Pre and Post-construction Avian Survey, Monitoring, and Mitigation at the Lempster, New Hampshire Wind Power Project

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1. Executive Summary

The purpose of this white paper is to discuss the data collected as well as describe the proposed activities by Lempster Wind, LLC, project development affiliate of Community Energy, Inc. (the Project), to understand, document, and offset the potential impacts to birds and bats of the Lempster Mountain Wind Power Project, proposed for Lempster, New Hampshire ("the Project"). This white paper addresses avian and bat sampling activities completed in from the fall 2004 through the spring 2006 as well as other task and project activities at both the pre and post-construction stages of the project. The ultimate purpose of this document is to make transparent the full suite of activities that have been conducted to-date along with other activities being proposed regarding birds, bats at the Lempster site. Ultimately, the goal of this white paper is to garner collaboration, input, and support from all key stakeholders including federal, state, and not-for-profit entities.

Much of what is being proposed and carried out by the Project is a function of the considerable lessons learned over many years about the impact of utility-scale wind power projects on birds and other wildlife. These issues have been extensively studied and monitored around the U.S. and Europe. Impacts are generally partitioned into two categories: **1. direct effects** which include the chance that birds that live in or migrate through a wind power project will collide with turbine blades, nacelles, or the towers that support the blades and nacelle, and **2. indirect effects** which include the chance that that birds and other wildlife will avoid visiting or nesting in land that supports wind turbines, due to the presence of tall turbines, the sound from rotating blades and gear boxes, or from habitat fragmentation or loss due to the interconnect roads and turbine pad clearings.

As will be summarized below, wind power projects have been carefully monitored over the past decade and have been shown to not have a significant impact on birds either from direct or indirect effects. Having said that, more is known about direct effects from collision than about the indirect effects of avoidance for the simple reason that direct effects can be measured by conducting post-construction mortality surveys wherein bird carcasses are counted in the vicinity of a wind turbine, while indirect effects vis-à-vis avoidance may take several years to manifest.

Both direct and indirect effects are nicely summarized in a 2005 document by the National Wind Coordinating Committee (NWCC) entitled: *Wind Turbine Interactions with birds and bats: a summary of research results and remaining questions*. This document, generally referred to as the "avian fact sheet", reports that some impacts of wind turbines to birds and bats have been demonstrated, but that these impacts are overall very low and are not biologically significant at the population level and that they also vary from wind plant to wind plant. The fact sheet reports that **the average number of birds that die from collision with wind turbines is 2.3 bird deaths per turbine per year**.

A summary of other significant findings in the avian fact sheet are as follows:

- Two types of local impacts to birds have been demonstrated at existing wind plants: 1) **direct** mortality from collisions and 2) **indirect** impacts from avoidance, habitat disruption and displacement.

- There have been **no documented large fatality events of nocturnal migrant songbirds at wind projects**. The two largest events reported include 14 spring migrant passerines found at two adjacent turbines in Minnesota on one night and approximately 30 spring migrants in West Virginia on one night.

- Songbirds (and in some locations bats), appear to be exposed to heightened risk at wind projects as well as at communication towers during foggy weather or where flood-lights and other artificial lighting is nearby.

- While bat mortality at most wind parks is lower than bird mortality, two wind parks located in the ridge-and-valley region of Pennsylvania and West Virginia have documented annual mortality of between 2,000 – 4,000 bats per wind park for the last two years. Efforts are underway to try and determine the cause of these unique events at the two sites.

- Both migrating and resident birds and bats sometimes die in wind farms as a result of collisions with wind turbines and meteorological towers (and their supporting guy wires). For birds, the national average is between 2-4 bird deaths per turbine per year (National Wind Coordinating Committee).

- Several studies have been published or are on-going on the displacement and avoidance impacts of wind turbines and associated infrastructure/activities on grassland breeding songbirds and other open country birds (prairie grouse, shorebirds, waterfowl, etc.). Some of these studies have documented decreased densities of and avoidance by grassland song and other birds as a function of distance to wind turbines and roads. The level of impact varies by species, and on-going research is quantifying the distance of avoidance caused by the presence of infrastructure and human activity. Some birds adapt to areas previously avoided (habituate).

With these and other data as a backdrop, the Project is focusing on both pre and post-construction activities (described below) that will allow them to both **monitor and mitigate** the known impact of wind turbines on birds and other wildlife. Specifically, the Project is committed to undertaking the following avian/wildlife activities (described in more detail below):

Pre-construction Activities:

1. The Project has conducted a Phase I Avian Risk Assessment.
2. The Project made initial investigations with federal and state agencies about threatened and endangered species, and has structured its study and analysis of the site with a heightened attention paid potential threatened, endangered or species of special concern both within and near to the Lempster Project.
3. The Project has established 16 avian sampling plots (Figure 1) within the Lempster Project footprint and begun to monitor resident and migrating bird use. Sampling plots will be updated as design of Project roads and turbine areas is finalized, in order to ensure that observation areas provide a complete and representative view of potential use areas.
4. The Project has completed one fall and one spring raptor migration survey to document the distribution and abundance of birds of prey over the Lempster site.
5. The Project has completed one fall and one spring bat migration survey using "Anabat" acoustical sensor technology, and has scheduled Anabat surveys for the summer and fall of 2006, including a focus on specific areas of concern around the proposed site.

6. The Project has planned surveillance radar surveys for the fall of 2006 and spring of 2007, to provide a sampling of nocturnal migrant activity around at the Project site area.
7. The Project is working with engineers, ecologists and regulatory agencies to design sustainable project roads and turbine pad clearings that minimize habitat fragmentation and loss and thereby some of the known indirect impacts of wind facilities on wildlife.

Post-construction Activities:

1. The Project will conduct mortality surveys for birds and bats under its turbines to measure any direct mortality that may occur post-construction.
2. The Project will conduct both searcher efficiency studies as well as measure the rate at which scavengers remove bird and bat carcasses in order to “calibrate” the mortality surveys.
3. The Project will conduct monitoring, study and analysis of resident and migrant birds in the avian sampling plots to allow for before-and-after comparison.
4. The Project will conduct raptor migration surveys to allow for before-and-after comparison.
5. The Project will continue to maintain and manage all Project roads and clearings such that they continue to provide as much ecological benefit as possible.

2. Pre-construction Activities

The primary purposes of pre-construction assessment studies are to; 1) describe the resident bird communities at the site as well as the birds and bats that use the site during migration with special attention to the birds of prey (raptors); and 2) design the Project layout (e.g., roads, and turbine pad locations) so that Project impact on these and other biological resources are avoided and/or minimized.

To the extent possible, pre-construction assessments utilize existing information from projects in comparable habitat types in locations close to the proposed Project. The site-specific components and the duration of the pre-construction assessments typically depend on the size of the project, the availability and extent of existing and applicable information in the vicinity of the project, and especially on the habitats potentially impacted. Pre-construction assessment also must address the likelihood and timing of threatened, endangered or species of special concern at or near to the site.

Each component of pre-construction is discussed below. The expectation is that the results from all pre-construction efforts will be shared in a timely manner with all the key stakeholders including but necessarily limited to Project abutters, not-for-profit agencies, state and federal wildlife agencies.

2.1 Phase 1 Avian Risk Assessment

In 2004 the Project conducted a "Phase I" Avian Risk Assessment for the Project. Like most Phase I assessments, this effort included a single site visit but was largely based on existing information from other similar wind facilities as well as from ornithological data in the public domain. The Phase one also included a fall 2004 bird survey that recorded 69 species at the site (Table 1.).

The Phase I assessment made the following recommendations:

- Electrical lines within the Project site should be underground between the turbines and any new above ground lines from the site and substations to transmission lines, should follow APLIC (Avian Power Line Interaction Committee) guidelines to reduce the potential for electrocution.
- Permanent meteorology towers should be free-standing and un-guyed to minimize the potential for avian collisions.
- Size of roads and turbine pads should be minimal to disturb as little habitat as possible. After construction, forested habitat should be permitted to regenerate as close to turbines and roads as possible to minimize habitat fragmentation and displacement impacts to nesting birds.
- Lighting of turbines and other infrastructure (turbines, substations, buildings) should be minimal to reduce the potential for attracting night migrating songbirds and similar species. FAA lighting for night use, if needed, should be red or white flashing, strobe-like or strobe lights with the longest off cycle permissible. No steady burning FAA lights should be used and sodium vapor lamps, spotlights, and other lights should not be used onsite at night except for emergency maintenance or personnel safety.
- Because the forests on site appear to be suitable for forest interior species that are sensitive to fragmentation, pre- and post-construction breeding bird studies should be done to determine the degree of displacement of nesting birds, the impacts of

forest fragmentation to these birds, and whether or not interior forest nesting birds habituate to the presence of wind turbines. An impact gradient study design is recommended. That research design should be peer reviewed or reviewed by the state or federal wildlife agency to insure it is robust and will measure impacts accurately.

