Bat Monitoring Report (2006 – 2008)
Flesherton Wind Farm Project

Prepared for:
Flesherton Wind Farms Inc.
c/o Environmental Business Consultants
Mississauga, Ontario

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NATURAL RESOURCE SOLUTIONS INC.
Aquatic, Terrestrial and Wetland Biologists

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1.0 Introduction

Natural Resource Solutions Inc. (NRSI) was retained by Flesherton Wind Farms Inc. in April 2006 to conduct a review of natural environment resource issues that might influence the location, potential impacts, and mitigation of a proposed wind power generating facility in Grey County, Ontario. The analysis of biological factors affecting the proposed site is just one issue being considered. Other factors under consideration include wind dynamics, land ownership, and social impacts.

This report summarizes the findings of background reviews relating to bats as well as bat field studies that have been ongoing for this project since 2006. Extensive work on birds, vegetation and other wildlife was conducted by NRSI concurrently, and results of these field investigations are summarized in the following reports:

- Baseline Bird Behaviour Monitoring Report (February 2009) prepared by NRSI
- Flesherton Wind Farm Environmental Screening Report (March 2009) prepared by Environmental Business Consultants.

The specific extent of land leases, as well as the locations for proposed turbines, access roads, and other ancillary facilities were either unknown during much of the time of conducting field work, or changed over the course of the study. Access to private land was available in 2007 and 2008, but not in 2006. When possible, field surveys were completed by walking throughout the study area, although at other times only road-side surveys were feasible. Inclusion of the lands in the biological study does not imply that all lands are being considered for wind turbines.

2.0 Study Area

The Flesherton Wind Energy Project is located in Grey County, Ontario, just northeast of the Town of Flesherton. Originally the Flesherton Wind Energy Project was comprised of two separate land parcels. After several changes to the project area, it was reduced to a smaller land parcel of approximately 64ha on April 15, 2008. The current study area is located northeast of the 35th Sideroad and 8th Concession intersection (see Figure 1 for both the old and new study area boundaries).

The study area is primarily used for agricultural purposes and is mainly comprised of agricultural lands, consisting primarily of rotational cash crops, along with some grazing pasture, hayfields, and naturally vegetated communities. Also present within the study area are occasional woodlots, wetlands, hedgerows, small ponds and farm structures. The turbines for this project and their access roads are all proposed to be situated within agricultural lands.

Figure 1. Study Area and Natural Features

(Insert PDF: NRSI_0676_Study Area_ Natural Areas_ Fig 1_)

3.0 Background Review

3.1 Background Information

Collection and review of background information on biological features in the study area and vicinity have occurred since work commenced in 2006, and have continued until the completion of this report. Background collection and review included frequent reference to the Natural Heritage Information Centre website (NHIC), Species at Risk Act (SARA), and liaison with knowledgeable local naturalists and agency staff. Sources used in this study are included in the References section of this report.

The proposed work program was submitted to Brenda Robinson (Midhurst MNR District Planner) on June 9, 2008 by Caroline Walmsley (NRSI). Comments on this workplan were received by email on March 24, 2009. A copy of this email is appended to this report (see Appendix I). The work program was not submitted to the MNR until to 2008, as project components were not finalized until 2008.

Colour aerial photographs of the proposed Flesherton study area, taken in 2006, were obtained from the County of Grey"s GIS website (County of Grey 2006).

3.2 Project Site Sensitivity

The characteristics of the overall study area, proposed turbine layout, and natural features were compared with the August 2007 Draft Guidance Document for bat monitoring at proposed wind farms (OMNR 2007). The study area does not contain any geographic features which would be considered significant bat habitat, however, it is within 50km of a known bat hibernacula at Mono Cliffs Provincial Park. The hibernaculum is located approximately 45km southeast of the study area. Because of this, the study area was given a "medium" sensitivity rank.

3.3 Ontario Bat Species

There are eight species of bats that are known to occur within Ontario. Five of these bat species are year-round resident species that overwinter in areas of Ontario, using caves, abandoned mines, buildings, either individually or in groups. The remaining three bat species are migratory bats that spend periods of time during the warmer months in Ontario before flying south to overwinter in warmer climates. None of Ontario‟s bat species are considered nationally or provincially rare. Brief natural history information for each of Ontario‟s bat species is provided below. Information is based on Banfield (1974), Gerson (1984), and Dobbyn (1994).

Little Brown Bat

This species is Ontario‟s most common bat species, and can be found throughout most of the province, with records as far north as James Bay. Little brown bats (*Myotis lucifugus*) will use a variety of different habitats, usually preferring forests with nearby rivers, creeks, or meadows. This species has also adapted to urban settings and will regularly roost in buildings.

Little brown bats will begin hibernating in September, congregating in caves and mines throughout Ontario. Females will move from hibernation sites to nurseries in April, while males will remain in hibernation until mid-May. This species is very common with secure populations in Ontario (NHIC 2009).

Big Brown Bat

Big brown bats (*Eptesicus fuscus*) are the most urbanized of any Ontario bat species, and are frequently found near cities and towns, foraging along streetlamps. One of the most common Ontario bat species, the big brown bat, is found throughout southern Ontario and as far north as Red Lake, and is a provincially secure species (S5) (NHIC 2009).

Big brown bats often forage above meadows, ponds, rivers, and along streetlights in towns and cities. Roosting of this species regularly occurs in barns and other buildings. Occasionally they will roost under bark or within small rock crevices. Big brown bats are very cold tolerant, and will often not begin hibernation until late in the fall, sometimes as late as early December. Hibernation of this species occurs within Ontario, often in close proximity to summer roosting sites. Big brown bats are usually the first bat to emerge from hibernation in early April.

Red Bat

Red bats (*Lasiurus borealis*) are a very distinctive, medium-sized, Ontario bat species. An apparently secure Ontario bat species (S4) (NHIC 2009), red bats are found throughout southwestern Ontario with some isolated sightings further east, and as far north as James Bay. Red bats are known to be strong fliers and many records of this species have been found well outside of its distribution range.

Red bats are one of Ontario‟s three migrating species, and will usually migrate to Ontario in late May, staying until early September. Foraging of this species often occurs at or above tree height, sometimes as high as 200 m above the ground. Preferred foraging habitats include hilly forest, streams, ponds, and can sometimes be found foraging in towns near streetlights. Roosting of this species will usually occur solitarily in trees.

Hoary Bat

Hoary bats (*Lasiurus cinerus*) are Ontario"s largest species of bats, and one of the most distinctive. They are a solitary species, often roosting high in the trees. Hoary bats will emerge from their daytime roosts late in the evening to forage among forested habitats, often near open meadows or lakes within a forested community. Hoary bats are secure within Ontario (S4) (NHIC 2009), and occupy an extensive range as far north as James Bay but with regular populations throughout southern Ontario.

As one of Ontario"s three migratory species, hoary bats do not usually arrive in Ontario until late May. This species can usually be found within Ontario as late as October before migrating to the southern United States.

Silver-haired Bat

As one of Ontario"s three migrating species, silver-haired bats (*Lasionycteris noctivagans*) will usually remain in Ontario until August and September before migrating south to the United States. After hibernation, silver-haired bats will usually return to Ontario in late May or June. Range of this species stretches as far north as Thunder Bay and James Bay, with the majority of the known populations occurring in southern Ontario. Populations of this species are apparently secure (S4) within Ontario (NHIC 2009).

Silver-haired bats can often be found foraging near forested habitats, above lakes and streams, and prefers aquatic insects. Summer roosting will usually occur in hollow trees, loose bark, or large, abandoned bird nests.

Small-footed Bat

Small-footed bats (*Myotis leibii*) are the least common species in Ontario and are classified as vulnerable to impaired within Ontario (2009). The range of this species includes most of southern Ontario with some isolated summer sightings as far north as Sault Ste. Marie.

Hibernation of this species does not generally begin until late November, often emerging from hibernation by mid-April. Hibernation sites are often smaller caves with higher rates of air movement than other bat species. Populations of this species appear to show a preference to hilly coniferous forested habitats for foraging. Little is known about roosting site habitat preference.

Northern Long-eared Bat

Northern long-eared bats (*Myotis septentrionalis*) can be found foraging in forested areas with nearby meadows and rivers. Roosting habitats of this species can include under tree bark, rock crevices, and sometimes behind shutters or under shingles.

This species can be found within much of southern Ontario, with individual records reaching Thunder Bay and Moosonee (Dobbyn 1994). This species is anticipated to be a vulnerable Ontario species indicated by a provincial S-rank of

S3? (NHIC 2009) Northern long-eared bats will often use the same hibernation sites as little brown bats and begin hibernation in late October, emerging again in early May.

<u>Eastern Pipistrelle</u>
Eastern pipistrelles (*Pipistrellus subflavus*) can often be found foraging along slow moving rivers, forest edge, or above open meadows. These bats begin feeding around sunset, often flying high in the canopy hunting flying insects. Eastern pipistrelles are rarely found in heavily wooded areas or open areas unless large trees are present. This species hibernates in Ontario in caves and abandoned mines, usually from mid-October through May.

The range of this species covers much of southern Ontario. Populations are considered vulnerable within Ontario (S3?) (2009), and are usually found as single individuals or small groups.

3.4 Bat Habitats

Review of background sources, topographic mapping, aerial photographs, on-site vegetation mapping, and agency consultation were all used to analyze the habitats within the study area for the potential to concentrate bat activity.

The MNR lists significant bat habitat as caves and abandoned mines, buildings, snags, and riparian and aquatic habitat (OMNR 2006), and the 2007 Draft Guidance document lists proximity to major shorelines, forested ridges, and known hibernacula or maternity roosts as features known to concentrate bat activity (OMNR 2007). All of the habitats and landscape features were examined within the study area for the potential to concentrate bat activity.

No known hibernacula, maternity roosts, forested ridges, caves or abandoned mines present within the project area. Other significant habitats described by the MNR, including buildings, snags, and riparian and aquatic habitat, are present within the study area (OMNR 2000). A variety of buildings including residential buildings, silos, and barns are all present within the study area and may provide roosting habitat for local bat populations. Snags are present along hedgerows and within forested and wooded communities.

