CONESTOGO WIND FARM
Bat Monitoring Report and Environmental Impact Study

Prepared for:
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NATURAL RESOURCE SOLUTIONS INC.
Aquatic, Terrestrial and Wetland Biologists

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Bat Monitoring Report and Environmental Impact Study

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1.0 Introduction

Natural Resource Solutions Inc. (NRSI) was retained in June 2010 by NextEra Energy Canada to conduct bat monitoring in accordance with the Renewable Energy Approval (REA) regulations and using the 2010 DRAFT Bat and Bat Habitat (OMNR 2010a) document as guidance. This assessment included a records review, site investigation, evaluation of significance, and impact assessment on any potentially significant bat habitats at a proposed 22.91MW wind energy facility in the County of Wellington, immediately south of the Town of Arthur, Ontario. The analysis of the bat habitats and activity levels is one issue being considered. Other factors, such as avian habitat, vegetation communities, Species at Risk, wind dynamics, land ownership, and social impacts are also being assessed by other team members.

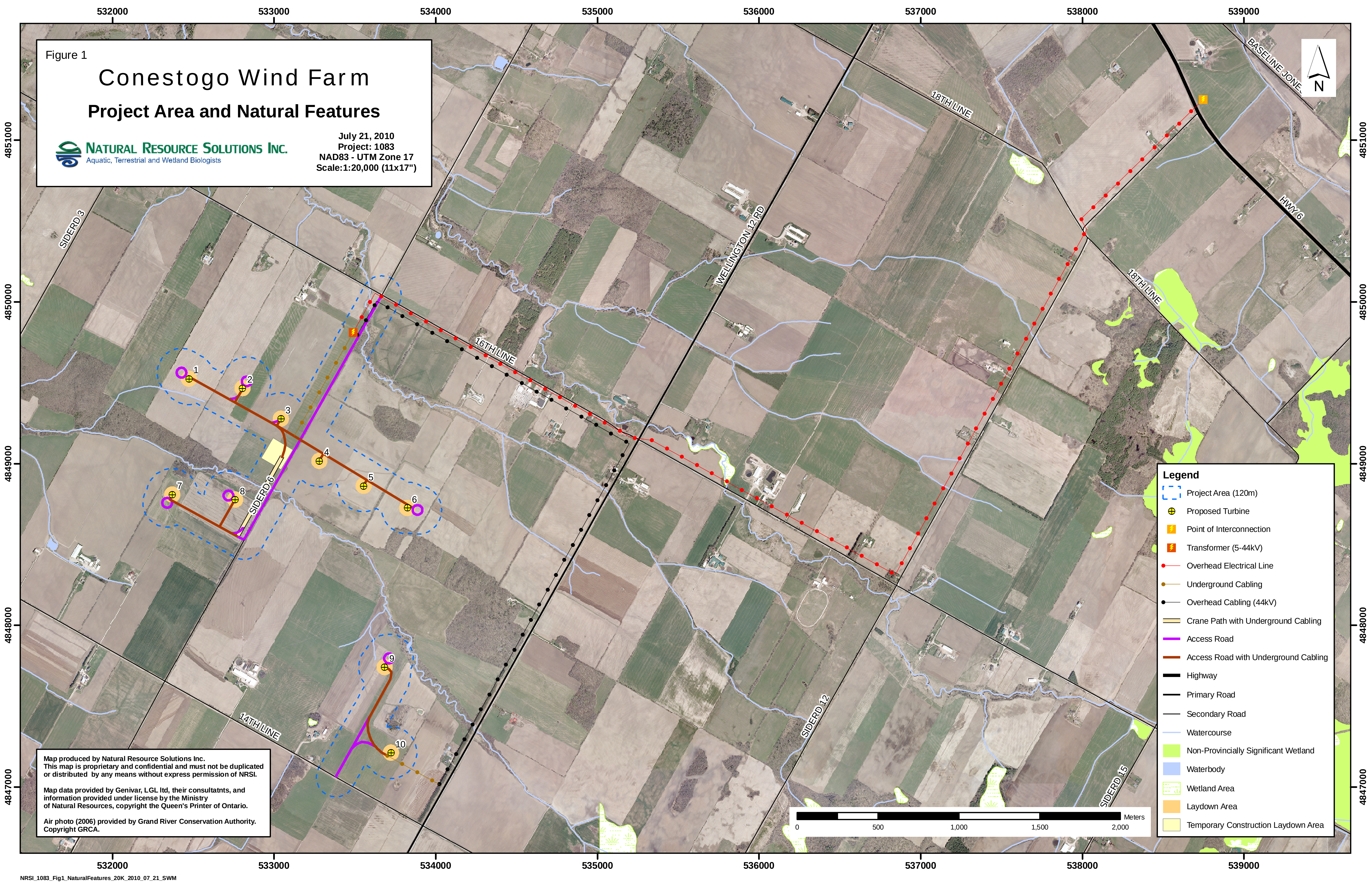
Ontario Regulation 359/09 under the Environmental Protection Act sets forth the requirements for Renewable Energy Approvals. This *Bat Monitoring Report and Environmental Impact Study* has been prepared to satisfy the reporting requirements of Sections 24-27, 37, and 38 of Ontario Regulation 359/09. Section 24 of this regulation specifies the requirement for a records review and site investigation according to Sections 25 and 26, respectively. Sections 37 and 38 of this regulation set forth limitations on renewable energy projects within certain proximities to a variety of natural features, and addresses the need for a report that identifies and assesses negative effects, identifies mitigation measures, and describes the environmental monitoring plan. This reporting component is consistent with the requirements of an Environmental Impact Study, specific to potentially significant bat habitats. This report will be combined with other project components to compile the full *Natural Heritage Assessment*.

This *Bat Monitoring Report and Environmental Impact Study* summarizes the findings of a detailed site investigation conducted by Natural Resource Solutions Inc. at the proposed Conestogo Wind Farm project area in June and early July 2010. Preliminary bat monitoring was already completed by Pandion Systems, Inc. in 2007. The results of this study have been summarized below, and the 2007 report, *Bat Monitoring at the Proposed Conestogo Wind Farm in Wellington County, Ontario* (Pandion 2007), has been appended to this report.

2.0 Project Details

The Conestogo Wind Farm project area is located in Mapleton Township, County of Wellington, immediately south of the Town of Arthur, ON. The proposed undertaking includes the installation of 10 wind energy generators, with a total energy capacity of approximately 22.91MW. In addition to the wind turbines, associated infrastructure designs, including access roads and cabling, have also been reviewed for potential impacts to significant bat habitats. In accordance with REA regulations, NRSI biologists have reviewed the proposed development layouts provided by NextEra Energy Inc. and have examined an area of 120m from any development activity, including access roads, cabling, and turbines, for potentially significant bat habitats.

The project area, as defined by the REA regulations includes all areas within 120m of proposed development activities. The proposed development layer has been provided by NextEra Energy and has been incorporated into Figure 1 below, including the 120m project area surrounding areas proposed for development activities. The project area represents habitat and landscape features typical of a southern Ontario landscape. The approximate boundaries of the area proposed for turbine placement are Sixteenth Line and Fourteenth Line to the north and south respectively, and County Road 12 and Sideroad 3 to the east and west, respectively. The project area is dominated by agricultural habitats, including both actively tilled cropland and pasture. Fallow fields, hedgerows, and occasional deciduous woodlots are also present throughout the project area.



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3.0 Records Review

In accordance with the Renewable Energy Approval (REA) regulations, an area of at least 120m beyond the proposed development activities was examined for natural heritage features, with emphasis on potentially significant bat habitat. Numerous agencies were contacted during a records review led by NextEra Canada, GENIVAR, Inc., and LGL Ltd., including correspondence with the Ministry of Natural Resources (MNR) and Ministry of Northern Development, Mines and Forestry (MNDM), and query of Natural Heritage Information Centre (NHIC). Information collected during the records review, pertaining to other aspects of the natural environment, such as birds, vegetation, or aquatics, have been addressed by other team members.

3.1 Significant Wildlife Habitat

A detailed records review and correspondence with local MNR specialists have identified a bat hibernacula located more than 20km southeast of the Conestogo Wind Farm project area. Due to the considerable distance of this feature from the proposed development activities, this significant habitat was not considered during the site investigation or evaluation of significance stages of this project. No other information pertaining to potentially significant wildlife habitat has been identified in the vicinity of the project area.

3.2 Significant Species

None of the bat species known to occur in Ontario are considered to be nationally significant, and are not listed as Species at Risk in Ontario (COSEWIC 2010, OMNR 2009).

4.0 Site Investigation Methodology

In accordance with the REA regulations and the requirements of the Ministry of Natural Resources, comprehensive site investigations were undertaken to document the environmental and biological characteristics of the Conestogo Wind Farm. These site-specific field investigations began in 2007 when another consulting firm, Pandion Systems, Inc. conducted a full season of fall bat monitoring at the Conestogo Wind Farm. Site-specific bat surveys were continued in June 2010 by Natural Resource Solutions Inc. to further identify any potentially significant bat habitats within the project area. The monitoring programs and site investigation methodology have been summarized below. Other aspects of the environmental monitoring and associated impact assessments, pertaining to avian habitats, vegetation mapping, and aquatics, have been completed by other environmental consulting firms and summarized in separate reports.

4.1 2007 Bat Monitoring

Acoustic bat monitoring was conducted by Pandion Systems, Inc. during August and September 2007 (Pandion 2007). These surveys were completed according to the recommendations in the MNR guidance document that was current at the time of monitoring. The monitoring program is summarized below.

The monitoring program implemented by Pandion Systems, Inc. focused on monitoring through-the-night bat activity at two MET towers in the vicinity of the Conestogo Wind Farm. The original area proposed for turbine placement was considerably larger than the current project extent. As a result, both of the MET towers used for data collection are beyond the current project boundaries, however they are still found within habitat representative of the project area, and are expected to provide comparable results to the current project area. The closest 2007 monitoring location to the current project area is approximately 5km from the general project boundary, and 7km from areas proposed for turbine placement. Exact monitoring locations can be seen in Appendix I of this report.

Acoustic monitoring used a combination of an Anabat II detector and Pettersson D240x detector, mounted to each of the two MET towers. Using a microphone extension, the Anabat detector was placed at a height of approximately 40m on each MET tower. Due to equipment limitations, the Pettersson D240x detector was placed at a lower height of 20m on each MET tower. The acoustic monitoring set-up at each MET tower recorded 15 and 19 nights of acoustic data from August 15 to September 14, 2007, for an overall total of 34 nights, or 408 hours, of acoustic monitoring.

Detailed methodology for the preliminary acoustic bat monitoring surveys can be seen in the *Bat Monitoring at the Proposed Conestogo Wind Farm in Wellington County, Ontario* (Pandion 2007), in Appendix I of this report.

4.2 2010 Bat Monitoring

In response to the recent release of the 2010 Bats and Bat Habitats guidance document (OMNR 2010a), NRSI was retained by NextEra Energy to further evaluate bat activity and examine potentially significant bat habitats within the project area.

4.2.1 Identification of Potentially Significant Habitat

NRSI reviewed the proposed development layouts, provided by NextEra Energy, and identified habitat types that were found within 120m of proposed development layouts. Following a records review of available information, NRSI biologists conducted a site investigation of all potentially significant habitats located within 120m of proposed turbine locations. Potentially significant habitats found within 120m of other components (i.e. access roads and transmission lines) were also examined and are addressed later in this report, but were not determined to require acoustic monitoring to determine significance.

The detailed site investigation occurred within three habitats located closer than 120m to proposed turbine placement. NRSI biologists examined these woodlots for potentially significant bat habitat, with a focus on preferred habitat for maternity roosts. Each natural area was examined for large dead or dying trees with obvious crevices, cavities, or loose bark that could be used as roosting habitat. Any habitat that exhibited these conditions was considered to be a potentially significant bat habitat, and was identified for further study.