- A post-construction study of collision fatalities would be helpful to future wind power development in New England and New Hampshire. Such a study would provide information on the number and type of fatalities that occur, and determine the biological significance of the fatalities documented.

In the current development and design phase of the Project, Community Energy is not only following the recommendations contained in the Phase I assessment but is also expanding upon several of them, as described below.

2.2 Establishment of Avian Study Plots and Initial Breeding Bird Field Survey – *Overview*

In June of 2005 the Project established a network of 16, 50 meter diameter avian study plots and initiated summer and fall 2005 bird surveys at each of these plots as well as along the linear transects that inter connect the avian study plots (Figure 2.2). Hence, birds were counted by both the plot method at each plot as well as by the transect method along the straight lines that interconnect the plots. The avian sampling points (and others that could be added in the future) will be monitored before, during, and after construction.

The objectives, methods, initial results, and discussion of future work regarding these initial avian field surveys are as follows:

2.2.1 Summer Breeding and Fall Migration Bird Field Surveys – *Objectives*

- To establish avian survey plots and transects at the Lempster wind power Project site.
- To conduct summer surveys of breeding birds for the purpose of sampling and characterizing the resident bird communities at the Project site.
- To conduct fall surveys of resident birds and raptors for the purpose of sampling and characterizing these populations at the Project site.

2.2.2 Summer Breeding and Fall and Spring Bird and Raptor Surveys – *Methodology*

A combination of point and transect counting methods were use to document summer breeding birds at the Lempster site. Point counting was done by stopping and observing all birds for a 15 minute interval at each of 16 avian plots and identifying as many birds as possible either visually (with the aid of 10X binoculars) or from the identification of their songs or calls. Transect counting entailed recording all birds seen or heard while walking the transect lines between the 16 avian plots and identifying birds by sight or sound. This resulted in birds being observed and recorded at all times while on the site (approximately 8 hours per survey day).

Fall 2005 and spring 2006 migration surveys (for all birds including raptors) were surveyed from the vicinity of meteorological tower # 1 (Figure 1.). As with the summer surveys, identification was made visually or by songs or calls.

Summer surveys of breeding birds were conducted on June 8-9, July 10, 11, and September 9, 10, 2005. And the fall and spring surveys of resident birds and raptors were conducted between September 19 and October 23, 2005 and April 28 through May 9, 2006. For all surveys, birds were continuously monitored during all available daylight hours.

2.2.3 Breeding and Migratory Bird Surveys – *Results*

Table 1 presents a compilation and summary of the fall 2004 survey (conducted by Paul Kerlinger), the summer 2005 survey for local breeders, the fall 2005 survey for raptors and fall migrants and the spring 2006 survey for raptors and fall migrants. A total of 88 bird species have been documented for the Lempster site over approximately 18 months of sampling. Over the survey period, the avian community structure has been remarkably stable with 69 of the total 86 species seen in the fall 2004, 65 species seen during the breeding season of 2005, 70 species recorded during fall 2005 and 54 seen in the spring of 2006.

2.2.4 Breeding and Migratory Bird Surveys – *Discussion*

The mix of species recorded during the sampling period were consistent with birds typically seen in this type of New England habitat – a large and relatively contiguous stand of mixed hard and softwoods dominated by spruce on varied terrain of around 2000 feet. These included especially members of the foliage-gleaning guild such as wood warblers, bark-gleaners, and other insectivores birds. These breeding birds typically stay well below the canopy and would not be at risk under normal conditions to collide with wind turbines.

2.2.5 Breeding/Migratory Bird Field Surveys – *Future Work*

Future work could include the resampling of the sample plots throughout the summer and into the fall during future years. This would yield a more comprehensive characterization of the breeding birds that are currently using the Project site and may allow for the establishment of a baseline dataset for possible future comparison.

2.3 Threatened, Endangered or Species of Special Concern – *With special attention to Bicknell's Gray-cheeked Thrush*

There were no species of special concern found among the 88 species recorded as using the site. The only species of special concern recorded was a single Bicknell's Thrush (fall 2004), several Bald Eagles, 2 Common Loon, 4 Cooper's Hawk, 2 Peregrine Falcons and 19 osprey recorded as migrants at the site in the fall 2005 and spring 2006.

Of these species of special concern only the Bicknell's Thrush is a possible breeding bird on the Project site. And because of the status of this bird as a species of special concern and because the bird may use and/or breed at the site, the Project is mindful of the need to take this species into account in its planning.

Bicknell's Thrush is one of the rarest songbirds in North America, with an estimated continental population of no more than 25,000 pairs (Rimmer et al. 2001). It is listed as a species of "High responsibility, High Concern" by Partners in Flight Canada (Downes et al. 2000), as a species of Special Concern by the Committee on the Status of Endangered Wildlife In Canada (COSEWIC), as provincially vulnerable by the Nova Scotia Department of Natural Resources and as globally vulnerable by the International Union for Conservation of Nature and Natural Resources (Stattersfield and Capper 2000). These designations are largely due to the species fragmented population distribution (Figure 2), limited breeding range, and lack of information about the population status and breeding biology due in large part to its shy habits and remote breeding habitat.

According to Birds of North American (Rimmer *et al* 2001), no documented cases of mortality from collisions with TV or other towers have been found for Bicknell's Thrush. However, several migrants that may have been Bicknell's Thrush have been recovered below towers in Leon Co., FL (Tall Timbers Research Station specimen data; *n* = 5) and in downtown Atlanta, GA (Georgia Museum of Natural History [GMNH] specimen data; *n* = 2). There is one record of a fall migrant killed by striking a building in Atlanta (GMNH specimen data).

According to Rimmer *et al* 2001, Bicknell's Thrush seem to favor low, fir-spruce thickets of gradually increasing height such as those found along roads and at the edges of recently cleared land. And presently, on the Project site, there is already a lot of this type of cover. Indeed, in many parts of the site, low, dense spruce seems to be a very common early successional stage of the forest. Hence, the Project could easily manage turbine clearings and road edges for this type of cover and possibly provide habitat for Bicknell's Thrush.

2.4 Fall 2005 and Spring 2006 Raptor Surveys - *Overview*

Raptors, or birds of prey, are a group of birds that are of particular concern to the wind power industry in large part because of the risk that first generation wind turbines posed to birds of prey primarily in the Altamont Pass Wind Resource Area (APWRA). Birds of prey are known to migrate along north-south oriented ridges and valleys throughout North America on their fall and spring migrations. During migration they are saving energy by catching tailwinds and riding thermals that rise from these linear ridges. And the very fast rotating first generation wind turbines sited on important raptor migrating ridges like APWRA resulted in high raptor mortality. Current generation wind turbines spin much more slowly than first generation turbines (75 v. 15 rpm) though they are much taller and larger.

2.4.1 Fall 2005 and Spring 2006 Raptor Surveys - *Methodology*

The hawk counting methods used at Lempster in the fall of 2005 and spring of 2006 are with one exception identical to those defined by the Hawk Migration Association of North American (HMANA) and are used at hundreds of hawk watching sites around the US. This method essentially has the number of all raptors species recorded for all day light hours at the observation site. The one exception was that in addition to these data, we also estimated the height above the ground (in these increments: 0-50, 51-100, 101-150, 151-200, 201-300, 301-500, 501-1,000, and 1001+), for every raptor counted. Raptors were surveyed for a total of 10 days between September 19 and October 23, 2005 and from April 28 through May 9, 2006 from the location of meteorological tower #1 (Figure 1).

2.4.2 Fall 2005 and Spring 2006 Raptor Surveys – *Results and Discussion*

A grand total of 264 raptor individuals were observed during 10 days (80 hours) of fall sampling (Table 2) and 102 raptors were seen during the spring of 2006. In 2005 a total of 10 raptor species were observed (1 individual unidentified), with Broad-winged being the most abundant species with 170 individuals (64.39% of total) and followed by Sharp-shinned hawks with 49 individuals (18.56% of total) respectively (Table 2). Sharp-shinned Hawks were the most common hawk to fly between 0 and 5 feet above the ground (Table 3) and overall, 157 or 60 percent of the 264 raptors observed were spotted flying at or above 500 or more feet above the ground (Table 4). All tolled, 48 raptors (18.1%) flew below 100 feet above the ground, 49 (18.6%) flew between 100 and 300 feet and the remaining 167 (63.3%) at heights greater than 300 feet (Table 4).

