Appendix A – COMFIT Approval Document

NOVA SCOTIA
Energy
Office of the Minister

Joseph Howe Building, 11th Floor, 1690 Hollis Street, PO Box 2664, Halifax, Nova Scotia, Canada B3J 3J9
Telephone 902 424-7793 Fax 902 424-3265 • novascotia.ca

May 20, 2014
Amended June 6, 2014

Paul Pynn
Watts Wind Energy Inc.
300 Prince Albert Road
Dartmouth, N.S. B2Y 4J2

Dear Watts Wind Energy Inc.:

Re: Community Feed-In Tariff Approval

On behalf of the Nova Scotia Department of Energy, I am pleased to present you with your Community Feed-In Tariff (COMFIT) approval for your 3.6 MW large-wind project in Liverpool, NS (COMFIT application #326). Attached to this letter is a certificate indicating your approval.

In order to maintain your COMFIT approval, you must comply with the conditions set by Nova Scotia Power Incorporated, the Renewable Electricity Regulations made under Section 5 of the *Electricity Act* and all program Directives. You will also be expected to comply with the terms and conditions of the project as outlined in your COMFIT application submitted September 23, 2011. Any alterations to this submission (technology type, partnership structure etc.) must be submitted in writing and approved by the Department.

As a condition of approval, your project will be expected to complete:

- Community Consultation: Two public information sessions must be held prior to the construction of the project. Results of the information session must be submitted to the Department of Energy, outlining any community concerns with the proposed project.

- Project Time Line and Milestones: A detailed project schedule including timelines and key milestones must be submitted to the Department of Energy within 60 days. You will be required to report regularly on the progress of the project, as outlined in the submission.

- Evidence of Ownership: This project is approved because it was received when exceptions to a policy ruling large-wind projects were ineligible but were allowed if they had an R&D component. This approval is conditional that the developer continues to work on energy storage with Lightsail and Innovacorp to further advance research and development in the area of energy storage. Also, please provide final details regarding the projects ownership structure and any partnership details and agreements relating to the project. If the ownership of this project changes, the Department of Energy will need to be notified immediately.

- An Environmental Assessment.

- Wind Energy Mapping: The Department of Energy and Department of Natural Resources are endeavoring to map wind development within the province. All approved projects are required to submit the appropriate geographic information system data, and work collaboratively to address any recommendations emerging from an assessment of the cumulative impact of wind energy in the province. More information is provided in the guidance note.

- Please be aware this project was approved because of the research and development component of the project. As of March 26, 2014 with the announcement of the results of the COMFIT review, anyone wanting to apply for a COMFIT program with an R & D component can no longer do so. Any future projects over 500 kw will not be approved.

These conditions are not an exhaustive list of the permits and approvals needed for your project. COMFIT approval does not supersede any additional regulations, permits or approval required by other government authorities as your project unfolds. Projects must still comply with all other conditions and milestones as set by government entities and Nova Scotia Power Inc. Failure to meet additional requirements may result in revocation of your COMFIT approval, even though they may not be an explicit condition at this time.

A COMFIT guidance note is attached with information pertaining to the implementation of your project. The guidance note is not a condition of approval, but information that may be useful to you as you implement your project. As per Directive 004: Annual Progress reports, the Department looks forward to receiving your annual reports on how COMFIT proceeds have assisted in meeting community sustainability goals.

Please note that you are also required to submit a report to the Department of Energy within 30 days of your project's connection to the distribution grid as identified in Section 34 of the Renewable Electricity Regulations. Failure to do so may result in revocation of your COMFIT approval.

If you have any questions about your approval, or if we can be of further assistance to you, please call COMFIT Clerk at (902) 424-5293 and a representative will be happy to assist you.

Sincerely,

Andrew Younger
Minister

Enclosure

NOVA SCOTIA
Energy

Suite 400
5151 George Street
PO Box 2664
Halifax, Nova Scotia B3J 3P7

424-4575 T
424-0528 F
www.gov.ns.ca/energy

Paul Pynn
Watts Wind Energy Inc.
300 Prince Albert Road
Dartmouth, N.S. B2Y 4J2

Re: COMFIT Guidance Note

Dear Watts Wind Energy Inc.:

A substantive review of your COMFIT application has been completed by the Department of Energy, in consultation with relevant government departments. During this review, factors have been identified that you should be aware of as your project proceeds. These are **not** conditions of approval, but guidance to assist you in the successful implementation of your COMFIT project.

Nova Scotia Environment has noted that there is presently a joint federal-provincial-territorial initiative to develop national guidelines for wind turbine noise. The guidelines are currently in draft format and may be adopted provincially. The guidelines are expected to pertain to:

1. large land-based (hub height of 60 meters or higher, blades larger than 30 meters and electrical output greater than one megawatt) and
2. land-based commercial scale turbines with a name plate capacity of greater than or equal to 50 kilowatts and a maximum sound power level of greater than or equal to 102 A-weighted decibels (dBA).
3. Updated GIS information for the Environmental Assessment.

In terms of sound level limits, the proposed guidelines recommend limits ranging from 40 - 45 dBA (based on wind speed) for all classes of wind turbine facilities. In terms of setback distances, the proposed guidelines recommend that wind turbines with a name-plate capacity of greater than or equal to 50 kW and a sound power level of greater than or equal to 102 dBA be constructed, installed or expanded at least 550 metres from the nearest noise receptor. Please contact the Environmental Assessment Branch of the Department of Environment for any updates to these proposed Guidelines.

If you have any questions about your approval, or if we can be of further assistance to you, please call COMFIT Clerk at (902) 424-5293 and a representative will be happy to assist you.

Sincerely,

Karen Daniels
Policy AnalystCOMFIT
Nova Scotia Department of Energy

№. Project 326

Community Feed-In Tariff Approval

This certifies that the *Watts Wind Energy Inc.* has received Community Feed-In Tariff Approval by the Nova Scotia Department of Energy for a 3.6 MW large-wind project in Liverpool, NS. Approval may be revoked should a project not meet the requirements of the Community Feed-In Tariff program or deviate from details specified in its Community Feed-In Tariff application.

NOVA SCOTIA
Department of Energy

Andrew Younger

Minister

№. Project 326

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NOVA SCOTIA
Department of Energy

Andrew Younger

Minister

Appendix B – Federal Approvals

Trent MacDonald <tmacdonald@eonwind.com>

Detailed Analysis Results - Liverpool Wind Farm - WTA-4054

1 message

Kayla.Bowser@forces.gc.ca <Kayla.Bowser@forces.gc.ca> Wed, Nov 12, 2014 at 12:49 PM
To: tmacdonald@eonwind.com
Cc: vinceph@navcanada.ca

Trent,

Thank you for your patience on this matter and for considering DND radar and airport facilities in your project development process.

We have completed the detailed analysis of your proposed site, **Liverpool Wind Farm**, located in **Liverpool, NS** (**WTA-4054**). The results of the detailed analysis and subsequent technical and operational impact assessments have confirmed there is likely to be minimal interference with DND radar and flight operations.

Therefore, as a result of these findings we have no objections with your project as submitted (attached).

If however, the layout were to change/move, please re-submit that proposal for another assessment using the assigned WTA number listed above. The concurrence for this site is valid for 24 months from date of this correspondence. If the project should be cancelled or delayed during this timeframe please advise my point of contact.

It should be noted that each submission is assessed on a case by case basis and as such, concurrence on this submission in no way constitutes a concurrence for similar projects in the same area, nor does it indicate that similar concurrence might be offered in another region.

The issuance of this Letter of Non-Objection shall not constitute a waiver or alienation of any existing or future legal rights of the DND/CF nor shall it be construed to create any exemptions, indemnification, approvals, rights, acceptances in favour of **EON WindElectric**. The DND/CF expressly reserves its rights to take legal action or seek remedy for any and all liability, loss, harm, degradation of services or equipment, mitigation costs, damages, judgements or expenses that arise from the adverse effects, whether incidental, indirect or causal, of the **Liverpool Wind Farm** Project upon the DND/CF radars, equipment and its provision of Air Traffic Services.

I trust that you will find this satisfactory. If you have any technical questions or concerns regarding any aspect of this investigation, please contact the ATESS Liaison Officer at (613) 392-2811 extension 4834, or at +windturbines@forces.gc.ca.

A hard-copy of this response will be mailed separately.

Sincerely,

Kayla Bowser
Capt
AEC Liaison Officer/C2SSO
CCISF/ESICC
ATESS/ESTTMA
Défense nationale | National Defence
8 Wing Trenton, Astra, ON K0K 3W0
TEL: 613 392-2811 Ext4834 (CSN: 827-4834)
FAX: 613 965-3200

Gouvernement du Canada | Government of Canada

Liverpool Wind Energy Storage Project Inc..pdf
8K

Trent MacDonald <tmacdonald@eonwind.com>

Interference Assessment - Liverpool Wind Farm

Grégoire, Martin <Martin.Gregoire@dfo-mpo.gc.ca> Thu, Dec 11, 2014 at 11:08 AM
To: Trent MacDonald <tmacdonald@eonwind.com>

Hello,

The proposed wind farm (Liverpool) is located 12 km away from the Western Head DGPS site.

Therefore no interference issues are anticipated.

Regards,

Martin Grégoire, P. Eng

Canadian Coast Guard

From: Trent MacDonald [mailto:tmacdonald@eonwind.com]
Sent: October 31, 2014 8:32 AM
To: XNCR, Windfarm Coordinator
Subject: Interference Assessment - Liverpool Wind Farm

Dear Sir or Madam,

[Quoted text hidden]

Transport Canada / Transports Canada

APPENDIX C TO CAR 621.19 - ANNEXE C RAC 621.19

AERONAUTICAL OBSTRUCTION CLEARANCE FORM / **FORMULAIRE D'AUTORISATION D'OBSTACLE AÉRIEN**

TC File No./Ref No. - TC n° du dossier/N° de réf.: 2014-246,249, 248 249

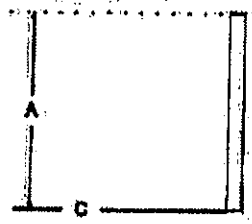
TO BE COMPLETED BY APPLICANT - À REMPLIR PAR LE REQUÉRANT

Operator's Name - Nom de l'opérateur: LIVERPOOL WIND ENERGY STORAGE PROJECT INC.		
Operator's Address - Adresse de l'opérateur: 300 PRINCE ALBERT RD. SUITE 200		
Operator's Contact - Agent de liaison de l'opérateur: TRENT MACDONALD		
Contact's Telephone No. - N° de téléphone de l'agent de liaison: 902-482-8687	Contact's FAX No. - N° de télécopieur de l'agent de liaison: 866-314-5319	Contact's Email Address - Adresse électronique de l'agent de liaison: tmacdonald@eonwind.com
Applicant's Name - Nom du requérant: SEE ABOVE	Address - Adresse	
City - Ville	Province/Territory - Province/Territoire	Postal - Code postal
Applicant's Telephone No. - N° de téléphone du requérant	Applicant's FAX No. - N° de télécopieur du requérant	Applicant's Email Address - Adresse électronique du requérant

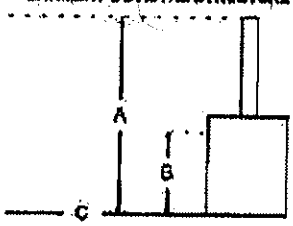
Nearest city / town to proposed facility - Ville la plus proche de la structure proposée: LIVERPOOL, NS

Geographic coordinates of structure - coordonnées géographiques de la structure: ° ' " N Latitude / Latitude N; ° ' " W Longitude / Longitude O; ☐ NAD27 ☐ NAD83 ☐ WGS84

TOWERS / ANTENNAS - TOURS / ANTENNES



BUILDING OR OTHER STRUCTURE - BÂTIMENT OU AUTRE STRUCTURE



		Feet - Pieds	Metres - Mètres
A	Height above ground - Hauteur au-dessus du sol	varies	
B	Building height - Hauteur du bâtiment	varies	
C	Ground elevation above sea level - Hauteur du sol au-dessus du niveau de la mer	varies	

List any tall adjacent buildings and structures which may shield this proposed structure (Attach sketch) - Faire une liste indiquant les structures et bâtiments avoisinants plus haut que le bâtiment projeté (inclure un diagramme)

New struc. - Nouv. struc.	Add. to exist. struc. (ref. total ht.) - Ajout à un bât. exis. (réf. hauteur totale)	Proposed Construction - Date - de construction proposée
☑ Yes Oui ☐ No Non		DECEMBER 1, 2014

TYPE OF STRUCTURE (narrative description and function) - GENRE DE STRUCTURE (description narrative et fonction):
WIND TURBINES & METEOROLOGICAL TOWER. SEE ATTACHED DOCUMENT FOR TURBINE DETAILS

Signature (of applicant) (du requérant) ▶ [signature] Date (Y/A-M-D/J): 2014/10/31.

TRANSPORT CANADA USE ONLY - À L'USAGE DE TRANSPORTS CANADA

AERONAUTICAL ASSESSMENT - ÉVALUATION AÉRONAUTIQUE

Site acceptable - Emplacement acceptable: ☑ Yes Oui ☐ No Non (if no, reason) (si non, pourquoi)

Lightning as per (TP312) required - Balisage lumineux tel que demandé au (TP312): ☑ Yes Oui ☐ No Non

Painting as per (TP312) required - Balisage peint tel que demandé au (TP312): ☑ Yes Oui ☐ No Non

Temporary lighting required - Nécessité d'un balisage lumineux temporaire: ☑ Yes Oui ☐ No Non (if yes, type) (si oui, de quel genre) Medium intensity white flashing.

Advise Transport Canada in writing 60 days before construction - Aviser Transports Canada par écrit 60 jours avant la construction ▶ ☐ when construction starts au commencement de la construction ☐ end of completion à la fin des travaux ☐ Valid to Valide jusqu'au

Civil Aviation Inspector (as required) - Inspecteur Aviation Civile (si nécessaire)
Comments - Commentaires: Only the turbines Need to be lighted, Not the met tower. Temp lighting reference! Standard 621 Para: 4.4.

Signature [signature] 2014-12-09 Date

Regional Manager Aerodrome Safety - Gestionnaire Régional Sécurité des aérodromes ▶ Signature [signature] Date (Y/A-M-D/J): 2014-12-09

26-0427 (2009-01)

Canada

February 25, 2015

Your file
Liverpool Wind Energy Storage Project 122 Liverpool
Our file
14-3672

Mr. Trent MacDonald
Eon WindElectric Inc.

RE: Wind Farm: 3 Wind Turbines and 1 Met Tower - Liverpool NS
Geo Centre (N44° 5' 17.275" W64° 42' 20.58" / 492.13' AGL / 804.11' AMSL)

Mr. MacDonald,

We have evaluated the captioned proposal and NAV CANADA has no objection to the project as submitted.