One Provincially Significant Wetland (PSW) and Life Science ANSI, Lake Eugenia Wetland Complex, is found in close vicinity to the project area. A small pocket of this wetland is found within the northeast portion of the study area. While Lake Eugenia is not considered a major waterbody, the majority of Ontario bat species are known to feed primarily over wetlands, forest edges, and watercourses, all of which are features of this Complex.

One provincially significant natural area, the 1,965ha Eugenia Lake Drumlins Earth Science ANSI, is partially located within the study area (NHIC 2007a), although the majority of the ANSI is located southwest of the study area.

A variety of woodlots and hedgerows within the study area may provide roosting habitat for local bat populations. Overall, the amount of bat habitat within the study area is expected to provide some roosting habitat for local bat populations. High concentrations of bat populations are not expected, due to the absence of concentrating features, such as forested ridges, hibernacula, and maternity roosts within the study area.

3.5 Significant Bat Species

None of the bat species found within Ontario are provincially or nationally protected species (NHIC 2009, Environment Canada 2007, OMNR 2008).

Three of Ontario"s bat species, northern long-eared bat, eastern pipistrelle, and eastern small-footed bat, are considered provincially significant species and have all been given provincial S-Ranks that suggest they may have sensitive populations and may be at risk in Ontario (NHIC 2009). None of these species are currently listed by the Species At Risk in Ontario (SARO) as being provincially significant species.

The eastern small-footed bat is considered to have imperiled to vulnerable populations that may be at risk within Ontario. The northern long-eared bat and eastern pipistrelle are both considered potentially vulnerable species and have populations that may be at risk within Ontario. Although the eastern small-footed and eastern pipistrelle were not recorded within the study area, 46 suspected northern long-eared bat calls were recorded (1.9% of recorded bat calls). Large populations of these species are not expected to be present due to limited roosting and foraging habitat within the study area.

4.0 Study Methodology

4.1 Station Selection

NRSI biologist conducted bat monitoring on the Flesherton Wind Farm in 2006, 2007 and 2008. Table 1 summarizes the dates that monitoring was conducted.

Table 1. Bat Monitoring Dates

2006	2007	2008
May 31, June 12		
	August 1/2, 2/3, 27/28, 29/30, 30/31	Aug 12/13, 13/14, 14/15, 15/16, 16/17, 17/18, 18/19, 19/20, 20/21, 21/22, 22/23, 24,/25, 25/26. 26/27, 27/28, 28/29, 30/31, 31/Sept 1
September 26	September 19/20, 20/21	September 1/2, 2/3, 3/4, 4/5, 5/6, 6/7, 7/8, 8/9, 9/10, 10/11, 11/12, 12/13, 13/14, 14/15, 15/16, 16/17, 17/18, 19/20, 20/21

In 2006 bat monitoring was conducted through the use of transect surveys, to provide a project area-wide assessment of bat activity patterns and possible concentration areas. The MNR draft bat monitoring guidelines had not yet been released. A detailed discussion of methodology and results for these surveys can be found in Sections 4.4 and Section 6.4.

In 2007, monitoring occurred solely at station BAT-001, which is found within the northeastern portion of the study area. During the 2008 bat monitoring period, 2 stations (BAT-001 and BAT-002) were monitored. Each of these stations is shown on Figure 2 and described in more detail below:

BAT-001

This station is located approximately 100m east of Osprey-Artemesia Townline. The bat monitoring equipment was set-up in an open area at the edge of a hayfield, adjacent to a large deciduous woodlot near proposed turbine # 2

BAT-002

This station is located in the west portion of the study site on Sideroad 35, approximately 150m north of Concession 8. The bat monitoring equipment was set-up at the corner of a deciduous hedgerow and pasture field that was actively used by cattle. This station was chosen as it provided a good representation of the habitat found within the study area, as well as it was in close proximity to Eugenia Lake.

4.2 Abundance Monitoring

In 2007, acoustic monitoring was used to gather information on usage rates of bats at station BAT-001. Data was collected and analyzed for the presence of bat passes, and total passes through-the-night in August and September 2007. Passage rates (passes/hr) were calculated based on the total number of passes recorded and length of monitoring period, and give indication of total activity recorded through the night. Bat „calls" were also recorded directly into laptop computers using Pettersson D240x ultrasonic monitoring devices, through SonoBat software. The calls were recorded using a time expansion of 10, and were analyzed with SonoBat software, and compared with recorded calls of known species.

Bat call sonograms are often extremely variable and may share attributes with multiple species. It has been well documented that even expert bat researchers may misidentify bat species based on call sonograms. NRSI biologists use large call libraries from various sources, including previous projects, as a basis for call analysis. Call sonograms were compared on the basis of peak frequency, call length, call shape, harmonics, and other acoustic attributes.

During 2008 monitoring period NRSI biologists conducted through-the-night (dusk to dawn) bat monitoring on a total of 51 nights, totaling more than 510 hours of monitoring data. The chosen monitoring period began on the night of August 12/13, 2008 and lasted through to the night of September 20/21, 2008. On some of the monitoring nights, monitoring occurred at more than one station on the same night, contributing to the overall 51 nights of monitoring.

On each monitoring night, a Pettersson D240X ultrasound bat detector was paired with a portable computer to record all bat activity. This monitoring system was powered by marine and/or gel deep cycle batteries and left to record between 2-5 nights of data at a time. The portable computer recorded wave files at a moderate sampling rate of 22.2kHz/sec, which typically provides ample sonogram resolution to identify the call sonograms of Ontario‟s bat species.

Monitoring equipment was designed to record both Heterodyne and Time Expansion data simultaneously to allow for a full analysis of activity within the study area. Although Time Expansion records broadband data, the Heterodyne setting typically records narrowband data within approximately 5kHz of the recording frequency. Based on call frequencies of Ontario bat species, a recording frequency of 35kHz was chosen to provide the most accurate representation of bat abundance through the study area. Representative calls of all of Ontario‟s bat species demonstrate that at least some of the call will overlap with the 30-40kHz detectable range. It is possible that some distant or uncharacteristic calls were not picked up by the Heterodyne recordings, however when paired with the broadband recordings of the Time Expansion data, this data is expected to give an accurate representation of the bat activity through the study area.

4.3 Sonogram Analysis

In conjunction with through-the-night abundance data, the recording equipment was designed to record bat call sequences and sonograms through the Pettersson D240X. The calls were recorded using a time expansion of 10x, and were analyzed with SonoBat software, using numerous acoustic call attributes including characteristic frequency, maximum and minimum frequencies, call duration, bandwidth, and various other call attributes. These parameters were used to compare the recorded calls with calls of known species.

Bat call sonograms are often extremely variable and can change dramatically depending on differing environmental and behavioural situations (Murray et. al. 2001, Barclay et. al. 1998). Wherever possible, bat sonograms were identified to species, however in cases where this was not possible, sonograms were identified to family group or approximate characteristic frequency. Call sonograms were compared on the basis of peak frequency, call length, call shape, harmonics, and other acoustic attributes.

4.4 Transect Point Count Monitoring

In addition to the through-the-night monitoring described above, transect based acoustic monitoring was conducted.. Point count locations were chosen to represent both agricultural habitat and potential areas of increased bat activity such as forest and woodlot edges, farm buildings, wetland, and open water habitats. These locations were chosen in order to identify any potential bat concentration areas within the study area, and to compare passage rates between different habitat types. These locations were also selected to give adequate spatial representation of the entire Flesherton study area (see Figure 2).

In 2006, monitoring occurred at 10 point count stations (BTR-001 – BTR-010) based on the original larger extent of the proposed project. Six of these stations (BTR-001 – BTR-005 and BTR_010) are too far outside of the final (smaller) study area boundaries to be included in this report. Data from 5 stations (BTR-006 to BTR-009) has been included in the analysis.

NRSI biologists conducted point count transects at stations BTR-006 to BTR-009 over three nights in May, June and September, 2006. Point counts were conducted at 10-minute intervals every 2km using Pettersson D240x ultrasonic monitoring devices. Observations of bat passes, including frequency (Hz) and behaviour, were recorded.

In 2007 transect surveys were not conducted, as the study area boundaries were in flux at the time of monitoring.

Transect surveys occurred at a total of 6 locations during the 2008 monitoring period, These stations were new stations, than the 2006 monitoring stations, and were selected based on their close proximity to the proposed turbine locations. Stations were selected to represent a variety of habitats and locations within the study area (see Figure 2). . Each of the 6 stations were surveyed twice during the monitoring season on August 27 and September 29, 2008. Point counts were conducted between sunset and midnight, and consisted of five minute surveys at each point count location. During each point count, the observer used the manual trigger setting of the Pettersson D240X ultrasound detector to record bat calls while listening to the total number of bat passes during the point count.

The Heterodyne data collected from these point counts has been analyzed separately to identify any potential concentration areas with the study area and confirm that the through-the-night monitoring stations were representative of the habitats within the study area. Species calls recorded during the point count surveys have been grouped with all other species data recorded to provide a detailed representation of the species usage rates within the study area during different periods of bat activity.

Figure 2. Bat Monitoring Stations

(Insert PDF of Bat Monitoring Stations)

5.0 Results

The chosen monitoring period of mid August through to mid September is expected to overlap with the anticipated peak periods of bat activity, including both the later stages of summer swarming and the entire fall migration period of Ontario bat species. This period is also consistent with the recommended period by the MNR bat monitoring guidance document (2007).

The level of bat activity was found to vary from year to year. During the 2007 bat monitoring period the average passage rate was observed to be 2.2 passes/hr. Passage rates were higher in 2008 with an overall average passage rate of 14.0 passes/hr at the Flesherton Wind Farm. This passage rate of 14.0 passes/hr is slightly higher compared to other bat monitoring projects conducted by NRSI at similar wind farm located in Southern Ontario. Average passage rates at other wind farm projects which have been studied by NRSI with similar characteristics to the Flesherton Wind Farm were observed to be 1.5 passes/hr.

Weather data collected during the monitoring periods suggests that most of the monitoring nights are considered favorable weather conditions for bat activity, with overnight temperatures above 10°C, no precipitation, and low wind speeds.

The comprehensive data and analysis results for each year of monitoring are discussed in greater detail below.

5.1 Monthly Abundance Trends

During acoustic monitoring in 2007, 166 bat passes were recorded in 76 hours, resulting in an overall average passage rate of 2.2 passes/hr. Overall, average passage rates in August and September 2007 did not vary greatly, with values of 2.0 and 2.5 passes/hr, respectively.