Preliminary site investigations to identify potentially significant bat habitat were overseen by Andrew Ryckman. A corporate CV has been included in Appendix III of this report.

4.2.2 Monitoring Locations

A total of three monitoring locations were chosen, each in close proximity to potentially significant bat habitats identified during the site investigation. Each of these monitoring locations, seen in Figure 2, were placed approximately 10-20m from a large, dead or dying, tree. Each monitoring location, including general habitat characteristics, is described in more detail below. Photographs of each monitoring station can be found in Appendix II of this report.

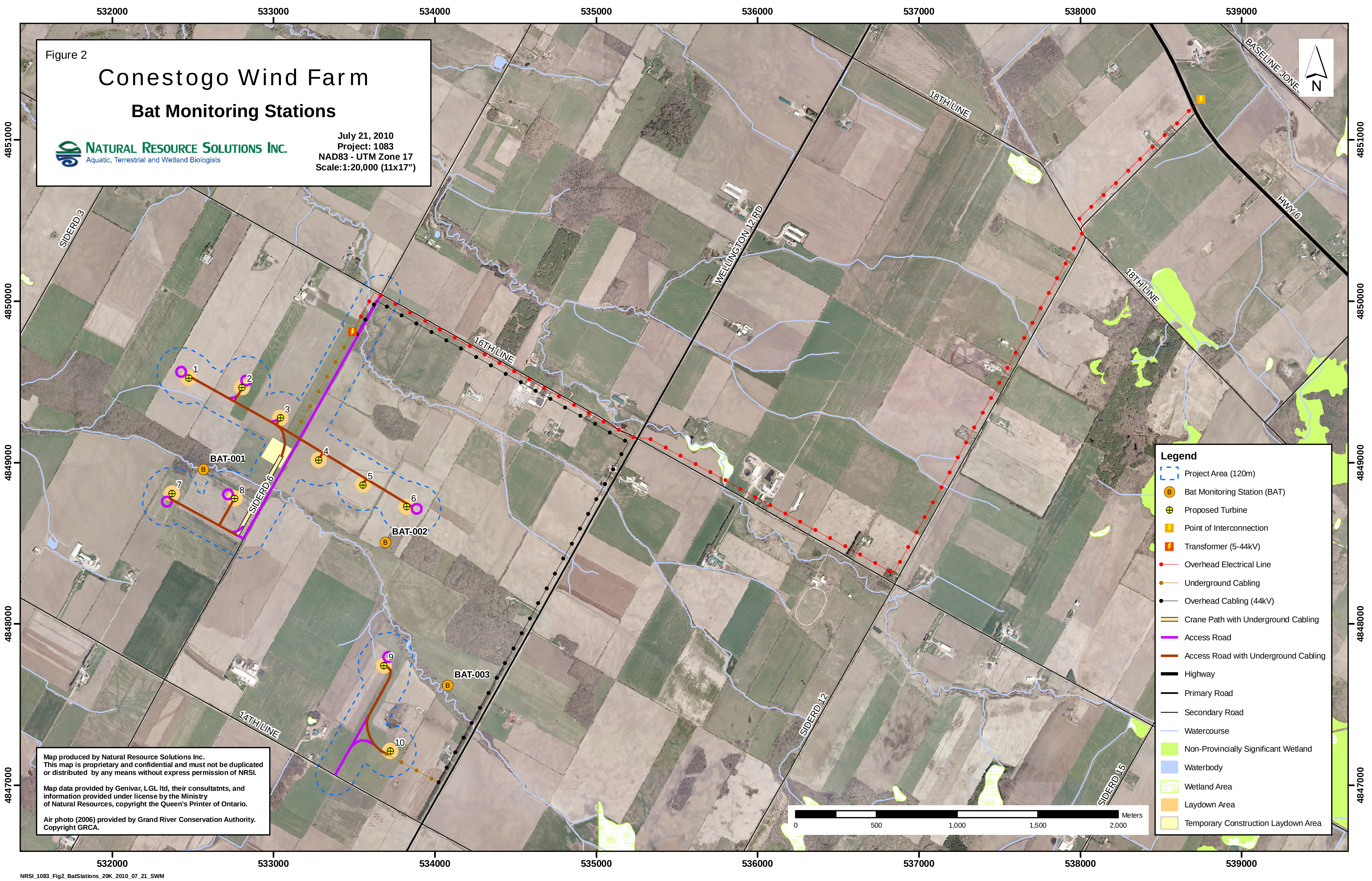
> <u>BAT-001</u>
> This monitoring location is placed along the southern bank of a small watercourse that runs through a lowland, deciduous forest. Bat monitoring at this location was directed towards a large deciduous snag, located approximately 12m away, however numerous other deciduous snags were present throughout the eastern portion of this community, including several others within 100m of this monitoring location.
>
> <u>BAT-002</u>
> Centrally located within the project area, this station was placed along the edge of a small, deciduous woodlot. Occasional snags were present within this community, generally concentrated along the western edge of the community. This monitoring station was placed within 20m of two deciduous snags, with several other small to moderate sized snags within 100m.
>
> <u>BAT-003</u>
> The third monitoring location was placed in the southeastern portion of the project area in a wooded creek corridor. A site investigation had identified that portions of this community are actively used as pasture. The community is generally young to mid-aged, however this monitoring station was placed approximately 20m from a group of 3 large deciduous snags.

4.2.3 Acoustic Monitoring

At each of these three monitoring location, NRSI biologists conducted at least 10 nights of acoustic monitoring. Acoustic monitoring was conducted using a Pettersson D240x ultrasound detector connected to a portable computer. The unique set-up implemented by NRSI allows for the simultaneous recording of abundance data while still recording call sequences of passing bats. On each monitoring night, acoustic monitoring began at 2000hrs and recorded bat activity for 6hrs, following the MNR recommended guidelines (OMNR 2010a).

4.2.4 Visual Surveys

In conjunction with through-the-night acoustic surveys, biologists also conducted visual surveys at each potentially significant habitat. In accordance with the MNR recommended guidelines (OMNR 2010a), these surveys began at dusk and included visual surveys around potentially significant habitats. Since a full season of bat monitoring had already been completed at the Conestogo Wind Farm by Pandion Systems, Inc., NRSI modified the MNR recommendations to conduct a total of 4 visual surveys at each monitoring station, lasting 10 minutes on each survey night. These visual surveys were conducted with a Pettersson D240x paired with a digital recorder to record species calls. Spotlights were also used to identify any trees with high bat activity. The results of these visual surveys were compared with the acoustic monitoring to identify potential areas of significant bat activity within the project area. It is expected that this adjusted monitoring effort for visual surveys, in conjunction with comprehensive acoustic monitoring and the 2007 monitoring program, will provide an adequate examination of the bat activity and habitats within the project area.



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5.0 Weather

Environmental conditions have the potential to strongly influence bat activity, and can help to explain nights of high or low activity levels. Overnight temperature, wind speed, and precipitation are the three weather parameters that are thought to show the most influence on bat activity. As a result, weather data has been collected and reviewed throughout the monitoring period in order to properly address bat activity levels and analyze bat patterns throughout the project area.

On nights of visual surveys, site-specific data was recorded by field biologists, including temperature, wind speed, and precipitation (if any). For acoustic monitoring, weather data was obtained from Environment Canada`s National Climate Archive, using the Fergus MOE weather station. This station is located within 20km of the Conestogo Wind Farm, near the Town of Fergus, ON. Available data from this weather station includes daily records of maximum temperature, minimum temperature, and precipitation. Wind speed and direction is not available from this weather station. Although this weather station is located approximately 20km from the Conestogo Wind Farm, it is expected to provide similar weather to that observed at the Conestogo Wind Farm.

During the period of data collection, nightly low temperatures ranged from 7.0°C to 19.0°C, averaging 13.2°C. Nightly low temperatures on four of these nights, from June 29 to July 2, 2010, dropped below 10°C. During the monitoring period, precipitation was prevalent, with several nights in June experiencing moderate to heavy rain. As a result, acoustic monitoring at the Conestogo Wind Farm continued into early July to ensure ample nights of ideal weather were monitored, resulting in more than 10 nights of acoustic monitoring at each station. Weather data, collected from the Fergus MOE weather station have been compiled into Figure 3.

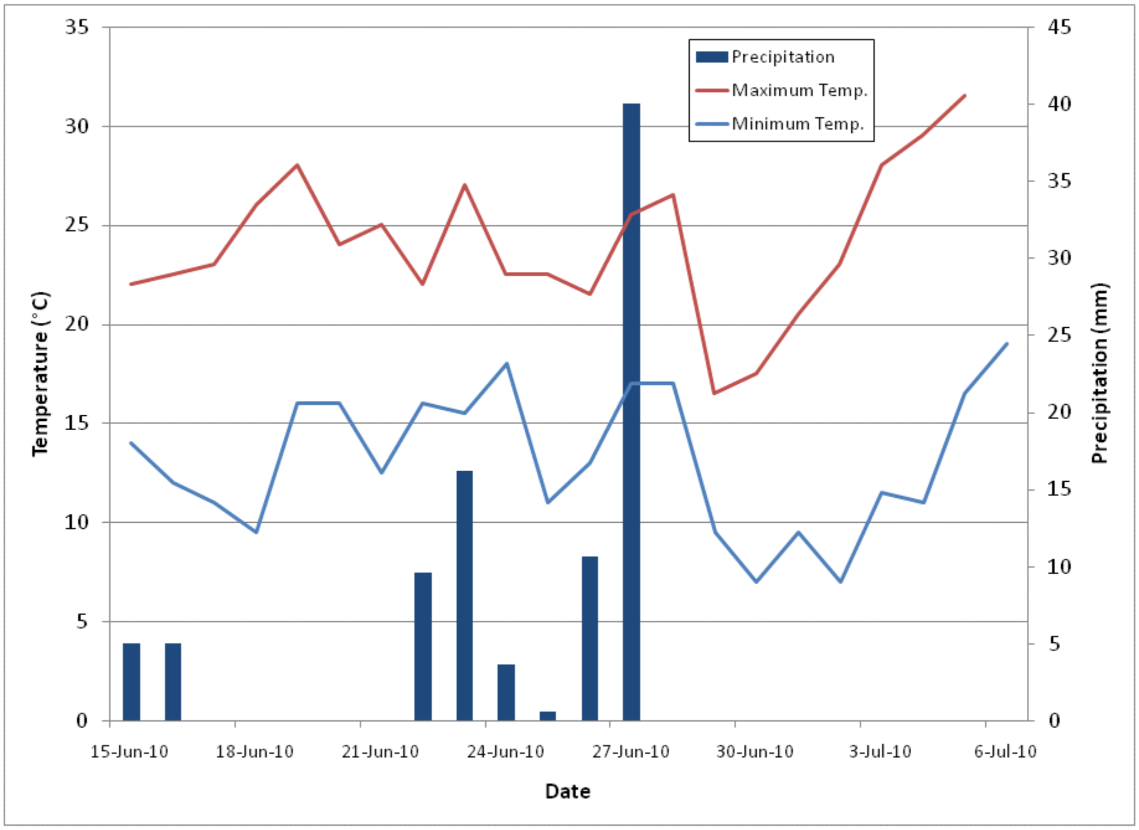


Figure 3. Temperature (°C) and Precipitation (mm) Values Recorded During the 2010 Monitoring Period

6.0 Site Investigation Results

A multi-year inventory of bat activity and habitats has been completed through a combined effort of Pandion Systems, Inc. and Natural Resource Solutions Inc. These surveys have included fall migration monitoring on nearby MET towers, habitat assessments and identification of potentially significant habitats, ground-based acoustic monitoring, and dusk visual surveys. The results of this multi-year assessment are provided below:

6.1 2007 Bat Monitoring

Bat monitoring was conducted in August and September 2007, based on an early draft of the recommended monitoring protocol released by the Ministry of Natural Resources. Pandion Systems, Inc. used an acoustic monitoring set-up that combined both Anabat and Pettersson D240x detectors to monitor 19 nights at two MET tower stations.