The nature and magnitude of electronic interference to NAV CANADA ground-based navigation aids, including RADAR, due to wind turbines depends on the location, configuration, number, and size of turbines; all turbines must be considered together for analysis. The interference of wind turbines to certain navigation aids is cumulative and while initial turbines may be approved, continued development may not always be possible.

In the interest of aviation safety, it is incumbent on NAV CANADA to maintain up-to-date aeronautical publications and issue NOTAM as required. To assist us in that end, we ask that you notify us at least 10 business days prior to the start of construction. This notification requirement can be satisfactorily met by returning completed, signed copy of the attached form(s) by e-mail at landuse@navcanada.ca or fax at 613-248-4094. In the event that you should decide not to proceed with this project or if the structure is dismantled, please advise us accordingly so that we may formally close the file.

If you have any questions, contact the Land Use Department by telephone at 1-866-577-0247 or e-mail at landuse@navcanada.ca.

NAV CANADA's land use evaluation is valid for a period of 12 months. Our assessment is limited to the impact of the proposed physical structure on the air navigation system and installations; it neither constitutes nor replaces any approvals or permits required by Transport Canada, Industry Canada, other Federal Government departments, Provincial or Municipal land use authorities or any other agency from which approval is required. Industry Canada addresses any spectrum management issues that may arise from your proposal and consults with NAV CANADA engineering as deemed necessary.

Yours truly,

David Legault
Manager, Data Collection
Aeronautical Information Services

cc ATLR - Atlantic Region, Transport Canada
CLQ2 - LIVERPOOL (QUEENS GEN HOSPITAL) (HELI)

Appendix C – Draft Environmental Protection Plan

Environmental Protection Plan

Liverpool Wind Farm

June 9, 2015

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Appendix A Site Plan
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1.0 Introduction

The Liverpool Wind Farm (Project; LWF) is proposed as a 4.7 megawatt (MW) wind energy installation four kilometres (km) northwest of Brooklyn in the Region of Queens Municipality. The site is located on Crown land between Nickerson's Pond and Highway 3 (Fishermen's Memorial Highway).

The general site plan can be found in Appendix A. Wetlands and watercourses have been identified in, or surrounding, the Project area. Wetlands have been delineated through field studies, and the Proponent has followed the approach of avoidance, mitigation, and/or compensation, if required. No watercourse alteration will occur at the Project site.

1.1 Environmental Protection Plan

This Environmental Protection Plan (EPP) describes protection measures that will limit the environmental effects associated with construction and operation of the Project. The EPP identifies Project mitigation measures to support Project planning, construction and operation.

The EPP is a guide for contractors, sub-contractors, and site personnel associated with the Project. It includes commitments made in the Nova Scotia Environmental Assessment (EA) Registration Document. The guide should be adhered to accordingly.

1.2 Objective

The purpose of the EPP is to provide guidelines and protocol regarding environmental protection measures relating to the Project. The EPP will also provide emergency information in the event of an incident on site. It is intended to direct the work completed by the contractors, sub-contractors and site personnel to ensure environmental protection.

1.3 Training

The Project Manager is responsible for ensuring that all personnel on site have a level of training that is commensurate with their responsibilities.

2.0 Erosion and Sediment Control

Construction and large scale earth-moving projects have the potential to speed up erosion when large areas of soil are exposed to rain and storm water runoff. The runoff must be properly handled to avoid siltation in nearby watercourses. The Proponent has committed to quarterly visual assessments of the site, as well as visual assessments following large storm events.

The Proponent and its contractors are responsible for erosion and sediment control specific to their activities within the Project site. This section details protocols and procedures for effective sediment and erosion control measures in accordance with the Erosion and Sediment Control Handbook for Construction Sites, 1988 (ESCH).

The Project footprint was delineated with input from the results of wetland identification and botanical surveys. No alteration to watercourses is expected; wetlands are avoided when feasible however, 60m^2 of wetland alteration is required and the Proponent will obtain Wetland Alteration Approval, if required, before any work commences. Control measures during wetland alteration periods will be in place prior to any construction activities in or around wetland areas.

The limits of work was designed in part to minimize potential of sedimentation of wetlands; however, as with an earth work activity, there remains some potential for sedimentation if erosion and sediment control measures are not well managed during or after heavy storm events. Hence erosion and sedimentation control is essential to this Project. Sediment and erosion control measures will be implemented during the construction of the LWESP.

2.1 Protocol

a) The Contractor must prepare a site specific Environmental Construction Plan and establish erosion and sediment control measures prior to construction activities to ensure the Project footprint is minimized and no sedimentation occurs.

b) Earth works should be avoided during heavy rainfalls or periods of high runoff. Where extreme events are forecast, the site shall be temporarily stabilized where possible.

c) The Contractor will avoid areas subject to flooding where possible, including defined wetlands as indicated on construction drawings and as marked in the field. The lay down areas must be selected to avoid natural drainage and preserve existing runoff channels, e.g., ditching. Any work in wetlands is clearly defined on the drawings and in this EPP; no work will occur without appropriate regulatory approvals.

d) Sedimentation fencing and vegetative filters (e.g., hay bales) will be installed as needed, i.e., down gradient of exposed soil areas. Detail on proper installation of such measures can be found in the ESCH, e.g., keying in of sedimentation fencing.

e) Extent and duration of exposed soil will be minimized as much as possible, i.e., expose the smallest feasible area and only areas that are being actively developed.

f) Care will be taken to minimize tracking of sediment from vehicles on the highway or main road from the access road. This area will be checked daily by the Contractor and swept as needed.

g) After grading is completed, the Contractor will stabilize exposed soils as soon as reasonably possible, including placing gravels and establishing permanent vegetation.

h) Sediment and erosion control measures will be monitored daily during active construction by the Project Manager or designate. Monitoring will continue post construction after excessive precipitation events until the site is stabilized.

3.0 Wetlands and Watercourses

It is imperative that all contractors and on-site personal understand the importance of avoiding wetlands unless their alteration has been identified in the construction package. Delineation of wetlands has been completed and alteration of 60m^2 has been identified as unavoidable by the Proponent. There will be a need to install one culvert as part of access road design.

The culvert installation will be done in accordance with NSE and NSDNR requirements and during the summer low flow period, and in compliance with the Nova Scotia Watercourse Alteration Specification (2006). Accordingly no effect on fish, or fish habitat, is expected from the Project.

As the Project avoids fresh water fish habitat and marine environments, the Department of Fisheries and Oceans (DFO) does not have a direct interest in this Project; however, should the Contractor not follow the site plan and this EPP and negatively impact fish or fish habitat, the Fisheries Act could be invoked by DFO. Accordingly, the Contractor must conduct on-site operations in a manner that causes minimal disturbance to receiving waters, e.g., no releases of heavily sediment laden water or hazardous materials, e.g., fuel.

Work will be completed in accordance with the Nova Scotia Wetland Conservation Policy, and appropriate approvals will be sought, if necessary, from NSE under the Activity Designation Regulations, including wetland compensation if required.

3.1 Protocol

a) No work will occur in watercourses. Work occurring in wetlands will only proceed after obtaining necessary approvals from NSE. This will be the responsibility of the Project Manager.

b) There is a need to upgrade the existing woods road and construct a new access road; this work will require one culvert and will be completed between June 1 and September 30 in accordance with NSE and NSDNR regulatory requirements. Work will be in compliance with the Nova Scotia Watercourse Alteration Specification (2006). NSDNR and NSE will be consulted as necessary throughout the construction process.

c) The Project Manager will define the limits of site work as it relates to wetlands by flagging boundaries and defining appropriate buffers. The Proponent will clearly define its limits of work to ensure maximum wetland alteration is 60m^2. All on-site personal will be informed of these sensitive areas as identified on mapping in Appendix A.

d) The disposal of any substance into a watercourse, directly or indirectly, is strictly prohibited during all phases of the Project.

e) Erosion and sediment control measures must be accurately followed to preserve the highest degree of water quality protection.

f) All refueling activities must take place with a 50m setback from all watercourses and wetland areas (see Section E for additional detail on hazardous materials).

g) All on-site equipment must be mechanically sound. No fuel or hydraulic leaks are permitted; accordingly, equipment must be inspected daily (see Section F for additional detail on equipment maintenance).

4.0 Wildlife

The Project Manager is responsible for ensuring all contractors and on-site personnel are provided with appropriate information and protocols in the event of a wildlife encounter and potential to encounter species at risk or of concern. Wildlife sightings should be reported to the Project Manager. All reasonable action will be taken to avoid disruption and injury to any wildlife encountered.

4.1 Protocol for Wildlife Encounters

a) Harassing wildlife in any manner is strictly prohibited on site.

b) There will be no interaction or feeding of wildlife on site.

c) To minimize the potential for attracting wildlife, all on-site personnel must use the garbage disposal units provided.

d) Equipment and vehicles will yield to wildlife.

e) Injured or deceased wildlife should be reported to the Project Manager who will then contact a Provincial Wildlife Officer to aid or remove the animal. Personnel are prohibited from making direct contact with the animal.

f) Any unlawful or accidental killing of wildlife must be reported to the Project Manager as soon as reasonably possible.

g) The possession or use of firearms on site is strictly prohibited.

4.2 Protocol for Nesting Birds

a) Site clearing is scheduled to take place before mid-April. No impact to nesting birds is expected to occur.

b) If nesting birds are encountered during construction, the Contractor will not disturb the nest. The sighting must be reported to the Project Manager immediately for direction.

c) If the Project Manager requires advice in avoiding the nest, a Regional Biologist at the NSDNR and the CWS may be contacted. The nest will not be disturbed until the fledglings have left the nest.

4.3 Monitoring for Bird and Bat Carcasses

a) As per the requirements of CWS and Environment Canada (EC), a follow up and monitoring plan has be developed for the site and will be implemented once approved by CWS and EC. This work will be in accordance with the two, 2007 guidance documents from EC: Wind Turbines and Birds: A Guidance Document for Environmental Assessment and Recommended Protocols for Monitoring Impacts of Wind Turbines on Birds. Results will be communicated in an annual report on January 15th on each year to NSE, CWS and EC.

b) The Project Manager will be notified of any bird or bat carcasses that are found on the site during regular maintenance checks, e.g., within the area of the turbine pad.

c) The Project Manager will log the discovery of a bird or bat carcass found during routine inspections. The information logged should include: species; date and time the carcass; state of decomposition; estimated number of days the bird has been deceased; and injury sustained (if identifiable). The Project Manager will contact CWS for advice on subsequent actions, such as potentially freezing the carcass to send to CWS. Any discovery outside of the formal carcass surveys will be included in the formal annual report.

4.4 Protecting Species at Risk and of Concern

a) Two separate rare plant surveys did not reveal any plant species at risk.

b) There is low-moderate potential for Wood Turtle to be present in the local area of the Project site. The Wood Turtle is a provincially and federally listed species, i.e., Threatened (Canada) & Threatened (NS) respectively.

    a. There is potential for Wood Turtles to nest in stream beds or in road shoulder, i.e., sandy/graveling substrate, during late May - early July. Accordingly the site personnel will be educated by the Project Manager on the potential presence of the Wood Turtle.

    b. NSDNR education materials will support this training.

    c. If any site personnel identify a Wood Turtle or the potential of a nest, the Project Manager will be notified immediately. The Project Manager will contact NSDNR with any questions and to share findings.

c) Surveys have been completed for Mainland Moose; no evidence was found of Mainland Moose in the local area based on the survey.

    a. Should the any personnel observe a Moose in the Project area or immediate environs of the Project, they will notify the Project Manager immediately. The Project Manager will notify DNR of these findings.

5.0 Hazardous Waste Management Including Spills

In the event of an accidental spill or hazardous waste incident, the primary concern is preventing the spill from entering a watercourse or wetland. Responding to the incident as quickly as possible will ensure a minimized risk of adverse environmental impact. At all times when hazardous materials are on-site, there must be operational personnel on site that are trained to handle, store, and dispose of hazardous materials.

5.1 Protocol

a) The Contractor and the Project Manager will adhere to the Notification of Contamination Protocol (2013) and Contaminated Sites Regulations (2012).

b) Spills or releases that are contained within the site will be the responsibility of the Project Manager; further assistance will be needed to respond to larger or more serious spills. See Appendix B for emergency contact table.

c) For a spill with an impacted area greater than $3m^2$, thickness of impact greater than 0.3m or volume of impact greater than $1m^3$, the Project Manager will notify Nova Scotia Environment (1-800-565-1633) and the Operator (902-755-2237).

d) If the spill has, or may enter, any watercourse or wetland, or the spill cannot be removed safely, the 24-hour spill reporting number (1-800-565-1633) will be called regardless of the estimated size of the spill.

e) The Contractor will be equipped with an emergency spill containment kit that will adequately control the loss of fuel or lubricant.

f) Only personnel with specific training in spill containment may attempt to respond to a release of a hazardous material.

g) A common method for controlling and containing spills is through the use of absorbents. Common materials used are: sand, dirt, gravel and wood chips. If used, the contaminated absorbent must be collected and placed in appropriate containers with proper labeling.

h) Fuel, fuel storage, lubrication and equipment maintenance will be done at a designated site away from watercourses or wetlands. The area must be on level terrain, and ideally have an impermeable surface and containment system. The area must not be within 50m of the ordinary high water mark of a body of water.

i) All dangerous goods must be transported in accordance with federal and provincial legislation.

j) All hazardous material must be stored in an approved container in accordance with federal and provincial legislation.

k) All hazardous materials must be disposed of at an approved facility in accordance with provincial and federal legislation.

l) Products must be properly labeled and handled only by trained on-site personnel.

m) A Material Safety Data Sheet (MSDS) will be kept on site to record all hazardous material inventory stored on site. The MSDS will be kept on file for emergency response teams in the event of a fire or explosion.

6.0 Use and Maintenance of Equipment and Vehicles

The Contractor is responsible for appropriate use and maintenance of equipment such that safety is considered at all times. Air emissions and noise will be minimized, as will be the potential for leaks and spills.

6.1 Protocol

a) All on-site personnel must comply with provincial and federal restrictions as it relates to transportation and vehicle management.

b) All drivers will obey local traffic laws, including speed limits, and practice safe, defensive driving.

c) The Project Manager will coordinate with the RCMP and Nova Scotia Transportation and Infrastructure Renewal (NSTIR) to ensure proper permitting and safe transport of wide or heavy loads.

d) All construction equipment and vehicles must be suitably clear or debris and cleaned / pressure washed if necessary before being brought to the site to reduce transport of invasive species.

e) Equipment must undergo routine maintenance to minimize noise impacts. See Section I, 3.0 for a discussion on noise.