Passage rates declined from a peak on August 1/2, to a low in early September. A larger peak was experienced on September 19/20, before plummeting sharply again. The month of September typically coincides with fall migration of Ontario‟s migratory bat species, and the September peak may suggest the presence of some bat migration through the study area. However, passage rates are lower than would be expected in an area of concentrated bat activity.

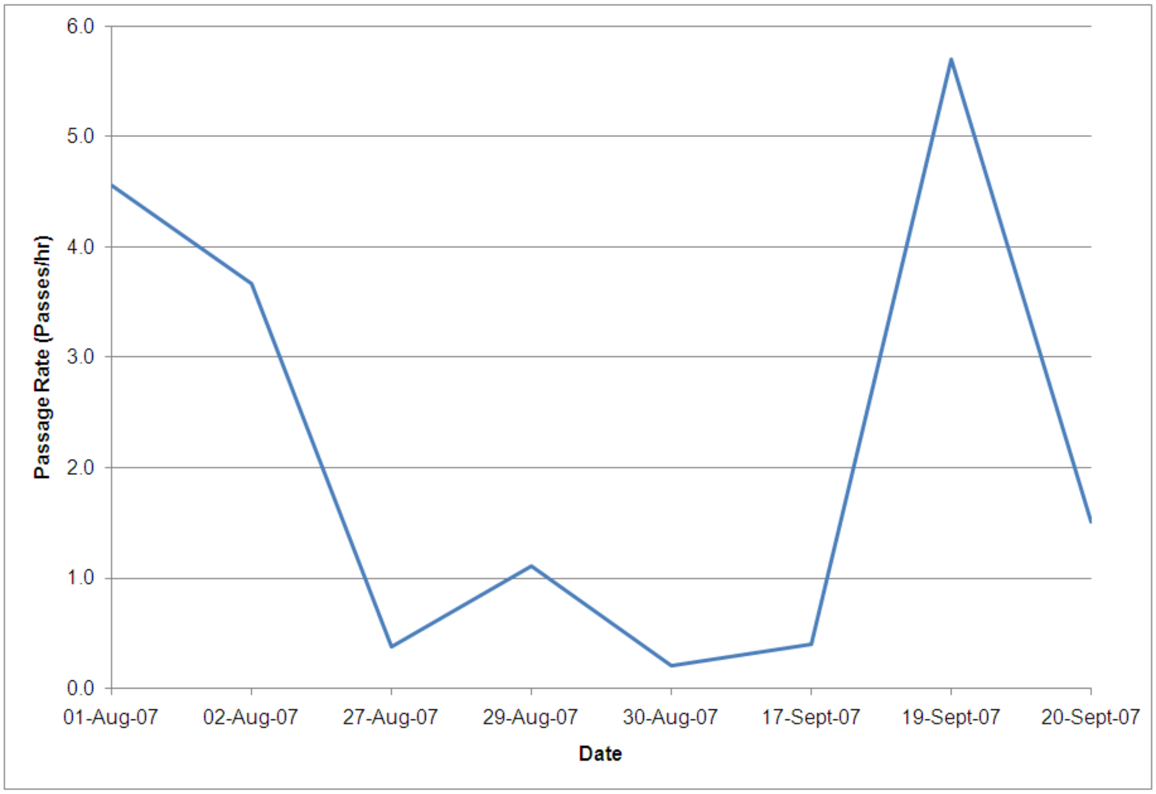

Figure 3. Passage Rate (passes/hr) by Date During Late Summer and Early Fall 2007 Bat Monitoring

During the 2008 monitoring period, a total of 7138 bat passes were recorded in just over 510 hours of monitoring resulting in an overall average passage rate of 14.0 passes/hr at the Flesherton Wind Farm. Data collected during the 2008 monitoring period was analyzed by date to determine if periods of increased bat activity, or potential bat migration, were present within the study area during the monitoring period. The average passage rate peaked from mid-late August and again in mid-late September, when passage rates reached 30.8, 36.0, and 60.5 passes/hr (August 18/19, August 21/22, and August 22/23 respectively) in August, while a secondary peak of 30.8 passes/hr was observed on the night of September 20/21 (see Figure 4). These peaks correspond with the late periods of summer swarming of Ontario"s local bat populations, and overlap with the fall migration period of some of Ontario"s migrant bat species. Bat activity in August varied, with passage rates ranging from 1.5 to 60.5 passes/hr, while passage rates in September were fairly consistent, with the exception of the peak observed on September 20/21 (passage rates in September ranged from 0.5 to 30.8). The average passage rate in August was more than twice that observed in September, with recorded average monthly passage rates of 20.8 and 8.5 passes/hr respectively.

Within the month of August, a total of 6 nights had passage rates of at least 25.0 passes/hr. In September however, only one night exceeded 25.0 passes/hr (see Figure 4). These peaks in passage rates likely represent late summer swarming activity of resident bats.

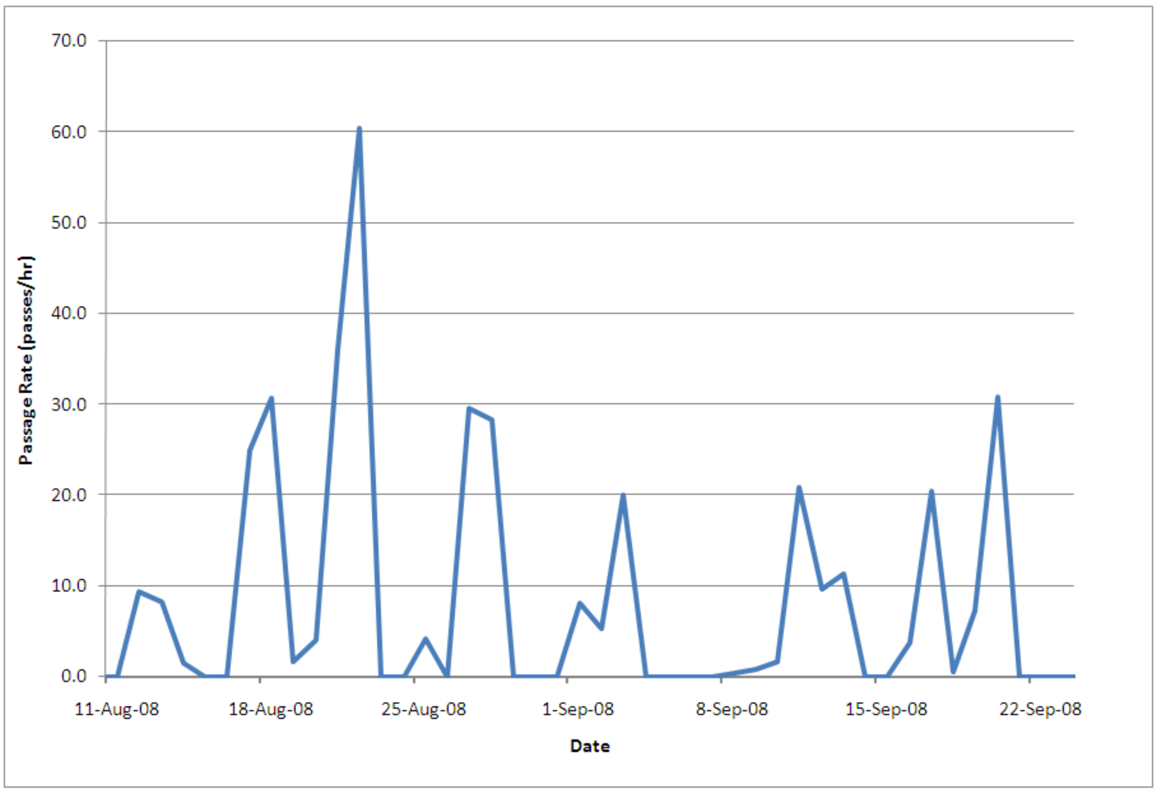

Figure 4. Passage Rate (passes/hr) by Date During Late Summer and Early Fall 2008 Bat Monitoring

5.2 Nightly Abundance Trends

Bat abundance data was collected and analyzed by the time of night for each pass that was recorded. During the 2007 monitoring period bat activity was observed to peak at

1900hrs, with an average passage rate of 12.0 passes/hr. Over the course of the night the level of bat activity was noted to slowly decrease, with a second peak at 0200hrs, resulting in an average passage rate of 4.0 passes/hr.

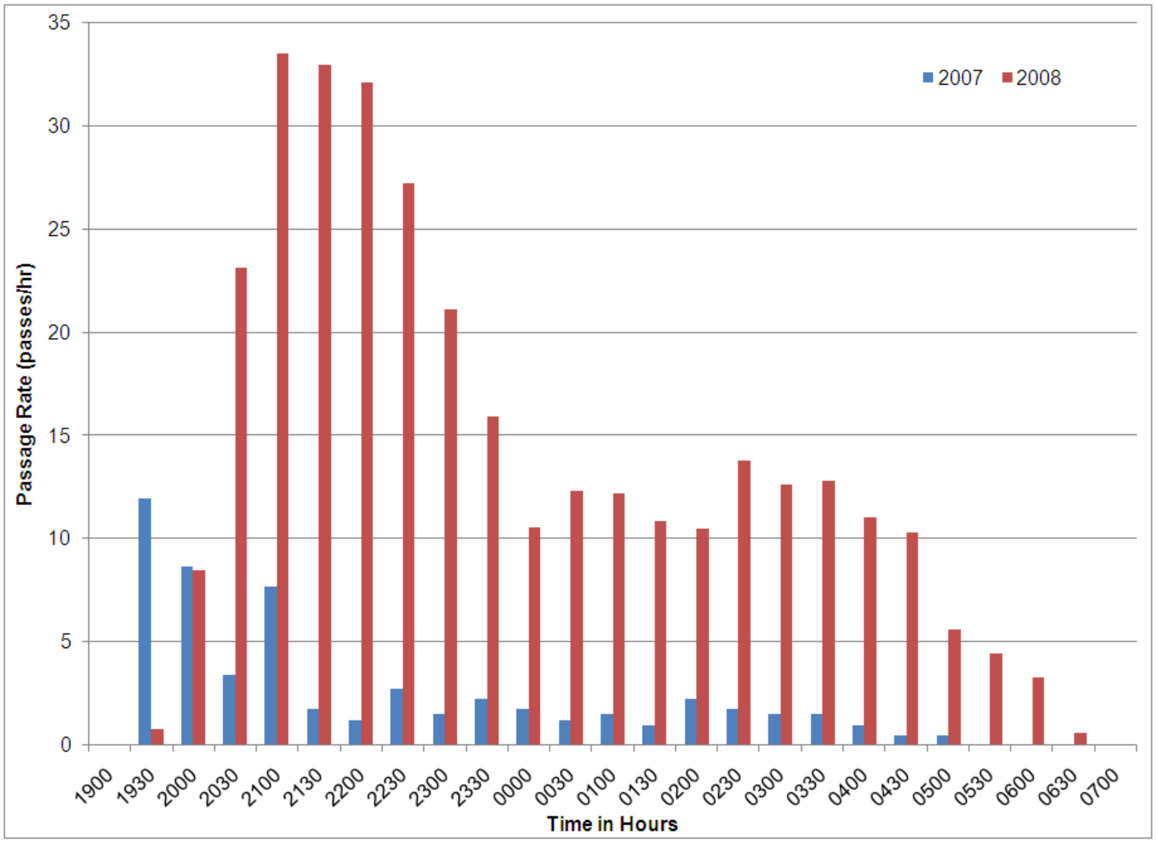

Figure 5. Hourly Passage Rates (passes/hr) during Fall 2007 and Fall 2008 Bat Monitoring