Assuming a turbine rotor hub height of 250 feet (78 meters) above the ground and a rotor diameter of 285 feet (87 meters) means that the rotor plane would lie between approximately 100 and 400 feet above ground. This would mean that 55 (or 20.8%) of the 264 raptors observed in the fall 2005 would have been flying at the same height of the rotor plane.

In terms of the timing of the hawk flight over Lemptser, sixty percent of the raptors passed the before noon (Table 5). Seasonally, a low of 2 raptors were seen on Oct. 4, 2005) and a high of 118 on Oct. 21, 2005) (Table 6).

Fall 2005 raptor migration rate was only 3.3 raptors per hour which indicates that Lempster Mountain is a relatively minor raptor migration site. In fact, when the fall 2005 hawk flight at Lempster is compared to 3 other hawk migration monitoring sites for the same time intervals to a nearby site in NH, one in MA and to Hawk Mountain, PA, Lempster hosted the fewer hawk migrants than these other sites (Table 7) providing further indication that Lempster Mountain is probably, at best, a minor raptor migration site. The Lempster hawk flights in the spring 2006 exceeded those for hawk Mountain, PA. However, in that spring the bulk of the Hawk Mountain raptors moved through the site during the 2 weeks ***prior*** to the April 28 start of observations at Lempster (http://hawkcount.org/month_summary.php?rsite=109&ryear=2006&rmonth=04&sec=key).

2.5 Surveillance Radar Surveys – *Overview*

Surveillance radar has often been used during pre-construction in an attempt to document and assess the risk to migrating birds over proposed wind projects.

Radar surveys are typically conducted twice a year at one or more locations (more if the project is very large) within a proposed wind project. The radars used are the same ones used by mariners, i.e. marine surveillance radar. These radars can be tuned to pick up objects at quarter mile intervals. When used at wind facilities they are typically tuned to a ¼, ½, or 1 mile radius. Within the chosen radius they return a twodimensional image of “targets” that can include trees, land features, birds, bats, large insects, and insect swarms. Radar needs to be set either horizontally or vertically. When set horizontal the radar returns a composite image of horizontal targets that are found between 100 and up to us much as 1,000 feet. When in horizontal mode the specific heights of individual targets cannot be determined. When focused vertically radar detect targets in the vertical domain and the heights of targets are easier to detect than when in horizontal mode. Other limitations to radar include:

- **Spatial Limitation:** When set in horizontal mode radar is very good at detecting targets and their relative distances out from the radar unit. However, because all targets above the ground are detected they tell the operator nothing about how high individual targets are actually flying. When set in vertical mode, the problem is the inverse of this – only the height data for targets directly above the radar unit are measured –i.e., there is no horizontal component. The reason this is a limitation is due to the fact that flight height data for nocturnal migrants is very important to estimate the risk to birds flying through the rotor sweep area of a wind turbine. Some wind developers have dealt with this problem by running two radars simultaneously, one vertical, on horizontal, or by switching a single radar between vertical and horizontal modes. But, again, target height data is very limited when in horizontal mode.

- **Biological Limitation:** In addition to not yielding data that can be directly used to measure direct effects, radar’s major limitation is that it cannot differentiate among most targets. Hence, individual birds, bats, and large insects can all look identical to each other or for that matter to flocks of birds, bats, or even to insect swarms. So, radar data only quantifies generic “targets” and therefore has no taxonomic specificity. To date, numerous nocturnal radar surveys have been performed at wind projects and these data have yet to yield information that has been able to improve the design or management of a wind facility. No State of Federal regulatory agency has asked for any improvements in the design or operation of a wind project based on the data collected from radar. The reason for this is that these surveys show that the vast majority of nocturnal migrants pass well above the rotor sweep plane and there is no species-specific information provided by these surveys.

- **High Cost Relative to Return-on-Investment:** Radar surveys are often conducted twice a year corresponding to the spring and fall migrations. And at the approximate cost of $100,000 per migration for not more than 30 nights of sampling this represents a sizable percentage of the pre-construction costs that developers incur during pre-construction. Resources should be more appropriately focused on avian and wildlife study activities that are more scientifically and practically useful for determining impacts of wind project sites on various species. The Project continues to believe that an ongoing, comprehensive and field-based program tailored to the Lempster site both pre- and post-construction is proposed to better document and mitigate any potential adverse impacts of the Project on avian and wildlife species. The Project and its senior biologists believe that more conservation and better mitigation can be achieved through the comprehensive initiatives articulated in this document.

Notwithstanding the limitations of surveillance radar for avian survey, as a result of continuing collaboration with federal and state agencies the Project has agreed to conduct surveillance radar studies during the fall 2006 and spring 2007 migration seasons. The studies will provide the Project with a sample of nocturnal migrant use at the site.

2.5.1 Surveillance Radar Survey - *Methodology*

The Project proposes to conduct surveillance radar surveys at the site to document the abundance, flight patterns, and flight altitudes of night-migrating passerines using marine radar supplemented by visual confirmation survey methods.

The specific methodology employed in the radar survey will be documented in future reports, once the scope of work is finalized and survey has commenced. In general, employed methods and survey durations will be in accordance with discussions with state and federal agencies. A longer survey period is anticipated for the fall 2006 migration period. The radar data will be post-processed and a report will be issued, providing average hourly and nightly traffic rate (targets/kilometer/hour), seasonal traffic rate, nightly and seasonal flight direction, and nightly and seasonal flight heights. Based on the characteristics of the proposed Gamesa turbines, the percentage of targets flying below the height of the turbines will be calculated. Qualitative descriptions of the general flight characteristics of radar targets will also be provided.

2.6 Bat Survey[1] - *Objectives*

Bat fatality at wind farms received little attention until 2003 when an estimated 2,000 to 4,000 bats were killed at the Mountaineer Wind Energy Center in West Virginia (Kerns and Kerlinger 2004). Prior to the Mountaineer survey, most survey efforts at wind farms did not consider the potential impact of wind turbines on bats simply because few bat fatalities had ever been observed. In fact, post-construction monitoring has provided most of what little information there is on bat fatalities at wind farms. Nevertheless, the Project decided to initiate pre-construction bat surveys using acoustic detectors (Anabat), to assess local bat species presence and activity. Future Anabat surveys are planned for the spring 2006.

2.6.1 Bat Survey - *Methodology*

Bat surveys during fall 2005 and spring 2006 migration periods have been and will be conducted using Anabat II® bat echolocation detectors. During survey periods, an array of Anabat detectors is installed at the site of the primary meteorological test tower, located at a central point in the proposed wind Project site. (See Figure 2.2)

Bat surveys were conducted and will be conducted during the following times:

- Fall migration period from September 20 to October 31, 2005 and included the deployment of three solar powered Anabat II detectors at the met tower site.

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[1] Bat surveys were not performed by Louis Berger Group. Information on bat survey methodology and results has been provided by Woodlot Alternatives, Inc., the contractor responsible for the surveys.

One detector was deployed high (15 m) in the met tower guy wire array, one was deployed low (7.5 m) in the array, and the third detector was deployed at the edge of the met tower clearing, at a height of approximately 2 m.

- Spring migration period from April 5 to June 12, 2006, and included the deployment of three Anabat II detectors at the met tower site. One detector was deployed high (40 meters) in the met tower guy wire array, one was deployed low (20 meters) in the array, and the third detector was deployed at the edge of the met tower clearing at a height of approximately 5 meters.
- Summer and fall migration period in August and September 2006, planned for the same locations as spring 2006. The Project will also perform specific survey using handheld Anabat units at the beaver pond located to the west of the site between proposed turbines 2 and 3, to document bat use at this area of concern.

Anabat II® bat echolocation detectors are frequency-division detectors, dividing the frequency of ultrasonic calls made by bats so that they are audible to humans. The frequency division setting literally divides ultrasonic calls detected by the detector by the division setting to produce signals at frequencies audible to the human ear. A factor of 16 was used in this study. Frequency division detectors were selected based upon their widespread use for this type of survey, their ability to be deployed for long periods of time, availability of reference calls using the same technique, and their ability to detect a broad range of frequency, which allows detection of all species of bats that could occur in the Project area. Each microphone will be capable of detecting the echolocation calls of approaching bats up to 11.6m away with a potential sampling volume of 254 m^3. Data from the Anabat detectors were logged onto compact flash media cards (256 MB minimum for storage of approximately 23,000 individual bat passes) using a CF ZCAIM (Titley Electronics Pty Ltd.) and downloaded to a computer for analysis. Detectors are programmed to operate from 6:00 pm to 8:00 am every night.