A combined total of 191 bat passes were recorded in 228 hours of monitoring, resulting in an average passage rate of approximately 8.4 passes/hr at station Met 13. This value combines the results of both the Anabat and Pettersson ultrasound detectors, which are presented separately in Pandion's bat monitoring report (see Appendix I). This value of 8.4 passes/hr represents a moderate level of bat activity, and is consistent with monitoring results of NRSI in 2010 (see below). A total of 85 bat passes were documented in a total of 180 hours of monitoring effort at monitoring station Met 12, resulting in a combined average passage rate of 4.7 passes/hr. This passage rate represents a slightly lower bat activity level, but remains consistent with acoustic monitoring conducted by NRSI at site-specific locations within the current project extent.

Nightly activity rates at these stations were relatively consistent throughout the monitoring period, with a few strong peaks in activity in mid-late August at station Met 13. Activity at Met 12 was highest in mid-August, before consistently lower values were observed through the remainder of the month. Two nights of activity reached values higher than 30 passes in a night, both recorded by the Anabat detector, on August 23, 2007 and August 15, 2007 when approximately 43 and 33 bat passes were recorded, respectively.

Species information collected from the 2007 bat monitoring data confirmed the presence of three bat species, hoary bat (*Lasiurus cinereus*), red bat (*Lasiurus borealis*), and silver-haired bat (*Lasionycteris noctivagans*). Of all species that could be identified to the species level, hoary bat was the most abundant call sequence, representing approximately 30% of all bat call recordings. Calls of the red bat and silver-haired bat represented 1% each of total bat call sequences. The remainder of the recorded call sequences represented different species associations, such as hoary bat/big brown (*Eptesicus fuscus*) bat/silver-haired bat (30%), big brown bat/silver-haired bat (7%), and *Myotis sp.* (2%). These species associations represent groups of species that often have calls with very similar characteristics, making further species identification difficult.

Full results from the 2007 monitoring program can be seen in the Pandion Systems, Inc. report found in Appendix I.

6.2 2010 Bat Monitoring

During the 2010 bat monitoring program, NRSI documented a total of 1601 bat passes, and identified 5 different bat species through the combined effort of acoustic and visual surveys conducted within the project area. Acoustic data was entered by project level biologists, however species identified was overseen by Andrew Ryckman. Andrew has considerable experience conducting acoustic bat surveys and has participated in several workshops relating to bat monitoring and echolocation call identification, and his corporate CV has been provided in Appendix III of this report. The results of these surveys are discussed in more detail below:

6.2.1 Acoustic Monitoring

A total of 1577 bat passes were recorded in approximately 235 hours of monitoring, resulting in an average passage rate of 6.7 passes/hr within the Conestogo Wind Farm project area. During the acoustic monitoring period, NRSI recorded a total of 686 call sequences, representing 5 different bat species.

A total of 256 bat passes were documented in 14 survey nights at monitoring station BAT-001. The monitoring effort of 83 hours results in an average passage rate of 3.1 passes/hr. This average passage rate represents low bat activity. Only two nights, June 17/18 and 18/19, 2010, had more than 30 bat passes per night when 112 and 72 bat passes were recorded, respectively. Bat activity on the remaining survey nights at this station was consistently low, with no passage rate higher than 3.0 passes/hr. Species activity documented at this monitoring station was primarily of little brown bats (*Myotis lucifugus*), which accounted for approximately 65% of the total 216 bat sequences recorded at this monitoring station. The next most abundant recorded sequence was calls recorded at an approximate frequency of 30kHz, representing either big brown or silver-haired bat calls. These two species are extremely difficult to distinguish as they share several sonogram characteristics. Also recorded at this station were occasional calls of red bat, big brown bat, and northern long-eared bat (*Myotis septentrionalis*).

Acoustic monitoring at station BAT-002 had consistently higher bat activity than BAT-001. A total of 665 bat passes were documented in 82 hours (14 nights) of monitoring, resulting in an average passage rate of 8.1 passes/hr. The highest single night of bat activity was documented at this station on the night of June 18/19, 2010 when 240 bat passes were recorded, representing a passage rate of 40.0 passes/hr. At least 30 bat passes were recorded on another 8 nights of monitoring, each resulting in a passage rate of more than 5.0 passes/hr. Of the 265 total bat call sequences recorded, calls at an approximate frequency of 30kHz were the most abundant, representing more than 80% of all recorded bat calls. Also recorded at this station were several calls of the little brown bat, and occasional calls of the red bat, hoary bat, and northern long-eared bat.

The highest average passage rate was documented at monitoring station BAT-003, with an average passage rate of 9.4 passes/hr. A total of 656 bat passes were documented at this station in 70 total hours, or 12 nights, of monitoring. Six monitoring nights at this station had more than 30 bat passes recorded, with two nights of relatively high activity on June 27/28 and July 4/5, 2010. Passage rates on these two nights were 24.5 and 27.0 passes/hr, respectively. At this monitoring station, call sequences recorded at approximately 30kHz, without further species identification, represented the largest proportion of recorded bat calls, accounting for 87% of all recorded calls. Also recorded at this station were species calls of the big brown bat and occasional calls of long-eared bat and hoary bat.

6.2.2 Visual Surveys

Visual surveys were conducted at all three monitoring locations on a total of four monitoring nights, June 21, 24, 28, and 30, 2010, to identify any areas of concentrated bat activity or significant roost habitats.

Visual surveys at monitoring station BAT-001 had a total of 5 bat passes documented on a single monitoring night, June 24, 2010. No bat passes were recorded on any of the other evenings of visual surveys at this station. Call sequences for four of these bat passes were recorded, and 3 were identified as little brown bat. The fourth species could not be identified to the species level, but was classified generally as a species calling at a frequency of approximately 40kHz. It is likely that this call also represents a little brown bat.

Dusk surveys at monitoring station BAT-002 resulted in a total of 12 bat passes recorded on the evening of June 21, 2010. No other bat passes were recorded during any of the other visual surveys at this station. The use of spotlights during this survey confirmed that these 12 bat passes represented no more than 2 individual bats that were observed foraging along the wooded edge. A total of six species calls were recorded during the visual surveys, including one hoary bat call and several calls identified as 30kHz bats. This call frequency represents either big brown bat or silver-haired bat, which are extremely difficult to distinguish based on very similar call characteristics.

A total of 7 bat passes were recorded on the evening on June 21, 2010 at monitoring station BAT-003. Visual observations confirmed that these 7 bat passes represented no more than 2 separate individual bats observed foraging along the edge of the field. No other bat passes were recorded during any of the other 3 survey nights at this station. A total of 5 call sequences were recorded at this monitoring station during the visual surveys. All five of these calls were identified as 30kHz bat calls, representing either big brown bat or silver-haired bat.

6.3 Significant Bat Species

None of the bat species known to occur in Ontario are considered to be nationally significant, and are not listed as Species at Risk in Ontario (COSEWIC 2010, OMNR 2009). Based on the Natural Heritage Information Centre (NHIC 2010), both of the tri-colored bat (*Perimyotis subflavus*) and the northern long-eared bat have a provincial S-Rank of S3? (potentially vulnerable within the province), and the small-footed bat (*Myotis leibii*) has a provincial rank of S2S3 which indicates that the species is imperiled to vulnerable within Ontario.

Only one provincially rare bat species, northern long-eared bat, was identified within the Conestogo Wind Farm project area. This species was recorded in very small numbers, with only 7 call sequences of this species recorded during the monitoring program. Even if these 7 calls represent different individuals, it does not satisfy the criteria of a significant maternity roost of more than 20 individuals of this species (OMNR 2009b). It is unlikely that this species has significant colonies within the project area.

6.4 Summary

The results of multi-year bat monitoring at the Conestogo Wind Farm project area has identified relatively consistent passage rates of between 3.0 - 9.0 passes/hr, regardless of the year, monitoring station, or type of detector used. This range of passage rates represents low to moderate bat activity according to other bat monitoring projects conducted by NRSI in southern Ontario.

A total of 5 different bat species have been identified within the Conestogo Wind Farm project area, including hoary bat, red bat, big brown bat, little brown bat, and northern long-eared bat. Several other calls were recorded during both monitoring programs that could not be identified to the species level. These calls typically represent call sequences at an approximate frequency of 30kHz, which corresponds to the big brown bat or silver-haired bat, which are difficult to distinguish based on call characteristics alone.

7.0 Evaluation of Significance

In accordance with the Renewable Energy Approvals (REA), the presence of significant wildlife habitat within the Conestogo Wind Farm project area has been reviewed by NRSI biologists. For the purposes of this report, NRSI focused on significant bat habitat, including potentially significant maternity roosts or winter hibernacula. Based on available project layouts and site plans, described in more detail in Section 8.0 and shown on Figure 1, NRSI identified a total of 3 potentially significant bat habitats within the 120m area of influence of proposed turbine locations. NRSI has used the detailed records review (Section 3.0) and site investigation results (Section 6.0) to evaluate the environmental significance of these features.

7.1 Significant Bat Maternity Colonies

NRSI has used the draft Ecoregion Criteria Schedules addendum to the Significant Wildlife Habitat Technical Guide, (OMNR 2009b) to identify potential areas of significant maternal colonies within the project area. These draft guidelines identify that the presence of 50 little brown bats, 30 big brown bats, 10 female silver-haired bats, or more than 20 tri-colored bats or northern long-eared bats represent a significant maternity colony. Current limitations in acoustic monitoring technology make identification of individual bats extremely difficult. NRSI has used the collection of abundance and species data collected from acoustic monitoring, combined with results of dusk visual surveys, to conservatively determine if these population numbers may exist.

Acoustic monitoring of the habitat northeast of BAT-001 had only two nights that may suggest the presence of a significant maternity roost. On these two nights, June 17/18 and 18/19, 2010, a total of 112 and 72 passes were recorded, respectively. At this monitoring station, more than 64% of all bat passes were of little brown bats. Visual surveys identified no more than 5 individual bats on any survey date. As a result of only two nights where moderate bat activity was observed and very few individual bats observed during visual surveys, NRSI does not consider this habitat to be significant bat habitat.