7.0 Waste Management

Wastes created during construction of the Project are the responsibility of the Contractor completing the construction activities. In terms of operation, wastes again are responsibility of the party completing the activity, e.g., regularly scheduled turbine maintenance. Hazardous waste management was addressed in Section E.

7.1 Protocol

a) Recycle and re-use solid and liquid (e.g., fuel, oil, solvents) waste, where possible; dispose of all remaining waste as per provincial and federal guidelines.

b) Sewage and grey wastewater collected on site should be disposed of according to provincial standards.

c) Proper garbage disposal units must be provided on site. All litter and site waste should be collected daily and disposed of at an approved facility.

d) Burning any products is strictly prohibited.

e) Merchantable timber shall be cut into lengths for salvage at discretion of Contractor with non-merchantable timber chipped and disposed of according to provincial standards.

8.0 Contingency and Emergency Response

All reasonable precautions will be taken by the Project Manager and on-site personnel to avoid an accident or injury. In the event of an accident or injury, preparation and quick response is crucial in minimizing adverse effects to on-site personnel and the environment. This section outlines plans and protocols for reasonably conceivable emergencies that could take place on site. The Emergency Reponses Table is Appendix B with relevant contact information beyond calling 911.

8.1 Explosion or Fire

Explosion or fire may occur on site as a result of many different factors, some of which include: vehicle accidents, combustion of spilled material, negligent handling of flammable materials or vandalism.

The Project Manager is responsible for having appropriate firefighting equipment (i.e., fire extinguisher) on site and available to respond to minor fires, if it is safe to do so. There must personnel on site at all times that are trained to use this fire protective equipment, such as fire extinguishers.

In the event of a fire:

a) Contact 911 Emergency Services for assistance.

b) If the fire is minor and it is safe and feasible to do so, a trained member of staff may attempt to extinguish the fire. Only individuals trained in the proper use of fire extinguishers may attempt to extinguish the fire.

c) Personal protective equipment will be used by all responding personnel to ensure protection from the fire and other hazardous materials potentially emitted in the process.

d) The area will be carefully monitored to ensure the fire has been completely extinguished.

As a preventative measure against fire, smoking is allowed in designated smoking areas only as defined by the Project Manager. These areas must be greater than 50m away from all flammable or hazardous materials.

8.2 Personal Injury or Fatality

If an accident or fatality does occur on site, the following actions will be taken immediately:

a) All personal injuries and accidents will be responded to immediately. Appropriate first aid measures will be employed provided the measures will not further aggravate the victim.

b) Only individuals with current First Aid Certification will perform the first aid. The severity of the injury should be assessed; 911 Emergency Services will be contacted if additional medical attention is required.

c) In the event of a fatality, contact 911 immediately and respond as further directed.

d) In the event of injury or fatality, the Project Manager will be informed as soon as possible.

8.3 Discovery of Human Remains

In the event suspected human remains are encountered on site, the following action will be taken:

a) Cease all work related activities and secure the site to avoid further disturbance.

b) Contact 911 services for further assessment of the remains.

c) If it is determined that the remains are human, representatives of the Nova Scotia Department of Communities, Culture and Heritage will be contact as soon as reasonably possible. If the remains or artifacts discovered are potentially of Mi'kmaq significance, KMK will also be notified.

8.4 Cultural Artifacts

If a suspected cultural artifact is found:

a) The Project Manager will stop all work in the vicinity of the artifact and secure the site to avoid further disturbance.

b) The Department of Communities, Culture and Heritage and the KMK will be contacted for advice and further assessment as appropriate.

c) Should trace fossils be encountered, the Curator of Geology, Nova Scotia Museum will be notified.

8.5 Emergency Response Table

In the event of any emergency where police, fire, or ambulance is required for response as soon as possible, call 911. Otherwise, the emergency response table in Appendix B has additional contacts related to the Project.

9.0 Site Management

During the Project construction and operations phases, the Project Manager is responsible for appropriate site management. In addition to the various aspects of site management already addressed in the EPP, site access and signage, noise and light management, and monitoring are key to minimizing impact on the environment and human receptors, such as neighbors.

Associated requirements for community liaison and resolution in the event of complaints are addressed in Section J.

9.1 Site Access and Signage

a) Public access to the Project site is prohibited. "Restricted Access" signs will be posted at the entrance to the access road.

b) A gate will be installed at the entrance road to the Project site to prevent unauthorized site access.

c) Appropriate signs will be placed on site during operation indicating the danger of falling ice, e.g., ice throw potential from the turbine blades or flying debris.

d) As defined in Section J, signage will contain contact information of the Proponent.

e) Following an icing event, the following procedures will be followed:

   a. Two representatives from the service company will visit the site, remaining in their vehicle to assess the level of icing, and ice melt/throw from the blades.

   b. When the site has been deemed safe by the technicians, first a call to remote operations will be made to request a remote restart. If the control center cannot restart the turbines remotely, a manual restart will be done.

9.2 Noise

During construction, noise will be generated from vehicles and equipment and related activities. The closest residence is greater than 1000m from the Project site; therefore, it is anticipated that any inconvenience caused by construction will be a temporary, short term nuisance. Should any public annoyance result from construction of the Project, it is expected to be very low and will be mitigated via the Contractor measures as noted below and community liaison as per Section J of this EPP.

To mitigate construction noise, the following will be adhered to by the Contractor.

a) Ensure that all vehicles are maintained properly and have appropriate noise suppression equipment.

b) Where possible, use rubber tire equipment.

c) Reduce idling, where practical.

d) Minimizing noise by training of employees on management practices such as avoiding use of loud radios, shouting excessively, slamming of equipment doors, etc.

Blasting may be required as part of this work; however, it is still unknown as to whether blasting will occur. Prior to any blasting for road upgrades or other site works, the Approval Holder will conduct a pre-blast survey for water wells within 800m of the point of blast. The survey will be conducted in accordance with "Procedure for Conducting a Pre-Blast Survey" provided by NSE. Any water well impacts from the blasting will be corrected by the Approval Holder to the satisfaction of NSE.

If noise complaints are made by community residents, a complaint resolution procedure is followed. Where possible, the Project Manager will alter the construction planning to accommodate concerns (see Section J).

The Project will use commercially reasonable efforts to limit construction activities to the daytime. Should the Project Manager require work to be completed during nighttime hours, the Project Manager will use the community liaison protocols outlined in Section J.

During operation of the wind turbine, there will be turbine noises that may be audible in terms of low-level continuous or intermittent swooshing, as well as low level frequencies. While noise is expected to be at very low levels at these distances from the turbines (greater than 1000m from closest residence), it is important that neighbors are informed that some increase to baseline sound pressure level is expected though it is expected to be inaudible under most conditions. Further, the community has been provided with contact information to share any questions or concerns with the Proponent. Community consultation and complaint resolution is discussed in Section J.

While no follow up monitoring of noise is proposed for this Project, it may be an outcome of the complaint resolution procedure (Section J) if concerns exist.

9.3 Lighting

Lighting can impact birds as well as neighbors. Like noise, consultation and complaint resolution should address issues respecting lighting with neighbors (see Section J).

Primary aspects in lighting as applied to this Project are:

a) Lighting on the turbines is required to comply with aviation legislation (Transport Canada).

b) Preparation of a lighting plan in consultation with Canadian Wildlife Service and Transport Canada.

c) Proponent will review use of LED lighting that has a definite on/off setting as recommended by Environment Canada.

d) Any required lighting on ancillary buildings will be shielded to shine down.

9.4 Project Monitoring Requirements

a) During active construction, ongoing monitoring will occur by the Contractor. Primarily this will involve erosion, site stabilization, and equipment maintenance including checking for leaks. The Project Manager will perform intermittent inspection of the Contractor's activities respecting compliance with Contract documents including this EPP.

b) Operation and maintenance will be coordinated by the Project Manager. The staff and contractors will report issues to the Project Manager as identified in this EPP, including but not limited to destabilized surfaces (i.e., exposed soil), bird or bat carcass discovery, as well as vandalism and other issues.

c) Malfunctions and parts replacement will be assessed on an ongoing basis during operation and are subject to calendar maintenance and regular inspection schedules.

d) As defined in Section D, 4.0, ongoing inspections during maintenance visits will include a review of area around wind turbine pad for bird / bat carcasses with notification of the Project Manager if any are found. Post construction requirements as per CWS and the Department mandates will also be followed, including design, implementation and annual reporting of the bird and bat follow up program.

e) Given the scope of this Project, no noise monitoring is required; however, noise monitoring will be considered in the event of public complaints (see Section J).

10.0 Community Liaison

The Project Manager will ensure that the community is updated on project planning, construction activities and commissioning of the wind turbine. As this is a community energy project, liaison with the community is integral in the planning. This also ensures that any neighbours or other interested community members with questions or concerns will have Proponent contact information such that their questions or concerns can be promptly addressed.

In the event of public complaints, the Project Manager will ensure that the complaints are addressed via respectful communication, including joint fact finding, and review and implementation of mitigation measures as appropriate.

10.1 Communication and Notification

a) The Project Manager will provide advance notice to neighbours concerning construction and operational phases via mail outs. Information will include construction schedule, defined activities that are expected to create noise and their expected duration, mitigation measures that are being used and noise respite periods, i.e., quiet times. Expectations in terms of potential noise and lighting during operation of the turbine will also be conveyed in the information prior to commissioning.

b) A website is constructed for communication with stakeholders, including neighbours (http://wattswind.com). This will be updated with construction schedule and other announcements.

c) Site information signage will be present at gated entry to site with Proponent contact details for stakeholders to gather more information.

d) Both signage and mail outs will have Proponent contact information such that all comments or complaints will be forward to the Proponent contact for review. See Appendix B for contact information; this list will be updated as appropriate.

e) The Proponent contact information and copies of the Environmental Assessment should be made available via the Lake Echo Community Center and the Cole Harbour Public Library, as well as on the Department's website.

10.2 Complaint Resultion Protocol

a) Complaints or comments will be reviewed by the Project Manager or designate.

b) Within a maximum of one week from receiving the communication, the Project Manager or designate will provide an initial response to the question or concern.

c) Where a member of public expresses a concern, the Proponent will seek to better understand the perspective of the community member and the specifics of the complaint. The Proponent and community member will embark on joint fact finding to identify the source of the complaint and possible mitigative measures.

d) The Project Manager will review possible mitigations available in consultation with the Proponent management team. These options will be discussed openly with the community member.

e) Appropriate and reasonable action will be taken to mitigate impacts caused by the Project, including noise monitoring, landscaping, etc.

f) In the unlikely event that complaints cannot be resolved directly with the community member, the Proponent will seek review options in a form of alternate dispute resolution as defined under the *Nova Scotia Environment Act*, including but not limited to conciliation, negotiation, mediation or arbitration. It is expected that most if not all concerns can be addressed directly with the resident or other stakeholder.

Appendix A
Site Plan

Appendix B
Emergency and Project Contact Information

Organization	Contact Name/ Service	Address	Phone Number
Lake Echo and District Fire Department		3035 Highway 7, Lake Echo, NS B3E 1A6	1 (902) 829-3105
Halifax RCMP Detachment		1975 Gottingen Street, Halifax, NS B3J 2H1	1 (902) 490-6883
Poison Control	NS Poison Information Centre		1 (800) 565-8161
CANUTEC	Dangerous Goods Emergencies		1 (613) 996-6666 (collect) *666 (cellular)
Regional Spill Reporting Number	24 hour Emergency and Environmental Response		1 (800) 565-1633 or 1 (902) 426 –6030
Hospital	Dartmouth General Hospital	325 Pleasant St. Dartmouth, NS	1 (902) 465-8300
Nova Scotia Power Inc.	Report Power Interruption		1 (877) 428-6004
Watts Wind Energy Inc.	Stan Mason, President	4 MacDonald Avenue Dartmouth, NS	1 (902) 482-8687
Eon WindElectric Inc.	Paul Pynn, President	4 MacDonald Avenue Dartmouth, NS	1 (902) 482-8687
Eon WindElectric Inc.	Hilary Steele, Project Engineer-In-Training	4 MacDonald Avenue Dartmouth, NS	1 (902) 482-8687
Nova Scotia Department of Labor	Occupation Health & Safety Division		1 (800) 952-2687
Nova Scotia Department of Transportation & Public Works	24 Hour Service		1 (800) 670-4357
Kwilmu'kw Maw-klusuaqn Negotiation Office	Twila Gaudet	851 Willow Street, Truro, NS B2N 6N8	1 (902) 843-3880
Acadia First Nation – Medway River 11	Judy Boutlilier, Cultural Officer	5163 Highway #210 P.O. Box 639 Milton, NS B0T 1P0	1 (902) 685-2956
Department of Natural Resources		1701 Hollis St. Halifax, NS B3J 2T9	1 (902) 424-5935
Nova Scotia Environment	Glen Warner, District Manager	30 Damascus Road, Bedford NS B4A 0C1	1 (902) 424-3856

Appendix D – Letter of Authority

NOVA SCOTIA

Natural Resources
Regional Services Branch
Western Region

PO Box 6000
312 Green Street
Lunenburg, NS
B0J 2C0

Phone: (902) 634-7555
Fax: (902) 634-7577

LOA# 2887603

December 15, 2014

By Email: smason@wattswind.com

Liverpool Wind Energy Storage Project Inc.
Attn: Stan Mason, Vice President / Director
300 Prince Albert Road, Suite 200
Dartmouth, NS B2Y 4J2

Dear Mr. Mason:

The purpose of this letter is to provide Liverpool Wind Energy Storage Project Inc., its agents and independent contractors with authority, pursuant to the *Crown Lands Act*, to install one meteorological test tower on Crown land in the vicinity of Liverpool, Queens County, at the approximate location shown as "Proposed Test Tower Location" on the attached plan.

The authority provided is subject to the following terms and conditions:

1. This Letter of Authority permits entry, pursuant to the *Crown Lands Act*, on the Crown land at the approximate location shown as "Proposed Letter of Authority" on the attached plan, for the purpose of installing 1 meteorological test tower and to commence wind testing. Work shall be carried out in a sequential manner that will limit the impact on the surrounding forest. That is:

    a) Only cutting trees within a certain perimeter of the tower and beyond and at the highest elevation/sight line possible (mid-point or base of the tower), whichever is technically reasonable.

    b) No cutting shall occur beyond the immediate construction site until the tower and equipment is in place and only with the further written permission from the Department of Natural Resources.

    c) Licensees with Provincial wood volume commitments shall have first option to conduct any required and approved harvesting or to purchase any wood cut.

    d) Any clearing or grubbing required for the installation of the test tower or for road improvement shall not take place between May 1 and August 1.

    No further construction, structures or activities, other than those listed above shall be undertaken on the subject property.

2. This Letter of Authority shall be for the term of one year commencing December 1, 2014 and shall expire on December 30, 2015.