Potential call files are extracted from the recorded data files using CFCread© software, with default settings in place. This software screens all data recorded by the bat detector and extracts call files based on the number of pulses recorded within a certain time period. Every potential call file is visually inspected, with any distinct grouping of recognizable calls or call fragments being considered a bat call sequence. Call sequences are identified based on visual comparison of call sequences with reference libraries of known calls collected by Chris Corben (designer of the analysis software), Lynn Robbins, and the University of Maine Mammalogy Department using the Anabat system.

Qualitative visual comparison of recorded call sequences of sufficient length to reference libraries of bat calls allows for relatively accurate identification of bat species. However, the accuracy of this method depends upon experience and the relevance of reference call files used. Poor quality recordings or brief fragments were labeled as unknown, except in cases where the fragment was exclusively within the *myotid* frequency range. *Myotids* are not identified to species, due to the similarity of calls between species within this genus.

Once all of the call files are identified, nightly tallies of detected calls by species are compiled for each detector. Mean detection rates (calls/night) were calculated for each night. Detection rates indicate only the number of calls detected and do not necessarily reflect the number of individual bats in an area.

In general, calls are classified to the lowest possible taxonomic order based on reference materials compiled from hand-captured bats in the region. Those calls are grouped into guilds for reporting purposes, due to similarity of call signatures between several species and local variation within individual species. This classification scheme is as follows:

- Unknown (UNKN) – all call sequences with too few pulses (less than seven) or of poor quality (such as indistinct pulse characteristics or background static);
- Myotid. (MYSP) – All bats of the genus *Myotis*. While there are some general characteristics believed to be distinctive for several of the species in this genus, these characteristics do not occur consistently enough for any one species to be relied upon at all times when using Anabat recordings;
- Red bat/pipistrelle (RBEP) – Eastern red bats and eastern pipistrelles. Like so many of the other northeastern bats, these two species can produce calls distinctive only to each species. However, significant overlap in the call pulse shape, frequency range, and slope can also occur; and
- Big brown/silver-haired/hoary bat (BBSHHB) – This guild will also be referred to as the big brown bat guild. These species' call signatures commonly overlap and will be included as one guild in the report.

Upon the completion of Summer/Fall 2006 surveys, a final report will be issued to document the findings of the three seasons of bat survey.

2.6.2 Bat Survey – *Results and Discussion*

2.6.2.1 Fall 2006 Survey

In fall 2006, the detectors were deployed for a total of 42 consecutive nights. One detector malfunctioned for eight nights. Consequently, a total of 118 detector-nights of data were collected. A total of only 43 bat calls were recorded during the observation period. The detector located the lowest on the met tower documented the greatest number of calls (27), followed by the high detector (14) and the forest edge (2) detector. The lack of calls from the edge detector is interesting, as that is a microhabitat that traditionally receives concentrated use by bats. Tests of that detector were performed and showed that it was operating correctly. Those tests were at very close range, however, and its sensitivity at greater ranges may have been less than the other two detectors. Detection rates varied from 0 to 4 calls per detector-night. The mean detection rate for the full sampling period was 0.4 calls per detector-night. The most calls were documented in late September and early October. After the first week of October very few calls were documented.

Four species or species groups were identified during data analysis. Calls of the genus *Myotis* were the most commonly recorded calls (20) followed by big brown bat (*Eptesicus fuscus*) and eastern red bat (*Lasiurus borealis*) (7 calls each). One hoary bat (*Lasiurus cinereus*) call was recorded and eight calls were of poor quality or not of sufficient length to identify. Calls of the myotids are too similar to reliably distinguish from one another. The little brown bat (*Myotis lucifugus*) and northern long-eared bat (*M. septentrionalis*) are the two most common myotids in the northeast and are most likely the myotids recorded at the site. However, other species whose ranges encompass the Lempster site include the Indiana bat (*M. sodalis*) and eastern small-footed bat (*M. leibii*).

This initial bat survey provided a list of species present on the site as well as sense for abundance over time. It is clear from this survey that the site needs to be monitored earlier given that very few calls were heard after the first week of October.

2.6.2.2. Spring 2006 Survey

The detectors were deployed for a total of 69 consecutive nights. Poor weather conditions caused disruption to the detectors from time to time, with occasional periods of water damage impairing the function of the detectors. In total, 131 detector-nights of data were collected during the survey period. A total of only 26 call sequences were recorded during that time (Table 1). The low detector documented the fewest number of call sequences (3), with progressively more call sequences recorded at the high detector (7) and the forest edge detector (16). The volume of call sequences recorded varied from 0 to 3 recordings per night at all the detectors combined. The actual detection rate, however, varied from 0 to only 1 call sequence per detector-night (this accounts for variable levels-of-effort on different nights). The mean detection rate for the full sampling period was 0.2 call sequences per detector-night, which is half of what was documented in fall 2006.

A few call sequences were recorded around the middle of April. There was then a large gap in recordings until near the end of May, when 23 of the 26 call sequences were recorded. As mentioned previously, weather hampered the effectiveness of one or two of the detectors periodically within the survey period. However, there was always at least one, but usually two, operating detectors at any given time, so the lack of calls at that time period is interesting. The increase in detections at the end of May is likely due to the full emergence of leaves and increase in flying insects at that time. This time period also likely marks the start of the summer activity season for bats and the end of the spring migration period.

Ten of the 26 calls were identified within the big brown/silver-haired/hoary bat complex (identified as LE in the species code column of Table 1). Only one of these calls appeared definitive enough to identify to species and was determined to be a big brown bat (EPFU code). The next most abundant category of calls were not possible to identify based on the criteria listed above. One call was identified definitively as a red bat within the red bat/eastern pipistrelle guild. Finally, six call sequences were classified as myotid in origin. One of these calls appeared to be most likely that of a little brown bat.

3. Mitigation: Sustainable Roads and Clearings

The environmental impact of roads and clearings at wind power projects is a significant concern to many regulators, interest groups, and local organizations, especially for roads that are being constructed through or near to lesser developed areas. To help address these concerns, which include the potential impact of habitat fragmentation and loss, the Project is proposing to integrate smart planning, sustainable design and engineering along the lines described below into the roads and clearings at the Project site.

3.1 Types of Road and Clearing Impacts

Wind power development at greenfields sites typically requires a number of roads and clearings - principally temporary crane access roads, permanent O&M roads, crane pad clearings, and turbine foundations.

The impacts of new or expanded roads generally fall into the following categories:

- **Human Disturbance:** Roads in wilderness areas increase the likelihood of humans and domestic animals entering and possibly disturbing a site. Such roads might also encourage secondary development.
- **Pathways for Invasive Species:** Roads represent entry-points for invasive plants and animals to enter a site.
- **Increase Habitat for Edge Species:** Sometimes referred to as “weedy species,” edge species are those that are found at the margins or transition areas (i.e. between forests and fields). Roads create habitats for these edge species in the forest interior thus changing the ecological mix of species found.
- **Increase in Habitat Fragmentation and loss:** Roads through wilderness areas convert contiguous habitat into divided habitat. This is commonly referred to as forest, habitat, or land fragmentation. The main concern with fragmentation is the reluctance of some species to traverse over roadways and encroachment into an otherwise unbroken habitat area. For some species, the result may be reduced opportunities to find food, mates, or to colonize otherwise intact nearby habitats.

3.2 Mitigation and Minimization of Impacts

The goal in minimizing the potential impacts of roads and clearings to birds and other wildlife impacted by habitat fragmentation and loss is to ***make cost-effective, significant commitments to employing the best methods available to design, build and operate a sustainable road system***. To accomplish these goals, ecologists, environmental scientists, and civil engineers will work together to plan, design, and engineer, sustainable road/clearing system at the Lempster site. This approach addresses issues at each stage of the Project: design, construction, and operations. Specific measures and examples to be implemented at Lempster are described below.

3.2.1 Project Design Phase

- Roadway and turbine pad clearings should be as small as the end-use will allow.
- Road bed material should inhibit colonization by edge and invasive species.
- Finish surfaces that minimize runoff (such as custom crushed stone) should be utilized.
- Loam and seed should be utilized on 4:1 or flatter side slopes near existing free-range or farmland. All other side slopes should use natural erosion-resistant finish surfaces.
- Detention and sedimentation basins should be utilized at ditch outfalls.
- Temporary 1:1 slopes for wide crane track roads (e.g. 30’ – 40’) should be graded (restored) to 3:1 slopes (if possible) for 12’-16’ wide maintenance roads.
- In steep areas where rock cut (blasting) is required, over blasting should be considered to minimize or eliminate fill slopes and leave a permanent, vertical

rock face. This minimizes disturbed width and nearly eliminates side slopes that host invasive species. The additional fill material can be utilized in other sections of the roadway where the design dictates that fill is needed.