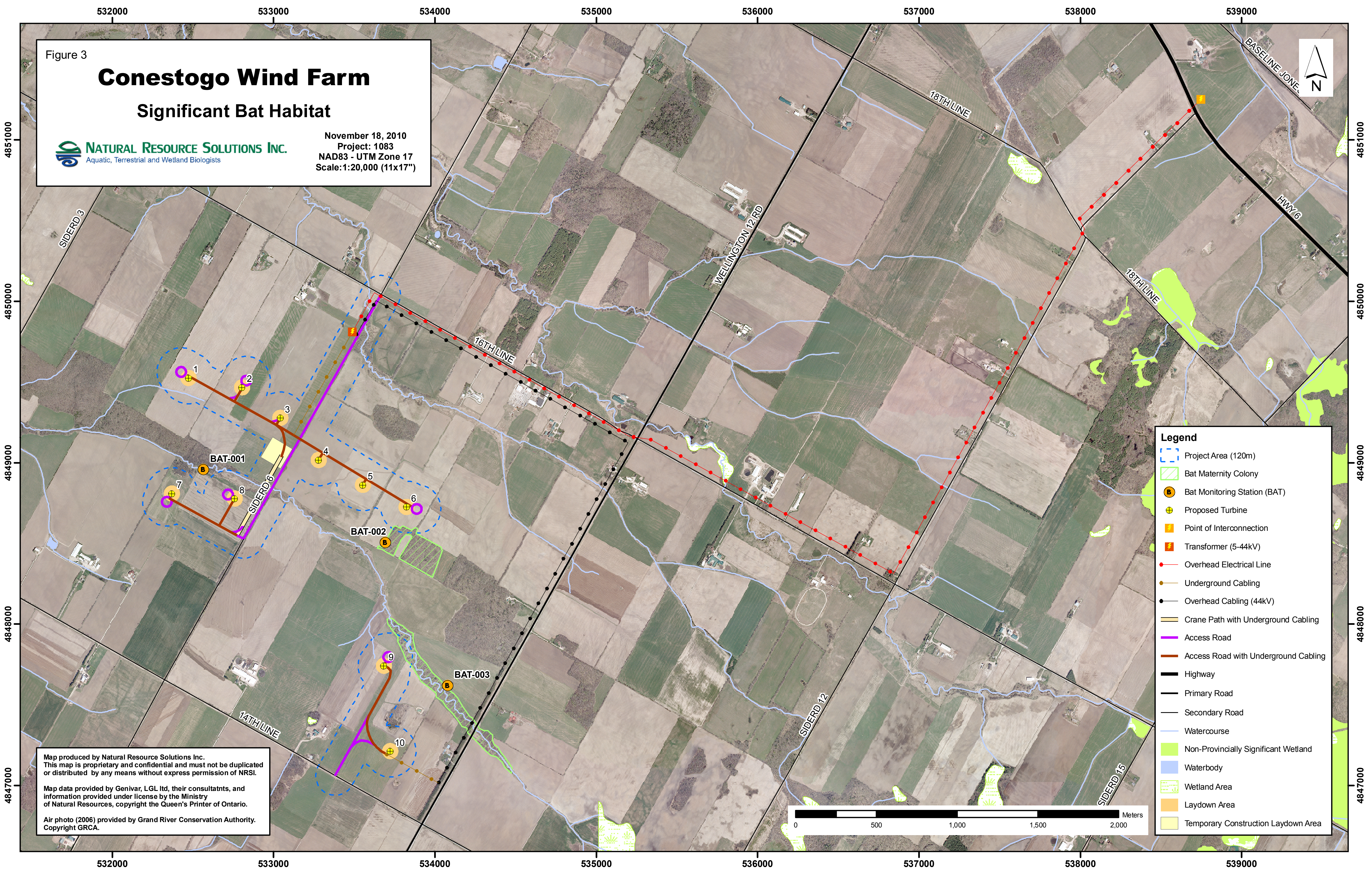
Acoustic monitoring at BAT-002, southwest of T6, resulted in 9 survey nights where more than 30 bat passes were recorded. At this monitoring station, more than 80% of all recorded passes were of species that call at approximately 30kHz, including the big brown bat and/or silver-haired bat. Despite moderate bat activity levels during acoustic monitoring, visual surveys confirmed the presence of only two individual bats foraging along the woodlot edge. Although only a few individuals were observed during visual surveys, the consistent nightly activity of either big brown bat and/or silver-haired bat during the acoustic monitoring period suggests that a significant maternity colony may be present .

Acoustic monitoring at station BAT-003, east of T9, confirmed moderate bat activity on six monitoring nights. During these six nights, at least 30 bat passes were recorded. At this monitoring station more than 85% of all recorded call sequences were of species calling at a frequency of approximately 30kHz, suggesting the presence of either big brown bat and/or silver-haired bat. Although visual call surveys did not confirm more than 2 separate individuals at this station, the consistent recording of more than 30 bat passes each night, of either big brown bat or silver-haired bat, during acoustic monitoring indicates that this habitat may represent a significant maternity roost.

NRSI has reviewed proposed development layouts provided by NextEra Energy, and notes that proposed turbine locations are considerable distances from any of these two potentially significant bat habitats (see Figure 2). Potential impacts to bat populations and habitat are discussed in more detail in 8.0 below.

7.2 Bat Hibernacula

A detailed records review has identified a bat hibernacula more than 20km southeast of the Conestogo Wind Farm project area. NRSI has reviewed 200m of surrounding habitat and landscape features, in accordance with the 2010 draft bat guidance document (OMNR 2010a), around the proposed development activities and has confirmed no suitable hibernacula habitats, specifically abandoned mines or caves. As such, it is unlikely that significant hibernacula are present within 200m of the proposed Conestogo Wind Farm, and no specific hibernacula buffers are recommended for this proposed development.



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7.3 Summary

Based on multi-year and multi-season acoustic monitoring surveys conducted at the Conestogo Wind Farm, NRSI has confirmed that the proposed wind farm is not considered to be a significant bat migration corridor.

Acoustic monitoring results from 2010 suggest that monitoring station BAT-001 is not a significant maternity roost, but that stations BAT-002 and BAT-003 are both near potentially significant bat maternity roosts. A review of proposed development layouts has confirmed that turbine locations, and other project components, are located within 120m of both of these potentially significant bat habitats.

8.0 Impact Assessment

8.1 Description of the Proposed Undertaking

The Conestogo Wind Farm is a proposed 22.91MW wind energy facility located in Mapleton Township, Ontario. The proposed layout includes 10 operational wind turbines and associated access road and underground cabling infrastructure. Each operational turbine will stand approximately 80m to the height of the hub, with a total of three rotating blades, each approximately 49m in length.

The installation of each turbine will involve a subterranean concrete base, and a temporary above-ground lay-down area where turbine components will be stored. Access roads will be gravel and will be placed throughout the project area, to allow for regular maintenance activities at each of the 10 turbines. Cabling will be underground and will primarily follow the placement of the access road. Minor grading activities and site alteration is expected to occur along proposed access road routes and at turbine locations.

Based on current layouts, minor vegetation removal may occur during the construction of the Conestogo Wind Farm and associated infrastructure. Current layouts indicate that any vegetation removal, if necessary, will be limited to hedgerow habitat along lot lines and roadways. No vegetation removal is anticipated to occur in wooded habitats or other naturally occurring vegetation communities. The extent of vegetation clearing, if any, and potential impacts of this project on vegetation communities has been examined by LGL Ltd., and is discussed in more detail in accompanying reports.

The potential environmental impacts to bats and bat habitats associated with the development of the Conestogo Wind Farm have been provided in detail in the following sections.

8.2 Approach to Impact Assessment

The purpose of this report is to focus on bat activity patterns and potentially significant bat habitats. Other aspects of the environmental investigations and impact assessment have been completed by other team members. As such, the following impact assessment has been divided into bat impacts and cumulative impacts relating to bat populations and habitats. Each of these impact types are described further below.

8.3 Bat Impacts

In December 2006, the Ontario Ministry of Natural Resources released a document with information on bat ecology, as well as a literature review of potential impacts (OMNR 2006). Mortality of bat species has been reported at some wind power facilities in North America, and the OMNR indicates that an average of 3.4 bat fatalities per turbine per year are reported from the United States with considerable higher rates (30 bats/turbine/year) at projects within the Appalachian Mountains region. This is further reinforced by Arnett et al (2007) who states that bat fatalities are reported to be highest at wind facilities located on ridges in eastern deciduous forests in the United States. Previous studies have also suggested that clearings that have created edge effects may be favorable to insect congregations and may also aid in a bat's ability to capture them in flight (Arnett et. al 2007). Recent monitoring results from some operational wind energy facilities in Ontario have resulted in higher than expected bat mortalities. These facilities typically represent projects located along major shorelines, and elevated mortality rates have not been observed at inland facilities within Ontario.

Possible explanations for increased bat mortality at wind energy facilities have included the attraction to warmth, lights, or concentrations of insects, however none of these have been found to adequately explain incidents of mortality. A recent mortality study in Alberta suggested that barotrauma played a large role in bat fatalities around wind turbines (Baerwald *et. al* 2008). It was suggested that the rotating turbine blades produce areas of decreased pressure that have the potential to result in tissue damage to any tissue structure that contains air, particularly the pulmonary system. This study suggested that as much as 90% of the bat fatalities observed showed internal injuries that are consistent with pulmonary barotraumas.

In addition to direct impacts to bat populations as a result of collisions with operational blades, wind energy facilities have the potential to indirectly impact bat populations through the loss of habitat. These two potential impacts are discussed in more detail below.

8.3.1 Habitat Loss

The Ministry of Natural Resources identifies significant bat habitat as including caves and abandoned mines, buildings, snags, maternity roosts, and riparian and aquatic habitat (OMNR 2006). In addition to these significant habitats, wooded areas or isolated trees may also provide suitable roosting habitat for some of Ontario's tree-roosting species. Proposed construction layouts indicate that all development activities will occur outside of natural occurring woodlots, including both woodlots identified as having potentially significant maternity roosts. Isolated snags and hedgerows also have the potential to concentrate bat activity and/or support maternity roosts. Vegetation clearing, if necessary, will be limited to a small number of trees within hedgerow habitat, and will not include snags or other significant bat habitat. Available project layouts indicate that turbine placement will be no closer than approximately 80m (measured from closest project component) to the nearest natural community, and more than 105m from turbines to the closest significant bat habitat. Most other turbines are located considerably further from any natural area, at distances of more than 200m.

The avoidance of significant bat habitat and the small amount of potential tree removal proposed for this development is expected to result in minimal impacts to bat habitat and is considered to be not significant.

8.3.2 Bat Collisions with Operational Turbines

A technical workshop entitled “Bats and Wind Power Generation”, conducted in February 2004 identified that bat/turbine interactions are resulting in mortality at some locations. The specifics of these interactions in terms of number, context, etc. are not well known and further research was recommended (Energetics Inc. 2004). However, at many wind farms, bat fatalities have outnumbered bird fatalities, and so the importance of researching bats at wind farms has become extremely important (Arnett 2005, Arnett et al 2004). Furthermore, Arnett *et. al* (2007) has found that bat fatalities at wind energy facilities appear to be distributed across most or all turbines at wind facilities, with no significant trends of collisions reported to date.

The post-construction results from the Melanchton I Wind Plant, which is located in Dufferin County, in a similar habitat approximately 30km northeast of Arthur, ON, yielded an estimated bat mortality rate of 4.4 bats/turbine over a twelve week monitoring period (Stantec Consulting 2008). This value represents a relatively low estimated mortality rate when compared with other operational wind energy facilities in North America (Arnett et al 2007). The results at this facility indicate that the three migratory bat species, hoary bat, silver-haired bat, and eastern red bat, represented approximately 65% of all bat mortalities (Stantec Consulting 2008). This is consistent with the results of Bat Conservation International, which identifies that migratory bat species appear to be the most at risk of collisions with turbine blades (2004).

Results from a two-year post-construction survey at the Erie Shores Wind Farm (James 2008) indicated that bat mortality estimates ranged from 1.05 to 5.8 bats/turbine/year, when searcher efficiency, scavenger removal, and other variables were all taken into consideration. Of all 66 turbines, only four turbines had estimated mortality rates higher than 3.5 bats/turbine/year. In both years of post-construction monitoring, the majority of mortalities were found to be resident bat species, primarily big brown bat, a local and common year-round resident species of Ontario. The combined numbers of the three migratory bat species, silver-haired bat, red bat, and hoary bat, accounted for less than half of the total observed bat mortalities. This report also indicated that turbines placed in close proximity to the Lake Erie shoreline (within 200m) showed higher overall mortality than those placed further inland. The two towers that showed the highest bat mortality were both within 200m of the Lake Erie shoreline. Unadjusted mortality numbers indicated that turbines within 200m of this shoreline had observed mortality rates that were more than twice as high as turbines located more inland.

