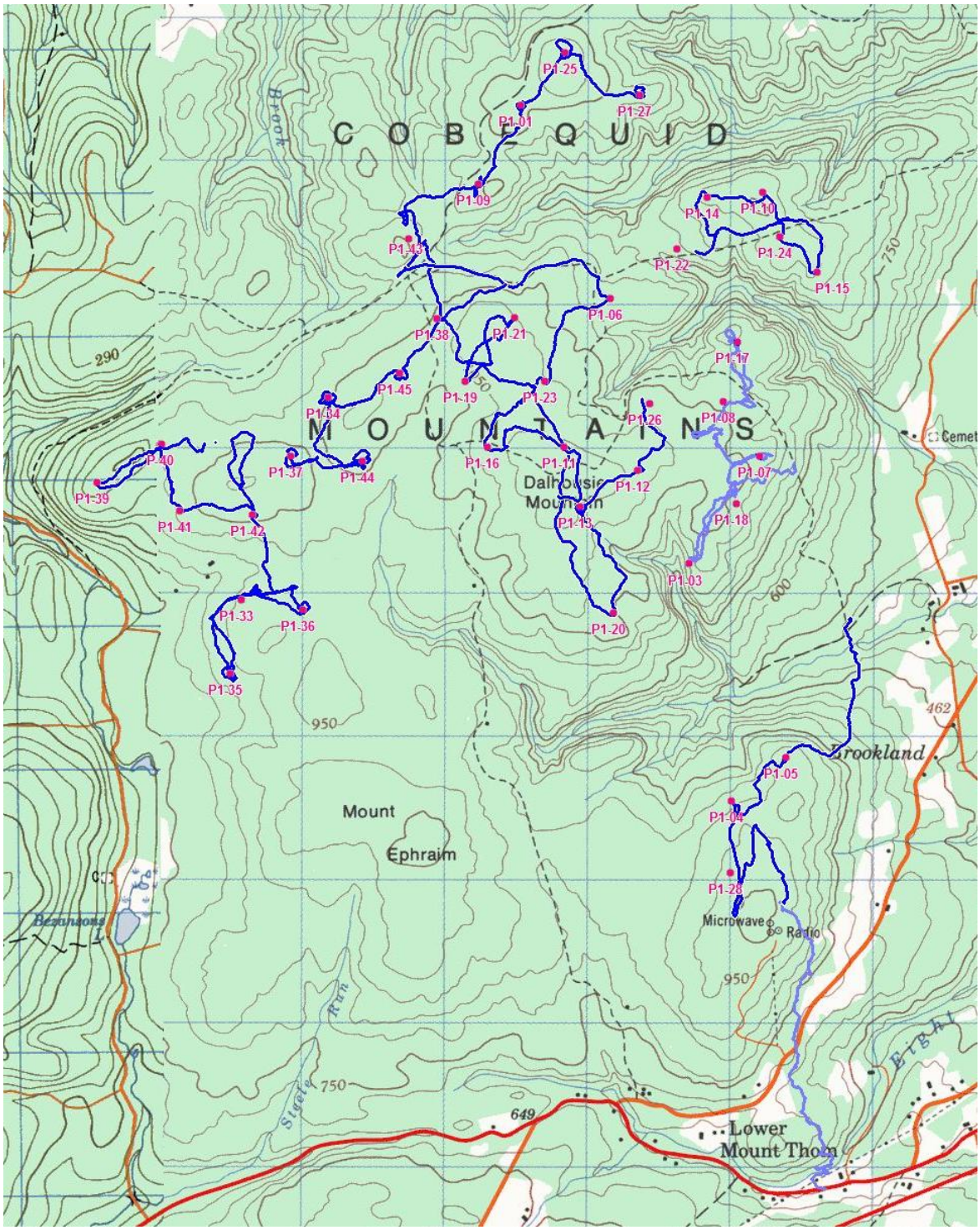

Figure 1. Map of on-foot site coverage on the June 18-20, 2007 survey, with proposed turbine locations. The both pale blue and dark blue lines are tracks recorded by GPS while on foot.

Table 1. Plant communities of proposed turbine and substantion sites. Sites match those mapped in Figure 1. Common names for species listed here are given in the site plant list in Table 2. Observers are: SB = Sean Blaney, DM = David Mazerolle. Cover value percentages in each size class (tree, tall shrub, herb/low shrub) are absolute values, whereas tree species composition percentages are relative to the total tree cover (i.e. 85% of the 35% tree cover at turbine 1 was balsam fir).

Turbine #	Tree Species (~order of abundance)	Forest Age (approx.)	Dominant tall shrub / sapling spp.	Herbaceous & Low Shrub Dominants (bracketed species are less common but indicative of community type)	General description of 75m radius around turbine site & Notes	Observer
1	balsam fir 85%, red maple 15%, red spruce 1%; 35% cover	~10	red maple, *Rubus idaeus* ssp. *strigosus, Rubus allegheniensis, Rubus canadensis*, balsam fir, *Acer pensylvanicum, Acer spicatum, Amelanchier* sp., yellow birch, gray birch, *Corylus cornuta, black spruce, Kalmia angustifolia*; 50% cover	35% cover; forb-graminoid+fern; spp. listed in Appendix 3	area is in recent clearcut; much woody debris; some blowdown	DM
3	sugar maple 80%, red spruce 5%, beech 5%, *Acer pensylvanicum* 5%, *Acer spicatum* 5%; 65% cover	50-75	*Lonicera canadensis*, balsam fir, *Corylus cornuta, Acer pensylvanicum*, sugar maple, beech, *Amelanchier* sp., *Rubus canadensis, Viburnum lantanoides; 55% cover*	70% cover; forb+fern-graminoid; spp. listed in Appendix 3	mesic deciduous forest on gently sloping ground; half of area is in recent clear cut block	DM
4	(sugar maple); 1% cover	10	*Acer spicatum, Acer pensylvanicum*, sugar maple, yellow birch, beech, *Corylus cornuta;* 90% cover	*Dryopteris intermedia, Oclemena acuminata, Maianthemum canadense, Aralia nudicaulis, Phegopteris connectilis;* 75% cover	recent deciduous forest clearcut	SB
5	sugar maple 100%, (yellow birch, beech); 90-95% cover	70-100	beech, sugar maple, *Acer pensylvanicum*; 5% cover	*Dennstaedtia punctilobula, Dryopteris campyloptera, Dryopteris intermedia, Maianthemum canadense, Aralia nudicaulis, (Thelypteris noveborecensis)*	mature deciduous forest	SB
6	sugar maple 100%, (beech, yellow birch); 75-80% cover	70	beech, balsam fir, Acer pensylvanicum; 25% cover	*Dryopteris campyloptera, Erythronium americanum, Aralia nudicaulis, Thelypteris noveboracensis, Maianthemum canadense, (Clintonia borealis, Oclemena acuminata, Carex arctata);* 80% cover	deciduous forest - commercial sugar bush	SB
7	sugar maple 100%; 90% cover	75+	Corylus cornuta, Acer pensylvanicum, white ash, Sambucus racemosa; 5% cover	90% cover; fern-forb-graminoid; spp. listed in Appendix 3	mesic to moist deciduous forest	DM
8	sugar maple 95%, beech 3%, yellow birch 2%; 95% cover	75-100	beech, sugar maple, yellow birch, balsam fir, *Cornus alternifolia, Corylus cornuta, Rubus idaeus* ssp. *strigosus, Sambucus racemosa*; 5% cover	90% cover; fern-forb-graminoid; spp. listed in Appendix 3	mesic deciduous forest	DM

Turbine #	Tree Species (~order of abundance)	Forest Age (approx.)	Dominant tall shrub / sapling spp.	Herbaceous & Low Shrub Dominants (bracketed species are less common but indicative of community type)	General description of 75m radius around turbine site & Notes	Observer
9	sugar maple 85%, beech 10%, balsam fir 5%, yellow birch 1%; 90% cover	75	beech, sugar maple, *Acer spicatum*, *Acer pensylvanicum*, balsam fir, red maple, yellow birch, white birch, *Cornus alternifolia, Corylus cornuta, Lonicera canadensis, Viburnum lantanoides*; 15% cover	70% cover; fern-forb-graminoid; spp. listed in Appendix 3	mesic deciduous forest; bordered by recent clearcut and possible fir plantation	DM
10	white ash 40%, sugar maple 30%, yellow birch 20%, balsam fir 10%; 70% cover	50	balsam fir, sugar maple, *Acer pensylvanicum*, yellow birch, Prunus virginiana, white ash, *Rubus idaeus* ssp. *strigosus*; 35% cover	*Polystichum acrostichoides, Maianthemum canadense, Trientalis borealis, Hieracium lachenalii*; 35% cover	edge of young deciduous forest and old field spruce-fir clearcut; turbine impacts would be slightly reduced by moving them fully within the clearcut (~50m W)	SB
11	yellow birch 50%, sugar maple 40%, (red spruce, balsam fir)1	65	*Corylus cornuta*, yellow birch, balsam fir; 10-15%	*Thelypteris noveboracensis, Dryopteris campyloptera, Dryopteris intermedia, Clintonia borealis, Viola blanda, Maianthemum canadense, Aralia nudicaulis, Oxalis montana, Cornus canadensis, (Coptis trifolia, Panax trifolius);* 90% cover	intermediate-mature, moist to wet deciduous forest; much seepage, seasonal stream flowing through exact spot of turbine	SB
12	yellow birch, sugar maple, balsam fir; 50% cover	60-70 (but heavy recent windthrow)	*Acer spicatum, Acer pensylvanicum*, yellow birch, *Rubus idaeus* ssp. *strigosus, Sambucus racemosa*, sugar maple; 80% cover	*Viola blanda, Coptis trifolia, Impatiens capensis, Cornus canadensis, Phegopteris connectilis, Aralia nudicaulis, Athyrium filix-femina, Osmunda claytoniana*	intermediate aged moist to wet deciduous forest, heavily affected by fairly recent windthrow (probably Hurricane Juan); site is very seepy so turbine perhaps better located further up slope	SB
13	sugar maple 100%, (yellow birch); 80-90% cover	65-75 to S & W; 45 to N & E	sugar maple, yellow birch, balsam fir, *Corylus cornuta*, beech; 30% cover	*Dryopteris campyloptera, Dryopteris intermedia, Clintonia borealis, Thelypteris noveboracensis, Aralia nudicaulis, Viola blanda, Oclemena acuminata, Erythronium americanum, (Prenanthes altissima, Polygonatum pubescens, Ranunculus recurvatus, Maianthemum racemosum, Panax trifolius)*	intermediate aged to mature deciduous forest; quite rich site and fairly seepy in places	SB
14	sugar maple 40%, yellow birch 30%, white ash2 (gray birch, white birch, red maple) 10%; 15% cover (small trees)	10 to 20	*Rubus idaeus* ssp. *strigosus*, balsam fir, yellow birch, *Prunus pensylvanicus;* 70% cover	*Chamerion angustifolium, Fragaria virginiana, Solidago canadensis, Solidago rugosa, Doellingeria umbellata, Euthamia graminifolia, Thelypteris noveboracensis*	recent cutover at margin of old field and deciduous forest	SB
15	yellow birch 40%, white birch 30%, balsam fir 20%, white ash 10%; (borderline in size between sapling & tree)	15	*Rubus idaeus* ssp. *strigosus, Acer spicatum*, white ash, *Prunus virginiana, Lonicera canadensis, Corylus cornuta*; 40-50% cover	*Rubus pubescens, Cornus canadensis, Dryopteris campyloptera, Linnaea borealis*; 65% cover	regenerating 15 year old deciduous forest clearcut	SB

Turbine #	Tree Species (~order of abundance)	Forest Age (approx.)	Dominant tall shrub / sapling spp.	Herbaceous & Low Shrub Dominants (bracketed species are less common but indicative of community type)	General description of 75m radius around turbine site & Notes	Observer
16	sugar maple 60%, yellow birch 20%, beech 20%; 85% cover	100	beech, balsam fir, *Viburnum lantanoides, Lonicera canadensis,* yellow birch, *Corylus cornuta;* 25% cover	*Dryopteris campyloptera, Thelypteris noveboracensis, Erythronium americanum, Aralia nudicaulis, Maianthemum canadense, Clintonia borealis, Osmunda claytoniana, Streptopus lanceolatus, (Panax trifolius)*	mature deciduous forest	SB
17	sugar maple 95%, white ash 3%, *Acer pensylvanicum* 2%; 90% cover	75-100	sugar maple, beech, *Corylus cornuta,* red maple, *Acer pensylvanicum, Acer spicatum, Lonicera canadensis,* red spruce, *Sorbus americana, Viburnum lantanoides;* 8% cover	90% cover; fern-forb-graminoid; spp. listed in Appendix 3	mesic deciduous forest with a few moist areas	DM
18	sugar maple 90%, beech 3%, red spruce 3%, balsam fir 3%; 90% cover	75	red spruce, balsam fir, *Lonicera canadensis;* 5% cover	80% cover; fern-forb-graminoid; spp. listed in Appendix 3	mesic deciduous forest	DM
19	yellow birch 40%, sugar maple 40%, balsam fir3	55-65	balsam fir, yellow birch, (*Corylus cornuta, Acer spicatum*)	*Osmunda claytoniana, Thelypteris noveboracensis, Rubus pubescens, Linnaea borealis, Coptis trifolia, Cornus canadensis, Oxalis montana, (Equisetum sylvaticum)*	very seepy mixed forest swamp and upland forest; becomes drier 40m N of turbine point	SB
20	sugar maple 90%, yellow birch 10%; 85% cover	90-100	beech, yellow birch, sugar maple, *Corylus cornuta;* 25-30% cover	*Dryopteris campyloptera, Thelypteris noveboracensis, Aralia nudicaulis, Viola blanda, Maianthemum canadense, Erythronium americanum, (Prenanthes altissima, Medeola virginiana); 90% cover*	fairly rich, mature deciduous forest; very seepy below turbine site	SB
21	sugar maple 100%, (yellow birch); 70-80% cover	70-100 but light selective cut 10-15 years ago	sugar maple, yellow birch, *Acer pensylvanicum,* balsam fir; 90%	*Dryopteris campyloptera, Erythronium americanum, Aralia nudicaulis, Maianthemum canadense, Phegopteris connectilis, (Polystichum acrostichoides);* 70% cover	mature deciduous forest - light selective cutting in recent past	SB
22	balsam fir, white birch, sugar maple, trembling aspen, white ash; 10-15% cover (small trees)	15	*Rubus idaeus* ssp. *strigosus,* balsam fir, white birch, sugar maple, trembling aspen, white ash, *Prunus pensylvanicus,* red maple, *Acer spicatum, Corylus cornuta, Rubus canadensis;* 85% cover	*Maianthemum canadense, Cornus canadensis, Chamerion angustifolium, Solidago rugosa, Carex debilis var. rudgei, Euthamia graminifolia*	balsam fir plantation or dense regrowth in cutover old field spruce-fir forest	SB
23	sugar maple 60%, yellow birch 30%, balsam fir 10%; 85% cover	75	sugar maple, balsam fir, *Corylus cornuta, Acer pensylvanicum, (Lonicera canadensis, Acer spicatum);* 35% cover	*Thelypteris noveboracensis, Maianthemum canadense, Erythronium americanum, Aralia nudicaulis, Dryopteris campyloptera, Phegopteris connectilis, Rubus pubescens; (Panax trifolius);* 90% cover	moist, moderately mature deciduous forest	SB

Turbine #	Tree Species (~order of abundance)	Forest Age (approx.)	Dominant tall shrub / sapling spp.	Herbaceous & Low Shrub Dominants (bracketed species are less common but indicative of community type)	General description of 75m radius around turbine site & Notes	Observer
24	yellow birch 40%, white birch 30%, balsam fir 30%, (red spruce, sugar maple); 10% cover	10 to 15	yellow birch, white birch, balsam fir, (red spruce, sugar maple); 100% cover	*Maianthemum canadense, Danthonia spicata, Hieracium lachenalii, Solidago puberula, Euthamia graminifolia; 25% cover*	dense young regeneration following recent clearcut, logging road occupies substantial area	SB
25	sugar maple 45%, red maple 20%, beech 10%, yellow birch 15%, red spruce 5%, balsam fir 5%; 75% cover	50; some blowndown trees are much older	balsam fir, *Acer spicatum*, sugar maple, yellow birch, *Lonicera canadensis;* 15% cover	75% cover; fern-forb-graminoid; spp. listed in Appendix 3	mesic deciduous forest with some areas of mixed forest; much blowdown	DM
26	white spruce, balsam fir, yellow birch, sugar maple, white birch; 10-15% cover	20-50	*Rubus idaeus* ssp. *strigosus, Rubus canadensis*, balsam fir, red maple, yellow birch, white spruce, gray birch; 70% cover	*Chamerion angustifolium, Maianthemum canadense, Dryopteris campyloptera, Doellingeria umbellata, Cornus canadensis, Coptis trifolia, Rumex acetosella, Solidago canadensis, Solidago rugosa*	partially cut over old field spruce-fir stand	SB
27	gray birch 60%, balsam fir 35%, red spruce 4%, *Prunus pensylvanica* 1%; 15% cover	15-20	gray birch, *Prunus pensylvanica*, balsam fir, red maple, *Spiraea alba*, yellow birch, black spruce, white birch, *Lonicera canadensis*, red spruce, Rubus idaeus ssp. *strigosus, Rubus canadensis, Sambucus racemosa*; 20% cover	100% cover; graminoid-forb-fern; spp. listed in Appendix 3	area is completely in old field with young woods around edges; signs of old and newer logging; several large old stumps present	DM
28	balsam fir, red maple, yellow birch, (gray birch); 10-25% cover	10	white spruce, yellow birch, *Rubus idaeus* ssp. *strigosus, Rubus canadensis*, red maple; 10% cover	cut over: *Dennstaedtia punctilobula, Maianthemum canadense, Cornus canadensis, Aralia nudicaulis, (Chamerion angustifolium, Doellingeria umbellata);* old field - *Agrostis sp., Anthoxanthum odoratum, Solidago canadensis, Chamerion angustifolium, Fragaria virginiana, Euthamia graminifolia, Doellingeria umbellata*	two habitats: recent deciduous forest cutover and grassy old field	SB
33	yellow birch 60%, sugar maple 30%, Acer spicatum 5%, red maple 5%; 35% cover	avg 20 (including young regrowth), trees left standing during harvest 75-100	yellow birch, *Acer spicatum*, red maple, *Sambucus racemosa*, sugar maple, balsam fir, *Acer pensylvanicum, Lonicera canadensis, Rubus canadensis, Rubus idaeus* ssp. *strigosus, Sorbus americana*; 20% cover	35% cover; forb-fern-graminoid; spp. listed in Appendix 3	selectively cut (recent) mesic deciduous forest; area is adjacent to road and includes disturbed roadsides	DM
34	sugar maple 40%, yellow birch 40%, beech 5%, balsam fir 5%, red maple 5%, *Acer spicatum* 3%, red spruce 2%; 50% cover	40-50 and 10	balsam fir, yellow birch, *Acer spicatum*, red maple, *Acer pensylvanicum, Rubus idaeus* ssp. *strigosus, Sambucus racemosa;* 75% cover	65% cover; forb-fern-graminoid; spp. listed in Appendix 3	moist to mesic young deciduous woods; NW quarter is shoulder height fir stand	DM

Turbine #	Tree Species (~order of abundance)	Forest Age (approx.)	Dominant tall shrub / sapling spp.	Herbaceous & Low Shrub Dominants (bracketed species are less common but indicative of community type)	General description of 75m radius around turbine site & Notes	Observer
35	yellow birch 75%, balsam fir 10%, spruce 8%, red maple 7%; 30% cover	0 and 40-65	balsam fir, red maple, *Acer spicatum*, yellow birch, *Lonicera canadensis, Rubus canadensis, Rubus idaeus* ssp. *strigosus, Ribes glandulosum, Ribes hirtellum;* 5% cover	15% cover; fern+forb-graminoid; spp. listed in Appendix 3	area centered on very recent clearcut (no regeneration yet); 60% percent of area in cut; E, S and W edges are in young to mature moist to wet deciduous forest	DM
36	black/red spruce 45%, red maple 35%, balsam fir 10%, yellow birch 10%; 30% cover	35-50	yellow birch, gray birch, red maple, black spruce, balsam fir, *Acer spicatum, Amelanchier* sp., *Lonicera canadensis,* red spruce, *Ribes triste, Rubus idaeus* ssp. *strigosus, Rubus canadensis;* 40% cover	55% cover; forb-fern-graminoid; spp. listed in Appendix 3	mostly moist to wet mixed acidic woods; wet in N end; centre and E end dry coniferous forest	DM
37	red spruce + Norway spruce 60%, balsam fir 40%; 70% cover	15-20	red spruce, Norway spruce, balsam fir, *Lonicera canadensis, Sambucus racemosa,* sugar maple, yellow birch, *Prunus virginiana, Sambucus racemosa;* 15% cover	25% cover; Fern-forb-graminoid; spp. listed in Appendix 3	dry young coniferous woods (8m tall avg); recent clearcut, probably at least partially old plantation	DM
38	sugar maple 80%, yellow birch 10%, (balsam fir, beech) 10%; 90% cover	60-70	balsam fir, sugar maple, *Corylus cornuta, Acer pensylvanicum, Lonicera canadensis;* 60% cover	*Thelypteris noveboracensis, Erythronium americanum, Aralia nudicaulis, Osmunda claytoniana, Maianthemum canadensis, Clintonia borealis, Phegopteris connectilis, Huperzia lucidula;* 60% cover	relatively dry, moderately mature deciduous forest; a reasonable site, but cutover 100m away would be better	SB
39	~0% cover	7 to 10	yellow birch, red maple, sugar maple, beech, trembling aspen, balsam fir, Salix bebbiana, Rubus idaeus *ssp.* strigosus, Acer pensylvanicum; 85% cover	*Dennstaedtia punctilobula, Thelypteris noveboracensis, Thelypteris noveboracensis, Maianthemum canadense, Erythronium americanum, Scirpus cyperinus, Aralia nudicaulis, Calamagrostis canadensis, Oclemena acuminata*	very young deciduous forest regenerating from clearcut	SB
40	yellow birch, balsam fir, sugar maple, beech; (borderline in size between sapling & tree); 0-85% cover (recent vs. old clearcut)	0-15	yellow birch, balsam fir, sugar maple, beech, *Corylus cornuta, Acer spicatum, Rubus canadensis, Rubus idaeus* ssp. *strigosus, (Cornus alternifllora)*; 5% cover in recent clearcut, 55% cover in older clearcut	*Dennstaedtia punctilobula, Maianthemum canadense, Dryopteris campyloptera, Erythronium americanum, Osmunda claytoniana, Thelypteris noveboracensis*; 50-75% cover	site located in a clearcut from this year, at the edge of a 10-15 year old deciduous forest clearcut	SB
41	~0% cover	0	balsam fir, yellow birch, *Corylus cornuta,* sugar maple, *Acer pensylvanicum, Prunus virginiana;* 85% cover	*Erythronium americanum, Thelypteris noveboracensis, Gymnocarpium dryopteris, Dryopteris campyloptera*	deciduous forest, clearcut last winter	SB

Turbine #	Tree Species (~order of abundance)	Forest Age (approx.)	Dominant tall shrub / sapling spp.	Herbaceous & Low Shrub Dominants (bracketed species are less common but indicative of community type)	General description of 75m radius around turbine site & Notes	Observer
42	~0% cover	10	balsam fir, yellow birch, gray birch, white birch, sugar maple, *Rubus idaeus* ssp. *strigosus;* 20% cover	*Danthonia spicata, Fragaria virginiana, Potentilla simplex, Anaphalis margaritacea, Euthamia graminifolia, Hieracium caespitosum, Hieracium x flagellare, Carex debiliis var. rudgei*	site located in an open log landing area near edge of young deciduous forest clearcut with logging road and balsam fir plantation (or very dense regeneration) nearby	SB
43	black spruce 55%, red maple 30%, balsam fir 15%; 40% cover	>10 and 50	red maple, balsam fir, *Acer pensylvanicum*, red spruce, *Kalmia angustifolia, Sambucus racemosa, Rubus idaeus* ssp. *strigosus;* 30% cover	60% cover; forb-fern+graminoid; spp. listed in Appendix 3	half of area mesic to dry coniferous forest; some areas quite moist with dense moss cover; half of area dry old field and recent cut; much blowdown	DM
44	yellow birch 35%, beech 35%, sugar maple 25%, red spruce 5%; 65% cover	15 and one area with older trees averaging 75-100	*yellow birch, beech, sugar maple, balsam fir, Corylus cornuta, Sambucus racemosa, Cornus alternifolia, Rubus idaeus* ssp. *strigosus, Salix discolor;* 35% cover	*55% cover; fern-forb-graminoid; spp. listed in Appendix 3*	mostly mesic to moist deciduous forest in regeneration; two thirds of area (SW part) is mostly 4m high deciduous woods; signs of fairly recent logging; N end is quite wet; much leaf litter	DM
44A	balsam fir 100%, (white spruce, yellow birch); 90-95% cover	20	balsam fir, *Salix bebbiana, Rubus idaeus* ssp. *strigosus*	*Cornus canadensis, Dennstaedtia punctilobula, Oclemena acuminata, Solidago rugosa, Doellingeria umbellata, Chamerion angustifolium*; 15-80% cover (closed canopy vs. open areas)	dense young balsam fir regenerated in old field	SB
45	balsam fir 30%, red spruce 35%, red maple 10%, sugar maple 10%, beech 15%; 45% cover	50-75 in forest edge, 10 in most of area	balsam fir, red maple, black spruce, red spruce, *Acer pensylvanicum, Acer spicatum,* yellow birch, *Rubus canadensis, Rubus idaeus* ssp. *strigosus, Salix discolor, Salix humilis, Sambucus racemosa, Sorbus americana;* 45% cover	60% cover; graminoid+forb-fern; spp. listed in Appendix 3	SW quarter of area is in edge of swampy deciduous forest; rest is in recent clearcut	DM
46	sugar maple 90%, (yellow birch, beech) 10%; 90% cover	90	Corylus cornuta, sugar maple, beech, balsam fir, *Acer spicatum, Acer pensylvanicum*	*Dennstaedtia punctilobula, Aralia nudicaulis, Thelypteris noveborecensis, Maianthemum canadense, Oxalis montana, Dryopteris campyloptera, (Trillium erectum, Phegopteris connectilis, Panax quinquifolius, Huperzia lucidula)*	mature deciduous forest	SB
substation	balsam fir 25%, spruce 25%, red maple 25%, yellow birch 25%; 5% cover	75 (trees left standing), 30 avg with new regrowth	yellow birch, black spruce, balsam fir, red maple, gray birch, *Salix bebbiana, Lonicera canadensis, Populus tremuloides, Rubus idaeus* ssp. *strigosus, Sambucus racemosa, Salix humilis*; 25% cover	35% cover; forb-fern-graminoid; spp. listed in Appendix 3	centered on 30m diameter ± bare gravel landing area; rest of surveyed area recently clearcut wet deciduous and mixed forest	DM

III. Vascular Plants

Table 2 lists the 304 vascular plant taxa (253 native or potentially native, 51 exotic) identified during fieldwork, with estimates of their abundance within the site and their provincial status under both the S-rank system used continent-wide by all conservation data centres and the National General Status ranks, which have been developed by each province and territory. Both sets of ranks for Nova Scotia were developed through the consensus of the NS Flora Ranking Committee, led through the cooperation of NS Department of Natural Resources (NS DNR) and Atlantic Canada Conservation Data Centre. The ranks reflect the best understanding of plant status at the time of ranking, but are subject to revision as new information becomes available.

Definitions of provincial (subnational) ranks (S-ranks):

S1 Extremely rare throughout its range in the province (typically 5 or fewer occurrences or very few remaining individuals). May be especially vulnerable to extirpation.

S2 Rare throughout its range in the province (usually 6 to 20 occurrences or few remaining individuals). May be vulnerable to extirpation due to rarity or other factors.

S3 Uncommon throughout its range in the province (usually 21 to 100 occurrences), or found only in a restricted range, even if abundant in at some locations.

S4 Usually widespread, fairly common throughout its range in the province (usually 100+ occurrences), and apparently secure, but the element is of long-term concern.

S5 Demonstrably widespread, abundant, and secure throughout its range in the province, and essentially ineradicable under present conditions (100+ occurrences).

S#S# Numeric range rank: A range between two consecutive numeric ranks. Denotes range of uncertainty about the exact rarity of the Element (e.g., S1S2).

SE Exotic: An exotic species established in the province (e.g., Purple Loosestrife or Coltsfoot); may be native in nearby regions.

? Is used as a qualifier indicating uncertainty: for numeric ranks, denotes inexactness, e.g., SE? denotes uncertainty of exotic status. (The ? qualifies the character immediately preceding it in the SRANK).

Definitions of National General Status Ranks (from *Wild Species: the General Status Program in Canada, Lisa Twolan and Simon Nadeau, 2004, Canadian Wildlife Service, Ottawa)*

- *Extirpated*: species that have disappeared from (or are no longer present in) a given geographic area but which occur in other areas
- *Extinct:* species that are extirpated worldwide (i.e., they no longer exist anywhere)
- *At Risk*: species for which a formal detailed risk assessment (COSEWIC assessment or provincial or territorial equivalent) has been completed, and which have been determined to be at risk of extirpation or extinction (i.e., Endangered) or are likely

to become at risk of extirpation or extinction if limiting factors are not reversed (i.e., Threatened)

- *May Be At Risk*: species that may be at risk of extirpation or extinction and are, therefore, candidates for a detailed risk assessment by COSEWIC or the provincial or territorial equivalent
- *Sensitive*: species that are believed to not be at risk of extirpation or extinction but which may require special attention or protection to prevent them from becoming at risk
- *Secure*: species that are believed to not belong in the categories At Risk, May Be At Risk, Extirpated, Extinct, Accidental, or Exotic. This category includes some species that show a declining trend in numbers in Canada but which remain relatively widespread or abundant. In such instances, the decline will be highlighted by an asterisk and an associated comment.
- *Undetermined*: species for which insufficient data, information, or knowledge is available with which to reliably evaluate their general status
- *Not Assessed*: species that are known or believed to be present in the geographic area in Canada to which the general status rank applies but which have not yet been assessed
- *Exotic*: species that have been moved beyond their natural range as a result of human activity. In the *Wild Species 2005* report, exotic species have been purposefully excluded from all other categories.
- *Accidental*: species occurring infrequently and unpredictably outside their usual range

Table 2. Vascular plants recorded in the study area, with abundance estimates and provincial status ranks. Site Status codes and provincial S-ranks are defined above. Taxonomy follows Kartesz (1999) – *Synthesis of the North American Flora*, CD-ROM. Status ranks in square brackets refer to an indefinite identification for which all potential species have the same rank.

Species / Family Name	Family / Species Common Name	Site Status	NS S-rank	NS General Status Rank	Note
LYCOPODIACEAE	**Clubmoss Family**				
Huperzia lucidula	Shining Fir-Clubmoss	c	S5	Secure	
Lycopodium annotinum	Stiff Clubmoss	r	S5	Secure	
Lycopodium clavatum	Running Pine	r	S5	Secure	
Lycopodium dendroideum	Treelike Clubmoss	f	S4?	Secure	
EQUISETACEAE	**Horsetail Family**				
Equisetum arvense	Field Horsetail	c	S5	Secure	
Equisetum sylvaticum	Woodland Horsetail	c	S5	Secure	
OSMUNDACEAE	**Flowering-Fern Family**				
Osmunda cinnamomea	Cinnamon Fern	c	S5	Secure	
Osmunda claytoniana	Interrupted Fern	c	S5	Secure	
DENNSTAEDTIACEAE	**Hay-Scented Fern Family**				
Dennstaedtia punctilobula	Eastern Hay-Scented Fern	c	S5	Secure	
Pteridium aquilinum var. latiusculum	Bracken Fern	f	S5	Secure	

Species / Family Name	Family / Species Common Name	Site Status	NS S-rank	NS General Status Rank	Note
THELYPTERIDACEAE	**Marsh-Fern Family**				
Phegopteris connectilis	Northern Beech Fern	c	S5	Secure	
Thelypteris noveboracensis	New York Fern	c	S5	Secure	
DRYOPTERIDACEAE	**Wood-Fern Family**				
Athyrium filix-femina	Lady-Fern	c	S5	Secure	
Deparia acrostichoides	Silvery Spleenwort	c	S4	Secure	
Dryopteris campyloptera	Mountain Wood-Fern	c	S5	Secure	
Dryopteris carthusiana	Spinulose Shield Fern	r	S5	Secure	
Dryopteris cristata	Crested Shield-Fern	u	S5	Secure	
Dryopteris intermedia	Evergreen Woodfern	c	S5	Secure	
Gymnocarpium dryopteris	Northern Oak Fern	c	S5	Secure	
Matteuccia struthiopteris	Ostrich Fern	f	S5	Secure	
Onoclea sensibilis	Sensitive Fern	c	S5	Secure	
Polystichum acrostichoides	Christmas Fern	c	S5	Secure	
Polystichum braunii	Braun's Holly-Fern	r	S3S4	Secure	
PINACEAE	**Pine Family**				
Abies balsamea	Balsam Fir	c	S5	Secure	
Picea abies	Norway Spruce	c	SE	Exotic	planted only
Picea glauca	White Spruce	c	S5	Secure	
Picea mariana	Black Spruce	r	S5	Secure	
Picea rubens	Red Spruce	f	S5	Secure	
Tsuga canadensis	Eastern Hemlock	r	S4S5	Secure	
RANUNCULACEAE	**Buttercup Family**				
Actaea rubra	Red Baneberry	c	S5	Secure	
Aquilegia vulgaris	European Columbine	r	SE	Exotic	
Coptis trifolia	Goldthread	c	S5	Secure	
Hepatica nobilis var. obtusa	Round-Leaved Hepatica	r	S1	May be at-risk	
Ranunculus abortivus	Kidney-Leaved Buttercup	c	S4S5	Secure	
Ranunculus acris	Tall Butter-Cup	u	SE	Exotic	
Ranunculus recurvatus	Hooked Crowfoot	f	S4	Secure	
Ranunculus repens	Creeping Butter-Cup	c	SE	Exotic	
Thalictrum pubescens	Tall Meadow-Rue	c	S5	Secure	
FUMARIACEAE	**Fumitory Family**				
Dicentra cucullaria	Dutchman's Breeches	c	S4	Secure	
MYRICACEAE	**Bayberry Family**				
Morella pensylvanica	Northern Bayberry	r	S5	Secure	
FAGACEAE	**Beech Family**				
Fagus grandifolia	American Beech	c	S5	Secure	
BETULACEAE	**Birch Family**				
Alnus incana ssp. rugosa	Speckled Alder	u	S5	Secure	
Alnus viridis ssp. crispa	Green Alder	r	S5	Secure	
Betula alleghaniensis	Yellow Birch	c	S5	Secure	
Betula papyrifera var. papyrifera	Heart-Leaved Paper Birch	c	S5	Secure	
Betula populifolia	Gray Birch	c	S5	Secure	
Corylus cornuta	Beaked Hazelnut	c	S5	Secure	
Ostrya virginiana	Eastern Hop-Hornbeam	r	S5	Secure	
PORTULACACEAE	**Purslane Family**				
Claytonia caroliniana	Carolina Spring-Beauty	c	S4	Secure	

Species / Family Name	Family / Species Common Name	Site Status	NS S-rank	NS General Status Rank	Note
CARYOPHYLLACEAE	**Pink Family**				
Moehringia lateriflora	Grove Sandwort	r	S5	Secure	
Stellaria borealis	Northern Stitchwort	r	S4	Secure	
POLYGONACEAE	**Smartweed Family**				
Polygonum cilinode	Fringed Black Bindweed	f	S5	Secure	
Polygonum hydropiper	Marshpepper Smartweed	u	SE	Exotic	
Polygonum sagittatum	Arrow-Leaved Tearthumb	u	S5	Secure	
Rumex acetosa	Garden Sorrel	r	SE	Exotic	
Rumex acetosella	Sheep Sorrel	c	SE	Exotic	
Rumex crispus	Curly Dock	u	SE	Exotic	
Rumex obtusifolius	Bitter Dock	r	SE	Exotic	
CLUSIACEAE	**St. John's-wort Family**				
Hypericum ellipticum	Pale St. John's-Wort	r	S5	Secure	
Hypericum perforatum	A St. John's-Wort	f	SE	Exotic	
VIOLACEAE	**Violet Family**				
Viola blanda	Smooth White Violet	c	S5	Secure	
Viola cucullata	Marsh Blue Violet	c	S5	Secure	
Viola macloskeyi	Smooth White Violet	f	S5	Secure	
Viola pubescens	Downy Yellow Violet	r	S4	Secure	
Viola renifolia	Kidney-Leaf White Violet	r	S4	Secure	
SALICACEAE	**Willow Family**				
Populus grandidentata	Large-Tooth Aspen	r	S5	Secure	
Populus tremuloides	Quaking Aspen	c	S5	Secure	
Salix bebbiana	Bebb's Willow	c	S5	Secure	
Salix discolor	Pussy Willow	c	S5	Secure	
Salix eriocephala	Heart-Leaved Willow	u	S5	Secure	
Salix humilis	Prairie Willow	u	S5	Secure	
Salix pyrifolia	Balsam Willow	u	S5	Secure	
BRASSICACEAE	**Mustard Family**				
Barbarea vulgaris	Yellow Rocket	r	SE	Exotic	
Cardamine diphylla	Two-Leaf Toothwort	c	S4	Secure	
Cardamine pensylvanica	Pennsylvania Bitter-Cress	c	S5	Secure	
ERICACEAE	**Heath Family**				
Kalmia angustifolia	Sheep-Laurel	u	S5	Secure	
Ledum groenlandicum	Common Labrador Tea	r	S5	Secure	
Rhododendron canadense	Rhodora	u	S5	Secure	
Vaccinium angustifolium	Late Lowbush Blueberry	c	S5	Secure	
Vaccinium myrtilloides	Velvetleaf Blueberry	r	S5	Secure	
PYROLACEAE	**Pyrola Family**				
Moneses uniflora	One-Flower Wintergreen	r	S5	Secure	
Pyrola elliptica	Shinleaf	u	S5	Secure	
MONOTROPACEAE	**Indian Pipe Family**				
Monotropa uniflora	Indian-Pipe	u	S5	Secure	
PRIMULACEAE	**Primrose Family**				
Lysimachia terrestris	Swamp Loosestrife	r	S5	Secure	
Trientalis borealis	Northern Starflower	c	S5	Secure	

Species / Family Name	Family / Species Common Name	Site Status	NS S-rank	NS General Status Rank	Note
GROSSULARIACEAE	**Gooseberry Family**				
Ribes glandulosum	Skunk Currant	c	S5	Secure	
Ribes hirtellum	Smooth Gooseberry	u	S5	Secure	
Ribes lacustre	Bristly Black Currant	u	S5	Secure	
Ribes triste	Swamp Red Currant	u	S4	Secure	
CRASSULACEAE	**Stonecrop Family**				
Hylotelephium telephium	Witch's-Moneybags	r	SE	Exotic	
SAXIFRAGACEAE	**Saxifrage Family**				
Chrysosplenium americanum	American Golden-Saxifrage	f	S5	Secure	
Mitella nuda	Naked Bishop's-Cap	c	S5	Secure	
ROSACEAE	**Rose Family**				
Agrimonia striata	Woodland Agrimony	r	S5	Secure	
Amelanchier bartramiana hybrid	Bartram's Serviceberry x serviceberry species	r			
Amelanchier interior	Shadbush	u	S?	Secure	ID probable only
Amelanchier laevis	Allegheny Service-Berry	r	S5	Secure	ID probable only vs. *A. arborea*
Crataegus monogyna	A Hawthorn	r	SE	Exotic	
Fragaria virginiana	Virginia Strawberry	c	S5	Secure	
Geum macrophyllum	Large-Leaved Avens	c	S5	Secure	
Geum rivale	Purple Avens	f	S5	Secure	
Photinia melanocarpa	Black Chokeberry	r	S5	Secure	
Potentilla norvegica ssp. monspeliensis	Norwegian Cinquefoil	u	S5	Secure	
Potentilla recta	Sulphur Cinquefoil	r	SE	Exotic	
Potentilla simplex	Old-Field Cinquefoil	c	S5	Secure	
Prunus pensylvanica	Fire Cherry	f	S5	Secure	
Prunus serotina	Wild Black Cherry	r	S5	Secure	
Prunus virginiana	Choke Cherry	c	S5	Secure	
Rosa virginiana	Virginia Rose	r	S5	Secure	
Rubus (X Hispidi group)	Trailing Blackberry species	r			perhaps *R. provincialis*
Rubus allegheniensis	Allegheny Blackberry	r	S5	Secure	
Rubus canadensis	Smooth Blackberry	c	S5	Secure	
Rubus idaeus ssp. strigosus	American Red Raspberry	c	S5	Secure	
Rubus pubescens	Dwarf Red Raspberry	c	S5	Secure	
Sorbus americana	American Mountain-Ash	f	S5	Secure	
Sorbus aucuparia	European Mountain-Ash	r	SE	Exotic	
Sorbus decora	Northern Mountain-Ash	u	S4	Secure	
Spiraea alba var. latifolia	Northern Meadow-Sweet	u	S5	Secure	
Spiraea tomentosa	Hardhack Spiraea	r	S5	Secure	
FABACEAE	**Bean Family**				
Lotus corniculatus	Birds-Foot Trefoil	r	SE	Exotic	
Trifolium campestre	Low Hop Clover	r	SE	Exotic	
Trifolium hybridum	Alsike Clover	r	SE	Exotic	
Trifolium pratense	Red Clover	r	SE	Exotic	
Trifolium repens	White Clover	r	SE	Exotic	
Vicia cracca	Tufted Vetch	u	SE	Exotic	

Species / Family Name	Family / Species Common Name	Site Status	NS S-rank	NS General Status Rank	Note
ONAGRACEAE	**Evening-Primrose Family**				
Chamerion angustifolium	Fireweed	c	S5	Secure	
Circaea alpina	Small Enchanter's Nightshade	c	S5	Secure	
Epilobium ciliatum	Hairy Willow-Herb	f	S5	Secure	
Epilobium leptophyllum	Linear-Leaved Willow-Herb	u	S5	Secure	
Epilobium palustre	Marsh Willow-Herb	r	S5	Secure	
Oenothera biennis or parviflora	Evening-Primrose species	f	[S5]	[Secure]	
Oenothera perennis	Small Sundrops	f	S5	Secure	
CORNACEAE	**Dogwood Family**				
Cornus alternifolia	Alternate-Leaf Dogwood	c	S5	Secure	
Cornus canadensis	Dwarf Dogwood	c	S5	Secure	
ACERACEAE	**Maple Family**				
Acer pensylvanicum	Striped Maple	c	S5	Secure	
Acer rubrum	Red Maple	c	S5	Secure	
Acer saccharum	Sugar Maple	c	S5	Secure	
Acer spicatum	Mountain Maple	c	S5	Secure	
OXALIDACEAE	**Wood-Sorrel Family**				
Oxalis montana	White Wood-Sorrel	c	S5	Secure	
Oxalis stricta	Upright Yellow Wood-Sorrel	u	S5	Secure	
GERANIACEAE	**Geranium Family**				
Geranium robertianum	Herb-Robert	r	S4S5	Secure	
BALSAMINACEAE	**Touch-Me-Not Family**				
Impatiens capensis	Spotted Jewel-Weed	c	S5	Secure	
ARALIACEAE	**Sarsaparilla Family**				
Aralia hispida	Bristly Sarsaparilla	r	S5	Secure	
Aralia nudicaulis	Wild Sarsaparilla	c	S5	Secure	
Panax trifolius	Dwarf Ginseng	c	S3	Secure	
APIACEAE	**Carrot Family**				
Hydrocotyle americana	American Water-Pennywort	u	S5	Secure	
Osmorhiza claytonii	Hairy Sweet-Cicely	u	S4S5	Secure	
SOLANACEAE	**Nightshade Family**				
Solanum dulcamara	Climbing Nightshade	r	SE	Exotic	
LAMIACEAE	**Mint Family**				
Galeopsis tetrahit	Brittle-Stem Hempnettle	f	SE	Exotic	ID refers to the species in the broad sense, including *G. bifida*
Lycopus americanus	American Bugleweed	r	S5	Secure	
Lycopus uniflorus	Northern Bugleweed	c	S5	Secure	
Mentha arvensis	Corn Mint	r	S5	Secure	
Prunella vulgaris	Self-Heal	c	S5	Secure	
Scutellaria lateriflora	Mad Dog Skullcap	c	S5	Secure	
PLANTAGINACEAE	**Plantain Family**				
Plantago lanceolata	English Plantain	r	SE	Exotic	
Plantago major	Nipple-Seed Plantain	f	SE	Exotic	
OLEACEAE	**Olive Family**				
Fraxinus americana	White Ash	f	S5	Secure	