3. The Department of Natural Resources may terminate this Letter of Authority at any time, for any reason whatsoever by notifying the holder of this authority at its last known address.

4. Your Company must be properly registered at the Registry of Joint Stock Companies in Halifax, Nova Scotia (1-800-225-8227) and remain in good standing throughout the term of this Letter of Authority.

5. The test tower site shall not exceed one (1) hectare unless approved in writing by the Area Manager.

6. Entrance to the site shall be by way of an existing access road to be used in common with others. The Department of Natural Resources does not guarantee access. Use shall be at your own risk.

7. Should an extension to the existing access road be required, it must be constructed to the satisfaction of the Department of Natural Resources. A road specifications diagram would be provided for either class "C" or "D" construction. Kindly contact Patrick Murphy, Area Manager at (902) 634-7560 regarding any road extension requirements and for permission to commence any road construction and, upon completion, for inspection and approval.

8. Road maintenance/upgrading of the existing Crown road to the site shall be the responsibility of the holder of this authority. Any damage resulting from your use of the road shall be repaired, at the expense of the holder of this authority, to the satisfaction of the Department of Natural Resources.

9. The width of any necessary road cutting for either road construction or upgrading must also be determined in consultation with the Area Managers designate in Queens County, Mike Silver (District Supervisor) and approved in writing by the District Supervisor.

10. The Environmental Standards for the Construction of Forest Roads and Fire Ponds in Nova Scotia (1983/1985) must be followed. Formal approval must be obtained from the Nova Scotia Department of Environment and Labour prior to starting any work within 30 metres of a stream.

11. Should this Letter of Authority expire with no subsequent lease having been issued, or cancelled or earlier terminated, then the holder of this authority shall be responsible for removing of any structures or equipment and restoring the site to a condition satisfactory to the Department. This requirement shall survive the term of this Letter of Authority.

12. The holder of this authority shall not suffer or permit any waste or damage to the land and shall not cause or permit any nuisance to adjacent or nearby properties. The land

shall, at all times, be kept in a neat and tidy condition and free from garbage and other debris.

13. The holder of this authority shall comply with all laws including environmental, labour, industrial, and safety standards; including but not limited to the *Occupational Health and Safety Act*, the Construction Safety and Industrial Safety Regulations, and "The Forest Professional: A Code of Practice for the Stewards of Tomorrow's Forrest" made pursuant to the *Occupation Health and Safety Act*. The Area Manager may temporarily suspend the operations of the holder of this authority where the holder is not conducting an operation in conformance with this Letter of Authority or is causing damage to the Crown lands or resources thereon.

14. Commencement of work, including the testing, shall be at the Company's own risk.

15. The holder of this authority shall submit the tower site data to the Department of Natural Resources upon expiration, cancellation or termination of this Letter of Authority. The tower site data is to be forwarded to Department of Natural Resources, Land Administration Division, PO Box 698, Halifax, NS B3J 2T9 to the Attention of Cindy Steele, Manager of Acquisitions and Disposals. The data will be kept confidential for the period of five years, after which, it will be kept on file and be available to the public unless it is submitted by an applicant who has subsequently made application and been granted a wind energy generation lease, in which case the data will be kept confidential for the period of five years from the date of expiration, cancellation or termination of the wind energy generation lease.

16. The holder of this authority shall be responsible for obtaining any permits, approvals or services required to use the subject land for the purpose described herein clause one (1). The Department does not, by the fact of entering into this agreement, covenant that such permits, approvals or services will be issued by the Province of Nova Scotia or any other body.

17. The Minister of Natural Resources shall not be liable for any injury or damage (including death) to the person or for the loss of or damage to the property of the holder of this authority in any manner based upon, occasioned by or in any way attributable to the performance of any act under this Letter of Authority.

18. The subject land is considered to be Crown land free from any encumbrances. You may, however, wish to have the title certified by your solicitor. In any event, your signature on this Letter of Authority will be considered your agreement to release the Department of Natural Resources, her heirs, successors, agents and employees of and from all manner of actions, claims and demands relating to any title defect whatsoever.

19. The holder of this authority shall at all times indemnify and save harmless the Minister of Natural Resources from and against all claims, demands, losses, costs, debts, damages, actions, suits or other proceedings by whomever made, sustained, brought or prosecuted in any manner based upon, occasioned by, arising out of or attributable in any way to the performance or purported performance of the holder of this authority, its servants, agents or independent contractors.

20. The Department of Natural Resources shall not be responsible for costs incurred by the holder of this authority for any reason whatsoever.

21. The contractor installing the tower or your company must provide proof of a minimum Liability Insurance of $2,000,000.00 as well as a Letter of Good Standing from the Nova Scotia Workers Compensation Board before any work is commenced.

22. This Letter of Authority does not guarantee a long term lease will be issued.

To signify acceptance of the terms and conditions contained herein, please have this letter signed by the ***authorized signing agents*** in the spaces provided below, ***affix the Company's seal*** and return to the attention of Patrick Murphy, Area Manager, Lunenburg and Queens County, **within thirty days of receipt of this letter. This Letter of Authority will, otherwise, become null and void. No work shall commence until the signed Letter of Authority has been received by Mr. Murphy.**

Yours truly,

Patrick Murphy
Area Manager, Lunenburg and Queens Counties

c Cindy Steele, Manager, Acquisitions and Disposals
Mike Silver, District Supervisor
Dan Swim, Land Admin Co-ordinator

We, the authorized signing agents for Liverpool Wind Energy Storage Project Inc., have read, understand and agree to the above terms and conditions.

LIVERPOOL WIND ENERGY STORAGE PROJECT INC.

Date JAN 7 2015

Per: STAN MASON
Title: VICE PRESIDENT

Date JAN 7, 2015

Per: Russell MacKinlay
Title: Regional Director

Appendix E – Bird Species Reporting

Pre-construction survey of spring bird migration and breeding birds at the proposed Liverpool Wind Energy Project

Andrew G. Horn and Ron d'Entremont
for EON WindElectric Inc

Summary

As part of pre-construction assessment of a three-turbine wind farm proposed near Liverpool, Nova Scotia, a spring migration and breeding bird survey was undertaken. It consisted of 12 visits from 26 April to 13 July 2014 that included area searches, point counts (May and June), and searches for species at risk (June and July).

No obvious migrants and no federally listed species at risk were encountered. Several provincially sensitive species breed on the site, but overall (pending fall migration surveys), the results suggest the site has low sensitivity for impacts on birds.

Determining Site Sensitivity and Level of Concern

Background information

The site has an interesting mix of old growth spruce, hemlock and pine, combined with newer growth birch, maple, poplar and alder in areas that have been clearcut. The largest species variety can be found where the clearcut and old growth meet. Some clearcuts show more and varied growth because more time has elapsed since the clearcutting.

Pre-existing information on species found near the site (from sources suggested in EC 2007b) comes mainly from coverage by birders exploring the coast, 4 km or more from the site (Maybank 2005, http://ebird.org). Information at a closer range is available from the Maritimes Breeding Bird Atlas (http://www.mba-aom.ca), which lists four species at risk potentially breeding within the 10 X 10 km atlas square that contains the project area: Common Nighthawk, Olive-sided Flycatcher, Barn Swallow, Canada Warbler, and Bobolink. There is no suitable breeding habitat (open fields) for Bobolink on the site, but there is habitat that might conceivably be suitable for the other species, as well as for Chimney Swift, which has bred in three neighbouring atlas squares.

As for migrants, the present site is not on a ridge, cliff, shoreline, or other topographical feature that would concentrate migrating birds. The site is set back from the coast by 4km, and that portion of the coast itself is set back at least 3 km more from the main coastline (at Western Head, Liverpool to the south and East Berlin to the north). These features make it unlikely that the site lies on a heavily used migration corridor.

Because the site might have breeding habitat for several species of concern, it was initially treated as one of High Sensitivity. Combining that with the small size of the project (three turbines) yields a Level of Concern (from Table 3 of EC 2007b) of Category 2, which calls for "basic surveys spread over a one-year period".

Methods

For migration surveys, EC protocols (2007a) recommend near-weekly visits spread through the main migration period, and for breeding bird surveys, several visits during the main breeding period, with at least two of the latter visits including point counts and occurring at least 10 days apart. Thus the site was visited approximately every week from April 26 to June 8 (Table 1). The first two visits consisted of informal area searches during which the observer attempted to visit all the main habitats while keeping a list of all species encountered. The remaining eight visits consisted of point counts conducted between 0545 and 0900 from 10 stations placed approximately 250 m apart along the access road and including the three proposed turbine locations (habitats at each station listed in Table 2). Each point count lasted ten minutes and recorded all birds seen or heard within 50m, 100m, and > 100m of the observer. Breeding evidence was noted on all visits, using standard North American breeding bird atlas codes.

Three further visits in July focussed on species at risk. On July 3 and 12, points in and around the perimeter of the site that had suitable habitat were searched, specifically Olive-sided Flycatcher, Canada Warbler (both on July 3, using playback), Chimney Swift, Barn Swallow, and Rusty Blackbird (the latter three on July 12, using playback for Rusty Blackbird). On July 13, the site was visited from mid-afternoon to dusk, a period of warm conditions and abundant flying insects, to specifically search for Common Nighthawk.

Results

The species list is in Table 3. No migrants were detected that could be unambiguously distinguished from local breeding birds (specifically, none flocked with other species, were present in groups of five or more individuals, were well away from unsuitable breeding habitat, or flew in a single directed flight over the study site).

No federally listed species were found. Red Crossbills were found possibly breeding on the site, but recordings of their flight calls, sent to an expert for identification (Matt Young, Cornell University, Ithaca NY) confirmed that they were not of the federally Endangered subspecies *percna*, but rather of a type that is widespread and common in the region.

Nonetheless, the Red Crossbill has a provincial status of Yellow (Sensitive), and is one of several species with that ranking that were encountered (Table 3). The site lacks breeding site for two of them, Common Loon and Common Tern, which were encountered only once each, as single birds flying over or heard at a distance. The remaining four species, Gray Jay, Boreal Chickadee, Golden-crowned Kinglet, and Red Crossbill, breed in coniferous forests on or near the site.

Discussion

The spring migration surveys suggest the site does not concentrate migrants in the spring, and the breeding bird survey did not encounter any species at risk, despite intensive search. Four provincially sensitive species breed or might breed in the

coniferous forest on the site and may be displaced by clearing of that forest type. Two of these, Gray Jay and Boreal Chickadee, likely have only one territory each on the site. The other two, Golden-crowned Kinglet and Red Crossbill, are commoner on the site, with day totals of up to 15 individuals encountered at up to 5 point count stations (Table 3), although given the small size of the project any effect on their overall populations will be through the cumulative effects of multiple similar projects rather than this particular one. Such effects could be minimized by, as far as is practical, retaining the extent and continuity of mature coniferous forest in the area of the site.

Overall, these results suggest that the site has Low Sensitivity under the criteria of EC 2007b, pending the results of fall migration surveys.

References

Environment Canada, Canadian Wildlife Service (EC). 2007a. Recommended Protocols for Monitoring Impacts of Wind Turbines on Birds.

Environment Canada, Canadian Wildlife Service (EC). 2007b. Wind Turbines and Birds, A Guidance Document for Environmental Assessment.

Maybank, B. 2005. Birding Sites of Nova Scotia. Nimbus, Halifax (Nova Scotia).

Table 1. Search effort and weather conditions.

Date	Main method	Weather
April 26	Area search	Clear, light winds. +7
May 3	"	Clear, winds 15km/sw +8
May 8	Point counts	Partly cloudy +6, wind W 20km/h
May 14	"	Clear, +4, light winds
May 19	"	Rain, +10, Winds E 20km/h
May 25	"	Overcast, +7, Wind N 20km/h
May 31	"	Clear, +8, Light winds
June 8	"	Clear, +10, Light winds
June 28	Area search for species at risk	Clear, +11, Light winds.
July 3	"	Overcast, +15, Winds SW 30km/h
July 12	"	Clear, +10, Winds light.
July 13 (PM)	"	Sunny, +25, Winds NW 30 km/h

Table 2. Habitat at point count stations.

Point	Habitat
#1	Edge of clearcut. Old growth Spruce and Hemlock. Birch and Poplar with some Alder, Maple and a few Pines.
#2	Old growth Spruce, Hemlock with some Pine. Also Alder, Poplar and Birch.
#3	Edge of clearcut. Birch, Poplar, Alder with old growth Spruce and Hemlock nearby.
#4 (Turbine 1)	Near older clearcut. Mostly Spruce, Pine and Some Hemlock. Also Alder, Maple and Birch.
#5 (Turbine 2)	Tall old growth Spruce and Hemlock exclusively.
#6 (Turbine 3)	Mostly tall old growth Spruce, with a few Hemlock and Pine. Small water hole at site.
#7	Spruce, some Hemlock. Some Birch and a few Alder.
#8	Tall old growth Spruce predominantly.
#9	Mature Hemlock and Spruce. Some Birch and Alder.
#10	Swampy grasses with Poplar, Maple, Birch and Alder. Some Spruce nearby.

Table 3. Species list, with how often each species encountered, measured by number of visits, individuals per visit, and point counts per visit (medians; ranges in parentheses). Species in **bold** have a provincial status rank of Sensitive.