Significant habitat and concentration factors are expected to act as contributors to increased bat activity. Keeley *et. al* (1999) suggests that areas in close proximity to mines, caves, and expected migration corridors contribute to increased mortality rates at wind energy facilities. A detailed records review and bat monitoring program was used to identify any areas of potentially significant bat roosts within the project area, resulting in the identification of two potentially significant bat maternity roosts. No significant, or potentially significant, migration corridors or hibernacula were documented within the Conestogo Wind Farm project area.

Based on the moderate size of this facility, avoidance of significant bat habitat, and post-construction results of nearby wind energy facilities, the collision impact of this proposed facility on bat populations is expected to be low and not significant.

8.4 Cumulative Impacts

The cumulative impacts of wind energy facilities are largely understudied, and limited information is available on the potential impacts of the development of numerous facilities. However, available information indicates that average mortality rates are unrelated to the total number of turbines. This information indicates that the additional turbines do not correlate to higher average mortality rates, but will instead result in linear increases in mortality.

Another potential cumulative impact is habitat loss. The cumulative impacts of habitat loss is negligible within this area of Ontario since wind energy facilities are primarily located within agricultural habitats, with little or no impact on existing natural communities or significant bat habitat.

Through a review of available information, NRSI is not aware of any other operational wind facilities within Wellington County. NRSI is aware of the Melancthon Wind Plant, which consists of 45 turbines in phase I and 88 turbines in phase II, located in Dufferin County approximately 30km northeast of the proposed development layouts of the Conestogo Wind Farm. In addition to this nearby operational facility, NRSI is aware of several other proposed facilities within 30km of the Conestogo project area, including other proposals located within Wellington County.

Based on the available information on cumulative impacts and the considerable distances of other operational facilities to the proposed Conestogo Wind Farm, the expected cumulative impacts of this project, based on current information, are expected to be low and not significant.

8.5 Impact Summary

The records review, site investigations, and evaluation of significance have all been used to guide the proposed development and assess the potential impacts that the Conestogo Wind Farm may have on the natural environment.

Proposed development activities indicate that one turbines will be approximately 80m (measured from blade tip) to a non-significant bat habitat, two others will be approximately 105m from a potentially significant bat habitat, and all other turbine locations are beyond 120m (measured from blade tip) from any natural area or other significant bat habitat. Access roads are also found considerable distances from natural habitats, and although may result in temporary noise impacts to bat populations, are not expected to result in permanent impacts or disturbances to bat populations. Access roads may cross occasional hedgerow habitat, however removal of trees will be avoided wherever possible and potentially significant bat habitats (including snags) will either be retained or removed during non-sensitive time periods.

The impacts to bat populations within the Conestogo Wind Farm project area will largely consist of potential collision impacts, as habitat loss will be limited to non-significant habitats, specifically hedgerows, and will result in the loss of a minimal number of trees. Collision impacts on bat populations have been studied at several other operational wind energy facilities in Ontario. These facilities have consistently resulted in below average bat mortality rates, including a rate of 4.4 bats/turbine during a twelve week monitoring period at the Melancthon Wind Plant. Pre-construction monitoring results at the Conestogo Wind Farm has identified two habitats that may support significant maternity colonies. The closest turbines to these habitats are approximately 105m (measured from blade tip). The expected impacts to the bat populations at the Conestogo Wind Farm are considered to be not significant.

9.0 Recommendations

9.1 Natural Environment Buffers

The records review and site investigation have been used to evaluate the significance of all natural features found within the project area. Based on the determined significance of each feature, NRSI recommends the following natural environment buffers.

9.1.1 Significant Wildlife Habitat

The results of acoustic bat monitoring have identified two habitats as potentially containing significant bat maternity colonies. Current turbine layouts indicate that the closest turbines to potentially significant bat habitat, T6 and T9, are both located approximately 105m from these habitats, measured from the closest project component, in this case it is the turbine blade tip. All other turbines are located more than 120m from the boundaries of these communities. These distances from turbines to potentially significant bat habitat are considerable and expected to result in low impacts to bat populations and significant habitat within the project area.

9.1.2 Non-significant Natural Communities

NRSI has identified one natural community located northeast of turbine T7 as a non-significant habitat for bats. As such, NRSI recommends that no specific buffer be applied to this natural area, but that the boundaries of this feature are protected from development activities. This natural feature has potential to support small populations of bats, and should be retained if possible. Current layouts indicate that all development activities will be more than 80m from this community.

9.2 Construction and Design Related Mitigation

Based on a complete records review, site investigation, and impact assessment of the proposed development activities, NRSI can provide the following recommendations to ensure all potential impacts to the natural environment are mitigated:

To limit the potential impacts to bat populations within the Conestogo Wind Farm project area, the following mitigation measures are recommended:

1. Vegetation clearing should be kept to a minimum and will be limited to non-significant habitats.

2. Significant bat habitat, including snags, will be avoided during vegetation clearing and construction activities.
3. Lighting of towers and use of strobe lighting will be kept to minimum allowable levels.
4. Turbines should be dismantled at decommissioning.

9.3 Construction Phase Monitoring

During the construction phase of the Conestogo Wind Farm, environmental monitoring should occur ensure recommended mitigation measures are being implemented and adhered to. Construction inspectors should be provided a copy of the Environmental Management Plan (EMP) and should regularly inspect and review erosion and sediment measures, vegetation removal practices, prescribed buffers, and other environmental protection measures.

9.4 Operations Monitoring

In accordance with Ministry of Natural Resources guidelines, a comprehensive post-construction monitoring program should be implemented at the Conestogo Wind Farm. Based on the size of this project (10 turbines), all turbines should be searched for avian and bat mortality. The *Bat and Bat Habitats* document prepared by the MNR identifies that at least 3 years of post-construction mortality monitoring from May 1st to September 30th is required to assess the potential impacts to bat populations (OMNR 2010a). The detailed post-construction monitoring program should be prepared through consultation with both Environment Canada and the Ministry of Natural Resources, following the appropriate guidance documents (EC 2007, OMNR 2010a).

10.0 Summary and Conclusions

A detailed assessment of the bat habitats and bat activity within the proposed Conestogo Wind Farm occurred through the use of a records review, comprehensive site investigation, and evaluation of significance by Natural Resource Solutions Inc. biologists, with reference to preliminary acoustic monitoring conducted by Pandion Systems, Inc.

The proposed Conestogo Wind Farm is a 22.91MW wind energy facility located in the County of Wellington, Ontario, and consists of the proposed installation of 10 wind energy turbines and associated infrastructure, primarily in agricultural habitat. In accordance with the Renewable Energy Approval (REA) regulations, a records review, comprehensive site investigations, and evaluation of significance were all completed at the Conestogo Wind Farm. This information has been compiled into this *Bat Monitoring Report and Environmental Impact Study*. Bat monitoring at this proposed facility began in 2007, and included comprehensive acoustic surveys and visual dusk surveys to characterize the existing bat habitats within the Conestogo Wind Farm. The results of these field studies have been compared to available guidance documents to assess the significance of the natural features within the project area.

The results of the preliminary site investigation identified that three potentially significant bat habitats within the 120m consultation zone outlined in the REA regulations. In order to confirm significance, extensive bat monitoring occurred at each of these locations to examine bat activity. One of these stations had relatively low passage rates with species composition dominated by the little brown bat. The other two monitoring stations had moderate bat activity with call sequences primarily of species that call at approximately 30kHz, likely the big brown bat. As a result, NRSI recommends that the natural community at the western edge of the project area be considered non-significant as a result of consistently low bat activity during both the acoustic and visual surveys. NRSI recommends that the two other habitats monitored for bat activity be considered significant bat maternity colonies due to consistent moderate bat activity, likely of the big brown bat.

NRSI recommends that non-significant natural areas, including the wooded habitat northeast of T7 with low bat activity, be protected from development activity without any additional buffer to protect bat populations. The two habitats deemed potentially significant maternity colonies are both located beyond 105m from turbine placement. Other natural habitats, deemed non-significant bat habitat, are located more than 80m (measured from blade tip) from proposed turbine locations. These considerable distances are expected to result in low impacts to bat populations at the Conestogo Wind Farm project area.

In addition to the placement of turbines considerable distances from these habitats, NRSI has recommended numerous mitigation measures, including the implementation of an erosion control plan, avoidance of removal of significant bat habitats (i.e. snags), and recommended turbine lighting levels, that will further assist in limiting the potential environmental impacts of the Conestogo Wind Farm.

Providing that the appropriate recommendations are followed and that best management practices are implemented, the anticipated impacts of this facility on natural areas and local wildlife are expected to be minimal.

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Appendix I

Bat Monitoring at the Proposed Conestogo Wind Farm in Wellington County

Pandion Systems, Inc. 2007

Bat Monitoring at the Proposed Conestogo Wind Farm in Wellington County, Ontario

Fall 2007

FINAL REPORT

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EXECUTIVE SUMMARY

Per guidelines set by the Ontario Ministry of Natural Resources (OMNR), FPLE Canadian Wind, ULC has been tasked with performing pre-construction monitoring for at least 15 nights during the months of August and September at the proposed wind farm location; Conestogo Wind Farm in Wellington County, Ontario, Canada. Objectives consisted of documenting baseline bat activity within the project area and examining activity by resident and long-distance migratory bat species.

Acoustic monitoring was performed to address these objectives by using Anabat and Pettersson ultrasonic detectors attached at varying heights to two (2) met towers within the project area. A Pettersson and Anabat unit was placed at each met tower with Pettersson units placed at 20 meters off of the ground while Anabat units were placed at 40 meters off of the ground. A total of 276 bat passes were recorded during the period of 15 August 2007 to 14 September 2007. When bat activity was partitioned between resident and migratory species, activity by resident species was considerably lower than migratory species. Migratory activity was not uniform throughout the monitoring period and resulted in certain days with high activity recorded mostly at heights of 40 meters.

Overall activity levels resulted in 6.00 bat passes/detector/night and 0.50 bat passes/detector/hour for nights solely with recorded data. These activity rates were considered to be low and were lower when compared to hourly rates from a nearby pre-construction monitoring study conducted at a proposed wind farm site in Dufferin County, Ontario. This data is in agreement with the preliminary likelihood assessment and screening report (LGL Limited 2007), which suggested that the habitat within the project area had low potential for bat use especially by resident bat species. Nonetheless, post-construction monitoring should be performed to fully assess whether or not an impact on bats is present by the proposed Conestogo Wind Farm.

INTRODUCTION

Recently, the impact of wind energy projects on bats has become a concern due to an unexpected high number of bat fatalities found at a number of functional wind energy facilities (Arnett 2005; Kunz et al. 2007b). These results have been produced mostly from post-construction mortality surveys performed at a number of wind farms in the eastern United States. Yet, comparable results have also been found in a recent study of agricultural areas in southwestern Alberta, Canada (CWEA 2006; Kunz et al. 2007b). Most of the fatalities from these studies comprised of migratory species and were found during the fall migratory period. Known species included in fatalities at wind projects are big brown bats (*Eptesicus fuscus*), little brown bats (*Myotis lucifugus*), northern long-eared bats (*Myotis septentrionalis*), eastern pipistrelle (*Pipistrellus subflavus*), Mexican free-tailed bats (*Tadarida brasiliensis*) and migratory tree-roosting bats such as; eastern red bat (*Lasiurus borealis*), hoary bat (*Lasiurus cinereus*), silver-haired bat (*Lasionycteris noctivagans*), western red bat (*Lasiurus blossevillii*), and Seminole bat (*Lasiurus seminolus*) (Arnett 2005; Johnson 2005; Piorkowski 2006). Questions remain as to how bats are being killed by wind turbines and to what degree bat populations are being affected.