During the 2008 monitoring period overall bat activity within the Flesherton study area began to rise sharply at approximately 2000hrs, which corresponds roughly to the time of sunset at this time of year. This is the time period when bats are known to leave their daytime roosts to forage in nearby areas. Bat activity within the study area was found to peak at 2100hrs, with an average passage rate of 33.5 passes/hr (see Figure 5). Bat activity remained above 15.0 passes/hr from 2100hrs to 2330hrs, at which point the passage rates fluctuated between 10.0 and 15.0 passes/hr until 0430 when they began to steadily decline into the early hours of the morning. A small secondary peak in activity just prior to sunrise was apparent at the Flesherton study area between the hours of 0200 and 0400. This secondary peak in bat passes is typical of nightly bat activity patterns, and may correlate to nightly fluctuations in insect activity (Reynolds and MacFarland 2001, Shump and Shump 1982).

5.3 Abundance Trends by Location and Habitat

Abundance data was analyzed by monitoring station in order to determine if areas of concentrated bat activity are present within the study area.

2007

During the 2007 monitoring period, only one station was selected. This station was located at the edge of a hayfield, adjacent to a deciduous forest. The average passage rate at this station was observed to be 2.2 passes/hr. No large concentrations of bat activity were observed during the 2007 monitoring period.

In 2008, two monitoring stations were used at the Flesherton Wind Farm to represent the two main habitat types found within the study area. The average passage rate observed at BAT-002 was 18.5 passes/hr, while the passage rate observed at BAT-001 was half of that (9.5 passes/hr). BAT-002 was located at the corner of a deciduous hedgerow and edge of an active pasture field that was being grazed by cattle. This station was also noted to be approximately 1.18km from Eugenia Lake.

The high passage rates observed at the Flesherton study area are higher than what would be expected in an agricultural area and could be result of bats traveling to feed at the Eugenia wetland complex.

5.4 Point Count Transect Surveys

The chosen monitoring period of May, June and September is expected to encompass peak periods of bat activity, including the summer swarming and fall migration periods of Ontario bat species.

The average point count passage rate at the Flesherton study area in 2006 was 8.2 passes/hr, resulting from a total of 12 bat passes recorded in 90 minutes of point count monitoring. Passage rates observed at each point count station are presented in Figure 6.

Transect station BTR-008 had the highest passage rate, with 8.0 passes/hr. This station is located at a sugar maple deciduous hedgerow on the corner of Osprey-Artemesia Townline and Concession Road 8. The surrounding vegetation is pasture fields, which are actively used by cattle. The second highest passage rate was observed at BTR-006, with 6.0 passes/hr. This station is located at the corner of a deciduous woodlot near BAT-001, which is approximately 218m southeast. In 2007 BAT-001 have and average passage rate of 2.2, which slight lower than what was observed at BTR-006.

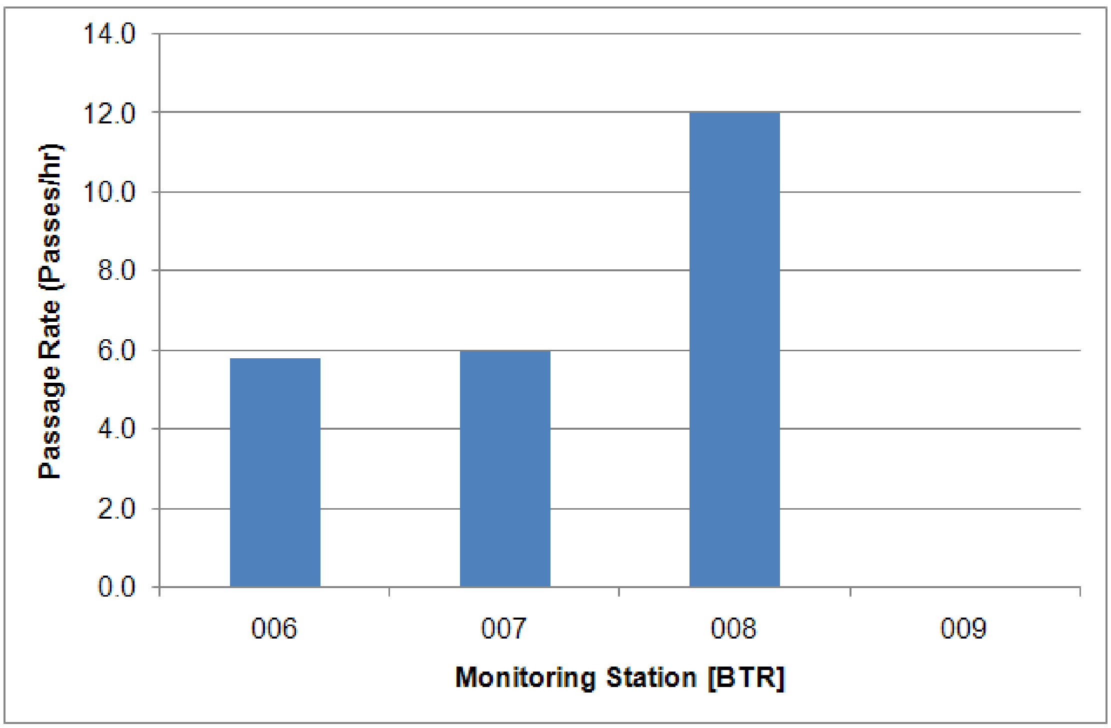

Figure 6. Point Count Transect Bat Passage Rates in 2006 by Monitoring Station

In 2008 point count monitoring occurred at a total of 6 stations, each monitored once in August and again in September. The first visit to each site occurred on the night of August 27, 2008 while the second visit took place on the night of September 29, 2008. Abundance data was analyzed at these stations in order to determine if areas of concentrated bat activity are present within the study area and whether the monitoring stations were representative of the project area. The first visit to each station had a total of 11 bat passes, while 4 bat passes were recorded during the second survey.

Of the 6 monitoring stations, BTR-014 was the only station where bat passes were recorded during the first survey, when a total of 11 bat passes were recorded (August 27). As a result, this station had a very high passage rate of 66 passes/hr. This station is located on the edge of a small pond. During the first visit, 4 individual bats were observed continually foraging over the pond area, as a result the forage activity of the 4 bats is likely the reason for the significantly high passage rate. A total of 4 bat calls were recorded at 2 of the 6 bat transect stations on the second survey night, resulting in an average of 18 passes/hr at BTR-012, and 6 passes/hr at station BTR-015 (Figure 7).

BTR-012 is located at the corner of a deciduous woodlot and hedgerow, approximately100m from turbine # 5. BTR-015 is also located at the corner of deciduous woodlot.

These average passage rates are considerably higher than the 14 passes/hr average passage rate for through-the-night monitoring (2008). Most point count monitoring was conducted between 2000hrs and 2300hrs, when peak activity is expected to be present. The average through-the-night monitoring passage rate during this time period was approximately 26.3 passes/hr. This suggests that some moderate bat activity is present within the study area.

Note that the passage rates observed during point count transects cannot be compared directly to those observed during acoustic monitoring. Point count stations were monitored for a maximum of 20 minutes each, while the single acoustic monitoring station was monitored for 8 nights.

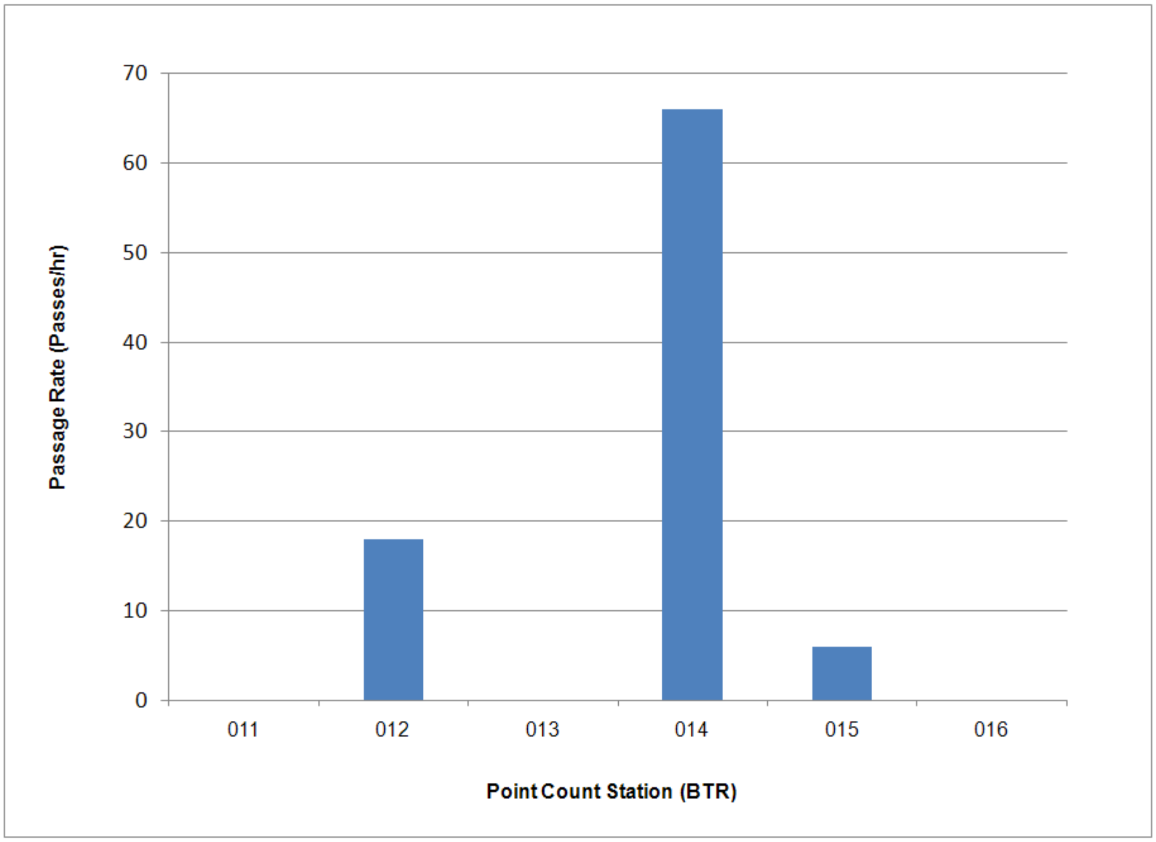

Figure 7. Passage Rates (passes/hr) at Each of the Point Count Monitoring Locations