Species / Family Name	Family / Species Common Name	Site Status	NS S-rank	NS General Status Rank	Note
SCROPHULARIACEAE	**Snapdragon Family**				
Chelone glabra	White Turtlehead	c	S5	Secure	
Verbascum thapsus	Great Mullein	r	SE	Exotic	
Veronica officinalis	Gypsy-Weed	c	S5SE	Exotic	
Veronica serpyllifolia ssp. serpyllifolia	Thyme-Leaved Speedwell	u	SE	Exotic	
RUBIACEAE	**Bedstraw Family**				
Galium asprellum	Rough Bedstraw	c	S5	Secure	
Galium mollugo	Great Hedge Bedstraw	u	SE	Exotic	
Galium palustre	Marsh Bedstraw	c	S5	Secure	
Galium trifidum	Small Bedstraw	u	S5	Secure	ID refers to the species in the broad sense, including *G. tinctorium*
Galium triflorum	Sweet-Scent Bedstraw	c	S5	Secure	
Mitchella repens	Partridge-Berry	r	S5	Secure	
CAPRIFOLIACEAE	**Honeysuckle Family**				
Diervilla lonicera	Northern Bush-Honeysuckle	u	S5	Secure	
Linnaea borealis	Twinflower	f	S5	Secure	
Lonicera canadensis	American Fly-Honeysuckle	c	S5	Secure	
Sambucus racemosa	Red Elderberry	c	S5	Secure	
Viburnum edule	Squashberry	r	S2	Sensitive	
Viburnum lantanoides	Alderleaf Viburnum	f	S5	Secure	
Viburnum nudum var. cassinoides	Wild Raisin	r	S5	Secure	
Viburnum opulus var. americanum	Highbush Cranberry	r	S5	Secure	
ASTERACEAE	**Aster Family**				
Achillea millefolium	Common Yarrow	c	S5	Secure	
Anaphalis margaritacea	Pearly Everlasting	c	S5	Secure	
Antennaria neglecta or howellii	Pussytoes species	r			neither species rare
Arctium minus	Lesser Burdock	r	SE	Exotic	
Bidens frondosa	Devil's Beggar-Ticks	r	S5	Secure	
Cirsium arvense	Creeping Thistle	r	SE	Exotic	
Doellingeria umbellata	Parasol White-Top	c	S5	Secure	
Erigeron strigosus	Daisy Fleabane	u	S5	Secure	
Eupatorium maculatum	Spotted Joe-Pye Weed	u	S5	Secure	
Eupatorium perfoliatum	Common Boneset	r	S5	Secure	
Eurybia macrophylla	Large-Leaf Wood-Aster	r	S5	Secure	
Euthamia graminifolia	Flat-Top Fragrant-Golden-Rod	c	S5	Secure	
Hieracium caespitosum	Meadow Hawkweed	c	SE	Exotic	
Hieracium canadense	Canada Hawkweed	r	S4S5	Secure	
Hieracium lachenalii	Common Hawkweed	c	SE	Exotic	
Hieracium pilosella or x flagellare	Hawkweed species (white leaf undersides)	c	[SE]	[Exotic]	
Hieracium scabrum	Rough Hawkweed	u	S5	Secure	
Hieracium x floribundum	Smoothish Hawkweed	f	SE	Exotic	
Lactuca biennis	Tall Blue Lettuce	f	S5	Secure	
Lactuca canadensis	Canada Lettuce	u	S5	Secure	
Leontodon autumnalis	Autumn Hawkbit	u	SE	Exotic	
Leucanthemum vulgare	Oxeye Daisy	f	SE	Exotic	
Leucanthemum vulgare	Oxeye Daisy	c	SE	Exotic	

Species / Family Name	Family / Species Common Name	Site Status	NS S-rank	NS General Status Rank	Note
Matricaria discoidea	Pineapple-Weed Chamomile	r	SE	Exotic	
Oclemena acuminata	Whorled Aster	c	S5	Secure	
Packera schweinitziana	Robbins Squaw-Weed	c	S4S5	Secure	
Petasites frigidus var. palmatus	Sweet Coltsfoot	r	S4S5	Secure	
Prenanthes altissima	Tall Rattlesnake-root	c	S4S5	Secure	
Prenanthes trifoliolata	Three-Leaved Rattlesnake-root	u	S5	Secure	
Senecio jacobaea	Tansy Ragwort	u	SE	Exotic	
Solidago bicolor	White Goldenrod	u	S5	Secure	
Solidago canadensis	Canada Goldenrod	c	S5	Secure	
Solidago flexicaulis	Broad-Leaved Goldenrod	f	S5	Secure	
Solidago juncea	Early Goldenrod	r	S5	Secure	
Solidago macrophylla	Large-Leaf Goldenrod	u	S4	Secure	
Solidago puberula	Downy Goldenrod	c	S5	Secure	
Solidago rugosa	Rough-Leaf Goldenrod	c	S5	Secure	
Solidago uliginosa	Bog Goldenrod	u	S5	Secure	
Sonchus arvensis	Field Sowthistle	r	SE	Exotic	
Symphyotrichum lateriflorum	Farewell-Summer	c	S5	Secure	
Symphyotrichum novi-belgii	New Belgium American-Aster	r	S5	Secure	
Symphyotrichum puniceum	Swamp Aster	c	S5	Secure	
Taraxacum officinale	Common Dandelion	c	SE	Exotic	
Tripleurospermum maritima	False Mayweed	r	SE	Exotic	
Tussilago farfara	Colt's Foot	u	SE	Exotic	
ARACEAE	**Arum Family**				
Arisaema triphyllum	Swamp Jack-In-The-Pulpit	r	S4S5	Secure	
JUNCACEAE	**Rush Family**				
Juncus balticus var. littoralis	Baltic Rush	r	S5	Secure	
Juncus brevicaudatus	Narrow-Panicled Rush	r	S5	Secure	ID probable only – very young
Juncus bufonius	Toad Rush	u	S5	Secure	
Juncus effusus	Soft Rush	c	S5	Secure	
Juncus filiformis	Thread Rush	r	S5	Secure	
Juncus tenuis	Slender Rush	f	S5	Secure	
Luzula acuminata	Hairy Woodrush	r	S5	Secure	
Luzula multiflora	Common Woodrush	c	S5	Secure	
CYPERACEAE	**Sedge Family**				
Carex arctata	Black Sedge	c	S5	Secure	
Carex brunnescens ssp. sphaerostachya	Brownish Sedge	c	S5	Secure	
Carex canescens	Hoary Sedge	u	S5	Secure	
Carex communis	Fibrous-Root Sedge	c	S5	Secure	
Carex crawfordii	Crawford Sedge	r	S5	Secure	
Carex crinita	Fringed Sedge	r	S4S5	Secure	
Carex debilis	White-Edge Sedge	c	S5	Secure	
Carex deweyana	Short-Scale Sedge	c	S4	Secure	
Carex disperma	Softleaf Sedge	c	S5	Secure	
Carex flava	Yellow Sedge	u	S5	Secure	
Carex gracillima	Graceful Sedge	u	S4S5	Secure	
Carex gynandra	A Sedge	c	S5	Secure	
Carex interior	Inland Sedge	f	S4S5	Secure	ID probable only

Species / Family Name	Family / Species Common Name	Site Status	NS S-rank	NS General Status Rank	Note
Carex intumescens	Bladder Sedge	c	S5	Secure	
Carex lenticularis	Shore Sedge	r	S4	Secure	
Carex leptalea	Bristly-Stalk Sedge	c	S5	Secure	
Carex leptonervia	Finely-Nerved Sedge	c	S5	Secure	
Carex magellanica ssp. irrigua	A Sedge	r	S5	Secure	
Carex novae-angliae	New England Sedge	c	S5	Secure	
Carex pallescens	Pale Sedge	u	S5	Secure	
Carex projecta	Necklace Sedge	c	S4S5	Secure	
Carex scabrata	Rough Sedge	u	S5	Secure	
Carex scoparia	Pointed Broom Sedge	f	S5	Secure	
Carex stipata	Stalk-Grain Sedge	c	S5	Secure	
Carex torta	Twisted Sedge	r	S5	Secure	
Carex trisperma var. trisperma	Three-Seed Sedge	u	S5	Secure	
Eleocharis tenuis	Slender Spike-Rush	r	S5	Secure	ID refers to the species in the broad sense, including *E. elliptica*
Scirpus atrocinctus	Black-Girdle Bulrush	r	S5	Secure	
Scirpus cyperinus	Cottongrass Bulrush	c	S5	Secure	ID probable only vs. *S. atrocinctus*
Scirpus hattorianus	Bulrush	f	S5	Secure	
Scirpus microcarpus	Small-Fruit Bulrush	f	S5	Secure	
POACEAE	**Grass Family**				
Agrostis gigantea	Black Bentgrass	u	SE	Exotic	
Agrostis perennans	Perennial Bentgrass	u	S4S5	Secure	ID probable only
Anthoxanthum odoratum	Sweet Vernal Grass	u	SE	Exotic	
Brachyelytrum septentrionale	Bearded Short-Husk	u	S4S5	Secure	
Bromus ciliatus	Fringed Brome	r	S4S5	Secure	
Calamagrostis canadensis	Blue-Joint Reedgrass	f	S5	Secure	
Cinna latifolia	Slender Wood Reedgrass	c	S5	Secure	
Dactylis glomerata	Orchard Grass	r	SE	Exotic	
Danthonia spicata	Poverty Oat-Grass	c	S5	Secure	
Dichanthelium acuminatum	Panic Grass	c	S5	Secure	
Dichanthelium boreale	Northern Witchgrass	r	S5	Secure	
Elymus repens	Quackgrass	r	SE	Exotic	
Festuca filiformis	Hair Fescue	c	SE	Exotic	
Festuca rubra	Red Fescue	u	S5	Secure	
Glyceria canadensis	Canada Manna-Grass	r	S5	Secure	
Glyceria striata	Fowl Manna-Grass	c	S5	Secure	
Milium effusum var. cisatlanticum	Tall Millet-Grass	u	S3	Secure	
Phalaris arundinacea	Reed Canary Grass	u	S5	Secure	
Phleum pratense	Meadow Timothy	r	SE	Exotic	
Poa alsodes	Grove Meadow Grass	u	S4	Secure	
Poa annua	Annual Bluegrass	u	SE	Exotic	
Poa compressa	Canada Bluegrass	u	SE	Exotic	
Poa palustris	Fowl Bluegrass	f	S5	Secure	
Poa pratensis	Kentucky Bluegrass	c	S5	Secure	
Poa saltuensis	Drooping Bluegrass	r	S4S5	Secure	
Torreyochloa pallida var. fernaldii	Pale Manna Grass	r	S4S5	Secure	

Species / Family Name	Family / Species Common Name	Site Status	NS S-rank	NS General Status Rank	Note
TYPHACEAE	**Cattail Family**				
Typha latifolia	Broad-Leaf Cattail	r	S5	Secure	
LILIACEAE	**Lily Family**				
Clintonia borealis	Clinton Lily	c	S5	Secure	
Erythronium americanum	Yellow Trout-Lily	c	S4S5	Secure	
Maianthemum canadense	Wild Lily-of-The-Valley	c	S5	Secure	
Maianthemum racemosum	Solomon's-Plume	c	S4S5	Secure	
Medeola virginiana	Indian Cucumber-Root	f	S5	Secure	
Polygonatum pubescens	Downy Solomon's-Seal	c	S4S5	Secure	
Streptopus amplexifolius	Clasping Twisted-Stalk	f	S4S5	Secure	
Streptopus lanceolatus	Rosy Twistedstalk	c	S5	Secure	
Trillium cernuum	Nodding Trillium	f	S4	Secure	
Trillium erectum	Red Trillium	f	S3	Secure	
Trillium undulatum	Painted Trillium	r	S5	Secure	
IRIDACEAE	**Iris Family**				
Sisyrinchium montanum	Strict Blue-Eyed-Grass	u	S5	Secure	
ORCHIDACEAE	**Orchid Family**				
Corallorhiza trifida	Early Coralroot	u	S3	Secure	
Cypripedium acaule	Pink Lady's-Slipper	u	S5	Secure	
Listera convallarioides	Broad-Leaved Twayblade	r	S3	Secure	
Platanthera dilatata	Leafy White Orchis	u	S4S5	Secure	
Platanthera orbiculata	Large Roundleaf Orchid	r	S3	Secure	ID probable only vs. *P. macrophylla*
Platanthera psycodes	Small Purple-Fringe Orchis	u	S4	Secure	ID probable only vs. *P. grandiflora*

III. Rare vascular plants

a) Screening pre-existing records for rare vascular plants

Seven of the 94 pre-identified potential rare plant species were found on the site (Table 4) and two additional rare plant species were also found. One of these (Round-Leaved Hepatica – *Hepatica nobilis* var. *obtusa*) had been considered unlikely to occur based on previous understanding of its habitat in Nova Scotia, and the other species (Squashberry – *Viburnum edule*) was not identified as a potential species because there were no previous records within 100 km.

b) Rare plants observed in the field

Nine rare plant species tracked by the Atlantic Canada Conservation Data Centre (S-ranks of S1 to S3S4) were found on the site. They are listed below, with their status on the site and within Nova Scotia described in detail. Only two of these rare species have General Status ranks of *May be at Risk* or *Sensitive* (the Round-Leaved Hepatica and Squashberry noted above), which make them of concern to NS DNR. The remaining seven species are ranked *Secure* in Nova Scotia under the National General Status of Wildlife process and are thus of limited concern to NS DNR. Figures 2 to 4 map rare species locations, with Figure 2 mapping species of concern to NS DNR, Figure 3 mapping species tracked by AC CDC mapping species tracked by AC CDC but ranked Secure by NS DNR (except for Dwarf Ginseng), and Figure 4 mapping Dwarf Ginseng.

i) Very rare species, of concern to Nova Scotia Department of Natural Resources, mapped in Figure 2.

Round-Leaf Hepatica - *Hepatica nobilis* var. *obtusa* (S1, May be at-risk)
Points 169-170
This species was found in a single area at the study site, with approximately 35 plants seen over 20m along a very rich, seepy streambed in sugar maple – yellow birch forest slightly east of the line between turbines 13 and 20. Round-Leaf Hepatica has been found in Nova Scotia between the Digby and Bridgewater areas and Pictou, with several sites not having been seen for over 50 years, and numbers low at most sites. The AC CDC is aware of XX extant records in Nova Scotia.

Squashberry - *Viburnum edule* (S2, Sensitive)
197
One small patch was found over a 3m x 3m area in balsam fir – black spruce swamp along or very close to the undeveloped access road and powerline alignment between turbines 16 and 23. This represents the first mainland Nova Scotia record for this northern species, 190 km from the nearest records in Cape Breton, where it is locally fairly frequent along rivers in the Cape Breton Highlands and 160 km from records in Fundy National Park in New Brunswick.

ii) Marginally rare species, tracked by Atlantic Canada Conservation Data Centre but of limited concern to Nova Scotia Department of Natural Resources, mapped in Figure 3 except for Dwarf Ginseng

Early Coralroot - *Corallorhiza trifida* (S3, Secure)
Plants were seen in three areas: 70m from turbine 20, 80m from turbine 18, 204, and 100m & 120m from turbine 19 (sites separated by 90m) with the latter site being unusually large with hundreds of stems. In all cases, plants were in small, wet, seepage areas with *Sphagnum* moss and Cinnamon Ferns (*Osmunda cinnomomea*) within sugar maple – yellow birch forest. The species is widespread but uncommon across northern Nova Scotia from the Annapolis Valley to Cape Breton and is rare in southern Nova Scotia.

Broad-Leaved Twayblade - *Listera convallarioides* (S3, Secure)
This species was seen in a single spot, where it co-occurred with Early Coralroot, in a wet, seepage area with *Sphagnum* moss and Cinnamon Ferns (*Osmunda cinnomomea*) in sugar maple – yellow birch forest, 70m of Turbine 20. Broad-lipped Twayblade is locally quite common in seepy, shaded sites along Cape Breton Highland rivers but is rare on the mainland of Nova Scotia where it is known primarily from rich, seepy sites in sugar maple forest.

Tall Millet-Grass - *Milium effusum* var. *cisatlanticum* (S3, Secure)
Plants were seen in three rich, seepy areas in sugar maple-dominated forest within 220m of Turbine 13 and also at two sites within 40m of Turbine 20. This grass species is

uncommon to locally common in richer, higher elevation sugar maple forests in the Cape Split area, the Cobequid Mountains and in Cape Breton. It is very rare in lowland deciduous forests in Nova Scotia.

Dwarf Ginseng - *Panax trifolius* (S3, Secure)
This species was present in large numbers, primarily in more mature deciduous forests, in 54 recorded sites within the proposed development area (mapped in Figure 4), including many stretches where it was present for many metres. Recent 2007 fieldwork by Sean Blaney and the AC CDC in Cobequid Mountain sites between Portapique and Marshy Hope has found this species to be widespread and locally abundant in deciduous forests. If this level of abundance (which is not known in other regions of the Maritimes) is general across the eastern part of the Cobequid Mountains, this species' S-rank should be revised to S4. Dwarf Ginseng occurrences observed on site are mapped in Figure XX, but these undoubtedly under-represent the total distribution of the species in the study area. It appears to be present in most deciduous forest on-site. Because of the widespread occurrence of Dwarf Ginseng, avoiding impacts on more mature and less-disturbed forest habitats, where possible, is probably more valuable for conserving the natural heritage value of the site than is concern over particular Dwarf Ginseng populations, especially the few that occur in already significantly disturbed habitats. The locations where Dwarf Ginseng is most abundant do, however, tend to correlate with the highest quality deciduous forest habitats on site.

Large Roundleaf Orchid - *Platanthera orbiculata* (S3, Secure*)
*The possibility of the plant being Larger Roundleaf Orchid (*P. macrophylla* – S2, Sensitive) cannot be ruled out.
A single plant was seen in young (about 25 years old) yellow birch – balsam fir forest 430m north of Turbine 28. The plant was not mature enough to allow it to be distinguished from the Larger Roundleaf Orchid (*Platanthera macrophylla*), which is significantly rarer but possible at the location. The plant's small leaf size and simple probability mean, however, that the record most likely reprensents *P. orbiculata*. This species is widespread but uncommon in a wide range of coniferous, mixed and deciduous forest types across northern Nova Scotia. Its unspecialized habitat and wide distribution make it a candidate for a future ranking revision to S4 that would remove it from the AC CDC tracking list.

Red Trillium - *Trillium erectum* (S3, Secure)
This species was scattered in sugar maple forest in the southeastern part of the study area and uncommon in similar habitats elsewhere. It has a relatively limited distribution in Nova Scotia, being restricted to the Annapolis Valley and Cobequid Mountains north to about the New Glasgow area but it can be locally abundant within those regions to the point where it is a strong candidate for ranking revision to S4, which would remove it from the AC CDC tracking list.

Braun's Holly-Fern - *Polystichum braunii* (S3S4, Secure)

A few individuals were seen in rich, seepy, deciduous slope forest between turbines 13 and 20. This species is locally common in Cape Breton and the Blomidon area and widespread but uncommon in cool ravines and steep slopes throughout the northern mainland of Nova Scotia, and may also warrant rank revision to S4.

IV. Breeding Birds

Table 3 lists the 41 bird species recorded within or around the site, along with the breeding evidence obtained for each. The list in Table 3 should not be considered a comprehensive list of the breeding birds of the site because birds were not the primary focus of the fieldwork, I made no early morning or nocturnal field effort, and conditions were very unfavourable for bird inventory (cool, windy and rainy) during two of the three days of surveying. All species found were non-rare with General Status ranks of Secure in Nova Scotia.

Table 3. Birds observed on or near site with breeding evidence obtained. Species are listed by breeding evidence obtained from highest to lowest breeding evidence.

Species	S-rank	General Status Rank	Breeding Evidence on Site	Comments
Lincoln's Sparrow	S5B	Secure	Confirmed - Adult carrying food	
Ovenbird	S5B	Secure	Confirmed - Adult entering or leaving presumed nest site	
Song Sparrow	S5B	Secure	Confirmed - Distraction display	
Common Yellowthroat	S5B	Secure	Confirmed - Distraction display	
Ruffed Grouse	S5	Secure	Confirmed - Fledged young	
Mourning Dove	S5B	Secure	Probable - Pair observed in suitable habitat	along road to south of site
Alder Flycatcher	S5B	Secure	Probable - Pair observed in suitable habitat	
Common Raven	S5	Secure	Probable - Pair observed in suitable habitat	
White-throated Sparrow	S5B,SZN	Secure	Probable - Agitated behaviour	
Dark-eyed Junco	S5	Secure	Probable - Agitated behaviour	
American Robin	S5B	Secure	Probable - Display or territorial interaction between two adults	
Black-throated Green Warbler	S5B	Secure	Probable - Display or territorial interaction between two adults	
Pileated Woodpecker	S5	Secure	No breeding evidence - old holes	
Yellow-bellied Sapsucker	S5B	Secure	Possible - Observed in suitable habitat	
Black-capped Chickadee	S5	Secure	Possible - Observed in suitable habitat	
Hairy Woodpecker	S5	Secure	Possible - Observed in suitable habitat	
American Goldfinch	S5	Secure	Possible - Observed in suitable habitat	
Cedar Waxwing	S5B	Secure	Possible - Observed in suitable habitat	
Northern Flicker	S5B	Secure	Possible - Observed in suitable habitat	
Common Grackle	S5B	Secure	Possible - Observed in suitable habitat	along road to south of site
American Crow	S5	Secure	Possible - Observed in suitable habitat	
Red-tailed Hawk	S5B	Secure	Possible - Observed in suitable habitat	
Blue Jay	S5	Secure	Possible - Observed in suitable habitat	
Blackburnian Warbler	S4S5B	Secure	Possible - Singing male in suitable habitat	
American Redstart	S5B	Secure	Possible - Singing male in suitable habitat	

Species	S-rank	General Status Rank	Breeding Evidence on Site	Comments
Least Flycatcher	S5B	Secure	Possible - Singing male in suitable habitat	
Magnolia Warbler	S5B	Secure	Possible - Singing male in suitable habitat	
Mourning Warbler	S5B	Secure	Possible - Singing male in suitable habitat	
Chestnut-sided Warbler	S5B	Secure	Possible - Singing male in suitable habitat	
Ruby-crowned Kinglet	S5B	Secure	Possible - Singing male in suitable habitat	
Palm Warbler	S5B	Secure	Possible - Singing male in suitable habitat	
Yellow-bellied Flycatcher	S5B	Secure	Possible - Singing male in suitable habitat	
Black-and-white Warbler	S5B	Secure	Possible - Singing male in suitable habitat	
Northern Parula	S5B	Secure	Possible - Singing male in suitable habitat	
Winter Wren	S5B	Secure	Possible - Singing male in suitable habitat	
Yellow-rumped Warbler	S5B	Secure	Possible - Singing male in suitable habitat	
Hermit Thrush	S5B	Secure	Possible - Singing male in suitable habitat	
Golden-crowned Kinglet	S5B	Secure	Possible - Singing male in suitable habitat	
Swainson's Thrush	S5B	Secure	Possible - Singing male in suitable habitat	
Blue-headed Vireo	S5B	Secure	Possible - Singing male in suitable habitat	
Red-eyed Vireo	S5B	Secure	Probable - Pair observed in suitable habitat	

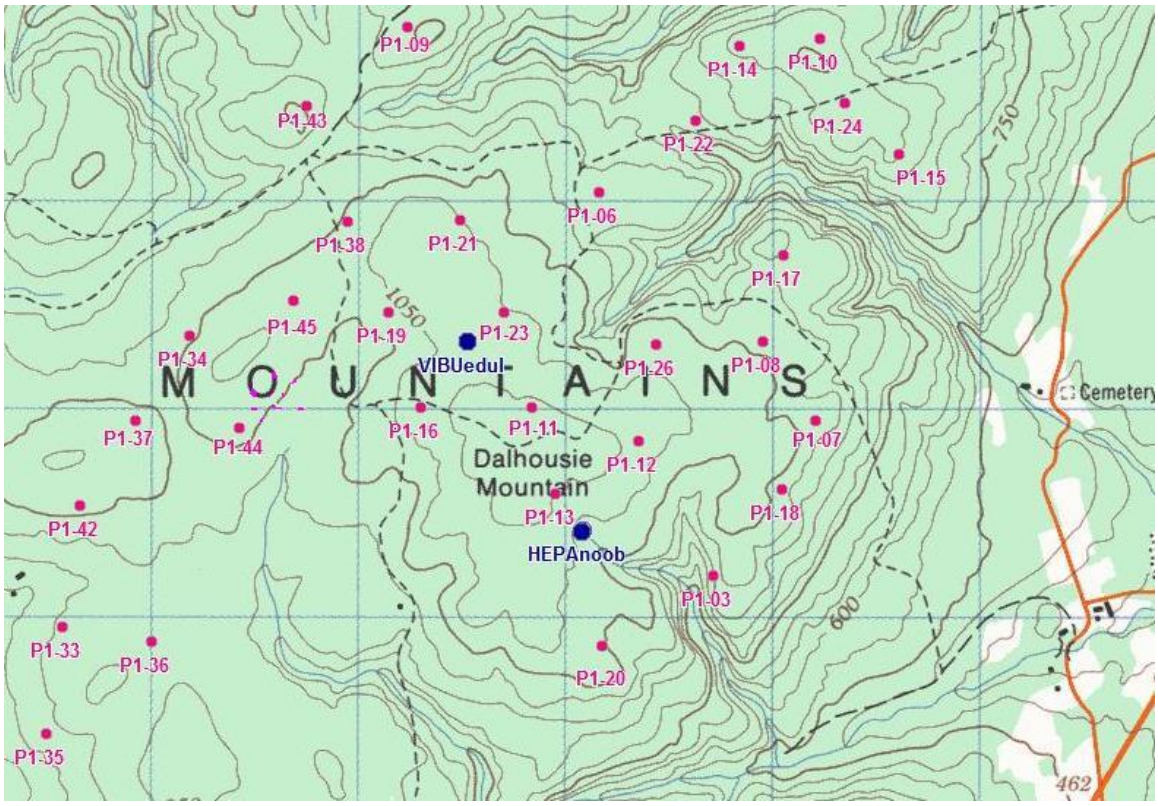

Figure 2. Locations of rare plant species of concern to Nova Scotia Department of Natural Resources, in relation to proposed turbine sites. Pink dots are proposed turbine

locations, blue dots are rare plant sites. VIBUedul = Squashberry (*Viburnum edule*), HEPAnoob = Round-Lobed Hepatica (*Hepatica nobilis* var. *obtusa*).

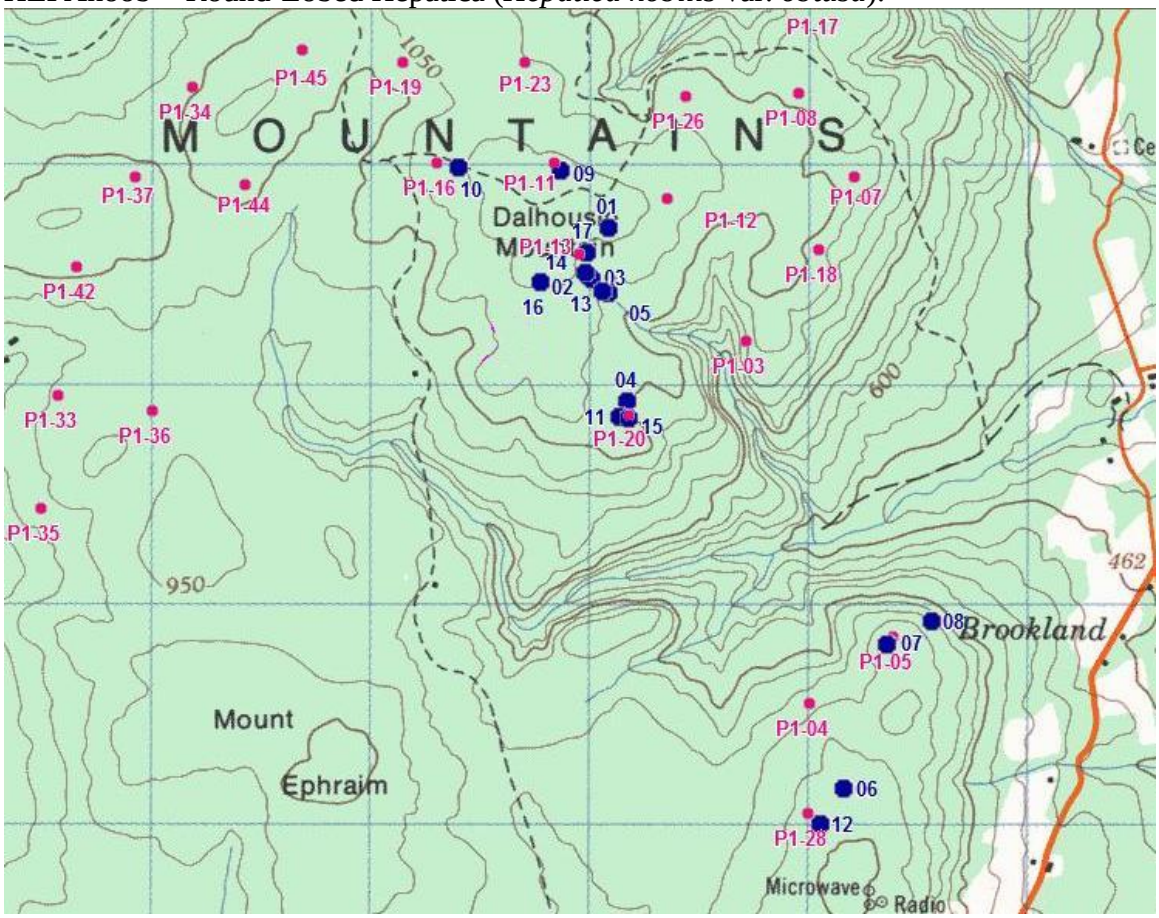

Figure 3. Rare plant species locations in relation to proposed turbine sites for species tracked by AC CDC but ranked Secure by NS DNR (Dwarf Ginseng - *Panax trifolius* excluded). Pink dots are proposed turbine sites and blue dots are rare plant locations, numbers correspond to species as noted below.

Species	**Common Name**	**Map Site Numbers**
Corallorhiza trifida	Early Coralroot	04, 09, 10
Listera convallarioides	Broad-Leaved Twayblade	04
Milium effusum var. cisatlanticum	Tall Millet-Grass	01, 02, 03, 11, 14, 15, 16
Platanthera orbiculata	Large Roundleaf Orchid	06
Polystichum braunii	Braun's Holly-Fern	05, 12, 13
Trillium erectum	Ill-Scent Trillium	07, 08, 17

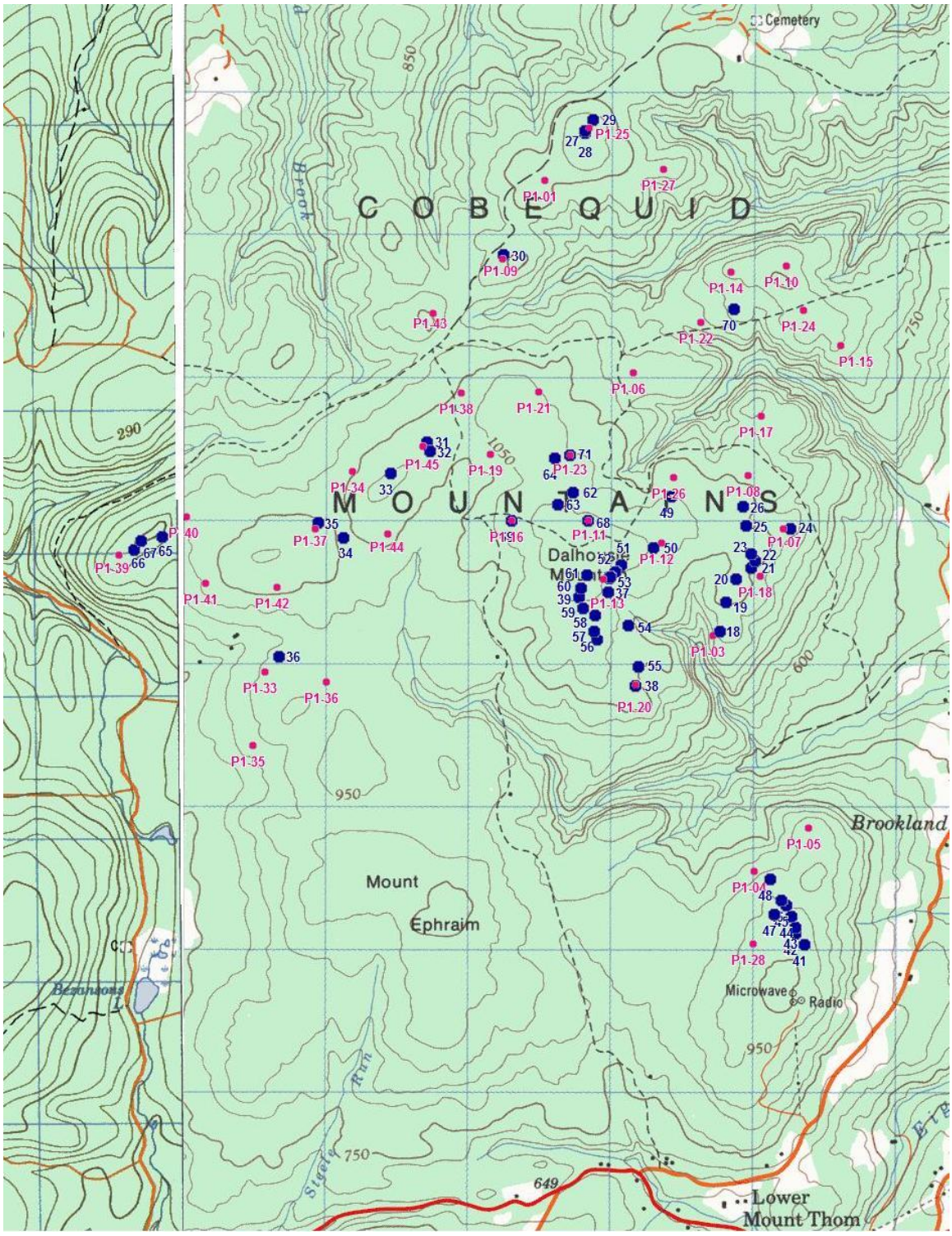

Figure 4. Dwarf Ginseng (*Panax trifolius*) locations in relation to proposed turbine locations plant species locations in relation to proposed development footprint. Blue dots are locations of Dwarf Ginseng and pink dots are proposed turbine locations.

Appendix 1. Plant species rare in Nova Scotia and occurring within 100 km of the proposed development in AC CDC records that were identified as potentially occurring on the site. Species are listed alphabetically, along with Nova Scotia S-rank, General Status rank and distance to the nearest known record.

Species	Common Name	S-rank	GS Rank	Distance
Ageratina altissima	White Snakeroot	S1	Sensitive	82 km +/-10 km
Agrimonia gryposepala	Tall Hairy Groovebur	S3?	Secure	9 km +/-0 km
Allium tricoccum	Small White Leek	S1	May be at-risk	14 km +/-0.1 km
Alopecurus aequalis	Short-Awn Foxtail	S2S3	Sensitive	28 km +/-10 km
Amelanchier fernaldii	Fernald Serviceberry	S2?	Undetermined	83 km +/-5 km
Amelanchier stolonifera	Running Serviceberry	S3?	Secure	56 km +/-1 km
Anemone quinquefolia	Wood Anemone	S2	Sensitive	39 km +/-0.1 km
Bidens connata	Purple-Stem Swamp Beggar-Ticks	S3?	Sensitive	51 km +/-0 km
Botrychium dissectum	Cutleaf Grape-Fern	S3	Secure	10 km +/-5 km
Botrychium lanceolatum var. angustisegmentum	Lance-Leaf Grape-Fern	S2	Sensitive	8 km +/-1 km
Botrychium simplex	Least Grape-Fern	S2S3	Sensitive	78 km +/-1 km
Caltha palustris	Marsh Marigold	S2	Sensitive	40 km +/-0.1 km
Campanula aparinoides	Marsh Bellflower	S3?	Sensitive	7 km +/-0 km
Carex adusta	Crowded Sedge	S2S3	Sensitive	34 km +/-0.5 km
Carex albicans var. emmonsii	Emmons Sedge	S3S4	Secure	56 km +/-5 km
Carex alopecoidea	Foxtail Sedge	S1	May be at-risk	85 km +/-5 km
Carex argyrantha	Hay Sedge	S3S4	Secure	61 km +/-5 km
Carex bebbii	Bebb's Sedge	S1S2	May be at-risk	49 km +/-0 km
Carex bromoides	Brome-Like Sedge	S3	Secure	12 km +/-0 km
Carex foenea	Dry-Spike Sedge	S3?	Secure	42 km +/-0.5 km
Carex hirtifolia	Pubescent Sedge	S2S3	Sensitive	12 km +/-0 km
Carex houghtoniana	A Sedge	S2?	Sensitive	50 km +/-5 km
Carex ormostachya	Necklace Spike Sedge	S1	May be at-risk	94 km +/-1 km
Carex peckii	White-Tinged Sedge	S2?	Undetermined	30 km +/-0.1 km
Carex pensylvanica	Pennsylvania Sedge	S1S2	Undetermined	90 km +/-0.1 km
Carex plantaginea	Plantain-Leaved Sedge	S1	May be at-risk	28 km +/-0.1 km
Carex rosea	Rosy Sedge	S3	Secure	17 km +/-0 km
Carex tenera	Slender Sedge	S1S2	Sensitive	6 km +/-5 km
Carex tincta	Tinged Sedge	S1	May be at-risk	92 km +/-1 km
Carex wiegandii	Wiegand's Sedge	S1	May be at-risk	56 km +/-5 km
Coeloglossum viride var. virescens	Long-Bract Green Orchis	S2	Sensitive	60 km +/-0.1 km
Corallorhiza trifida	Early Coralroot	S3	Secure	34 km +/-0.5 km
Crataegus robinsonii	A Hawthorn	S1?	Undetermined	18 km +/-1 km
Cypripedium parviflorum var. pubescens	Large Yellow Lady's-Slipper	S2	Sensitive	22 km +/-10 km
Cypripedium reginae	Showy Lady's-Slipper	S2	May be at-risk	42 km +/-10 km
Cystopteris bulbifera	Bulblet Fern	S3S4	Secure	26 km +/-0.1 km
Cystopteris tenuis	A Bladderfern	S3?	Secure	14 km +/-1 km
Eleocharis nitida	Slender Spike-Rush	S3	Secure	76 km +/-1 km
Eleocharis ovata	Ovate Spikerush	S2?	Sensitive	14 km +/-0.5 km
Epilobium coloratum	Purple-Leaf Willow-Herb	S2?	Sensitive	28 km +/-1 km
Equisetum pratense	Meadow Horsetail	S2	Sensitive	25 km +/-0.1 km
Equisetum scirpoides	Dwarf Scouring Rush	S3S4	Secure	30 km +/-1 km
Equisetum variegatum	Variegated Horsetail	S3	Secure	23 km +/-0 km
Erigeron philadelphicus	Philadelphia Fleabane	S2	Sensitive	46 km +/-5 km

Species	Common Name	S-rank	GS Rank	Distance
Festuca subverticillata	Nodding Fescue	S1S2	May be at-risk	64 km +/-5 km
Fraxinus nigra	Black Ash	S3	Sensitive	13 km +/-0 km
Galium boreale	Northern Bedstraw	S2	May be at-risk	57 km +/-5 km
Geranium bicknellii	Bicknell Northern Crane's-Bill	S3	Secure	76 km +/-0.1 km
Goodyera pubescens	Downy Rattlesnake-Plantain	S1	May be at-risk	70 km +/-1 km
Goodyera repens	Dwarf Rattlesnake-Plantain	S2S3	Sensitive	47 km +/-1 km
Goodyera tesselata	Checkered Rattlesnake-Plantain	S3	Secure	25 km +/-0 km
Gratiola neglecta	Clammy Hedge-Hyssop	S1	Sensitive	41 km +/-0.1 km
Halenia deflexa	Spurred Gentian	S2S3	Sensitive	88 km +/-1 km
Hedeoma pulegioides	American Pennyroyal	S2S3	Sensitive	24 km +/-5 km
Hieracium kalmii	Kalm's Hawkweed	S2?	Undetermined	7 km +/-1 km
Hieracium umbellatum	Umbellate Hawkweed	S2?	Undetermined	34 km +/-5 km
Humulus lupulus var. lupuloides	American Hop	S1?	Undetermined	57 km +/-5 km
Hypericum dissimulatum	Disguised St. John's-Wort	S2S3	Sensitive	82 km +/-0.5 km
Hypericum majus	Larger Canadian St. John's Wort	S1	May be at-risk	76 km +/-0 km
Juncus alpinoarticulatus ssp. nodulosus	Richardson's Rush	S1S2	Undetermined	97 km +/-0.5 km
Juncus dudleyi	Dudley's Rush	S2?	Sensitive	23 km +/-0 km
Juncus nodosus	Knotted Rush	S3S4	Secure	12 km +/-0 km
Lactuca hirsuta var. sanguinea	Hairy Wild Lettuce	S2	Sensitive	74 km +/-5 km
Lindernia dubia	Yellow-Seed False-Pimpernel	S3S4	Secure	16 km +/-0 km
Liparis loeselii	Loesel's Twayblade	S3S4	Secure	46 km +/-1 km
Listera convallarioides	Broad-Leaved Twayblade	S3	Secure	60 km +/-0.1 km
Lobelia spicata	Pale-Spiked Lobelia	S1S2SE	May be at-risk	48 km +/-10 km
Lycopodium complanatum	Trailing Clubmoss	S3?	Secure	76 km +/-5 km
Lycopodium hickeyi	Hickey's Clubmoss	S2?	Undetermined	35 km +/-1 km
Lycopodium sabinifolium	Ground-Fir	S3?	Secure	42 km +/-0.1 km
Milium effusum var. cisatlanticum	Tall Millet-Grass	S3	Secure	58 km +/-0.5 km
Oenothera fruticosa ssp. glauca	Shrubby Sundrops	S2SE	Undetermined	14 km +/-10 km
Ophioglossum pusillum	Adder's Tongue	S2S3	Sensitive	90 km +/-0 km
Panax trifolius	Dwarf Ginseng	S3	Secure	29 km +/-1 km
Plantago rugelii	Black-Seed Plantain	S1SE	Undetermined	17 km +/-0 km
Platanthera grandiflora	Large Purple-Fringe Orchis	S3	Secure	27 km +/-1 km
Platanthera hookeri	Hooker Orchis	S3	Secure	48 km +/-0.1 km
Platanthera macrophylla	Large Round-Leaved Orchid	S2	Sensitive	7 km +/-5 km
Platanthera orbiculata	Large Roundleaf Orchid	S3	Secure	7 km +/-10 km
Polygala sanguinea	Field Milkwort	S2S3	Sensitive	22 km +/-1 km
Polystichum braunii	Braun's Holly-Fern	S3S4	Secure	46 km +/-5 km
Pyrola asarifolia	Pink Wintergreen	S3	Secure	19 km +/-0 km
Pyrola minor	Lesser Wintergreen	S2	Sensitive	92 km +/-5 km
Rhamnus alnifolia	Alderleaf Buckthorn	S3	Sensitive	51 km +/-0 km
Rubus pensilvanicus	Pennsylvania Blackberry	S3?	Secure	56 km +/-5 km
Salix petiolaris	Meadow Willow	S3	Secure	18 km +/-0 km
Sanguinaria canadensis	Bloodroot	S3S4	Secure	12 km +/-0 km
Sphenopholis intermedia	Slender Wedge Grass	S3S4	Sensitive	12 km +/-0 km
Spiranthes ochroleuca	Yellow Nodding Ladies'-Tresses	S2	Sensitive	83 km +/-1 km
Spiranthes romanzoffiana	Hooded Ladies'-Tresses	S3S4	Secure	10 km +/-0.1 km
Symphyotrichum ciliolatum	Lindley's Aster	S2S3	Sensitive	22 km +/-0 km
Tiarella cordifolia	Heart-Leaved Foam-Flower	S2	Sensitive	9 km +/-10 km
Trillium erectum	Red Trillium	S3	Secure	25 km +/-0.1 km
Viola sagittata var. ovata	Arrow-Leaved Violet	S3S4	Secure	72 km +/-1 km

Appendix 2. Plant species rare in Nova Scotia and occurring within 100 km of the proposed development in AC CDC records but which were identified as very unlikely to occur on the site based on habitat needs. Species are listed alphabetically with Nova Scotia S-rank and General Status rank, along with preferred habitat type.