Due to these findings, pre-construction monitoring is essential in understanding the current levels of bat activity as well as in projecting potential levels of bat mortality once pre-construction monitoring has been compared to post-construction monitoring. Per the guidelines of the Ontario Ministry of Natural Resources (OMNR), bat pre-construction monitoring is to be performed during the fall 2007 migratory period at the proposed wind project location; Conestogo Wind Farm in Wellington County, Ontario, Canada, based on the following objectives:

Objective 1. Document baseline use by bats within the Wind Project Area

Objective 2. Partition activity by non-migratory (typically resident) bats from long-distance migratory species

Objective 1 is necessary to document bat activity as it potentially relates to general bat and turbine interactions and site specificity. Objective 2 is necessary because current knowledge based on post-construction mortalities indicate that long-distance migratory species are at the most risk. An initial likelihood assessment of the proposed location of the Conestogo Wind Farm indicates that the site has a low potential for bats (LGL Limited 2007). Nonetheless, the OMNR has suggested pre-construction monitoring be performed to assess the potential bat activity in the area. A total of 8 species of bats occur in Ontario consisting of resident and migratory species (Gerson 1984; Table 1). Of these 8 species, 3 species are considered sensitive/at risk under provincial rankings (S-rank).

Common Name	Species Name	Ontario General Status	G-rank S-rank
Eastern Pipistrelle	*Pipistrellus subflavus*	Sensitive	G5, S3?
Northern Long-eared Myotis	*Myotis septentrionalis*	Sensitive	G4, S3?
Eastern Small-footed Myotis	*Myotis leibii*	May be at Risk	G3, S2/S3
Little Brown Myotis	*Myotis lucifugus*	Secure	G5, S5
Eastern Red Bat	*Lasiurus borealis*	Secure	G5, S4
Hoary Bat	*Lasiurus cinereus*	Secure	G5, S4
Big Brown Bat	*Eptesicus fuscus*	Secure	G5, S5
Silver-haired Bat	*Lasionycteris noctivagans*	Secure	G5, S4

Table 1. List of bat species possibly found in the project area with sensitivity status. Status information taken from "Wind Power and Bats: Bat Ecology Background Information and Literature Review of Impacts" (OMNR 2007).

METHODS

Passive Acoustical Monitoring

Passive acoustical monitoring was performed to obtain approximately 15 nights of recording within the months of August and September 2007 according to the guidelines suggested by OMNR by placing bat detectors on meteorological or 'met' towers within the project area, as stated in the "Conestogo Wind Farm Proposed Pre-Construction Bat Monitoring Workplan." The two met towers used in this study were Met Tower 12, which is located near 25 Sideroad and Jones Baseline Road, and Met Tower 13, which is located on 21 Sideroad between Fourteenth Line and Sixteenth Line (Figure 1A and 1B). These two towers are both located in agricultural fields, which is representative of the surrounding area.

Choice of placing the ultrasonic detector on the met tower was made due to the ability to record bat echolocation calls at a level relatively near the potential turbine rotor sweep and to record the activity of potentially migrating bats, since mortalities of migratory species have been found to be highest at wind project sites (Kunz et al. 2007b). In addition, migrating bats have been suggested to fly up to heights of 100 meters and the number of bat fatalities has been shown to increase exponentially with turbine height (Barclay et al. 2007). Site choice was made based upon the location of the met towers, which are in the vicinity of representative habitat types of the project area; agricultural, wooded patches, and water courses. Monitoring within these habitats will essentially provide information on bat activity of these representative areas.

Bat detectors consisted of two types of systems; one (1) Anabat Bat Detection System (Titley Electronics, Ltd.) and one (1) Pettersson D240X (Pettersson Elektronik AB) attached to each met tower for a total of four (4) systems. Although, these two systems provide different methodologies in the acquisition of ultrasonic calls, both have been

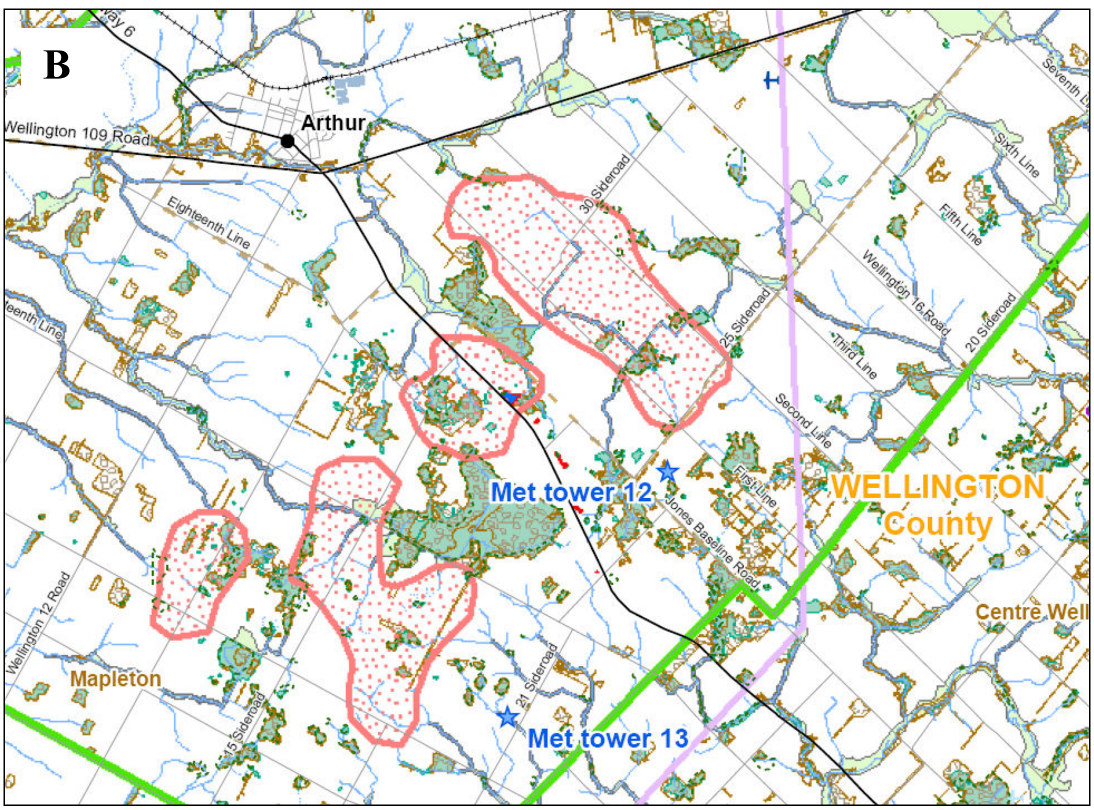

Figure 1. Map of project area. (A) Map of "Environmental Features for Bat Study FPL Energy – Conestogo Wind Farm." (B) Enlarged area on map where bat detectors were placed on met towers 12 and 13.

widely used in the acoustic monitoring of bats. The Anabat system is comprised of the Anabat II bat detector connected to the Zero Crossing Analysis Interface Module (ZCAIM) to extract frequency and time information of bat echolocation. Long-term use can be obtained by the system's capability to use large 12 Volt batteries and minimal data burden. The Anabat II bat detector is a frequency-division detector which allows for detection of frequencies of 10-200 kHz within the range of 30 meters depending on the quality of the sound. In contrast, the Pettersson D240X is a time-expansion detector that retains the full information of the acoustic signal, yet due to its acquisition technique it may not record every passing bat. The Pettersson D240X is also constrained by limited battery power (one 9-Volt type) and high data burden. The Pettersson D240X has a detection range comparable to that the Anabat system yet sensitivity maybe variable depending on the quality of the sound. The Pettersson D240X is capable of detecting frequencies in the range of 10-120 kHz. Due to the frequency range of both systems, the detection of a diversity of bat species is possible.

Components of the Anabat system, a microphone with a 50 meter audio cable, allow for it to be attached up near 50 meters in height without having to raise and lower the unit. The Pettersson D240X does not allow for a microphone extension, thus the entire unit would have to be raised up to desired heights. Hence, the Anabat system was used to survey at the greater height while the Pettersson unit was used to survey at the lower height. Using a boom/pulley system that was attached to the met tower by GENIVAR personnel, the Anabat units were placed approximately 40 meters off of the ground. Anabat microphones were sheltered from weather and placed pointing downward towards a Lexan polycarbonate plate for reflection of sound. The plate was pointed approximately 45° in reference to the microphone to reflect sound coming generally above the microphone. This placement was used to assist in surveying a greater distance of airspace up towards the theoretical turbine sweep zone. The Anabat system did not have to be lowered in order to acquire the data. Sound files recorded with the Anabat system were stored onto a compact flash (CF) memory card within the ZCAIM. A 256 MB (megabyte) CF card was used to facilitate the collection of bat calls during extended periods of recording. The compact flash card and ZCAIM were programmed to start recording an hour just before sunset and to stop recording an hour after sunrise.

The Pettersson D240X with accompanying digital recorder (iRiver) was placed approximately 20 meters off of the ground using a semi-permanent housing installation with a pulley system. The housing provided shelter for the unit and the unit was placed pointing downward towards a plexi-glass plate for reflection of sound. The plate was pointed approximately 45° in reference to the microphone to reflect sound coming generally above the microphone. Again, this placement was used to assist in surveying a greater area of airspace. Recording with the Pettersson D240X was performed by connecting it to an iRiver digital recorder. Sound files were stored within the iRiver until retrieval. Due to the constraint of battery power for these systems, they had to be checked more frequently (every 3 days) compared to the Anabat systems. LGL Limited personnel performed the maintenance of all systems, change of batteries, download and maintenance of data.

Data Analysis

Analysis of recorded calls was performed to assess the species composition and relative activity of the bat fauna within the project area. Qualitative analysis of recorded echolocation calls from the Anabat system was performed using AnalookW bat call analysis software, version 3.3m (Corben 2006). Analysis of Pettersson data was performed using Sonobat version 2.5 (DNDesign 2000). Sound files were visually screened to remove files of non-bat calls, so that only suitable bat calls remained. Call files were examined visually, compared to libraries of known bat reference calls, and assigned to species or when a single species could not be deciphered from the call these calls were assigned to species-group categories. Assignment of a call to a species was possible only when clear calls were recorded and only with certain species. Fragmentary, unclear or calls that were assignable to more than 3 species were designated as "unknown."

To address objective 1, call rates by species, as well as total detections and trends in species' presence in the data were analyzed. To quantify rates and put call data in a comparable context to other studies, two indices were calculated; an index of average bat passes per night (ABN index) and an index of bat passes per hour (ABH index). Each index was calculated by using only the nights with recorded data and for each individual system. When calculating for bat passes per hour, twelve (12) hours were surveyed per night of data. Additionally, to address objective 2 species were classified as resident or migratory for discrimination between activity rates by these species.

RESULTS

From the combined two (2) Anabat systems and two (2) Pettersson/iRiver setups, a total of 4,405 sound files were recorded within a period from 15 August 2007 to 14 September 2007. Visual examination and filtering of files to eliminate extraneous noise (i.e. wind, insects, etc.) resulted in 276 bat passes between all of the systems at both met towers recorded over 19 nights. The number of bat passes recorded does not necessarily constitute the number of bats present, that is, a single bat could possibly make several passes within a night.

To quantify bat activity rates, the total number of bat passes was divided by the number of nights and the number of hours for nights with recorded data for each individual acoustic unit (ABN index and ABH index; Table 2A and 2B). Comparison between the Anabat and Pettersson systems reveal a drastic difference in the number of bat passes recorded. The low number of calls could be attributed to a combination of the lower number of days that the Pettersson was allowed to record due to battery power limitations, height at which the unit was placed, and difference in way the system acquired data. Based on the Anabat unit results, met tower 13 showed a higher index while based on the Pettersson unit data met tower 12 had a slightly larger value. When values are averaged for each met tower, met tower 12 has an ABN index of 4.95 and met tower 13 has an ABN index of 7.05. When values are averaged for the overall data, the ABN index is 6.00. ABH index values for overall rates were 0.50, which translates to on average less than 1 bat passing the microphone per hour. Generally, twelve (12) hours were surveyed per night of data.