5.5 Species Results

During the 2006 monitoring period, data was analyzed in the field by visual observations of individuals or by the frequency heard on the BATBOX III detectors. A total of three species were noted within the Flesherton study area. These species are listed in Figure 8. Big brown and little brown were the most abundant species observed. The remaining calls could not be identified to individual species and were grouped by characteristic frequency (i.e. 30kHz).

It is well documented that species calls are extremely variable and often difficult to distinguish. Even expert bat ecologists can have difficulty distinguishing certain bat species, particularly big brown and silver-haired bats, both exhibiting a characteristic frequency of approximately 30kHz with many other call similarities, such as duration, slope, and maximum frequency.

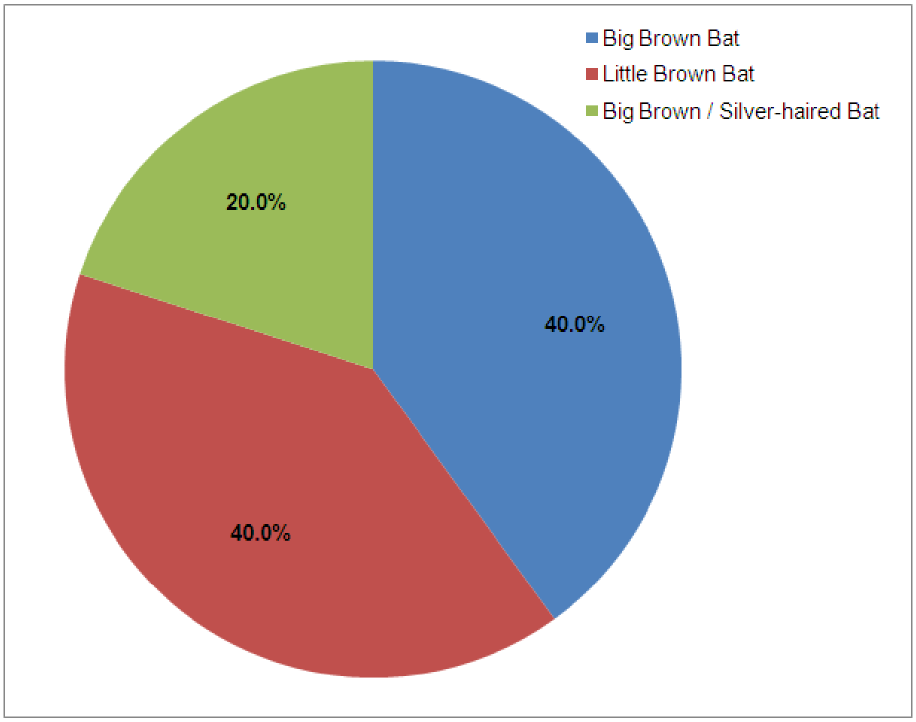

Figure 8. Bat Species Composition during Summer and the Fall 2006 Bat Monitoring.

During the 2007 monitoring period, a total of 72 call sequences were recorded by the bat monitoring equipment. Of these calls, a total of 31 were identified to the species level. The remaining calls could not be identified to individual species and were grouped by characteristic frequency (i.e. 30kHz or 40kHz) or into the *Myotis* family group. Figure 9 summarizes the species that were observed during the 2007 monitoring period.

Although the most abundant call, as seen in Figure 9, are calls recorded at 40Khz and 30kHz (Big Brown / Silver-haired bat) that could not be identified to species, the most abundant species was the little brown bat accounting for 26.4% of calls recorded. Hoary bats were also present, accounting for 8.3% of recorded calls.

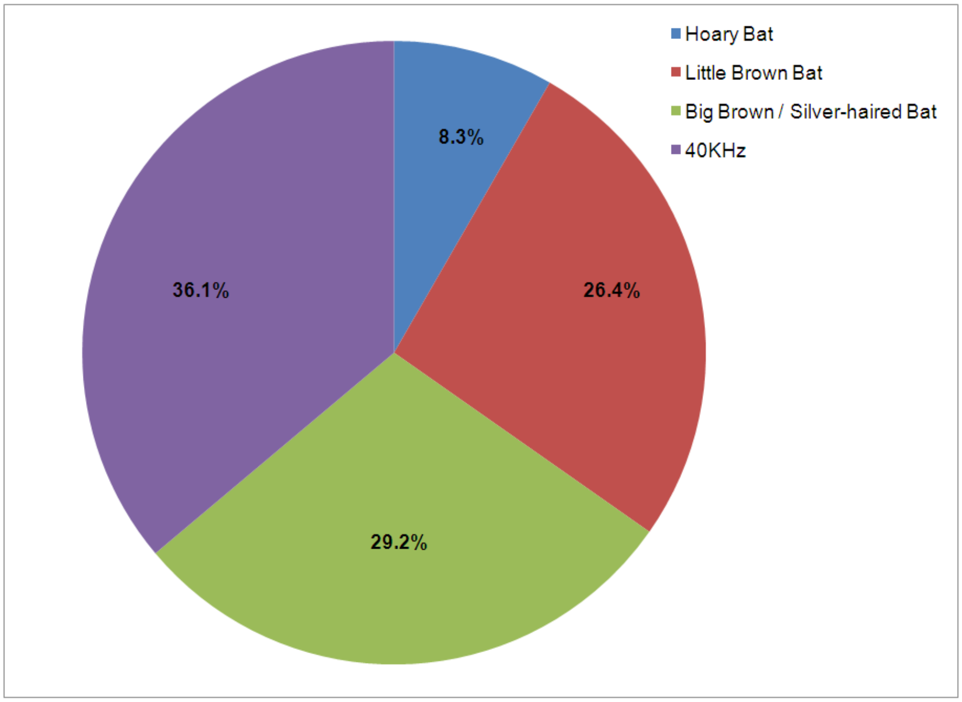

Figure 9. Bat Species Composition during the Summer and Fall 2007 Bat Monitoring Period.

During the 2008 monitoring period, a total of 2417 call sequences were recorded by the bat monitoring equipment. Of these calls, a total of 878 were identified to the species level. The remaining calls could not be identified to individual species and were grouped by characteristic frequency (i.e. 30kHz or 40kHz) or into the *Myotis* family group.

During the monitoring period, a total of 6 species were identified using recorded call sonograms from through-the-night monitoring. Although the most abundant call, as seen in Figure 10, are calls recorded at 30kHz (Big Brown / Silver-haired bat) that could not be identified to species, the most abundant identified species was little brown bat that accounted for 29.7% of all recorded bat calls. The silver-haired bat was the next most abundant species, representing 2.7% of recorded calls. Northern long-eared, eastern red, big brown, and hoary bat accounted for 1.9%, 1.8%, 0.2%, and 0.1% respectively. The remaining calls were classified as *Myotis* spp. or grouped as 40kHz bats accounting for 9.6 and 8.8% of recorded calls respectively.

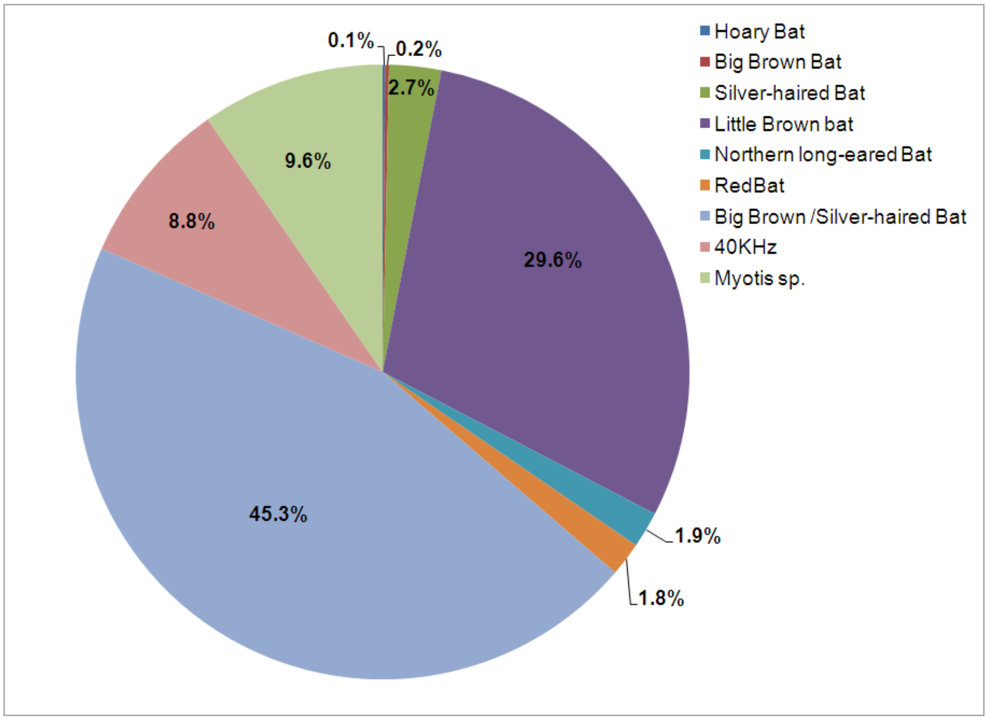

Figure 10. Bat Species Composition during Summer and the Fall 2008 Bat Monitoring

In addition to the review of abundance data to determine potential migratory periods, which were collect during the 2008 monitoring period, the recorded sonograms that could be analyzed to species were grouped into the year-round resident bats and the migratory species. Figure 14 shows the number of identified calls of each group throughout the monitoring period. A peak in local species calls was documented in mid-late August followed by a secondary peak in mid-late September. There were no substantial peaks observed with respect to migratory species calls on any given monitoring night. The most migratory bat calls recorded on any night was 14 (August 12 and August 28), and comprised of both eastern red and hoary bats on both nights. Although all three migratory bat species were confirmed within the study area, there is no evidence to suggest that the Flesherton study area lies within a major migratory bat route.