Species	Common Name	S-rank	GS Rank	Habitat	Distance
Myriophyllum farwellii	Farwell's Water-Milfoil	S2	Sensitive	acidic lakes & ponds	39 km +/-0.1 km
Potamogeton pulcher	Spotted Pondweed	S1	Undetermined	acidic lakes & ponds	48 km +/-0.1 km
Potamogeton confervoides	Algae-Like Pondweed	S3S4	Secure	acidic lakes & ponds	40 km +/-1 km
Eleocharis olivacea	Capitate Spikerush	S2	Sensitive	acidic lakeshore	76 km +/-0.1 km
Carex atlantica ssp. capillacea	Howe Sedge	S2	Undetermined	acidic peatland	94 km +/-10 km
Proserpinaca pectinata	Comb-Leaved Mermaid-Weed	S3	Sensitive	acidic swamps	40 km +/-1 km
Potamogeton zosteriformis	Flatstem Pondweed	S2S3	Sensitive	basic lakes & ponds	48 km +/-1 km
Potamogeton richardsonii	Redhead Grass	S3?	Undetermined	basic lakes & ponds	79 km +/-1 km
Potamogeton praelongus	White-Stem Pondweed	S3?	Undetermined	basic lakes & ponds	14 km +/-1 km
Potamogeton obtusifolius	Blunt-Leaf Pondweed	S2	Sensitive	basic lakes & ponds	62 km +/-0 km
Potamogeton friesii	Fries' Pondweed	S2	Undetermined	basic lakes & ponds	32 km +/-1 km
Ranunculus gmelinii	Small Yellow Water-Crowfoot	S3?	Secure	basic or circumneutral wetlands	47 km +/-5 km
Stuckenia filiformis ssp. alpina	Northern Slender Pondweed	S2S3	Undetermined	basic waters	67 km +/-0.5 km
Eriophorum chamissonis	Russet Cotton-Grass	S3S4	Secure	bog & poor fen	94 km +/-0.1 km
Listera australis	Southern Twayblade	S1	May be at-risk	bog & poor fen; acidic swamps	89 km +/-0 km
Bartonia virginica	Yellow Screwstem	S3	Secure	bog, acidic lakeshores & swamps	86 km +/-10 km
Geocaulon lividum	Northern Comandra	S2S3	Sensitive	bogs & poor fens; acidic conifer forest	77 km +/-0 km
Crassula aquatica	Water Pigmy-Weed	S2	Sensitive	brackish estuary shore	89 km +/-5 km
Samolus valerandi ssp. parviflorus	Water Pimpernel	S2	Sensitive	brackish river	70 km +/-0.1 km
Limosella australis	Mudwort	S2S3	Sensitive	brackish river	56 km +/-1 km
Callitriche hermaphroditica	Autumnal Water-Starwort	S1	May be at-risk	brackish river	95 km +/-0.5 km
Bidens hyperborea	Estuary Beggar-Ticks	S1	Sensitive	brackish river	70 km +/-0.1 km
Carex vacillans	Estuarine Sedge	S1S3	Undetermined	brackish shore & saltmarsh	92 km +/-0.5 km
Betula pumila	Swamp Birch	S2S3	Sensitive	calcareous fen	82 km +/-0 km
Carex livida	Livid Sedge	S1	May be at-risk	calcareous fen - wet	96 km +/-5 km
Carex chordorrhiza	Creeping Sedge	S1	May be at-risk	calcareous marsh or fen	90 km +/-1 km
Thuja occidentalis	Northern White Cedar	S1S2	At-risk	calcareous or circumneutral lowlands	67 km +/-0.1 km
Cryptogramma stelleri	Fragile Rockbrake	S1	May be at-risk	calcareous outcrop	76 km +/-0 km
Carex castanea	Chestnut-Colored Sedge	S2	May be at-risk	calcareous outcrops & woods	90 km +/-0 km
Symphyotrichum boreale	Boreal American-Aster	S2?	Sensitive	calcareous peatland	36 km +/-10 km
Salix pedicellaris	Bog Willow	S2	Sensitive	calcareous peatland	29 km +/-10 km
Galium labradoricum	Bog Bedstraw	S2	Sensitive	calcareous peatland	87 km +/-0.1 km
Conioselinum chinense	Hemlock Parsley	S2S3	Sensitive	calcareous river shore	6 km +/-5 km
Anemone virginiana	Virginia Anemone	S1S2	Sensitive	calcareous river shore	23 km +/-1 km

Species	Common Name	S-rank	GS Rank	Habitat	Distance
Viola nephrophylla	Northern Bog Violet	S2	Sensitive	calcareous rivershore or fen	9 km +/-1 km
Spiranthes lucida	Shining Ladies'-Tresses	S2	May be at-risk	calcareous rivershore seep	19 km +/-0 km
Carex pellita	Woolly Sedge	S1	May be at-risk	calcareous rivershore seep	23 km +/-0 km
Poa glauca	White Bluegrass	S2S3	Sensitive	calcareous rock outcrop	97 km +/-1 km
Carex garberi	Elk Sedge	S1	May be at-risk	calcareous shore	18 km +/-0 km
Parnassia palustris var. parviflora	a Marsh Grass-of-Parnassus	S2	May be at-risk	calcareous shore	65 km +/-1 km
Carex hystericina	Porcupine Sedge	S1S2	May be at-risk	calcareous shores	56 km +/-5 km
Carex eburnea	Ebony Sedge	S3	Sensitive	calcareous slopes & cliffs, esp. gypsum	53 km +/-0.1 km
Malaxis brachypoda	White Adder's-Mouth	S1	May be at-risk	calcareous swamp or outcrop seep	86 km +/-1 km
Elodea nuttallii	Nuttall Waterweed	S1	Undetermined	calcareous waters	90 km +/-1 km
Stuckenia vaginata	Sheathed Pondweed	S1	Undetermined	calcareous waters	85 km +/-0 km
Potamogeton nodosus	Longleaf Pondweed	S1	Undetermined	calcareous waters	98 km +/-5 km
Vallisneria americana	Eel-Grass	S2	May be at-risk	calcareous waters - moderate depth	48 km +/-1 km
Hudsonia tomentosa	Sand-Heather	S1	May be at-risk	coastal dune	33 km +/-10 km
Comandra umbellata	Umbellate Bastard Toad-Flax	S2	May be at-risk	coastal dune	89 km +/-0.5 km
Empetrum eamesii	Rock Crowberry	S2S3	Sensitive	coastal dune or outcrop	70 km +/-5 km
Iris prismatica	Slender Blue Flag	S1	May be at-risk	coastal meadows	78 km +/-10 km
Juncus subcaudatus	Woods-Rush	S3	Undetermined	conifer swamps & lakeshores	23 km +/-10 km
Hudsonia ericoides	Golden-Heather	S2	Sensitive	dry sand barren	96 km +/-5 km
Hepatica nobilis var. obtusa	Round-Leaved Hepatica	S1	May be at-risk	dryish, open, calcareous forest	46 km +/-0.1 km
Antennaria parlinii	a Pussytoes	S1	May be at-risk	dryish, open, calcareous forest	11 km +/-0 km
Cyperus lupulinus ssp. macilentus	Slender Flatsedge	SH	Extirpated	dune	72 km +/-10 km
Sagina nodosa ssp. borealis	Knotted Pearlwort	S2S3	Secure	dune & coastal headland	93 km +/-5 km
Pseudognaphalium obtusifolium ssp. obtusifolium	Fragrant Cudweed	S3S4	Secure	dune & dry open areas	99 km +/-5 km
Juncus vaseyi	Vasey Rush	S1	Undetermined	dune slacks & coastal meadows	63 km +/-10 km
Juncus greenei	Greene's Rush	S1S2	May be at-risk	dunes & coastal headland meadows	63 km +/-5 km
Pseudognaphalium obtusifolium	Fragrant Cudweed	S3S4	Secure	dunes & dry open ground	67 km +/-1 km
Botrychium lunaria	Moonwort Grape-Fern	S1	May be at-risk	dunes & headlands	99 km +/-0.1 km
Lycopodium sitchense	Alaskan Clubmoss	S3?	Secure	exposed headlands, highlands	27 km +/-5 km
Eriophorum gracile	Slender Cotton-Grass	S2	Sensitive	fen	34 km +/-10 km
Epilobium strictum	Downy Willow-Herb	S3	Sensitive	fen or richer marsh	75 km +/-5 km
Minuartia groenlandica	Mountain Sandwort	S2	Sensitive	granitic outcrop	79 km +/-0.1 km
Shepherdia canadensis	Canada Buffalo-Berry	S2	Sensitive	gypsum outcrop	100 km +/-10 km
Packera paupercula	Balsam Groundsel	S3	Secure	gypsum outcrop	23 km +/-0 km
Vaccinium boreale	Northern Blueberry	S2	May be at-risk	highlands; exposed shores	94 km +/-1 km
Lycopodiella appressa	Southern Bog Clubmoss	S3	Secure	lake & river shore	23 km +/-1 km
Decodon verticillatus	Hairy Swamp Loosestrife	S2S3	Sensitive	lake & river shore	92 km +/-0 km
Ranunculus flammula var. flammula	Greater Creeping Spearwort	S2	Sensitive	lake & river shore - sand or gravel	28 km +/-10 km
Sisyrinchium angustifolium	Pointed Blue-Eyed-Grass	S3S4	Secure	lake & river shores	23 km +/-0 km

Species	Common Name	S-rank	GS Rank	Habitat	Distance
Salix sericea	Silky Willow	S2	Sensitive	lake & river shores	86 km +/-1 km
Ranunculus pensylvanicus	Bristly Crowfoot	S1	May be at-risk	lake or pond shore	51 km +/-0 km
Utricularia gibba	Humped Bladderwort	S2	Sensitive	lakes & ponds	64 km +/-10 km
Sparganium natans	Small Bur-Reed	S3	Secure	lakes & ponds	36 km +/-5 km
Sparganium fluctuans	Floating Bur-Reed	S3?	Undetermined	lakes & ponds	62 km +/-5 km
Myriophyllum verticillatum	Whorled Water-Milfoil	S2	Sensitive	lakes & ponds	86 km +/-10 km
Elodea canadensis	Broad Waterweed	S3?	Secure	lakes & ponds	77 km +/-0 km
Ceratophyllum demersum	Common Hornwort	S3?	Secure	lakes & ponds	62 km +/-0 km
Megalodonta beckii	Beck Water-Marigold	S3	Sensitive	lakes & ponds	27 km +/-0.5 km
Isoetes lacustris	Lake Quillwort	S3?	Secure	lakes & rivers	46 km +/-1 km
Isoetes acadiensis	Acadian Quillwort	S3	Sensitive	lakes & rivers	46 km +/-1 km
Proserpinaca palustris	Marsh Mermaid-Weed	S3S4	Secure	lakes & rivers	48 km +/-0.1 km
Euthamia galetorum	Narrow-Leaf Fragrant Golden-Rod	S3S4	Secure	lakeshores	81 km +/-10 km
Euthamia caroliniana	Grass-Leaved Goldenrod	S3	Sensitive	lakeshores	78 km +/-10 km
Carex cryptolepis	Northeastern Sedge	S3?	Secure	lakeshores	62 km +/-0 km
Symplocarpus foetidus	Skunk Cabbage	S3	Secure	lowland swamps	93 km +/-0 km
Polygonum arifolium	Halberd-Leaf Tearthumb	S2	Sensitive	lowland swamps	47 km +/-1 km
Galium obtusum	Blunt-Leaf Bedstraw	S1	May be at-risk	lowland swamps	94 km +/-1 km
Polygonum pensylvanicum	Pennsylvania Smartweed	S3	Secure	muddy rivershores	16 km +/-0 km
Panicum philadelphicum	Philadelphia Panic Grass	S2S3SE	Sensitive	muddy rivershores	50 km +/-0 km
Isoetes prototypus	Prototype Quillwort	S2	Sensitive	oligotrophic lake	57 km +/-0 km
Schizaea pusilla	Curly-Grass Fern	S3	Secure	open peatland	95 km +/-1 km
Solidago simplex var. randii	Mountain Goldenrod	SH	Extirpated	open rock outcrop	96 km +/-1 km
Solidago hispida	Hairy Goldenrod	S1?	May be at-risk	outcrops, esp. calcareous	52 km +/-10 km
Carex rostrata	Beaked Sedge	S1?	May be at-risk	peatlands & shores	101 km +/-5 km
Cypripedium arietinum	Ram's-Head Lady's-Slipper	S1	May be at-risk	primarily forest on gypsum	51 km +/-5 km
Dirca palustris	Eastern Leatherwood	S1	May be at-risk	rich deciduous - esp. associated with gypsum	64 km +/-10 km
Elymus hystrix var. bigeloviana	Bottlebrush Grass	S1	May be at-risk	rich deciduous floodplain	33 km +/-1 km
Triosteum aurantiacum	Coffee Tinker's-Weed	S2	Sensitive	rich deciduous floodplain	14 km +/-0.1 km
Sanicula odorata	Black Snake-Root	S1	May be at-risk	rich deciduous floodplain	8 km +/-10 km
Rudbeckia laciniata	Cut-Leaved Coneflower	S2S3	Sensitive	rich deciduous floodplain	19 km +/-0 km
Ribes americanum	Wild Black Currant	S1SE	Undetermined	rich deciduous floodplain	34 km +/-5 km
Osmorhiza longistylis	Smoother Sweet-Cicely	S2	Sensitive	rich deciduous floodplain	16 km +/-0 km
Lilium canadense	Canada Lily	S2S3	Sensitive	rich deciduous floodplain	10 km +/-5 km
Laportea canadensis	Wood Nettle	S3	Sensitive	rich deciduous floodplain	16 km +/-0 km
Impatiens pallida	Pale Jewel-Weed	S2	Sensitive	rich deciduous floodplain	84 km +/-10 km
Floerkea proserpinacoides	False Mermaid-Weed	S2S3	Sensitive	rich deciduous floodplain	28 km +/-10 km
Elymus wiegandii	Wiegand's Wild Rye	S1	May be at-risk	rich deciduous floodplain	16 km +/-1 km
Caulophyllum thalictroides	Blue Cohosh	S2	May be at-risk	rich deciduous floodplain	14 km +/-0.1 km
Adiantum pedatum	Northern Maidenhair-Fern	S1	May be at-risk	rich deciduous forest	35 km +/-1 km

Species	Common Name	S-rank	GS Rank	Habitat	Distance
Desmodium glutinosum	Large Tick-Trefoil	S2	May be at-risk	rich deciduous forest or calcareous shore	98 km +/-0 km
Viola canadensis	Canada Violet	S1	0 extirpated	rich deciduous forest, esp. gypsum	28 km +/-10 km
Rudbeckia laciniata var. gaspereauensis	Cut-Leaved Coneflower	S2S3	Sensitive	rich floodplain	23 km +/-10 km
Stellaria longifolia	Longleaf Stitchwort	S3	Sensitive	rich floodplain	14 km +/-1 km
Polygonum scandens	Climbing False-Buckwheat	S2	Sensitive	rich floodplain	16 km +/-0 km
Crataegus submollis	A Hawthorn	S1?	Undetermined	rich floodplain	34 km +/-5 km
Carex tuckermanii	Tuckerman Sedge	S1	May be at-risk	richer floodplain pools	11 km +/-0.1 km
Carex lupulina	Hop Sedge	S3	Secure	richer floodplain pools	16 km +/-0 km
Carex comosa	Bristly Sedge	S2	Sensitive	richer marsh	40 km +/-10 km
Scirpus pedicellatus	Stalked Bulrush	S1	Undetermined	river & lake shores	68 km +/-1 km
Dichanthelium clandestinum	Deer-Tongue Witchgrass	S3	Secure	river & lake shores	67 km +/-0 km
Asclepias incarnata	Swamp Milkweed	S3	Secure	river & lake shores	50 km +/-1 km
Luzula parviflora	Small-Flowered Wood-Rush	S3	Secure	river and stream shores; highland forest	76 km +/-0 km
Allium schoenoprasum var. sibiricum	Wild Chives	S2	Undetermined	river shore	36 km +/-10 km
Zizia aurea	Common Alexanders	S1S2	Sensitive	river shore meadow & thicket	18 km +/-1 km
Vaccinium caespitosum	Dwarf Blueberry	S2	Sensitive	river shore rock outcrop	29 km +/-1 km
Platanthera flava var. herbiola	Pale Green Orchid	S1S2	Secure	river shores	17 km +/-0 km
Verbena hastata	Blue Vervain	S3	Secure	river shores	9 km +/-0.1 km
Dryopteris fragrans var. remotiuscula	Fragrant Fern	S2	Sensitive	rock outcrop	22 km +/-10 km
Arabis hirsuta var. pycnocarpa	Hairy Rock-Cress	S1S2	May be at-risk	rock outcrop	91 km +/-0.1 km
Trisetum spicatum	Narrow False Oats	S3	Secure	rock outcrop	23 km +/-0 km
Primula mistassinica	Bird's-Eye Primrose	S2	Sensitive	rock outcrop	31 km +/-10 km
Polypodium appalachianum	Appalachian Polypody	S3?	Undetermined	rock outcrop	31 km +/-0 km
Huperzia selago	Fir Clubmoss	S1S3	Undetermined	rock outcrop	26 km +/-5 km
Erigeron hyssopifolius	Daisy Fleabane	S2S3	Sensitive	rock outcrop	50 km +/-1 km
Asplenium trichomanes-ramosum	Green Spleenwort	S2	Sensitive	rock outcrop	59 km +/-10 km
Arabis drummondii	Drummond Rockcress	S2	Sensitive	rock outcrop	33 km +/-1 km
Hieracium robinsonii	Robinson's Hawkweed	S2	Sensitive	rocky river shore	8 km +/-10 km
Cochlearia tridactylites	Limestone Scurvy-grass	S1	May be at-risk	rocky shore & headland	100 km +/-1 km
Triglochin gaspensis	Gaspe Peninsula Arrow-Grass	S1?	Undetermined	saltmarsh	95 km +/-1 km
Stellaria humifusa	Creeping Sandwort	S2	Sensitive	saltmarsh	64 km +/-1 km
Stellaria crassifolia	Fleshy Stitchwort	S1	May be at-risk	saltmarsh	96 km +/-5 km
Schoenoplectus robustus	Saltmarsh Bulrush	S1?	Undetermined	saltmarsh	48 km +/-10 km
Rumex maritimus	Sea-Side Dock	S3	Secure	saltmarsh	67 km +/-0.1 km
Blysmus rufus	Red Bulrush	S1	May be at-risk	saltmarsh	96 km +/-5 km
Atriplex acadiensis	Maritime Saltbush	S1?	Undetermined	saltmarsh	42 km +/-10 km
Suaeda maritima ssp. richii	Rich's Sea-blite	S1	Undetermined	saltmarsh	84 km +/-10 km
Chenopodium rubrum	Coast-Blite Goosefoot	S1?	May be at-risk	saltmarsh & beach	23 km +/-10 km
Calamagrostis stricta var. stricta	Bentgrass	S1S2	Sensitive	saltmarsh edge	89 km +/-0 km
Teucrium canadense	American Germander	S2S3	Sensitive	saltmarsh edge	23 km +/-5 km
Cuscuta cephalanthi	Button-Bush Dodder	S1	May be at-risk	saltmarsh margins	19 km +/-1 km
Piptatherum canadense	Canada Mountain-Ricegrass	S2	Sensitive	sand barrens	42 km +/-0.5 km

Species	Common Name	S-rank	GS Rank	Habitat	Distance
Dichanthelium linearifolium	Slim-Leaf Witchgrass	S2?	Sensitive	sand barrens; sandy roadsides	22 km +/-10 km
Senecio pseudoarnica	Seabeach Groundsel	S2	Sensitive	sea beach	36 km +/-10 km
Chamaesyce polygonifolia	Seaside Spurge	S3	Secure	sea beach	46 km +/-1 km
Atriplex franktonii	Frankton's Saltbush	S3S4	Secure	sea beach	27 km +/-1 km
Suaeda calceoliformis	American Sea-Blite	S2S3	Secure	sea beach & saltmarsh	23 km +/-1 km
Polygonum buxiforme	Small's Knotweed	S2S3SE	Undetermined	sea beach & waste ground	36 km +/-10 km
Chenopodium berlandieri var. macrocalycium	a Pit-Seed Goosefoot	S2?	Undetermined	sea shore	45 km +/-5 km
Polygonum raii	Pondshore Knotweed	S2S3SE	Undetermined	sea shore & saltmarsh	93 km +/-5 km
Dichanthelium acuminatum var. lindheimeri	Panic Grass	S1?	Undetermined	shores	27 km +/-0.1 km
Alisma gramineum	Narrow-Leaf Water-Plantain	S1SE	Undetermined	shores	11 km +/-5 km
Desmodium canadense	Showy Tick-Trefoil	S1	May be at-risk	shores of larger rivers	23 km +/-0 km
Lysimachia thyrsiflora	Water Loosestrife	S3S4	Secure	swamp or marsh	20 km +/-1 km
Carex haydenii	Cloud Sedge	S1	May be at-risk	wet meadow	34 km +/-1 km
Pilea pumila	Canada Clearweed	S1	May be at-risk	x	40 km +/-0 km

Appendix 3. Herbaceous and low shrub species observed within turbine construction footprints by David Mazerolle.

Turbine #	Herb Species
1	*Oclemena acuminata, Doellingeria umbellata, Carex arctata, Carex brunnescens, Carex novae-angliae, Coptis trifolia, Cornus canadensis, Dennstaedtia punctilobula, Dryopteris campyloptera, Chamerion angustifolium, Festuca rubra, Fragaria virginiana, Kalmia angustifolia, Linnaea borealis, Luzula multiflora, Maianthemum canadense, Potentilla simplex, Pteridium aquilinium, Rhododendron canadense, Ribes lacustre, Solidago rugosa, Trientalis borealis*
17	*Actaea rubra, Aralia nudicaulis, Oclemena acuminata, Brachyelytrum septentrionale, Carex arctata, Carex brunnescens, Carex communis, Carex deweyana, Carex disperma, Carex leptonervia, Claytonia caroliniana, Clintonia borealis, Cornus alternifolia, Dennstaedtia punctilobula, Dryopteris campyloptera, Hieracium canadense, Huperzia lucidula, Lycopodium obscurum, Maianthemum canadense, Medeola virginiana, Onoclea sensibilis, Oxalis montana, Polygonatum pubescens, Polystichum acrostichoides, Prenanthes, Solidago flexicaulis, Solidago rugosa, Solidago rugosa, Thelypteris noveboracensis, Trientalis borealis, Viola blanda, Viola cucullata*
18	*Actaea rubra, Oclemena acuminata, Cardamine diphylla, Carex brunnescens, Carex communis, Carex deweyana, Carex disperma, Claytonia caroliniana, Dennstaedtia punctilobula, Dryopteris campyloptera, Dryopteris intermedia, Erythronium americanum, Maianthemum canadense, Panax trifolius, Phegopteris connectilis, Phegopteris connectilis, Polygonatum pubescens, Polystichum acrostichoides, Prenanthes altissima, Solidago rugosa, Streptopus amplexifolius, Trientalis borealis, Trillium cernuum, Trillium undulatum, Viola cucullata*
25	*balsam fir, red maple, sugar maple, Acer spicatum, Actaea rubra, Aralia nudicaulis, Oclemena acuminata, Doellingeria umbellata, yellow birch, Brachyelytrum septentrionale, Carex brunnescens, Carex cannescens, Carex communis, Carex gracillima, Carex leptonervia, Claytonia caroliniana, Cornus canadensis, Corylus cornuta, Dennstaedtia punctilobula, Dryopteris campyloptera, Dryopteris intermedia, Equisetum sylvaticum, Erythronium americanum, beech, Linnaea borealis, Lonicera canadensis, Maianthemum canadense, Osmunda cinnamomea, Osmunda claytoniana, Oxalis montana, Panax trifolius, Phegopteris connectilis, Pteridium aquilinium, Rubus allegheniensis, Rubus idaeus ssp. strigosus, Sambucus racemosa, Sorbus americana, Trientalis borealis, Trillium cernuum*
27	*Aralia nudicaulis, Symphyotrichum novi-belgii, Doellingeria umbellata, Carex brunnescens, Carex communis, Carex crinita, Carex debilis, Carex flava, Cornus canadensis, Danthonia spicata, Chamerion angustifolium, Euthamia graminifolia, Festuca rubra, Fragaria virginiana, Hieracium canadense, Hieracium x floribundum, Juncus effusus, Juncus filiformis, Leontodon autumnalis, Luzula multiflora, Maianthemum canadense, Potentilla simplex, Rumex acetosella, Scirpus atrocinctus, Solidago bicolor, Solidago puberula, Solidago rugosa, Spiraea alba, Spiraea tomentosa, Trientalis borealis, Vaccinium angustifolium*

Turbine #	Herb Species
3	*Actaea rubra, Aralia nudicaulis, Oclemena acuminata, Brachyelytrum septentrionale, Carex arctata, Carex communis, Carex debilis, Carex deweyana, Carex disperma, Clintonia borealis, Coptis trifolia, Cornus alternifolia, Cornus canadensis, Corylus cornuta, Dennstaedtia punctilobula, Dryopteris campyloptera, Dryopteris intermedia, Chamerion angustifolium, Huperzia lucidula, Linnaea borealis, Lonicera canadensis, Maianthemum canadense, Medeola virginiana, Oxalis montana, Panax trifolius, black spruce, red spruce, Polygonatum pubescens, Ribes glandulosum, Rubus canadensis, Rubus pubescens, Solidago rugosa, Trientalis borealis, Viburnum lantanoides*
33	*Anaphalis margaritacea, Aralia nudicaulis, Oclemena acuminata, Doellingeria umbellata, Carex arctata, Carex brunnescens, Carex communis, Carex deflexa, Carex novae-angliae, Cirsium arvense, Clintonia borealis, Danthonia spicata, Dennstaedtia punctilobula, Dryopteris campyloptera, Dryopteris intermedia, Equisetum sylvaticum, Erythronium americanum, Euthamia graminifolia, Festuca rubra, Fragaria virginiana, Hieracium cespitosum, Hieracium flagellare, Juncus bufonius, Juncus tenuis, Maianthemum canadense, Mitchella repens, Osmunda cinnamomea, Oxalis montana, Panax trifolius, Polygonum cilinode, Rubus pubescens, Solidago canadensis, Solidago flexicaulis, Solidago rugosa, Sonchus arvensis, Spiraea alba, Spiraea tomentosa, Streptopus lanceolatus, Sysirinchium montanum, Trientalis borealis, Trillium undulatum, Viola cucullata*
34	*Actaea rubra, Aralia nudicaulis, Oclemena acuminata, Doellingeria umbellata, Athyrium filix-femina, Cardamine diphylla, Carex communis, Carex deflexa, Carex gracillima, Carex intumescens, Carex leptalea, Carex leptonervia, Cirsium arvense, Clintonia borealis, Cornus canadensis, Corylus cornuta, Danthonia spicata, Dennstaedtia punctilobula, Deparia acrostichoides, Erythronium americanum, Fragaria virginiana, Galium triflorum, Geranium robertianum, Geum allepicum, Hieracium cespitosum, Huperzia lucidula, Maianthemum canadense, Matteuccia struthiopteris, Osmunda cinnamomea, Osmunda claytoniana, Phegopteris connectilis, Potentilla simplex, Ranunculus repens, Rubus pubescens, Solidago canadensis, Solidago flexicaulis, Solidago rugosa, Thalictrum pubescens, Trientalis borealis, Vicia cracca*
35	*Aralia nudicaulis, Oclemena acuminata, Symphyotrichum puniceum, Doellingeria umbellata, Calamagrostis canadensis, Carex leptalea, Circaea alpina, Clintonia borealis, Cornus canadensis, Dennstaedtia punctilobula, Dryopteris intermedia, Chamerion angustifolium, Epilobium ciliatum, Equisetum sylvaticum, Erythronium americanum, Fragaria virginiana, Galeopsis tetrahit, Galium palustre, Galium triflorum, Hieracium canadense, Maianthemum canadense, Matteuccia struthiopteris, Osmunda cinnamomea, Osmunda claytoniana, Phegopteris connectilis, Polygonatum pubescens, Polygonum sagittattum, Polystichum acrostichoides, Prenanthes altissima, Ranunculus abortivus, Ranunculus repens, Ribes triste, Rubus pubescens, Solidago flexicaulis, Solidago rugosa, Streptopus lanceolatus, Thelypteris noveboracensis, Trientalis borealis, Viola blanda, Viola cucullata*
36	*Aralia hispida, Aralia nudicaulis, Doellingeria umbellata, Athyrium filix-femina, Cardamine pensylvanica, Carex brunnescens, Carex gynandra, Carex leptalea, Carex leptonervia, Carex stipata, Carex trisperma, Clintonia borealis, Coptis trifolia, Cornus canadensis, Cypripedium acaule, Dennstaedtia punctilobula, Dryopteris campyloptera, Dryopteris intermedia, Chamerion angustifolium, Equisetum arvense, Equisetum sylvaticum, Eupatorium maculatum, Fragaria virginiana, Gymnocarpium dryopteris, Impatiens capensis, Linnaea borealis, Lycopodium clavatum, Lysimachia terrestris, Onoclea sensibilis, Osmunda cinnamomea, Osmunda claytoniana, Oxalis montana, Phegopteris connectilis, Rubus pubescens, Solidago flexicaulis, Solidago rugosa, Sorbus americana, Trillium cernuum, Trillium undulatum, Typha latifolia, Viburnum lantanoides, Viola cucullata*
37	*Agrostis gigantea, Aralia nudicaulis, Oclemena acuminata, Coptis trifolia, Cornus canadensis, Danthonia spicata, Dennstaedtia punctilobula, Dryopteris campyloptera, Dryopteris intermedia, Chamerion angustifolium, Erythronium americanum, Euthamia graminifolia, Fragaria virginiana, Hieracium canadense, Hieracium flagellare, Hieracium x floribundum, Lycopodium clavatum, Lycopodium obscurum, Maianthemum canadense, Moneses uniflora, Osmunda claytoniana, Oxalis montana, Panax trifolius, Phegopteris connectilis, Polygonatum pubescens, Prunella vulgaris, Rubus pubescens, Solidago canadensis, Solidago rugosa, Streptopus lanceolatus, Taraxacum officinalis, Trientalis borealis, Trifolium pratense, Trifolium repens, Trillium cernuum, Vaccinium angustifolium, Viola cucullata*
43	*Oclemena acuminata, Doellingeria umbellata, Cornus canadensis, Cypripedium acaule, Danthonia spicata, Dennstaedtia punctilobula, Dryopteris intermedia, Festuca rubra, Fragaria virginiana, Kalmia angustifolia, Lycopodium clavatum, Maianthemum canadense, Onoclea sensibilis, red spruce, Potentilla simplex, Prunus pensylvanica, Rhododendron canadense, Ribes hirtellum, Trientalis borealis, Vaccinium angustifolium*
44	*Actaea rubra, Aralia nudicaulis, Oclemena acuminata, Doellingeria umbellata, Cardamine diphylla, Cardamine pensylvanica, Carex gynandra, Carex intumescens, Carex leptalea, Carex leptonervia, Carex stipata, Claytonia caroliniana, Coptis trifolia, Dennstaedtia punctilobula, Dicentra cucullaria, Dryopteris campyloptera, Dryopteris intermedia, Erythronium americanum, Fragaria virginiana, Galeopsis tetrahit, Galium triflorum, Impatiens capensis, Lonicera canadensis, Maianthemum canadense, Matteuccia struthiopteris, Osmunda cinnamomea, Osmunda claytoniana, Panax trifolius, Phegopteris connectilis, Polygonatum pubescens, Polystichum acrostichoides, Prenanthes altissima, Prunus virginiana, Ranunculus abortivus, Ribes hirtellum, Rubus pubescens, Solidago canadensis, Solidago flexicaulis, Solidago rugosa, Sonchus arvensis, Streptopus lanceolatus, Thalictrum pubescens, Thelypteris noveboracensis, Torreyochloa pallida, Trillium cernuum, Viola blanda, Viola cucullata*

Turbine #	Herb Species
45	*Actaea rubra, Anaphalis margaritacea, Doellingeria umbellata, Athyrium filix-femina, Calamagrostis canadensis, Cardamine diphylla, Carex arctata, Carex brunnescens, Carex cannescens, Carex gynandra, Carex intumescens, Carex leptalea, Carex leptonervia, Carex stipata, Clintonia borealis, Coptis trifolia, Cornus canadensis, Danthonia spicata, Dennstaedtia punctilobula, Euthamia graminifolia, Galium palustre, Hieracium canadense, Impatiens capensis, Luzula multiflora, Lycopus uniflorus, Maianthemum canadense, Maianthemum racemosum, Matteuccia struthiopteris, Onoclea sensibilis, Osmunda cinnamomea, Oxalis montana, Panax trifolius, Phegopteris connectilis, Polygonatum pubescens, Potentilla simplex, Ranunculus abortivus, Ribes glandulosum, Ribes hirtellum, Scirpus atrocinctus, Solidago canadensis, Solidago rugosa, Streptopus lanceolatus, Thalictrum pubescens, Trillium cernuum, Viola cucullata, Viola mackloskeyi*
7	*Actaea rubra, Aralia nudicaulis, Oclemena acuminata, Brachyelytrum septentrionale, Carex brunnescens, Carex communis, Carex deflexa, Carex leptonervia, Claytonia caroliniana, Danthonia spicata, Dennstaedtia punctilobula, Dryopteris campyloptera, Dryopteris intermedia, Erythronium americanum, Maianthemum canadense, Maianthemum racemosum, Osmunda claytoniana, Oxalis montana, Panax trifolius, Phegopteris connectilis, Polygonatum pubescens, Polystichum acrostichoides, Prenanthes altissima, Solidago rugosa, Trientalis borealis, Trillium cernuum, Veronica officinalis, Viola cucullata, Viola pubescens*
8	*Aralia nudicaulis, Oclemena acuminata, Athyrium filix-femina, Brachyelytrum septentrionale, Cardamine diphylla, Carex communis, Carex deweyana, Carex disperma, Carex gracillima, Carex intumescens, Carex leptonervia, Dennstaedtia punctilobula, Dryopteris campyloptera, Dryopteris intermedia, Erythronium americanum, Geranium robertianum, Huperzia lucidula, Lonicera canadensis, Lycopodium obscurum, Maianthemum canadense, Maianthemum racemosum, Medeola virginiana, Oxalis montana, Phegopteris connectilis, Polygonatum pubescens, Polystichum acrostichoides, Rubus idaeus ssp. strigosus, Rubus pubescens, Sambucus racemosa, Streptopus lanceolatus, Trientalis borealis, Trillium cernuum, Viola cucullata*
9	*Aralia nudicaulis, Athyrium filix-femina, Brachyelytrum septentrionale, Carex brunnescens, Carex debilis, Carex intumescens, Carex leptonervia, Carex pallescens, Claytonia caroliniana, Clintonia borealis, Dennstaedtia punctilobula, Dryopteris campyloptera, Dryopteris intermedia, Erythronium americanum, Maianthemum canadense, Osmunda claytoniana, Oxalis montana, Phegopteris connectilis, Prenanthes sp, Rubus pubescens, Solidago rugosa, Solidago rugosa, Thelypteris noveboracensis, Trientalis borealis, Trillium cernuum, Veronica officinalis*
substation	*Anaphalis margaritacea, Oclemena acuminata, Doellingeria umbellata, Carex scoparia, Cornus canadensis, Danthonia spicata, Chamerion angustifolium, Euthamia graminifolia, Fragaria virginiana, Hieracium cespitosum, Hieracium x floribundum, Maianthemum canadense, Solidago canadensis, Solidago rugosa*

C5- Breeding Bird and Plant Inventory Study 2005

Breeding Bird and Vascular Plant Inventory for wind turbine sites on Fitzpatricks Mountain, NS

Wind test tower at proposed turbine site on Mount Fitzpatrick, looking north. June 15, 2005.

Conducted for Reuben Burge

by Sean Blaney,
117 King St., Sackville NB, E4L 3G4

June 15, 2005

METHODS

The site visit was carried out by Sean Blaney, accompanied by Reuben Burge (the proponent of the wind turbine development), from 5:15 am to 11:00 am on June 15, 2005. The survey effort was divided into two parts:

1) A survey of the breeding birds and vascular plants of the immediate footprint and surroundings of a single wind turbine proposed for approximately 45.6245^{o}N, 62.9014^{o}W, on the southwest part of the crest of Fitzpatricks Mountain. This site is herein called Site #1 and is marked as such in Figure 1.

2) A survey of the breeding birds and vascular plants of other nearby areas that may be suitable for wind turbine development in the future. Any development occurring at these sites would take place after the above development, and the sites involved will not be affected by the above development. These sites include five locations on Burge family property between 0.35 and 1.2 km south and west of the above wind turbine site (sites numbered 4-8 on Figure 1), and two locations between approximately 0.4 and 0.76 km east of wind turbine Site #1 (the sites numbered 2 and 3 on Figure 1).

Methods, Results and Discussion for the footprint and surroundings of the first proposed turbine are always presented first, before the those for the potential future turbine sites.

Site coverage at Site #1 involved walks around the proposed turbine site and surrounding area at 5:15 to 5:40 and 7:45 to 8:10, including a single pass along the expected path of the access road that will have to be built to bring the turbine onto the site. Maximum breeding evidence for each bird species was recorded, using the system of the first *Atlas of the Breeding Birds of Ontario* (Cadman *et al.* 1986, University of Waterloo Press). A single five-minute silent point count was also undertaken, starting at 5:29, in which numbers of individuals were recorded for all bird species. "Pishing" sounds and Barred Owl calling were used extensively (but not during point counts) to attract non-singing birds into view. Site coverage as recorded by GPS is given in Figure 2.

Site coverage for the rest of the potential wind turbine sites involved a walk around the open portion of the site, along the road to the two easternmost potential turbine sites and in the forest around and between the two westernmost potential turbine sites (5:40am to 7:45am and 8:10am to 11:00am). Figure 2 maps site coverage as recorded by GPS. As above, maximum breeding evidence was recorded for each bird species, using the system of the first Ontario Breeding Bird Atlas (Cadman *et al.* 1986). Five five-minute silent point counts were conducted at or near potential turbine sites 2 through 6, between 5:52am and 7:21am, in which numbers of individuals were recorded for all species of birds seen. "Pishing" sounds and Barred Owl calling were used extensively (but not during point counts) to attract non-singing birds into view.

Conditions for recording breeding bird species were excellent throughout the visit, with temperatures estimated at 7°C before sunrise, rising to 16°C by 11:00am and wind speeds ranging from approximately 0 at sunrise to an estimated 15 km/h in open areas at 11:00 am.

All vascular plant species observed were recorded for each site, with estimates of overall abundance on the whole of the site visit as follows:

Rare – seen only in one to three locations and not in large numbers
Uncommon – seen in three to approximately six locations, not in large numbers, or in fewer locations in large numbers. Often restricted to an uncommon habitat.
Fairly Common – thinly scattered over large portion of site, or locally common within a suitable habitat of restricted distribution on site.
Common – widespread in suitable habitat, which is itself widespread.

These terms are not especially precise, but do provide good relative estimates of abundance.

Where rare species were found, GPS coordinates were taken with detailed information on abundance and habitat. Rarity is defined by AC CDC S-ranks and NS DNR ranks. These ranks were developed cooperatively by the Atlantic Canada Conservation Data Centre (AC CDC) and the Nova Scotia Department of Natural Resources (NS DNR) at ranking meetings that convened provincial botanical experts. The ranks reflect the best current understanding of plant status at the time of ranking, but are subject to revision as new information becomes available. Species with S-ranks of S1, S2 or S3 are considered significant enough that their known locations are maintained in a GIS-linked database by AC CDC. NS DNR considers any species ranked as Red, Yellow, or Undetermined as significant or potentially significant.

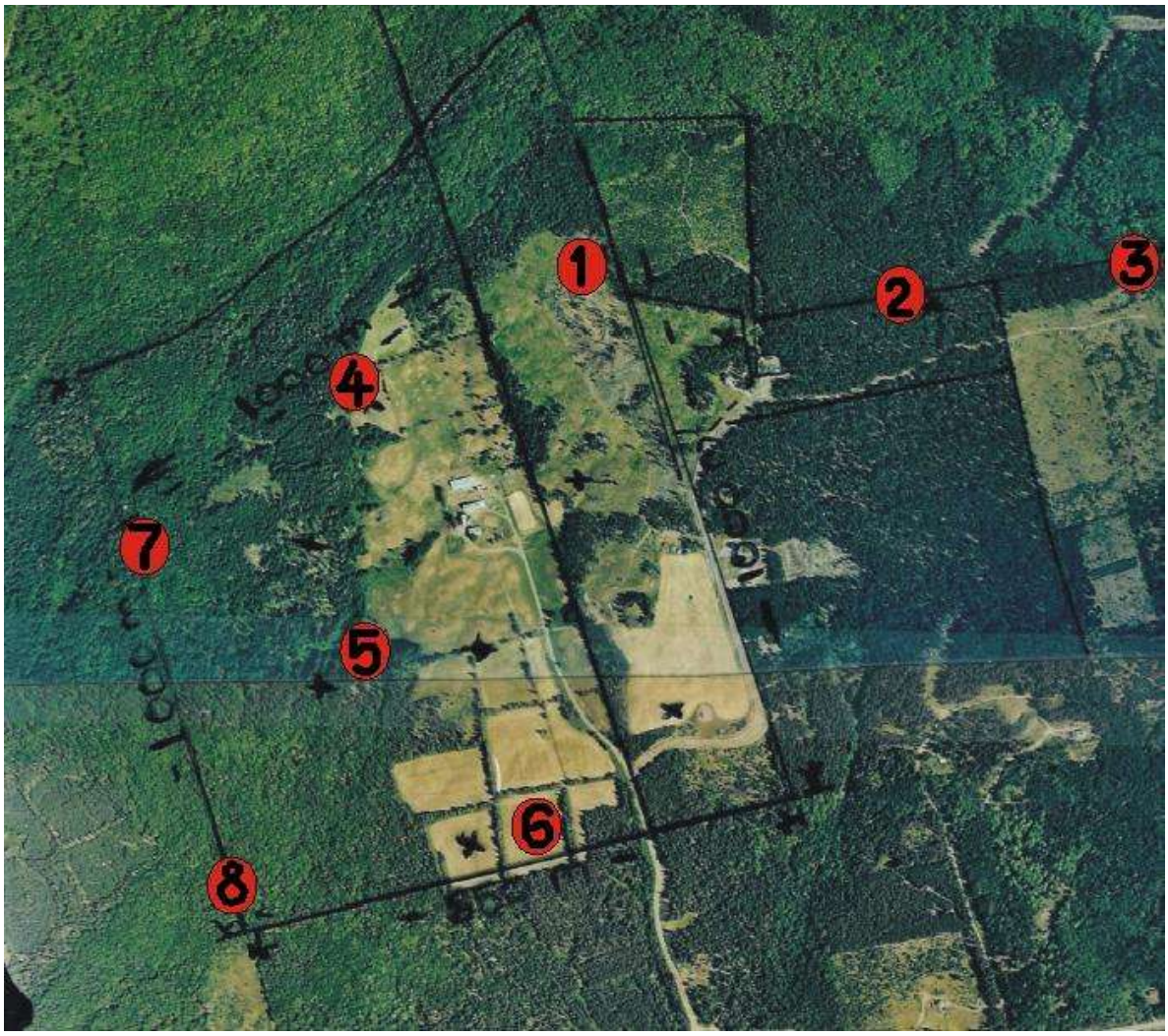

Figure 1. Aerial photograph of survey site, showing the proposed turbine location (Site 1) and potential future turbine locations (Sites 2-8).

RESULTS AND DISCUSSION

Site coverage

Figure 1 maps the route covered on site. For proposed turbine site, I have covered the breeding birds and vascular plants quite thoroughly. Additional species could certainly be found in both these groups with further effort elsewhere on the Burge property, but the goal of this survey for the potential future turbine sites was simply to get an overview of the landscape features and species diversity rather than to get complete coverage.