Species	Binomial	Visits	#/visit	Points /visit	Breeding evidence
Common Loon	*Gavia immer*	1	1	1	
Herring Gull	*Larus argentatus*	3	1	1	
Great Black-backed Gull	*Larus marinus*	1	1	1	
Common Tern	*Sterna hirundo*	1	1	1	
Barred Owl	*Strix varia*	2	1	1.5 (1, 2)	Confirmed (FY)
Belted Kingfisher	*Megaceryle alcyon*	1	1	1	
Downy Woodpecker	*Picoides pubescens*	2	1	1	
Hairy Woodpecker	*Picoides villosus*	5	1 (1, 5)	1 (1, 5)	Possible (H)
Northern Flicker	*Colaptes auratus*	3	1	1	
Eastern Wood-Pewee	*Contopus virens*	1	1	1	
Alder Flycatcher	*Empidonax alnorum*	1	3	3	
Blue-headed Vireo	*Vireo solitarius*	7	2 (1, 4)	2 (1, 4)	Possible (S)
Red-eyed Vireo	*Vireo olivaceus*	4	4 (3, 7)	3.5 (3, 6)	Probable (A)
Gray Jay	*Perisoreus canadensis*	1	4	1	
Blue Jay	*Cyanocitta cristata*	4	2.5 (1, 7)	2 (1, 3)	
American Crow	*Corvus brachyrhynchos*	2	1 (1, 1)	1 (1, 1)	
Common Raven	*Corvus corax*	1	1	1	
Black-capped Chickadee	*Poecile atricapillus*	7	5 (2, 9)	4 (1, 5)	Confirmed (CF)
Boreal Chickadee	*Poecile hudsonicus*	1	2	1	
Red-breasted Nuthatch	*Sitta canadensis*	7	3 (2, 5)	2 (1, 4)	Possible (H)
Winter Wren	*Troglodytes troglodytes*	5	2 (1, 3)	2 (1, 3)	
Golden-crowned Kinglet	*Regulus satrapa*	7	8 (2, 15)	4 (1, 5)	Confirmed (FY)
Swainson's Thrush	*Catharus ustulatus*	3	5 (3, 5)	4 (3, 5)	Confirmed (CF)
Hermit Thrush	*Catharus guttatus*	7	8 (6, 14)	6 (4, 7)	Possible (S)
American Robin	*Turdus migratorius*	6	2 (1, 7)	2 (1, 6)	Probable A)
Northern Parula	*Parula americana*	1	2	2	
Yellow Warbler	*Dendroica petechia*	1	1	1	
Chestnut-sided Warbler	*Dendroica pensylvanica*	2	1	1	
Magnolia Warbler	*Dendroica magnolia*	6	6 (3, 7)	4.5 (2, 5)	Possible (S)
Yellow-rumped Warbler	*Dendroica coronata*	7	3 (2, 9)	4 (2, 9)	Possible (S)
Black-throated Green Warbler	*Dendroica virens*	7	12 (5, 19)	6 (4, 10)	Possible (S)
Blackburnian Warbler	*Dendroica fusca*	5	2 (1, 4)	2 (1, 3)	Possible (S)
Palm Warbler	*Dendroica palmarum*	7	2.5 (2, 7)	2 (1, 4)	Possible (S)
Black-and-white Warbler	*Mniotilta varia*	6	3 (2, 5)	3 (3, 4)	Possible (S)
American Redstart	*Setophaga ruticilla*	2	1	1	

Species	Binomial	Visits	#/visit	Points /visit	Breeding evidence
Ovenbird	*Seiurus aurocapilla*	6	5 (2, 7)	4.5 (3, 6)	Possible (S)
Common Yellowthroat	*Geothlypis trichas*	6	4 (1, 8)	3 (1, 6)	Possible (S)
White-throated Sparrow	*Zonotrichia albicollis*	7	3 (1, 6)	3 (1, 4)	Possible (H)
Dark-eyed Junco	*Junco hyemalis*	7	6 (1, 7)	3 (1, 5)	Confirmed (FY)
Common Grackle	*Quiscalus quiscula*	1	1	1	
Purple Finch	*Carpodacus purpureus*	5	2 (1, 6)	1 (1, 4)	Possible (S)
Red Crossbill	*Loxia curvirostra*	6	4 (4, 14)	1 (1, 3)	Possible (H)
American Goldfinch	*Spinus tristis*	3	2 (2, 6)	1 (1, 4)	

Pre-construction survey of autumn bird migration at the proposed Liverpool Wind Energy Project

Andrew G. Horn and Ron d'Entremont
for EON WindElectric Inc

Summary

As part of pre-construction assessment of a three-turbine wind farm proposed near Liverpool, Nova Scotia, an autumn migration bird survey was undertaken. It consisted of 8 visits from 30 August to 20 July 2014 that included transects and passage migration watches. Migrants of several species passed through or stopped over at the site, but not in high numbers. Two species at risk, a group of five Barn Swallows and a Bicknell's Thrush, were detected passing over the site on one occasion each. Applying current guidelines on Site Sensitivity (EC 2007b), these results, together with the habitats at the site and its setting well away from the coast, suggest the site does not concentrate migrants or serve as an important stopover site, so its Site Sensitivity is Low.

Determining Site Sensitivity and Level of Concern

Background information

Much of this background information is repeated from the spring and summer report for this site (Horn and d'Entremont 2014), although here the emphasis is on migrants.

The site has mixed old growth spruce, hemlock, and pine, with younger birch, maple, poplar and alder in clearcuts. Species variety is highest where clearcut and old growth meet and in older clearcuts.

Pre-existing information on migratory species found near the site (from sources suggested in EC 2007b) comes mainly from coverage by birders exploring the coast, 4 km or more from the site (Maybank 2005, http://ebird.org). The present site is not on a ridge, cliff, shoreline, or other topographical feature that would concentrate migrating birds, and is set back from the coast by 4km. Even the closest coast is set back a further 3 km from the main coastline (at Western Head, Liverpool to the south and East Berlin to the north).

These features make it unlikely that the site lies on a heavily used migration corridor. Nonetheless, as a precautionary measure, it was initially treated as one of High Sensitivity. Combining that with the small size of the project (three turbines) yields a Level of Concern (from Table 3 of EC 2007b) of Category 2, which calls for "basic surveys spread over a one-year period".

Methods

For migration surveys, EC protocols (2007a) recommend near-weekly visits spread through the main migration period. Thus the site was visited 8 times between 30 August and 20 October (Table 1). On each visit, the observer (Ron d'Entremont) conducted area searches for four hours, covering a transect that followed the proposed access road and all habitat patches on the site, including the three proposed turbine locations. Four visits (Table 1) included a four-hour passage migration watch

from a point overlooking the site. All species and individuals encountered were listed, and for birds flying overhead, flight height and direction were also noted

Results

The species list is in Table 2. Two federally listed species were detected flying over the site: one group of five Barn Swallows sighted on 30 August, and a Bicknell's Thrush whose flight call was heard on 2 September. The several provincially yellow-listed species that were encountered (Table 2) were likely not migrants, because they showed no behavioural signs of being on migration (e.g., flying in a single directed flight over the study site) and were present during the breeding season (they are discussed in the spring and summer report, Horn and d'Entremont 2014).

No large flocks were seen, apart from one flock of 80 Double-crested Cormorants passing 500 m over the site on 24 September, and aggregations of 15-30 common resident seed-eaters (juncos, siskins, and goldfinches; Table 2) that are routine in the province at this time of year.

More notable were frequent detections of warblers or sparrows flying over the site in small groups (1-3 individuals) on 54 (warblers) and 13 (sparrows) occasions (Table 2), usually flying southwest (Table 2).

Discussion

The survey showed that migrants of several species pass through the site, although not in exceptionally high numbers for the province at this time of year. On two occasions, a species at risk was detected passing over the site, but this finding, too, is not exceptional, especially given the search effort involved (48 hours over 8 days; Table 1).

As with other coastal locations, the intensity of autumn songbird migration through Nova Scotia is highly variable in time and space. The factors that concentrate birds are only beginning to be understood though intensive methods, such as night flight call recordings, radar, and radio tracking (e.g., Woodworth et al. 2014). The factors as presented in EC 2007b, however, particularly the site's unexceptional habitats and its setting well away from the coast, suggest the site does not concentrate migrants or serve as an important stopover site, and the present results are consistent with that conclusion. Combined with the results of the spring and summer survey (Horn and d'Entremont 2014), the present results suggest that the site has Low Sensitivity under the criteria of EC 2007b.

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Table 1. Search effort and weather conditions. Visits with only transects were from 06:30 to 10:30; those with passage watches were from 06:30 to 14:30.

Date	Main method	Weather
30 Aug	Transect, passage watch	Clear, light wind
2 Sep	Transect, passage watch	Showers, light wind, 15 °C
9 Sep	Transect, passage watch	A few clouds, NE wind 10 km/h, 12 °C
15 Sep	Transect	Clear, light wind, 10 °C
24 Sep	Transect, passage watch	Clear, N wind 15km, 8 °C
6 Oct	Transect	Clear, light wind, 10 °C
11 Oct	Transect	Partly cloudy, light wind, 10 °C
20 Oct	Transect	Partly cloudy, NW wind 30 km/h, 6 °C

Table 2. Species detected, number of detections, the number detected per day (when they were detected; i.e., 0's excluded) and flight behaviour where applicable. Provincially sensitive species bold, federally listed species starred.

Species	Binomial	Records	Fly-overs	Median birds/day	Median height (m)	Bearing	
						SW	Other
Common Loon	Gavia immer	5	5	1 (1-2)	100 (75-300)	1	4
Double-crested Cormorant	Phalacrocorax auritus	1	1	80	500	1	0
Sharp-shinned Hawk	Accipiter striatus	3	3	1 (1-2)	100 (75-150)	2	1
Broad-winged Hawk	Buteo platypterus	2	2	1 (1-1)	125 (100-150)	2	0
Red-tailed Hawk	Buteo jamaicensis	1	1	1	25	0	1
American Kestrel	Falco sparverius	1	1	1	25	1	0
Merlin	Falco columbarius	1	1	1	25	0	1
Least Sandpiper	Calidris minutilla	1	1	5	50	0	1
Herring Gull	Larus argentatus	3	3	1 (1-2)	50 (50-50)	0	3
Mourning Dove	Zenaida macroura	2	0	2 (2-2)			
Great Horned Owl	Bubo virginianus	1	0	1			
Barred Owl	Strix varia	1	0	1			
Downy Woodpecker	Picoides pubescens	1	0	1			
Hairy Woodpecker	Picoides villosus	4	0	1 (1-2)			
Northern Flicker	Colaptes auratus	4	1	1 (1-2)	25 (25-25)	0	1
Woodpecker sp.		1	0	1			
Blue-headed Vireo	Vireo solitarius	4	0	1.5 (1-3)			
Red-eyed Vireo	Vireo olivaceus	2	0	2 (1-3)			
Gray Jay	Perisoreus canadensis	2	0	2 (2-2)			
Blue Jay	Cyanocitta cristata	9	1	6 (3-18)	25 (25-25)	1	0
American Crow	Corvus brachyrhynchos	6	4	1.5 (1-2)	37.5 (20-150)	0	4
Common Raven	Corvus corax	8	7	1 (1-3)	50 (25-100)	1	6
Barn Swallow*	Hirundo rustica	1	1	5	50	0	1
Black-capped Chickadee	Poecile atricapillus	8	0	7.5 (5-14)			
Red-breasted Nuthatch	Sitta canadensis	7	0	2 (2-5)			
Golden-crowned Kinglet	Regulus satrapa	6	0	6 (4-11)			
Ruby-crowned Kinglet	Regulus calendula	1	0	1			
Swainson's Thrush	Catharus ustulatus	3	0	1			
Bicknell's Thrush*	Catharus bicknellii	1	0	1			
Hermit Thrush	Catharus guttatus	6	0	1.5 (1-3)			
American Robin	Turdus migratorius	3	0	2 (2-3)			
Cedar Waxwing	Bombycilla cedrorum	5	3	1 (1-4)	25 (20-25)	0	3
Nashville Warbler	Vermivora ruficapilla	1	0	1			
Magnolia Warbler	Dendroica magnolia	3	0	1 (1-2)			
Black-throated Blue Warbler	Dendroica caerulescens	1	0	2			
Yellow-rumped Warbler	Dendroica coronata	6	0	3.5 (1-5)			
Black-throated Green Warbler	Dendroica virens	4	0	2 (1-5)			
Blackburnian Warbler	Dendroica fusca	1	0	1			
Palm Warbler	Dendroica palmarum	8	5	2 (1-10)	50 (10-75)	4	1
Blackpoll Warbler	Dendroica striata	3	0	1 (1-6)			
Black-and-white Warbler	Mniotilta varia	1	0	1			
Ovenbird	Seiurus aurocapilla	1	0	1			
Common Yellowthroat	Geothlypis trichas	3	0	1			
Warbler sp.		49	49	1 (1-4)	50 (10-150)	31	18
Song Sparrow	Melospiza melodia	2	0	1 (1-1)			
White-throated Sparrow	Zonotrichia albicollis	4	0	1 (1-2)			
Dark-eyed Junco	Junco hyemalis	8	0	8.5 (2-25)			
Sparrow sp.		13	13	1 (1-3)	100 (25-150)	12	1
Common Grackle	Quiscalus quiscula	1	0	1			
Red Crossbill	Loxia curvirostra	3	1	4 (2-4)	25 (25-25)	0	1
Pine Siskin	Spinus pinus	3	3	30 (5-30)	25 (25-25)	1	2
American Goldfinch	Spinus tristis	13	11	4 (2-15)	50 (25-100)	8	3

Appendix F – Bat Inventory Reporting

Characterization of the magnitude of bat activity at the proposed Brooklyn Wind Energy Project, Queens County, NS

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Context

Project Background

EON WindElectric is proposing to install three wind turbines to generate 3.6 megawatts (MW) of electricity near the community of Brooklyn, Queens County, Nova Scotia. The project is in an early phase with no infrastructure installed at the time of survey efforts.

Commercial scale wind energy production is one of the fastest growing sectors of the global energy industry as the demand for renewable energy sources for electricity generation continues to increase (Nelson 2009). This demand, combined with recent advances in wind turbine technology that have improved the cost-competitiveness of wind energy, has led to a global increase in the number of wind energy installations. In Canada, energy production and regulation falls under provincial jurisdiction and thus most renewable energy targets are set at the provincial level. In the province's Renewable Electricity Plan, the Provincial Government of Nova Scotia has set an aggressive target of 40% of the province's electricity needs to be met by renewable energy by the year 2020 (Nova Scotia Department of Energy 2010). Of this amount, 25% has been set as coming from made-in-Nova Scotia sources by 2015, and the wind energy sector is anticipated to be the largest contributor in meeting these goals. As of 2014, Nova Scotia power estimates that close to 10% of current electricity needs are met by wind energy (NSP 2014). The Brooklyn project is part of the Community Feed-In Tariff program (COMFIT) of the Renewable Electricity Plan which facilitates small-scale, local renewable projects that involve community groups.

Despite the many environmental benefits of electrical generation via wind energy, the rapid global growth of the wind energy sector has raised concerns regarding the impacts of these developments on both resident and migratory populations of wildlife (Arnett et al. 2008b). Large numbers of bat fatalities have occurred at wind energy facilities (Johnson 2005a) and this is gaining considerable global attention. As a result, fatalities of bats have become a primary environmental concern associated with wind energy development.

Efforts to minimize conflicts between wildlife and wind energy have focused mainly on two areas: risk avoidance and impact mitigation (Weller and Baldwin 2012). Impact mitigation refers to those efforts focused on developing methods to reduce wildlife fatalities at operational wind facilities and does not apply to this project at this time. Risk avoidance involves conducting surveys prior to construction to avoid sites, or areas within sites, with high levels of usage by wildlife. The assumption of this approach is that low indices of activity prior to construction should result in low fatality rates post-construction since there should be fewer animals 'available' to be killed. This further assumes that bats are not attracted to the infrastructure once built (Baerwald and Barclay 2009). As the planning phase proceeds for the development of the project, surveys of the wildlife at the proposed site are being undertaken to address any potential wildlife issues related to the development of the site. This document provides a summary of the echolocation survey undertaken for bats at the Brooklyn Wind Energy Project in 2014.