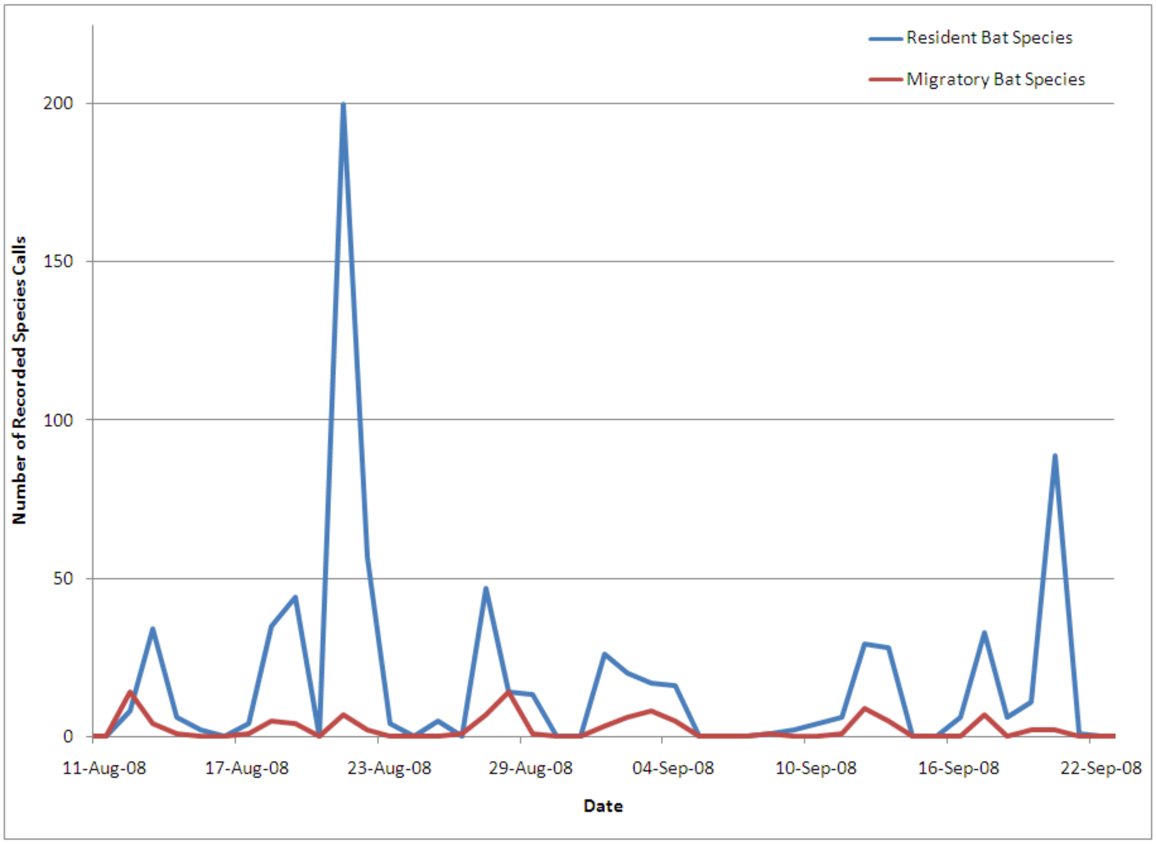

Figure 11. Number of Identified Resident and Migratory Species Calls During the 2008 Bat Monitoring Period.

6.0 Weather Data

Environmental conditions can 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 known to show the most influence on bat activity (Arnett et. al. 2007, OMNR 2007). As a result, weather data has been collected and reviewed for the 2007 and 2008 monitoring periods from numerous sources and locations in order to address bat activity levels and analyze bat patterns throughout the study area.

Sources of weather data for the Flesherton study area included:

- EC National Climate Archive (Mount Forest AUTO)
- Eastern Canada Visible Satellite Images
- Weather Network Weather Maps
- Last 24hrs Weather Data (Mount Forest, ON)
- Local Field Observations

Wind speed and overnight temperatures for the Flesherton Wind Farm have been obtained from Environment Canada`s National Climate Archive, using the Mount Forest (Auto) weather station (Environment Canada 2008). This station is the closest weather station to the Flesherton Wind Farm and is located approximately 43km south of the proposed study area. This weather station is located more than 80km from any major shoreline, which may influence weather patterns, and is expected to provide some indication of weather at the Flesherton study area.

Figure 12 shows the precipitation and temperature that were observed at the Mount Forest Weather Station during the 2007 monitoring period. The minimum nightly temperatures ranged from 6.3 ^{O}C to 20.3 ^{O}C, averaging 13.1 ^{O}C throughout the monitoring period. Temperatures were variable throughout the monitoring period, with lower temperatures observed during the September, which is normal for this time of year.

Precipitation values were also found to be variable throughout the 2007 monitoring period, with a peak of approximately 18.4mm of precipitation falling on September 11, 2007. August had the highest average rain fall with 6.5mm of precipitation recorded, compared to September when 5.8mm of precipitation was recorded.

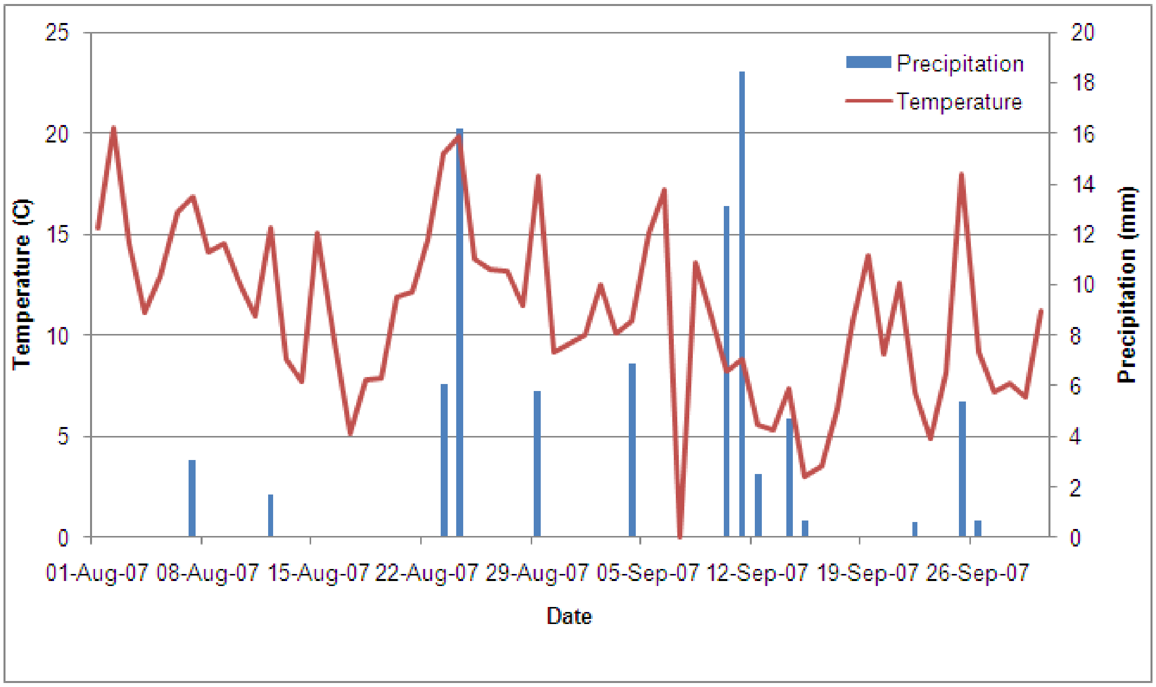

Figure 12. Temperature (°C) and Precipitation (mm) Values Recorded During the 2007 Bat Monitoring Period

During the 2008 monitoring period nightly low temperatures ranged from 2.7°C to 19.3°C, averaging 10.2°C, throughout the monitoring period. Although temperatures varied, average temperature showed small but steady declines later in the monitoring period, with a slightly lower average minimum temperature for the month of September than observed in August.

Precipitation values during the monitoring period varied greatly, with a peak of approximately 64.6mm of precipitation falling on September 14, 2008. A large amount of the total precipitation fell between early and mid-September, resulting in a monthly average of 4.7mm compared to only 3.6mm in August. Figure 13 displays the temperature and precipitation recordings from the Mount Forest Weather Station during the 2008 bat monitoring period of August and September.