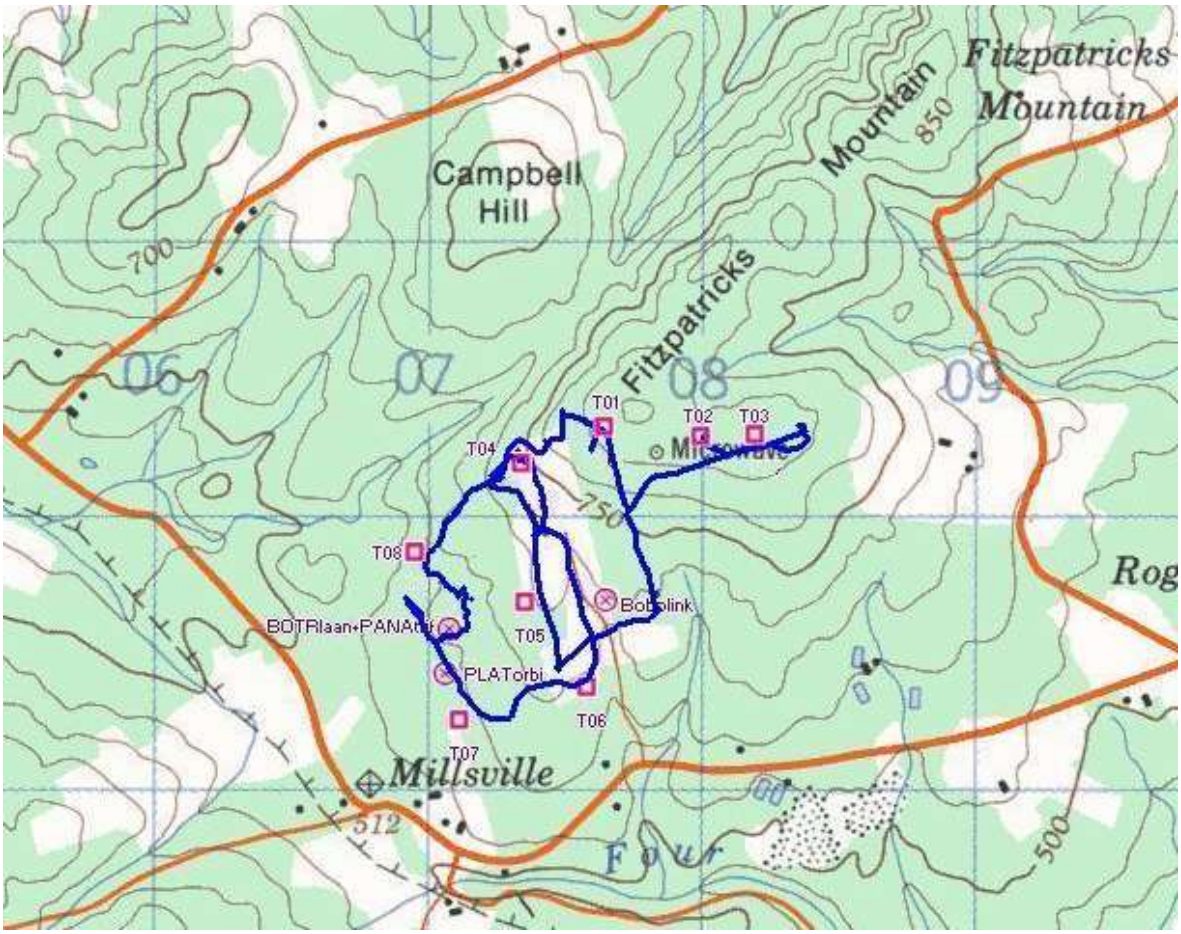

Figure 2. Site coverage, as recorded by GPS, with rare species marked. The blue line is the track walked, with some gaps due to poor GPS satellite reception filled in. The pink squares are the proposed turbine location (T01) and potential future turbine locations (T02-T08). Rare species: BOTRlaan = *Botrychium lanceolatum* var. *angustisegmentum* – Lance-Leaf Grape-Fern, PANAtrif = *Panax trifolius* – Dwarf Ginseng, PLATorbi = *Platanthera orbiculata* – Large Roundleaf Orchid, Bobolink = *Dolichonyx oryzivorus*.

Site conditions and plant communities

The plant communities at the proposed turbine site indicate that it has a long history of human alteration. The site is sparsely treed, heavily cut-over forest (formerly white spruce dominated, now a mix of mostly young white spruce, gray and white birch, balsam fir and red maple). Low heath shrubs, and taller shrubs such as Pin Cherry (*Prunus pensylvanica*), Wild Raisin (*Viburnum nudum* var. *cassinoides*) and Green Alder (*Alnus viridis* ssp. *crispa*) are common around the margins of the tower site. Much of the herbaceous plant cover in the area surrounding the proposed turbine (which had been spruce forest understory prior to heavy logging in the last few years), was dominated by the European species Common Hawkweed (*Hieracium lachenalii*) and Hair Fescue (*Festuca filiformis*), rather than by native plants typical of the coniferous forest. The Hair Fescue is a near-obligate open area species, so its occurrence clearly indicates that the cut-over spruce forest had been relatively young and had developed over a formerly cleared field. The Common Hawkweed can be a very invasive species, and it occurred at exceptionally high densities

over a large area at the site. Similar semi-open, disturbed, ridge-top habitats on the highest part of Mount Fitzpatrick to the east of the proposed turbine included some shrubby blueberry barrens that were not dominated by exotic species, and are apparently harvested on a limited commercial basis. These habitats may have had a different land-use history prior to recent clearing, either having been continuously forested or having regenerated from open field at a more distant point in the past. In any case, none of the plant communities present on or around the proposed turbine site had any significance in terms of rarity in Nova Scotia or in being unusually good representatives of common community types.

The potential future turbine sites 4, 5 and 6 were in open pastures, which were heavily dominated by exotic species and grazed by sheep and cattle. These are clearly not significant from a natural heritage perspective.

The most significant natural habitat seen during the site visit was the mature forest along the west boundary of the Burge property. In this area, forests were dominated by various combinations of sugar maple, hemlock, yellow birch and red spruce on undulating terrain with substantial groundwater seepage around the bases of the hills forming small streams. This forest area, although fairly small, was quite mature and impressive, with some trees that could be in the range of 200 years old. This is by no means a rare community type within Nova Scotia, but the example observed was certainly in much better than average condition and a good representative example of its type. As noted below the only significant plants observed, Lance-Leaved Grape-Fern and Dwarf Ginseng, were found in this habitat. Potential future turbine sites 7 and 8 are mapped within this habitat in Figure 1, but their placement is quite preliminary at present and topography and soil wetness may preclude their placement here (Reuben Burge, pers. comm.).

Breeding Birds

Birds recorded during the five minute point counts are given in Table 1. Eleven species were recorded on the point count at the proposed turbine site and five additional species were recorded from the two point counts in very similar habitat further east. None of these species are considered rare or significant by the NS Department of Natural Resources (NS DNR) or the Atlantic Canada Conservation Data Centre (AC CDC). A short point count will never record all species using a site, and Table 2 lists the maximum breeding evidence obtained for the 35 species recorded in or from the thinly treed, cut-over white spruce forest that had developed over former open field. This list thus represents a more complete listing of the species potentially impacted by turbine development. One species, Boreal Chickadee, is considered marginally rare by AC CDC (ranked S3S4), but secure by NS DNR. The Boreal Chickadee rank of S3S4 is an overestimation of the rarity of the species, which although declining, is still common through almost the entire province. This rank is almost certain to change to S4 in the next iteration of the NS S-ranks. Table 3 lists an additional 10 species recorded only from habitats not present within the turbine footprint: mature sugar maple – hemlock dominated mixed forest, open field and around farm buildings. One species, Bobolink, is considered rare by the AC CDC and NS DNR (ranked S3B, typically meaning 21-100 known breeding locations in the province and Yellow, or "sensitive to human disturbance or natural events"). A single male Bobolink was seen

singing over the large field in the southeast of the cleared farm area as shown on Figure 2, 600 m south of the proposed turbine site. The habitat of the proposed turbine is too densely shrubby and treed for Bobolink breeding, and as long as the access road to the turbine site does not disturb the field in which the Bobolink was found, it seems unlikely that the turbines would affect Bobolink nesting on the property.

Table 1. Five-minute point count results for birds, with species ordered by decreasing abundance within ridge-top habitats and then in other habitats. Shaded columns are from the proposed turbine site (Site#1) or from similar habitat on the mountain ridge to the east (Sites#2 & 3). Sites 4, 5 and 6 are from open fields, also sampling some old-field white spruce habitat similar to sites 1-3 and some mature mixed forest. S-ranks and GS ranks are defined in Appendix 1.

Common Name	**Scientific Name**	**NS S-rank**	**NS DNR rank**	**Site#1**	**Site#2**	**Site#3**	**RIDGE TOTAL**	**Site#4**	**Site#5**	**Site#6**	**OVERALL TOTAL**
White-throated Sparrow	*Zonotrichia albicollis*	S5B,SZN	Green – Secure	3	2	4	**9**	2	2	2	**15**
American Crow	*Corvus brachyrhynchos*	S5	Green – Secure	1	3	4	**8**	1	2	4	**15**
American Robin	*Turdus migratorius*	S5B	Green – Secure	3	2		**5**	3	2	1	**11**
Lincoln's Sparrow	*Melospiza lincolnii*	S5B	Green – Secure	2	2	1	**5**	1		1	**7**
Song Sparrow	*Melospiza melodia*	S5B	Green – Secure	1	2	2	**5**		1		**6**
Magnolia Warbler	*Dendroica magnolia*	S5B	Green – Secure	2		1	**3**	3	2	1	**9**
Common Yellowthroat	*Geothlypis trichas*	S5B	Green – Secure	2	1		**3**	1			**4**
Olive-sided Flycatcher	*Contopus cooperi*	S4S5B	Green – Secure	2		1	**3**	1			**4**
Dark-eyed Junco	*Junco hyemalis*	S5	Green – Secure	1	1		**2**	1	1	1	**5**
Red-eyed Vireo	*Vireo olivaceus*	S5B	Green – Secure		1	1	**2**			1	**3**
Blue-headed Vireo	*Vireo solitarius*	S5B	Green – Secure		2		**2**			1	**3**
Chipping Sparrow	*Spizella passerina*	S5B	Green – Secure			1	**1**		3	1	**5**
Yellow-rumped Warbler	*Dendroica coronata*	S5B	Green – Secure	1			**1**		1	2	**4**
Common Raven	*Corvus corax*	S5	Green – Secure	1			**1**		1		**2**
Purple Finch	*Carpodacus purpureus*	S5B	Green – Secure		1		**1**	1			**2**

Common Name	Scientific Name	NS S-rank	NS DNR rank	Site#1	Site#2	Site#3	RIDGE TOTAL	Site#4	Site#5	Site#6	OVERALL TOTAL
Black-and-White Warbler	*Mniotilta varia*	S5B	Green – Secure		1		**1**				**1**
Savannah Sparrow	*Passerculus sandwichensis*	S5B	Green – Secure				**0**		1	2	**3**
Golden-crowned Kinglet	*Regulus satrapa*	S5B	Green – Secure				**0**	1		1	**2**
Mourning Dove	*Zenaida macroura*	S5B	Green – Secure				**0**	1			**1**
European Starling	*Sturnus vulgaris*	SE	Exotic				**0**	1			**1**
Hairy Woodpecker	*Picoides villosus*	S5	Green – Secure				**0**	1			**1**
Swainson's Thrush	*Catharus ustulatus*	S5B	Green – Secure				**0**		1		**1**
Northern Parula	*Parula americana*	S5B	Green – Secure				**0**		1		**1**
Blue Jay	*Cyanocitta cristata*	S5	Green – Secure				**0**		1		**1**
Alder Flycatcher	*Empidonax alnorum*	S5B	Green – Secure				**0**			1	**1**
Ruby-crowned Kinglet	*Regulus calendula*	S5B	Green – Secure				**0**			1	**1**
American Goldfinch	*Carduelis tristis*	S5	Green – Secure				**0**			1	**1**
Nashville Warbler	*Vermivora ruficapilla*	S5B	Green – Secure				**0**			1	**1**
Ovenbird	*Seiurus aurocapillus*	S5B	Green – Secure				**0**	1			**1**
Black-throated Green Warbler	*Dendroica virens*	S5B	Green – Secure				**0**			1	**1**
woodpecker species							**0**			1	**1**

Table 2. Maximum breeding evidence and provincial status for all species recorded in or from ridge-top white spruce forest and cut-over (habitat of proposed turbine) S-ranks and GS ranks are defined in Appendix 1.

Common Name	Scientific Name	NS S-rank	NS GS rank	Maximum Breeding Evidence
Dark-eyed Junco	*Junco hyemalis*	S5	Green – Secure	Probable - Agitated behaviour
Song Sparrow	*Melospiza melodia*	S5B	Green – Secure	Possible - Singing male in suitable breeding habitat
American Crow	*Corvus brachyrhynchos*	S5	Green – Secure	Probable - Pair in suitable breeding habitat
Common Raven	*Corvus corax*	S5	Green – Secure	Possible - Single bird in suitable breeding habitat
Yellow-rumped Warbler	*Dendroica coronata*	S5B	Green – Secure	Possible - Singing male in suitable breeding habitat
Common Yellowthroat	*Geothlypis trichas*	S5B	Green – Secure	Probable - Courtship or display, including interaction between male and female or between two males
Lincoln's Sparrow	*Melospiza lincolnii*	S5B	Green – Secure	Probable - Courtship or display, including interaction between male and female or between two males
Olive-sided Flycatcher	*Contopus cooperi*	S4S5B	Green – Secure	Probable - Courtship or display, including interaction between male and female or between two males
Magnolia Warbler	*Dendroica magnolia*	S5B	Green – Secure	Probable - Courtship or display, including interaction between male and female or between two males
White-throated Sparrow	*Zonotrichia albicollis*	S5B,SZN	Green – Secure	Probable - Agitated behaviour
American Robin	*Turdus migratorius*	S5B	Green – Secure	Probable - Agitated behaviour
Red-eyed Vireo	*Vireo olivaceus*	S5B	Green – Secure	Probable - Pair in suitable breeding habitat
Purple Finch	*Carpodacus purpureus*	S5B	Green – Secure	Possible - Singing male in suitable breeding habitat
Black-and-White Warbler	*Mniotilta varia*	S5B	Green – Secure	Possible - Singing male in suitable breeding habitat
Blue-headed Vireo	*Vireo solitarius*	S5B	Green – Secure	Probable - Courtship or display, including interaction between male and female or between two males
Chipping Sparrow	*Spizella passerina*	S5B	Green – Secure	Probable - Pair in suitable breeding habitat
Mourning Dove	*Zenaida macroura*	S5B	Green – Secure	Probable - Pair in suitable breeding habitat

Common Name	Scientific Name	NS S-rank	NS GS rank	Maximum Breeding Evidence
Golden-crowned Kinglet	*Regulus satrapa*	S5B	Green – Secure	Possible - Singing male in suitable breeding habitat
European Starling	*Sturnus vulgaris*	SE	7 exotic	Confirmed - Flightless or dependent young observed
Hairy Woodpecker	*Picoides villosus*	S5	Green – Secure	Possible - Single bird in suitable breeding habitat
Swainson's Thrush	*Catharus ustulatus*	S5B	Green – Secure	Probable - Courtship or display, including interaction between male and female or between two males
Northern Parula	*Parula americana*	S5B	Green – Secure	Possible - Singing male in suitable breeding habitat
Blue Jay	*Cyanocitta cristata*	S5	Green – Secure	Possible - Single bird in suitable breeding habitat
Alder Flycatcher	*Empidonax alnorum*	S5B	Green – Secure	Possible - Singing male in suitable breeding habitat
Ruby-crowned Kinglet	*Regulus calendula*	S5B	Green – Secure	Possible - Singing male in suitable breeding habitat
American Goldfinch	*Carduelis tristis*	S5	Green – Secure	Possible - Single bird in suitable breeding habitat
Nashville Warbler	*Vermivora ruficapilla*	S5B	Green – Secure	Possible - Singing male in suitable breeding habitat
Boreal Chickadee	*Poecile hudsonica*	S3S4	Green – Secure	Possible - Single bird in suitable breeding habitat
Gray Jay	*Perisoreus canadensis*	S5	Green – Secure	Probable - Pair in suitable breeding habitat
Red-breasted Nuthatch	*Sitta canadensis*	S5	Green – Secure	Probable - Pair in suitable breeding habitat
Black-capped Chickadee	*Poecile atricapilla*	S5	Green – Secure	Possible - Single bird in suitable breeding habitat
Bay-breasted Warbler	*Dendroica castanea*	S5B	Green – Secure	Possible - Singing male in suitable breeding habitat
Hermit Thrush	*Catharus guttatus*	S5B	Green – Secure	Possible - Singing male in suitable breeding habitat
Cedar Waxwing	*Bombycilla cedrorum*	S5B	Green – Secure	Possible - Single bird in suitable breeding habitat
Northern Flicker	*Colaptes auratus*	S5B	Green – Secure	Possible - Singing male in suitable breeding habitat

Table 3. Maximum breeding evidence and provincial status for all species recorded only from habitats outside the footprint of the proposed turbine development. S-ranks and NS DNR ranks are defined in Appendix 1.

Common Name	Scientific Name	NS S-rank	NS GS rank	Maximum Breeding Evidence	Habitat where observed
Barn Swallow	*Hirundo rustica*	S5B	Green – Secure	Confirmed - Adult entering presumed nest site	buildings and field
Bobolink	*Dolichonyx oryzivorus*	S3B	Yellow - Sensitive	Possible - Singing male in suitable breeding habitat	field
Killdeer	*Charadrius vociferus*	S5B	Green – Secure	Possible - Single bird in suitable breeding habitat	field
Savannah Sparrow	*Passerculus sandwichensis*	S5B	Green – Secure	Probable - Pair in suitable breeding habitat	field
Barred Owl	*Strix varia*	S5	Green – Secure	Probable - Pair in suitable breeding habitat	mature mixed forest
Blackburnian Warbler	*Dendroica fusca*	S4S5B	Green – Secure	Probable - Courtship or display, including interaction between male and female or between two males or	mature mixed forest
Black-throated Green Warbler	*Dendroica virens*	S5B	Green – Secure	Possible - Singing male in suitable breeding habitat	mature mixed forest
Eastern Wood-Pewee	*Contopus virens*	S5B	Green – Secure	Possible - Singing male in suitable breeding habitat	mature mixed forest
Ovenbird	*Seiurus aurocapillus*	S5B	Green – Secure	Possible - Singing male in suitable breeding habitat	mature mixed forest
Winter Wren	*Troglodytes troglodytes*	S5B	Green – Secure	Possible - Singing male in suitable breeding habitat	mature mixed forest

Vascular Plants
Table 4 lists the vascular plant species (77 native or potentially native, 21 exotic – those listed as SE) recorded within the footprint of the proposed turbine development at Site #1 and in adjacent areas of similar habitat around potential turbine sites 2 and 3. No effort was made to record which species occurred within the potential footprint of the proposed turbine development, but that would represent a small subset of the species listed in Table 4.

Table 5 lists the all of the 221 vascular plant species (180 native or potentially native, 41 exotic) recorded during the entire visit.

Significance of vascular plants
No significant species of vascular plants were noted within the footprint of the proposed turbine development at Site #1 or in similar habitat in adjacent areas to the east.

Three significant species were noted elsewhere during the site visit, their locations are mapped in Figure 2. All of these were in the mature forest along the western boundary of the area of interest:

Lance-Leaf Grape-Fern *(Botrychium lanceolatum var. angustisegmentum*) – one plant noted at 45.61975°N, 62.90819°W in mature sugar maple – hemlock forest with some red spruce and yellow birch. This location is 950 m southwest of the proposed turbine site and well away from any potential access road location. As such it is very unlikely to be affected by this turbine development. This species is ranked S2 in Nova Scotia by the AC CDC (fewer than 20 locations known) and is the only species found that is considered significant by NS DNR who rank it as Yellow (Sensitive). This species is widespread but rare in Nova Scotia and is usually found in mature hardwood-dominated forest on richer soils. It is on the more common side of the S2 rank, and may be somewhat overlooked due to its very small size and similarity to other species in the same genus. It is, however, very likely to be decreasing, especially on private land, in association with forestry activities.

Dwarf Ginseng *(Panax trifolius)* – Six mature plants and about 12 seedlings noted at 45.61975°N, 62.90819°W (precisely the same location as above) in mature sugar maple – hemlock forest with some red spruce and yellow birch. This location is 950 m southwest of the proposed turbine site and well away from any potential access road location. As such it is very unlikely to be affected by this turbine development. This species is ranked S3 in Nova Scotia by the AC CDC (20-100 known occurrences) but is considered Green - Secure by NS DNR. This species is also widespread but uncommon in Nova Scotia and is usually found in mature hardwood-dominated forest on richer soils. It is on the rare side of the S3 rank, and is very likely to be decreasing, especially on private land, in association with forestry activities.

Large Roundleaf Orchid *(Platanthera orbiculata)* – One plant noted at approximately 45.61826°N, 62.90838°W in mature sugar maple – hemlock forest. This location is 950 m

southwest of the proposed turbine site and well away from any potential access road location. As such it is very unlikely to be affected by this turbine development. This species is ranked S3 in Nova Scotia by the AC CDC (20-100 known occurrences) but is considered Green - Secure by NS DNR. It occurs in a fairly wide range of forest types (usually in more mature stands) in both basic and slightly acidic areas and is on the more common side of the S3 rank, though it is probably declining in association with forestry.

Table 4. Vascular plants observed at the proposed turbine site (Site#1) and in similar habitat further east, with abundance estimates (defined in Methods) and provincial ranks. Rank definitions are given in Appendix 1.

Family / Species Name	Family / Species Common Name	Comments	Abundance	NS S-rank	NS DNR rank
LYCOPODIACEAE	**Clubmoss Family**				
Lycopodium digitatum	Fan Club-Moss		R	S5	Green
Lycopodium lagopus	One-Cone Gound-Pine		C	S4	Green
Lycopodium tristachyum	Deep-Root Clubmoss		R	S4	Green
OSMUNDACEAE	**Flowering-Fern Family**				
Osmunda cinnamomea	Cinnamon Fern		U	S5	Green
DENNSTAEDTIACEAE	**Hay-Scented Fern Family**				
Dennstaedtia punctilobula	Eastern Hay-Scented Fern		C	S5	Green
Pteridium aquilinum var. latiusculum	Bracken Fern		U	S5	Green
DRYOPTERIDACEAE	**Wood-Fern Family**				
Athyrium filix-femina ssp. angustum	Lady Fern		C	S5	Green
Dryopteris campyloptera	Mountain Wood-Fern		C	S5	Green
Onoclea sensibilis	Sensitive Fern		F	S5	Green
PINACEAE	**Pine Family**				
Abies balsamea	Balsam Fir		C	S5	Green
Picea glauca	White Spruce		C	S5	Green
MYRICACEAE	**Bayberry Family**				
Morella pensylvanica	Northern Bayberry		C	S5	Green
BETULACEAE	**Birch Family**				
Alnus viridis ssp. crispa	Green Alder		F	S5	Green
Betula alleghaniensis	Yellow Birch		F	S5	Green
Betula papyrifera var. papyrifera	Heart-Leaved Paper Birch		F	S5	Green
Betula populifolia	Gray Birch		F	S5	Green
POLYGONACEAE	**Smartweed Family**				
Polygonum aviculare	Knotweed	ID refers to the species in the broad sense	R	S5SE	Green
Polygonum cilinode	Fringed Black Bindweed		R	S5	Green
Rumex acetosella	Sheep Sorrel		U	SE	Exotic
CLUSIACEAE	**St. John's-Wort Family**				
Hypericum perforatum	A St. John's-Wort		U	SE	Exotic
VIOLACEAE	**Violet Family**				

Family / Species Name	Family / Species Common Name	Comments	Abundance	NS S-rank	NS DNR rank
Viola sororia	Woolly Blue Violet		U	S5	Green
SALICACEAE	**Willow Family**				
Populus tremuloides	Quaking Aspen		F	S5	Green
Salix bebbiana	Bebb's Willow		F	S5	Green
Salix discolor	Pussy Willow		R	S5	Green
Salix humilis	Prairie Willow		R	S5	Green
Salix pyrifolia	Balsam Willow		R	S5	Green
ERICACEAE	**Heath Family**				
Kalmia angustifolia	Sheep-Laurel		U	S5	Green
Vaccinium angustifolium	Late Lowbush Blueberry		C	S5	Green
PYROLACEAE	**Pyrola Family**				
Pyrola elliptica	Shinleaf		U	S5	Green
PRIMULACEAE	**Primrose Family**				
Trientalis borealis	Northern Starflower		F	S5	Green
GROSSULARIACEAE	**Currant Family**				
Ribes hirtellum	Smooth Gooseberry		R	S5	Green
ROSACEAE	**Rose Family**				
Amelanchier interior	Serviceberry sp.	ID uncertain	U	S?	Green
Fragaria virginiana	Virginia Strawberry		C	S5	Green
Potentilla simplex	Old-Field Cinquefoil		U	S5	Green
Prunus pensylvanica	Fire Cherry		C	S5	Green
Prunus virginiana	Choke Cherry		C	S5	Green
Rosa virginiana	Virginia Rose		U	S5	Green
Rubus allegheniensis	Allegheny Blackberry		R	S5	Green
Rubus idaeus ssp. strigosus	American Red Raspberry		C	S5	Green
Rubus sp.	Blackberry sp.	low species aligned with R. canadensis group	R	native	
Sibbaldiopsis tridentata	Three-Toothed Cinquefoil		U	S5	Green
Sorbus aucuparia	European Mountain-Ash		R	SE	Exotic
Sorbus decora	Northern Mountain-Ash		C	S4	Green
Spiraea alba var. latifolia	Northern Meadow-Sweet		C	S5	Green
FABACEAE	**Bean Family**				
Lotus corniculatus	Birds-Foot Trefoil		U	SE	Exotic
Lupinus polyphyllus	Large-Leaved Lupine		R	SE	Exotic
Melilotus officinalis	Yellow Sweetclover	ID refers to the species in the broad sense (including M. alba, also SE)	R	SE	Exotic
Trifolium pratense	Red Clover		U	SE	Exotic
Vicia cracca	Tufted Vetch		C	SE	Exotic
ONAGRACEAE	**Evening-Primrose Family**				
Chamerion angustifolium	Fireweed		F	S5	Green
Oenothera parviflora	Northern Evening-Primrose	ID probable vs. O. biennis (S5)	R	S4?	Green
CORNACEAE	**Dogwood Family**				
Cornus alternifolia	Alternate-Leaf Dogwood		R	S5	Green

Family / Species Name	Family / Species Common Name	Comments	Abundance	NS S-rank	NS DNR rank
Cornus canadensis	Dwarf Dogwood		F	S5	Green
ACERACEAE	**Maple Family**				
Acer pensylvanicum	Striped Maple		F	S5	Green
Acer rubrum	Red Maple		F	S5	Green
Acer saccharum	Sugar Maple		C	S5	Green
Acer spicatum	Mountain Maple		U	S5	Green
ARALIACEAE	**Sarsaparilla Family**				
Aralia hispida	Bristly Sarsaparilla		F	S5	Green
Aralia nudicaulis	Wild Sarsaparilla		C	S5	Green
APIACEAE	**Carrot Family**				
Daucus carota	Wild Carrot		R	SE	Exotic
PLANTAGINACEAE	**Plantain Family**				
Plantago major	Nipple-Seed Plantain		U	SE	Exotic
CAPRIFOLIACEAE	**Honeysuckle Family**				
Lonicera canadensis	American Fly-Honeysuckle		F	S5	Green
Sambucus racemosa	Red Elderberry		F	S5	Green
ASTERACEAE	**Aster Family**				
Achillea millefolium	Common Yarrow		F	S5	Green
Anaphalis margaritacea	Pearly Everlasting		C	S5	Green
Antennaria howellii	Small Pussy-Toes	ID probable vs. A. neglecta	U	S4?	Green
Doellingeria umbellata	Parasol White-Top		C	S5	Green
Euthamia graminifolia	Flat-Top Fragrant-Golden-Rod		C	S5	Green
Hieracium caespitosum	Meadow Hawkweed	ID uncertain vs. H. aurantiacum (pre-flowering)	U	SE	Exotic
Hieracium lachenalii	Common Hawkweed		C	SE	Exotic
Hieracium sp	Hawkweed sp.	*glabrous with acaulescent stolons, exotic whatever species it is	F	SE*	Exotic
Leontodon autumnalis	Autumn Hawkbit		U	SE	Exotic
Leucanthemum vulgare	Oxeye Daisy		U	SE	Exotic
Matricaria discoidea	Pineapple-Weed Chamomile		R	SE	Exotic
Oclemena acuminata	Whorled Aster		F	S5	Green
Solidago bicolor	White Goldenrod		F	S5	Green
Solidago canadensis	Canada Goldenrod		R	S5	Green
Solidago nemoralis	Field Goldenrod		U	S4S5	Green
Solidago puberula	Downy Goldenrod		U	S5	Green
Solidago rugosa	Rough-Leaf Goldenrod		C	S5	Green
Symphyotrichum lateriflorum	Farewell-Summer		R	S5	Green
Symphyotrichum novi-belgii	New Belgium American-Aster		R	S5	Green
Taraxacum officinale	Common Dandelion		F	SE	Exotic
JUNCACEAE	**Rush Family**				
Luzula multiflora	Common Woodrush		C	S5	Green
CYPERACEAE	**Sedge Family**				

Family / Species Name	Family / Species Common Name	Comments	Abundance	NS S-rank	NS DNR rank
Carex communis	Fibrous-Root Sedge		U	S5	Green
Carex crinita	Fringed Sedge	ID refers to the species in the broad sense (including C. gynandra)	C	S4S5	Green
Carex debilis var. rudgei	White-Edge Sedge		R	S5	Green
Carex pallescens	Pale Sedge		F	S5	Green
Carex sp. (section Ovales)	Sedge sp. (section Ovales)	too early for identification; unlikely to be rare	R	native	
POACEAE	**Grass Family**				
Agrostis sp.	Bent-Grass sp.	*either A. capillaris (SE) or A.. gigantea (S5SE); too early for positive ID	U	SE*	Exotic
Dactylis glomerata	Orchard Grass		F	SE	Exotic
Danthonia spicata	Poverty Oat-Grass		C	S5	Green
DIchanthelium acuminatum	Panic Grass		R	S5	Green
Festuca filiformis	Hair Fescue		C	SE	Exotic
Festuca rubra	Red Fescue		U	S5	Green
Lolium pratense	Meadow Rye Grass	ID probable vs. L. arundinaceum (both SE)	R	SE	Exotic
LILIACEAE	**Lily Family**				
Maianthemum canadense	Wild Lily-of-The-Valley		C	S5	Green
ORCHIDACEAE	**Orchid Family**				
Cypripedium acaule	Pink Lady's-Slipper		F	S5	Green

Table 5. All vascular plants observed during the site visit, including areas within and outside the footprint of the proposed turbine development, with abundance estimates (defined in Methods) and provincial ranks. Rank definitions are given in Appendix 1.

Family / Species Name	Family / Species Common Name	Comments	Abund-ance	NS S-rank	NS DNR rank
LYCOPODIACEAE	**Clubmoss Family**				
Huperzia lucidula	Shining Fir-Clubmoss		U	S5	Green
Lycopodium annotinum	Stiff Clubmoss		R	S5	Green
Lycopodium clavatum	Running Pine	ID probable vs. L. lagopus	U	S5	Green
Lycopodium dendroideum	Treelike Clubmoss		U	S4?	Green
Lycopodium digitatum	Fan Club-Moss		R	S5	Green
Lycopodium lagopus	One-Cone Gound-Pine		C	S4	Green
Lycopodium obscurum	Tree Clubmoss	ID probable vs. hickeyi	R	S5	Green
Lycopodium tristachyum	Deep-Root Clubmoss		R	S4	Green
EQUISETACEAE	**Horsetail Family**				
Equisetum arvense	Field Horsetail		U	S5	Green
Equisetum sylvaticum	Woodland Horsetail		U	S5	Green
OPHIOGLOSSACEAE	**Grape-Fern Family**				
Botrychium lanceolatum var. angustisegmentum	Lance-Leaf Grape-Fern		R	S2	Yellow - Sensitive
OSMUNDACEAE	**Flowering-Fern Family**				
Osmunda cinnamomea	Cinnamon Fern		U	S5	Green
Osmunda claytoniana	Interrupted Fern		U	S5	Green

Family / Species Name	Family / Species Common Name	Comments	Abund-ance	NS S-rank	NS DNR rank
DENNSTAEDTIACEAE	**Hay-Scented Fern Family**				
Dennstaedtia punctilobula	Eastern Hay-Scented Fern		C	S5	Green
Pteridium aquilinum var. latiusculum	Bracken Fern		U	S5	Green
THELYPTERIDACEAE	**Marsh-Fern Family**				
Phegopteris connectilis	Northern Beech Fern		U	S5	Green
Thelypteris noveboracensis	New York Fern		U	S5	Green
DRYOPTERIDACEAE	**Wood-Fern Family**				
Athyrium filix-femina ssp. angustum	Lady Fern		C	S5	Green
Deparia acrostichoides	Silvery Spleenwort		U	S4	Green
Dryopteris campyloptera	Mountain Wood-Fern		C	S5	Green
Dryopteris carthusiana	Spinulose Shield Fern		R	S5	Green
Dryopteris cristata	Crested Shield-Fern		R	S5	Green
Dryopteris intermedia	Evergreen Woodfern		U	S5	Green
Gymnocarpium dryopteris	Northern Oak Fern		F	S5	Green
Matteuccia struthiopteris	Ostrich Fern		U	S5	Green
Onoclea sensibilis	Sensitive Fern		F	S5	Green
Polystichum acrostichoides	Christmas Fern		U	S5	Green
PINACEAE	**Pine Family**				
Abies balsamea	Balsam Fir		C	S5	Green
Picea glauca	White Spruce		C	S5	Green
Picea rubens	Red Spruce		F	S5	Green
Tsuga canadensis	Eastern Hemlock		F	S4S5	Green
RANUNCULACEAE	**Buttercup Family**				
Coptis trifolia	Goldthread		R	S5	Green
Ranunculus acris	Tall Butter-Cup		F	SE	Exotic
Ranunculus repens	Creeping Butter-Cup		U	SE	Exotic
MYRICACEAE	**Bayberry Family**				
Morella pensylvanica	Northern Bayberry		C	S5	Green
FAGACEAE	**Beech Family**				
Fagus grandifolia	American Beech		U	S5	Green
BETULACEAE	**Birch Family**				
Alnus viridis ssp. crispa	Green Alder		F	S5	Green
Betula alleghaniensis	Yellow Birch		F	S5	Green
Betula papyrifera var. papyrifera	Heart-Leaved Paper Birch		F	S5	Green
Betula populifolia	Gray Birch		F	S5	Green
Corylus cornuta	Beaked Hazelnut		R	S5	Green
Ostrya virginiana	Eastern Hop-Hornbeam		U	S5	Green
CARYOPHYLLACEAE	**Pink Family**				
Cerastium fontanum ssp. vulgare	Common Mouse-Ear Chickweed		R	SE	Exotic
Stellaria graminea	Little Starwort		R	SE	Exotic
POLYGONACEAE	**Smartweed Family**				
Polygonum aviculare	Knotweed	ID refers to the species in the broad sense	R	S5SE	Green
Polygonum cilinode	Fringed Black Bindweed		R	S5	Green
Polygonum hydropiper	Marshpepper Smartweed		U	SE	Exotic
Polygonum sagittatum	Arrow-Leaved Tearthumb		U	S5	Green

Family / Species Name	Family / Species Common Name	Comments	Abund-ance	NS S-rank	NS DNR rank
Rumex acetosa	Garden Sorrel		R	SE	Exotic
Rumex acetosella	Sheep Sorrel		U	SE	Exotic
Rumex orbiculatus	Water Dock		R	S5	Green
CLUSIACEAE	**St. John's-Wort Family**				
Hypericum boreale	Northern St. John's-Wort	ID probable vs. H. mutilum (S4)	R	S5	Green
Hypericum perforatum	A St. John's-Wort		U	SE	Exotic
VIOLACEAE	**Violet Family**				
Viola blanda var. palustriformis	Large-Leaf White Violet		U	S5	Green
Viola cucullata	Marsh Blue Violet		U	S5	Green
Viola macloskeyi ssp. pallens	Smooth White Violet		U	S5	Green
Viola renifolia	Kidney-Leaf White Violet		R	S4	Green
Viola sororia	Woolly Blue Violet		U	S5	Green
SALICACEAE	**Willow Family**				
Populus tremuloides	Quaking Aspen		F	S5	Green
Salix bebbiana	Bebb's Willow		F	S5	Green
Salix discolor	Pussy Willow		R	S5	Green
Salix humilis	Prairie Willow		R	S5	Green
Salix pyrifolia	Balsam Willow		R	S5	Green
BRASSICACEAE	**Mustard Family**				
Barbarea vulgaris	Yellow Rocket		R	SE	Exotic
Cardamine pensylvanica	Pennsylvania Bitter-Cress		R	S5	Green
ERICACEAE	**Heath Family**				
Kalmia angustifolia	Sheep-Laurel		U	S5	Green
Vaccinium angustifolium	Late Lowbush Blueberry		C	S5	Green
PYROLACEAE	**Pyrola Family**				
Pyrola elliptica	Shinleaf		U	S5	Green
MONOTROPACEAE	**Indian Pipe Family**				
Monotropa uniflora	Indian-Pipe		R	S5	Green
PRIMULACEAE	**Primrose Family**				
Trientalis borealis	Northern Starflower		F	S5	Green
GROSSULARIACEAE	**Currant Family**				
Ribes hirtellum	Smooth Gooseberry		R	S5	Green
SAXIFRAGACEAE	**Saxifrage Family**				
Chrysosplenium americanum	American Golden-Saxifrage		R	S5	Green
ROSACEAE	**Rose Family**				
Amelanchier interior	Serviceberry sp.	ID uncertain	U	S?	Green
Fragaria virginiana	Virginia Strawberry		C	S5	Green
Geum laciniatum	Rough Avens	ID probable only (pre-flowering plant)	R	S4S5	Green
Potentilla recta	Sulphur Cinquefoil		R	SE	Exotic
Potentilla simplex	Old-Field Cinquefoil		U	S5	Green
Prunus pensylvanica	Fire Cherry		C	S5	Green
Prunus virginiana	Choke Cherry		C	S5	Green
Rosa virginiana	Virginia Rose		U	S5	Green
Rubus allegheniensis	Allegheny Blackberry		R	S5	Green
Rubus idaeus ssp. strigosus	American Red Raspberry		C	S5	Green
Rubus pubescens	Dwarf Red Raspberry		U	S5	Green

Family / Species Name	Family / Species Common Name	Comments	Abund-ance	NS S-rank	NS DNR rank
Rubus sp.	Blackberry sp.	low species aligned with R. canadensis group	R	native	
Sibbaldiopsis tridentata	Three-Toothed Cinquefoil		U	S5	Green
Sorbus aucuparia	European Mountain-Ash		R	SE	Exotic
Sorbus decora	Northern Mountain-Ash		C	S4	Green
Spiraea alba var. latifolia	Northern Meadow-Sweet		C	S5	Green
FABACEAE	**Bean Family**				
Lotus corniculatus	Birds-Foot Trefoil		U	SE	Exotic
Lupinus polyphyllus	Large-Leaved Lupine		R	SE	Exotic
Medicago lupulina	Black Medic		R	SE	Exotic
Melilotus officinalis	Yellow Sweetclover	ID refers to the species in the broad sense (including M. alba, also SE)	R	SE	Exotic
Trifolium pratense	Red Clover		U	SE	Exotic
Trifolium repens	White Clover		R	SE	Exotic
Vicia cracca	Tufted Vetch		C	SE	Exotic
Vicia sepium	Bush Vetch		R	SE	Exotic
ONAGRACEAE	**Evening-Primrose Family**				
Chamerion angustifolium	Fireweed		F	S5	Green
Circaea alpina	Small Enchanter's Nightshade		R	S5	Green
Epilobium ciliatum	Hairy Willow-Herb	ID refers to the species in the broad sense	R	S5	Green
Oenothera parviflora	Northern Evening-Primrose	ID probable vs. O. biennis (S5)	R	S4?	Green
Oenothera perennis	Small Sundrops		R	S5	Green
CORNACEAE	**Dogwood Family**				
Cornus alternifolia	Alternate-Leaf Dogwood		R	S5	Green
Cornus canadensis	Dwarf Dogwood		F	S5	Green
ACERACEAE	**Maple Family**				
Acer pensylvanicum	Striped Maple		F	S5	Green
Acer rubrum	Red Maple		F	S5	Green
Acer saccharum	Sugar Maple		C	S5	Green
Acer spicatum	Mountain Maple		U	S5	Green
OXALIDACEAE	**Wood-Sorrel Family**				
Oxalis montana	White Wood-Sorrel		R	S5	Green
Oxalis stricta	Upright Yellow Wood-Sorrel		U	S5	Green
GERANIACEAE	**Geranium Family**				
Geranium robertianum	Herb-Robert		R	S4S5	Green
BALSAMINACEAE	**Touch-Me-Not Family**				
Impatiens capensis	Spotted Jewel-Weed		C	S5	Green
ARALIACEAE	**Sarsaparilla Family**				
Aralia hispida	Bristly Sarsaparilla		F	S5	Green
Aralia nudicaulis	Wild Sarsaparilla		C	S5	Green
Panax trifolius	Dwarf Ginseng		R	S3	Green
APIACEAE	**Carrot Family**				
Carum carvi	Common Caraway		R	SE	Exotic
Daucus carota	Wild Carrot		R	SE	Exotic
Hydrocotyle americana	American Water-Pennywort		R	S5	Green

Family / Species Name	Family / Species Common Name	Comments	Abund-ance	NS S-rank	NS DNR rank
BORAGINACEAE	**Borage Family**				
Myosotis laxa	Small Forget-Me-Not		R	S5	Green
LAMIACEAE	**Mint Family**				
Galeopsis tetrahit	Brittle-Stem Hempnettle	ID refers to the species in the broad sense (including G. bifida, also SE)	R	SE	Exotic
Lycopus americanus	American Bugleweed		R	S5	Green
Lycopus uniflorus	Northern Bugleweed		R	S5	Green
Prunella vulgaris	Self-Heal		F	S5	Green
Scutellaria lateriflora	Mad Dog Skullcap		R	S5	Green
PLANTAGINACEAE	**Plantain Family**				
Plantago major	Nipple-Seed Plantain		U	SE	Exotic
OLEACEAE	**Olive Family**				
Fraxinus americana	White Ash		F	S5	Green
SCROPHULARIACEAE	**Figwort Family**				
Chelone glabra	White Turtlehead		R	S5	Green
Linaria vulgaris	Butter-And-Eggs		R	SE	Exotic
Rhinanthus minor	Little Yellow-Rattle		U	S5	Green
Verbascum thapsus	Great Mullein		R	SE	Exotic
Veronica americana	American Speedwell		R	S5	Green
Veronica officinalis	Gypsy-Weed		U	S5SE	Exotic
Veronica serpyllifolia	Thyme-Leaved Speedwell		U	S5	Green
RUBIACEAE	**Bedstraw Family**				
Galium mollugo	Great Hedge Bedstraw		R	SE	Exotic
Galium palustre	Marsh Bedstraw		R	S5	Green
Galium trifidum	Small Bedstraw	ID refers to the species in the broad sense (including G. tinctorium, S5)	R	S5	Green
Mitchella repens	Partridge-Berry		R	S5	Green
CAPRIFOLIACEAE	**Honeysuckle Family**				
Linnaea borealis ssp. americana	Twinflower		R	S5	Green
Lonicera canadensis	American Fly-Honeysuckle		F	S5	Green
Sambucus racemosa	Red Elderberry		F	S5	Green
Viburnum lantanoides	Alderleaf Viburnum		U	S5	Green
ASTERACEAE	**Aster Family**				
Achillea millefolium	Common Yarrow		F	S5	Green
Anaphalis margaritacea	Pearly Everlasting		C	S5	Green
Antennaria howellii	Small Pussy-Toes	ID probable vs. A. neglecta	U	S4?	Green
Bidens frondosa	Devil's Beggar-Ticks		R	S5	Green
Cirsium arvense	Creeping Thistle		R	SE	Exotic
Doellingeria umbellata	Parasol White-Top		C	S5	Green
Erigeron strigosus	Daisy Fleabane		U	S5	Green
Eupatorium maculatum	Spotted Joe-Pye Weed		R	S5	Green
Euthamia graminifolia	Flat-Top Fragrant-Golden-Rod		C	S5	Green
Hieracium caespitosum	Meadow Hawkweed	ID uncertain vs. H. aurantiacum (pre-flowering)	U	SE	Exotic
Hieracium lachenalii	Common Hawkweed		C	SE	Exotic
Hieracium sp	Hawkweed sp.	glabrous with acaulescent stolons	F	SE**	Exotic

Family / Species Name	Family / Species Common Name	Comments	Abund-ance	NS S-rank	NS DNR rank
Leontodon autumnalis	Autumn Hawkbit		U	SE	Exotic
Leucanthemum vulgare	Oxeye Daisy		U	SE	Exotic
Matricaria discoidea	Pineapple-Weed Chamomile		R	SE	Exotic
Oclemena acuminata	Whorled Aster		F	S5	Green
Omalotheca sylvatica	Woodland Cudweed		R	S4S5	Green
Prenanthes altissima	Tall Rattlesnake-root		U	S4S5	Green
Senecio jacobaea	Tansy Ragwort		R	SE	Exotic
Solidago bicolor	White Goldenrod		F	S5	Green
Solidago canadensis	Canada Goldenrod		R	S5	Green
Solidago gigantea	Smooth Goldenrod		R	S5	Green
Solidago nemoralis	Field Goldenrod		U	S4S5	Green
Solidago puberula	Downy Goldenrod		U	S5	Green
Solidago rugosa	Rough-Leaf Goldenrod		C	S5	Green
Solidago uliginosa	Bog Goldenrod		R	S5	Green
Symphyotrichum lateriflorum	Farewell-Summer		R	S5	Green
Symphyotrichum novi-belgii	New Belgium American-Aster		R	S5	Green
Taraxacum officinale	Common Dandelion		F	SE	Exotic
ARACEAE	**Arum Family**				
Arisaema triphyllum	Swamp Jack-In-The-Pulpit		R	S4S5	Green
JUNCACEAE	**Rush Family**				
Juncus effusus	Soft Rush		R	S5	Green
Luzula multiflora	Common Woodrush		C	S5	Green
CYPERACEAE	**Sedge Family**				
Carex arctata	Black Sedge		U	S5	Green
Carex brunnescens ssp. sphaerostachya	Brownish Sedge		U	S5	Green
Carex communis	Fibrous-Root Sedge		U	S5	Green
Carex crinita	Fringed Sedge	ID refers to the species in the broad sense (including C. gynandra)	C	S4S5	Green
Carex debilis var. rudgei	White-Edge Sedge		R	S5	Green
Carex deweyana	Short-Scale Sedge		U	S4	Green
Carex disperma	Softleaf Sedge		R	S5	Green
Carex flava	Yellow Sedge		R	S5	Green
Carex gracillima	Graceful Sedge		R	S4S5	Green
Carex interior	Inland Sedge	ID probable - young	R	S4S5	Green
Carex intumescens	Bladder Sedge		R	S5	Green
Carex leptalea	Bristly-Stalk Sedge		R	S5	Green
Carex leptonervia	Finely-Nerved Sedge		F	S5	Green
Carex nigra	Black Sedge		R	S5	Green
Carex novae-angliae	New England Sedge		U	S5	Green
Carex pallescens	Pale Sedge		F	S5	Green
Carex scabrata	Rough Sedge		U	S5	Green
Carex sp. (section Ovales)	Sedge sp. (section Ovales)	too early for identification; unlikely to be rare	R	native	
Carex stipata	Stalk-Grain Sedge		U	S5	Green
Carex trisperma var. trisperma	Three-Seed Sedge		R	S5	Green

Family / Species Name	Family / Species Common Name	Comments	Abund-ance	NS S-rank	NS DNR rank
Scirpus cyperinus	Cottongrass Bulrush	ID refers to the species in the broad sense (including S. atrocinctus, also S5)	R	S5	Green
Scirpus microcarpus	Small-Fruit Bulrush		U	S5	Green
POACEAE	**Grass Family**				
Agrostis sp.	Bent-Grass sp.	either A. capillaris (SE) or A.. gigantea (S5SE); too early for positive ID	U	SE**	Exotic
Anthoxanthum odoratum	Sweet Vernal Grass		U	SE	Exotic
Brachyelytrum septentrionale	Bearded Short-Husk		R	S4S5	Green
Calamagrostis canadensis	Blue-Joint Reedgrass		R	S5	Green
Cinna latifolia	Slender Wood Reedgrass		R	S5	Green
Dactylis glomerata	Orchard Grass		F	SE	Exotic
Danthonia spicata	Poverty Oat-Grass		C	S5	Green
DIchanthelium acuminatum	Panic Grass		R	S5	Green
Festuca filiformis	Hair Fescue		C	SE	Exotic
Festuca rubra	Red Fescue		U	S5	Green
Glyceria grandis	American Mannagrass		R	S4S5	Green
Glyceria striata	Fowl Manna-Grass		U	S5	Green
Lolium pratense	Meadow Rye Grass	ID probable vs. L. arundinaceum (both SE)	R	SE	Exotic
Poa annua	Annual Bluegrass		R	SE	Exotic
Poa pratensis	Kentucky Bluegrass		C	S5	Green
Poa saltuensis	Drooping Bluegrass		R	S4S5	Green
LILIACEAE	**Lily Family**				
Clintonia borealis	Clinton Lily		F	S5	Green
Maianthemum canadense	Wild Lily-of-The-Valley		C	S5	Green
Maianthemum racemosum	Solomon's-Plume		R	S4S5	Green
Medeola virginiana	Indian Cucumber-Root		U	S5	Green
Polygonatum pubescens	Downy Solomon's-Seal		R	S4S5	Green
Streptopus lanceolatus	Rosy Twistedstalk		F	S5	Green
IRIDACEAE	**Iris Family**				
Sisyrinchium montanum	Strict Blue-Eyed-Grass		R	S5	Green
ORCHIDACEAE	**Orchid Family**				
Cypripedium acaule	Pink Lady's-Slipper		F	S5	Green
Platanthera lacera	Green-Fringe Orchis	ID probable by habitat and morphology - well before flowering	R	S4S5	Green
Platanthera orbiculata	Large Roundleaf Orchid		R	S3	Green
Platanthera psycodes	Small Purple-Fringe Orchis	probably this species by habitat and morphology, but well before flowering	R	S4	Green

Photographs

Photo 1. Mature sugar maple-dominated forest near western edge of Burge property.