Regulatory Context

The following legislation and policy were considered in relation to the proposed survey at the Brooklyn Wind Energy Project:

- Federal Species at Risk Act (http://laws-lois.justice.gc.ca/eng/acts/S-15.3/page-1.html)
- Nova Scotia *Wildlife Act* (http://nslegislature.ca/legc/statutes/wildlife.pdf)
- Nova Scotia *Endangered Species Act* (http://www.novascotia.ca/legislature/legc/statutes/endspec.htm)

Additional resources that are relevant to the proposed surveys used include:

- Atlantic Canada Conservation Data Centre (http://www.accdc.com/)
- Wild Species: The General Status of Species in Canada (http://www.wildspecies.ca/home.cfm?lang=e)
- Global Species Rankings (http://www.natureserve.org/explorer/)

Study Objectives

The objectives of this project were to:

(1) Provide information on the occurrence and relative magnitude of bat activity in the proposed development area, based on analysis of echolocation survey results;

(2) Provide relevant information on the resource requirements of local bat species that may be useful for the decision-making process on the proposed development; and

(3) Make relevant recommendations based on the results of this project and recent developments in the field of bats and wind energy.

Review of Key Issues

Background

As of July (2014) in Nova Scotia, there are >150 wind turbines in operation with a total capacity of approximately 335 MW (CanWEA 2014). As of yet, we are not aware of any incidents of major mortality, though bats have been killed. For context and qualification, most of these turbines have been in operation for only a short period of time (months to less than 10 years) and it is not known how thoroughly all existing operational turbines have been surveyed for bat fatalities, or how well documented and reported the findings are. In the following sections we discuss the various means by which bats may be impacted by wind energy developments, including direct mortality, changes to habitat availability, and disruption of movement patterns (e.g., foraging, mating, migrations, or abandonment of sites).

Direct Mortality

Proximate causes of bat fatalities at wind energy developments may be due to direct strike by rotating turbine blades, collision with turbine towers, barotrauma or any combination of the three. Barotrauma involves tissue damage to the lungs due to rapid or excessive air-pressure reduction near moving turbines blades (Baerwald et al. 2008, Cryan and Barclay 2009). The discussion of the relative role of barotrauma in the death of bats at wind energy developments remains on-going (Grodsky et al. 2011, Capparella et al. 2012, Rollins et al. 2012). In North America, significant bat fatality events at wind energy developments occur primarily in the late summer and early fall, peaking during the period that coincides with fall migration (Johnson 2005b, Cryan and Brown 2007, Arnett et al. 2008a). These trends have led researchers to believe that migration plays a key role in the susceptibility of certain bat species to wind turbine fatalities (Cryan and Barclay 2009). Although some fatality has also been documented during the spring (Brown and Hamilton 2006, Arnett et al. 2008a), numbers are much lower, and are thought to be a result of more scattered migratory behaviour, or possibly the use of different routes compared to fall migration.

The species that have the largest number of kills at wind farms are the long-distance migratory bats, including the hoary bat (*Lasiurus cinereus*), the eastern red bat (*L. borealis*), and the silver-haired bat (*Lasionycteris noctivagans*). In North America, these species make up about 75-80% of the documented fatalities at wind energy developments, with the hoary bat alone comprising almost half (Kunz et al. 2007, Arnett et al. 2008a). The cumulative impacts of current mortality rates as a result of wind turbines on these affected species could have long-term population effects (Kunz et al. 2007). With mortalities at wind turbines in Europe from a large catchment area, including resident and migrating individuals, (Voigt et al. 2012, Lehnert et al. 2014), these effects could be having large scale impacts on these species. Bat fatalities in North America have also been reported for resident hibernating bat species, including the big brown bat (*Eptesicus fuscus*), the little brown bat (*Myotis lucifugus*), the northern long-eared bat (*M. septentrionalis*), and the tri-colored bat (*Perimyotis subflavus*) (Nicholson 2003, Johnson 2005b, Jain et al. 2007, Arnett et al. 2008a). At some sites in the eastern United States high numbers of fatalities of these resident, hibernating species have been reported (Kunz et al. 2007).

Various explanations for the high incidence of bat fatalities at wind energy developments have been proposed (Johnson 2005b, Kunz et al. 2007, Arnett et al. 2008a, Cryan and Barclay 2009). Estimates of the number of bat fatalities vary widely from less than 3 bats/turbine/year (Johnson et al. 2003, Johnson et al. 2004) to upwards of 50 bats/turbine/year (Nicholson 2003, Kerns et al. 2005, Jain et al. 2007). Given the considerable variability in species composition and rates of bat fatalities among wind energy facilities, it is likely that location-specific qualities of individual facilities are important (e.g., located along migration routes or other flight corridors). It has also been proposed that the use of turbines with increasing height has extended developments further into the flight space used by migrating bats (Barclay et al. 2007). However, behavioural observations of bats around wind turbines shows flight patterns typical of foraging activity prior to collisions with turbines which may put bats at increased risk for collisions or interactions (Horn et al. 2008). Recent work has demonstrated that many bats are actively foraging during migration (Reimer et al. 2010, Valdez and Cryan 2013). Others have hypothesized that collisions may result from bats being attracted to turbines out of curiosity, misperception (failure to avoid a detected obstacle or interference with perception of an obstacle), or as potential feeding, roosting, and mating opportunities (reviewed in Cryan and Barclay 2009). New work

using thermal imaging cameras found bats closely approached turbine structures (monopoles, nacelles and turbine) as well as made flight loops, dives, and hovering behaviours , and chased other bats around structures (Cryan et al. 2014). The authors suggest that bats are attracted to these structures, perhaps to roost, forage around or seek mates, but to date, the cause(s) of bat fatalities at turbines remains unclear and is an active area of research.

As mortalities may be the result of site-specific and design-specific characteristics and conditions, it is important to conduct site-specific monitoring studies to make reliable inferences on the potential impacts of a wind energy development on local bat populations (American Society of Mammalogists 2008).

Habitat Availability

In forested landscapes, habitat availability for bats may be impacted by the alteration or removal of vegetation to accommodate roads and wind turbine installations. This may include the direct loss of resources (e.g., roost trees), fragmentation of habitat components (e.g., foraging and roosting areas), or other disturbance that may cause bats to vacate certain areas. Together these can act to degrade the local environment for bat colonies/populations that reside in the area during the summer. This negative impact of new wind energy developments is likely to occur, and will contribute to the cumulative effect of habitat loss that is occurring throughout the range of most bat species (Altringham 2011).

At the site level, small-scale clearings in forested landscapes have been shown to attract certain bat species, which use these areas for foraging (Grindal and Brigham 1998, Hayes and Loeb 2007). Removal of vegetation can create edges and small clearings which can act to concentrate prey for bats. The extent to which this loss of vegetation can be perceived to be beneficial to bats is not known. Further, the extent of fragmentation varies from site to site, as there must be a balance between the availability of suitable roosting resources with the availability of suitable foraging areas within commuting distance to provide conditions that favour the occupancy of resident bat species (Henderson and Broders 2008). Differential effects of forest fragmentation are known for different species of a bat community (Patriquin and Barclay 2003, Segers and Broders 2014) thus necessitating the need for bat species considerations in managements plans, not just broad level management plans for bat communities.

Movement Patterns

From the perspective of bat movement, resident bats may be affected by wind energy developments through alterations to foraging areas and possible disruption of commuting movements between roosting and foraging areas. There is some genetic evidence to suggest that bat movements can be impeded by fragmentation of habitat, which can scale up to population or distributional level effects (Kerth and Petit 2005, Meyer et al. 2009). However, this is not well understood for most species.

Little is known about the dynamics of movement (e.g., altitude, travel routes, frequency of visitation) of resident, hibernating bats to and from hibernation sites. Anecdotal evidence suggests that bats likely use ridges and other linear landscape elements (e.g., riparian corridors) as travel routes, depending on

the landscape (Arnett 2005, Lausen 2007, Furmankiewicz and Kucharska 2009). In the late summer and early autumn large numbers of bats congregate at the entrances to underground hibernacula in an activity referred to as 'swarming' (Davis and Hitchcock 1965, Fenton 1969, Thomas and Fenton 1979, Glover and Altringham 2008). During the swarming period bats do not roost in hibernacula; research being conducted in Nova Scotia indicates that resident bats are 'on the move', roosting transiently on the landscape (Lowe 2012), though we do not have a full understanding of the dynamics of these behaviours. Swarming may serve several functions, including courtship, copulation, and orienting young-of-the-year to over-wintering sites (Fenton 1969, Thomas and Fenton 1979).

Movement data from Ontario and Manitoba suggests that resident bats may move up to at least 120 km between hibernacula within a year, and up to at least 500 km between years (Fenton 1969, Norquay et al. 2013). In New England, there are records of bats moving 214 km between hibernacula within one year, with one female moving 128 km in only three nights during spring emergence from hibernation (Davis and Hitchcock 1965). Thus these resident hibernating species are at least capable of large scale migratory movements on the order of hundreds of kilometers. It is not known whether flight behaviour (e.g., height, routes, etc.) during this time differs from when resident species are in their summering area; the paucity of information on this aspect of their biology would appear to be one of the largest impediments in accurately predicting the impact of wind energy developments on local bat populations (Weller et al. 2009).

Bats in Nova Scotia

Nova Scotia Bat species

In Nova Scotia there are occurrence records for six species of bats (Table 1; van Zyll de Jong 1985, Broders et al. 2003, Segers et al. 2013), and each have been documented to have experienced fatalities at wind turbine sites (Arnett et al. 2008a). There are three species of long-distance migratory bats recorded in the province, the hoary bat, the eastern red bat, and the silver-haired bat. These three species have extensive distributional ranges throughout North America, with Nova Scotia at or near their northern range limit (van Zyll de Jong 1985). Low numbers of echolocation recordings of the long-distance migratory species in Nova Scotia by Broders (2003), other unpublished work, and recent compilation of sighting records (Lucas and Hebda 2011) suggests that there are no significant populations or large scale migratory movements of these species in the province. However, they do occur regularly and are often associated with coastal or off-shore autumn occurrences (Cryan and Brown 2007, Czenze et al. 2011, Segers et al. 2013). Two species of bats in the genus *Myotis*, the little brown bat and the northern long-eared bat, were the only abundant and widely distributed bats in Nova Scotia (Broders et al. 2003, Henderson et al. 2009). These 5–8 g insectivorous bats are sympatric over much of their range (Fenton and Barclay 1980, van Zyll de Jong 1985, Caceres and Barclay 2000). A third species, the tri-coloured bat, had a significant population in the province, however they were likely restricted to southwest Nova Scotia (Broders et al. 2003, Rockwell 2005, Farrow and Broders 2011). These three species are gregarious that over-winter in caves and abandoned mines in the region (Moseley 2007, Randall and Broders 2014). There is only one unconfirmed observation of the big brown bat, also a gregarious species, hibernating at a cave in central mainland Nova Scotia (Taylor 1997).

Ecology of Resident Species

Northern long-eared, little brown and tri-coloured bats are expected to be the most likely species to occupy the proposed development area. The life history of these species is typical for temperate, insectivorous bats. Their annual cycle consists of a period of activity (reproduction) in the summer, and a hibernation period in the winter. Females of the three species appear to bear the full cost of reproduction in the summer, from pregnancy to providing sole parental care to juveniles (Barclay 1991, Hamilton and Barclay 1994, Broders 2003).

The northern long-eared bat is a forest interior species that primarily roosts and forages in the interior of forests (Broders 2003, Jung et al. 2004, Henderson and Broders 2008). Females form maternity colonies, roosting in coniferous or deciduous trees, depending on availability (Foster and Kurta 1999, Broders et al. 2006, Garroway and Broders 2008). Males typically roost solitarily in either deciduous or coniferous trees (Lacki and Schwierjohann 2001, Jung et al. 2004, Ford et al. 2006). The little brown bat is a generalist species that is associated with forests and human-dominated environments (Barclay 1982, Jung et al. 1999). This species has been found to forage over water and in forests (Anthony and Kunz 1977, Fenton and Barclay 1980), and both males and females (i.e., maternity colonies) have been documented roosting in both buildings and trees (Crampton and Barclay 1998, Broders and Forbes 2004). During the summer, it appears that most of the commuting and foraging activity of northern long-eared and little brown bats occurs close to the ground (Broders 2003). Nonetheless, our ability to survey bat activity at high altitudes is extremely limited, and therefore our ability to make inference on the vertical distribution of bats is also limited.

The third species that occurs year-round in Nova Scotia is the tri-colored bat. This species is known primarily from southwest Nova Scotia where this represents the northern limit of the species range in North America (Broders et al. 2003, Farrow and Broders 2011, Naughton 2012). Work that we have done in Kejimkujik National Park suggests that this species roosts in clumps of *Usnea* lichen species, typically in spruce trees where females show fidelity to small roosting areas within and among years as found in other areas (Veilleux and Veilleux 2004, Poissant et al. 2010). Tri-coloured bats typically forage over water along forested riparian areas or forested edges (Fujita and Kunz 1984).

White Nose Syndrome

In 2012, three species of bats found in Nova Scotia were listed by COSEWIC as Endangered, and in 2013 were listed as Endangered by the Province of Nova Scotia. This is primarily due to the spread of an emerging infectious disease known as White Nose Syndrome (WNS) that is responsible for unprecedented mortality in hibernating bats through much of eastern North America (Blehert et al. 2009, United States Fish & Wildlife Service 2012). The condition is caused by *Pseudogymnoascus destructans* (formerly *Geomyces destructans)*, a cold-loving fungus that thrives in cave conditions and as such, impacts bat population directly during the winter hibernation period (Lorch et al. 2011, Blehert 2012, Minnis and Lindner 2013). It is thought to disrupt patterns of torpor which results in death by starvation or dehydration (Cryan et al. 2010, Reeder et al. 2012, Warnecke et al. 2013). First documented in New York State in 2006 (Blehert et al. 2009), WNS spread rapidly to 22 states and five Canadian provinces by 2013 and is thought to be responsible for the death of more than 5.5 million bats (United States Fish & Wildlife Service 2012). White Nose Syndrome has been confirmed among populations of seven species of bats. The little brown bat, the most abundant species in the region currently affected by WNS, has experienced the most dramatic population declines (Frick et al. 2010). Some hibernacula have seen mortality rates of 90 to 100 percent of resident hibernating bats as a result of infection with WNS (United States Fish & Wildlife Service 2012), leading researchers to believe that WNS could lead to local extinctions of the little brown bat, as well as other species (Frick et al. 2010).