3.2.2. Project Construction Phase

- Control of runoff (sediment) should be a top priority during construction.
- Compliance with State and Local storm water, sediment and erosion control regulations, as well as National Pollution Discharge Elimination System (NPDES) requirements for Stormwater Pollution Prevention Plans (SWPPP) will be ensured. .
- Straw bales, silt fencing, or other temporary erosion and sediment control devices, should be utilized where necessary. Such measures would limit any surface run-off from disturbed areas and protect nearby areas from run-off during rain events and during spring snow melt.
- Clearly identify site boundaries through the utilization of fences and markers to ensure that construction crews are aware of Project limits.
- Clearly mark trees to be removed as well as nearby trees that are to be undisturbed. Mark no-cut lines/no-disturbance lines so that construction crews are provided clear direction.
- If applicable, replant/re-seed disturbed areas as soon as possible to limit surface disturbance and for site stability and erosion control.
- As applicable (and should be documented in SWPPP), drip pans/mats should be used for any heavy construction equipment left on-site. If there is to be any on-site storage of fuels, lubricants, solvents, or other hazardous materials, impermeable mats or temporary approved storage sheds are recommended. Appropriate containment measures are recommended for any fuel tanks on-site during construction.
- Instruct construction crews to limit unnecessary engine idling.
- The construction contractor should be required to have and post on-site a site-specific plan and procedures for stowing, securing, or removing construction equipment, materials, and debris in the event of anticipated major storm events (major storms, icing, gale winds).

3.2.3 Operations & Maintenance Phase

- Vegetation along the roadways and at clearings should be maintained by cutting and never through the application of herbicides.
- Gates should be utilized at the roadway openings and at clearings to ensure use by authorized vehicles only. This will also minimize animal / vehicle encounters.
- An annual search for and control of any invasive plants species should be performed along road edges and Project clearings.

4. Post-construction Activities

4.1 Mortality Monitoring

The most effective way to ascertain whether a wind project is causing mortality to birds or bats from collision is to go into the field and try to document it. Mortality surveys entail observers systematically walking underneath and between wind turbines on a set schedule and systematically searching for dead birds and bats. It is also necessary to conduct mortality searches ***before a project is built*** because of the need to document pre-construction mortality at the site.

4.2 Searcher Efficiency and Carcass Removal Studies

However, because no searcher is 100% accurate and because scavengers are quick to remove and eat dead birds and bats, the Project will conduct both **searcher efficiency** as well as **scavengers removal studies** in order to "calibrate" the mortality surveys. Searcher efficiency studies entail testing the searchers to see how many dead birds and bats they are likely to be missing during mortality searches. To do this, dead birds and bats are placed at random in the area(s) to be surveyed and the errors of omission are recorded for each observer. Carcass removal studies are performed by placing bird carcasses in the sites to be surveyed and recording the length of time before they disappear from the site.

4.3 Migrant and Breeding Bird Surveys

The Project will continue in post-construction the monitoring of resident and migrant birds it initiated pre-construction in the 16 avian sampling plots to allow for before-and-after comparison. The Project will also continue raptor migration monitoring as initiated in the pre-construction phase. This will be the best way to document the possibility that indirect effects are impacting birds at the Lempster site.

4.4 Regulator and Stakeholder Outreach

The Project is committed to continuing to reach out to all stakeholders and to collaborate with agencies and NGO through frequent meetings, site visits, and open hearings.

4.5 Sustainable Land Use Plan

The Project will continue to maintain and manage all Project roads and clearings such that they continue to provide as much ecological benefit as possible, as discussed in Section 3 above.

APPENDIX: Figures and Tables

Figure 1. Avian survey plots are shown in **pink**, Anabat survey point in **green** and fall raptor survey point in **red**.

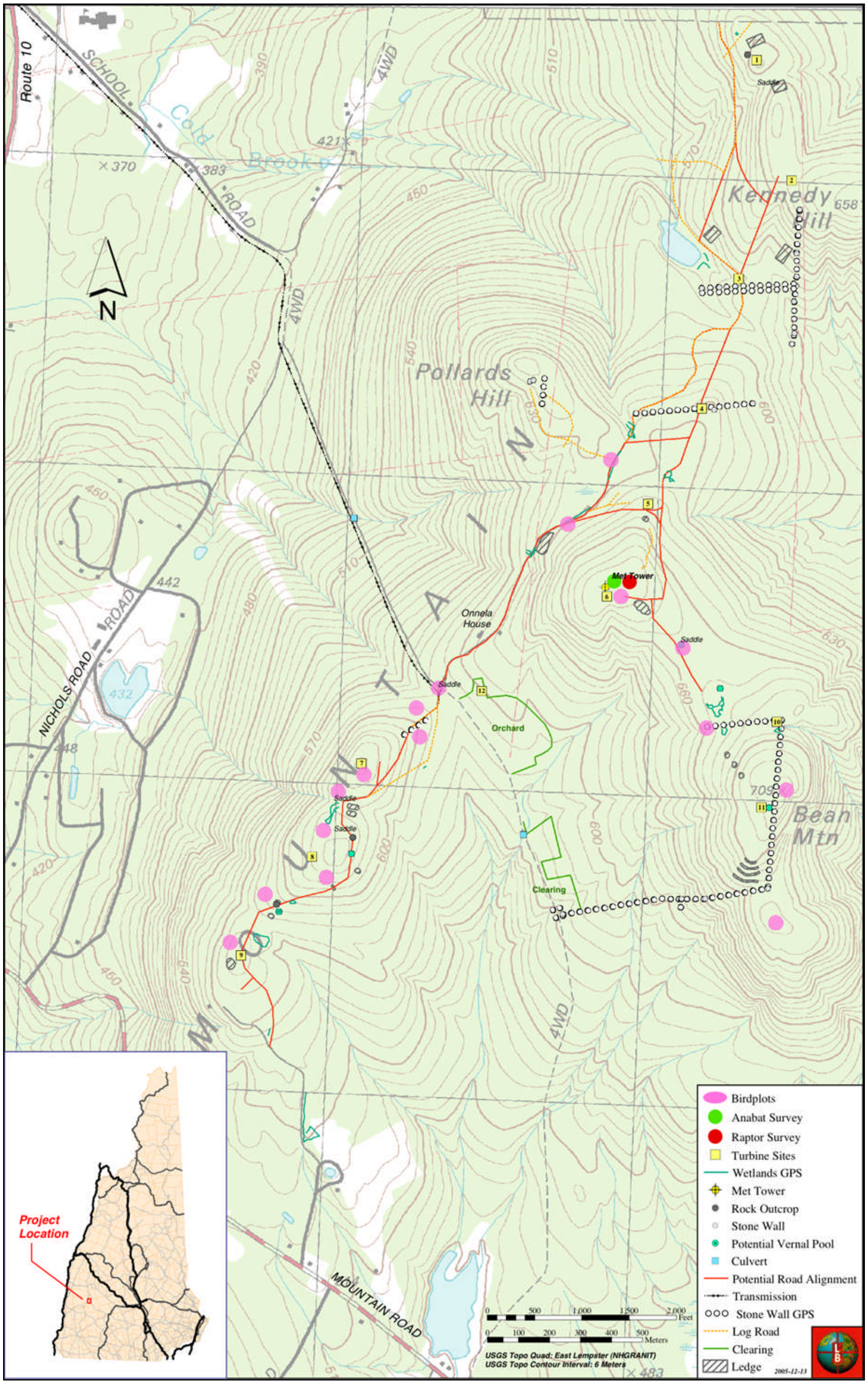

Figure 2. Range map for Bicknell's Thrush (Rimmer et. al. 2001). Lempster Mountain is just to the south of the known breeding range in NH.