Photo 2. Dwarf Ginseng (*Panax trifolius*) plants near western edge of Burge property.

Photo 3. Large Roundleaf Orchid (*Platanthera orbiculata*) near western edge of Burge property.

Appendix 1. Definitions for AC CDC and NatureServe (i), Federal Species at Risk Act (COSEWIC) and Nova Scotia Endangered Species Act (ii) and Nova Scotia Department of Natural Resources (iii) ranking systems.

i) Definitions of AC CDC and NatureServe ranks

G-rank and N-rank definitions are equivalent to those below at the global and national scale.

S1 Extremely rare throughout its range in the province (typically 5 or fewer occurrences or very few remaining individuals). May be especially vulnerable to extirpation.

S2 Rare throughout its range in the province (usually 6 to 20 occurrences or few remaining individuals). May be vulnerable to extirpation due to rarity or other factors.

S3 Uncommon throughout its range in the province (usually 21 to 100 occurrences), or found only in a restricted range, even if abundant in at some locations.

S4 Usually widespread, fairly common throughout its range in the province (usually 100+ occurrences), and apparently secure, but the element is of long-term concern.

S5 Demonstrably widespread, abundant, and secure throughout its range in the province, and essentially ineradicable under present conditions (100+ occurrences).

S#S# Numeric range rank: A range between two consecutive numeric ranks. Denotes range of uncertainty about the exact rarity of the Element (e.g., S1S2).

SR Reported: For New Brunswick, an SR rank indicates that the species is definitively known to occur in the province, it is considered a native species, and it is not considered rare. Once these species are given numeric ranks, they will typically be ranked S4 or S5.

SE Exotic: An exotic species established in the province (e.g., Purple Loosestrife or Coltsfoot); may be native in nearby regions.

? Is used as a qualifier indicating uncertainty: for numeric ranks, denotes inexactness, e.g., SE? denotes uncertainty of exotic status. (The ? qualifies the character immediately preceding it in the SRANK).

ii) Nova Scotia Department of Natural Resources Ranking Definitions

Extinct / Extirpated – No longer in Nova Scotia or extinct in the wild.
Red – Known to be or thought to be at risk.
Yellow – Sensitive to human activities or natural events.
Green – Not believed to be sensitive or at risk.
Undetermined – Insufficient data exists to assess status.
Not assessed – Known or believed to be present in Nova Scotia, but not assessed.
Exotic – Introduced as a result of human activity.

C6- Breeding and Migratory Bird Studies / Methods

DALHOUSIE MOUNTAIN BIRD MONITORING 2007/2008

Steve Vines

INTRODUCTION

RMS Energy Limited has proposed to construct and operate a 60 megawatt wind turbine facility in Western Pictou County, Nova Scotia. The project would see the construction of forty 1.5 megawatt wind turbines over a 28 square kilometer area of Dalhousie Mountain and Mount Ephraim.

As part of the environmental assessment process for such a project, RMS Energy Limited is required to carry out a pre-construction and post-construction bird monitoring program to establish the baseline populations of breeding, migrating, and wintering birds. This report will establish the methodology for sampling avian populations of the study area during each of these critical periods to be carried out both pre-construction and post-construction.

METHODOLOGY

Literature Review

There has been a great deal of research done on the potential impacts of wind turbines on avian populations. In recent years, the Canadian Wildlife Service of Environment Canada (CWS) has published a number of documents to help the proponents of wind turbine projects to establish appropriate monitoring protocols. This monitoring is designed to measure the impact of wind turbine projects on avian populations through first establishing the baseline bird population and species composition. Monitoring continues through the construction and post-construction phases of the project.

The monitoring protocols established in this document were designed using information from personal communication with Dan Busby of CWS and two documents published by CWS:

- Environment Canada (2006) Recommended protocols for monitoring impacts of wind turbines on birds.
- Environment Canada (2006) Wind turbines and birds: A guidance document for environmental assessment.

Bird Migration Surveys

The bird migration surveys will be carried out to determine if the study area is an important migration route for birds. The migration period can extend over several months as different species will move at different times. It is also impossible to predict exactly when birds may be moving through the region. Determining the study area's importance to migrating birds will require multiple visits in the spring and fall months.

In this region there is generally a core migration period when large numbers of birds will pass through in the spring and fall. There are also shoulder migration periods when birds can be observed migrating in smaller numbers. The core spring migration period is the first three weeks of May. In the fall of the year, core migration can be observed during the first three weeks of September. The shoulder migration period can extend several weeks on either side of the core period (Pers. Com. Dan Busby, 2007).

During the core migration periods site surveys will be carried out two days per week. During spring migration this will require two surveys per week for the first three weeks in May 2008 (May 4, 11, 18). The core fall migration surveys will be carried out during the first 3 weeks of September 2007 (September 2, 9, 16). During the shoulder periods site surveys will be carried out one day per week. These surveys will be carried out during the weeks of April 13, 20, 27, May 25, June 1, 8, August 22, 29, September 23, 30, October 7, 14, 21.

The same survey methodology will be used in the spring and the fall migration. Each survey will follow the protocols established by the Canadian Wildlife Service (CWS) for migration stopover counts. Each stopover count will use standardized area searches and sample each of the habitat types identified in the study area. The area searches will make use of transects used during other phases of the bird monitoring program. Surveys will only be conducted on days when weather conditions are within excepted parameters. Each survey will be conducted between one-half hour before sunrise and four hours after sunrise.

Breeding Bird Surveys

Breeding bird populations were sampled during the month of June through the use of area searches and point counts. Point counts were established to sample each of the major habitat types in the study area. Each point count was within 500 metres of a proposed wind turbine location. Several point counts were preformed at proposed turbine locations, others sampled the slopes below proposed turbine locations while others sampled the same habitat as proposed turbine locations. Point counts were carried out in the mornings between one-half hour before sunrise and four hours after sunrise. Thirty-two areas were sampled between June 10, 2007 and June 18, 2007. The point counts were repeated using the same geo-referenced positions between June 25th and June 30$^{th.}$ A total of 65 point counts were completed. Weather conditions in June were not optimal for conducting point counts and many days were not suitable due to excessive wind, precipitation and/or fog. Several of the days point counts were conducted the wind speed

did increase as the morning went on but not to the point that recommended parameters were exceeded. When the wind-speed did increase, attempts were made to conduct point counts which were in the lee of the wind. Due to the fragmented nature of the study area due to forest harvesting it was at times difficult to sample only one habitat type per point count.

Each point count followed the protocols established by the Canadian Wildlife Service (CWS). Ten minute point counts were conducted in two 5 minute consecutive intervals. All species and numbers of individuals detected were recorded for the first 5 minute interval. During the second 5 minute interval additional species and individuals not detected in the first interval were recorded. The results of the two intervals were then added together.

Species at Risk

A desk-top search was conducted to determine if there are any species of conservation concern which may be found in the area of the proposed wind project. The following websites were consulted:

- Committee on the Status of Endangered Wildlife in Canada – www.speciesatrisk.ca
- The Nova Scotia Department of Natural Resources General Status Ranks of Wild Species in Nova Scotia – www.gov.ns.ca/natr/wildlife/genstatus
- The Atlantic Canada Conservation Data Centre – www.accdc.com/products/lists

The search revealed a number species of conservation concern which may be present in the study area. In April of 2007, COSEWIC raised the status of the Common Nighthawk and the Chimney Swift to 'Threatened'. The Department of Natural Resources lists 10 species as 'Yellow' or sensitive to human activities or natural events which could potentially be found in the study area. No 'Red' or endangered listed species are likely to be present.

Raptor Watch

The raptor watch will be conducted between mid September and the end of October 2007. During that period a minimum of four days will be spent watching for migrating raptors. Depending on initial results, more effort may be required if the study area is determined to be in an area important to migrating raptors.

Two vantage points have been identified in the study area that provide good panoramic views of the study area. Effort will be divided between these two viewing areas.

Observations will be made between 9 am and 4 pm. All raptors observed will be identified and notes taken on observed behavior (i.e. hunting).

Wintering Birds

During the winter months (December-March) standardized area searches sampling the variety of habitats in the study area will be conducted. One visit each month during the winter will be carried out to determine the over-wintering species composition of the study area and population estimates. The area searches will make use of transects used during other phases of the bird monitoring program.

RESULTS

Breeding Birds Survey Results

A total of 58 bird species were detected in the study area during the point count surveys and the area searches (See Table 1). No species listed by the Committee on the Status of Endangered Species in Canada (COSEWIC) as species of conservation concern were found. In April 2007, COSEWIC raised the conservation status of the Common Nighthawk and the Chimney Swift to Threatened. Neither species was detected during the breeding bird survey but there is suitable habitat, especially for the Common Nighthawk. Additional evening visits in the later half of June would help to determine if Common Nighthawk is present and breeding in the study area.

Three species found in the study area, Olive-sided Flycatcher, Gray Jay, and Boreal Chickadee, are described as 'Yellow' or sensitive to human activities or natural events by the Nova Scotia Department of Natural Resources (DNR). The Olive-sided Flycatcher benefits from the forest harvesting activities in the region. The study area is comprised of approximately 40% regenerating young forest with many dead snags scattered throughout. Such environments provide excellent feeding areas for the Olive-sided Flycatcher. It was been suggested that the decline in numbers of the Olive-sided

Table 1. Species List for Dalhousie Mountain Study Area

COMMON NAME	SCIENTIFIC NAME	SRANK	BREEDING EVIDENCE	ABUNDANCE 1st SURVEY	ABUNDANCE 2nd SURVEY
Ruffed Grouse	Bonasa umbellus	S5B	H	1	
Spruce Grouse	Falcipennis canadensis	S5B	H	1*	
Sharp-shinned Hawk	Accipiter striatus	S4B	H		1F
Red-tailed Hawk	Buteo jamaicensis	S5B	T	1*	1*
American Kestrel	Falco sparverius	S5B	H	1*	

Mourning Dove	Zenaida macroura	S5B	S	1*	
Barred Owl	Strix varia	S5B	T	1*	
Ruby-throated Hummingbird	Archilochus colubris	S5B	H		1F
Yellow-bellied Sapsucker	Sphyrapicus varius	S5B	NY	4	4
Downy Woodpecker	Picoides pubescens	S5B	NY	1	1
Hairy Woodpecker	Picoides villosus	S5B	NY	2	3
Black-backed Woodpecker	Picoides arcticus	S4B	NY	2*	
Northern Flicker	Colaptes auratus	S5B	T	2	2+1F
Olive-sided Flycatcher	Contopus cooperi	S4B	T	9	6
Eastern Wood-Pewee	Contopus virens	S4B	S	1	1
Yellow-bellied Flycatcher	Empidonax flaviventri	S5B	T	7	5
Alder Flycatcher	Empidonax alnorum	S5B	T	11	6
Least Flycatcher	Empodonax minimus	S5B	T	7	6
Blue-headed Vireo	Vireo solitarius	S5B	CF	3	4
Red-eyed Vireo	Vireo olivaceus	S5B	CF	18	31
Gray Jay	Perisoreus canadens	S4B	T	3*	
Blue Jay	Cyanocitta cristata	S5B	T	3	2
American Crow	Corvus brachyrhynchos	S5B	FY	3	4
Common Raven	Corvus Corax	S5B	FY	1	1
Black-capped Chickadee	Poecile atricapillus	S5B	FY	4	9
Boreal Chickadee	Poecile hudsonica	S4B	S	1	1
Red-breasted Nuthatch	Sitta canadensis	S5B	H	1	2
White-breasted Nuthatch	Sitta carolinensis	S4B	H		1
Winter Wren	Troglodytes troglodytes	S5B	T	7	12
Golden-crowned Kinglet	Regulus satrapa	S5B	S	2	3
Ruby-crowned Kinglet	Regulus calendula	S5B	CF	14	10
Swainson's Thrush	Catharus ustulatus	S5B	CF	4	5
Hermit Thrush	Catharus guttatus	S5B	T	20	17
American Robin	Turdus migratorius	S5B	CF	35	43
Cedar Waxwing	Bombycilla cedrorum	S5B	S	6F	2
Nashville Warbler	Vermivora ruficapilla	S5B	S		1
Northern Parula	Parula americana	S5B	NB	5	2
Chestnut-sided Warbler	Dendroica pensylvanica	S5B	T	3	1
Magnolia Warbler	Dendroica magnolia	S5B	A	11	16
Black-throated Blue Warbler	Dendroica caerulescens	S4B	S	2	
Yellow-rumped Warbler	Dendroica coronata	S5B	CF	7	10
Black-throated Green Warbler	Dendroica virens	S5B	CF	49	40
Blackburnian Warbler	Dendroica fusca	S4S5B	S	4	1
Palm Warbler	Dendroica palmarum	S5B	S	2	2
Bay-breasted Warbler	Dendroica castanea	S5B	S	1*	
Black-and-white Warbler	Mniotilta varia	S5B	CF	12	15
American Redstart	Setophaga ruticilla	S5B	A	7	3
Ovenbird	Seiurus aurocapilla	S5B	CF	40	24
Mourning Warbler	Oporornis philadelphia	S5B	T	2	4
Common Yellowthroat	Geothlypis trichas	S5B	CF	25	15
Song Sparrow	Melospiza melodia	S5B	NY	7	7
Lincoln's Sparrow	Melospiza lincolnii	S5B	T	7	5
Swamp Sparrow	Melospiza georgiana	S5B	S	1*	
White-throated Sparrow	Zonotrichia albicollis	S5B	CF	40	35
Dark-eyed Junco	Junco hyemalis	S5b	CF	7	12

Common Grackle	Quiscalus quiscula	S5B	H	1F	
Purple Finch	Carpodacus purpure	S5B	S	2	1
American Goldfinch	Carduelis tristis	S5B	T	8	4

*Species found in area search or between point counts

F – Species flew through point count area without stopping

[1]Nova Scotia S-ranks from the Atlantic Canada Conservation Data Centre Website

[2]Breeding Evidence Codes: (Taken from Maritime Breeding Bird Atlas Project)

POSSIBLE
H – Species observed in its breeding season in suitable nesting habitat
S – Singing male(s) present, or breeding calls heard, in suitable nesting habitat in breeding season

PROBABLE
P – Pair observed in suitable nesting habitat in nesting season
T – Permanent territory presumed through registration of territorial song, or the occurance of a adult bird, at the same place, in breeding habitat, on at least two days a week or more apart, during its breeding season
D – Courtship or display, including interaction between a male and a female or two males, including courtship feeding or copulation
A – Agitated behavior or anxiety calls of an adult

CONFIRMED
NB – Nest-building or carrying nest materials, for all species except wrens and woodpeckers
DD – Distraction display or injury feigning
NU – Used nest or egg shells found (occupied or laid within the period of the survey)
FY – Recently fledged young or downy young, including incapable of sustained flight
AE – Adults leaving or entering nest site in circumstances indicating occupied nest
FS – Adult carrying faecal sac
CF – Adult carrying food
NE – Nest containing eggs
NY – Nest with young seen or heard

Flycatcher is due to loss of wintering areas. (Cornell Website) The same cannot be said for the Gray Jay and the Boreal Chickadee which have suffered from the fragmentation and loss of mature coniferous habitats. Gray Jays were only encountered during one visit while traveling between point counts. The Gray Jays location was not within 500 metres of any proposed wind turbine location and at a lower elevation. Boreal Chickadee was detected on the same point count during both survey periods. Only one individual was found on each point count. The low number of Gray Jays and Boreal Chickadees encountered during the surveys and the lack of suitable habitat suggest that the study area is of low importance to both species.

Area searches were conducted at various times during the day to detect species which may not be easily detected by listening or are more active at other times then the early morning hours. Area searches were conducted in each of the major habitat types in the study area. The amount of effort for each search was recorded both in time and distance

traversed. Each species encountered by a search was recorded and individual birds counted.

Habitats

The study area consists largely of two major habitat types, mature deciduous forest and regenerating young forest. There is mature coniferous forest in the study area, however, this habitat type is greatly reduced due to commercial forest harvesting. The mature coniferous forest that does exist in the study area is generally in ravines or on the lower portion of slopes at much lower elevations then the proposed turbine locations. One small area of mature coniferous forest was sampled during the later survey period. The site is so small it was not found during the first survey. At less than 2 hectares in size, the area was found to be too small to sample by point count as species from bordering habitats were also detected. The open upland surrounding the Dalhousie Mountain fire tower was sampled. See Table 2 for a list of habitats sampled and the number of point counts conducted in each.

Table 2. Habitats Sampled During Point Count Surveys

HABITAT TYPE	NUMBER OF POINT COUNTS COMPLETED		
	1ST SURVEY	2ND SURVEY	TOTAL
Mature Deciduous Forest	13	13	26
Mature Mixed Forest	3	3	6
Mature Coniferous Forest		1	1
Young Deciduous Forest	1	1	2
Young Coniferous Forest	5	5	10
Young Mixed Forest	8	8	16
Young Pine Forest	1	1	2
Open Upland Country	1	1	2
TOTAL	32	33	65

Fall Migration

Fall migration sampling was carried out between the weeks of August and October 2007. The primary method used involved stopover counts to determine the species composition and relative abundance of birds using the study area during the migration period. The stopover counts involved walking four established routes which were selected to sample the variety of habitats in the study area. Each route was along established roads and trails edged with secondary growth which would be attractive to foraging migrants. These routes were also used during the breeding bird survey to access a number of the point count locations. All counts were conducted between sunrise and 4 hours after sunrise.

Each bird observed during the migration monitoring period was counted, including those considered permanent residents. A number of individuals which were not identified various reasons (i.e. poor viewing conditions and/or no sounds made) were also counted.

Table 3. Fall Migration Monitoring Results

COMMON NAME	SCIENTIFIC NAME	SRANK	Aug 26	Sept. 2	Sept 6	Sept.10	Sept.15	Sept. 19	Sept 22	Sept.29	Oct. 6	Oct. 13
Ruffed Grouse	Bonasa umbellus	S5B									1	
Spruce Grouse	Falcipennis canadensis	S5B								1		
Sharp-shinned Hawk	Accipiter striatus	S4B	1			1				1		
Red-tailed Hawk	Buteo jamaicensis	S5B		1		1	1					
Ruby-throated Hummingbird	Archilochus colubris	S5B	4									
Downy Woodpecker	Picoides pubescens	S5B			1			1				1
Hairy Woodpecker	Picoides villosus	S5B					1	1		1		
Northern Flicker	Colaptes auratus	S5B	1	1			2	2	1	2		
Pileated Woodpecker	Dryocopus pileatus	S5B								*		
Alder Flycatcher	Empidonax alnorum	S5B	8		3							
Blue-headed Vireo	Vireo solitarius	S5B	1	1	2	2	2	1				
Red-eyed Vireo	Vireo olivaceus	S5B	6	14	11	1	5	4		2		
Gray Jay	Perisoreus canadens	S4B		1	5	2		3	2	2	2	2
Blue Jay	Cyanocitta cristata	S5B	4	4		5	12	1	1	2		1
American Crow	Corvus brachyrhynchos	S5B	1									
Common Raven	Corvus Corax	S5B		1		6		2	3	3		1
Black-capped Chickadee	Poecile atricapillus	S5B	17	18	17	7	35	28	26	24	12	28
Boreal Chickadee	Poecile hudsonica	S4B	1	3	1	2	2	3	1	5	2	15
Red-breasted Nuthatch	Sitta canadensis	S5B	5	1	1		1	1	1	2		1
Winter Wren	Troglodytes troglodytes	S5B	1									
Golden-crowned Kinglet	Regulus satrapa	S5B	2	8	6	2	4	4	2	9	4	19
Ruby-crowned Kinglet	Regulus calendula	S5B		5	5	7	14	13	5	18		2
Hermit Thrush	Catharus guttatus	S5B					2	4	1	1	1	
American Robin	Turdus migratorius	S5B	9	7	10		7	13	4	2	2	6
Thrush Species	Catharus sp.				2							
Cedar Waxwing	Bombycilla cedrorum	S5B					12	3				
Tennessee Warbler	Vermivora peregrina					1						
Nashville Warbler	Vermivora ruficapilla	S5B	1					1				

Northern Parula	Parula americana	S5B			3		1					
Yellow Warbler	Dendroica petechia	S5B			1							
Chestnut-sided Warbler	Dendroica pensylvanica	S5B	1									
Magnolia Warbler	Dendroica magnolia	S5B	15	17	8	8	11	4	1	1		
Black-throated Blue Warbler	Dendroica caerulescens	S4B	1									
Yellow-rumped Warbler	Dendroica coronata	S5B		5	5	7	21	20	10	8		2
Black-throated Green Warbler	Dendroica virens	S5B	12	11	17	8	11	5	1			
Blackburnian Warbler	Dendroica fusca	S4S5B	4	1			1					
Palm Warbler	Dendroica palmarum	S5B				2	2	11	2	10		
Blackpoll Warbler	Dendroica striata	S4B								2		
Black-and-white Warbler	Mniotilta varia	S5B	4			2	4	1				
American Redstart	Setophaga ruticilla	S5B	2	1	2							
Ovenbird	Seiurus aurocapilla	S5B		1	3							
Common Yellowthroat	Geothlypis trichas	S5B	9	8	7	3	5	6	1	4		
Savannah Sparrow	Passerculus sandwic	S5B								1		
Fox Sparrow	Passerella iliaca	S4B										1
Song Sparrow	Melospiza melodia	S5B	4	9	4	2	7			9		10
White-throated Sparrow	Zonotrichia albicollis	S5B	4	4	8	6	18	7	3	7	1	18
Dark-eyed Junco	Junco hyemalis	S5b	11	16	12	11	17	17	6	13	9	10
Sparrow Species												2
Common Grackle	Quiscalus quiscula	S5B						1				
Purple Finch	Carpodacus purpure	S5B						12		1		
American Goldfinch	Carduelis tristis	S5B	4	1	8	3	6	5	1			2
Finch Species												2
Unidentified			7	2					1			2

A total of 55 species of birds were observed during the migration monitoring period. Table 3 contains a complete listing of all birds observed and the date of the observation. Of the 55 species observed, 50 species are considered migratory. None of the species observed are considered provincially uncommon.

Raptor Migration

Raptor watches were conducted on 4 days in September and October. Watches were conducted at two locations in the study area near proposed turbine locations which offered a good panoramic view to the east, north, and west. Observations were carried out on clear days with the wind from a northerly direction (northwest to northeast). Observations were conducted between 9 a.m. and 3 p.m.

While the study area is at elevation, there do not appear to be any strong geological features which would be attractive to migrating raptors. Very few raptors were observed in the study area. None of the birds observed were flying at high altitude. The highest number of raptors observed in one day occurred on September 16 when four birds were noted. On October 9 no raptors were observed (See Table 4).

Table 4. Raptor Migration Results

DATE	TIME	WIND	COMMON NAME	SCIENTIFIC NAME	SRANK	HEADING	BEHAVIOR
Sept 16	11:28	NW	American Kestral	Falco sparverius	S5B	South	Hunting
	12:03		Northern Harrier	Circus cyaneus	S5B	North	Hunting
	13:43		Sharp-shinned Hawk	Accipiter striatus	S4B	East	Low Flight
	14:02		Bald Eagle	Haliaeetus leucocephalus	S5B	East	Fly Over
Sept 27	12:45	NE	American Kestrel	Falco sparverius	S5B	West	Hunting
Oct. 9		N	No Observations				
Oct. 22	10:57	NW	Sharp-shinned Hawk	Accipiter striatus	S4B	West	Low Flight

Winter Monitoring

Winter monitoring is ongoing. Preliminary findings have not turned up any species or populations which would be considered unusual for this part of Nova Scotia. Winter monitoring is being carried out one day each month from December through March.

Each day of monitoring involves an area search of the study area, visiting the variety of habitats found. The area searches make use of the stopover count routes used during the fall migration as well as snowmobile trails found in the study area. A greater emphasis has been placed on visiting coniferous and mixed habitats during the winter monitoring. Table 5 shows the results of the monitoring to date.

Table 5. Winter Monitoring Results

COMMON NAME	SCIENTIFIC NAME	SRANK	Dec. 27	Jan. 16
Blue Jay	Cyanocitta cristata	S5B	1	
American Crow	Corvus brachyrhynchos	S5B		3
Common Raven	Corvus Corax	S5B	4	2
Black-capped Chickadee	Poecile atricapillus	S5B	4	8
Boreal Chickadee	Poecile hudsonica	S4B	12	2
Red-breasted Nuthatch	Sitta canadensis	S5B	1	2
Golden-crowned Kinglet	Regulus satrapa	S5B	2	5
Pine Grosbeak	Pinicola enucleator	S4	20	6
White-winged Crossbill	Loxia curvirostral	S5	2	

Preliminary Findings

Pre-construction monitoring will continue through the spring migration period. However, having completed the breeding bird, fall migration, and raptor migration monitoring there are a number of observations which can be made.

1. No birding bird colonies are present in the study area
2. The study area does not appear to be an important breeding area for any bird species at risk
3. There do not appear to be landforms in the study area that concentrate migrating birds
4. The study area is not of importance to migrating raptor species
5. Numbers and species of migrating birds counted during the fall season are representative of what one would expect to encounter in similar habitat types in this region of Nova Scotia
6. There are no lit structures nearby that would attract birds

C7- Bat Population Study

Bat Species Composition and Activity at the Proposed Dalhousie Mountain Wind Development Site, Nova Scotia

Final Report

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Introduction and Background

Wind generated energy is a relatively new addition to the commercial energy market that is displaying phenomenal growth on a global scale. During the last decade, global wind energy capacity has doubled every three years, about a 30% increase annually (CanWEA 2006). Contrary to past perceptions of the industry, wind power is now modeled as a stable, cost-competitive sector that can substantially contribute to future power generation portfolios. This new stability has come from technological advancements, making the industry more economically competitive, and also from the continuing global demand for renewable energy sources (Andersen & Jensen 2000; Menz & Vachon 2006). In Canada the trend continues with expectations of 10,000 megawatts of wind capacity to be installed by 2010 (CanWEA 2001).

The Atlantic Provinces are poised to substantially contribute to the growth of wind energy in Canada. Objectives for installed capacity in the region are to reach 1,130 megawatts by 2015 (Hornung 2006). In Nova Scotia, wind energy will take a leading role in achieving the requirement for new renewable energy sources to comprise 5% of electricity by 2010 (Hornung 2006). Clearly as wind energy expands in the province, the role of identifying and selecting wind power sites which meet criteria set by government, industry and the public will become increasingly important.

Wind power is commonly cited as a model of an ‘environmentally friendly’ renewable resource because it does not contribute direct atmospheric emissions, has minimal economic expenditure following decommission and uses limited land area for operation (Andersen & Jensen 2000). Despite these environmental advantages, bird and bat mortalities have been documented for several wind generation facilities across the

globe (Ahlén 2003; Johnson et al. 2003b; Johnson et al. 2004; Kerns & Kerlinger 2004; Osborn et al. 2000; Young et al. 2003). In comparison to avian fatalities, the documentation and analysis of bat fatalities at wind facilities is relatively recent and is gaining considerable attention.

Bat mortality as a result of collisions with man-made structures is not unique to wind turbines, with reports of bats colliding with such structures as lighthouses, communication towers and buildings dating as far back as 1930 (Johnson et al. 2004). Bat collision mortality from wind turbines first made its way into the media in North America following a large bat kill at a West Virginia wind farm in 2003 (Williams 2003 in Johnson et al. 2004). Since that time there has been many documented bat fatalities at wind development sites. Estimates of bat fatalities are highly variable ranging from less than 3 bats/turbine/year (Johnson et al. 2003a; Johnson et al. 2004) to 20-50 bats/turbine/year (Jain et al. 2007; Kerns et al. 2005; Nicholson 2003). Species composition of collision fatalities is typically comprised of hoary bats (*Lasiurus cinereus*), silver-haired bats (*Lasionycteris noctivagans*), eastern red bats (*Lasiurus borealis*), and big brown bats (*Eptesicus fuscus*), with smaller numbers of eastern pipistrelles (*Perimyotis subflavus*), northern long-eared (*Myotis septentrionalis*) and little brown bats (*Myotis lucifugus*) predominantly in eastern North America.

Occurrence records exist for seven species of bats in Nova Scotia, the same seven species with documentations of fatalities at wind turbine sites listed above (Broders et al. 2003a; van Zyll de Jong 1985). Nova Scotia is close to the northern periphery of the current known range for each of these species, with the exceptions of the northern long-eared and the little brown bat (van Zyll de Jong 1985). These two species, as well as the

eastern pipistrelle, are the only bat species with significant populations in Nova Scotia (Broders et al. 2003a; Farrow 2007).

The eastern pipistrelle is a non-migratory bat species found throughout the eastern forests of North America (Fujita & Kunz 1984; Veilleux et al. 2004). This species occurs in very low numbers in southern coastal New Brunswick (Broders et al. 2001) and in 2001, Broders (2003a) discovered the first concentration of eastern pipistrelles in Nova Scotia at Kejimkujik National Park. Subsequent ultrasonic monitoring throughout mainland Nova Scotia confirmed the presence of a significant population of this species in the province, yet indicated restriction of the population to southwest Nova Scotia in the summer (Farrow 2007; Rockwell 2005). The restriction of this population to southwest Nova Scotia suggests that the population of eastern pipistrelles is disjunct, at least during the summer (Broders et al. 2003b; Farrow 2007).

Only the northern long-eared and little brown bat are common in Nova Scotia (Broders et al. 2003a) and they both have distributional ranges that extend into Newfoundland (Grindal & Brigham 1999; van Zyll de Jong 1985). They are therefore likely ubiquitous throughout the province (Broders et al. 2003a). The northern long-eared bat is a forest interior species (Broders et al. 2003a; Henderson 2007; Jung et al. 2004), while the little brown bats is more of a generalist species, associated with forests, as well as human-dominated environments (Barclay 1982; Jung et al. 1999). Both species are year-round residents in the province with over-wintering documented at a number of hibernacula located throughout central Nova Scotia (Garroway 2004; Moseley 2007; Tutty 2006).

The hoary bat, silver-haired bat and eastern red bat, are all migratory species with extensive distributional ranges in North America (van Zyll de Jong 1985). Historically, there have been few occurrence records for these species in Nova Scotia, though several reports of these species flying ashore in Massachusetts and aboard ships off the coast of Nova Scotia in the fall, suggest the possibility of a migratory movement across the Gulf of Maine (Broders et al. 2003a). In 2001, Broders et al. (2003a) recorded greater than 30,000 echolocation sequences from May to September at Kejimkujik National Park and Brier Island, yet fewer than fifteen of these, all in September, were attributed to any of the migratory species. Therefore, it was suggested that there are no significant migratory movements of these species through Nova Scotia and the incidence of individuals of these species during the summer are low (Farrow 2007; Rockwell 2005; Garroway and Broders unpublished data)

Localized over-wintering and reproduction records have been recorded for big brown bats in New Brunswick in low numbers, where their presence was associated with buildings. McAlpine *et al*. (2002) subsequently suggested that the species may exist in that province in low numbers where it is closely associated with human occupied buildings. Taylor (1997) identified 3 big brown bats hibernating in a hibernaculum in Nova Scotia. These findings indicate that the conditions may exist for year round-residency of the species in the province. However, a general lack of evidence for their presence given the increased research effort since Taylor's work suggests that if the species is present in Nova Scotia they are very localized and in very low numbers.

Echolocation is the primary sensory means by which all of these microchiropteran bat species orient themselves and hunt for prey (Fenton 1997; Fenton & Griffin 1997),

where they emit vocalizations and analyze the returning echoes created when these sounds encounter objects (Fenton 2003). Instruments sensitive to these frequencies are referred to as bat detectors and allow investigators to record, hear, and even visualize the otherwise inaudible echolocation calls of bats (O'Farrell et al. 1999). Detectors permit identification of many bat species by their calls (Fenton & Bell 1981; O'Farrell et al. 1999; Thomas et al. 1987), assessment of activity patterns, and studies of behavior and habitat relationships of many species of echolocating bats (Fenton 1997). Bat detectors often permit investigators to sample a much larger area than conventional capture techniques and generally yield a more complete inventory of bat species than captures alone (O'Farrell & Gannon 1999).

Project Objective

It is likely that local resident bats will be impacted by the clearing of land to make room for turbines via the loss of roosting and foraging areas. However, it seems likely that if there will be significant direct mortality of bats associated with this project it will occur during the fall migration period (from mid-August until late September/early October); this project was designed to assess this. Therefore, the goal of this study was to provide local data that could be used to make inference on the potential for a wind development at Dalhousie Mountain to cause unacceptable levels of bat mortality. Specifically the objectives were to:

1) Document species composition

2) Determine whether there are abnormally high levels of bat activity at the site. It there is abnormally high bat activity it might indicate that the area represents a migration corridor and warrants further investigation.

Study Area

The proposed Dalhousie turbine site is approximately 340 m in elevation located near the community of Brookland, Pictou County, Nova Scotia. Dalhousie Mountain is situated in the Cobequid Hills ecodistrict theme region and the upland forest cover is primarily composed of sugar maple, yellow birch and American beech and can be intermixed with balsam fir, red spruce and black spruce (Davis & Browne 1996).

Methods

We used Anabat II detection systems to sample the echolocation calls of bats. Each system was deployed at ground level and consisted of an ultrasonic Anabat II detector interfaced to a CF Storage ZCAIM (Titley Electronics Ltd., NSW Australia). The seasonal timing of the sampling period likely corresponded to fall migration activity by migratory species and movement by resident species to local hibernacula. Activity was monitored at three locations (Location 1, 504290 E 5043190 N, Location 2, 503946 E 5049736 N and Location 3, 503810 E 5042461 N; UTM NAD83 Zone 20 format). Detectors were placed along forest edges or forested trails to maximize recordings of bats commuting or foraging in the area. Monitoring began on the evening of 08 August 2007 and was completed on the morning of 7 September 2007 (Location 1: 8 to 16 August; Location 2: 17 to 29 August; Location 3: 31 August to 7 September).

Identification of many bat species is possible because of the distinctive nature of their echolocation calls (Fenton & 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 and little brown bat), we did not identify sequences to the species level, as their calls are too similar to be separated. The calls of silver-haired bats and big brown bats are also very similar and therefore we also grouped these two species together. Identifications were accomplished using frequency-time graphs in ANALOOK software (C. Corben, www.hoarybat.com). An anabat echolocation file that approximates a call sequence, defined as a continuous series of greater than two calls (Johnson et al. 2004), was used as the unit of activity.

Results

A total of 461 bat echolocation call sequences were recorded over thirty detector nights at the three sample locations (Table 1). All of the recorded sequences except for one were attributable to *Myotis* species, with a single recorded call sequence that was consistent with characteristics of a big brown bat or silver-haired bat (recorded at 02:17 AM at location 2 on the evening beginning on 17th August). Only 12 of the *Myotis* call sequences were recorded at location 3 and 80 of the call sequences were recorded at location 1. The remaining 368 Myotis echolocation sequences and the single big brown sequence were recorded at location 2. The average number of sequences per night at Dalhousie Mountain (all locations) was 16 (SD = 20) during the sampling period. For 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 level of activity found at Dalhousie Mountain was less than the average nightly activity level found during the summer in southern New Brunswick.

Although we did not distinguish the calls of Myotis species, the majority of the Myotis sequences recorded at both locations likely represent the little brown bat for at least two reasons. First, the northern long-eared has low intensity calls and is thus not recorded as well as the little brown bat (Broders et al. 2004). Secondly, the northern long-eared bat is a recognized forest interior species (Broders et al. 2006; Jung et al. 1999; Lacki & Hutchinson 1999; Sasse & Pekins 1996) and is less likely to use open areas for foraging and commuting (Henderson 2007).

Discussion

The majority of the recorded echolocation sequences at the proposed Dalhousie Mountain wind development site were calls of 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 two species are the most common species in the province and are two of only three species of bats with significant populations in Nova Scotia (Broders *et al.* 2003b). We recorded only one call sequence of a species other than a Myotis (either a big brown bat or a silver-haired bat) both of which are rarely encountered in Nova Scotia (Broders et al. 2003a; Taylor 1997) and therefore, it was expected that these species would not be well represented in this survey. The majority of the Myotis calls are likely attributable to the little brown bat because it has calls that are more easily recorded (higher intensity;

Broders *et al.* 2004, Miller and Treat 1993) and is a generalist species that forages in a variety of habitats, including open areas and over water (Anthony & Kunz 1977; Lacki & Hutchinson 1999). Both species may be potentially impacted by the loss of roost sites (tree cavities) and foraging areas when sites are cleared of forest cover for developments if suitable roost trees were situated in the area.

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 Chiropteran fauna in these open areas due to an association with forested landscapes. More recently, evidence of Myotis fatalities from collisions with wind turbines have been noted at sites in forested areas in eastern North America (Jain et al. 2007; Johnson 2005; Kerns & Kerlinger 2004).

Another explanation for the paucity of Myotis species from fatalities is that they tend to fly close to the ground (Broders 2003), and thus are less impacted by the rotating blades. A study of bat activity at potential turbine sites prior to construction is currently in progress in the eastern United States where bat activity is being monitored at three heights, ground level (1.5 m), 22m and 44m (Arnett et al. 2006). Preliminary results from this study show that Myotis activity is greater at ground level compared with activity at heights of 22 and 44 m. These findings may lend support to the suggestion that Myotis bats tend to fly lower to the ground but do not account for the relatively high numbers of Myotis fatalities found at wind turbine sites on forested ridges.

To date, very little is known about the real implications of wind developments on populations of small, non-migratory bat species. Little is known about the flight behaviour and dynamics of movements (e.g., height agl of travel and travel routes) of bats to/from hibernacula sites during their regional migration in the fall and spring, and their behavior once they arrive at the hibernacula but before they begin to hibernate. Further, bats arrive at hibernacula 1-2 months before the onset of hibernation when courtship and copulation is believed to occur (Fenton 1969). Exploratory research in Nova Scotia in 2006 indicates that bats are moving significant distances in the fall during swarming (reproductive period) (Poissant and Broders, unpublished data). During this time the majority of bats present during swarming activity at night did not roost in the hibernacula during the day. Additionally, the incidence of recapture was exceptionally low (<1%) and 4 bats with radio transmitters could not be located after release suggesting they moved significant distances from the hibernacula where they were captured. Movement data in other areas of eastern North America indicate bats moved in excess of 200 km between hibernacula within a year and up to 500 km between years (Davis & Hitchcock 1965; Fenton 1969) which demonstrates large scale movements by resident hibernating species.

With data lacking on the activities and movements of regional hibernators like the little brown and northern long-eared bat, it is difficult to predict the specific effects that a wind development will have on local populations of these bats. The high number of fatalities of non-migratory bats at turbine locations on forested ridges in eastern North America suggests that it is an important issue requiring continued research attention and monitoring in the future.

No calls were recorded for the other migratory species (hoary or eastern red bats) at any of the detector sites. Location records for all of these migratory species in the province are patchy with off-shore accounts suggesting only occasional migratory movements through the province (Broders et al. 2003b; van Zyll de Jong 1985). Thus, the lack of recorded call sequences from migratory species was not unexpected. Although the survey did not take place over the entire migratory period, it was approximately 4-weeks long and it is therefore expected that if the area was an important migration corridor we should have detected it.

Recently it has been hypothesized that the size (height) of wind turbines plays a key role in bat fatalities. An on-going study by Arnett *et al.* (2006) that is assessing the height of recorded bat activity at sites prior to construction of turbines, has found that migratory bat species are flying at the highest sampled heights (44m and above). These heights put these species at the greatest risk of collision with rotor blades and may explain high mortality at certain sites. In another study, Barclay *et al.* (2007) compiled data from published and unpublished reports regarding bat (migratory and year-round resident species) and bird mortality at 33 wind energy sites in North America. They provided evidence that suggests that the increased size of new turbines at installations (i.e. height of turbines has increased) may be impacting the number of bat mortalities. Turbines with towers exceeding 60 m potentially resulted in a disproportionately high number of mortalities compared to towers shorter than 60 m. However, the authors noted that turbine height (and therefore size) alone does not explain all of the documented differences in the number and composition of bat species mortalities.