White Nose Syndrome was first documented in Nova Scotia in April 2011 and declines of 80 % to 100 % have since been recorded in winter populations (Broders and Burns, unpublished data). A similar magnitude of decline in summer activity was also observed from 2012 to 2013, following the first full winter WNS was documented in the province (Segers and Broders 2014). Therefore, it would be prudent to protect any surviving animals that may be genetically predisposed to surviving the infection. Even prior to WNS, bats were increasingly recognized as a conservation priority in North America. Now, in consideration of the sharp declines and rapid spread of WNS, serious concerns have been raised about the impact of WNS on the population viability of affected bat species, consequently impacting the conservation status of bat species at the local, national and global level (Table 1). Given that hibernacula represent one of the more critical resources for bats, as they allow successful over-wintering, they are important to protect.

Proximity to Hibernacula

The Nova Scotia Proponent's Guide to Wind Power Projects (Nova Scotia Environment 2012) states that wind farm sites within 25 km of a known bat hibernacula have a 'very high' site sensitivity. There are no known hibernacula within 25 km of the Brooklyn Wind Energy Project area (Moseley 2007, Randall and Broders 2014). The nearest known bat hibernaculum, Vault Cave, was a site with high autumn swarming activity pre-WNS (Randall 2011) in the Annapolis Valley. It is located approximately 106 km from the proposed development area.

Table 1. Over-wintering strategy and conservation status of bat species recorded in Nova Scotia.

Species	Overwintering Strategy	Global Ranking[1]	COSEWIC Status	ACCDC status[3]	NSESA[4]
Little brown bat	Resident hibernator	G3	Endangered[2]	S1	Endangered
Northern long-eared bat	Resident hibernator	G2G3	Endangered[2]	S1	Endangered
Tri-coloured bat	Resident hibernator	G3	Endangered[2]	S1	Endangered
Big brown bat	Resident hibernator	G5	Not assessed	N/A	Not listed
Hoary bat	Migratory	G5	Not assessed	S1	Not listed
Silver-haired bat	Migratory	G5	Not assessed	S1	Not listed
Eastern red bat	Migratory	G5	Not assessed	S1	Not listed

[1] Global Ranking based on the NatureServe Explorer: G1 = Critically Imperiled, G2 = Imperiled, G3 = Vulnerable, G4 = Apparently Secure, G5 = Secure. All the above species were reassessed in July 2012.

[2] Assessed by COSEWIC and designated in an emergency assessment on February 3, 2012.

[3] Atlantic Canada Conservation Data Centre ranking, based on occurrence records from NB and NS: S1 = Extremely rare: May be especially vulnerable to extirpation (typically five or fewer occurrences or very few individuals).

[4] Listing status under the Nova Scotia Endangered Species Act: Endangered = a species facing imminent extirpation or extinction; species were reassessed in July 2013.

Methods

Study Area

The project area is located near the communities of Brooklyn and the former town of Liverpool (population approximately of 2 600) in Queens County. This area is on the fringe of the Mersey Meadows Lake Rossignol district of the Atlantic Interior Theme Region (Davis and Browne 1996). As such it is also on the fringes of the Rossignol Ecodistrict of the Southwest Nova Scotia Uplands Ecoregion (Webb and Marshall 1999). This Ecodistrict is highly productive encompassing one of the areas in the province with the greatest number of growing-degree days. It supports a mix of softwood, hardwood and mixedwood forests with hardwood or mixedwood dominating the in eastern portion where the project area is located. Tree species include white and red pine, sugar maple, beech, and red oak. The dominant land use activity in the area has been forestry and much of the current forests are second growth.

Ultrasonic Surveys

We used three automated bat detectors (2x model Song Meter SM2Bat+, Wildlife Acoustics, Concord, MA; 1x Anabat, Titley Scientific, Columbia, MO) to sample at three locations within the proposed development area (Table 2, Figure 1). Detectors were placed along forest edges along roads or tracks (Table 3). Microphones on the SM2Bat+ units were oriented slightly down to shed rain. The seasonal timing of sampling likely corresponded to the end of the summer residency period, through to the autumn movements of resident species to local hibernacula, and autumn migration by migratory species. Detectors were programmed to turn on ½ hour before and after sunset and were reprogrammed throughout the season to adjust for increasing night length.

Identification of many bat species is possible because of the distinctive nature of their echolocation calls (Fenton and Bell 1981, O'Farrell et al. 1999). Species were quantitatively identified using Kaleidoscope™ software (Wildlife Acoustics) which compares recorded sequences to known echolocation call sequences supplied to the company. We used the "Bats of North America 2.1.0" classifier of the program with the region set as Eastern Canada, and only included the 7 species with records for the province. Following the automatic classification by this program, we manually inspected all call spectrograms and assigned/confirmed call sequence identification. 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 for two reasons. First, the Kaleidoscope program uses reference calls from other regions of the species ranges and thus a regional-specific call library is not available for these species. Second, since the calls of the two species can be quite similar depending on the spatial context (Barclay 1999, Broders et al. 2004b), they cannot often not be reliably separated and we had some calls that were clearly *Myotis* species but not auto-identified by the program to one species or another. Recordings from both detector types (SM2Bat+ and Anabat) were subject to the same identification process with manual verification for Anabat files in AnalookW. We used the number of recorded echolocation files as the unit of bat activity, which

approximates an echolocation call sequence, defined as a continuous series of greater than two calls (Johnson et al. 2004). Because an individual bat may be recorded making multiple passes, the data presented represent a measure of bat activity, and cannot be used as a direct measure of the number of bats within or passing through an area.

Differences in bat call sequence detections, call quality and ultimately species identifications are known among different models of bat detectors. Recent comparisons have shown that Wildlife Acoustics SM2Bat units record more bat call sequence files than Anabat units (Allen et al. 2011, Adams et al. 2012) and these differences must be incorporated into the interpretations and inferences of data when using both detectors.

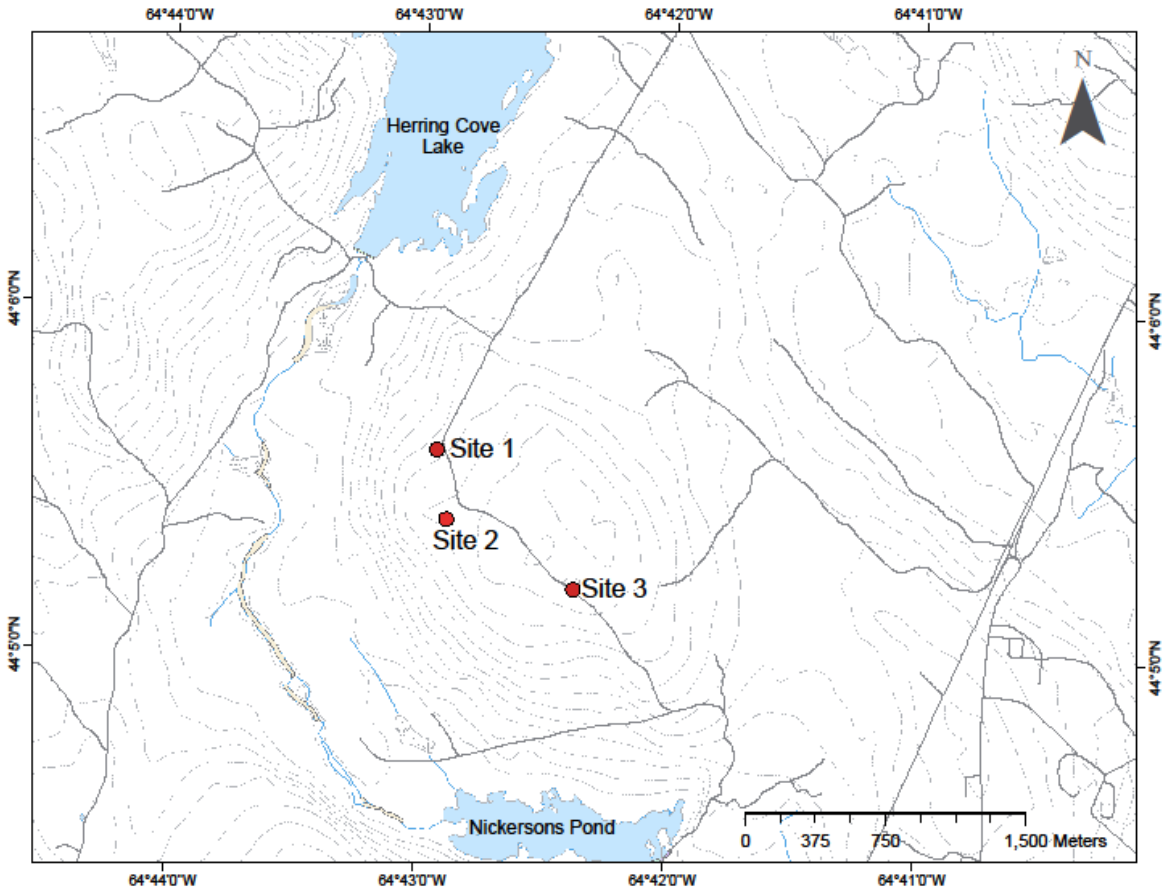

Figure 1. Locations of bat detectors used to sample for bat activity the Brooklyn Wind Energy Project, July to October 2014. GIS data supplied by Service Nova Scotia and Municipal Relations.

Table 2. Locations of ultrasonic survey sites for the 2014 survey of bat activity at the proposed Brooklyn Wind Energy Project area, Queens County, Nova Scotia. Coordinates are NAD83 UTM Zone 20.

Site	Location	Detector type	Coordinates		Deployed	Retrieved
1	Forest road	SM2Bat+	362676 E	4883644 N	28 Jul 2014	09 Oct 2014
2	Forest road	Anabat	362724 E	4883272 N	28 Jul 2014	09 Oct 2014
3	Forest road	SM2Bat+	363400 E	4882894 N	28 Jul 2014	09 Oct 2014

Table 3. Site descriptions for ultrasonic survey sites for the 2014 survey of bat activity at the Brooklyn Wind Energy Project area, Queens County, Nova Scotia.

Site	Description
1	Approximately 20 m down a secondary forest track off the main access road; microphone placed 2 m off the ground
2	Located along a secondary forest road off the main access road approximately 100 m from the main road; microphone 0.5 m off the ground
3	Located directly along the main access road, microphone placed in tree approximately 1.5 m off the ground.

Assessment of Potential for Hibernacula

To assess the potential for hibernacula to occur in proximity to the project area, we examined the available literature and the Nova Scotia Abandoned Mine Openings (AMO) Database (Fisher and Hennick 2009). To assess the AMO database location and attribute data were imported into a Geographic Information System (GIS; ArcMap 10.2, ESRI, Redlands, California). We estimated the centre of the Brooklyn project area and buffered the surrounding landscape to 25 km since wind farm sites within 25 km of a known bat hibernacula are to be considered to have a 'very high' site sensitivity (Nova Scotia Environment 2012). Records of underground abandoned mine openings occurring within the buffer were then exported into a spreadsheet where we subsequently excluded specific AMO's as being unlikely hibernacula based on four sequential attribute criteria (Table 4).

Table 4. Attributes of fields used from the Nova Scotia Abandoned Mine Openings Database used to exclude openings from the list of unexplored potential hibernacula for bats near the Brooklyn Wind Energy Project Area, Queens County, Nova Scotia.

Ordering	Field Heading	Criteria used for exclusion
1	Origdepth	≤19 m in depth
2	Flooded	attribute = T (true)
3	Protection	those that are backfilled, excavated and backfilled, filled or sealed
4	Plug	those containing a plug of rock, rock & vegetation, rock & garbage, garbage (and where field "Landuse"= municipal garbage dump site)

Results

Bat detectors within the proposed wind energy development were deployed from July 28 through to October 9 2014 and recorded continuously throughout this period for a total of 219 detector nights. One bat detector running continuously from sunset to dawn is considered as 1 detector night.

Within the proposed wind energy development area there were 1363 acoustic files recorded on the 3 detectors. A total of 204 of these were classified as bat-generated ultrasound files and the remaining classified as extraneous noise (Table 5). Of the 204 echolocation sequences, 77 were recorded at site 1 (SM2Bat+), 62 were recorded at site 2 (Anabat) and 65 were recorded at site 3 (SM2Bat+). The majority of call sequences (120/204; 58.8%) were classified as *Myotis* species (i.e., includes northern long-eared and little brown bats); as stated above no attempt was made to identify these call sequences to the species. This was followed by 18.1% (37/204) classified as tri-coloured call sequences, 16.7% (34/204) classified as hoary bat call sequences and 1.9% (4/204) of the calls sequences classified as red bats. We also detected 9 call sequences of silver-haired bats representing 4.4% of the total bat call sequences. One of these call sequences was auto-identified by the Kaleidoscope software as a big brown bat sequence on the evening of 04 September, 2014 at site 1. The calls of big brown and silver-haired bats can be difficult to distinguish between (Betts 1998). However, based on our knowledge of bats in Nova Scotia where only one, unverified record occurs of the big brown bat, and the fact that three other silver-haired bat sequences were recorded at site 2 on this same evening we believe this sequence was also a silver-haired bat, not a big brown bat.

The average number of recorded bat call sequences per night (averaged over all detectors at all three sites together) in the proposed development area was 2.79 (SD =3.61) during the sampling period. To place the relative magnitude of activity recorded in the study area into context, in 129 nights of monitoring along five forested edges in the Greater Fundy National Park Ecosystem from June to August 1999, the average number of sequences per night was 27 (SD = 44; Broders unpublished data). In 650 nights of monitoring at river sites in forested landscapes in southwest Nova Scotia from June to August of 2005-2006, the average number of sequences per night was 128 (SD = 232; Farrow unpublished data), though note that rivers act to concentrate bat activity, as they are used as foraging and commuting corridors (Laval et al. 1977, Fenton and Barclay 1980, Krusic et al. 1996, Zimmerman and Glanz 2000,

Lacki et al. 2007). Both of these previous comparisons were conducted prior to the emergence of white nose syndrome and therefore are likely not directly comparable. In a forested landscape in Colchester County, Nova Scotia, an approximate 99% decrease in bat echolocation activity was detected after significant mortality was noted in Nova Scotia following the arrival of white nose syndrome to the province. In that study the average number of bat call sequences recorded at forested and riparian areas, per night, dropped from 111.22 (SD 163.54) in 2012 to 0.95 (SD=1.84) in 2013 (Segers and Broders 2014).

According to the Nova Scotia Abandoned Mine Openings Database (Fisher and Hennick 2009), there are 40 underground abandoned mine opening records in the vicinity of the Brooklyn wind energy project (within 25 km). Following our exclusion analysis, none of the 40 AMO records remained as potential bat hibernacula where 32 were excluded being <20 m in original depth, 3 were excluded due to flooding , 3 excluded due to being filled in and 2 excluded due to a plug type listed as rock and vegetation.