For general consideration of species composition and migratory activity within the project area, bat passes were classified into the following 8 designations (Figure 2):

HOBRSI – Hoary, brown and silver-haired bat group
HOSI – Hoary and silver-haired bat group
BROSI – Brown and silver-haired bat group
HOAR – Hoary bat
SILVER – Silver-haired bat
RED – Eastern red bat
MYOTIS – Myotis bat group
Unknown – unassignable to species or species group

A - Nightly		Total Bat Passes	No. of Nights Recorded	ABN Index
Anabat	Met 12	71	10	7.10
	Met 13	183	16	11.44
Pettersson	Met 12	14	5	2.80
	Met 13	8	3	2.67

B - Hourly		Total Bat Passes	No. of Hours Recorded	ABH Index
Anabat	Met 12	71	120	0.59
	Met 13	183	192	0.95
Pettersson	Met 12	14	60	0.23
	Met 13	8	36	0.22

Table 2. Overall bat activity indices. (A) Bat activity based upon number of bat passes and number of nights solely with recorded data. (B) Bat activity based upon number of bat passes and number of hours for nights with solely recorded data. “Total Nights Surveyed” and “Total Hours Surveyed” includes nights that were monitored and did produce any recorded data. Twelve (12) hours were surveyed per night.

Bat passes were put into the most specific category when possible as sufficient data allowed, for example a bat pass with specific enough data could be put into the category HOSI rather than HOBRSI. Percent species/species group composition from the combined data of the two met towers was as follows from highest to lowest; HOBRSI (n = 84), HOAR (n = 84), BROSI (n = 18), HOSI (n = 10), MYOTIS (n = 6), SILVER (n = 4), and RED (n = 2) (Figure 2). Unknown calls represented 25% (n = 68) of the total detections due to a large number of fragmentary calls.

To examine activity between resident and migratory species, species or species groups were classified as 'Resident' or 'Migratory' (Figure 3). Residents consisted of the MYOTIS, while 'Migratory' were made up of HOAR, HOSI, SILVER, and RED. The 'Resident/Migratory' category consisted of HOBRSI, BROSI, and Unknown. These groupings contained species that are either resident or migratory, because insufficient data to distinguish between the species. Peak activity was found on 5 nights; 15, 18, 23, 27, and 29 August 2007 (Figure 3) and commonly at heights around 40 meters in the vicinity of met tower 13 (Anabat units; Figure 4). Activity on these nights can be attributed to bat passes recorded from migratory species and species categorized within the 'Resident/Migratory' group. These migratory species consist primarily of hoary bats (HOAR; HOBRSI) and potentially silver-hair bats (HOBRSI) (Table 3).

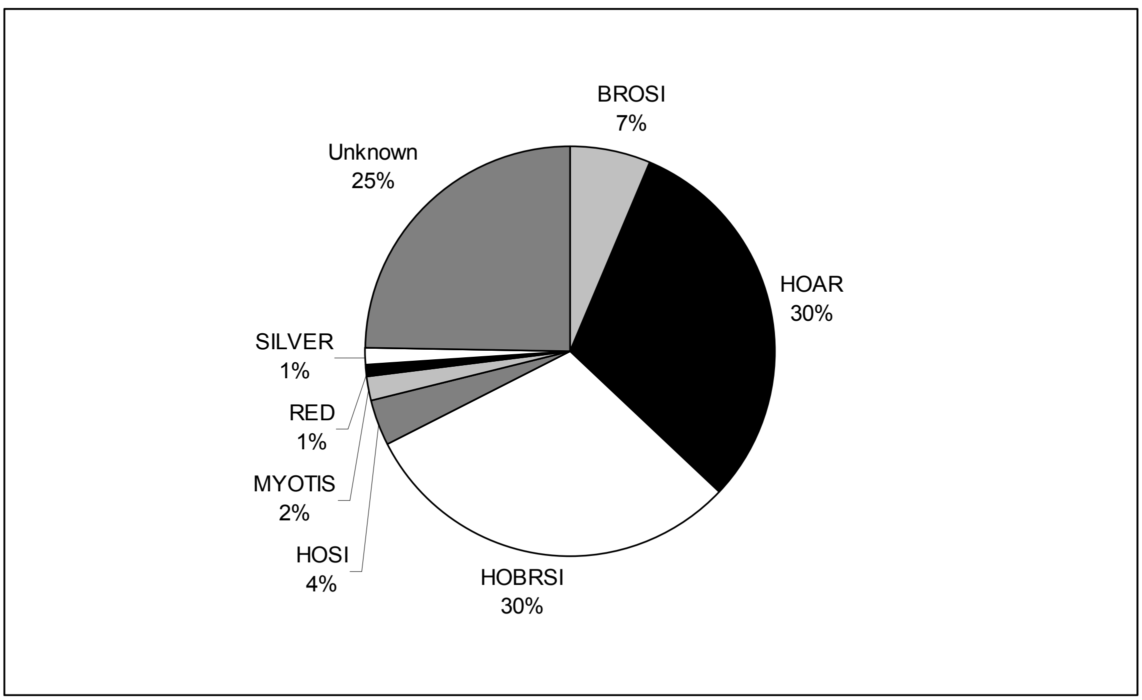

Figure 2. Percent composition of species and species groupings from overall bat passes.

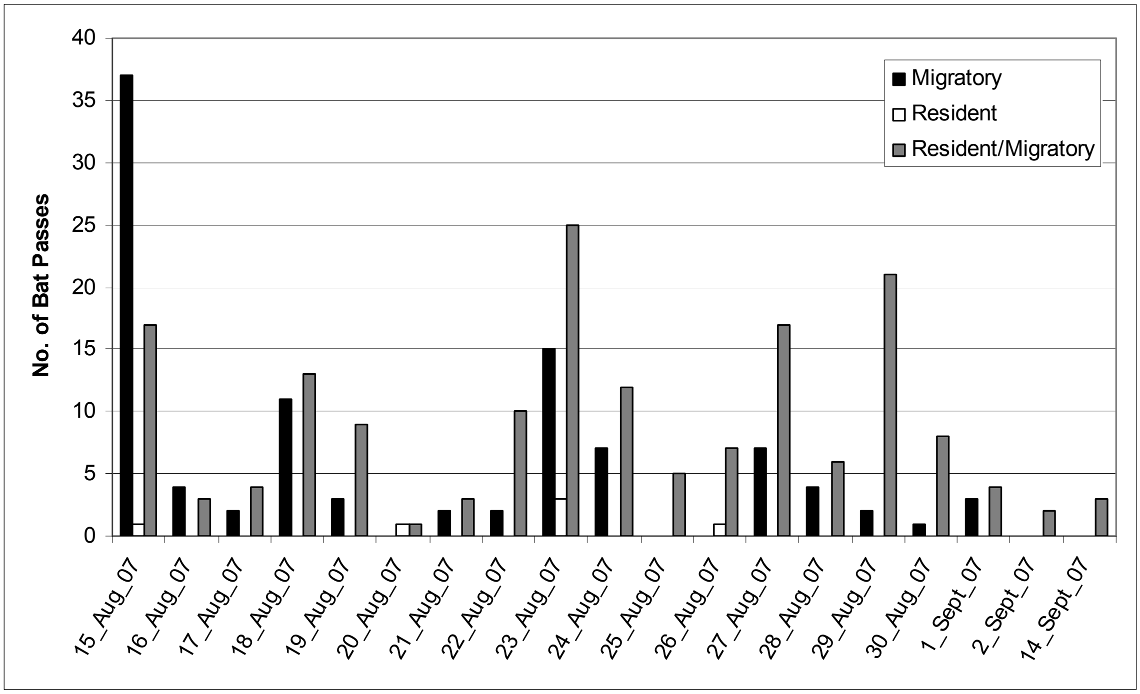

Figure 3. Nightly total of bat passes classified into resident or migratory.

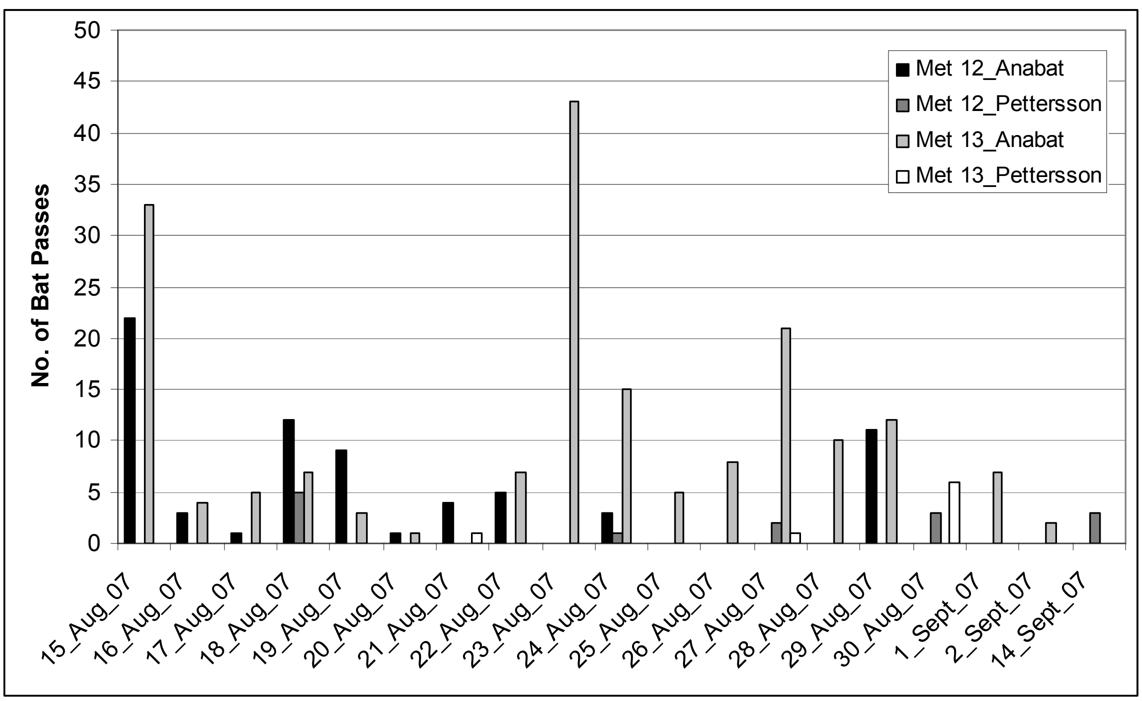

Figure 4. Nightly total of bat passes per individual detector unit.

Dates	Species/Species Group Categories								TOTAL
	BROSI	HOAR	HOBRSI	HOSI	MYOTIS	RED	SILVER	Unknown	
15-Aug-07	4	35		1	1		1	13	55
16-Aug-07		4	1					2	7
17-Aug-07		2						4	6
18-Aug-07	4	10	3			1		6	24
19-Aug-07	1	3	1					7	12
20-Aug-07	1				1				2
21-Aug-07		2						3	5
22-Aug-07		2	6					4	12
23-Aug-07		9	23	6	3			2	43
24-Aug-07		5	11	1			1	1	19
25-Aug-07			3					2	5
26-Aug-07			1		1			6	8
27-Aug-07	2	4	8	2			1	7	24
28-Aug-07		4	4					2	10
29-Aug-07		2	15					6	23
30-Aug-07	5		3				1		9
1-Sep-07		2	2			1		2	7
2-Sep-07			1					1	2
14-Sep-07	1		2						3

Table 3. Number of bat passes per species/species group on dates with recorded data.