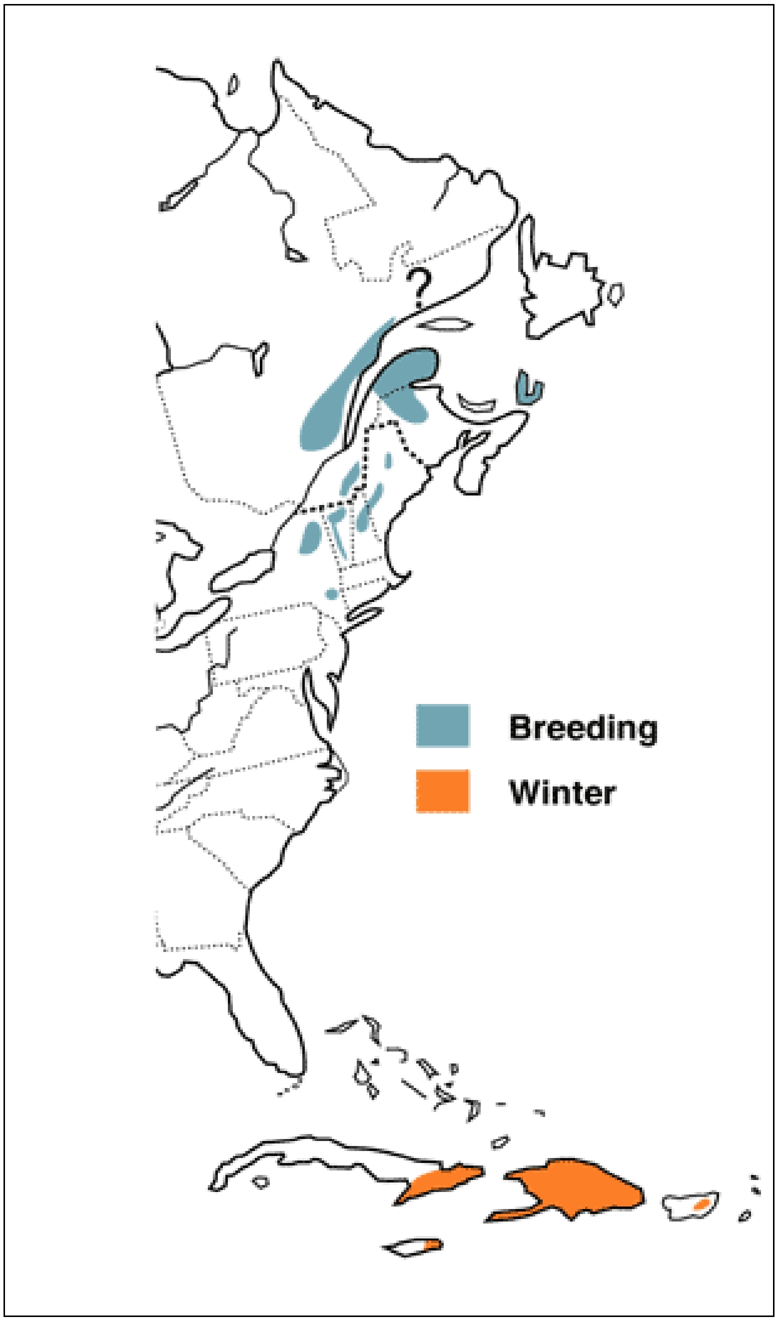

Table 1. Summary of all bird species recorded at Lempster, NH wind power Project site from fall 2004 through spring 2006. Numbers in red reflect total raptor numbers counted when available.

#	Species	Fall 2004	Summer 2005	Fall 2005	Spring 2006	Notes and Status (US and NH)
1	American Crow	□	□	□	□	
2	American Goldfinch	□	□	□	□	
3	American Kestrel	4	□	3	3	
4	American Redstart	□	□	□	0	
5	American Robin	□	□	□	□	
6	Bald Eagle	□	0	2	0	Status: Threatened Species
7	Barn Swallow	□	□	□	□	
8	Barred Owl	0	0	0	□	
9	Black-and-white Warbler	□	□	0	□	
10	Blackburnian Warbler	□	□	□	0	
11	Black-capped Chickadee	□	□	□	□	
12	Blackpoll Warbler	□	□	0	0	
13	Black-throated Blue Warbler	□	□	□	□	
14	Black-throated Green Warbler	□	□	□	□	
15	Blue Jay	□	□	□	□	
16	Blue-headed Vireo	□	□	□	□	
17	Bobolink	0	0	□	0	
18	Broad-winged Hawk	28	0	170	39	
19	Brown Creeper	□	□	□	□	
20	Canada Goose	□	□	□	□	
21	Canada Warbler	0	0	□	0	
22	Cape May Warbler	□	□	□	0	
23	Cedar Waxwing	□	□	□	0	
24	Chestnut-sided Warbler	□	□	0	0	
25	Chipping Sparrow	□	□	□	0	
26	Common Loon	0	0	□	□	Status: Threatened Species
27	Common Grackle	0	0	0	□	
28	Common Raven	□	□	□	□	
29	Common Yellowthroat	□	□	□	0	
30	Cooper's Hawk	1	0	4	4	Status: Threatened Species
31	Dark-eyed Junco	□	□	□	□	

32	Double-crested Cormorant	0	0	0	**31**	
33	Downy Woodpecker	□	□	□	□	
34	Eastern Bluebird	□	□	0	0	
35	Eastern Phoebe	□	□	□	□	
36	Eastern Towhee	□	□	0	□	
37	Eastern Wood-Pewee	□	□	0	0	
38	European Starling	□	□	0	□	
39	Evening Grosbeak	0	0	□	□	
40	Field Sparrow	□	□	0	0	
41	Golden-crowned Kinglet	□	□	□	□	
42	Gray Catbird	□	□	0	0	
43	Gray-cheeked/Bicknell’s Thrush	□ (1)	0	0	0	Species of Special Concern
44	Great Blue Heron	□	□	□	□	
45	Greater Yellowlegs	0	0	□	0	
46	Hairy Woodpecker	□	□	□	□	
47	Hermit Thrush	0	0	□	□	
48	House Finch	0	0	□	0	
49	Lincoln’s Sparrow	□	0	□	0	
50	Magnolia Warbler	□	□	□	□	
51	Merlin	□	0	4	2	
52	Monarch Butterfly	0	□	□	0	
53	Mourning Dove	□	□	□	□	
54	Nashville Warbler	□	□	□	□	
55	Northern Flicker	□	□	□	□	
56	Northern Goshawk	0	0	0	3	
57	Northern Parula	□	□	□	□	
58	Osprey	□	0	12	7	Status: Threatened Species
59	Ovenbird	0	0	0	□	
60	Palm Warbler	□	□	□	0	
61	Peregrine Falcon	0	0	2	0	Status: Endangered
62	Pileated Woodpecker	□	□	□	□	
63	Pine Siskin	0	0	□	0	
64	Pine Warbler	□	□	0	0	
65	Purple Finch	□	□	□	0	
66	Red-breasted Nuthatch	□	□	□	□	
67	Red-eyed Vireo	□	□	□	0	

68	Red-shouldered Hawk	□	□	0	0	
69	Red-tailed Hawk	6	□	4	7	
70	Red-winged Blackbird	□	□	□	□	
71	Rose-breasted Grosbeak	□	□	□	0	
72	Ruby-crowned Kinglet	0	0	□	□	
73	Ruby-throated Hummingbird	0	0	□	0	
74	Ruffed Grouse	□	□	□	□	
75	Scarlet Tanager	□	□	0	0	
76	Sharp-shinned Hawk	8	□	49	20	
77	Song Sparrow	□	□	□	□	
78	Swainson's Thrush	□	□	0	0	
79	Tennessee Warbler	□	□	0	0	
80	Tree Swallow	□	□	0	□	
81	Tufted Titmouse	0	0	□	□	
82	Turkey Vulture	□	□	9	11	
83	Unidentified Buteo	0	0	1	6	
84	Unidentified Warbler	0	□	□	0	
85	White-breasted Nuthatch	□	□	□	0	
86	White-throated Sparrows	0	0	□	□	
87	Wild Turkey	□	□	□	□	
88	Winter Wren	□	□	□	□	
89	Yellow-bellied Sapsucker	□	□	□	0	
90	Yellow-rumped Warbler	□	□	□	□	
	Total Species:	**69**	**65**	**70**	**54**	

Table 2. Raptor species (in descending abundance) for Lempster Mountain

Fall 2005

Raptor Species	#	%
American Kestrel	3	1.14
Bald Eagle	2	0.77
Broad-winged Hawk	170	64.39
Cooper's Hawk	4	1.51
Merlin	4	1.51
Northern Harrier	4	1.51
Osprey	12	4.54
Peregrine Falcon	2	0.77
Red-tailed Hawk	4	1.51
Sharp-shinned Hawk	49	18.56
Turkey Vulture	9	3.40
Unidentified Buteo	1	0.39
Total	**264**	**100**

Spring 2006

Raptor Species	#	%
American Kestrel	3	2.9
Northern Goshawk	3	2.9
Broad-winged Hawk	39	38.2
Cooper's Hawk	4	3.8
Merlin	2	2
Northern Harrier	0	0
Osprey	7	6.8
Peregrine Falcon	0	0
Red-tailed Hawk	7	6.8
Sharp-shinned Hawk	20	19.6
Turkey Vulture	11	10.8
Unidentified Buteo	6	5.8
Total	**102**	**99.6**

Table 3. Height (ft) of flight analysis for raptor species seen on Lempster Mountain. Columns and numbers in red correspond approximately to the height of the rotor sweep plan proposed (assuming a Gamesa G87 2.0 MW WTG).