Table 5. Number of echolocation bat call sequence files recorded per night for the 2014 survey of bat activity at the proposed Brooklyn Wind Energy Project area, Queens County, Nova Scotia. MYO = *Myotis* species, LABO = *Lasiurus borealis,* LACI= *Lasiurus cinereus,* LANO = *Lasionycteris noctivagans,* PESU = *Perimyotis subflavus.*

	Site 1					**Site 2**					**Site 3**				Nightly
Night of	LABO	LACI	LANO	MYO	PESU	LABO	LACI	LANO	MYO	PESU	LACI	LANO	MYO	PESU	All sites
28-Jul-14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
29-Jul-14	0	0	0	0	2	0	0	0	0	0	0	0	1	1	4
30-Jul-14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
31-Jul-14	0	0	0	1	0	0	0	0	0	1	0	0	1	0	3
1-Aug-14	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1
2-Aug-14	0	0	0	2	1	0	0	0	0	0	0	0	1	0	4
3-Aug-14	0	0	0	0	0	1	0	0	0	0	1	0	1	0	3
4-Aug-14	0	0	0	0	0	0	0	0	0	1	1	0	1	0	3
5-Aug-14	0	0	0	1	1	1	1	0	0	2	0	0	2	0	8
6-Aug-14	0	0	0	0	1	0	0	0	0	1	1	0	1	0	4
7-Aug-14	0	0	0	1	0	0	0	0	0	1	0	0	2	1	5
8-Aug-14	0	0	0	0	0	0	0	0	0	2	0	0	0	0	2
9-Aug-14	0	0	0	1	0	0	0	0	0	0	0	0	1	0	2
10-Aug-14	0	0	0	2	1	0	11	0	1	0	4	0	2	0	21
11-Aug-14	0	0	0	1	3	0	0	0	0	0	0	0	0	0	4
12-Aug-14	0	0	0	1	0	0	0	0	0	1	1	0	0	0	3
13-Aug-14	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1
14-Aug-14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15-Aug-14	0	0	0	3	0	0	0	0	1	1	0	0	7	0	12
16-Aug-14	0	0	0	3	0	0	0	0	0	0	0	0	1	1	5
17-Aug-14	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1
18-Aug-14	0	0	0	0	1	0	0	0	2	0	0	0	0	1	4
19-Aug-14	0	0	0	1	0	0	0	0	2	0	0	0	1	0	4
20-Aug-14	0	0	0	0	1	0	0	0	1	0	0	0	0	1	3

	Site 1					Site 2					Site 3				Nightly
Night of	LABO	LACI	LANO	MYO	PESU	LABO	LACI	LANO	MYO	PESU	LACI	LANO	MYO	PESU	All sites
21-Aug-14	0	0	0	0	0	0	0	0	1	0	0	0	0	1	2
22-Aug-14	0	0	0	1	0	0	0	0	1	0	0	0	3	0	5
23-Aug-14	1	0	0	0	1	0	0	1	1	0	0	0	0	0	4
24-Aug-14	1	0	0	0	2	0	0	0	2	0	0	0	1	0	6
25-Aug-14	0	1	0	0	1	0	0	1	1	0	0	0	0	0	4
26-Aug-14	0	11	0	2	0	0	0	0	2	0	0	0	1	1	17
27-Aug-14	0	0	0	1	0	0	0	1	0	0	0	0	0	0	2
28-Aug-14	0	0	0	1	0	0	0	0	1	0	0	0	0	0	2
29-Aug-14	0	0	0	1	0	0	0	0	1	0	0	0	1	0	3
30-Aug-14	0	0	0	1	0	0	0	0	1	0	0	0	0	1	3
31-Aug-14	0	0	0	1	0	0	0	0	0	0	0	0	1	0	2
1-Sep-14	0	0	0	7	0	0	0	0	1	0	0	0	0	0	8
2-Sep-14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3-Sep-14	0	0	0	2	0	0	0	0	1	0	0	0	0	0	3
4-Sep-14	0	0	1	0	0	0	1	3	0	0	0	0	1	1	7
5-Sep-14	0	0	0	0	0	0	1	0	0	0	0	1	1	0	3
6-Sep-14	0	0	0	1	0	0	0	0	0	0	0	0	2	1	4
7-Sep-14	0	0	0	1	0	0	0	0	1	0	0	0	1	0	3
8-Sep-14	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1
9-Sep-14	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1
10-Sep-14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11-Sep-14	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1
12-Sep-14	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1
13-Sep-14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14-Sep-14	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1
15-Sep-14	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1
16-Sep-14	0	0	0	2	0	0	0	0	0	0	0	0	0	0	2
17-Sep-14	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1

	Site 1					Site 2					Site 3				Nightly
Night of	LABO	LACI	LANO	MYO	PESU	LABO	LACI	LANO	MYO	PESU	LACI	LANO	MYO	PESU	All sites
18-Sep-14	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1
19-Sep-14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20-Sep-14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21-Sep-14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
22-Sep-14	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1
23-Sep-14	0	0	0	0	0	0	0	0	0	0	0	0	2	0	2
24-Sep-14	0	0	0	0	0	0	0	0	0	0	0	0	4	0	4
25-Sep-14	0	0	0	1	0	0	0	0	1	0	0	1	3	0	6
26-Sep-14	0	0	0	1	0	0	0	0	1	0	0	0	2	0	4
27-Sep-14	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1
28-Sep-14	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1
29-Sep-14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30-Sep-14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1-Oct-14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2-Oct-14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3-Oct-14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4-Oct-14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5-Oct-14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6-Oct-14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7-Oct-14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8-Oct-14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Site totals	2	12	1	45	17	2	12	6	7	9	8	2	45	10	204
Project Ave															2.79
Num nights															73

Discussion

Results from our work at the Booklyn site have recorded the highest bat species richness that we have ever recorded during our projects in Atlantic Canada. We have recorded 6-7 species that include resident and migratory species. That being said, no one species was recorded at exceptionally high activity levels.

For the *Myotis* spp., interpretation of our data are problematic for assessing relative risk to bats at the proposed development given our knowledge of the devastating impacts that white nose syndrome has had, and is having, on local bat populations. The disease is now confirmed in nine counties in mainland Nova Scotia and three counties in Cape Breton. It has not yet been confirmed in Queens County where the project area is located. Elsewhere, white nose syndrome significantly reduced the summer Myotis bat activity by as high as 75% (Dzal et al. 2011, Jachowski et al. 2014). In the winter of 2012-2013, there were hundreds of fatalities recorded at several known hibernacula in the province and annual monitoring counts of bats at such hibernacula down, on average, by 94% (Broders and Burns, unpublished data). These observations are suggestive of a major mortality event in the area, likely decreasing the magnitude of bat activity in many areas in the summer. This is supported by other work we are conducting in the region suggesting a >99% reduction in the magnitude of echolocation activity in 2013, relative to 2012 (Segers and Broders 2014), and decimation of a number of maternity colonies in the region. For these reasons this dataset must be interpreted with caution.

Given the context of white-nose syndrome, as discussed above, there was no acoustic evidence of a significant movement or concentration of bats through the area investigated during this pre-construction survey of bat activity. The magnitude of activity was low compared to baseline levels (collected prior to 2007), and more comparable to levels recorded in 2013 (following white nose syndrome) that one would expect in a forested ecosystem in the region. Although we cannot rule out the possibility that mortality events associated with this development will occur, we have found no evidence to suggest that the proposed project will cause large numbers of direct mortality of bats. That being said, in light of white nose syndrome and the recent listing of the several species as endangered, the significance of any mortality is much greater than it would have been just a couple of years ago.

The majority of the identified echolocation sequences recorded for this project were attributable to the two species of *Myotis* bats known to occur in Nova Scotia, the little brown bat and the northern long-eared bat. This was expected as they were the only abundant and widely-distributed species in the province, and are two of only three species that had large numbers in the province (Broders et al. 2003). Although we did not distinguish the calls of *Myotis* species, the majority of the recorded sequences likely represent the little brown bat, as this species is known to forage in open areas and over water. The northern long-eared bat is a recognized forest interior species (Jung et al. 1999, Henderson and Broders 2008), and is less likely to use open areas for foraging and commuting (Henderson and Broders 2008). Additionally, the northern long-eared bat has lower intensity echolocation calls and is thus not recorded as well as the little brown bat (Miller and Treat 1993, Broders et al. 2004a).

After the *Myotis* call sequences, the next most frequently recorded species was the tri-colored bat. This was expected as this species was locally abundant within the region of southwest Nova Scotia including the area of the proposed development (Broders et al. 2003, Farrow and Broders 2011).

Myotis species and tri-colored bats are relatively new to the list of species among fatalities at wind turbines sites. This may be due to the fact that the first large scale wind developments were located primarily in western North America, typically in agricultural and open prairie landscapes (reviewed in Johnson 2005b). Fatalities of these resident, non-migratory species were largely absent from these sites, likely due to the association of these species with forested landscapes. More recently, evidence of *Myotis* fatalities resulting from collisions with wind turbines have been noted at sites in eastern North America (reviewed in Johnson 2005b, Jain et al. 2007, Arnett et al. 2008a). Although there are fewer documented fatalities of *Myotis* bats compared to long-distance migratory species, there is still a risk of direct mortality.

Other than direct bat mortality as a result of collisions with turbines, there is also the potential that disruption of the forest structure (e.g., removal of trees and fragmentation of forest stands for roads and clearings) will degrade the local environment for colonies/populations of *Myotis* or tri-colored bats that reside in the area during the summer. This can occur by the elimination of existing roost trees, the isolation of trees left standing, as well as the elimination or degradation of foraging areas for bats.

Additionally, resident bat species make what are generally considered to be short distance migrations (range of tens to hundreds of kilometres) from their summering areas to underground sites where they hibernate. Little is known about the flight behaviour and dynamics of these movements (i.e., height of travel, and routes); therefore, it is difficult to predict the specific effects that wind developments will have on the movements of local populations of bats. With no known bat hibernacula in Queens, Lunenberg, Shelburne, Yarmouth and Digby counties, we have no information on the routes of movement that resident bats make in the spring or fall from summering sites to hibernation sites.

Collectively, call sequences of migratory species (hoary, red and silver-haired bats) represented 23% of the total calls recorded. These species were detected sporadically throughout the sampling period. Typically, at least one of the three migratory species was recorded each week from the beginning of the survey to the first week of September although the maximum number of call sequences recorded on any one night was 11 (hoary bat; on each of 10 and 26 August 2014, site 2 and site 1, respectively). Although migratory bat call sequences comprised almost one quarter of the recorded bat call sequences in the project area, *Myotis* activity was likely severely depressed stemming from declines in their populations due to white-nose syndrome as has been found in other areas with WNS confirmed (Moosman et al. 2013, Jachowski et al. 2014).

Overall, the low number of call sequences attributed to the red, hoary and silver-haired bat, the long-distance migratory bat species, suggests that there are no large populations or significant migratory movements of these species at the study area. This fits with our current knowledge of the status of this species in the province where sightings are rare and often occur in the late summer/early autumn on the coast or offshore (Broders et al. 2003, Czenze et al. 2011, Lucas and Hebda 2011, Segers et al. 2013). However occurrences do occur regularly, albeit in low frequency, and these species are especially vulnerable to wind facilities. All three species are generally solitary, tree-roosting species with extensive distributional ranges throughout North America (van Zyll de Jong 1985, Naughton 2012). These species have received the greatest attention with regards to wind energy developments because they make up the large majority of documented fatalities at existing developments in North America. Any mortality of this species would be significant to Nova Scotia given there low numbers in the region. Significant bat fatality events at wind energy developments occur primarily in the late summer and early fall, peaking during the period that coincides with the long-distance fall migration of these species (Johnson 2005b, Cryan and Brown 2007, Arnett et al. 2008a). This has lead researchers to believe that migration plays a key role in the susceptibility of certain bat species to wind turbine fatalities (Cryan and Barclay 2009). It

has been proposed that this may be because these species travel at a height that puts them at increased risk of collisions with rotating turbine blades (Barclay et al. 2007, Arnett et al. 2008a).

Recommendations

1. *Post-construction monitoring* – A rigorous post-construction monitoring program, appropriately designed to account for searcher efficiency and scavenger rates, needs to be established to quantify bat fatality rates. These surveys should be conducted over an entire season (April to October), but especially during the fall migration period (mid-August to late-September) for at least two years. Should fatalities occur, they should be investigated with respect to their spatial distribution relative to wind turbines, turbine lighting, weather conditions, and other site specific factors. Should trends be identified, operations should be adjusted in an adaptive management framework whereby mitigation can be focused on any identified high risk areas/infrastructure to minimize future fatalities. These data are essential for assessing potential risks at future developments in the region via assessment of cumulative effects; therefore it is critical that the results of these surveys be appropriately reported.

2. *Retain key bat habitat* – Key bat habitat should be identified in the project area (e.g., wetlands, riparian areas, mature deciduous-dominated forest stands) and retained to continue to support any existing summer colonies and or potential fall movement corridors of bats. At this site, the major recommendation would be to minimize the clearing of forest so as to maintain as much of the existing roosting and foraging areas as possible.

3. *Return to pre-project state upon decommissioning* – The project area should be returned to the state that existed prior to the development of the site once the project is decommissioned. This should include planning to ensure the continuity of forest stand succession to provide and maintain appropriate roosting areas well into the future as existing roost trees die off. Retention of forest stands of a range of ages will provide mature trees for bat roosting resources in the future.

4. *Develop an operations fatality mitigation plan* – Recent experimental case studies in Alberta and the United States have demonstrated dramatic reductions in bat fatalities at operational wind energy facilities can be made by changing operational parameters during the peak fatality period (Baerwald et al. 2009, Arnett et al. 2010). These include changes to when turbine rotors begin turning in low winds via alterations to wind-speed triggers and blade angles to lower rotor speed. These studies have found decreases in bat mortalities ranging from 44% to as high as 93% reductions on a nightly basis at relatively low cost to annual power production loss, at approximately ≤ 1%. This plan should be adaptive as operations continue through time and be in place prior to operations commencing such that if any bat mortalities be observed at the site once operational, the plan can be implemented immediately.

5. *Remain up to date with current research* –There is presently an abundance of on-going research aimed at determining the impacts of wind energy developments on populations of bats. Other studies are focusing on investigating the efficacy of potential mitigation measures, including the effects of weather on bat activity patterns and collisions with wind turbines, and possible bat deterrents (including acoustic (Arnett et al. 2013)and radar emissions). As these are active areas of research, it is essential that the most current studies and guidelines are used to guide management decisions and development plans for wind energy projects.

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Appendix 1. Survey site photographs

Figure A1: Bat detector (SM3Bat+) placement at site 1.

Figure A2. Bat detector (AnaBat) placement at site 2 (photographed from behind) with inset showing the front view of the detector taken from the forest road.

Figure A3. Bat detector (SM2Bat+) placement at site 3 with circle showing microphone placement in foliage.