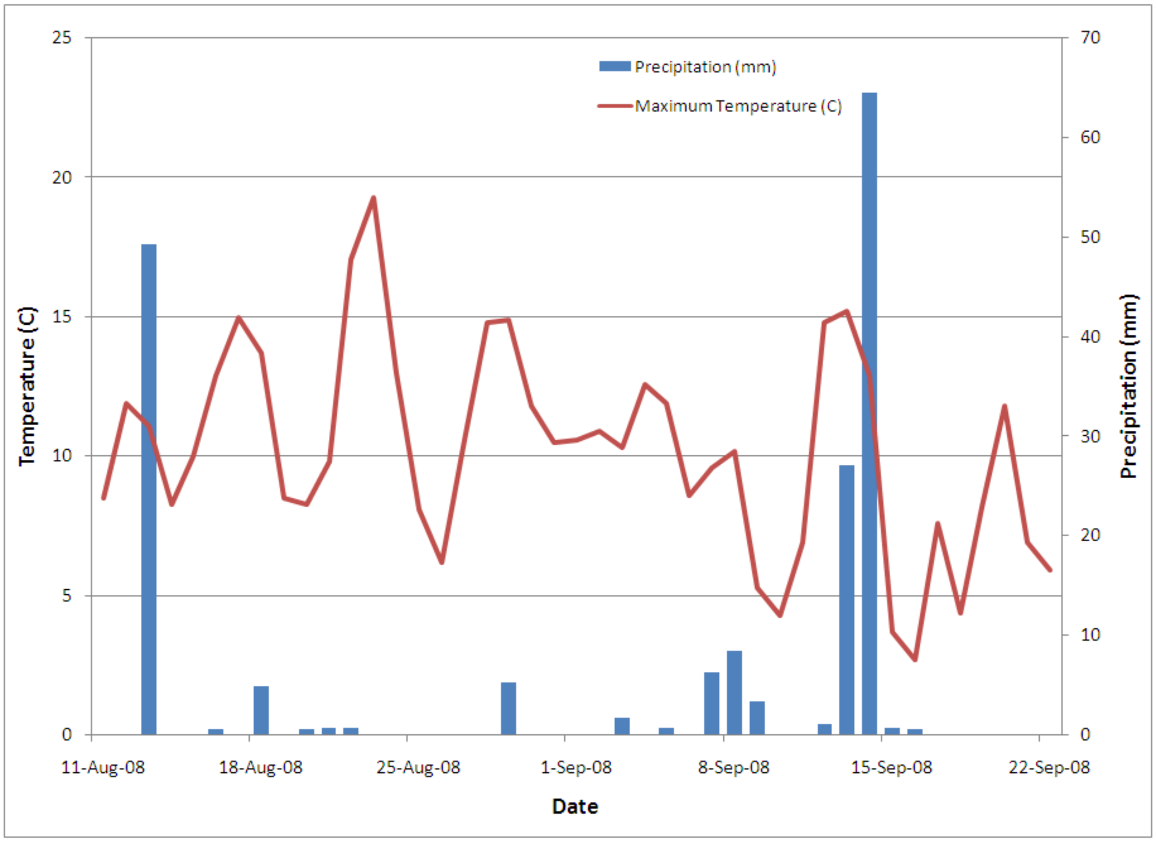

Figure 13. Temperature (°C) and Precipitation (mm) Values Recorded During the 2008 Bat Monitoring Period.

In addition to detailed information on temperature and precipitation, wind speed information was also recorded from the vicinity of the study area. Daily maximum wind speeds ranged from 8.6 to 14.4m/s, and averaged 9.1m/s throughout the monitoring period. Average wind speeds were similar in August and September.

All weather parameters, including temperature, precipitation, and wind speed, are analyzed in greater detail in Section 6.6.

6.1 Weather Results

Weather patterns, particularly overnight temperatures, precipitation, and wind speeds, are known to have a strong influence on local and migratory bat activity levels (Arnett et. al. 2007). These weather conditions have been recorded in detail based on numerous sources including field observations, Environment Canada weather stations, satellite imagery, and local weather conditions.

Overnight temperatures are known to influence bat activity as bats are less likely to be active when temperatures are recorded below 10.5°C (Arnett et. al. 2007, Reynolds 2006). The Bat Monitoring Guidance Document (OMNR 2007) recommends that monitoring occur at temperatures greater than 10°C due to decreased bat activity at lower temperatures.

Figure 14 displays the bat activity in relationship to temperatures for the 2007 monitoring period. Strong correlations are observed between bat activity and temperature, on nights when temperatures were observed to peak, bat activity was also noticed to increase. On nights when the temperatures were observed to decrease, for example on August 28, 2007, the level of bat activity was also observed to decrease.

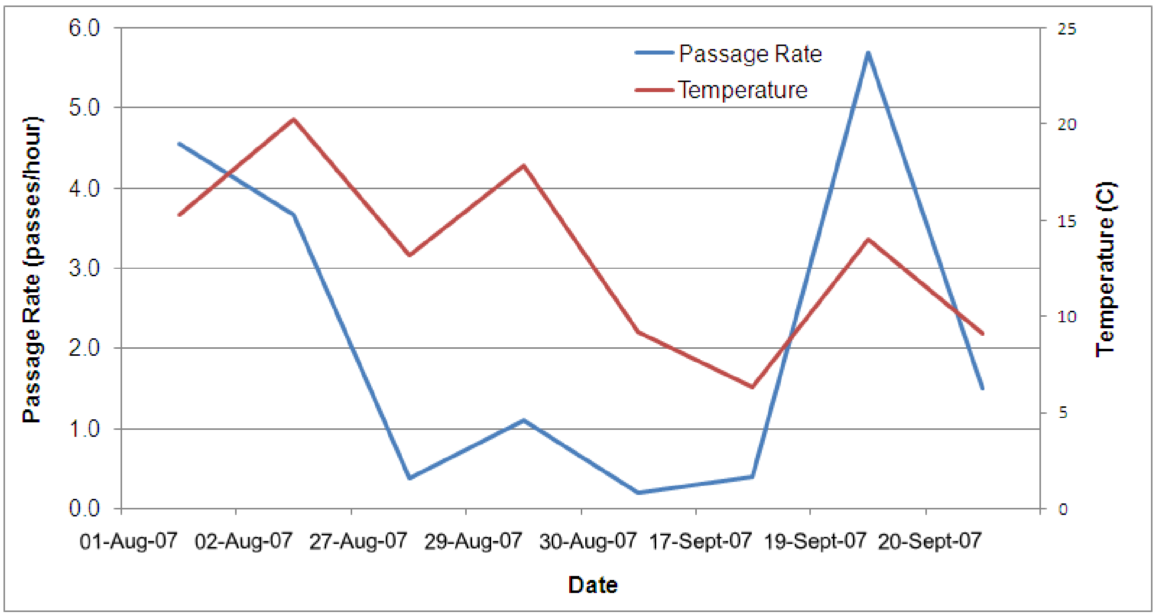

Figure 14. Bat Passage Rates (passes/hr) and Overnight Minimum Temperatures (°C) During the Fall 2007 Bat Monitoring

Figure 15 shows the relationship of overnight temperature and bat activity patterns for the 2008 bat monitoring period. Strong correlations between the temperature and bat activity throughout the monitoring period were not consistently observed. On the dates of August 18, 22, and September 20, 2008, increases in both temperature and bat activity was observed.

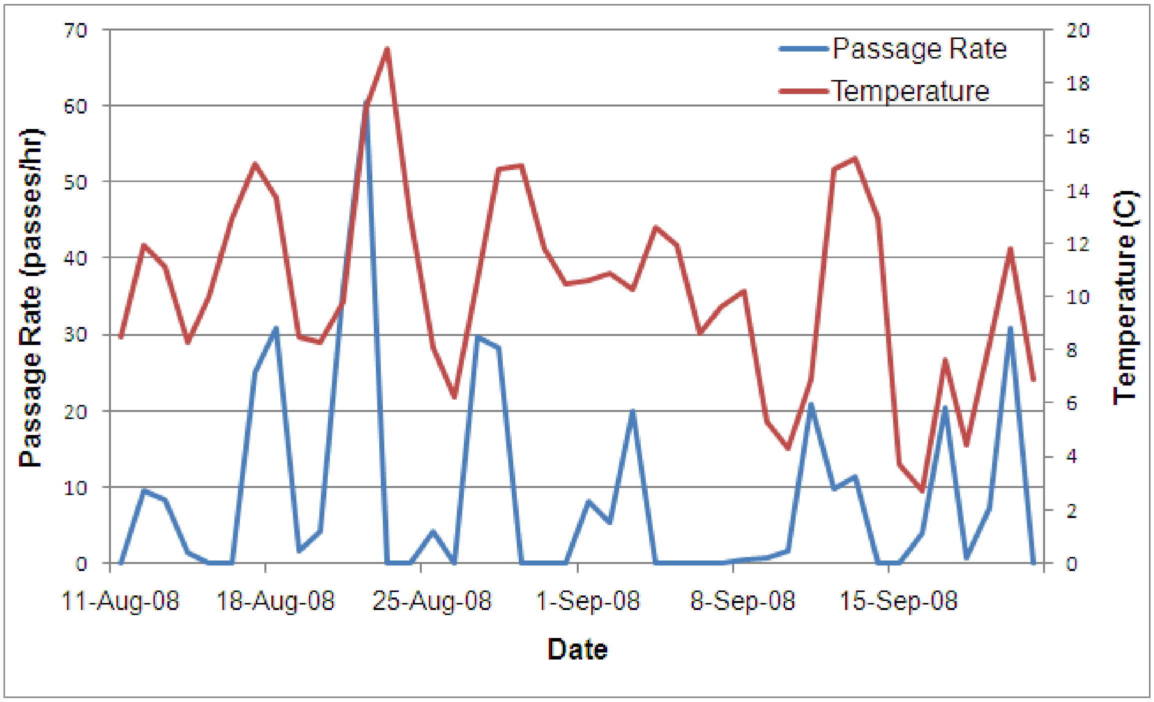

Figure 15. Bat Passage Rates (passes/hr) and Overnight Minimum Temperatures (°C) During the Fall 2008 Bat Monitoring

Another weather condition that may influence bat activity is precipitation. The MNR Bat Monitoring Guidance Document (OMNR 2007) recommends monitoring to occur on nights with little to no precipitation.

Figure 16 displays the relationship of bat activity to the precipitation levels for the 2007 monitoring period. Strong correlations between the precipitation and bat activity were not observed during the monitoring period. However, this may be due to the distance of the weather station from the project area. It is possible that precipitation recorded by the weather station is not entirely indicative of precipitation events within the study site.