We only used ground based echolocation sampling which may have affected our ability to detect calls by high-flying species if they did move through the area. The range of detection of the systems is dependent on a number of factors, including the frequency and orientation of the call source. However, at its maximum range for an intense, low-frequency call it likely does not exceed 15 to 20 m. Some migratory bats may be flying at heights that exceed 100 m, outside of the range of our ability to detect them but within the area that puts them at risk of collisions. However, our expectation is that if there were any significant numbers of long distance migrants moving through the area we would detect a portion of them with our sampling design. Given the results of other research we have been doing in the region (which suggests few individuals of these species are present), and the fact that we recorded only one echolocation sequence with characteristics consistent with one of the long-distance migrants in this survey it is unlikely that there was any significant amount of activity of these species in the study area.

It is likely that many design and site-level differences determine fatality events as well as various aspects of bat behaviour and movements during the fall swarming and migration period although information on these phenomena are poorly understood (Holland 2007). For example, it is not known if bats actively echolocate when migrating (either locally or long-distance) and the role of landmarks (natural or artificial) as visual cues for swarming and/or migration are also not understood (Cryan & Brown 2007). It is also not known if certain bat species routinely and predictably migrate at certain heights and routes (specific to a region or site) nor is it known if there is large variation in the number of migrants passing through an area from year to year (Barclay et al. 2007;

Johnson et al. 2003a). Stochastic weather factors that vary spatially (regionally from topography) and temporally (in frequency) may also contribute to bat fatality events in an unpredictable manner. In particular, low barometric pressure, low relative humidity and low wind velocities (conditions associated with the passing of storm fronts in an area) have been shown to be associated with high bat mortality events (Erickson et al. 2003; Kerns et al. 2005). Therefore pre-construction activity surveys may be limited in their ability to detect and predict migrating bats moving through an area and thus unexpected mortalities may be found once turbines have been installed and are on-line.

Conclusions

Migratory species of bats have received the greatest attention because they make up the large majority of fatalities at existing wind turbine developments. Past evidence (Broders et al. 2003b), as well as the results of this survey, suggest that there is likely no significant movements of migratory bats species (hoary, red, silver-haired bats) and big brown bats through the region. Although we cannot rule out the possibility that there will be mortality events associated with this development, we have found no evidence with our study that the proposed structures will indeed cause significant direct mortality of long distance migrants, and this is supported by other research in the region that suggests that the abundance and distribution of these species in the province is small.

Bat activity recorded at the proposed site was dominated by Myotis species (little brown bat and northern long-eared), which typically forage at heights below the level of turbine blades. Because the proposed Dalhousie wind development is located in a forested area and bat mortalities have recently been noted at other forested wind

developments in eastern North America, their may be a risk of mortality of Myotis bats at this site. Little is known, however, about how these bats interact with turbines and the impact of turbines on their populations may become of concern in the future.

There are a number of significant hibernacula in northeastern Nova Scotia where thousands of bats congregate for courtship and spend the winter months. We know little about the dynamics of the spatial and temporal movement patterns of bats from summering areas to hibernacula and among hibernacula (e.g. are they following specific corridors? Are spatio-temporal aspects of movements in response to particular weather patterns? etc.). Without this information it is difficult to be certain that the development will not impact bats during this time. With our study we have found no evidence to suggest that significant numbers of bats are moving through this area during the migratory period (i.e., no evidence that it is a migration corridor). Therefore, although we cannot rule out the possibility that there will be significant direct mortality associated with the development, we found no evidence to suggest there would be.

To date, there is no established link between pre-construction surveys and post-installation mortalities. Presently there are a number of studies aimed at determining the impacts of wind turbines on bats (e.g. Baerwald and Barclay in southern Alberta) and others are trying to link pre-construction activity with resulting bat mortalities following construction in order to predict relative risk of installation at sites as well as potential fatalities. In response to these concerns, we are making the following recommendations for this proposed project.

Recommendations

- Conduct post-construction fatality searches, ideally for an entire season (April to October), but especially during the fall migration season from mid-August to late-September to fully understand temporal patterns of fatalities. Standardized methods for these searches, including the necessary corrections for scavenging losses and searcher efficiency, can be found in the literature. These data are essential for assessing potential risks at future developments in the region.
- Remain up to date with current research on bats and wind energy developments. There is presently an abundance of research aimed at determining the impacts of wind energy developments on populations of bats. Studies focus on a number of potential mitigation methods, including the effects of weather on activity patterns and collisions, various mitigation treatments (such as turning off turbines when wind speeds are low) or possible deterrents (including acoustic and radar emissions).

Appendix A

Table 1. Number of echolocation call sequences by species group recorded per night at three locations at the proposed Dalhousie Mountain Wind Development Site, Pictou County, Nova Scotia.

	Myotis*				BBB/SHB**	Total for
Evening of	Loc. 1	Loc. 2	Loc. 3	Total	Loc. 2	all species
8-Aug-07	2	n/a	n/a	2	0	2
9-Aug-07	8	n/a	n/a	8	0	8
10-Aug-07	5	n/a	n/a	5	0	5
11-Aug-07	4	n/a	n/a	4	0	4
12-Aug-07	13	n/a	n/a	13	0	13
13-Aug-07	9	n/a	n/a	9	0	9
14-Aug-07	2	n/a	n/a	2	0	2
15-Aug-07	15	n/a	n/a	15	0	15
16-Aug-07	22	n/a	n/a	22	0	22
17-Aug-07	n/a	17	n/a	17	1	18
19-Aug-07	n/a	93	n/a	93	n/a	93
20-Aug-07	n/a	29	n/a	29	n/a	29
21-Aug-07	n/a	30	n/a	30	n/a	30
22-Aug-07	n/a	45	n/a	45	n/a	45
23-Aug-07	n/a	30	n/a	30	n/a	30
24-Aug-07	n/a	2	n/a	2	n/a	2
25-Aug-07	n/a	23	n/a	23	n/a	23
26-Aug-07	n/a	15	n/a	15	n/a	15
27-Aug-07	n/a	42	n/a	42	n/a	42
28-Aug-07	n/a	32	n/a	32	n/a	32
29-Aug-07	n/a	10	n/a	10	n/a	10
30-Aug-07	n/a	n/a	2	2	n/a	2
31-Aug-07	n/a	n/a	1	1	n/a	1
1-Sep-07	n/a	n/a	4	4	n/a	4
2-Sep-07	n/a	n/a	2	2	n/a	2
3-Sep-07	n/a	n/a	1	1	n/a	1
04-Sep-07	n/a	n/a	0	0	n/a	0
05-Sep-07	n/a	n/a	0	0	n/a	0
06-Sep-07	n/a	n/a	2	2	n/a	2
Total	80	368	12	460	1	461

* Includes the little brown bat (*Myotis lucifugus*) and the northern long-eared bat (*M. septentrionalis*).

**BBB/SHB is big brown bat (*Eptesicus fuscus*) or silver-haired bat (*Lasionycteris noctavigans*)

n/a are nights not monitored at a location for bat activity

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C8- Mainland Moose Search Study 2007

Assessment of Impact of Dalhousie Mountain Wind Turbine Field on Mainland Moose (*Alces alces americana*)

Ross Hall, Wildlife Biologist
August, 2007

A review of Nova Scotia wildlife with red or yellow status within a 100 km radius of the proposed Nuttby Mountain wind turbine site identifies mainland moose (*Alces alces americana).* A listing process for rarity of wildlife species in Nova Scotia places mainland moose in a red category, meaning endangered; and in 2003 the mainland portion of Nova Scotia moose population was legislated protected as an endangered species by the Nova Scotia Endangered Species Act.

Mark Elderkin, Nova Scotia Department of Natural Resources Species at Risk biologist, has expressed special concern for this species. Several proponents for wind power have expressed an interest in elevated locations along the Cobequid Hills. The interest in these elevated locations is because wind velocities are determined higher. The Cobequid Hills over the past 40 years has comprised the better moose habitat through northern Nova Scotia. While the impact of one wind power development might have only small effect, there is the potential cumulative degradation of moose habitat following several developments.

In 2007 the Nova Scotia Department of Natural Resources released a Recovery Plan for mainland moose. The document describes a decline in mainland moose numbers from 2500 – 4000 in the 1960's to a present estimated population near 1000 animals. In explaining the decline the Recovery Plan states " The decline is not well understood but may involve a complex of threats including: historic excessive hunting, poaching, climate change, parasitic brainworm, increased road access to moose habitat, spread of white-tailed deer, possible high levels of cadmium and dietary deficiencies (e.g. cobalt), unknown viral disease, and disturbance."

Of the above threats, wind turbine fields will result in increased or improved road access and disturbance. Disturbance would result from an increased human presence and vehicle traffic. Whether moose will additionally avoid wind turbine sites because of the actual physical presence of the towers, turbine generated noise or possibly shadow affect of rotating blades is unknown.

Historically the Dalhousie Mountain area had a good population of moose. The Nova Scotia Department of Natural Resources Significant Species and Habitat Mapping places a polygon for mainland moose to include elevated habitats near Dalhousie Mountain in western Pictou County. In the late 1960's and 1970's moose were in sufficient numbers to allow a hunting season in the Cobequid Hills area of Pictou County. There was a very significant decline in moose numbers in the 1980's coincidental to very high white-tailed deer numbers at that time. Forest access roads on the Cobequid Hills have greatly increased and improved over the years and there is a great proliferation of off highway vehicle traffic and trails. The Snowmobile Association of Nova Scotia (SANS) has an extensive network of groomed snowmobile trails through the Cobequid Hills.
White-tailed deer are carriers of a parasitic brainworm (*Parelaphostrongylus tenuis*). The parasite remains clinically silent in deer but infection of moose is often fatal. Both moose and deer become infected after ingesting gastropods, an intermediate host. Gastropods become infective after feeding on deer faeces. Changes in forest practices and increased roads perhaps have encouraged more deer onto the Cobequid Hills, thus increasing a likelihood of moose infection. Remoteness of moose habitat has diminished. It is believed that a greater access into forests has increased the opportunity for illegal hunting and this activity suppresses a recovery of low moose populations suffering from other mortality factors.

(1) **Present status of moose population near Dalhousie Mountain**

An initial question for an assessment is what is the present status of moose near the proposed Dalhousie Mountain Wind Farm site? Is there a present population immediately to be affected by the construction phase of the wind farm and the subsequent presence of the turbines?

There are two methods for surveying moose population numbers. One is an aerial survey in winter looking for moose tracks and animals on the snow. There are various quantitative designs to carry out aerial surveys. Another method is to search the forest floor following winter and using a plot system count the number of moose fecal pellet groups deposited on fall leaf litter, usually over a time period starting November 1 to a date of survey in May. A number used in this survey and calculations is that over a 200 day winter interval one moose will deposit 3400 pellet groups. The number, if not totally accurate, at least allows comparisons to other surveys. A pellet group survey was chosen to measure present status of moose near the Dalhousie Mountain area and done in May, 2007.

Fifteen transects, each 1 kilometre long, were located in expected good moose habitats within and surrounding the Dalhousie site. Plot locations were chosen by Ross Hall, Wildlife Biologist. Plots were done by Jody Hamper, Technician Forest Resources. The technique for the survey involves following a straight compass direction through the forest and laying a line of thin string from a hip chain box a distance of one kilometre. Then returning along the string and counting moose pellet groups near the string, the string being the centre of the plot. For this survey the ground was searched 1 metre distant on each side of the string for moose pellet groups. As a result of the fifteen plots, a total distance of 15 kilometres and 3 hectare of forest floor was searched for moose pellet groups. The dispersed plot locations and long layout of plots allowed a sampling of different habitats and increased the likelihood of encountering moose sign if moose occupied habitats in a clumped fashion.

No moose pellet groups were observed. In fact no moose sign was observed. On softer shoulders of wood roads or softer ground, either while on plot or preparing to begin plots, no moose tracks were observed. For quantitative purposes the plots for this survey were 2 metres wide for moose. However at many locations the observer's eye can see further outside the 2 metres and at times plots would lead through small openings in advanced regeneration where moose would tend to walk or bed but no moose sign was seen. Jody Hamper remarks "I walked through softwood stands, hardwood stands, young plantations and cutovers. The terrain varied from flat lying areas, hills, even some gorges were encountered. There was no sign of moose scat on any transects. I also observed lots of striped maple on transects which had no evidence of moose browse."

The absence of moose is further substantiated by observations of landowners and long time residents. Mr. J. W. Sinclair, a retired forest technician from Natural Resources in Pictou County, writes (correspondence attached) " up to the mid 1970's it was common to observe moose, or several of them in the above mentioned area (Mount Thom, Mount Ephriam, Dalhousie Mountain, and Loganville). However as time advanced the population appeared to decline and I did not see nor hear of as many sightings as before. To be more specific, I cannot recall seeing a moose, nor signs-i.e. tracks, manure, yards, scraping of soil nor tree damage for probably twenty to twenty-five years, nor have I heard of others making contact with them." The MacKinnon family (correspondence attached) that frequently works on their woodlot on Dalhousie Mountain echoes similar observation.

The conclusion from the survey and resident testimonials is that no moose presently occupy the area near the proposed Dalhousie Mountain wind farm.

(2) **If moose do not occur presently, will they return to occupy this area?**

This is a difficult, if impossible, question to answer. Nova Scotians who appreciate this fine animal wish to remain optimistic that a turn around will occur in the mainland moose decline.

The decline of mainland moose has been more severe over the eastern range of the Cobequid Hills. Populations are stronger in west Cumberland County but weaker through Colchester and Pictou Counties. Should a recovery occur, the author anticipates the repopulation will spread from the west and be slow to reach Dalhousie Mountain.

The Moose Recovery Plan suggests a complex of factors cumulatively depressing moose numbers. There are many research needs. Apart from management initiatives to control poaching and control human access into remaining moose refugia, many factors are without control. If parasitic brain worm, spread by white-tailed deer, is the leading reason for moose decline and deer population numbers are given momentum by climate warming, then the recovery outlook for mainland moose is not encouraging. There is a declining demography of persons that hunt deer and future populations of deer will only be controlled in wide fluctuations of overpopulations and declines caused by severe winters. On an encouraging note there are a few locations in eastern North America where both deer and moose populations have increased. Parker (2003) in a literature review refers to one hypothesis that on some ranges because of subtle differences in feeding behavior, moose ingestion of infective larvae even in heavily contaminated areas may be reduced or absent. High fines and public education will it is hoped eliminate illegal hunting of moose.

Whether moose repopulate this area depends as well on the present and progress of other land uses, as well as the additional presence of a wind farm. West Pictou County, including Dalhousie Mountain, is an area of many human influences. The proposed Dalhousie wind farm is situated on the northeast corner of the Cobequid Hill Ecodistrict. To the north and east the land elevation drops down onto the Northumberland Lowlands where there is a greater density of agricultural and residential land use. At Mount Thom highways 104 and 4 pass on the south of Dalhousie Mountain. On the Lower Mount Thom side of Dalhousie Mountain at elevation 457 metres are radio and cell telephone towers. Nova Scotia Natural Resources has a fire tower on Dalhousie Mountain. There are large rock, sand and gravel quarries on all sides of Dalhousie Mountain. The rock quarry has single rock blasts of 30 to 80 tons and crushed rock is transported by several large trucks. The Gully Lake Wilderness Area occurs on the west side of Dalhousie Mountain and remains one area of calm in an otherwise busy landscape. Over Dalhousie Mountain and Mount Ephraim, forestry is the present major land use. In the project area there are over 30 roads of various qualities. Some are the result of recent forestry. There are also old and abandoned government roads that once served old Dalhousie Mountain settlements. Much of the road network is part of organized snowmobile and ATV trails. One property on Dalhousie Mountain is a large sugar woods.

Forestry use has been intensive. There is probably an equal amount of both large industrial and small private land ownership. The wind farm at present is only sited for small private ownerships and along ridges of higher elevations. There are steep ravines, inaccessible to forestry. From a traditional definition of habitat which describes food, cover and water, Dalhousie Mountain offers what appears good moose habitat. There is excellent browse and sufficient cover opportunities. The habitat is also excellent for white-tailed deer although deer would move to locations of lower elevation during winters of deep snow. Obviously at Dalhousie Mountain there are poorly understood threats which have not allowed mainland moose to persist.

Infrastructure for the Dalhousie Mountain wind farm will require 8 km of new road and 15 km of improvements to existing roads. Each turbine site will impact about 0.4 ha of area during the

construction stage and 0.2 ha in the following operations stage. The direct impacted area, including roads and turbine footprints, is about 2% of the total forest area. A somewhat positive aspect of improved roads is that is will encourage and allow permanent closure of many poorly directed and superfluous roads and trails used by landowners and OHV traffic.

Will moose avoid the actual area near turbines? Will the turbine appearance, movement, noise and blade shadow alarm moose and cause avoidance? Wildlife does have an ability to acclimate. White-tailed deer eat tulips in yards of urban housing. Crows feed unconcerned at roadsides as traffic passes. Where wind farms occur on agricultural land, livestock continues to feed under the towers. One important consideration at Dalhousie Mountain is as recent forest harvest sites age, they will eventually develop an overstory. Under the forest canopy the turbines become less visible. Wind movement in the tree canopy will muffle turbine noise. A definitive answer for the question of moose avoidance is not possible. With no present moose population no monitoring of moose reaction to the placement of turbines is possible.

There is the possibility to repeat the fifteen moose pellet plots done in 2007 perhaps at 3 or 5 year intervals to reassess moose population. Also of interest and a recommendation is to watch for and keep records of any moose activity close to the towers or on Dalhousie Mountain..

(3) **Mitigation**

Although no mainland moose presently occur on Dalhousie Mountain, a door should not be shut to their return. Decades might pass but there must be hope that moose will return in numbers to Pictou County and an effort made to safeguard suitable forest conditions for moose in this event.

Mitigation possibilities are limited and maintenance of moose habitat has a reliance on other land uses over the 98% of Dalhousie Mountain for which the wind farm has no control.
Dalhousie Mountain has old government roads and much thoroughfare by off highway vehicles. Closure of this access or this recreational use would be impossible. A mitigation possibility is to redirect OHV and landowner traffic onto wind farm access roads for a net reduced road presence and for a more efficient traffic network. Private landowners should discourage unauthorized OHV traffic at locations away from organized routes. The wind farm operator can work collectively with landowners and municipal trail planners but cannot dictate any outcome.

There are possible mitigative forest harvest practices. Selective harvest methods and promotion of long lived Acadian Forest type tree species should be encouraged in a zone surrounding turbines to maintain a sustained mature forest canopy. On a much broader effort, and more the responsibility of the province, woodland owners in historic and presently occupied moose ranges can learn and implement practices intended to maintain or improve habitat conditions for moose. Both industrial and small private owners of forest land at Dalhousie Mountain are selected audiences for messages on moose habitat stewardship.

References:

Nova Scotia Department of Natural Resources. 2007. Recovery Plan for Moose (Alces alces americana) in Mainland Nova Scotia.

Status Report on the Eastern Moose (Alces alces americana) in Mainland Nova Scotia by Gerry Parker. June 2003.

Plot start coordinates are provided in the event the plots are repeated in future years.

Plot	UTM Coordinates	Direction (True)
1	20 T 500255 5041001	South
2	20 T 498953 5041744	North
3	20 T 498562 5044317	North
4	20 T 497429 5044727	North
5	20 T 477429 5044727	South
6	20 T 498646 5045951	North
7	20 T 500574 5043044	North
8	20 T 502226 5043487	North
9	20 T 502243 5045266	North
10	20 T 500942 5047314	North
11	20 T 502546 5047338	North
12	20 T 503338 5049326	South
13	20 T 503942 5049718	South
14	20 T 505503 5045407	West
15	20 T 505352 5045888	East

3230 Rte 376
Post Box 580
Pictou, NS
B0K 1H0
1-902-485-1881
07-07-02

Mr. Reuben Burge
Greenhill, Pictou County, NS
B0K 2A0

Dear Mr. Burge,

In response to your question regarding my observations of moose in the general area of Mount Thom, Mount Ephraim, Dalhousie Mountain, and Loganville.

I was employed in the forest industry, both with the Department of Natural Resources, formerly Lands and Forests, as well as in the private forestry sector and have traveled extensively over the aforementioned areas since the mid 1960's.

I was also a resident of West River Station, an area bordering on the south of the region for sixteen years.

Up to the mid 1970's, it was common to observe a moose, or several of them in the above mentioned area.

Several times there were collisions between a moose and a motor vehicle and reports from motorists of 'near misses' as well as general sightings and reports of illegal hunting or poaching of moose throughout the area.

However, as time advanced the population appeared to decline and I did not see nor hear of as many sightings as before.

To be more specific, I cannot recall seeing a moose, nor signs – i.e. tracks, manure, yards, scraping of soil nor tree damage for probably twenty to twenty-five years, nor have I heard of others making contact with them.

I hope this reply will satisfy your request.

Yours Truly,

J. W. Sinclair

C9- Archaeology Study

DALHOUSIE MOUNTAIN WIND FARM:

ARCHAEOLOGICAL RESOURCE IMPACT ASSESSMENT

Heritage Research Permit A2007NS40

July 2007

Submitted by:
Davis Archaeological Consultants Limited
6519 Oak Street
Halifax, Nova Scotia
B3L 1H6

Submitted to:
RMSenergy Limited
796 Dan Fraser Rd.
Westville, Pictou County
Nova Scotia
B0K 2A0

DALHOUSIE MOUNTAIN WIND FARM:

ARCHAEOLOGICAL RESOURCE IMPACT ASSESSMENT

Heritage Research PermitA2007NS40
Category C

Davis Archaeological Consultants Limited

Principal Investigator: April D. MacIntyre
Report Compiled by: Heather MacLeod-Leslie & April D. MacIntyre

Cover: A portion of the *Topographical Map of Pictou County* by Ambrose F. Church, 1967.

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EXECUTIVE SUMMARY

An archaeological resource impact assessment of the proposed Dalhousie Mountain Wind Farm development was conducted by Davis Archaeological Consultants Limited. The impact assessment was limited to a desktop study which included consultation of the Maritime Archaeological Resource Inventory database at the Nova Scotia Museum, historical documents at Nova Scotia Archives and Records Management in Halifax, aerial photographs at the Department of Natural Resources Library and a limited collection of local knowledge. The study revealed that the general area has been impacted by historical settlement of the area, beginning in the last half of the eighteenth century, though most heavily in the nineteenth century. High potential exists for archaeological resources related to those periods. The likelihood of encountering Mi'kmaq archaeological resources is low on the mountaintops, though moderate to high potential exists in the intervening valleys - a concern for corridors, right-of-ways and access roads. It is recommended that the study area be subjected to an archaeological reconnaissance prior to any ground disturbance.

1.0 INTRODUCTION

In June 2007 Davis Archaeological Consultants Limited was contracted by RMSenergy Limited to conduct an archaeological resource impact assessment of the proposed Dalhousie Mountain Wind Farm in Pictou County. The purpose was to determine the potential for archaeological resources within the development zone and to provide recommendations for further mitigation if deemed necessary. This assessment included consultation of the Maritime Archaeological Resource Inventory in the Heritage Division of the Nova Scotia Museum as well as historic maps, manuscripts, and aerial photographs of the study area.

This assessment was conducted under Category C Heritage Research Permit A2007NS40 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 DEVELOPMENT AREA

The study area for the Dalhousie Mountain Wind Development falls within Pictou County. The impact area is defined by the turbine locations as well as that of access roads and right-of-ways, which expand across the breadth of the study area. The development area is located on top of Dalhousie Mountain and Mount Ephraim and encompasses areas north of Lower Mount Thom and west of Brookland (Figure 2.0-1). There are 45 turbines currently proposed for the initial phase of development; it is the area covered by these that is the focus of this study. The development area is located over a convergence of three Nova Scotia Theme Regions – 1. Pictou Rivers, 2. Cobequid Hills and 3. Dissected Margins (sub unit # 320a: Waughs River) (Figure 2.0-2).

The first of these, Pictou Rivers (natural region # 582a) is characterized by, "…well-drained gravely clay loam soils associated with imperfectly drained Millbrook clay loams with small amounts of Hebert soils formed on glaciofluvial deposits". These deposits overlay Late Carboniferous Canso and Pictou strata composed largely of sandstone and siltstone and minor amounts of gypsum and anhydrite. The study area falls, largely within the Middle and West River tertiary watersheds in this region which support significant salmonid species. Forests in this region are comprised of White Spruce and Balsam Fir growing on lands formerly used for agriculture. As well, Sugar Maple, Yellow Birch, and American Beech grow on slopes, with stands of shade-intolerant birches, Red Maple and aspen interspersed. Davis and Browne comment on the productivity of the soils in this unit for Scottish farmers arriving in the late eighteenth century and the extensive forestry that exploited the hardy resources here in the nineteenth century.[1]

[1] Davis and Brown 1996:141.

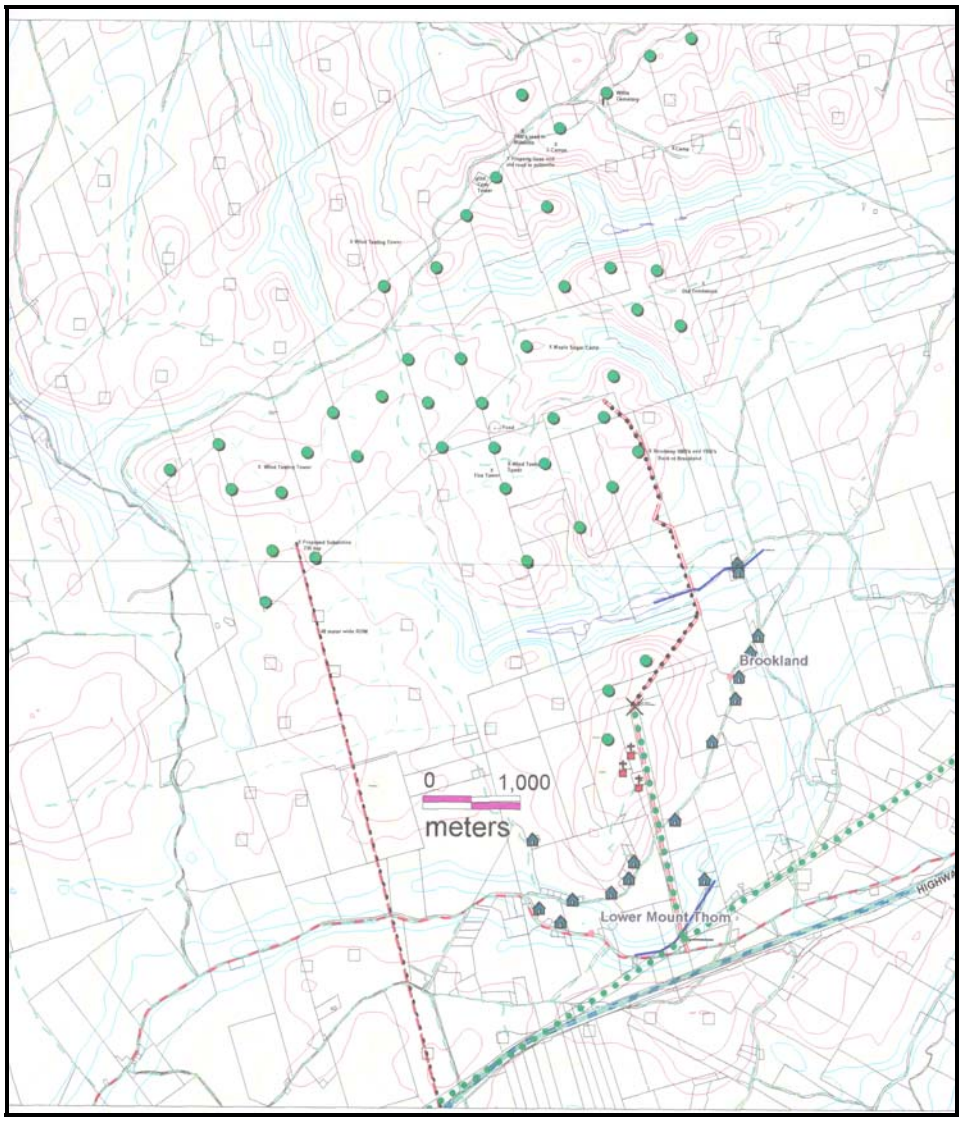

Figure 2.0-1: Green dots indicate proposed turbine locations. Right-of-ways indicated, though access roads are not presented between turbines (RMSenergy 2007).

The Cobequid Hills unit (# 311) covers the southern portion of the study area and, therefore, the characteristics of this unit's northern edge apply. Here the unit drops abruptly by a series of steps where the Cobequid Fault is covered with carboniferous deposits. Soils here include Wyvern and Hebert soils, again where land cleared by early settlers has begun to revert to forests containing Sugar maple, Yellow Birch, American Beech, Balsam Fir, Red and Black Spruce. Davis & Browne note that "Sugar Maple stands in the Cobequid Hills have…been used for the commercial production of maple syrup. In some areas, such as Mount Thom [on the southern edge of the study area], forests were cleared for farming [in the 1800s and 1900s] which are still in use. Variable ground and shrub vegetation presents potential for unusual arctic-alpine and Alleghanian

plant species found in the cooler, moister environments within the ravines and rich Sugar Maple woods. Within this unit, Goshawk, Red-tailed Hawk, Barred Owl and the Great Horned Owl nest and others species present include Common Raven, Pileated Woodpecker, Ruffed Grouse, Grey jay, chickadees, warblers and insectivorous birds may be found. Other fauna present here include Eastern Redback Salamanders, beaver, coyotes, bobcats and Snowshoe Hares.[2]

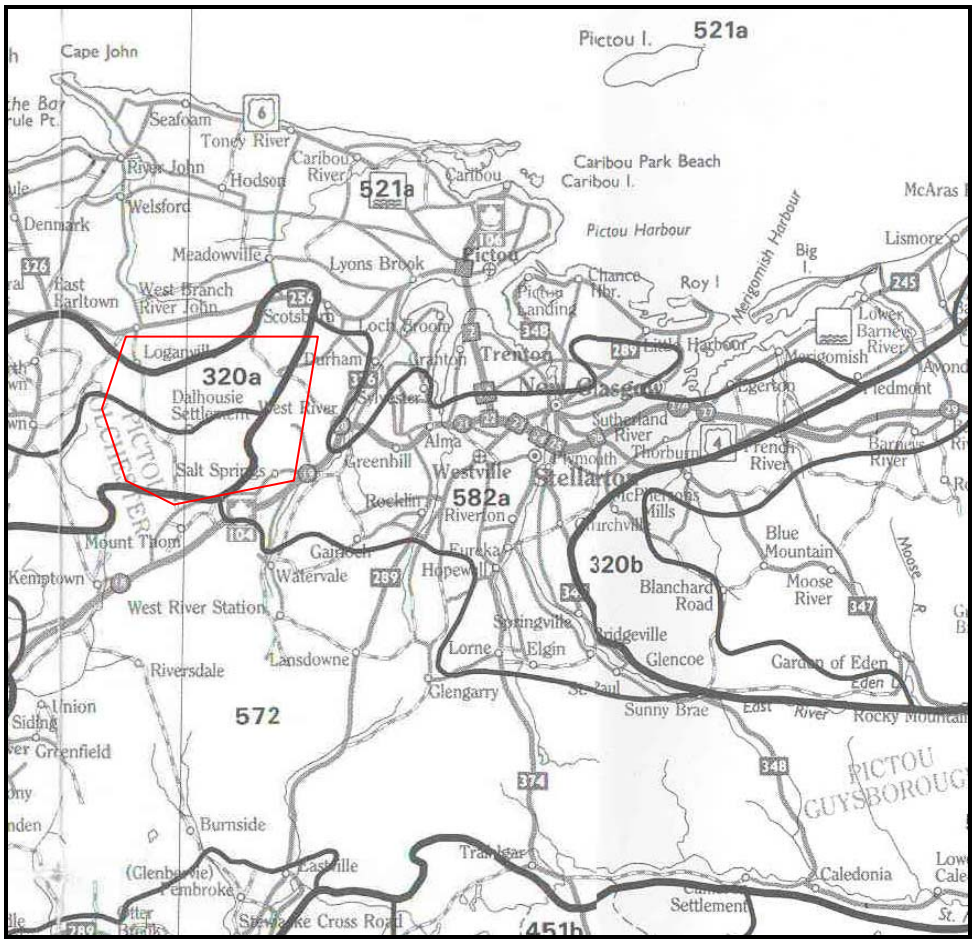

Figure 2.0-2: Approximate study area (red outline) on subset of *The Natural History Theme Regions of Nova Scotia* map (Province of Nova Scotia 1997) in Davis & Browne (1996).

The final theme region that converges within the study area at its north is sub unit #320a Waughs River of the Dissected Margins theme. This area occurs at the margins of the Cobequid Hills where kame and esker fields are evident. Waughs River is characterized by a series of small faults creating slices down to the Northumberland Plain with numerous rivers and streams. These areas would, undoubtedly have created many opportunities for mill locations. Its well-drained loam soils have developed from the

[2] Davis and Browne 1996:29.

gravely loam till that defines the local geology. Forests in the area are typically mixed with hardwood stands on well-drained ridges. While many of the fauna which characterize the Cobequid Hills unit (unit #311) extend to this unit as well, Brown Trout and Brook Trout are common in this unit's smaller tributaries.[3]

In sum, the study area's physiography and natural resources provided many opportunities for aboriginal people and early settlers in the late eighteenth and into the nineteenth century to, by the technology of the day, eke out a modest existence. As a result, mills, abandoned farmland, century and bicentenary farms, forestry operations and traditional hunting and gathering activities may, each, have influenced the cultural landscapes cast over these mountains and valleys.

3.0 METHODOLOGY

Historical maps and manuscripts, aerial photographs, and published literature were consulted at Nova Scotia Archives and Records Management and the Department of Natural Resources Library in Halifax. A published volume of local family history connected with early nineteenth century Scottish settlers atop of Dalhousie Mountain was also consulted. The Maritime Archaeological Resource Inventory, held at the Nova Scotia Museum's Heritage Division was searched to understand prior archaeological research neighbouring the study area.

3.1 Historical Background

A total of ten archaeological sites were recorded in the Maritime Archaeological Resource Inventory near the study area, nine of which date to the historic period and one dating to the precontact period. The nine historic sites were recorded in 1997 and 1999 in conjunction with the Maritimes & Northeast Pipeline survey. However, none of these historic sites are located within the development area. These sites represent some of the domestic and agricultural features in the area as well as structures related to a saw mill.

First Nations' presence in Pictou County bordered the coast and river valleys to exploit both the food sources and transportation routes that the water afforded. There is little to suggest that Mi'kmaq people or their ancestors inhabited the mountaintops in and around the study area, though the valley in which Brookland is situated and the many streams, rivers, cascades and waterfalls are considered to have greater potential for Mi'kmaq archaeological resources. A single archaeological site, BjCr-01, is recorded within or near the northeastern edge of the study area and represents the find of a single Late Archaic or *Mu Awsami Sagiwe'k* (5,000 – 2,500 years BP) projectile point in a disused quarry near the headwaters of Six Mile Brook on the northeastern slope of Dalhousie Mountain. This indicates a moderate to high potential for the presence of other sites in the vicinity of this find and, therefore, further field investigation of this area is warranted.

[3] Davis and Browne 1996: 26.

As well, family tradition passed down to through the Raes suggested that, in historic times, Mi'kmaq people were settled and occupying lands within the area.[4]

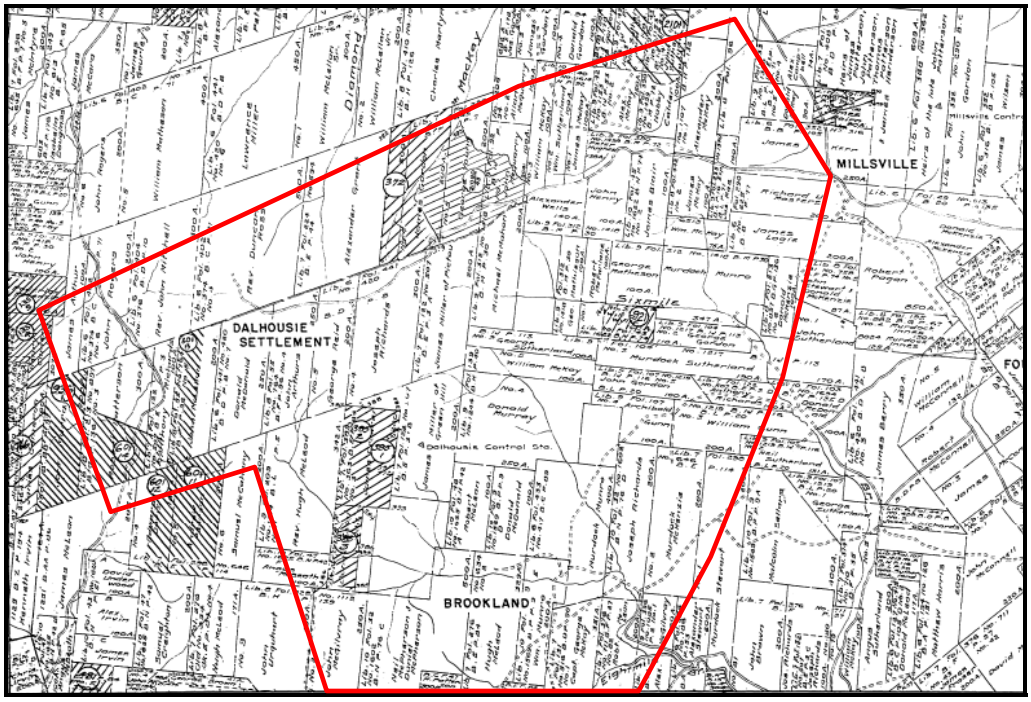

Figure 3.1-1: Crown Land Grant mapsheet no. 86. Study area included in background historical document (study area outlined in red).

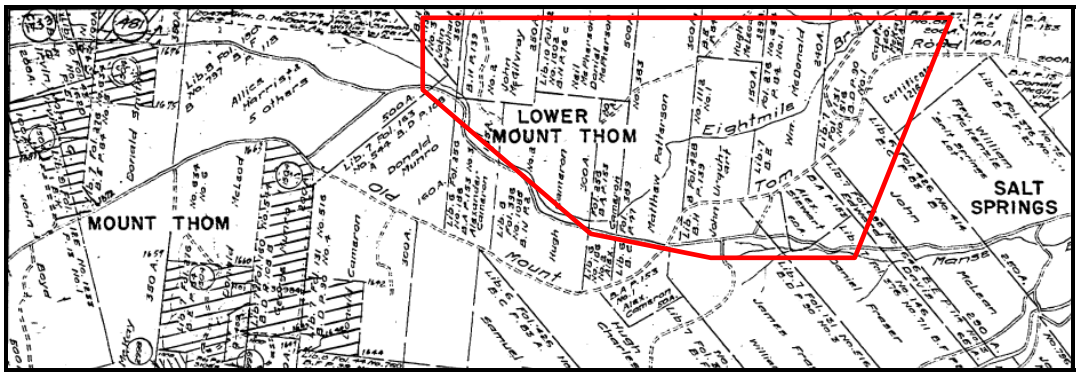

Figure 3.1-2: Crown Land Grant mapsheet no. 87. Study area included in background historical document (study area outlined in red).

[4] Rae Watt 1996: 22.

Patterson's history of Pictou County mentions the remains of a cellar, possibly associated with seventeenth century French presence in the area that was, into the nineteenth century, visible between the Town Gut bridge and Brown Point in the township of Pictou.[5] Beer records mention of Pictou Harbour in a French publication dated 1672, though he does not provide a reference for this document.[6] It is doubtless that the French passed along the shores, and perhaps into the harbour at Pictou, though the depth of their inland exploration is unknown.

The earliest indications of British historic land use of Dalhousie Mountain and the area immediately surrounding it (which often includes Millsville and Rogers Hill) are its inclusion within the Philadelphia Grant (also referred to as Crawley and Company) of 200,000 acres on October 31st 1765. This grant encompassed much of the county of Pictou and extended into Colchester County.[7] With the exception of Rogers Hill (Figure 3.1-3), early development of this grant was limited to the area on or adjacent the shoreline at Pictou Harbour with some further improvement at Lyons Brook. Rogers Hill is immediately adjacent Dalhousie Mountain and a Geological Survey Map dated 1903 identifies the road that travels from Rogers Hill (near Millsville) over Dalhousie Mountain as "Old Road" (Figure 3.1-4). Perhaps this road was that blazed by Philadelphia Grant settlers with two men from Truro to facilitate passage between the two nascent communities.[8] Certainly remains from this period of historic settlement are present in the local area, as Beer relates local tradition that the original foundation built by John Rogers at Rogers Hill was, at that time, still supporting the home of the modern owners of that property, the DeDeckers. These factors and the possibility of omission in the historical documentation suggest elevated potential for mid-to-late eighteenth century resources in the area.

The Philadelphia Grant was largely escheated and re-granted to settlers from Dumfrieshire, Scotland in the period 1815- 1818.[9] The period between the Philadelphia Grant and the Dumfrieshire settlers saw the arrival of the Hector (1773) and hundreds of Scottish immigrants, however, many of them dispersed to areas beyond Pictou County, leaving Dalhousie Mountain and its immediate vicinity to await the Dumfrieshire settlers' arrival. It is unclear what year Peter Arthur took up residence on Dalhousie Mountain, but it seems that this native of the Orkneys was the first Scottish immigrant to settle on Dalhousie Mountain, likely in the first decades of the 1800s. He received two fifty acre allotments for free from larger land grantees and built a home and log barn and is said to have been located five or six miles from any other of his contemporaries.[10] Following the arrival of the Dumfrieshire settlers, the population of this place had become 961 in just a decade.[11] These families continued to occupy the area within and around the study area throughout the 1800s and 1900s. The settlers' names, Rae, Adamson, Willis, Ross, MacDonald, McKay, Munro, Arthur and many others, are consistent on mapping

[5] Patterson, 1877:67.
[6] Beer, 1967:25.
[7] Beer 1967:5; Meacham & Co. 1879:6.
[8] Beer 1967:15.
[9] Rae Watt 1992:10.
[10] Patterson 1877: 275.
[11] Rae Watt 1992: 10.

throughout the nineteenth and early twentieth centuries and properties associated with these across the top, perimeter and area surrounding Dalhousie Mountain (Figures 3.1-3, 3.1-4 & 3.1-5).

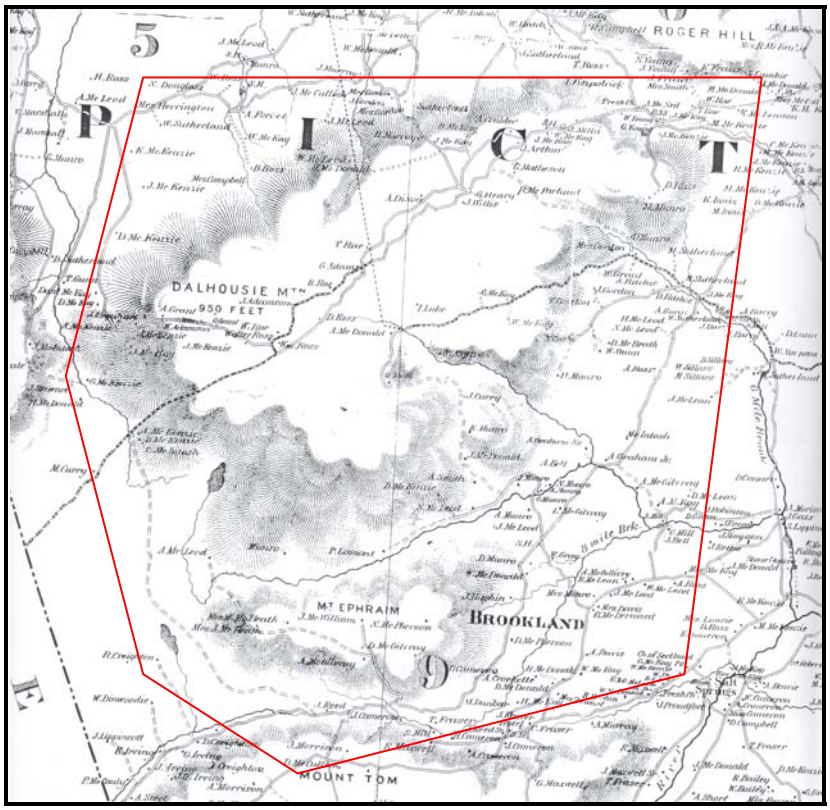

Figure 3.1-3: Study area superimposed on A.F. Church's map of Pictou County (1867).

In addition to the houses, barns and outbuildings constructed by the settlers, there were churches, mills, schoolhouses, forges, cemeteries, a printing press and bookbindery at Dalhousie Mountain and its immediate vicinity.[12] Church's map (1867) suggests that a minimum of fifty properties were improved at Dalhousie Mountain, though, certainly the number of structures associated with each exceeds this total.