DISCUSSION

In accordance with the objectives, acoustical monitoring during the fall 2007 season was performed to document baseline bat activity in the project area of the proposed Conestogo Wind Farm in Wellington and Dufferin Counties, Ontario, Canada. Species (described by species group) that were detected in this study consisted of species that potentially occur in the project area based on existing distributional records (Gerson 1984; OMNR 2006). In Ontario, three bat species (eastern pipistrelle, northern long-eared myotis, and eastern small-footed myotis) have a sensitive/at risk status by provincial rankings. None of these species were specifically detected in the study, yet a trivial number of bat passes (n = 6) were detected and classified to the MYOTIS group. These calls could possibly be due to the more common little brown bat. The majority of calls detected in this study were by species not labeled as sensitive by provincial rankings.

The resulting level of bat activity was variable depending on detector type. In the case of detector type and location of the detector, low number of recorded bat passes by the Pettersson units is complicated by a combination of recording on fewer nights, height placement, and possibly lower sensitivity of the detector. Yet, higher activity recorded by the Anabat units (those placed at greater heights) could be the result of higher activity of migrating bats since migrating bats are believed to fly at heights up to 100 meters (Barclay et al. 2007). In general, bat activity was similar in the proximity of met towers 12 and 13 with slightly more bat passes detected at met tower 13 on a per night basis.

When acoustic data was partitioned between resident and migratory species, this suggested that the majority of activity was more attributable to migratory species which mainly consisted of the HOAR and HOBRSI groups. A considerable number of bat passes were recorded for hoary bats (HOAR) alone. The group HOBRSI consisted of hoary, big brown and silver-haired bats. Hoary and silver-haired bats are species considered to exhibit long-distance migratory behavior (OMNR 2006). Both species are among the most reported in fatalities from wind energy facilities in the United States (Kunz et al. 2007b). Alternatively, big brown bats were also included in this grouping (HOBRSI) and have made up a small percentage of those found among the reported fatalities (Kunz et al. 2007b). Nonetheless, migratory activity appeared episodic and resident activity was considerably low which is in agreement with the preliminary likelihood assessment and screening report (LGL Limited 2007), which suggested that the habitat within the project area had low potential for use by resident bat species.

The overall rates of bat activity detected in the present study reveal relatively low activity. The monitoring results demonstrate that on average between 3 and 11 bat passes could be detected during the night (ABN index; Table 2) and between 0 and 1 bat passes could be detected during an hour (ABH index; Table 2). These rates are lower than rates (average of 1.5 passes/hour with highest rate of 2.7 passes/hr) detected in a nearby pre-construction monitoring study for a proposed wind farm in the Township of East Luther Grand Valley, Dufferin County, Ontario (Environmental Business Consultants 2008). A projection of expected post-construction bat activity and/or mortality could not be determined because of the current lack of data. To date, a thorough study has not been completed to demonstrate the correlative nature between pre-construction acoustic bat pass rates and post-construction mortality rates.

Given the make up of the habitat in the project area, bat use could be variable. The majority of the project area is made up of agricultural open areas. Hoary and big brown bats could potentially forage in this area, since they have been known to forage in open areas (OMNR 2006). Additionally, a large percentage of a hoary bat's diet is made up of moths, which some moth species are considered agricultural pests. Hoary bats have been suggested to consume these moth species in agricultural areas (Tuttle 1995). A dearth of knowledge is known on bat use in agricultural areas, yet some studies have shown some considerable levels of activity (Cleveland et al. 2006; Gehrt and Chelsvig 2003). The presence of woodlands can potentially provide foraging and roosting habitat for all 8 species of bats expected in the project area. Riparian and aquatic areas also provide considerable habitat for all 8 species as potential foraging and drinking sites. Buildings, such as barns and houses, may provide habitat for big brown, little brown, and eastern small-footed bats, since these species have been known to roost in man-made structures (OMNR 2006). Yet, based on the preliminary likelihood assessment and screening report, woodlands, riparian/aquatic, and buildings were considered to provide low habitat use by bats in the project area (LGL Limited 2007). Nonetheless, turbine placement should be determined with distances away from woodland and riparian/aquatic habitat since these areas can potentially provide the habitat with the most use by bats.

The detailed post-construction monitoring protocol will be developed in discussions with MNR.

CONCLUSION

In accordance with the preliminary likelihood assessment and screening report, bat use is considered low for the project area. Rates of bat activity detected in the project area indicate lower rates than those reported in a nearby pre-construction monitoring study conducted at a proposed wind farm site in Dufferin County, Ontario. Bat activity as determined by this acoustic monitoring survey suggests the majority of activity is by migratory species recorded at heights approximately at 40 meters and that activity by migratory species is episodic. Post-construction monitoring should be performed to fully assess whether or not an impact on bats is present by the proposed Conestogo Wind Farm.

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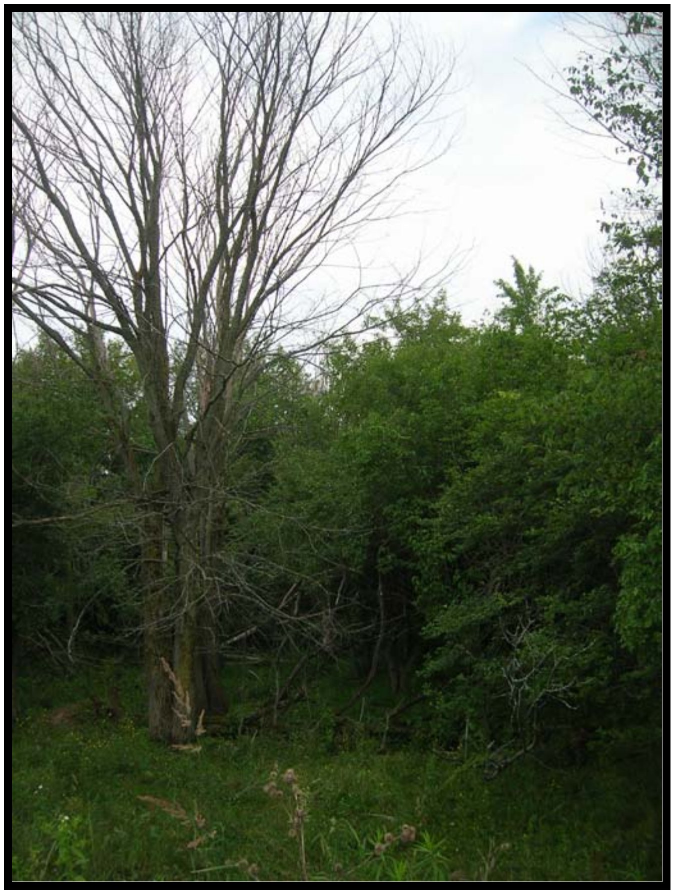
Appendix II
Bat Monitoring Station Photographs

BAT-001: Facing North at Two Deciduous Snags along Creek Corridor

BAT-002: Facing East at Two Deciduous Snags along Wooded Edge



BAT-003: Facing Southeast at Deciduous Snag in Open Woodlot Pasture

Appendix III
Corporate CVs

ANDREW G. RYCKMAN, B.Sc.
TERRESTRIAL AND WETLAND BIOLOGIST

EDUCATION

- Bachelor of Science, Honours, Zoology (2004), University of Guelph, Guelph, Ontario

CERTIFICATIONS

- Ecological Land Classification for Southern Ontario, OMNR (September 2010)
- Bat Acoustic Monitoring Workshop, Bat Conservation International (July 2008)

AREAS OF PROFESSIONAL EXPERIENCE

Andrew is a terrestrial and wetland biologist with extensive experience working on a variety of environmental projects. He has managed numerous projects in Ontario, Manitoba, and Alberta, and routinely oversees and completes natural area inventories, vegetation community mapping, and surveys of bats, reptiles, amphibians, plants, breeding and migrating birds, and terrestrial mammals. He has worked in a variety of sensitive and rare habitats and is capable of identifying conservation targets, realizing potential habitat for rare species, and addressing potential threats and providing appropriate mitigation measures.

Andrew provides expertise in the following areas:

- inventories of wetland and terrestrial biological resources.
- identification of significant and sensitive natural areas and species.
- analysis of interrelations between biological and physical components of ecosystems.
- analysis of environmental impacts on wetland and terrestrial resources.
- management plans for significant species and habitats.
- rehabilitation of disrupted habitats.
- impact mitigation in sensitive habitats.

Terrestrial and Wetland Ecosystem Studies

The assessment of terrestrial ecosystems and associated wildlife is Andrew's primary area of expertise. He routinely characterizes vegetation communities, sensitive habitats, and conducts inventories of bats, reptiles, birds, amphibians, terrestrial mammals, and vascular plants. He has applied Ecological Land Classification on many projects in southern Ontario, northern Ontario and Manitoba. Andrew has participated in wetland studies, including wetland delineation. He is experienced with aerial photographs and community mapping and is able to use these resources as navigational and field work aids.

Andrew's specific expertise includes:

- inventories and mapping of terrestrial and wetland vegetation communities, fauna, and soils.
- design and coordination of vegetation surveys in natural, fragmented, and wilderness habitats.
- field and laboratory identification of plants in Ontario and Manitoba.
- identification of conservation targets, threat assessments, and sensitive and significant habitats.
- development and undertaking of conservation and restoration plans.
- design and implementation of management plans.
- analysis and determination of wetland buffers and setbacks.

Wildlife Studies
Andrew has worked extensively with reptiles and amphibians, birds, mammals, butterflies, and dragonflies. He has worked closely with a variety of reptile species including COSEWIC listed species such as eastern fox snake, black rat snake, and spotted turtle. He has strong amphibian auditory identification skills, and has taken part in numerous amphibian call surveys. Andrew also has considerable experience conducting bird point count surveys, migration monitoring, and breeding bird surveys. Andrew specializes in bat surveys and has experience with a variety of bat monitoring techniques, including extensive experience with major acoustic bat monitoring systems. He is trained in acoustic bat monitoring and sonogram recognition and is comfortable with a variety of bat analysis software packages. Andrew has helped create a comprehensive reference call library using recorded bat sonograms and call sequences. Andrew has worked on site rehabilitation plans that incorporate specific habitat requirements for herptiles and butterflies, and has organized and led butterfly inventories, identifying species distributions, densities, and diversity.

Andrew’s specific expertise includes:

- field surveys and acoustic call analysis of bats.
- strong visual and auditory identification skills for surveying herpetofauna and birds.
- identification of significant or preferred habitat for sensitive or significant species.
- comprehensive impact assessment and proposed mitigation measures.
- background review, agency consultation, and work program preparation.

Wind Power Projects
Andrew has managed and participated in numerous Environmental Screening Reports and Environmental Assessments for proposed wind generating facilities in Ontario, Manitoba, and Alberta. He routinely deals with federal, provincial, and regional agency staff during the monitoring process, and works closely with these agencies to develop monitoring programs based on specific site characteristics. Andrew has completed the full range of biological analysis including monitoring of bats, birds, herpetofauna, mammals, butterflies, as well as vegetation community mapping. He uses the environmental characterization reports to address potential impacts of proposed facilities and works closely with the developers to establish any recommended follow-up monitoring. Andrew has also managed post-construction monitoring at operational facilities, producing detailed reports on the estimated impact on bird and bat populations.

Andrew’s specific expertise includes:

- development and implementation of full biological work programs.
- impact assessment, follow-up recommendations, and mitigation measures.
- agency consultation, public meetings, and open houses.
- during construction and post-construction monitoring.

EMPLOYMENT HISTORY

Terrestrial and Wetland Biologist
Natural Resource Solutions Inc., Waterloo, Ontario. 2005 to present

Field Technician
Nature Conservancy of Canada, Peterborough, Ontario 2005

Naturalist Interpreter
Ontario Parks / MNR, Awenda Provincial Park, Midland, Ontario 2004