Fall 2005

Height of Flight (ft.)	0-50	51-100	101-150	151-200	201-300	301-500	501-1,000	1001+	Total
American Kestrel	2	0	0	1	0	0	0	0	**3**
Bald Eagle	1	0	0	0	0	0	0	1	**2**
Broad-winged Hawk	5	8	4	12	13	6	23	99	**170**
Cooper's Hawk	1	0	0	0	0	0	1	2	**4**
Merlin	2	0	0	1	0	1	0	0	**4**
Northern Harrier	0	1	0	0	1	1	1	0	**4**
Osprey	1	2	0	5	0	0	3	1	**12**
Peregrine Falcon	1	0	0	0	0	0	1	0	**2**
Red-tailed Hawk	0	0	0	0	0	0	0	4	**4**
Sharp-shinned Hawk	17	6	2	4	3	2	7	8	**49**
Turkey Vulture	1	0	2	0	0	0	5	1	**9**
Unidentified Buteo	0	0	0	1	0	0	0	0	**1**
Total	**31**	**17**	**8**	**24**	**17**	5 (5)	**41**	**116**	**264**

Spring 2006

Height of Flight (ft.)	0-50	51-100	101=150	151-200	201-300	301-500	501-1,000	1001+	Total
American Kestrel	1	1	0	0	1	0	0	0	**3**
Northern Goshawk	1	0	0	0	0	2	0	0	**3**
Broad-winged Hawk	5	5	4	4	8	8	5	0	**39**
Cooper's Hawk	0	1	0	0	3	0	0	0	**4**
Merlin	0	0	1	0	0	0	1	0	**2**
Osprey	0	0	0	0	2	1	4	0	**7**
Red-tailed Hawk	0	0	2	0	0	2	3	0	**7**
Sharp-shinned Hawk	2	1	2	3	3	4	5	0	**20**
Turkey Vulture	0	1	2	3	0	1	4	0	**11**
Unidentified Raptor	0	1	0	0	1	0	4	0	**6**
Total	**9**	**9**	**11**	**10**	**18**	18	**26**	**0**	**101**

Table 4. Height (ft) of flight analysis for all raptors seen on Lempster Mountain. Rows and numbers in red correspond approximately to the height of the rotor sweep plan proposed (assuming a Gamesa G87 2.0 MW WTG).

Fall 2005

Height of Flight (ft.)	#	%
0-50	31	11.74
51-100	17	6.44
101=150	8	3.03
151-200	24	9.09
201-300	17	6.44
301-500	5 (5)	3.79
501-1,000	41	15.53
1001+	116	43.94
Total	**157**	**100**

Spring 2006

Height of Flight (ft.)	#	%
0-50	9	8.8
51-100	9	8.8
101=150	11	10.8
151-200	10	9.8
201-300	18	17.6
301-500	18	17.6
501-1,000	26	25.5
1001+	0	0
Total	**102**	**100**

Table 5. Time of day analysis for all raptors seen on Lempster Mountain.

Fall 2005

Time of Day	7-8AM	9-10AM	11-12AM	1-2PM	3-4PM	5-6PM	total
American Kestrel	0	2	0	1	0	0	**3**
Bald Eagle	0	0	0	1	1	0	**2**
Broad-winged Hawk	0	85	18	34	5	28	**170**
Cooper's Hawk	0	1	2	1	0	0	**4**
Merlin	3	1	0	0	0	0	**4**
Northern Harrier	0	0	0	3	1	0	**4**
Osprey	0	1	6	1	3	1	**12**
Peregrine Falcon	1	0	0	1	0	0	**2**
Red-tailed Hawk	0	0	1	3	0	0	**4**
Sharp-shinned Hawk	4	5	22	10	7	1	**49**
Turkey Vulture	0	0	3	5	1	0	**9**
Unidentified Buteo	0	1	0	0	0	0	**1**
Total	**8**	**96**	**52**	**60**	**18**	**30**	**264**
Percent	**3.03**	**36.36**	**19.70**	**22.73**	**6.82**	**11.36**	**100**

Spring 2006

Time of Day	7-8AM	9-10AM	11-12AM	1-2PM	3-4PM	5-6PM	total
American Kestrel	1	1	0	1	0	0	**3**
Broad-winged Hawk	5	12	12	10	0	0	**39**
Northern Goshawk	0	1	1	1	0	0	**3**
Cooper's Hawk	0	3	0	1	0	0	**4**
Merlin	0	1	1	0	0	0	**2**
Osprey	0	0	2	5	0	0	**7**
Red-tailed Hawk	1	0	2	4	0	0	**7**
Sharp-shinned Hawk	1	6	6	7	0	0	**20**
Turkey Vulture	0	2	4	5	0	0	**11**
Unidentified Buteo	1	3	2	0	0	0	**6**
Total	**9**	**29**	**30**	**34**	**0**	**0**	**102**
Percent	**8.8**	**28.4**	**29.4**	**33.3**	**0**	**0100**	

Table 6. Day of month analysis for all raptors seen on Lempster Mountain.

Fall 2005

Day of Month	9/19	9/20	10/2	10/3	10/4	10/5	10/6	10/21	10/22	10/23	Total
American Kestrel	1	0	0	0	1	1	0	0	0	0	**3**
Bald Eagle	0	0	0	0	0	1	0	0	1	0	**2**
Broad-winged Hawk	58	0	0	0	0	1	0	103	7	1	**170**
Cooper's Hawk	0	0	1	1	0	2	0	0	0	0	**4**
Merlin	1	1	0	1	0	0	1	0	0	0	**4**
Northern Harrier	0	0	1	0	0	2	0	1	0	0	**4**
Osprey	0	1	0	1	0	1	0	1	8	0	**12**
Peregrine Falcon	0	0	0	0	0	1	0	1	0	0	**2**
Red-tailed Hawk	0	0	1	0	0	2	0	1	0	0	**4**
Sharp-shinned Hawk	3	0	4	4	1	15	9	10	1	2	**49**
Turkey Vulture	0	0	1	3	0	2	2	1	0	0	**9**
Unidentified Buteo	0	1	0	0	0	0	0	0	0	0	**1**
Total	**63**	**3**	**8**	**10**	**2**	**28**	**12**	**118**	**17**	**3**	**264**
Percent	**23.86**	**1.14**	**3.03**	**3.78**	**0.75**	**10.61**	**4.55**	**44.70**	**6.44**	**1.14**	**100**

Spring 2006

Day of Month	4/28	4/29	4/30	5/1	5/2	5/4	5/5	5/6	5/7	5/9	Total
American Kestrel	0	0	0	2	0	0	0	0	0	1	**3**
Northern Goshawk	0	1	1	0	0	0	0	0	0	1	**3**
Broad-winged Hawk	3	4	12	2	1	7	3	2	2	3	**39**
Cooper's Hawk	0	0	1	0	0	3	0	0	0	0	**4**
Merlin	0	0	1	1	0	0	0	0	0	0	**2**
Osprey	0	0	0	0	0	5	0	2	0	0	**7**
Red-tailed Hawk	0	0	0	3	1	1	1	0	0	1	**7**
Sharp-shinned Hawk	0	1	4	2	0	5	4	2	0	2	**20**
Turkey Vulture	0	2	2	1	0	4	2	0	0	0	**11**
Unidentified Buteo	0	1	0	0	0	1	3	1	0	0	**6**
Total	**3**	**9**	**21**	**11**	**2**	**26**	**13**	**7**	**2**	**8**	**102**
Percent	**2.8**	**8.8**	**20.7**	**10.8**	**2**	**25.5**	**12.7**	**6.8**	**2**	**7.8**	**100**

Table 7. Raptors per day at Lempster Mountain versus Peterborough, NH (36 miles south east of Lempster and the closest HMANA monitoring site), Blueberry Hill, MA (122 miles south of Lempster) and Hawk Mountain, PA, (370 miles south of Lempster) for the same days during the Fall 2005.