In consideration of the potential impact that the proposed wind turbine locations at Dalhousie Mountain could have on archaeological resources, the following properties, identified in Meacham's Atlas (1879), indicate structures within the study area and in close proximity to turbines (Figure 3.1-5).

[12] Cameron 1972:165.

Property owner	Acreage	No. structures	Section Plan No.
Jno. Rae	180	1	5
Jno. McKenzie Jr.	100	1	5
School House (on above property)	Same property as above	1	5
Alex Ross	275	1	5
Jno. Adamson (a)	200	1	5
Robt. Rae	100	1	5
Jno. Adamson (b)	200	1	5
Chas. McIntosh	100	1	5
Jno. Arthur	200	1	5
Wm. Ross	100	1	5
Dond. McKenzie	200	1	5
Geo. Ross	100	1	9
Jno. McDonald	100	1	9
Kenneth Munro	100	1	9
Alex McLeod	111	1	9
Alex Smith	50	1	9
Geo. Gunn	60	1	9
Duncan McKenzie	75	1	9
Angus & Archd. McBeath	100	1	9
Wm. Fraser	110	1	9
Jas. Reid	100	1	9
Anthony McLean	190	1	9
Jno. Adamson	102	1	6
Hugh McKay	87	1	6
Jason Willias	140	1	6
Solomon Robinson Derbyson	83	1	6
Anthony E. Simpson	80	1	6

Table 3.1-1: Properties and structures identified in Meacham's Atlas as being directly at or adjacent turbine locations.

Geological Survey of Canada maps from 1902 and 1903 (joined below) give a clear indication of the progression of land use and settlement in the study area when compared with the other historic maps for the time period between 1867 and 1902-03. While, toward the end of the nineteenth century and into the twentieth, farms and facilities remained, some fell into disuse and were abandoned, dismantled or moved, as the Hermon Church was in Millsville.[13]

[13] Rae Watt 1996: 16.

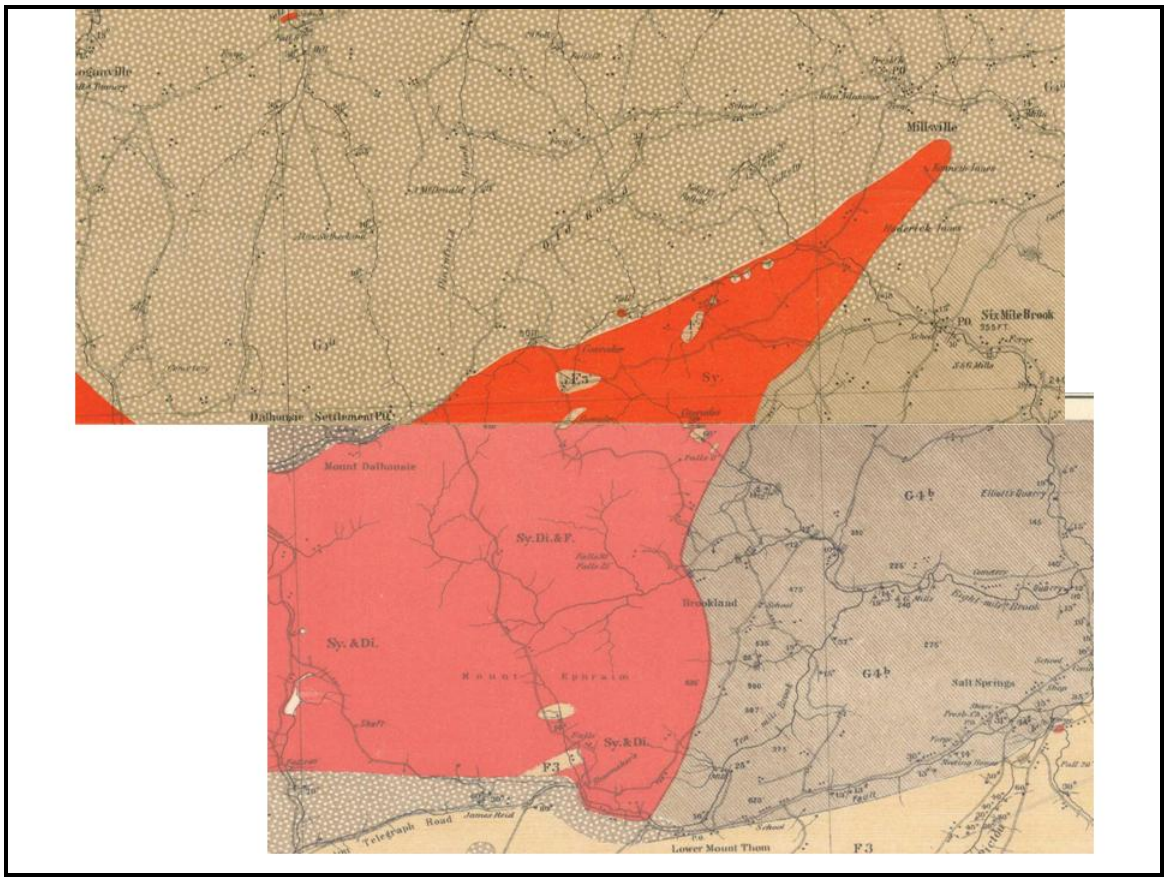

Figure 3.1-4: Mosaic of Geological Survey of Canada (GSC) map sheets 609 (top) & 610 (bottom) from 1903 and 1902 respectively.

Below and left from the Mount Ephraim label on the 1902 GSC mapsheet a mining shaft is indicated that may affect one of the right-of-ways identified on the map of the proposed wind farm.

There is no mention on any of the historic maps of a cemetery on the Jason Willis property on Dalhousie Mountain, however one does exist that was used at least by 1822 until 1911 and was restored in 1991 by local residents and descendants of the decedents.[14] This name does appear on both the Church (1863) and Meacham (1879) maps, but appears to have been granted, originally, to Alexander Wells. It is likely that one of these surnames, Wells or Willis is improperly recorded and that the grant remained in the family. Rae Watt mentions that a forest fire prior had left the cemetery in a poor state. It is unclear the year or extent of this forest fire, however it may have affected archaeological remains of structures and other cultural resources that had been left abandoned in addition to the cemetery.

[14] Rae Watt 1996: 12-15.

Figure 3.1-5: Coverage of study area in Sections 5, 6 and 9 from Meacham's Atlas of Pictou County (1879). Orientation is not continuous between sections.

Aerial photos from 1945 and 1948 over the Dalhousie Mountain, Brookland and Mount Ephraim area clearly show vegetation and field delineation patterning that reflects property boundaries as defined in the Crown Land Grant maps and Meacham's 1879 Atlas of Pictou County.[15] As well, these photos suggest that house and barn structures remained on the properties of George Gunn, Angus & Archibald McBeath, Charles McIntosh, John Rae, John Ross, Esquire, John McKenzie, Jr., Kenneth Munro and John McDonald within the study area until at least that time.[16] We know that structures from the early period of settlement remained into the late twentieth century as evidenced by the drawing of Bella Jane Munroe's House (circa 1800) at Brookland in the 1970s.[17]

[15] A8471-109 (1945) & A8471-112 (1948).
[16] Meacham 1879: Section 5.
[17] Jenson 1974:27.

4.0 RESULTS AND DISCUSSION

Historical documentation and previous archaeological research suggest a hierarchy of regions within the study area of high, moderate and low potential for First Nations archaeological resources based on both the natural landscape and cultural resources. It is doubtless that Mi'kmaq people and their forebears were living in the area and using the complex of natural resources that occur in the Pictou area and its contributing watersheds for thousands of years.

Historic period settlement and use of the area has also been identified through documentary and archaeological research. As the eighteenth century progressed, Pictou township and the surrounding landscape was increasingly colonized by people from the southern colonies, such as Crawley and Company, and waves of Scottish immigrants, beginning with the Hector in 1773 and continuing, most directly within the study area, with the Dumfrieshire settlers in 1815-1818.

5.0 CONCLUSIONS AND RECOMMENDATIONS

The area has been determined to be of high potential for eighteenth and nineteenth century archaeological sites associated with Scottish settlement and use of the area. Nine historic archaeological sites have been previously recorded within the Maritime Archaeological Resource Inventory near the study area.[18] Additionally, there is moderate potential for First Nations' resources within the study area and a confirmed site adjacent the study area may serve only to increase that potential. Therefore, it is recommended that the area be surveyed by qualified archaeologists prior to any ground disturbance.

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[18] Davis Archaeological Consultants Limited, 2000.

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APPENDIX A:
HERITAGE RESEARCH PERMIT

NOVA SCOTIA
Tourism, Culture and Heritage

Heritage Division

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

Application for
Heritage Research Permit
(Archaeology)

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

Permit No. **A2007NS40**

The undersigned April MacIntyre

of c/o 6519 Oak Street, Halifax, NS B3L 1H6

representing (institution) Davis Archaeological Consultants Limited

hereby applies for a permit under Section 8 of the Special Places Protection Act to carry out archaeological investigations during the period:

from 11 June 2007 to 30 September 2007

at Dalhousie Mountain Wind Farm

general location Dalhousie Mountain, Pictou County

specific location(s) (cite Borden numbers and UTM designations where appropriate

Centre: NAD83 Lat 45 34' 02" N Long 62 57' 34" W

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.

I certify that I am familiar with the provisions of the Special Places Protection Act of Nova Scotia, and that I will abide by the terms and conditions listed in the Heritage Research Permit Guidelines for the category (check one).

- ○ Category A - Archaeological Reconnaissance
- ○ Category B - Archaeological Research
- ◉ Category C - Archaeological Resource Impact Assessment

Signature of applicant A MacIntyre **Date** 05 June 2007

Approved:
Executive Director Bill Meahan **Date** 07 June 2007

C10- Wind Resource and Climate study

Summary Report

ORTECH Power
a division of ORTECH Consulting Inc.

Wind Resource Assessment
for Dalhousie Mountain Wind Farm

Prepared for:
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47 pages

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APPENDICES

1. INTRODUCTION

RMSenergy Ltd. ("RMSenergy") is developing Dalhousie Mountain Wind Farm in Pictou County, Nova Scotia, as shown in Figure 1.

RMSenergy retained ORTECH Power, a division of ORTECH Consulting Inc., ("ORTECH") to perform the following services:

- Review and QA/QC meteorological data provided to ORTECH by RMSenergy
- Provide a summary analysis of the data and carry out a Measure-Correlate-Predict (MCP) procedure in order to determine the long-term wind regime at the meteorological tower
- Compute a wind flow map for the wind farm area
- Carry out an energy yield analysis for a proposed 51MW wind farm

In performing the analysis, ORTECH made certain assumptions with respect to conditions that may exist or events that may occur in the future. While ORTECH believes that these assumptions were reasonable for the purpose of the report, they are dependent upon future events and actual conditions may differ from those assumed. In addition, ORTECH used and relied upon certain information provided to it by sources which it believes to be reliable. While ORTECH believes the use of such information was reasonable for the purposes of the report, ORTECH offers no other assurances with respect thereto and some assumptions may vary significantly due to unanticipated events and circumstances. To the extent that future conditions differ from those assumed in the report or provided to ORTECH by others, the actual results will vary from those forecasted. The report summarizes ORTECH's work up to the date thereof. Thus, changed conditions occurring or becoming known after such date could affect the information presented based upon the extent of such changes.

2. SITE DESCRIPTION

Figure 1 shows the location of the 60m-Mast, from which wind data was collected by RMSenergy and submitted to ORTECH, and the general location of the proposed wind farm. Also shown in this figure is the location of Brier Island, Hart Island, Grand Etang and Halifax International Airport which were used as the sources of long-term reference data for this assessment.

The terrain is complex with an approximate elevation of 300 m.a.s.l. The DEM or terrain contour lines were provided by ORTECH.

The land cover at the site and surrounding area is dominated by forests, and felled trees.

3. WIND DATA EVALUATION

The purpose of the wind data evaluation is to derive a comprehensive and defensible data set that can serve as the basis for the wind resource assessment. The wind resource assessment consists of:

- On-site wind measurement data QA/QC and analysis;
- Long-term reference wind data analysis;
- Correlation of on-site wind measurements to long-term reference wind data;
- Prediction of long-term wind regime at the on-site met tower;
- Wind flow modeling using computational fluid dynamics software;
- Energy yield assessment, including loss analysis and uncertainty analysis, for a proposed 51MW wind farm using turbine locations provided by RMSenergy.

3.1 On-Site Wind Measurement Data

Wind measurement data has been collected by RMSenergy at the Mt. Thom 60m Met Mast ("Mt. Thom-60m-Mast") within the proposed wind farm since June 26, 2004. An installation and instrumentation report was provided by RMSenergy to ORTECH (Appendix 1). Data was submitted to ORTECH for analysis. For the purposes of this report, a 36 month period was used for the analysis of data from Mt.Thom-60m-Mast. Wind measurement data from two additional meteorological towers at sites within the proposed wind farm, namely site 36 ("Neenah-Mast36") and site 37 ("MacKinnon-Mast37"), was also collected by RMSenergy and submitted to ORTECH for analysis. A summary of the tower details, instrumentation and configuration, and data collection and analysis periods at Mt. Thom-60m-Mast, Neenah-Mast36 and MacKinnon-Mast37 are shown in Table 1. The instrument configuration described below was provided to ORTECH by RMSenergy. Upon visiting the site on April 13, 2007, ORTECH confirmed that the tower location and instrument configuration information provided by RMSenergy was accurate.

3.2 Quality Check

Data was received by ORTECH from RMSenergy as raw data files from the NRG data-logger. The individual raw data files were processed through the NRG Symphonie Data Retriever to generate a text file containing the complete data set.

The data set was then quality assured/quality controlled by ORTECH using industry standard methods. Data sets were screened through ORTECH's in-house, proprietary data processing routine for range tests, relation tests and trend tests to filter out data in which the sensors were suspected to be frozen, in error or to eliminate physically impossible conditions (i.e. significantly higher wind speeds at 30m as compared to 60m). The suspected data points were flagged and further analysed to produce a final data set for analysis. Since Mt. Thom-60m-Mast, Neenah-Mast36 and MacKinnon-Mast37 were configured with redundant anemometers, tower shading was taken into consideration when generating the final data set.

3.2.1 Data Recovery Rate

The wind data primarily collected from Mt. Thom-60m-Mast between July 1, 2004 and June 30, 2007 was used in this assessment for Dalhousie Mountain Wind Farm. The data recovery rate for the final data set (i.e. after screening) is provided as Table 2 and Table 3.

The data recovery rate is defined as the number of valid data records collected versus that possible over the reporting period and were determined for each sensor at all levels at this site. The method of calculation is as follows:

$$Data\ Recovery\ Rate = \frac{Data\ Records\ Collected}{Data\ Records\ Possible}(100)$$

Where,

Data Records Collected = Data Records Possible – Number of Invalid Records

As shown in Table 2 and Table 3, the data recovery rates at the 30m and at the 45m level for the analysis period (July 2004 - June 2007) were very good (96% and 95% respectively). At 60m the data recovery rate was lower (84%) due to the anemometers being out of service during certain months as a result of malfunction or low temperatures causing freezing/icing. For instance, the data recovery rate at the 60m level in 2005 was low due to the anemometers being out of service from March 31, 2005 to May 7, 2005 as a result of malfunction. And in 2006 it was low as well due to the anemometers being out of service from December 27, 2005 to March 31, 2006 as a result of malfunction. A 90% overall recovery rate is normally considered as the minimum requirement by the industry to be temporally representative.

Tables 10 through 12 and Tables 13 through 15 show the data recovery rates and mean wind speeds for Neenah-Mast36 and MacKinnon-Mast37 respectively. As shown in Tables 10 through 12 the recovery rates during the 6 month period at site 37 were relatively high excluding the month of March. The recovery rate during this month was around 51% as a result of a long period of missing data from March 12, 2007 to March 25, 2007. The recovery rates returned for the months of February and April were less than 90% as a result of low temperatures that caused freezing/icing. The same applies for site 36 as shown in Tables 10 through 12.

Table 4: Mt. Thom-60m-Mast - R^2 for Wind Speeds and Wind Directions between Different Levels (30m, 45m and 60m)

Year	R^2 Wind speed (60m vs. 45m)	R^2 Wind direction (60m vs. 45m)	R^2 Wind speed (60m vs. 30m)	R^2 Wind speed (45m vs. 30m)
2004*****	0.99	0.93	0.97	0.99
2005*****	0.99	0.98	0.97	0.99
2006*****	0.98	0.90	0.96	0.99
2007*****	0.99	0.93	0.97	0.99
All	**0.99**	**0.95**	**0.97**	**0.99**

***** analysis period: July 1, 2004 – June 30, 2007

Table 5: Neenah-Mast36 - R^2 for Wind Speeds and Wind Directions between Different Levels (30m, 40m, and 50m)

Year	R^2 Wind speed (50m vs. 30m)	R^2 Wind direction (50m vs. 30m)	R^2 Wind speed (50m vs. 40m)	R^2 Wind speed (40m vs. 30m)
2007*****	0.98	0.72	0.99	0.99

***** analysis period: January 17, 2007 – June 30, 2007

Table 6: MacKinnon-Mast37 - R^2 for Wind Speeds and Wind Directions between Different Levels (30m, 40m, and 50m)

Year	R^2 Wind speed (50m vs. 30m)	R^2 Wind direction (50m vs. 30m)	R^2 Wind speed (50m vs. 40m)	R^2 Wind speed (40m vs. 30m)
2007*****	0.95	0.80	0.96	0.98

***** analysis period: January 11, 2007 – June 30, 2007

3.3 Data Summary

Monthly wind speed summary statistics for the three different measurement heights during the analysis period at Mt. Thom-60m-Mast, Neenah-Mast36 and MacKinnon-Mast37 are presented in Tables 7 to 9, Tables 10 to 12 and Table 13 to 15, respectively.

The wind speed frequency distributions for the three measurement heights at Mt. Thom-60m-Mast during the analysis period are presented in Table 16.

The 60m wind direction frequency roses and frequency distribution histograms for Mt. Thom-60m-Mast are illustrated in Figures 2 and 3, respectively.

Figures 4 and 5 show the diurnal variations in wind speeds and wind power density at each measurement height for Mt. Thom-60m-Mast. The diurnal patterns of wind speed and wind power density at the two levels are quite similar, dominated by one trough around 08:00 am, a slight increase around 13:00 and another trough around 17:30 with the highest wind speeds occurring in the evening and early morning.

Winter peaks and summer troughs with a spring time peak are features of the monthly variations in the wind speeds and wind power density, as shown in Figures 6 and 7.

Turbulence is a feature in the atmospheric boundary layer that is created by aerodynamic friction resulting from the motion of air relative to the earth's surface, as well as thermal gradients between the upper atmosphere and the surface. Wind turbulence is the rapid disturbance or perturbation or irregularities in the wind speed, direction and vertical components. The presence of turbulence increases the kinetic energy available to the wind turbine. However, it also tends to decrease the efficiency of the turbine in converting the kinetic energy into mechanical or electric power because excessive wind turbulence may cause extreme loading on wind turbine components. Its dual influence on the turbine power production makes it an important site characteristic. The common indicator of turbulence for wind energy industry is the standard deviation of wind speed. Normalizing this value with the mean wind speed gives the turbulence intensity (TI). Figure 8 shows the monthly variations in TI at Mt. Thom-60m-Mast. The TI pattern is similar at the different heights, with higher TI at the lower measurement height (45m) as compared to the higher (60m) measurement height. The highest TI occurs in the spring months, while lower TI is experienced in the summer months. Figures 9 through 11 show the average TI as a function of wind speed at 60m, 45m and 30m, respectively for Mt. Thom-60m-Mast. Figures 12 through 14 show the directional distribution of TI for wind speeds greater than 4 m/s at 60m, 45m and 30m respectively for Mt. Thom-60m-Mast.

Figure 15 shows the average wind shear in each direction sector during the analysis period. The calculated average wind shear exponent (calculated from the 60m and 45m wind speed data) is 0.20 for the Mt. Thom-60m-Mast during the analysis period. Wind shear is a meteorological phenomenon in which the winds generally increase with height above ground. This phenomenon is dictated by both the mechanical turbulence and thermal turbulence in the atmospheric boundary layer, and its magnitude is influenced by site-specific characteristics. This common characteristic of wind is now being used to advantage by wind turbines at increased hub heights to capture more kinetic energy, thereby boosting power production. Therefore, wind shear is a very important factor in determining the power production from a wind farm. The wind shear is influenced by both the immediate environment and upwind trajectory (fetch distance) of the wind. It is also influenced by the energy balance in the atmosphere.

Based on the calculated wind shear exponent, the wind speed data from the 60m level was extrapolated to estimate the wind speed at the 80m level as shown in Table 17. The turbulence intensity at wind speeds greater than 4m/s and at wind speeds greater than 15m/s from the 60m level at Mt. Thom-60m-Mast were extrapolated (using calculated wind shear at wind speeds greater than 4m/s and at wind speeds greater than 15m/s, respectively) to estimate the turbulence intensity at 80m and are also incorporated in Table 17.

Table 16: Mt. Thom-60m-Mast - Wind Speed Frequency Distribution at each Measurement Height for the Analysis Period

Wind Speed Bin Range (m/s)	Frequency (%)		
	60m	45m	30m
0-1	0.81	1.08	1.02
1-2	1.54	1.93	2.23
2-3	3.16	3.63	4.32
3-4	5.22	5.98	7.56
4-5	7.81	8.76	11.11
5-6	9.87	11.24	13.25
6-7	11.44	12.57	13.50
7-8	11.94	12.44	12.45
8-9	11.32	11.21	9.94
9-10	9.76	8.79	7.51
10-11	7.56	6.68	5.58
11-12	5.92	5.03	4.09
12-13	4.51	3.75	2.76
13-14	3.21	2.51	1.78
14-15	2.17	1.56	1.15
15-16	1.39	1.07	0.74
16-17	0.89	0.68	0.44
17-18	0.57	0.46	0.26
18-19	0.36	0.27	0.14
19-20	0.23	0.15	0.08
20-21	0.13	0.10	0.05
21-22	0.09	0.05	0.03
22-23	0.05	0.03	0.02
23-24	0.03	0.02	0.01
24-25	0.01	0.02	0.00
25-26	0.01	0.00	0.00
26-27	0.00	0.00	0.00
27-28	0.00	0.00	0.00
28-29	0.00	0.00	0.00
29-30	0.00	0.00	0.00

Figure 4: Mt. Thom-60m-Mast - Diurnal Variations in Wind Speeds at each Measurement Height for the Analysis Period

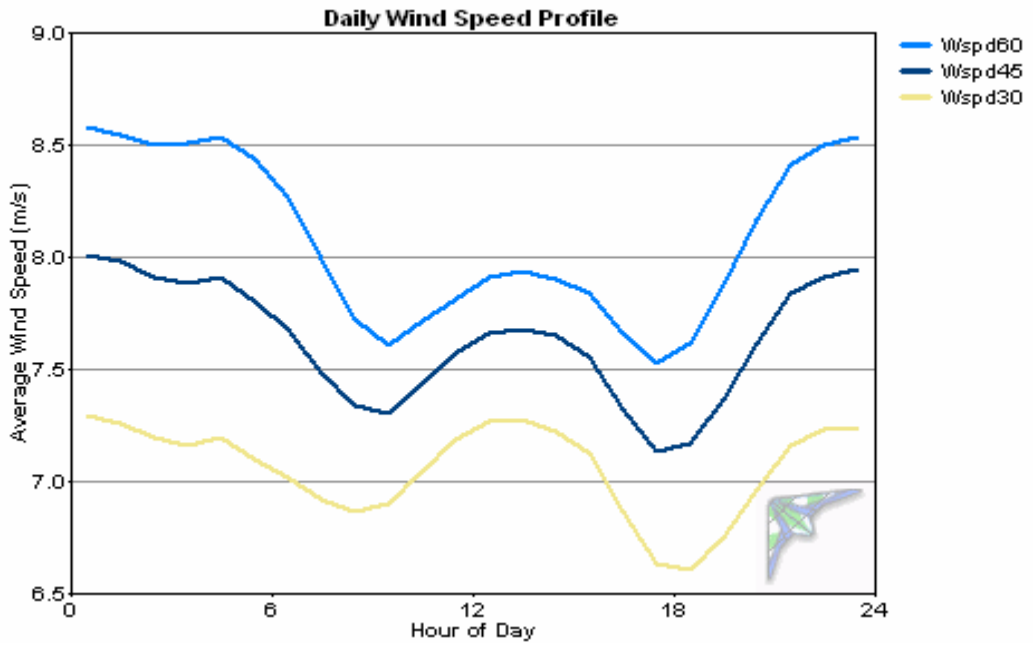


Figure 5: Mt. Thom-60m-Mast - Diurnal Variations in Wind Power Density at each Measurement Height for the Analysis Period

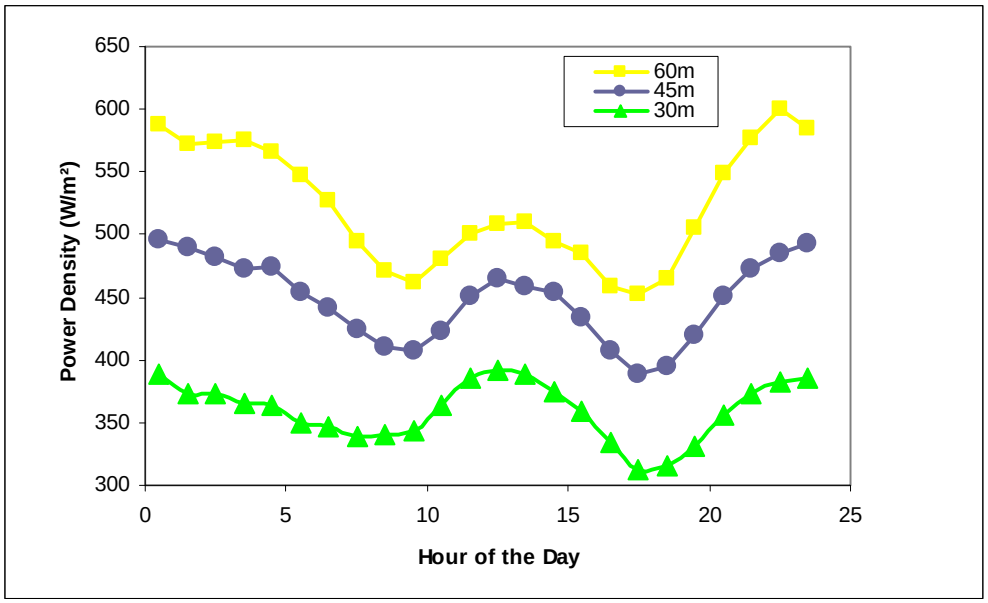


Figure 6: Mt. Thom-60m-Mast - Monthly Variations in Wind speeds at each Measurement Height for the Analysis Period

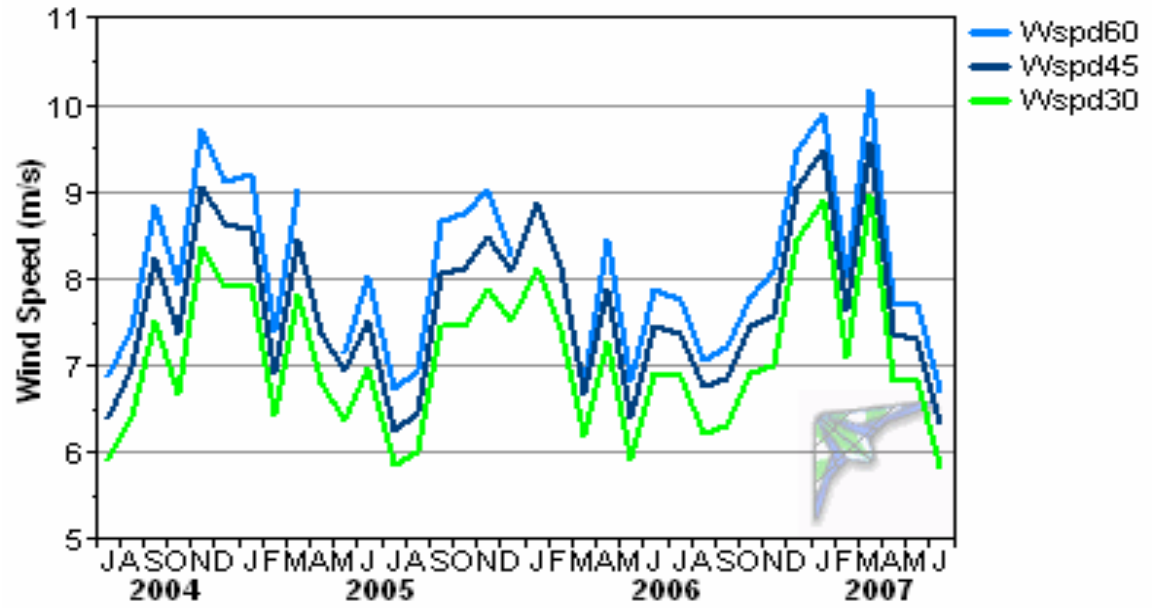


Figure 7: Mt. Thom-60m-Mast - Monthly Variations in Wind Power Densities at each Measurement Height for the Analysis Period

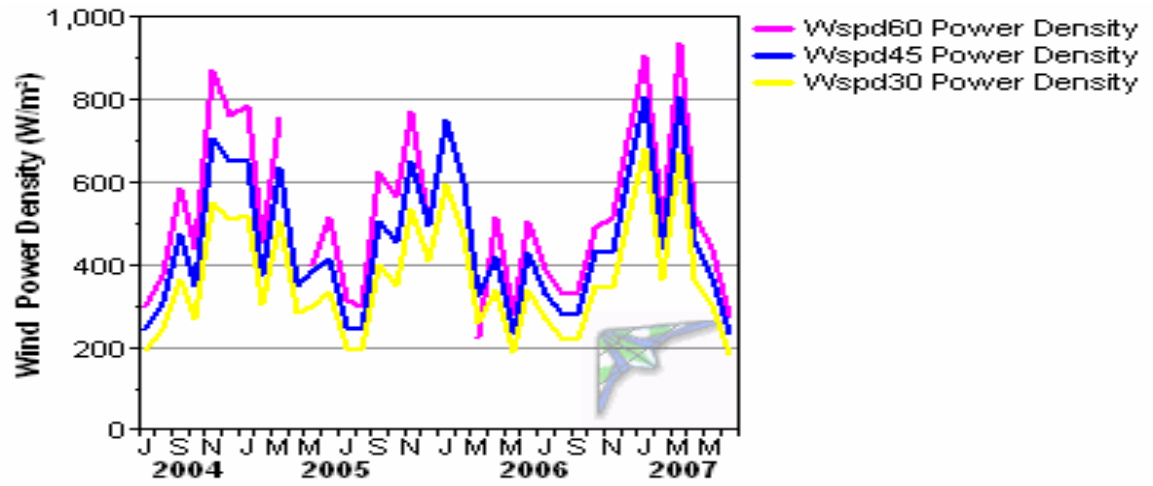


Figure 8: Mt. Thom-60m-Mast - Monthly Variations in Turbulence Intensity at each Measurement Height for the Analysis Period

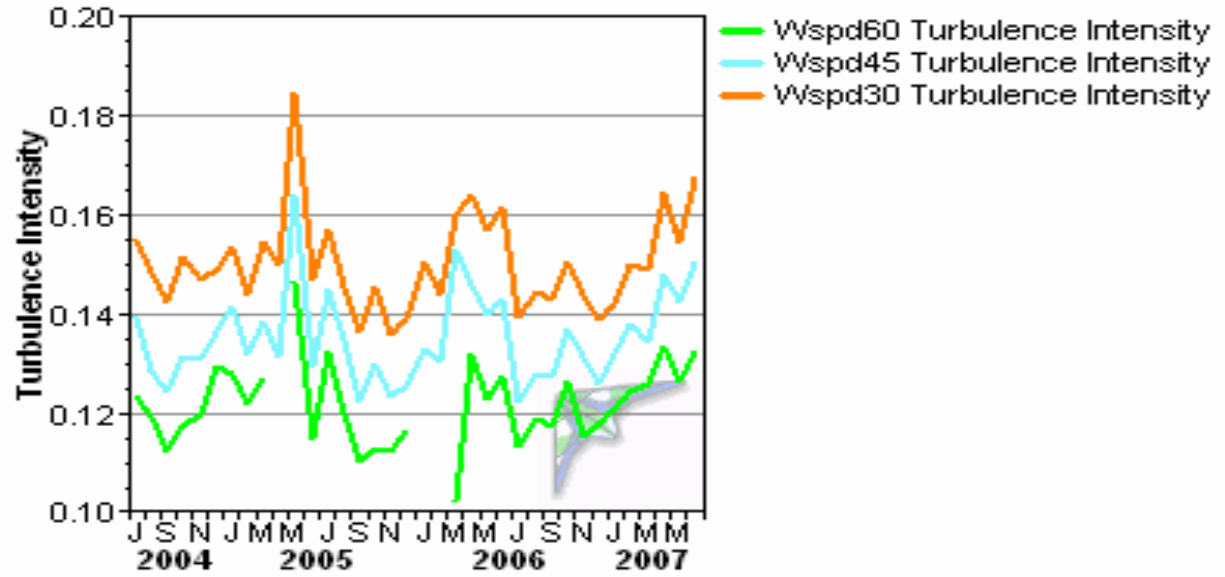


Figure 9: Mt. Thom-60m-Mast - Average Turbulence Intensity at 60m

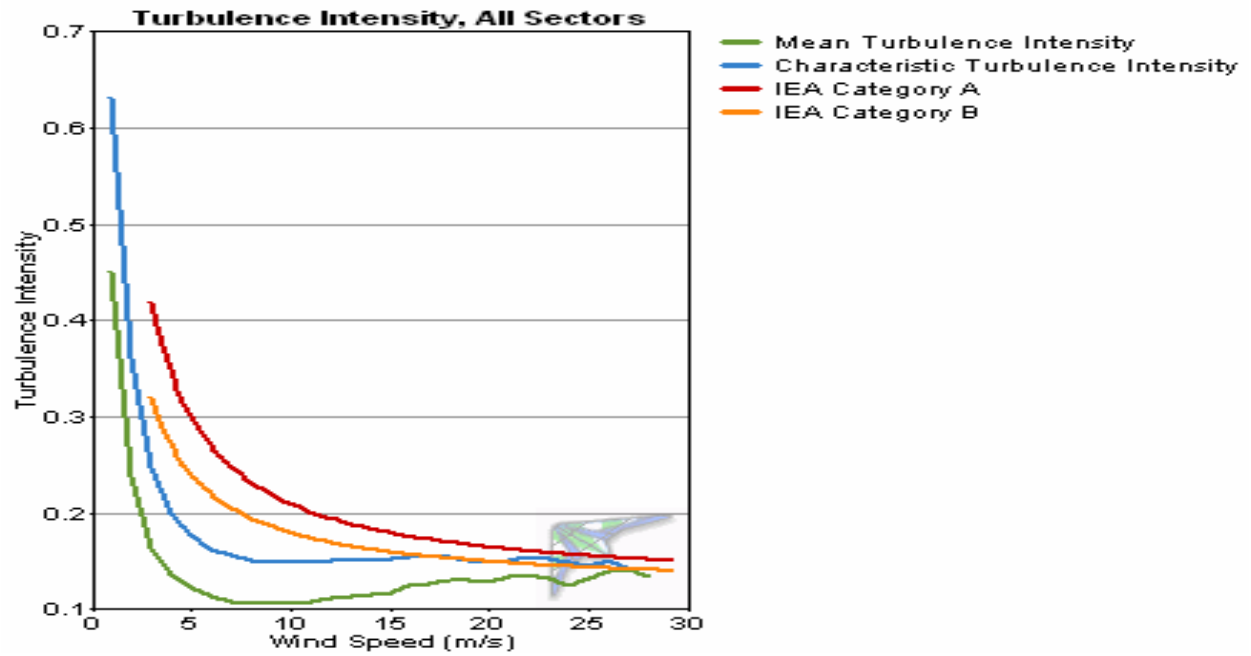


Figure 10: Mt. Thom-60m-Mast - Average Turbulence Intensity at 45m

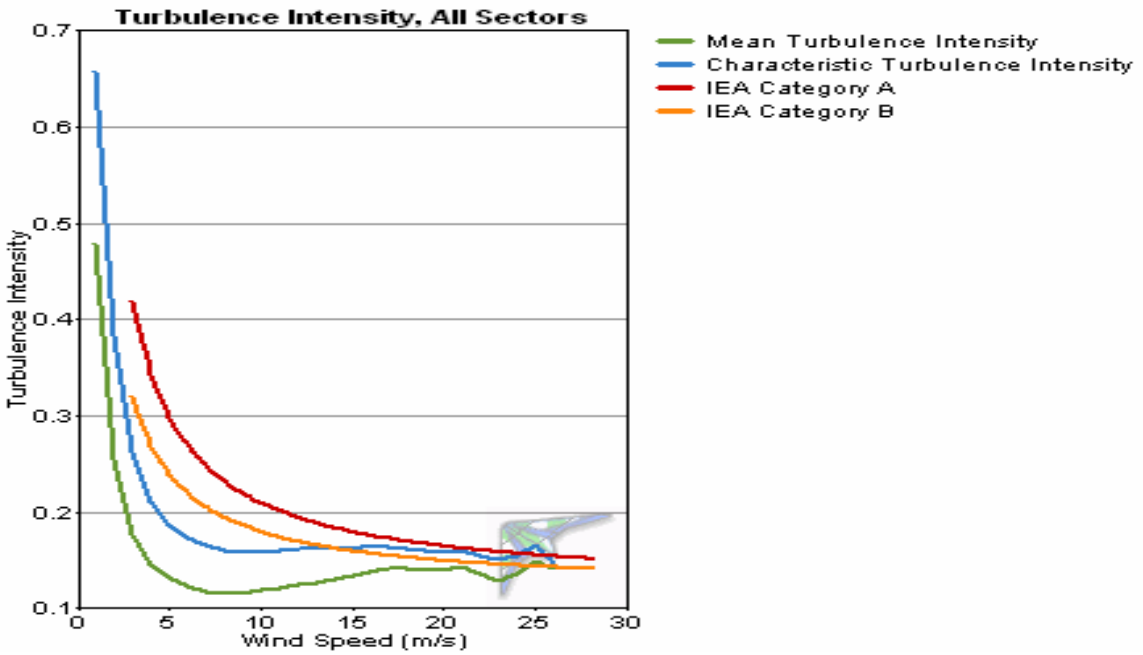


Figure 11: Mt. Thom-60m-Mast - Average Turbulence Intensity at 30m

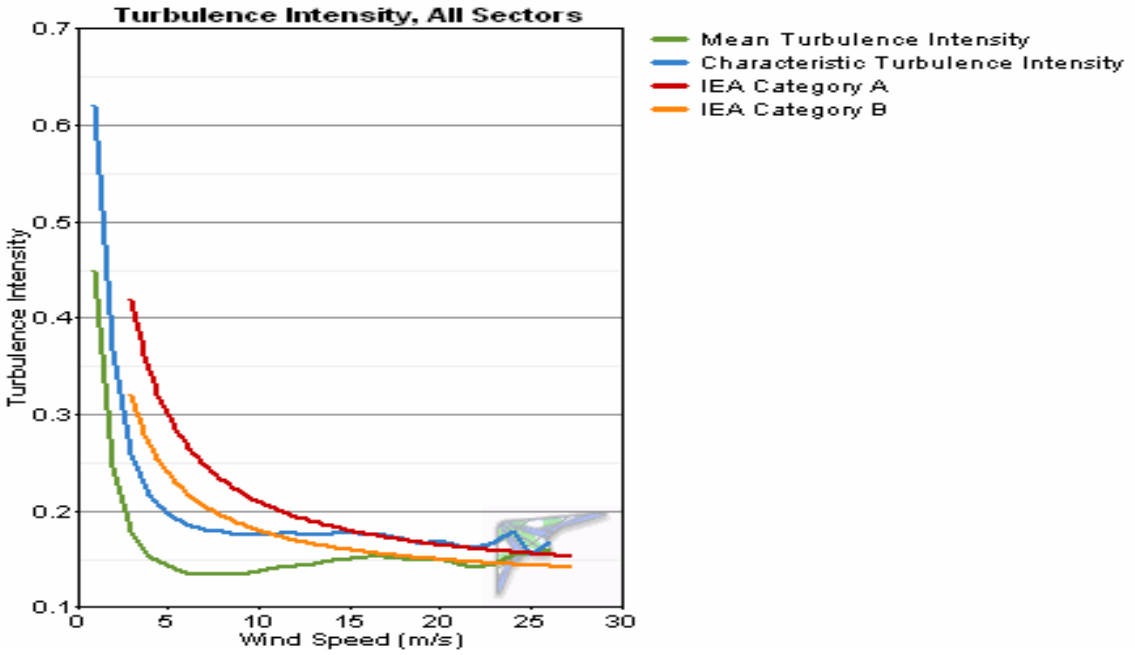


Figure 12: Mt. Thom-60m-Mast - Directional Distribution of Turbulence Intensity (for wind speeds > 4 m/s) at 60m

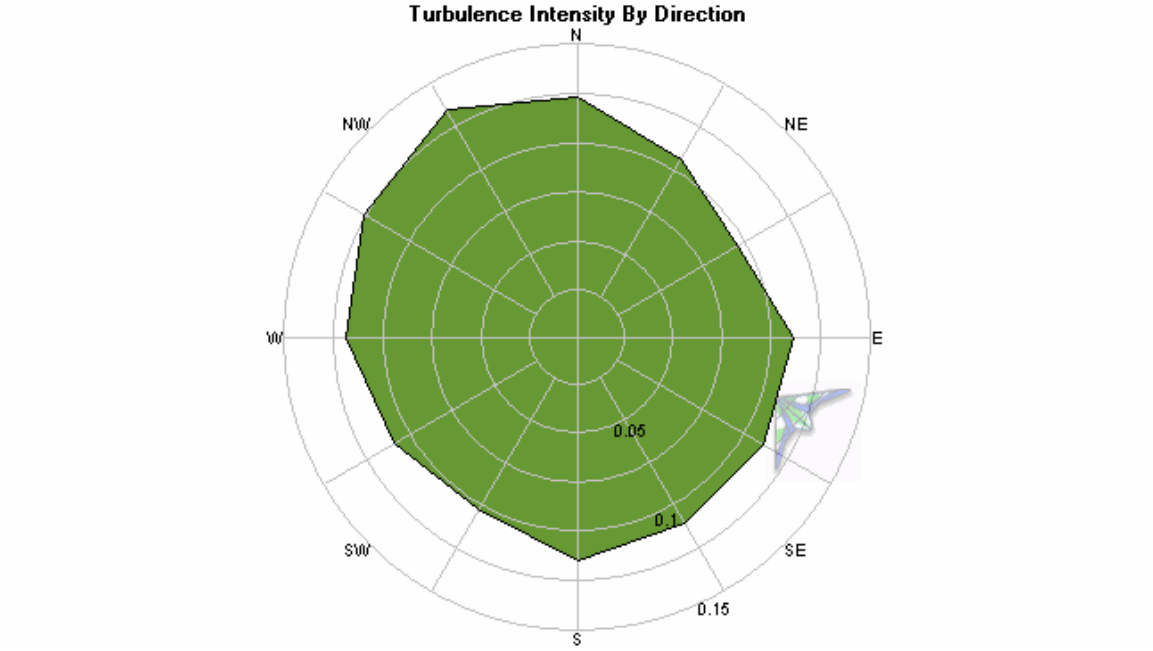


Figure 13: Mt. Thom-60m-Mast - Directional Distribution of Turbulence Intensity (for wind speeds > 4 m/s) at 45m

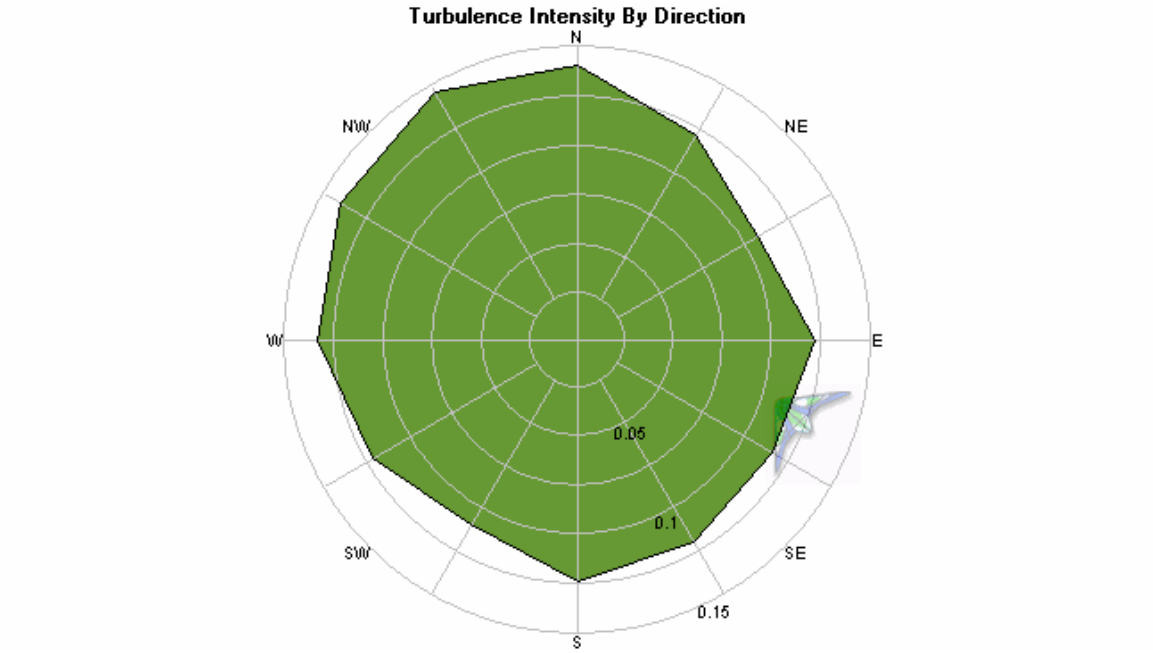


Figure 14: Mt. Thom Directional Distribution of Turbulence Intensity (for wind speeds > 4 m/s) at 30m

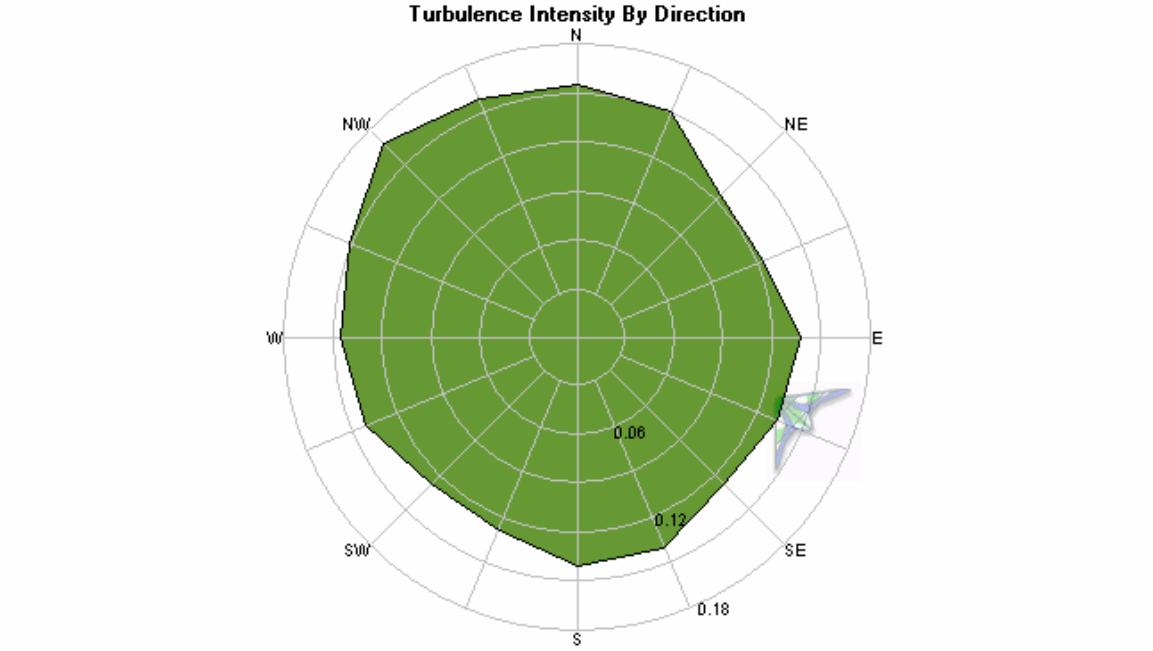
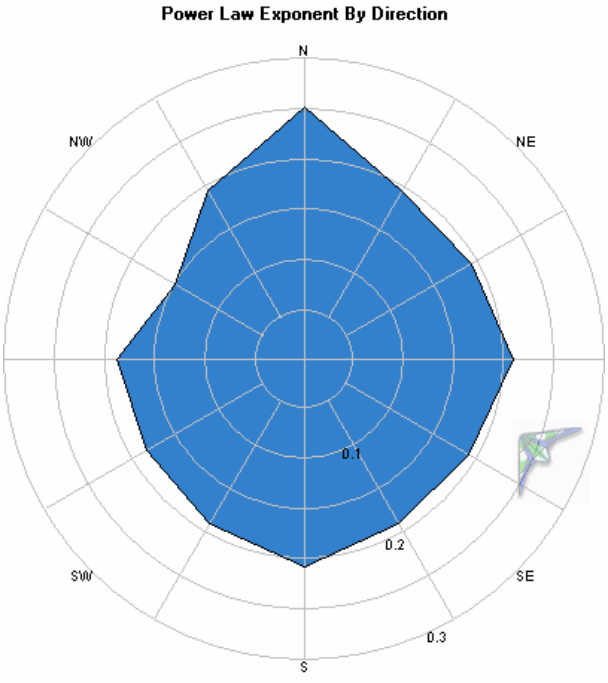


Figure 15: Mt. Thom-60m-Mast - Directional Distribution of Wind Shear Exponent (Power Law)



4. DATA CORRELATION AND LONG-TERM PREDICTION FOR ON-SITE DATA EXTENSION

ORTECH has investigated potential sources of consistent, long-term reference wind data in the region, with over ten Environment Canada (EC) Meteorological Stations in Nova Scotia being analyzed. The EC Meteorological Stations located at Brier Island, Halifax International Airport, Hart Island and Grand Etang, as shown in Figure 1, have been identified as potential reference stations. These reference stations were selected because they:

- Have no instrument changes over the reference period;
- Have at least 10-year consistent long term average wind speed trend;
- Have a good annual data recovery rate for the long-term period (>80%)
- Have a good monthly data recovery rate for the concurrent period (>80%)
- Can yield a good correlation with Mt. Thom-60m-Mast.