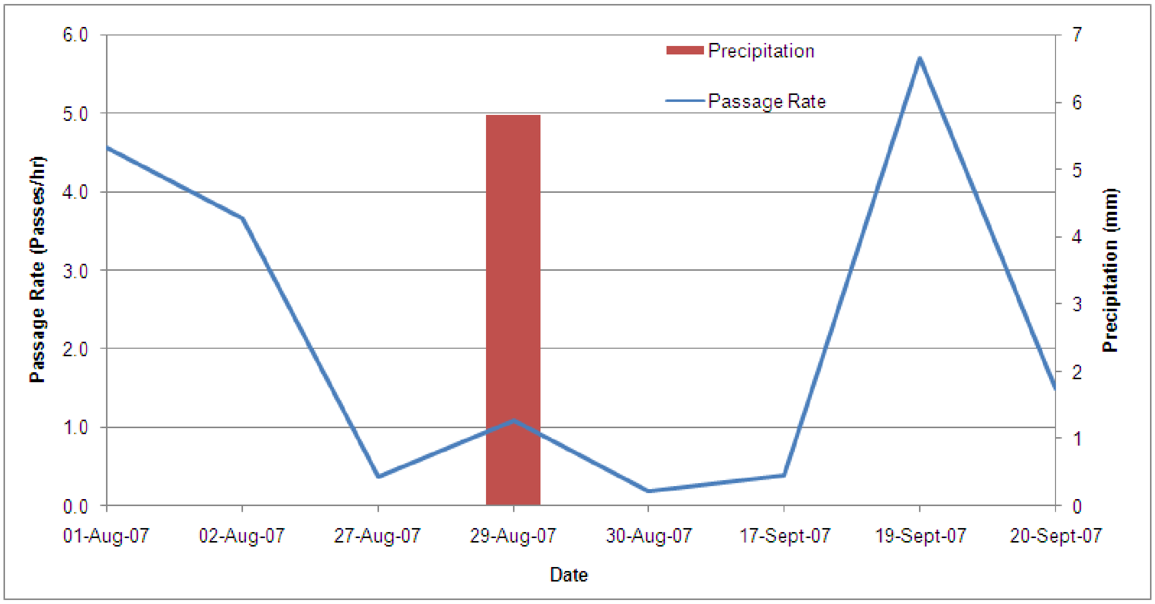

Figure 16. Precipitation (mm) and Bat Passage Rates (passes/hr) during the Fall 2007 Monitoring Period.

Figure 17 shows the precipitation values throughout the monitoring period compared to bat passage rates. Some local patterns can be observed, as seen on September 8, and 9, 2008, when increased precipitation can be associated with decreased bat activity level. On the night with the highest recorded precipitation (September 14, 2008), no bat passes were recorded. Following this night of heavy precipitation, bat activity once again increased to normal levels. Although some bat activity did occur on nights when minor precipitation occurred, the data observed in mid-late September indicated that heavy precipitation may limit bat activity.

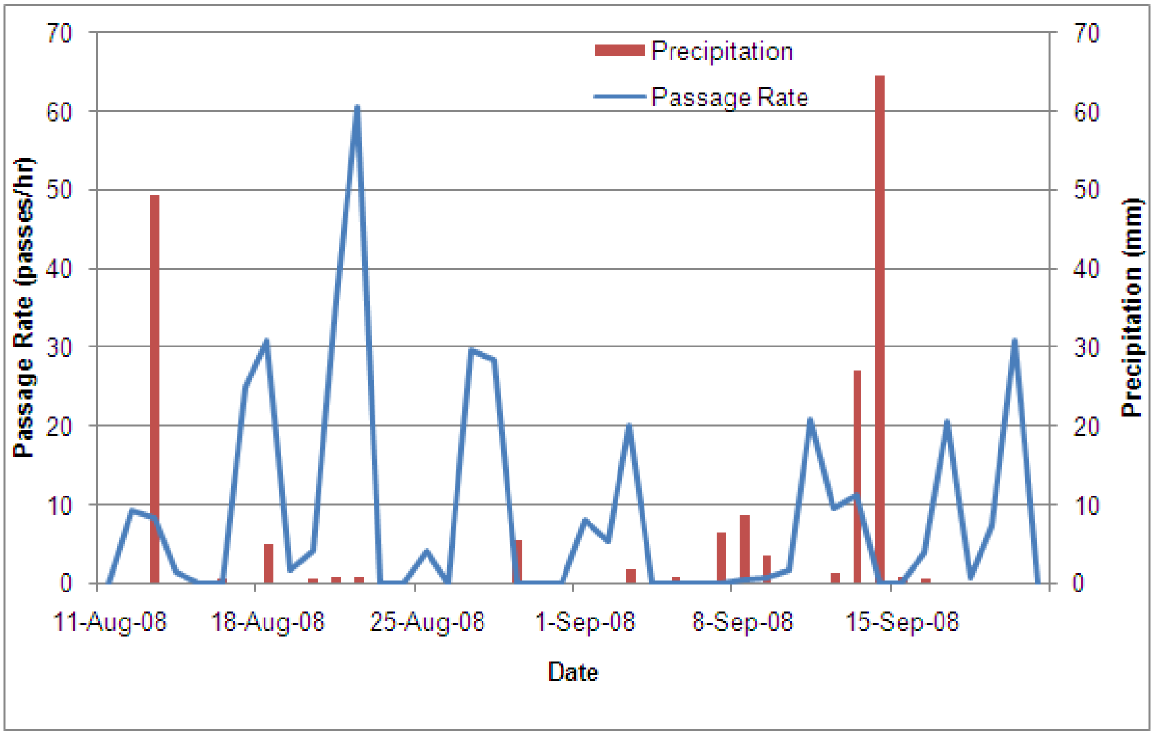

Figure 17. Precipitation (mm) and Bat Passage Rates (passes/hr) during the Fall 2008 Monitoring Period.

6.2 Bat Monitoring Discussion

This report discusses the results of the bat monitoring conducted during the late summer and early fall of 2006 through to 2008 at the Flesherton Wind Farm by Natural Resource Solutions Inc. This includes surveys of bat habitat, abundance trends, and bat species within the study area.

During the 2007 bat monitoring period an average passage rate of 2.2 passes/hr was observed. This is substantially lower than the overall average passage rate of 14 passes/hr that was recorded during the 2008 monitoring period. Monitoring in both 2007 and 2008 showed peak activity periods in mid-late September, likely a result of late summer swarming activity, due to few migrant bat species being identified within the area. Bat activity during the 2007 and 2008 monitoring period peaked just after sunset between 1900hrs and 2100hrs, with an average passage rate of 12.0 and 33.5 passes/hr respectively. The overall average passage rate (which includes data from 2007 and 2008) was 12.4 passes/hr. This is fairly high, comparable to other wind farm studies that have been conducted in southern Ontario. The average passage rate at the

Grand Valley Wind Farm, which is located approximately 42km south of the Flesherton Wind Farm was 0.9 passes/hr.

Bat activity in 2008 was considerably higher than observations in 2007. This is likely due to a combination of increased monitoring effort in 2008, as well as the addition of a second monitoring station. BAT-002, which was not monitored in 2007, is situated in close proximity to Eugenia Lake (approximately 1.18km), which is part of a Provincially Significant Wetland Complex. The majority of Ontario bat species are known to feed primarily over wetlands, forest edges, and watercourses, all of which are features found in this complex. Therefore, increased bat activity is expected to occur at this station. Results of 2008 monitoring indicated that bat activity was two times higher at BAT-002, than observations at BAT-001. The addition of the second monitoring station better represents bat movement throughout the study area, and may demonstrate an area of increased bat activity due to prime foraging grounds in the vicinity of the Eugenia Lake Wetland Complex.

Species analysis indicated the presence of 6 of the 8 species known to occur in Ontario. These species include the little brown, silver-haired, northern long-eared, eastern red, hoary, and big brown bat. In addition to these identified species, numerous calls were recorded at a frequency of 30kHz that could not be identified to species due to very strong similarities between silver-haired bat and big brown bat call characteristics, as well as 40kHz and *Myotis* spp. that could not be identified to species. The little brown bat, hoary bat, red bat, silver-haired and big brown bat are all common with secure populations in Ontario. The northern long-eared bat is considered to be potentially vulnerable and have populations that may be at risk in Ontario. Although this species was recorded within the Flesherton study area, large populations are not expected due to limited roosting and foraging habitat. The little brown bat, and the big brown/silver-haired bats were the most abundant species recorded within the project area in all monitoring years. The small composition of migratory species observed within the Flesherton study area indicates that there is likely very limited bat migration movements occurring through the project site.

There is little known about bat passage rates and migration routes within Ontario, making comparison of passage rates with known areas of concentrated bat activity difficult. However, based on additional bat monitoring conducted by NRSI within similar geographical areas and habitats, some initial comparisons in bat activity levels can be made. Average passage rates at other wind farm projects which have been studied by NRSI with similar characteristics to the Flesherton Wind Farm were observed to be 1.5 passes/hr. Therefore, bat passage rates are higher than expected for this region.

Abundance and species trends indicate that summer swarming and limited fall migration likely occurs within the study area during August and September. Results also demonstrate that bats may be utilizing the Eugenia Lake Wetland Complex for foraging and roosting purposes, resulting in the significantly higher passage rates observed at station BAT-002.

Other data trends and species identified within the study area are generally consistent with data found by NRSI at other monitoring sites within Ontario.

7.0 Conclusion

The bat monitoring conducted by Natural Resource Solutions Inc. at the Flesherton Wind Farm study area was conducted in 2006 through to 2008 in August and September, which overlaps with peak periods of bat movement, for these monthly periods. The level of bat monitoring that was conducted in accordance with the August 2007 MNR Bat Guidance Document (OMNR 2007).

Based on the habitat and landscape features present within the study area and the placement of 2 monitoring stations and 9 point count stations, data collected by Natural Resource Solutions adequately characterizes bat populations and activity patterns within the Flesherton study area. Data has been collected in such a way to allow for accurate comparison with post-construction monitoring results and easy study replication during the operational phase of this wind facility to determine the extent of impact.

Based on the results from the 2007 and 2008 monitoring period the Flesherton Wind Farm project is found to have a relatively high level of bat activity. However, this may be due to the presence of the small portion of the Lake Eugenia Wetland Complex located within the study site. Bat activity at this station (BAT-002) was observed to be twice as high as that observed at BAT-001 which was located at the edge of a hayfield, adjacent to a large deciduous woodlot. The addition of the second monitoring station in 2008 better represents bat movement throughout the study area, and may demonstrate an area of increased bat activity due to prime foraging grounds in the vicinity of the Eugenia Lake Wetland Complex. However, habitat at station BAT-001 represents the majority of habitat found throughout the study area.

8.0 References

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Appendix I
Email Comments from Brenda Robinson (Midhurst District MNR)