Day of Month	9/19	9/20	10/2	10/3	10/4	10/5	10/6	10/21	10/22	10/23	total
Lempster Mountain, NH	63	3	8	10	2	28	12	118	17	3	264
Peterborough, NH	863	0	93	26	31	38	10	37	39	0	1137
Blueberry Hill, MA	215	8	136	39	15	27	46	168	13	75	742
Hawk Mountain, PA	231	230	63	67	64	44	15	8	*	974	974

*no count due to inclement weather.

Day of Month	4/28	4/29	4/30	5/1	5/2	5/4	5/5	5/6	5/7	5/9	total
Lempster Mountain, NH	3	9	21	11	2	26	13	7	2	8	102
Hawk Mountain, PA	2	13	-	8	15	-	9	9	1	2	59

- No data available.

Table 8. Summary of Lempster, NH bat detector surveys, fall 2005 and spring 2006

Table 1. Summary of Lempster, NH fall 2005 bat detector survey.

Date (night of)	# Detectors	Survey Time	Number of Calls				Detection Rate*
			High	Low	Field	Total	
9/20/05	2	19:00-7:00	2	n/a	0	2	1.0
9/21/05	2	19:00-7:00	3	n/a	0	3	1.5
9/22/05	2	19:00-7:00	2	n/a	0	2	1.0
9/23/05	2	19:00-7:00	0	n/a	0	0	0
9/24/05	2	19:00-7:00	2	n/a	0	2	1.0
9/25/05	2	19:00-7:00	1	n/a	0	1	0.5
9/26/05	2	19:00-7:00	0	n/a	0	0	0
9/27/05	2	19:00-7:00	1	n/a	0	1	0.5
9/28/05	3	19:00-7:00	3	8	1	12	4.0
9/29/05	3	19:00-7:00	0	1	0	1	0.3
9/30/05	3	19:00-7:00	0	0	0	0	0
10/1/05	3	19:00-7:00	0	0	0	0	0
10/2/05	3	19:00-7:00	0	0	0	0	0
10/3/05	3	19:00-7:00	0	1	0	1	0.3
10/4/05	3	19:00-7:00	0	1	0	1	0.3
10/5/05	3	19:00-7:00	0	6	0	6	2.0
10/6/05	3	19:00-7:00	0	0	1	1	0.3
10/7/05	3	19:00-7:00	0	3	0	3	1.0
10/8/05	3	19:00-7:00	0	1	0	1	0.3
10/9/05	3	19:00-7:00	0	3	0	3	1.0
10/10/05	3	19:00-7:00	0	0	0	0	0
10/11/05	3	19:00-7:00	0	2	0	2	0.7
10/12/05	3	19:00-7:00	0	0	0	0	0
10/13/05	3	19:00-7:00	0	0	0	0	0
10/14/05	3	19:00-7:00	0	0	0	0	0
10/15/05	3	19:00-7:00	0	0	0	0	0
10/16/05	3	19:00-7:00	0	0	0	0	0
10/17/05	3	19:00-7:00	0	0	0	0	0
10/18/05	3	19:00-7:00	0	0	0	0	0
10/19/05	3	19:00-7:00	0	0	0	0	0
10/20/05	3	19:00-7:00	0	0	0	0	0
10/21/05	3	19:00-7:00	0	0	0	0	0
10/22/05	3	19:00-7:00	0	1	0	1	0.3
10/23/05	3	19:00-7:00	0	0	0	0	0
10/24/05	3	19:00-7:00	0	0	0	0	0
10/25/05	3	19:00-7:00	0	0	0	0	0
10/26/05	3	19:00-7:00	0	0	0	0	0
10/27/05	3	19:00-7:00	0	0	0	0	0
10/28/05	3	19:00-7:00	0	0	0	0	0
10/29/05	3	19:00-7:00	0	0	0	0	0
10/30/05	3	19:00-7:00	0	0	0	0	0
10/31/05	3	19:00-7:00	0	0	0	0	0
Total detector-nights	118	**Detection rate* per detector**	0.3	0.8	0.05	***Overall***	***0.4***

* Calls per detector-night

Table 8. Summary of Lempster, NH bat detector surveys, fall 2005 and spring 2006

Table 2. Fall 2005 -Species distribution of recorded calls.

Species	High	Low	Field	Total
Big brown bat	1	5	1	7
Eastern red bat	2	5	0	7
Hoary bat	1	0	0	1
Myotis spp.	5	14	1	20
Unknown	5	3	0	8
Total # of calls	14	27	2	43

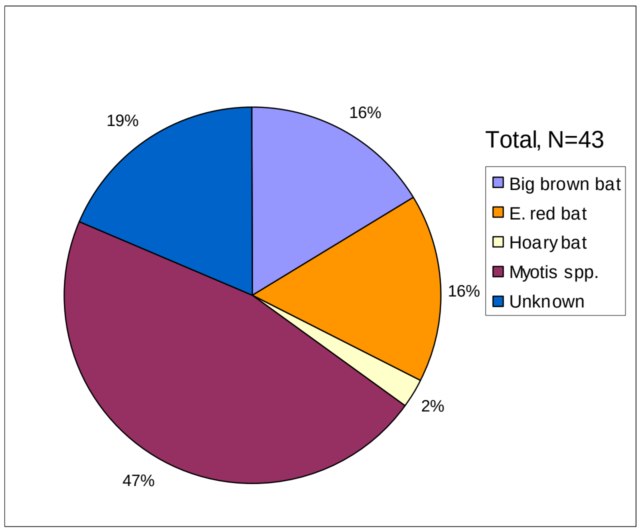

Table 8. Summary of Lempster, NH bat detector surveys, fall 2005 and spring 2006

Table 3. Spring 2006[2] -- Timing and identities of recorded bat call sequences					
File Name	**Night of**	**Time**	**Detector**	**Species Code**	**Guild**
G4092154.16#	Apr 9	9:54 PM	Low	UNK	Unknown
G4130042.45#	Apr 12	12:42 AM	Low	LABO	Red bat/E. pipistrelle - prob. Red bat
G4140200.18#	Apr 13	2:00 AM	Low	LE	Big brown/Silver-haired/Hoary Bat
G5232100.06#	May 23	9:00 PM	High	UNK	Unknown
G5232100.09#	May 23	9:00 PM	Tree	MY	*Myotis*
G5242118.08#	May 24	9:18 PM	High	LE	Big brown/Silver-haired/Hoary Bat
G5250004.49#	May 24	12:04 AM	Tree	UNK	Unknown
G5250032.52#	May 24	12:32 AM	Tree	UNK	Unknown
G5262353.22#	May 26	11:53 PM	Tree	UNK	Unknown
G5270047.14#	May 26	12:47 AM	Tree	UNK	Unknown
G5270053.30#	May 26	12:53 AM	Tree	MY	*Myotis*
G5272259.14#	May 27	10:59 PM	High	LE	Big brown/Silver-haired/Hoary Bat
G5290040.29#	May 28	12:40 AM	Tree	MY	*Myotis*
G5300132.07#	May 29	1:32 AM	Tree	LE	Big brown/Silver-haired/Hoary Bat
G5310109.13#	May 30	1:09 AM	High	LE	Big brown/Silver-haired/Hoary Bat
G5310109.16#	May 30	1:09 AM	Tree	LE	Big brown/Silver-haired/Hoary Bat
G6010435.54#	May 31	4:35 AM	Tree	MYLU	*Myotis* - probably little brown bat
G6012320.46#	Jun 1	11:20 PM	Tree	UNK	Unknown
G6022155.02#	Jun 2	9:55 PM	Tree	UNK	Unknown
G6042109.09#	Jun 4	9:09 PM	Tree	MY	*Myotis*
G6042124.40#	Jun 4	9:24 PM	Tree	MY	*Myotis*
G6052105.17#	Jun 5	9:05 PM	High	UNK	Unknown
G6052235.57#	Jun 5	10:35 PM	High	EPFU	Big brown/Silver-haired/Hoary Bat
G6060030.43#	Jun 5	12:30 AM	Tree	LE	Big brown/Silver-haired/Hoary Bat
G6122207.22#	Jun 12	10:07 PM	High	LE	Big brown/Silver-haired/Hoary Bat
G6130034.31#	Jun 12	12:34 AM	Tree	LE	Big brown/Silver-haired/Hoary Bat

[2] Survey and reporting for Spring 2006 took a slightly more conservative approach to identifying bat calls than was used for the fall 2005 surveys. See notes on methodology described in Section 2.6.1, p. 12, last paragraph.

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