At this time, ORTECH has not visited these four stations.

Table 18 gives the details of the four Environment Canada stations that were used as the sources of long-term reference data in the Measure-Correlate-Predict (MCP) procedure.

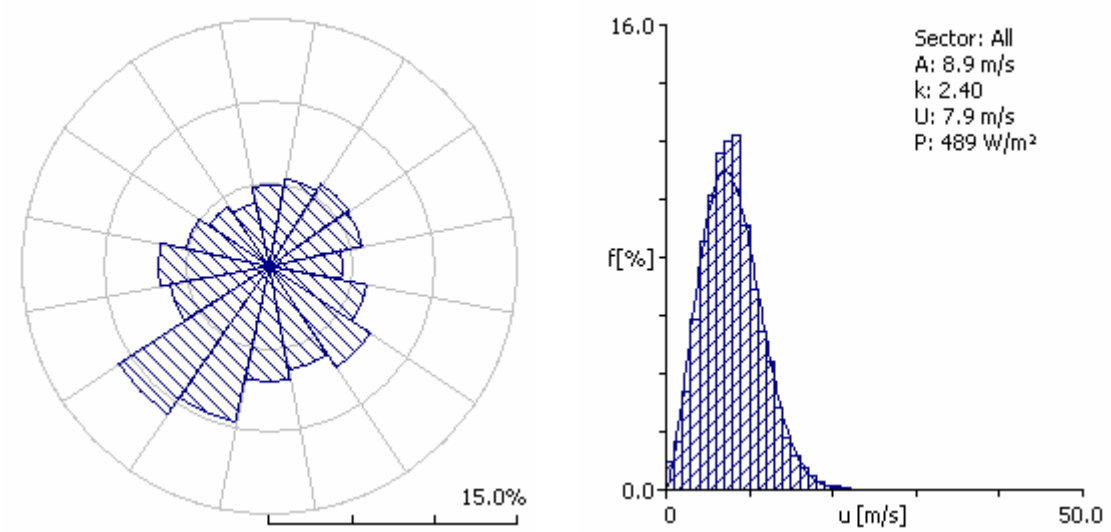
Table 18: Environment Canada Reference Stations Used for MCP Procedure

Station Name	Location		Period of Data Used	Monthly Correlation with 60-m Mast (R^2)
	Latitude	Longitude		
Brier Island, NS	44° 17' N	66° 21' W	1995-2007	0.36
Halifax Int'l A, NS	44° 52' N	63° 31' W	1985-2007	0.68
Hart Island (AUT), NS	45° 21' N	60° 58' W	1985-2007	0.75
Grand Etang, NS	46° 33' N	61° 3' W	1995-2007	0.66

Figure 16 shows the predicted long-term wind distribution for the 60m-Mast at the 60-m level.

A monthly correlation between the temperature measured at Mt. Thom-60m-Mast with the long-term temperature data at the EC Halifax International Airport reference station yields a correlation coefficient of R^2=0.998. The long-term average temperature at Mt. Thom-60m-Mast is 6.9°C. The long-term average air density was then calculated to be 1.204 kg/m^3 at approximately 380 m above sea level (a.s.l.), i.e. at 80m hub height, for a turbine situated at 300 m a.s.l.

Figure 16: Predicted Long-term Wind Direction Frequency Rose and Wind Speed Frequency Distribution at Mt. Thom-60m-Mast at 60m



5. WIND FLOW MODELING

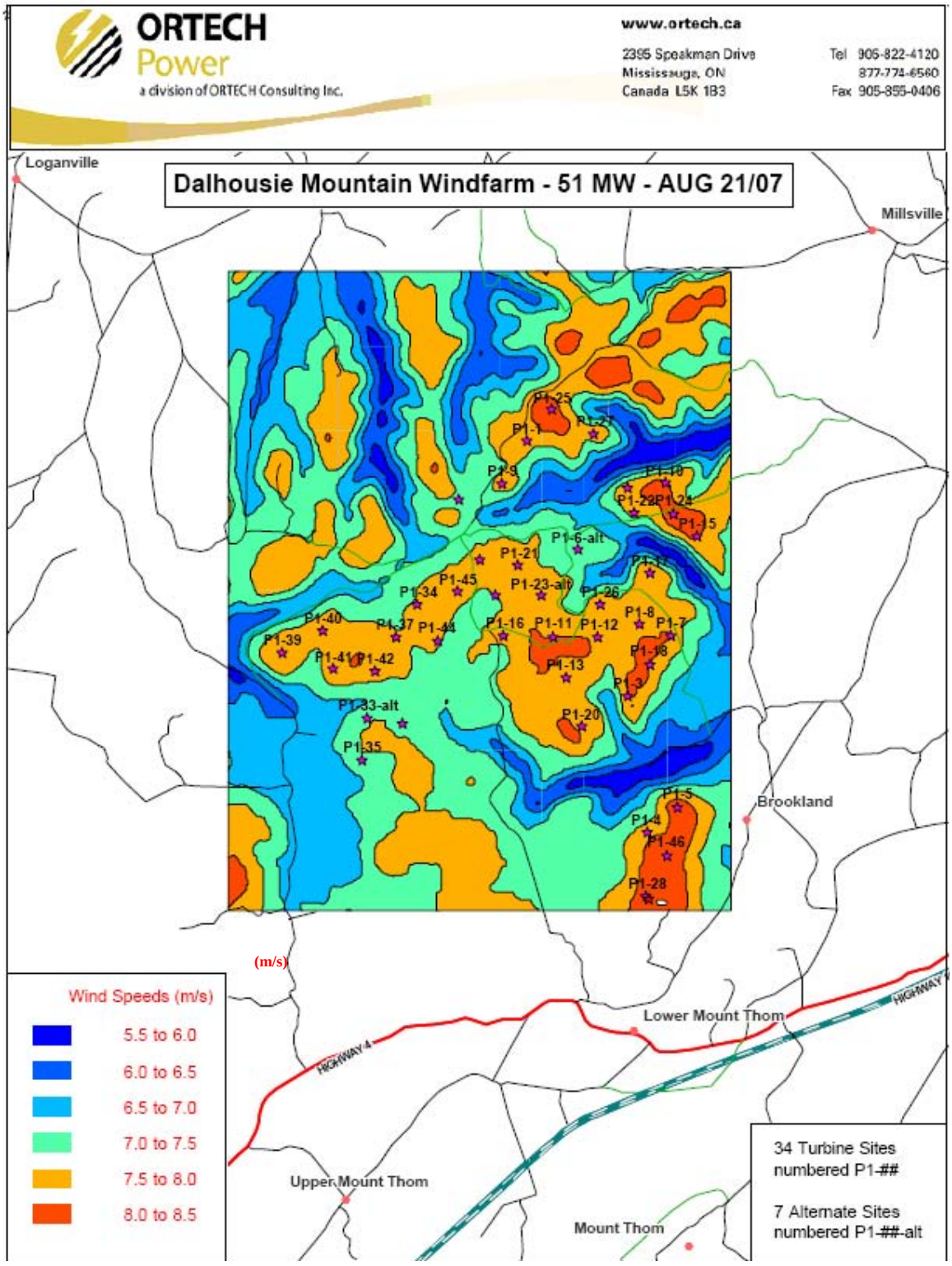
The adjusted long-term data at Mt. Thom-60m-Mast location was then used to create a wind flow map (Figure 17) using ***meteodyn WT: Version 2.2.3*** ("Meteodyn"), a computational fluid dynamics software package used for wind flow modeling and energy yield calculations. Figure 17 includes 41 turbine locations, proposed by RMSEnergy. ORTECH selected 34 locations in order to provide an energy analysis for a 51MW wind farm, using wind turbine generators rated at 1.5MW nameplate capacity. The 34 locations selected represent the most energetic locations of the 41 possible locations. It is understood that a turbine with lower energy yield might be experiencing strong wake effects from nearby turbines, so simply eliminating the "poorer performers" does not guarantee the most optimal choice of 34 turbines. A more detailed study for micrositing is recommended in order to optimize the wind farm layout.

5.1 Modeling Package

The CFD modeling package that was used for this study is ***meteodyn WT: Version 2.2.3*** obtained from

S.A.S. Meteodyn
75, Bd Alexandre Oyon
72100Le Mans
FRANCE

Figure 17: Wind flow map and turbine locations for Dalhousie Mountain Wind Farm



5.2 Model Features

The model solves the averaged Navier-Stokes equations of mass and momentum conservation for turbulent flow over complex terrain. Turbulent fluxes are parameterized using a first-order K-theory closure model. The dynamic model equations are iterated until a steady state flow is reached for the wind flow direction being modeled. The inflow wind profile into the modeled domain is given by a logarithmic profile. The momentum fluxes in the atmospheric surface layer near the terrain surface are modeled using Monin-Obukhov similarity theory. In this way the effect of atmospheric stability, surface roughness and the porosity of forest areas are incorporated into the model. Turbulence intensity is estimated as the ratio between the square root of the turbulent kinetic energy and the local speed of the flow.

Wake losses in a multi-turbine wind farm layout are computed using an axisymmetric flow model of the wind speed deficit in the wake of each turbine. The axisymmetric model considers the turbulence intensity generated in a turbine wake and the thrust coefficient of the turbine which depends on wind speed.

The three-dimensional partial differential model equations are solved using the well tested MIGAL iterative solver. The Meteodyn model has been validated using wind-tunnel test as well as atmospheric flow over the Askervein Hill that is an accepted standard test site for CFD simulation for complex terrain.

Given a topographic map with x, y and z coordinates for the wind site to be assessed, the Meteodyn model creates a 3-D mesh for the solution of the discretized differential equations. Those areas of the mesh that are not near a turbine site have a horizontal grid cell size of 100m. In the vicinity of turbine locations, Meteodyn increases the mesh resolution to optimize the CFD simulation. The highest resolution in near turbine locations is chosen on the user and for small domains can be as fine as 25m in the horizontal and 4m in the vertical. For large model domains a minimum fine resolution of 50m and a vertical resolution of 4m are used to ensure that the memory capacity of the computer is not exceeded. CPU time for completing a wind assessment depends on the domain size and minimum resolution chosen; for a typical wind farm layout, execution time ranges from 6 to 20 hours.

5.3 Model Input Requirements

For the first computation step there are three data files that the user must provide for the site being assessed:

- An orography file of northing and easting coordinates of topography altitude contours.
- A file of northing and easting coordinates surface roughness contours (expressed as roughness length)
- A file of turbine locations and turbine hub heights.

Using this information, Meteodyn maps the wind speed-up factor for each wind sector direction included in the wind climate file that is used in the second step of computation. This is a CPU intensive step that iteratively solves the differential equations for the wind farm domain with a special focus on the wind at turbine sites.

The second step in the assessment using Meteodyn is the computation of the climatologically average wind speeds at hub height for each turbine in the domain. For this step the user must supply the following data files:

-
- A wind climate file derived from wind measurements from a meteorological mast located within the domain of interest. This file is generally prepared by the user using MCP (Measure-Correlate-Predict) methods that extend limited period site measurements with long-period (for example, 20 years) measurement made at nearby climate observing stations to produce a long term wind climate at the wind farm mast location (Mt. Thom-60m-Mast location).
- A power curve in the form of a table of wind speeds at hub height and turbine power production
- A table of thrust coefficients for the turbine that are used to calculate wake effect within a multi-turbine layout.

5.4 Model Outputs

There are several user options for displaying and analyzing the results of the CFD computations. Tabular output is available with the following results for each turbine:

- Weibull parameters *c* and *k*
- Energy density (W/m^2)
- Energy production before wake losses (MWh/year)
- Energy production including wake losses (MWh/year)
- Power factor
- Mean wind speed at hub height
- Mean turbulence intensity
- Mean wind inflow angle
- Estimated extreme wind (50 year return period)
- Estimated extreme 3-second wind gust (50 year return period)

The averages over all wind sectors as well as the averages for each individual wind sector are also output.

6. ENERGY YIELD ANALYSIS

6.1 Turbine Layout

RMSenergy provided 41 possible turbine locations for Dalhousie Mountain Wind Farm (Phase 1). ORTECH chose 34 turbine locations in order to determine the energy production of a 51MW wind farm, using model GE 1.5 sle wind turbine generators, each rated with a nameplate capacity of 1.5 MW. The 34 most energetic locations were chosen for the energy yield calculation and subsequent analysis.

The layout options and constraints were neither considered nor examined by ORTECH for the turbine layout. It is understood that RMSenergy has considered environmental constraints, setbacks from roads, setbacks from power lines, setbacks from watercourses and waterbodies, setbacks from dwellings based on noise constraints, visual impact constraints, etc. in determining the possible turbine locations.

It is assumed that the minimum clearing distances will be maintained by RMSenergy to minimize the effect of the trees on the turbine performance.

6.2 Turbine Equipment Specifications

RMSenergy provided the following specifications for the wind turbine generator to be used for the Dalhousie Mountain Wind Farm:

- Model: GE 1.5 sle
- Nominal rating: 1.5 MW
- Hub height: 80m a.g.l.
- Rotor diatmeter: 77m
- Type of power curve: theoretical

The calculated energy yield depends strongly on the accuracy of the power curve used. The magnitude of deviation may be in the order of several percent. Thus it is recommended to use a power curve that is measured in accordance with 'IEC61400-12' and 'MEASNET' standards and guaranteed by the manufacturer, or alternatively to obtain a guarantee in energy yield based on specified wind measurements. A power curve guarantee has to define the type of anemometer used as a reference.

The power curves of the GE 1.5 sle turbines, as provided to ORTECH, are theoretical power curves.

6.6 Uncertainty Analysis

The assessment also examines the uncertainty and variability of the average Net AEP (P50 Net AEP) to arrive at risk-adjusted energy output values at varying probability levels. The statistical uncertainty associated with the projected Net AEP estimate has been assessed to quantify the wind-related uncertainties and the energy-related uncertainties. In addition, the uncertainty related to the typical yearly fluctuations in wind resource has been quantified. The uncertainties are presented in the form of standard uncertainty; thus, it is possible that higher deviations can occur.

6.6.1 Wind Resource Uncertainties

The uncertainty of the projected wind conditions arises from different sources. All values of the uncertainty presented here refer to the individual standard uncertainty. Table 22 shows major aspects of the analysis of uncertainties in the wind farm pertaining to the calculated wind speed.

Table 22: Summary of the Uncertainties Related to the Predicted Wind Speed

Overall Uncertainty in Wind Resources	
Wind measurement	4%
Long-term scaling	3%
Horizontal and vertical extrapolation	3%
Overall uncertainty in wind resources (12-year period)	**6%**
Wind variability (1-year)	7%
Overall uncertainty in wind resources (1-year period)	**9%**

The uncertainty of the measurement is shown as the first value. It characterizes the uncertainty due to the quality of the measurement set-up and the measurement data. The main components which are taken into account are the anemometer calibration and the mounting effects.

The uncertainty of the wind measurement is mainly associated with the wind measurement at 60m at Mt. Thom-60m-Mast and takes into consideration the calibration status of the anemometers.

The long-term scaling value comprises the uncertainty of the calculated wind conditions over a long time period, reflecting the following aspects:

1) The statistical uncertainty of correlation, expressed by incomplete mapping of the data.
2) The uncertainty of the correction or correlation procedure (this can coincide with (1)).
3) The uncertainty of whether or not the long-term period of wind or energy yield data considered is free of inconsistencies and errors.
4) The variation of the long-term average over several years as opposed to a longer and more representative period (e.g. 30 years).
5) Additionally and irrespective of (4), the uncertainty whether the future wind resource (e.g. for the next ten or twenty years) corresponds to the period examined in the past (i.e. long-term trends or future climate changes are not considered).

The long-term scaling value is considered to be the most important source of uncertainty regarding the wind resource.

The value for horizontal and vertical extrapolation reflects the uncertainty of extrapolating the wind resource from the reference point to the various turbine locations and extrapolating the wind resource from the measurement height to the turbine hub height. The vertical extrapolation is associated with estimating the correction factors for terrain and roughness used in the flow model.

6.6.2 Energy Yield Uncertainties

The energy uncertainties depend on the turbine type and location. The uncertainties are assumed to be stochastic and independent for each turbine location; hence, an overall wind speed uncertainty is calculated for each wind turbine site. Table 23 shows major aspects of the analysis of uncertainties in the wind farm pertaining to the calculated energy yield.

Table 23: Summary of the Uncertainties in the Calculated Energy Yield

Uncertainty in Annual Energy Production (AEP)	
Wind turbine generator model	GE 1.5 sle
Overall uncertainties of the wind climate relate to the site	10%
Uncertainty in power curve	10%
Uncertainty in farm efficiency	2%
Overall uncertainty in AEP (12-year period)	**14%**
Wind variability (1-year)	13%
Overall uncertainty in AEP (1-year period)	**20%**

The wind speed uncertainty is converted into wind energy uncertainty by a calculated sensitivity of the energy yield in relation to the wind speed (dE/dv). For the given turbine types and location layouts, the values of that sensitivity is about 1.84. That means, for example, that a variation of 10% in wind speed leads to a variation of 18.4% in energy yield.

The wind speed uncertainty is combined with the wind farm efficiency uncertainty and the power curve uncertainty.

The uncertainties associated with the turbine type from a scientific point of view have been regarded here. The limitation of the theoretical power curve has been discussed above.

Given the reliance on a theoretical power curve, the uncertainty is judged to be higher than it would be for a measured one. The uncertainty of measured power curves is usually in the order of 6% – 10%. The uncertainty associated with the dynamic outdoor behavior used for the measurement has been added to this. The application of a measured power curve and the review of a complete measurement report of the power curve and of the contract conditions might potentially lower the uncertainties of the power curve.

The value for the farm efficiency relates to the uncertainty associated with the long-term mean of the energy yield. Due to the natural year-to-year variation of the wind, this is not equivalent to the uncertainty of the energy yield of each single year.

The year-to-year variability in wind resource is an intrinsic aspect of the climatic conditions over time. The magnitude of the variability in annual energy production can be expressed as a statistical uncertainty. Based on the reference data the uncertainty is 13%.

windserver

phoenix engineering

Data Source Details
NS-Mount Thom 1-60 (1101)

NRG #40 Maximum Anemometer (PE# 01827)

Sensor Height	30	MountType	Boom	Boom Direction	189T
Logger PE #	1840	Offset	0.188	Boom Length	1.5
Channel Code	C2	Deadband Loc		Boom Post Height	0.13
Mount Description	30m @ 209deg				

NRG #40 Maximum Anemometer (PE# 01828)

Sensor Height	59.9	MountType	Boom	Boom Direction	189T
Logger PE #	1840	Offset	0.188	Boom Length	1.5
Channel Code	C6	Deadband Loc		Boom Post Height	0.13
Mount Description	59.9m @ 209deg				

NRG #40 Maximum Anemometer (PE# 01829)

Sensor Height	30	MountType	Boom	Boom Direction	008T
Logger PE #	1840	Offset	0.188	Boom Length	1.5
Channel Code	C1	Deadband Loc		Boom Post Height	0.13
Mount Description	30m @ 28deg				

NRG #40 Maximum Anemometer (PE# 01830)

Sensor Height	59.9	MountType	Boom	Boom Direction	008T
Logger PE #	1840	Offset	0.188	Boom Length	1.5
Channel Code	C5	Deadband Loc		Boom Post Height	0.13
Mount Description	59.9m @ 28deg				

NRG #40 Maximum Anemometer (PE# 01831)

Sensor Height	45	MountType	Boom	Boom Direction	193T
Logger PE #	1840	Offset	0.188	Boom Length	1.5
Channel Code	C4	Deadband Loc		Boom Post Height	0.13
Mount Description	45m @ 213deg				

NRG #40 Maximum Anemometer (PE# 01832)

Sensor Height	45	MountType	Boom	Boom Direction	012T
Logger PE #	1840	Offset	0.188	Boom Length	1.5
Channel Code	C3	Deadband Loc		Boom Post Height	0.13
Mount Description	45m @ 32deg				

NRG #200P Wind Vane 10K (PE# 01833)

Sensor Height	44	MountType	Boom	Boom Direction	098T
Logger PE #	1840	Offset	0.04	Boom Length	1.5
Channel Code	A7	Deadband Loc	0	Boom Post Height	0.13
Mount Description	44m @ 118deg				

Data Source Details
NS-Mount Thom 1-60 (1101)

NRG 110S Temperature Sensor + Radiation Shield (PE# 01835)

Sensor Height	2	MountType	Tower	Boom Direction	
Logger PE #	1840	Offset	0	Boom Length	
Channel Code	A9	Deadband Loc		Boom Post Height	
Mount Description	NRG 60m tower				

NRG BP20 Barometric Pressure Sensor (PE# 01836)

Sensor Height	1	MountType	Tower	Boom Direction	
Logger PE #	1840	Offset	0	Boom Length	
Channel Code	A10	Deadband Loc		Boom Post Height	
Mount Description	NRG 60m tower				

NRG #200P Wind Vane 10K (PE# 01834)

Sensor Height	59.1	MountType	Boom	Boom Direction	098T
Logger PE #	1840	Offset	0.04	Boom Length	1.5
Channel Code	A8	Deadband Loc	0	Boom Post Height	0.13
Mount Description	59.1m @ 118deg				

Note:

1.Boom directions are stated as the heading when travelling from the boom tip in toward the tower.

2. Windvane deadband directions are measured clockwise relative to the boom heading.

Site Report

NS-Mount Thom 1-60 (1101) as of 2004/06/26

Client	Saltspring Wind Farms	Site Number	1101
Site Type	MonitoringSite	Time Zone	Atlantic (4 hrs)
Municipality	County of Colchester		
Province/State	Nova Scotia		
Country/Region	Canada		
Land Location	X		
Land Type Description	Rolling hills w ith trees		
Key	Master 3595		
Magnetic Declination	-20 degrees East		
Fenced	No		

Towers

PE #	1865
Installation Date	2004/06/25
Elevation (metres)	309
Gin Pole Orientation	121
Latitude	45.53995
Longitude	-62.94735
Logger UTM Coordinate	
Datum	NAD 83
Easting	504111
Northing	5042937
Zone	20
Lightning Protection	Lightning rod at top connected to 2 4' ground rods at base.

Anchors

Rock	13
Dead Man	1

Loggers

PE_Number	1840
Averaging Interval (seconds)	600
Communications Interval	0
Time of Day	
Day of Week	
Logger Phone Number	902-957-0425
ESN_Code	

Land Owners

Cellular Modems

PE_Number	1839
ESN_Code	214-00290055

Site Report
NS-Mount Thom 1-60 (1101) as of 2004/06/26

Site Configuration

PE #	Type	Manufacturer / Model	Serial #	Height (metres)	Boom PE #	Boom Direction (True)	Deadband Direction (Relative)
01819	Boom	NRG 1.5m Boom					
01820	Boom	NRG 1.5m Boom					
01821	Boom	NRG 1.5m Boom					
01822	Boom	NRG 1.5m Boom					
01823	Boom	NRG 1.5m Boom					
01824	Boom	NRG 1.5m Boom					
01825	Boom	NRG 1.5m Boom					
01826	Boom	NRG 1.5m Boom					
01827	Sensor	NRG #40 Maximum Anemometer		30	1820	189T	
01828	Sensor	NRG #40 Maximum Anemometer		59.9	1826	189T	
01829	Sensor	NRG #40 Maximum Anemometer		30	1819	008T	
01830	Sensor	NRG #40 Maximum Anemometer		59.9	1824	008T	
01831	Sensor	NRG #40 Maximum Anemometer		45	1823	193T	
01832	Sensor	NRG #40 Maximum Anemometer		45	1821	012T	
01833	Sensor	NRG #200P Wind Vane 10K		44	1822	098T	0
01834	Sensor	NRG #200P Wind Vane 10K		59.1	1825	098T	0
01835	Sensor	NRG 110S Temperature Sensor + Radiation		2			
01836	Sensor	NRG BP20 Barometric Pressure Sensor		1			
01837	BaseType	Shell Solar ST10 10W Solar Panel	021447 P 1 33 03				
01838	BaseType	NRG Symphonie Shelter Box					

Site Report
NS-Mount Thom 1-60 (1101) as of 2004/06/26

01839	CellularMod	NRG Symphonie iPack/AMPS	31210726
01840	Logger	NRG Symphonie 2	30904624
01865	Tow er	NRG 60m x 8"	
02387	GinPole	NRG 60m Gin Pole	

Note:
1.Boom directions are stated as the heading when travelling from the boom tip in toward the tower.
2. Windvane deadband directions are measured clockwise relative to the boom heading.

Site Maintenance

Date	Technician	Details

Site Notes

Date	User ID	Details

Equipment Maintenance

PE #	Date	Technician	Details

Equipment Notes

PE #	Date	User ID	Details

APPENDIX 2

GE 1.5 sle Technical Specifications
(provided by RMSenergy to ORTECH)
(2 pages)

Turbine model:	GE 1.5 sle
Hub height:	80m
Rotor diameter:	77m
Rated power:	1.5 MW
Cut-in wind speed:	3 m/s
Cut-out wind speed:	25 m/s
Generator type:	Doubly fed asynchronous generator with slip rings
Power curve:	Theoretical

GE 1.5 sle Power Curve and Thrust Coefficients (Ct) Curve Air density: 1.225 kg/m^3		
Wind speed at Hub Height (m/s)	Electrical Power (kW)	Thrust Coefficient
3.0	0	1.27
3.5	20	1.27
4.0	43	1.03
4.5	83	1.03
5.0	131	0.91
5.5	185	0.91
6.0	250	0.89
6.5	326	0.89
7.0	416	0.89
7.5	521	0.89
8.0	640	0.87
8.5	785	0.87
9.0	924	0.80
9.5	1062	0.80
10.0	1181	0.69
10.5	1283	0.69
11.0	1359	0.55
11.5	1402	0.55
12.0	1436	0.42
12.5	1463	0.42
13.0	1481	0.32
13.5	1488	0.32
14.0	1494	0.25
14.5	1500	0.25
15.0	1500	0.20
15.5	1500	0.20
16.0	1500	0.17
16.5	1500	0.17
17.0	1500	0.14
17.5	1500	0.14
18.0	1500	0.12
18.5	1500	0.12
19.0	1500	0.10
19.5	1500	0.10
20.0	1500	0.09
20.5	1500	0.09
21.0	1500	0.07
21.5	1500	0.07
22.0	1500	0.07
22.5	1500	0.07
23.0	1500	0.06
23.5	1500	0.06
24.0	1500	0.05
24.5	1500	0.05
25.0	1500	0

C11- Geotechnical Study

Jacques Whitford

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Job No. 1027790

August 2, 2007

Ms. Lisa Fulton
Fulton Energy Research
796 Dan Fraser Road
RR#3 Westville, NS B0K 2A0
On behalf of RMSenergy

Dear Ms. Fulton:

RE: Preliminary Geotechnical Assessment, Proposed Wind Farms
Dalhousie Mountain Wind Farm, Mt Thom, NS

Jacques Whitford Limited, acting at your request, has completed a preliminary geotechnical site assessment for the project noted above. Based on our recent telephone conversation and your email of June 4, 2007, we understand the assessment will be used to gain a better understanding to the general soils and bedrock conditions at the site to assist with the design and budgeting of a site geotechnical survey in advance of design and construction of the project.

This report is intended for preliminary use and should be used in conjunction with a full geotechnical report based on subsurface information obtained at each wind tower location.

Our scope of work for this assessment included the following:

- Review of bedrock and surficial geological mapping;
- Site visit to project location, conducted on June 27, 2007;
- Preparation of this report.

Surficial Geology

The surficial geology of the proposed wind farm location is typical of the area. Bedrock can be encountered at the surface in many areas, while soil cover consists of mainly silty glacial till (ground moraine) deposits and colluvial deposits. A desktop review of the surficial geology showed the following:

a.) Silty Glacial Till (ground moraine) deposits

The silty glacial tills are generally found to be of a compact to dense relative density with varying thickness. These soil conditions are generally suitable for spread footings construction for this application.

b.) Colluvial Deposits

Colluvial deposits typically have little or no sorting and are not consistent within the soil strata. These soil conditions also are generally suitable for spread footings construction for this application.

c.) Surface Bedrock

Bedrock at the surface is typically weathered and in some cases may be rippable with a large sized dozer. Bedrock outcrops are observed in these areas, but generally will have a thin soil cover which supports vegetation and may have thin overlying till layers. Towers at these locations may have to be anchored to the bedrock by means of grouted rock anchors.

Bedrock Geology

The bedrock geology of the proposed wind farm site generally consists of three types of bedrock. Claremont and Millsville Formations (LCCc) of the Cumberland Group (LCC), and Dalhousie Mountain Volcanics (3dm) are present in the majority of the proposed tower locations. The Pleasant Hills pluton (DCg) of the Fountain Lake Group (DCf) and the Greendale pluton (3dg) of the Jeffers Group (3j) are present in the south portion of the site. A desktop review of the bedrock geology showed the following:

a.) Claremont and Millsville Formations (LCCc)

This formation consists of alluvial conglomerate and sandstone.

b.) Dalhousie Mountain Volcanics (3dm)

This formation consists of metamorphosed felsic mavic lavas and pyroclastics and turbiditic wacke.

c.) Pleasant Hills pluton (DCg)

This formation consists of granite.

d.) Greendale pluton (3dg)

This formation consists of diorite and gabbro.

Please note this information should be used for preliminary planning purposes. Geological mapping is very approximate and often interpolated from limited data. A geotechnical field program would be required to accurately assess subsurface conditions at each windmill location in order to provide engineering input and recommendation for site development and foundation design of wind tower foundations.

The following table provides a summary of surficial and bedrock geology conditions of the areas of each proposed tower location following a desktop review based on mapping produced by the Nova Scotia Department of Natural Resources. Please note that conditions encountered in the field may vary from those indicated by the mapping.

Table 1 Summary of Surficial and Bedrock Geology

Proposed Wind Tower Location (P1)	Surficial Geology	Till Formation	Bedrock Formation
1	Bedrock	---	LCCc
2	Bedrock	---	LCCc
3	Bedrock	---	3dm
4	Bedrock	---	DCg
5	Bedrock	---	DCg
6	Till	Colluvial Deposits	3dm
7	Till	Silty Glacial Till	3dm
8	Bedrock	---	3dm
9	Till	Colluvial Deposits	LCCc
10	Till	Silty Glacial Till	3dm
11	Bedrock	---	3dm
12	Bedrock	---	3dm
13	Till	Colluvial Deposits	3dm
14	Till	Silty Glacial Till	3dm
15	Till	Silty Glacial Till	3dm
16	Bedrock	---	3dm
17	Till	Colluvial Deposits	3dm
18	Bedrock	---	3dm
19	Bedrock	---	3dm
20	Bedrock	---	DCg
21	Till	Silty Glacial Till	3dm
22	Till	Colluvial Deposits	3dm
23	Bedrock	---	3dm
24	Till	Silty Glacial Till	3dm
25	Bedrock	---	LCCc
26	Bedrock	---	3dm
27	Bedrock	---	LCCc
28	Bedrock	---	3dg
29	Till	Silty Glacial Till	LCCc
30	Bedrock	---	LCCc
31	Bedrock	---	LCCc
32	Bedrock	---	LCCc
33	Till	Silty Glacial Till	DCg
34	Till	Silty Glacial Till	3dm
35	Till	Silty Glacial Till	DCg
36	Till	Silty Glacial Till	DCg
37	Till	Silty Glacial Till	3dm
38	Bedrock	---	3dm
39	Till	Silty Glacial Till	3dm
40	Bedrock	---	3dm
41	Till	Silty Glacial Till	3dm
42	Till	Silty Glacial Till	3dm
43	Till	Silty Glacial Till	LCCc
44	Till	Silty Glacial Till	3dm
45	Till	Silty Glacial Till	3dm

If you have any questions or require any further details, please contact the undersigned at your convenience.

Yours very truly,

JACQUES WHITFORD

Mark L. Macdonald, P.Eng.
Port Hawkesbury, NS
/mmd

C12 Study Team Bios

Birder
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EDUCATIONAL EXPERIENCE:

Master of Environmental Studies, Dalhousie University

- **Thesis -** The relationship between protected areas and adjacent lands: A case study of Kejimkujik National Park

Bachelor of Recreation, Dalhousie University

- Graduated with the highest grade point average in my class
- Received the Duane Ervanowitz Memorial Award for dedication to conservation and outdoor recreation

Birding Experience:

- Over 20 years experience birding in the Pictou County area
- Experienced in identifying birds by songs
- Experience in volunteer-based bird monitoring programs:
  - Coordinate and compile the Springville Christmas Bird Count
  - Piping Plover Guardian Program
  - 1st and current Maritimes Breeding Bird Atlas
  - Maritimes Nocturnal Owl Survey

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Education: B.Sc (honours) Biology Queens University; M.Sc Biology Acadia University

Experience: Retired after 32 years as a Regional Wildlife Biologist for NS Dept. Natural Resources in Central Nova Scotia.. While with DNR implemented all DNR wildlife management programs (Large Mammals, Wetland Habitats, Terrestrial Habitats, Furbearers and Upland Game, Biodiversity and Species at Risk) in co-operation with Wildlife Division biologists. Member of Central Region Integrated Resource Management team for Crown land management. As a Regional Biologist contributed to the NS Species at Risk Database and Mapping. Assisted NS Dept. of Environment and Labour with wetland reviews and other environmental assessments. Employment as a Regional Biologist for these several years has provided insight into the status of mainland moose. Current member of the Nova Scotia Recovery Team for mainland moose

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Sean Blaney has extensive experience in botanical and bird fieldwork in relation to environmental impact assessment studies, which he does in addition to his work as the Botanist and Assistant Director of the Atlantic Canada Conservation Data Centre (AC CDC). There he is responsible for maintaining status ranks and a rare plant occurrence database for plants in each of the three Maritime provinces. Since beginning with the AC CDC in 1999, he has conducted an extensive fieldwork program across the Maritimes region, discovering dozens of new provincial records for vascular plants and documenting several thousand rare plant locations. Sean is also a member of the COSEWIC Vascular Plant Species Specialist Committee, the Nova Scotia Atlantic Coastal Plain Flora Recovery Team, and has co-authored several COSEWIC and provincial status reports. Prior to employment with AC CDC, Sean received a B.Sc. in Biology (Botany Minor) from the University of Guelph and an M.Sc. in Plant Ecology from the University of Toronto, and worked on a number of biological inventory projects in Ontario as well as spending eight summers as a naturalist in Algonquin Park, where he co-authored the second edition of the park's plant checklist.

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Stephen A. Davis, D.Phil is President of *Davis Archaeological Consultants Limited*. He holds a D. Phil in prehistory from the University of Oxford, M.A. in Anthropology (specialization in prehistoric archaeology) from Memorial University of Newfoundland, and a B.A. (Honours) in Anthropology from the University of New Brunswick, Fredericton. Steve is presently a tenured Professor of Anthropology at Saint Mary's University, Halifax. During his professional career he has directed archaeological investigations of fifteen prehistoric sites, twenty-five historic sites and conducted one hundred and twenty cultural resource assessment surveys under the guidelines for a Category C Permit (Nova Scotia Heritage Division).

April MacIntyre

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April MacIntyre, M.A. is Vice President of Field Operations at *Davis Archaeological Consultants Limited*. She holds a M.A. from Memorial University of Newfoundland and a B.A. (Honours) in Anthropology from Saint Mary's University. She has been employed in the consulting field since 1997. Her specialization is in the historic archaeology of Nova Scotia. April has extensive experience in field and laboratory methods as well as in conducting documentary research and is well-trained in 18th - and 19th - century material culture identification and analysis. April has worked in a supervisory capacity on several projects and has held Category B and C heritage research permits with the Nova Scotia Heritage Division.

Heather MacLeod-Leslie, Ph.D Candidate

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Heather MacLeod-Leslie, PhD candidate is a senior archaeologist at *Davis Archaeological Consultants Limited*. Her experience in archaeological research and consulting spans more than 15 years. Over the last three years she has taught archaeology at Saint Mary's University. Heather studied GIS and remote sensing at the Centre for Geographic Sciences (COGS) and spent five years working in geomatics research and consulting with national, First Nations and international clients. Heather has acted as a forensic archaeological consultant to the Office of the Chief Medical Examiner of Nova Scotia. She is qualified to hold all levels of heritage research permits in the province of Nova Scotia.

DAVIS ARCHAEOLOGICAL CONSULTANTS LIMITED

Davis Archaeological Consultants Limited (DAC) was incorporated under the laws of Nova Scotia in 1989, and is an independent, Halifax-based company.

The general objectives of *DAC* are to provide comprehensive professional services in undertaking archaeological and historical cultural resource assessments. These services include the full range required by the Nova Scotia Environmental Protection Act (1973) and An Act Respecting Environmental Assessment (1988). Company personnel have held numerous permits issued under The Special Places Protection Act (1980 with amendments C.45, S.N.S. 2005). In addition, the company has conducted projects which come under The Federal Environmental Assessment and Review process (1987).

DAC specializes in consulting in the areas of precontact and historical archaeology as well as cultural resource assessment. Experience includes, but is not limited to:

- Management of multi-disciplinary projects;
- Environmental Impact Assessments;
- Environmental Effects Monitoring;
- Mitigation design for cultural resources;
- Cultural resource data acquisition; and
- Direction of cultural resources field projects.

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Education

PhD (Ecology) Summer roosting and foraging behaviour of sympatric *Myotis septentrionalis* and *M. lucifugus*. University of New Brunswick (Supervisor: Dr. G.J. Forbes)

Some relevant research papers

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As President and C.E.O of Strum Engineering Associates Ltd., Mr. N.R. Strum, M. Eng., P. Eng., brings more than thirty-nine years of experience in the power systems and project engineering fields to the Company. Mr. Strum's career began as a staff electrical engineer in the Systems Engineering department of Nova Scotia Power Commission in the late 1960's and 1970's, which lead to his becoming Manager of that Department by 1975. Mr Strum entered the consulting engineering industry in 1978 and by 1982 had risen to the level of Vice-President and Manager of the Engineering Department of the Halifax, N.S. office of a large international, multi-disciplined engineering consulting firm. In 1983 Strum Engineering Associates Ltd. was federally incorporated as a consulting engineering firm, offering specialized electrical power systems engineering services to power utilities and heavy industries in the Atlantic Canada region, and Mr. Strum has served in the positions of President, C.E.O., and Engineering Manager since the formation of the company. Mr. Strum has been a practitioner throughout his career and, as a power systems specialist, continues to be heavily involved in the conceptual and preliminary phases of development and design of the electrical power systems projects the Company undertakes, and is also responsible for leading the Company QA/QC efforts. More recently, Mr. Strum has served as a Power System Specialist and Concept Design Engineer for the development of several multiple machine wind-derived generation facilities up to 120MW in connected generation capacity, for application in Nova Scotia, Prince Edward Island, and New Brunswick. His input to these projects included the preparation of overall project electrical protection and control single line diagram, execution of preliminary short circuit and protection coordination studies, load flow and stability studies, preparation of installed cost estimates for generation collection systems and wind farm-to-utility interconnection substations.